NATIONAL SEMINAR

on

Agricultural Extension for *Viksit Bharat*: Innovations and Strategies for Sustainable Development

27-28, December 2024

COMPENDIUM

Lead Papers & Abstracts

Jointly Organized by

Society of Extension Education, Gujarat

&

Navsari Agricultural University, Navsari

Gujarat – 396 450

Society of Extension Education, Gujarat

EXECUTIVE COUNCIL

NATIONAL SEMINAR

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Lead Papers and Abstracts

Organizing Secretary

Dr. O. P. Sharma

Joint Organizing Secretary

Dr. P. B. Khodifad

Dr. S. R. Kumbhani

Society of Extension Education, Gujarat

and

Navsari Agricultural University

Navsari – 396450, Gujarat, India

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Scan for SEEG Compendium

Dr. Z. P. Patel
Vice Chancellor
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Message

The journey of Indian agriculture has been marked by significant transformations which has not only shaped the agricultural landscape of India but has also played a crucial role in ensuring food security of the nation and providing economic stability for millions of farmers. In recent years, there has been a significant shift towards sustainable agriculture in India. This change aims to address the challenges such as soil degradation and water scarcity. Farmers are now encouraged to adopt practices that are environment friendly and economically viable like use of biochar, biofertilizers, crop rotation, rainwater harvesting, natural and organic farming, etc.

Technology plays a crucial role in modernizing Indian agriculture. The focus on sustainable practices and technology integration is essential for the future of Indian agriculture, ensuring food security and environmental health. Technological Advancements such as drones, precision farming and mobile applications for weather forecasts and market prices helps improve productivity and efficiency. The future of agriculture in India will depend on how well we adapt to new technologies and sustainable practices.

Agricultural extension programs have long been the backbone of rural development and farming education in India. These programs serve as a vital bridge between research institutions and farmers, bringing the latest agricultural innovations and best practices directly to those who work on the field. Innovative Agricultural extension approaches and strategies are vital to realize the dream of Viksit Bharat by bringing together an ecosystem of innovation, collaboration, and inclusivity.

I am happy to note that Navsari Agricultural University in collaboration with the Society of Extension Education, Gujarat (SEEG) has considered these vital and concurrent issues and is organizing a National seminar on "Agricultural Extension for *Viksit Bharat*: Innovations and strategies for Sustainable Development" during 27-28 December, 2024. This Seminar is a unique forum for exchange of innovative ideas, expertise, emerging issues and opportunities in this evergreen field.

I congratulate the Organizing Secretary and committee members for bringing out this valuable Seminar Compendium comprising success stories of farmers, lead papers and abstracts in time-bound and an efficient manner. I warmly extend my greetings to all the participants, delegates and the society members and wish them all the best for making the National Seminar a successful event.

Navsari
November 16, 2024

(Z.P. Patel)

Dr. H. B. Patel
President, SEEG and Former DEE
Anand Agricultural University
Anand, Gujarat 388 110

Presidential Message

Agricultural extension plays a crucial role in transforming the agricultural sector and enhancing the productivity and income of farmers. For India to achieve the vision of Hon. Prime Minister – "Viksit Bharat @ 2047" (Developed India), it is essential to focus on innovative agricultural extension methods and sustainable development strategies such as Information and Communication Technology (ICT), Zero Budget Natural Farming (ZBNF) and Agroforestry, Farmer Producer Organizations (FPOs) and Cooperative Farming, Climate-smart agriculture (CSA), Post-Harvest Management, Microfinance and Crop Insurance that can uplift the rural economy, promote environmental sustainability, and improve the livelihood of farmers.

The Society of Extension Education Gujarat has always played proactive vital role in developing suitable well-defined linkages between scientists and farmers, so as to give a boost to bring positive changes in the society in general and agriculture in particular for last 34 years. At this juncture, I express my deep sense of gratitude to Dr. Z. P. Patel, Hon'ble Vice Chancellor, Navsari Agricultural University for providing whole hearted support and for acting as a guiding spirit in organizing this National Seminar in collaboration with Navsari Agricultural University at Navsari. I also extend my warm greetings to Dr. M. R. Bhatt, Vice President, SEEG & Associate Professor, College of Agriculture, NAU, Bharuch as well as other members of Executive Council of SEEG for taking all concrete and measured steps right from the beginning which have immensely boosted the morale of the organizers.

I must appreciate the help rendered by Dr. O. P. Sharma, Organizing Secretary, Dr. P. B. Khodifad & Dr. S. R. Kumbhani, Joint Organizing Secretaries for the success of this Seminar. I am also thankful to all convenors & members of different committees of the National Seminar who have worked days and nights for making the event a grand success. Eventually, I also appreciate the efforts and constant supports from Editors & Co-Editors of Souvenir for the preparation of souvenir.

I acknowledge and appreciate all the lead speakers, participants, innovative farmers, society members, well-wishers and all those who have contributed directly or indirectly to organize the seminar.

(H. B. Patel)

Dr. T. R. Ahlawat
Director of Research & Dean PG Studies
Navsari Agricultural University
Navsari, Gujarat – 396 450

Message

India's aspiration to become a developed country by 2047, articulated as *Viksit Bharat* is a bold and inspiring vision. To realise the dream of *Viksit Bharat* is to make India self-sufficient (*Aatm Nirbhar*) in agriculture as well which requires the country to address the inherent challenges of agricultural sector and leverage the emerging opportunities in food and agriculture sector. The future of Indian agriculture looks promising with innovative farming techniques on the rise.

Agricultural extension has been recognized as a mechanism for delivering information and advice as an essential "input" into modern farming. Extension has long been grounded in the diffusion model of agricultural development, in which technologies are passed from research scientists via extensionists to farmers. To farmers, extension is a form of assistance to help improve their know-how, efficiency, productivity, profitability and to promote their wellbeing. To politicians, planners and policy makers extension is a policy instrument to increase agricultural production, to achieve national food security, and at the same time, to help alleviate rural poverty. To field extension agents, agricultural extension enhances and accelerates the transfer of useful know-how and technologies to farmers. All these objectives may be achieved through nonformal education and trainings and two-way technology transfer and feedback systems.

It is indeed the matter of great pleasure to learn that the Society of Extension Education, Gujarat (SEEG) in collaboration with Navsari Agricultural University is organising a National Seminar on "Agricultural Extension for *Viksit Bharat*: Innovations and strategies for Sustainable Development". The theme selected for seminar is of great importance and relevance which will provide opportunity to extension personnel of Gujarat as well as other states to interact and recommend innovative extension strategies for *Viksit Bharat*.

I take this opportunity to congratulate the Executive Council members of the SEEG. I also compliment the Organising Secretary and team for publishing a Compendium of Lead papers and Abstracts on various themes and sub themes of seminar to enable participants to conceptualize various innovative Agricultural Extension and management strategies as well as to identify avenues for better performance of their organizations, farming community and society in general. The Seminar promises to transcend to a new and unprecedented level of excellence. I wish the Seminar a grand success.

(**T. R. Ahlawat**)

Dr. O. P. Sharma
Organizing Secretary & Professor and Head
Department of Agricultural Extension & Communication
N. M. College of Agriculture
Navsari Agricultural University
Navsari, Gujarat - 396450

Foreword

Agricultural extension services and programs that support farmers by disseminating knowledge, skills, and technologies are essential to the mission of sustainable Agriculture. By providing farmers with the resources and expertise needed to improve productivity, sustainability, and resilience, Agricultural extension services empower rural communities and promote sustainable agricultural practices. The impact of extension services extends far beyond farming, fostering economic stability, gender equality, climate resilience, and improved health and nutrition across communities. With continued support, innovation, and investment, agricultural extension can play an even more transformative role in addressing global challenges and driving sustainable development of Agriculture.

Keeping all these concurrent issues in mind, the Gujarat Society of Extension Education in collaboration with Navsari Agricultural University (NAU) is organising a National Seminar on “Agricultural Extension for Viksit Bharat: Innovations and strategies for Sustainable Development” during 27-28 December, 2024 at Navsari, Gujarat commemorating the diamond Jubilee celebration of N.M. College of Agriculture, NAU,Navsari. The Seminar intends to bring together scientists, extension educationists and practitioners to discuss and deliberate on various themes and sub themes of the seminar. The seminar covers seven broad thematic areas representing an integrated and holistic view of extension.

On behalf of whole organizing committee, I am highly indebted and grateful to Dr. Z.P. Patel, Hon’ble Vice-Chancellor, Navsari Agricultural University, Navsari, Gujarat, for granting approval and all the guidance and leadership for the organisation of National Seminar at NAU, Navsari. I extend heartful thanks to Dr. T.R. Ahlawat, DR & Dean PGS, Dr. Hemant Sharma, DEE and Dr. H. M. Virdia, Registrar NAU for their immense support. I extend gratitude to Dr. R. M. Naik, Principal & Dean, N.M. College of Agriculture, NAU, for providing continuous support, guidance and encouragement. Thanks are due to Dr. H. B. Patel, President, SEEG and members of the Executive Council of SEEG for giving us the opportunity to organise the Seminar at NAU, Navsari.

I would like to congratulate all the award recipient innovative farmers, students, researchers and extension educationists. I thank all the lead speakers, delegates and sponsors for their support and co-operation. I hope that the Seminar serves as a locus for interdisciplinary discourse and collaboration. I would like to express my deep appreciation and acknowledge the hard efforts of all conveners, co-convenors and members of various committees, colleagues, friends and students for rendering their valuable services to make the seminar successful. It gives me a great pleasure to share that all lead papers, abstracts and success stories of innovative farmers in the Seminar have been published as Seminar Compendium. I am sure it will provide useful insights to participants, researchers, extension workers and policy makers to make agriculture more scalable, inclusive and sustainable in the time to come.

(O. P. Sharma)

INDEX

SUCCESS STORY

SS-1
Chili cultivation and Value addition

Dadhaniya Bipinbhai Becharbhai

Village: Nasitpar Ta. Tankara Dist. Morbi

Name	Dadhaniya Bipinbhai Becharbhai
Age	44
Education	12th Pass
Occupation	Agriculture
Permanent Address	Village: Nasitpar Ta. Tankara Dist. Morbi
Agricultural Land	5.6 ha.
Source of Irrigation	Tube well

Innovative Approach Adoption

- Chili cultivation and Value addition
- Used Scientific cultivation of Chili crop and Value addition of Chili powder gave him higher return then other crops.
- Selling Chili powder under his own brand “A1 NASITPAR”

INCOME DETAILS

Year	Crop	Cultivation Area (ha.)	Total Production (q)	Total Income (Rs.)	Total Cost (Rs.)	Net Profit (Rs.)
2020-21	Chili	5.6	29	42,00,000	17,00,000	25,00,000
2021-22		5.6	30.8	52,00,000	19,00,000	33,00,000
2022-23		5.6	29.4	79,00,000	22,00,000	57,00,000

Award received:

Not apply for any award

SS-2
Rose cultivation under Natural Farming and Value addition

Khatrani Baldevbhai Bhanjibhai
Village: Kanpur Ta. Dhrol Dist. Jamnagar

Name	Khatrani Baldevbhai Bhanjibhai
Age	43
Education	9th Pass
Occupation	Agriculture
Permanent Address	Village: Kanpur Ta. Dhrol Dist. Jamnagar
Agricultural Land	5.0 ha.
Source of Irrigation	Well

Innovative Approach Adoption

- Adopting Rose cultivation under Natural Farming and value addition of Rose water and Gulkand
- Adopting Natural Farming helps to reduce the cost of cultivation and Value addition provide higher return for their products.
- Selling of Gulkand @ 500 Rs./Kg.
- Also selling the Groundnut oil @ 4700/ 15kg.

INCOME DETAILS

Year	Crop	Cultivation Area (ha.)	Total Production (Kg.)	Total Income (Rs.)	Total Cost (Rs.)	Net Profit (Rs.)
2020-21	Rose, Beet, Groundnut, Cotton, Wheat	4.04	16495	702000	456301	245699
2021-22	Rose, Beet, Groundnut, Cotton, Wheat	3.72	17620	590875	384069	206806
2022-23	Rose, Beet, Turmeric, Groundnut, Carrot, Palak, Wheat	4.96	27700	932500	602925	329575

Award received:

1. Plant Protection Association Award for Natural Farming, Year 2022-23.
2. PPAG, Gujarat Best Farmer Award, Year 2022-23.
3. Sardar Patel Sansodhan Purskar for Rose cultivation under Natural Farming, year 2022-23
4. Amit Sindha Memorial Award for Value addition of Rose, Year 2023-24.

SS 3

Off seasonal muskmelon production using crop cover technology for higher income generation

Y.D. Pawar, S.H. Malve, D.A. Sadrasaniya and V.V. Prajapati
Krushi Vigyan Kendra, SDAU, Deesa

Name	Dineshbhai Hamirabhai Patel
Address	Thavar Ta. Dhanera, Dist: Banaskantha, Gujarat
Age	37 yrs
Mobile No	9428983818
Education	HSC
Land holding	5-45-63 ha
Occupation	Agriculture

INFORMATION ABOUT INNOVATION ADOPTED BY FARMER:

- Mr. Dineshbhai Patel, farmer of Dhanera taluka cultivating muskmelon from 2017 under the guidance of Scientist of KVK, Deesa (Banaskantha-I) and he traned for adoption of crop cover technology for off seasonal production of muskmelon on plastic mulch along with MIS.
- Mr. Dineshbhai adopted this crop cover technology on 1.00 ha area for muskmelon cultivation in first week of January, he has sown hybrid variety of muskmelon on mulching at 30 cm spacing on paired row using drip irrigation system. Generally, farmers are sowing muskmelon on 2nd week of February.
- Recommended dose of FYM and fertilizers was applied along with micronutrients as a basal dose on raised bed before laying of mulch. Then drip irrigation system was installed and mulch laying was done by tractor operated machine.
- The crop cover of non-woven fabric material laid on muskmelon using wooden round support for keep away from mulch.
- The crop cover kept laid upto flowering stage of muskmelon and after that it was removed.
- Due to crop cover, there was no initial incidence of sucking pest and leaf miner.
- The organic preparations like Jeevamruta, buttermilk, cow urine, NPK consortium, etc. were used. Timely application of water soluble fertilizers *viz.,* 19:19:19, 12:61:0, 0:52:34, calcium nitrate, boron and chelated micronutrients was done through fertigation for efficient use of nutrient and better growth of plant. Foliar application of micronutrients @ 0.2% was given at flowering stage for more fruit setting and reduced flower drop.
- Now a days pest and disease management is very crucial task in muskmelon so, for encounter this problems the IPDM technology was adopted which include use of bio-fungicide *i.e. Trichoderma viride* ans *Pseudomonas* for fungal problem, Pochoniya for nematode, *Biveria, metarhizium* and yellow stick trap for sucking pest and trap for fruit fly management.
- The need based foliar sprays of Neem oil (0.5%), Dimethoate (0.1%), Imidacloprid (0.05%), mencozeb+ carbendazim fungicide (0.2%) in rotational way for effective management of pest and diseases in muskmelon.
- Mr. Dineshbhai received very higher market prices due to off-seasonal production of muskmelon through crop cover technology as compared to traditional practice. So, he has adopted this crop cover technology in various crops *viz*., intercropping in pomegranate as well as in cowpea, cucumber, watermelon *etc.*
- Cost involvement for crop cover is Rs. 50,000 per hectare and he has used that crop cover for last three years.
- Looking into economics, muskmelon fruits sold by Rs.22 to 28 per kg and crop gained net return of Rs.4,68,022 to 5,38,800 from 2020-21 to 2022-23 within 70-75 days crop duration.

HORIZONTAL SPREAD OF INNOVATION:

- Many farmers from different districts of Gujarat as well as Agri. students visiting his farm.
- After his success in offseasonal vegetable cultivation; 5 farmers from my village have started the use of crop cover technology on 28 vigha land, Anapur Gadh farmers on 18

vigha, Deesa farmers 35 vigha, Lakhani and Dantiwada taluka farmers 41 vigha and total around 119 vigha land is under this technology.

- His success story was published in newspapers and telecasted in various TV channels also.
- **HONOUR:**

Awards/honour	Achievement	By whom	Year
Taluka level best farmer certificate	Offseasonal vegetable cultivation	ATMA, Banaskantha	2018
Commendation certificate	Offseasonal vegetable cultivation	Krushi Mela, KVK, Deesa	2019-20

Table 1: Details of yield and economics in innovative practices

Muskmelon under crop cover	Production (kg)/ha	Cost of cultivation (Rs.)/ha	Gross return (Rs.)/ha	Net return (Rs.)/ha	BCR
2020-21	26,751	1,20,500	5,88,522	4,68,022	4.88
2021-22	27,100	1,21,200	6,50,400	5,29,200	5.36
2022-23	27,850	1,29,600	6,68,400	5,38,800	5.15

Note- Innovative practices: Selling rate of muskmelon was Rs. 22-28 per kg

Crop cover technology

Muskmelon under crop cover technology

Muskmelon plot after removal of crop cover

Muskmelon fruits

Organic input preparations

Media coverage for horizontal spread

SS 4

Success story on sustainable vegetable production in arid condition

Name of Applicant:	Jogabhai Devjibhai Chaudhary
Age:	40
Occupation:	Farming
Address:	Village – Ranpur, Post - Rampura, Taluka - Tharad, District - Banaskantha
Agriculture land:	3.87 ha.
Source of irrigation:	Tub well/Canal

Information about innovation adopted by farmer:

Status before KVK intervention

- Village Ranpur comes under tharad taluka which is in arid region. There are various limitations for farming, Water table is low and the cannel water available only up to the March - April months. The summer season is too harsh. Before adopting this, I was cultivating castor and pearl millet in kharif and mustard in Rabi season. I was fallowing conventional farm practices and old crop verity and was getting minimal yield from per unit area.

KVK interventions

- Training and awareness on Preparation and use of Natural fertilizers i.e. Jeevamrut, Ghanjeevamrut, Nimastra
- Training on Vegetable cultivation and support for inputs

Farmers Intervention

- Based on advice from scientists of the Krishi Vigyan Kendra, SDAU, Tharad. I have started vegetable cultivation in 1.0 hectare of land. Vegetable crops, including Tomato, Kalingda , Garlic, Cucumber, Beetroot and Matira were taken over the last three years.
- In the year 2019-20 and 2020-21 during the monsoon season, Matira and Kakadi were cultivated in one bigha and Kalingda in two bigha. However, during winter cultivated tomato. during winter 2021-22 garlic and beetroot were taken using natural farming practices
- Since last five years, I have consistently prepared and utilized organic bio-inputs such as Jivamrut, Ghanjivamrut, Bijamrut, and Neemastra in vegetable cultivation to enhance productivity and sustainability.

Impact of intervention

- Total production of **Matira, Cucumber** and **Kalingda was obtained 15517,** 10513 and **21026** kg/ha respectively. This resulted in a total net profit of ₹ **3, 88,674** in year 2019-20. However during 2020-21 the combined production of **Matira, Kakadi, and Kalingda** during the Kharif season and tomato during rabi season generated a net profit of ₹ 5,05, 605.
- In 2021-22, a net profit of ₹ **5, 32,135** was achieved from cultivating **Matira, Cucumber, and Kalingda** during the Kharif season. Additionally, during the Rabi season, profits of ₹ 3, 76,343 was obtained from garlic and beetroot
- Overall, the net profit from vegetable crops was increased. This demonstrates that the arid vegetables required less inputs and can perform better the natural farming production practices, the natural farming practices reduces the cost of cultivation significantly resulting in higher profits compared to normal cultivation with use of camicals and fertilizers.
- Moreover, the practice has enhanced soil fertility, even in sandy and dry areas. Techniques such as **intercropping** and **mulching** have contributed to better soil health and increased production.

Year wise Production and profit

Particular	2019-20			2020-21				2021-22				
	Kharif			Kharif			Rabi	Kharif			Rabi	
	Matira	Cucumber	Kalingda	Matira	cucumber	Kalingda	Tomato	Matira	cucumber	Kalingda	Garlic	Beetroot
Production (kg)/ha	15517	10513	21026	13793	10303	27334	7393	11690	23549	15139	6728	14971
Total Income (₹/ha)	189307	197644	157695	168274	197817	218656	162624	294354	200158	257346	336400	187125
Total cost (₹/ha)	44870	61228	49874	48360	56442	50463	86501	69176	75694	74853	69386	77796
Net profit (₹/ha)	**144437**	**136416**	**107821**	**119914**	**141375**	**168193**	**76123**	**225178**	**124464**	**182493**	**267014**	**109329**
profit/year (₹)	**3,88,674**			**5,05,605**				**9,08,478**				

Average selling price of Matira @16/kg, Cucumber @15/kg, Kalingda@12/kg, Tomato @22/kg, Garlic @ 50 /kg and beetroot @ 15 /kg

Horizontal Spread of innovation: Many farmers, Scientist and extension personal visited to the farm, the farmers of nearby villages nearer to the canal command area stared growing vegetables.

Award Received : Nil

Kalingda var (Gujarat Kadigna 1)

Tomato (Arka Rakshak)

Garlic

Beet root

Vegetable install in krishi mela

SS 5

Anand Agricultural University Zone

A story of success from village pond fish farmer to owner of a fish hatchery

Name	:	Mr. Chandrakant Ishwarbhai Talpada
Age	:	37 years
Education	:	10th
Occupation	:	Fish Farming
Address	:	Char kuva Bhagol, Lili Talavadi, Po, Sojitra, Ta. Sojitra, Dist. Anand
Land	:	2.5 ha

Innovative Approach Adoption

- Previously, I reared fish seeds and marketable fishes in leased village ponds, importing the majority of the fish seeds (Catla, Rohu, and Mrigal) from Calcutta, which was expensive and often included mixed or small quantities of seeds, increasing the overall cost.
- With experience in private freshwater fish hatchery operations, I decided to start my own hatchery in 2021. Using the hypophysation technique (induced breeding with pituitary extracts), I prefer the stripping method over natural breeding to produce high-quality spawn of Catla, Rohu, and Mrigal.
- From April to August, I supply these seeds locally, reducing the dependency of farmers on other state suppliers.
- In recent years, Catla breeding through induced breeding with Hormones has declined in Central Gujarat during July. To address this, I adopted the stripping method, which has a high survival rate. This approach meets the high demand for Catla seeds, allowing me to maintain good prices.
- In the first year, I produced 8 crore fish seeds and now produce up to 20 crores annually. This contains Catla, Rohu, Mrigal, Silver Carp, Grass Carp, and Common Carp.
- Producing seeds ourselves has resulted in more income, as has releasing our produced seeds into the leased village pond.
- It requires about 8 to 12 months in the village pond to grow the fish at marketable size and only then the estimation of income is recognized. Since the hatchery season is from April to August, more income can be received in a short time and even later, other earnings might be taken by breeding of common carp.
- In addition to Anand district, fish farmers from other districts of the state, such as Kheda, Vadodara, Panchmahal, Surat, Bhavnagar, Rajkot, and even from Madhya Pradesh, also purchase seeds from this hatchery. Many fish farmers, trainees of KVK, Devataj, Anand and college students receive appropriate guidance during their visits each year.

Income details:

Particulars	**2021-22**	**2022-23**	**2023-24**
Spawn Production (in crores)	8.0	13.50	18.50
Income (Rs. /year)	920000	1620000	2220000
Cost (Rs. /year)	550000	10,00,000	1250000
Profit (Rs. /year)	370000	620000	970000

SS 6
Anand Agricultural University Zone
Success Story of Natural Farming & Value Addition in Turmeric

Name	:	**Jayeshkumar Anilbhai Patel**
Age	:	**44 Years**
Occupation	:	**Farming**
Permanent Address	:	**Village- Chalamali, Taluka – Bodeli, Dist- Chhotaudepur**
Agricultural Land	:	**03 ha.**
Source of Irrigation	:	**Tubewell**

Innovative Approach Adoption

1. Adopted Natural Farming & Value Addition in Turmeric.
2. He used drip irrigation, an advanced *Jivamrut* tube to prepare *Jivamrut*, and also prepared botanical pesticides, which can reduce the cost of cultivation.
3. He cultivated medicinal turmeric varieties Salem, Black & Lakadong, which have high curcumin content compared to the local varieties.
4. He processes turmeric into powder and sells it in the market under the brand name **"RUDRA FARM."**
5. By implementing Natural Farming techniques and adding value to his products, he made Rs. 3,50,000/- per ha., which surpasses traditional farming in terms of elevation.

Income Details

Year	**Name of Crop**	**Area (ha.)**	**Yield (Kg.)**	**Total Income (Rs.)**	**Total Cost**	**Total Profit**
2020-21	**Turmeric**	1.2	1100	5,50,000/-	2,10,000/-	3,40,000/-
2021-22	**Turmeric**	1.2	1400	7,00,000/-	2,20,000/-	4,80,000/-
2022-23	**Turmeric**	1.2	1800	9,00,000/-	2,40,000/-	6,60,000/-

Note :- Above mentioned yield data are after Value Addition in Turmeric into Turmeric Powder.

SS 7

સફળ વાર્તા

દેશી ડાંગર ની પ્રાકૃતિક ખેતી

ખેડુતનુ નામ : સખારામભાઈ પુન્યાભાઈ પાલવા	
ગામ	કોટબા
તાલુકો	આહવા
જિલ્લો	ડાંગ
રાજય	ગુજરાત
અભ્યાસ	૧૦પાસ
સમ્પર્ક નંબર	૯૪૨૬૧૬૧૩૭૩ / ૯૪૨૯૧૪૪૯૦૨

૧. પરિસ્થિતી વિશ્લેષણ/સમસ્યા નિવેદન

પહેલા અમે જુના પુરાના કાળથી ચાલી આવેલ ખેતી પદ્ધતિ પ્રમાણે ચોમાસામાં થતા પાકો ડાંગર, નાગલી, વરઈ, ખરસાણી વગરે અને શિયાળામા કઠોળ વર્ગના પાકો જેવાકે ચણા,વટાણા,તુવેર,મકાઈ અને શાકભાજી જેવા પાકો કોઈ પણ ખેતી પદ્ધતિ વગર ખેતરમાં છુટા હાથે વાવેતર કરી દેતા. જેથી ઉત્પાદનમા જોયે તેટલો સુધારો જોવા ના મળતો. અમોને કોઈપણ રસાયણ ખાતરો કે જંતુનાશક દવાની જાણ નહીવટ હતી. તેથી ખૂબ ઓછા પ્રમાણમાં ખાતરો, જંતુનાશક દવાઓનો ઉપયોગ કરતાં હતા. ફક્ત હાઇબ્રિડ ડાંગરના પાકમાં રસાયણીક ખાતરનો ઉપયોગ કરતાં હતા. મોટા ભાગના આદિજાતિના ખેડૂતો ગરીબ અને ઓછા સંસાધનો ધરાવતા હોવાને કારણે અમોને પણ પ્રાકૃતિક કૃષિ પધ્ધતિ વિશે સમજણ ના હતી.

૨. યોજના, અમલીકરણ અને સહકાર

કૃષિ વિજ્ઞાન કેન્દ્ર, ન.કૃ.યુ., વઘઇ (ડાંગ), જિલ્લા કૃષિ વિભાગ (ડાંગ), આત્મા પ્રોજેકટ (ડાંગ) વગેરે જેવી સંથાઓના માર્ગદર્શનથી અમોએ રાસાયણિક ખાતરોનો ત્યાગ કરી સંપૂર્ણપણે પ્રાકૃતિક ખેતી અપનાવી છે. પોતાના ખેતરને કેમિકલથી બચાવવા માટે બિયારણ ઘરનું વાપરવું, તેમજ જીવામૃત, બ્રમાસ્ત્ર, અગ્નિસ્ત્ર, સુઠાસ્ત્ર પોતે જ બનાવી અને તેનો ઉપયોગ કરી ખેતી ખર્ચ ઘટાદીયે છીએ. કે.વી.કે. ડાંગના તાલીમ, જાગૃતિ કાર્યક્રમ અને અન્ય વિસ્તરણ પ્રવૃતિઓની મદદથી અમોયે હંમેશા આયોજન પૂર્વક ખેતી કરી છે, તેથી અમોને ભાગ્યે જ ખેતીમાં નુકશાન સહન કરવું પડે છે. ઉપરાંત અમારી છાપ પ્રાકૃતિક ખેતી કરતા ખેડૂતો મા ગણાય છે.

કૃષિ વિજ્ઞાન કેન્દ્ર, ન.કૃ.યુ., વઘઇ (ડાંગ), ની વારંવાર મુલાકાત લઈને વિવિધ વિષયના વૈજ્ઞાનિકો પાસેથી માહિતી મેળવી છે. કિસાન ગોષ્ઠી, કૃષિ મેળાઓ, તાલીમોમાં ભાગ લઈ વૈજ્ઞાનિકો પાસેથી નવી ટેકનૉલોજિ અને કેવી રીતે ખર્ચ ઘટાડી શકાય એની પણ માહિતી મેળવી છે. કૃષિ વિજ્ઞાન કેન્દ્ર, વઘઇના વૈજ્ઞાનિકો દ્વારા ડાંગરની નવી જાતો જેવી કે, GR 17, GR 18, નાગલીની ગિરા

જાત, વરીની ગુજરાત વરી 3, મગની GM 6, ચણાની GJG 5, તુવેરની GT 105 અને GT 104 તથા એઝેટોબેક્ટર અને રાઈઝોબિયમનો ઉપયોગ કરેલ છે. નિદામણ નિયત્રણ માટે હાથ કરબડી અને આછાદનનો ઉપયોગ કરેલ છે.

3. ઉત્પાદન:

ક) ખેતી માંથી

વિગત	2020-21			2021-22			2022-23		
	ખરીફ	રવી	ઉનાળુ	ખરીફ	રવી	ઉનાળુ	ખરીફ	રવી	ઉનાળુ
પાક	ડાંગર (ઇન્દ્રાણી)	ચણા + વટાણા	-	આંબામોર	ચણા+વટાણા	-	કૃષ્ણકમોદ	ચણા+વટાણા	-
કુલ વિસ્તાર (હેક્ટર)	0.40	0.20	-	0.60	0.20	-	0.60	0.20	-
કુલ ઉત્પાદન (કિ.ગ્રા)	2000	200	-	3000	270	-	3200	300	-
કુલ આવક (રૂા.)	50,000	12,000	-	1,20,000	18,900	-	1,60,000	21,000	-
કુલ ખર્ચ (રૂા.)	11,750	3,000	-	15,000	3500	-	17000	4,000	-
કુલ ચોખ્ખો નફો (રૂા.)	38,250	9000	-	1,05,000	15,400	-	1,43,000	17,000	-

ખ) પશુપાલન ક્ષત્રે છેલ્લે ત્રણ વર્ષની વિગતો

વર્ષ	કુલ પશુઓની	દૂઝણા પશુઓની	વર્ષ દરમ્યાન	વર્ષ દરમ્યાન	વર્ષ દરમ્યાન	દૂઝણા પશુ દીઠ	વિશેષ નોંધ

	સંખ્યા	સંખ્યા	કુલ આવક	થયેલ કુલ ખર્ચ	કુલ નફો	વાર્ષિક નફો	
2020-21	2	1	63,000	45,000	18,000	18,000	-
2021-22	2	1	70,000	40,000	30,000	30,000	-
2022-23	2	1	70,000	38,000	32,000	32,000	-

૪. પરિણામ:

ગુજરાતના ડાંગ જિલ્લાના કોટબા ગામના એક પ્રગતિશીલ ખેડૂતે પ્રાકૃતિક ખેતી અભિગમ અપનાવી ખેડૂતોને પ્રેરણા પૂરી પાડી રહયો છું. અમારા ગામમા મારી પ્રાકૃતિક ખેતી જોય ને આજુ બાજુ ના 15 થી 20 ગામના ખેડૂતોએ આ પદ્ધતિ અપનાવેલ છે અને તેઓ પણ વધુ માર્ગદર્શન મેળવીને પ્રાકૃતિક ખેતી અપનાવતા થયા છે. છાણનો ઉપયોગ, ગૌ મૂત્રનો ઉપયોગ, ડાંગરના પલાટિયાનો ઉપયોગ કરે છે અને તેમાથી જીવામૃત અને ઘનજીવામૃત બનાવતા થયા છે અને આછાદન પણ થયા છે.

પ્રાકૃતિક ખેતીમાં સ્થાનિક ખેતી કરતાં ઉત્પાદન વધુ થાય છે. જમીનનું ધોવાણ થતું અટકે છે જમીનની તંદુરસ્તી જળવાઈ રહે છે. રાસાયણિક ખાતરથી જમીન બગડતી હતી એ અટકાવી છે. જંતુ-નાશક દવાઓ જાતે બનાવી તેનો ખર્ચ ઘટાડયો છે પ્રાકૃતિક ખેતી દ્વારા ઉત્પન કરેલ અનાજનો ભાવ પણ વધુ મળે છે. ખર્ચ ઓછો થાય છે અને આવકમાં વધારો થાય છે. ડાંગરને લાઇનમાં રોપણી કરવાથી નિદામણ ખર્ચમાં ઘટાટો થયો.

૫. અસરઃ

સ્થાનિક પધ્ધતિમાં બિયારણનો ખર્ચ વધુ આવે છે. જ્યારે પ્રાકૃતિ ખેતીમાં ખર્ચ વધુ આવતો નથી. બિયારણ ઘરનું વાપરવું, તેમજ જીવામૃત, બ્રહ્માસ્ત્ર, અગ્નિસ્ત્ર, સુઠાસ્ત્ર પોતે જ બનાવીએ છીએ અને તેને વાપરવાથી એનો ખર્ચ બચી જાય છે. પ્રાકૃતિક ખેત ઉત્પાદક હોવાથી માર્કેટિંગ પણ સરળતાથી મળી રહે છે. સ્થાનિક પધ્ધતિમાં ડાંગરનું આંધળું વાવેતર થાય છે જ્યારે લાઇનમાં વાવવાથી ખર્ચમાં ઘટાડો થાય છે અને ઉત્પાદન પણ વધુ મળે છે. યુનિવર્સિટીની ટેકનોલોજિ વાપરવાથી ઓછા ખર્ચમાં વધુ ઉત્પાદન મળે છે અને સારી એવી આવક થાય છે.

દેશી ડાંગરની પ્રાકૃતિક કૃષિ માટે બેસ્ટ આત્મા ફાર્મર એવોર્ડ- ૨૦૨૨-૨૩,નાં વર્ષ નો માનનીય કૃષિ મંત્રીશ્રી રાઘવજીભાઈ પટેલનાં હાથે સન્માન કરવામાં આવ્યું.


NoteCam
Latitude: 20.830486
Longitude: 73.741710
Elevation: 500.89±8.00 m
Accuracy: 5.00 m
Time: 08-08-2022 09:44:38

SS 8

સફળ વાર્તા – વર્ષ – ૨૦૨૪-૨૫

ડ્રેગન ફ્રૂટની ખેતી

ખેડુતનું નામ	:	ભરતભાઈ ઓધાભાઈ ગોધાણી
પિતાનું નામ	:	ઓધાભાઈ ગોધાણી
વૈવાહિક દરજ્જો	:	પુરુષ, વૈવાહિક
જન્મ તારીખ	:	૩૦/૦૧/૧૯૬૯
પત્રવ્યવહારનું સરનામું	:	સી-૫૫, સાધના સોસાયટી, વરાછા પોલીસ સ્ટેશનની પાછળ, સુરત, ગુજરાત – ૩૯૫૦૦૬ મો.નં. ૯૪૨૮૫૭૮૧૦૧
ભણતર	:	નવ ધોરણ સુધી
જમીન	:	૮ હેક્ટર
પાકનું વાવેતર	:	• આ વ્યવસાય સાથે ૮ હેક્ટર આરા વિસ્તારમાં શેરડી અને શાકભાજીનું વાવેતર કરીએ છીએ. જેની વાર્ષિક (૨૦૨૩-૨૪) આવક ૨૭.૦૦ લાખ (શેરડી) તથા ૨.૫૦ લાખ (શાકભાજી) થયેલ છે.
ફાર્મની માહિતી તથા તેનો વિકાસ	:	• જેમ બધા ખેડૂતો કરે છે તેમ અમે શેરડીના પાકની ખેતી કરતા હતા . • અમારે ત્યાં ખેતીમાં કંઈક નવું જ કરવાની ઈચ્છા હતી. કે જે આ વિસ્તારમાં કોઈ જ ના કરતું હોય શેરડી કરતા વધુ આવક પણ મળે એવી ઈચ્છા હોવાથી અમોએ કમલમ ફ્રુટની ખેતી કરવાનો વિચાર કર્યો. બજારમાં મળતા કમલમના ફળો કરતા વધુ સારી ક્વોલિટી મળે તે માટે અમે પ્રાકૃતિક પધ્ધતિથી કમલમ ફ્રૂટની ખેતી કરવાનું શરૂ કર્યું જેમાં ખૂબ જ સફળતા મળી.

પ્રવૃતિઓ પ્રમાણેનું ઉત્પાદન, કુલ આવક, કુલ ખર્ચ અને ચોખ્ખી આવકની ગણતરી (છેલ્લા 3 વર્ષની) :

વિગત	૨૦૨૦-૨૧			૨૦૨૧-૨૨			૨૦૨૨-૨૩		
	ખરીફ	રવી	ઉનાળુ	ખરીફ	રવી	ઉનાળું	ખરીફ	રવી	ઉનાળું
પાક	કમલમ			કમલમ			કમલમ		
કુલવિસ્તાર (હેક્ટર)	૦.૮૩			૦.૮૩			૦.૮૩		
કુલ ઉત્પાદન (કિ.ગ્રા.)	૧૨,૦૦૦			૧૮,૦૦૦			૨૪,૦૦૦		
કુલ આવક (રૂપિયા)	૨૧,૬૦,૦૦૦			૨૮,૮૦,૦૦૦			૩૩,૬૦,૦૦૦		
કુલ ખર્ચ (રૂપિયા)	૭,૨૦,૦૦૦			૧૦,૨૮,૦૦૦			૧૨,૯૦,૦૦૦		

કુલ ચોખ્ખો નફો (રૂપિયા)	૧૪,૪૦,૦૦૦	૧૮,૫૨,૦૦૦	૨૦,૭૦,૦૦૦
પ્રતિ હેક્ટર વિસ્તારનીની માહિતી			
ઉત્પાદન (ટન)	૧૪,૪૫૮	૨૧,૬૮૬.૭૫	૨૮,૯૧૫.૬૬
આવક (રૂપિયા/હેક્ટર)	૨૬,૦૨,૪૧૦	૩૪,૬૯,૮૮૦	૪૦,૪૮,૧૯૨.૪૦
ખર્ચ(રૂપિયા/હેક્ટર)	૮,૬૭,૪૭૦	૧૧,૭૫,૪૭૦	૧૪,૩૭,૪૭૦
નફો(રૂપિયા/હેક્ટર)	૧૭,૩૪,૯૪૦	૨૨,૯૪,૪૧૦	૨૬,૧૦,૭૨૨.૪૦

ઉત્પાદન, આવક અને આવક ટકાવી રાખવાના મુદ્દાઓ કે જેની અગત્યતાથી આવક અને ઉત્પાદન જાળવી રાખવા. :

- સ્થાનિક પધ્ધતિમાં તો ફક્ત ડાંગર અને શેરડી પાકો થાય છે જેમાં હેકટર ૪ થઈ ૫ લાખ નફો થાય છે.
- આમ, નવીન પાક દાખલ કરવાથી મળે આવકમાં ૪ ગણો વધારો મળેલ છે.

અન્ય માહિતી :

- કમલમ ફ્રુટની ખેતી શરૂ કર્યા બાદ ૫૦૦ થી વધુ ખેડૂતોએ અમારા ફાર્મની મુલાકાત લીધેલ છે.
- તથા ૫ ખેડૂતોએ તો અમારે ત્યાંથી જ રોપા લઈને કમલમની ખેતીની શરૂઆત કરેલ છે.


GATE 10


SBI

LEAD PAPER

LP 1.1

Novel extension approaches for reshaping Indian agriculture

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Agriculture remains the backbone of many economies, playing a crucial role in ensuring food security, livelihoods, and environmental sustainability. However, farmers face numerous challenges, including climate change, resource limitations, market fluctuations, and pest and disease outbreaks. Addressing these requires the dissemination of innovative, sustainable technologies that improve agricultural productivity, resilience, and sustainability. Traditional agricultural extension services, which focus on transferring knowledge and technology from research institutions to farmers, are often limited in reach, scale, and adaptability. New, more responsive extension approaches are essential to overcome these challenges and ensure that farmers can access, adopt, and benefit from sustainable agricultural technologies.

Approach is like a doctrine for the system, which informs, stimulates and guides such aspects of the system as its structure, its leadership, its programme, its resources and its linkages. According to Axinn (1988), the approach is the style of action within system. It's like the drummer which sets the pace for all activity of the system. Hagmann *et al.,* (2000) explained an approach as a way in which different guiding principles are applied in a specific situation to fulfill different purposes. It consists of a series of procedures for planning, organizing and managing the extension institution as well as for implementing practical extension work by staff with technical and methodological qualification and using the necessary and appropriately adapted means. Various extension approaches completed successfully by giving satisfactory results in past to improve the farmers knowledge regarding newly developed agricultural technologies. Some of them are continuously running in present along with newly developed extension approaches and requires little modifications in future to increase the agricultural potential of country. In the present time the extension is done mainly by Public sector, Private sector and Public private partnership.

Emerging Approaches for Effective Dissemination

Innovative extension approaches leverage modern technology, participatory methods, and multi-stakeholder collaboration to enhance the reach and effectiveness of sustainable technology dissemination. Digital tools, for example, have enabled the development of mobile applications, online platforms, and remote advisory services that allow real-time, location-specific support to farmers. Farmer Field Schools (FFS) and Participatory Technology Development (PTD) are examples of methods that encourage farmers to be active participants in learning and decision-making, which increases their willingness to adopt new practices and technologies.

Sustainability as a Core Objective

The focus on sustainable technology dissemination acknowledges the need to balance productivity with environmental and social sustainability. This includes technologies that conserve water, improve soil health, reduce reliance on chemical inputs, and promote biodiversity. Sustainable technology dissemination requires that farmers not only adopt but also adapt these technologies to their specific conditions, which can be achieved through approaches that are more tailored, participatory, and responsive to local needs.

Novel extension approaches for sustainable technology dissemination in agriculture are essential for building resilient agricultural systems that can meet current and future food demands without compromising environmental and social sustainability. By leveraging digital tools, participatory models, and partnerships, these approaches promise to bridge the gap between research institutions and farmers, empowering them to adopt sustainable practices that enhance productivity and resilience in the face of growing challenges.

The digital innovations, public-private partnerships (PPP), and community-level support mechanisms for agricultural extension are covered in extension approaches. The seminar highlighted the integration of ICT tools, such as mobile applications and e-Choupal, to enhance outreach and provide real-time advisory to farmers. There was also a focus on promoting institutional mechanisms that support resource-sharing and convergence between governmental, private, and community entities to facilitate knowledge dissemination and technical assistance in rural areas.

There is a growing recognition of ICT's role in agricultural extension. Platforms like mKISAN and QR code-based digital information boards enable localized, customized advice to farmers in their regional languages. Additionally, convergence mechanisms, where state agencies, research institutes, and private sector stakeholders collaborate; have proven essential for extending these services effectively across diverse farming communities in India.

The expansion of private and non-governmental involvement in agricultural extension is reshaping the landscape. Private input firms, cooperatives, and NGOs, such as PRADAN and SEWA, offer training, inputs, and support to farmers through various collaborative models. These partnerships play crucial roles in areas like contract farming, crop diversification, and value chain development, often targeting underserved rural areas and supporting marginalized groups, including women and young entrepreneurs.

Public extension

- State Development Departments
- ICAR, State Agricultural Universities
- Other Cooperative Agencies

Private extension

Privatization is the act of reducing the role of government on increasing the role of private sector in an activity or in the ownership of assets. Bloome (1993) reported that private extension involves personnel in the private sector that delivers advisory services in the area of agriculture and is seen as an alternative to public extension. Whereas, Vandenban and Hawkins (1996) observed that farmers are expected to share the responsibility for their services and pay all or part of the cost. In private extension, clientele are expected to pay for the service fee (e.g. Private Agricultural consultancies), or extension services provided for product promotion (e.g. Agri-business firms-seed companies), or for the procurement of farm produce (e.g. contract farming or free of cost extension (e.g. NGOs).

Private agricultural consultancies

Agricultural consultants or advisers offer advice, support and solutions to their clients to ensure their business or enterprise is running as efficiently and effectively as possible. Their clients may be farmers, landowners, other agricultural businesses in manufacturing and services (Singh *et al.,* 2006).

Agri-business firms

Agro-input companies dealing with seeds, fertilizers, pesticides and agro-machinery perform extension as one of their function for marketing. The inputs agencies are undertaking promotional activities through advertisement, organizing demonstration farmers meeting and seminars (Sulaiman and Vandenban, 2003).

Contract farming

Contract farming involves a forward contract according to which growers are committed to provide an agricultural commodity of a certain type at a certain time and price in a specified quantity to a known buyer, an agribusiness company (Singh, 2002). A number of agro-processing and trading firms makes contract with the farmers to produce specific commodity and these firms after provide extension services as part of contract farming arrangement providing extension services helps in procuring adequate quantity with specified quality and type of produce or processing or trading in high value market.

To support growers in producing the specified commodities, companies can provide credit, inputs, and extension services such as new technologies (Asokan and Singh, 2003).

In Punjab, Pepsico first started contract farming for tomatoes in the early 1990s and now contracts farmers for potatoes and chillies. Pepsi's own research and development activities helped develop and disseminate new technologies, including agricultural practices such as deep chiseling and new seed varieties, through Pepsi field officers, field demonstrations, and booklets (Singh, 2002).

Non-Government Organizations

It is any non-profit, voluntary citizen's group which is neither a part of a government nor a conventional for-profit business. NGOs may be funded by government, foundations, businesses or private persons. Estimates of the number of NGOs active in rural development in India range from fewer than 10,000 to several hundred thousand depending on the type of classification used. Some 15,000-20,000 are actively engaged in rural development. India has a number of NGOs with varying levels of capacity, implementing a wide range of programmes. Wide variation in density of NGOs exists among states. NGOs receive funding from the Government and corporate bodies as well as international donors. Due to their effectiveness and flexible operational mechanisms, governments are increasingly finding partnering with NGOs attractive. Bharatiya Agro-Industries Federation (BAIF) is an important NGO working very actively. BAIF works on livestock development, water resource management, environmental conservation and livelihood development (Ferroni and Zhou, 2011).

Public-Private Partnership

Public-Private Partnership (PPP) describes a government service or private business venture which is funded and operated through a partnership of government and one or more private sector companies (Agarwal, 2011). Reasons for this change include the following: Budget deficits make it difficult for the government to pay for such a service. It is hoped that by making extension agents accountable to farmers who are competent to judge the quality of their work, this in turn will make the extension service more efficient. Farmers are the main beneficiaries from extension services activities and therefore it is fair that they pay the costs.

Agri Clinics and Agri Business Centres (ACABC)

Agri clinics and agri business centers (ACABC) provide agricultural advisory services to farmers through technically trained agricultural graduates at the village level. Bank loans are available for the agripreneurs to start an agriclinic. The central government provides 25 percent of the cost as a subsidy. MANAGE is also very active in this. In addition, the states have adopted the approach add their own additional subsidies for agriclinic implementation. The objectives of the program are to supplement the public extension system, increase the availability of inputs and services for farmers, and provide employment to agriculture graduates (Anonymous, 2008). Discussion with officials in Maharashtra, Andhra Pradesh and Rajasthan cleared that increased productivity of crops in areas where agriclinics are available. According to the farmers, benefits obtained from agriclinics included optimum usage of farm inputs, plant protection, and increased productivity. Across the country, Uttar Pradesh has the highest number of agriclinics and agribusinesses.

Cost-sharing approach

This approach assumes that cost-sharing with local people (who do not have the means to pay the full cost) will promote a programme that is more likely to meet local situations and where extension agents are more accountable to local interests. Its purpose is to provide advice and information to facilitate farmer's self-improvement. This approach is based on local people sharing part of the cost of the extension program. Its purpose is to provide advice and information to facilitate farmers' self-improvement. Problems may arise if local farmers are pressured into investing in unproven enterprises (Feder *et al.,* 2001).

Farmer Based Extension

Farmer interest group

A Farmer Interest Group (FIG) is a self-managed, independent group of farmers with a shared goal and interest. The members work together to achieve this goal by pooling their existing resources, gaining better access to other resources and to share in the resulting benefits. The joint action in financial activities like saving and interloaning can become model for future FIGs to help the resource poor farmers come out of debt-trap through mutual help. Regular meeting of group members is mandatory requirement to ensure smooth functioning of FIGs. Effective participation of members in meeting leading to consensus on various issues/problems, faced by of the group, is an important indicator of group health (Riar, 2006).

Successful groups

- ✓ Bee keeping farmers interest group, village Dida, Block Dinanagar, Distt. Gurdaspur.
- ✓ Dairy farmers interest group, Village Nandanpur, Block Jalandhar West, Distt. Jalandhar.
- ✓ Malwa Gramin Honey producer farmer interest group, village Kaulseri, Block Dhuri, Distt. Sangrur
- ✓ Malwa fruit and vegetable growers farmer interest group, Block Kotkapura, Distt. Faridkot.

Farmer Field School

It is a group-based learning process that has been used by a number of govt., NGOs, and international agencies. The first FFS was designed and managed by the UN Food and Agriculture Organisation in Indonesia in 1989 since then more than two million farmers across Asia have participated in this type of learning. FFS consists of 20-25 farmers who meet one morning every week for an entire crop growing season.

A FFS is facilitated by extension workers on skilled farmers. Employing non-formal education method, the field is used as the primary resource for learning (Vandenberg and Jiggins, 2007). Farmer field schools (FFS) are a participatory method of learning.

Farmer to Farmer Communication approach

Farmers show great interest on their fellow farmers. When one farmer shares his progressive views with others, then it could work very effectively than any other method of technology sharing. The Adike Pathrike, a farm monthly started by all India growers associations to encourage farmer to farmer communication was one of the success story of farmer to farmer communication (self-help journalism) for more than 15 years of existence in agricultural knowledge dissemination. The uniqueness of publication is that starting from writing articles, editing, publishing and distribution are mainly shouldered by practicing farmers.

Farmer Friend approach

As a grass root part of ATMA the farmer Friend (FF) serves as a vital link between extension system and farmers at village level. FF will be available in the village to advice on agriculture and allied activities. The FF facilitates dissemination of information to farmers, individual farmers and farm women directly through one to one interaction individually or in groups.

Group approach

The group approach programme encompassing several aspects of self-employment such as organisation of the poor into self-help groups, training, credit, technology, infrastructure and marketing was evolved (Najamuddin and Guliani, 2006).

Self-help group is a homogenous group of rural people who voluntarily come together to form a group or association for their income generation and empowerment for achieving a common objective. SHGs are small in size with membership ranging from 10-25 (Mondal and Ray, 2009). One important example is "All Women's Dairy Co-operative of Majowal Majara village in Nawanshahr district in Punjab. Milk producers were mainly rural women who lack scientific know-how.

Other valuable approaches

Farming systems approach

The farming systems approach considers the farm, farm household and off-farm activities in a holistic way to take care of not only farming but all aspects of nutrition, food security, sustainability, risk minimization, income and employment generation, which make up the multiple objectives of farm households. This approach considers interdependencies of the components under the control of members of the household, as well as how these components interact with the physical, biological and socio-economic factors not under the household's control. The farming systems approach emphasizes that research and extension agendas should be determined by explicitly defined farmers' needs through an understanding of existing farming systems rather than the perceptions by research scientists or extension functionaries (Meena *et al.,* 2013).

Mass media approach

The all India Radio and Doordarshan transmit program on agriculture. DD Kisan channel is an Indian agricultural 24-hours television channel, was launched on 16th May 2015. The channel has been dedicated to agriculture and allied sectors, which disseminates real-time inputs to farmers on new farming techniques, water conservation and organic farming among other information (Anonymous, 2015). In print media Newspapers are also covering agriculture news items. Almost all dailies presently devote one page once in a week covering aspects of agriculture. Newspapers are published in local languages are the close friends of farmers to familiar them about new technology.

Market-led extension approach

It is an approach through which extension system reached to the clientele on an end basis, beginning from package of practices for production to selling of produce at the consumer's door so that the farmers can get remunerative prices for their produces.

Farmers are sensitized on the production aspects like (i) what to produce (ii) when to produce (iii) how much to produce (iv) when and where to sell. Besides this, farmers are also sensitized on consumer preference, market intelligence, processing and value addition and market information system. The market-led extension deals with all these parameters from production to marketing of agricultural produce (Swanson, 2008).

In order to make farming more enterprising, extension professionals need to be pro-active beyond the regular objective of maximizing the productivity of the fishers by transferring improved technologies rather fishers should be sensitized on various aspects of farming like culture, harvest, quality, processing and value addition, consumer’s preference and market intelligence. This will help the fishing community to realize high returns for the produce, minimize the production costs, and improve the product value and marketability that may lead to realize the concept of doubling farmers’ income (DFI). With the globalization of agriculture, emphasis on productivity and profitability to the farm enterprises has been increased and, therefore the demand- driven agriculture (and allied sectors) has led to the paradigm shift from production-led extension to market- led extension. There are many challenges in the agricultural marketing system, which can be resolved through the efforts of market- led extension models.

Important market-led extension services in India

Dynamic Market Information (DMI)

Tamil Nadu Agricultural University implemented a pioneer project called Dynamic Market Information (DMI) which aims at providing daily market prices for 160 selected perishable commodities in Tamil Nadu, Kerala and Karnataka. DMI provides market price information via SMS through mobile phones.

Participatory approach

Participation means that the poor people themselves are involved in identifying the problems they face, determining ways to overcome them, designing realistic plans to achieve these goals, and carrying them out. Solutions devised and fulfilled by the people in need are far more likely to prove successful than those imposed from outside. Participatory extension provides a framework for extension staff to participate with village communities in facilitating development planning and activity implementation.

This approach ensures the extension response become community driven and assist village communities implement their planned activities with routine monitoring and evaluation of activities. Importantly, as the name implies, the extension process is seeking maximum participation from women and men from all groups within the target village community. The aim of the approach is bringing about change in people's attitude which is critical on the part of the people involved towards their environment and adoption of interventions for agricultural development (Suzler, 1989)

Project approach

This approach concentrates efforts on a particular location, for a specific time period, often with outside resources. Part of its purpose is often to demonstrate techniques and methods that could be extended and sustained after the project period. It uses large infusions of outside resources for a few years to demonstrate the potential of new technologies. Control is at the central government level and there are often considerable financial and technical inputs from an international development agency. Short-term change is the measure of success. In the aquaculture project in Nepal, for example, a loan from the Asian Development Bank was used by the Ministry of Agriculture to support extension work by fisheries officers in many different locations throughout the country. They were able to introduce pond fisheries through an effort which combined the project approach with the specialized commodity approach. One problem with this approach, however, is that a flow of ideas outside the project rarely occurs (Axinn, 1988).

Cyber extension approach

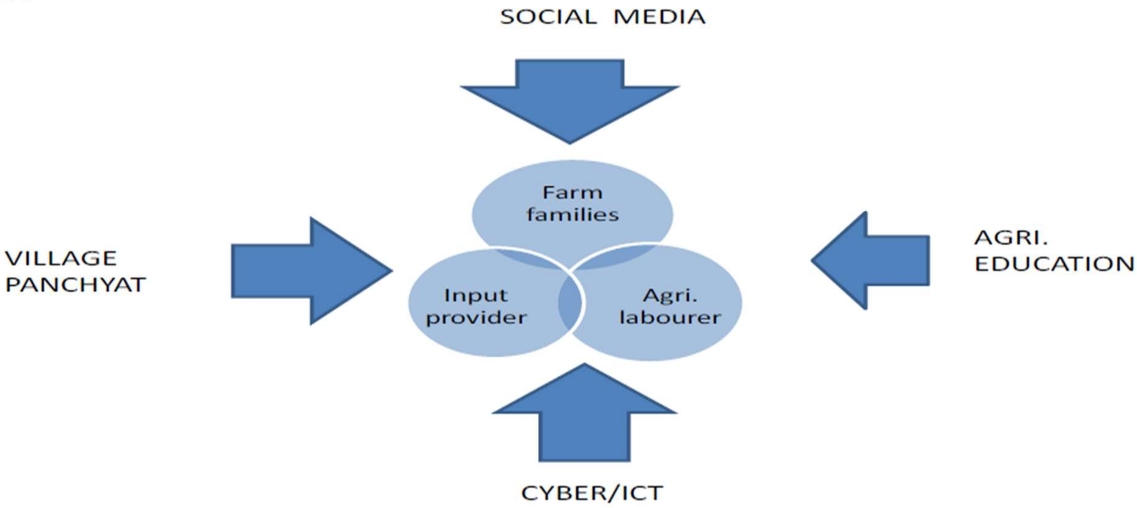
Cyber extension is defined as extension over cyber space, the imaginary space behind the interconnected telecommunication and computer networks (Mishra, 1999). Cyber extension approach includes effective use of Information Communication Technology (ICT), internet, expert systems, information kiosks and computer based training systems to improve information access to the farmers, extension workers, research scientists and extension managers.

Suggestions to make the extension work more effective

Redefining the role of public extension

There is an urgent need to redefine the role of public extension system because private extension providers such as: consultancies, agri-business and processing firms are increasingly concentrating on selected geographical area, crops and clientele. Hence public extension need to concentrate on resource poor farmers, food security issues, environmental extension and monitoring and regulatory roles of extension services.

Suggested Extension Model



For example; Kaur, (2005) found that composition of farmer advisory committee (FAC) under ATMA was not strictly as per prescribed norms. Regarding conduct of meetings, as per norms there should be 60 meetings but in actual only 50 meetings were held and attendance in these meetings were found to be 62 per cent.

Encouraging Multi Agency Extension Strategy

Involving public/private extension service providers. E.g. ATMA made good access but proper spirit is lacked. So there is a need to boost motivation dose for the various departments to work in flexible mode according to the work plan of ATMA.

Addressing gender concerns

Mobilizing farm women into groups. In all the training programme at all levels, women participation must be ensured. Specialized training for women trainers, women farmers have to be organized.

Introducing cost recovery approach

In the present time the farmers are willing to pay for better services, hence cost-recovery approach should be introduced at large level to ensure the financial sustainability of extension system and also increase the commitment of farmers.

Share cropping system

The extension worker provides advisory and inputs. Farmer uses his land and labour. Extension worker share the crop with farmer for a profit. Hired labour and other costs are shared. The extension workers using his link easily obtain farm inputs from input dealers even for credit until the harvest. Share cropped field serves as a demonstration plot. Since, extension worker has a personal stake, it motivates him to put maximum effort. Extension worker can also enter into agreement with as many farmers as he can, depending on his financial position and time (Prabhakar, 2010).

Suggested Model

Farm family, agricultural labourer and input supplier are the heart of this model. Ultimate aim of the extension approaches to disseminate the new technologies to the farmers and to convince them to adopt these ideas for their better development. For this the important component of this model are as follows:

Social media

With the popularization of new technologies and ICTs it is felt that there is a good scope for disseminating the information by various social apps like WhatsApp, face book, hikes etc. Farmers could make groups on social apps and could share their farm's status, newly followed technique at their farm with friend which will motivate the fellow farmers to adopt that new technique. Every farmer in our villages is not educated so gram panchayat could share with villagers.

Agricultural education

We all know the status of agricultural subject as an additional subject in the school curriculum. The teacher appointed for this subject is generally not belonged to the agricultural graduation. Then how we could expect the clearance of basic ideas of this field in mind of students at school level. There is a need to rethink and planned for proper qualification for agricultural teacher in school level. The other point is agriculture subject should be as compulsory subject rather than additional/choice subject at school level.

Village panchayats

The village panchayats have effective control on the village environment. There should be proper linkages of extension agencies and village panchayats. Although we are using progressive farmers at grass-root level but village panchayats have more effective strength to influence the farmers. It could be more effective by deciding the grants and the funds to the village panchayats according to the level of agricultural progressiveness at the village.

Cyber extension/ICTs

It should be available off-line in the villages because every time on-line access in village area is not possible. So, it is suggested to introduce Kiosks at every village with full information in off-line mode.

Today extension is passing through a major transformation for various domestic and global reasons. The present systems of extension in India are the outcome of several efforts and reforms made over the years for improving rural life of the country. Various reforms and developments witnessed in the extension system with great efforts from government and increasing involvement of private sector and NGOs in providing extension services. To secure a better future, the public extension system needs change for better services by structural reforms and improving function through transferring the ownership to and sharing responsibility of its management with the community. While developing any system, the farmer should be kept in focus as player, generator and user of the knowledge. Cost recovery approach and sharing cropping approach should be followed at large level. The social media, agricultural education, village panchayats, off-line initiation of ICT should be helpful for effective extension.

Here, there are some key points on novel extension approaches for reshaping Indian agriculture:

1. ICT and Digital Innovations in Extension Services: Information and Communication Technologies (ICT) have become integral, with services like Kisan Call Centres, Agri-Clinics, and e-Krishi Vipanan. These systems enhance farmers' access to real-time information on crop management, market prices, and climate adaptation strategies, helping to bridge rural-urban information gaps and supporting digital inclusion among farmers. Digital tools like mobile apps, e-learning platforms, and online portals connect farmers with real-time information on weather, market prices, and best practices, making agricultural knowledge more accessible.

2. Farmer Producer Organizations (FPOs): FPOs empower small farmers by collectively pooling resources, negotiating better prices, and gaining access to new markets, allowing them to compete more effectively. This model also helps empower local Farmer Producer Organizations (FPOs) and encourages entrepreneurial growth in rural youth.

3. Agri-Tech Startups and Innovation Hubs: Partnerships with tech startups and agri-innovation hubs promote the use of precision farming, drone technology, and AI in agriculture, which improve productivity and reduce costs.

4. Participatory Extension Approach: Involving farmers directly in decision-making ensures that agricultural practices and innovations are tailored to local needs, enhancing adoption rates and sustainability.

5. Value Chain Development: Extension services focusing on the entire value chain—from production to processing and marketing—enhance income opportunities and ensure that farmers can maximize profits at each stage.

6. Climate-Smart and Sustainable Agriculture: Many papers and projects are dedicated to integrating climate resilience and sustainability into farming practices. These include climate-smart extension programs, which promote resource-efficient practices, resilient crop varieties, and digital tools for monitoring weather patterns. Some studies emphasize using technology for nutrient management (like soil health cards) and sustainable resource utilization to address climate challenges. Providing guidance on resilient crop varieties, water-saving techniques, and soil health management helps farmers adapt to climate change and reduce environmental impact.

7. Public-Private Partnerships (PPP): Extension approaches increasingly involve PPPs to expand infrastructure and services. These partnerships link farmers with agribusinesses, tech providers, and financial institutions, promoting models like contract farming and support in post-harvest processing. Collaborations between government, private sector, and NGOs bring in resources, expertise, and infrastructure, expanding the reach and efficiency of extension services.

8. Use of ICT and AI for Customized Advisory Services: Tailored advice based on soil type, crop selection, and individual farm conditions helps farmers make more informed, productive choices.

9. Capacity Building and Skill Development: Regular training on modern farming techniques and financial literacy for farmers improves their ability to innovate and make strategic decisions.

10. Community-Centric Extension Programs: Emphasizing participatory approaches, these programs foster local leadership in agriculture by engaging farmer communities directly. The MANAGE institute and other agricultural bodies explore local needs and market opportunities, creating customized advisory services and establishing mechanisms for farmers to provide feedback, which strengthens policy and practice alignment with grassroots needs. Community-Based Extension Models are Peer-led groups, where experienced farmers share knowledge with their communities, foster learning and increase the adoption of best practices across regions.

11. Participatory and Market-led Extension: Participatory approaches, which encourage farmers to be actively involved in learning, address local needs directly and help build community resilience. Market-led extension supports farmers in understanding market demand, pricing strategies, and value addition, shifting the focus from production to profitability and sustainability.

12. Agricultural Education Institutions: There's also a push to utilize agricultural universities as hubs for extension services, tapping into their expertise for research and technology dissemination. Some models even propose making agriculture education mandatory at the school level to foster early awareness and skills among future farmers.

13. Self-Reliance (Atmanirbhar Bharat): Emphasizing self-sufficiency, initiatives such as Atmanirbhar Bharat stress the importance of indigenous knowledge, local resource mobilization, and a shift towards digital and entrepreneurial skill development for youth in agriculture.

Viksit Bharat 2047: Vision and Way Forward

With a clear focus on realising the vision of a "Viksit Bharat" (developed India) by 2047, the government has laid out a comprehensive plan aimed at empowering citizens and fostering a sustainable economy. This section outlines the key pillars and strategies envisioned to achieve this ambitious goal. The empowerment of citizens via social welfare programmes, skill development, and education is at the core of the Viksit Bharat goal. In order to produce a qualified workforce that can spur innovation and productivity, the government wants to guarantee that everyone has access to high-quality healthcare and education. Targeted interventions will also be implemented to promote inclusive growth and development by bridging socioeconomic gaps and elevating marginalised communities.

The creation of a sustainable economy that strikes a balance between social justice, environmental preservation, and economic growth is essential to the Viksit Bharat ideal. To reduce climate change and increase resilience to environmental issues, the government will give green infrastructure, renewable energy, and sustainable agricultural methods a priority. Efforts will be made to promote responsible consumption and production patterns, ensuring the efficient use of resources and minimising environmental impact. The recent initiatives like the PM Surya Ghar Yojana, which subsidises and promotes individual rooftop solar connections, have not just seen a massive surge in registrations, but have also led to a bottom-up movement about green and clean energy amongst the citizens, where all stakeholders, including startups, are pitching in to do their bit.

India's ability to use innovation and technology to its advantage will determine how developed the country becomes. In terms of cutting-edge technologies like artificial intelligence, quantum computing, and space exploration, India is envisioned as a worldwide leader under the Viksit Bharat vision. In order to achieve this goal, the government will fund R&D, encourage industry-academia cooperation, and establish an environment that is supportive of innovation and entrepreneurship. India wants to increase its competitiveness in the global market and promote inclusive growth by utilising technology for social and economic transformation. Moving forward, putting the initiatives in the vision paper into practice and overcoming obstacles in the way of progress will require sustained engagement with the corporate sector, foreign partners, and civil society.

The Viksit Bharat vision, which is based on the ideas of empowerment, sustainability, and innovation, offers an ambitious and aspirational development blueprint for India. India is positioned to fulfil its potential as a developed country and become a major player in the world economy in the twenty-first century by investing in its people, developing a sustainable economy, and embracing technology and teamwork.

Viksit Bharat with STRIDE

To achieve the Viksit Bharat dream, we will have to implement a STRIDE model of transformation. As senior stakeholders hold planning meetings for the next 100 day vision plan for the new government, the proposed model will be a good addition to take into 'stride'. Figure depicts the STRIDE model as it would be applicable to India's vision of becoming a developed country. The model focuses on six priority pillars:

- **S: Startups:** There is a need for around 5 lakh innovative startups and supporting the growth of these startups will enable them to innovate and achieve their potential.

- **T: Technology and Innovation:** Emerging technology and innovation need to be leveraged to enhance productivity, efficiency, and competitiveness across industries.
- **R: Research and Development**: Investments will be required for research and development to foster innovation and advance scientific and technological capabilities. A fund of funds may provide a much-needed shot in the arm.
- **I: Infrastructure:** Pervasive world-class infrastructure will be needed to improve quality of life and deploy the best tech products and services.
- **D: Deployment and adoption**: Comprehensive implementation and widespread adoption of advanced solutions to transform industries and society will be required.
- **E: Enhancing skills and capacity**: The workforce will need to be upskilled and trained to meet the requirements of jobs in the future.

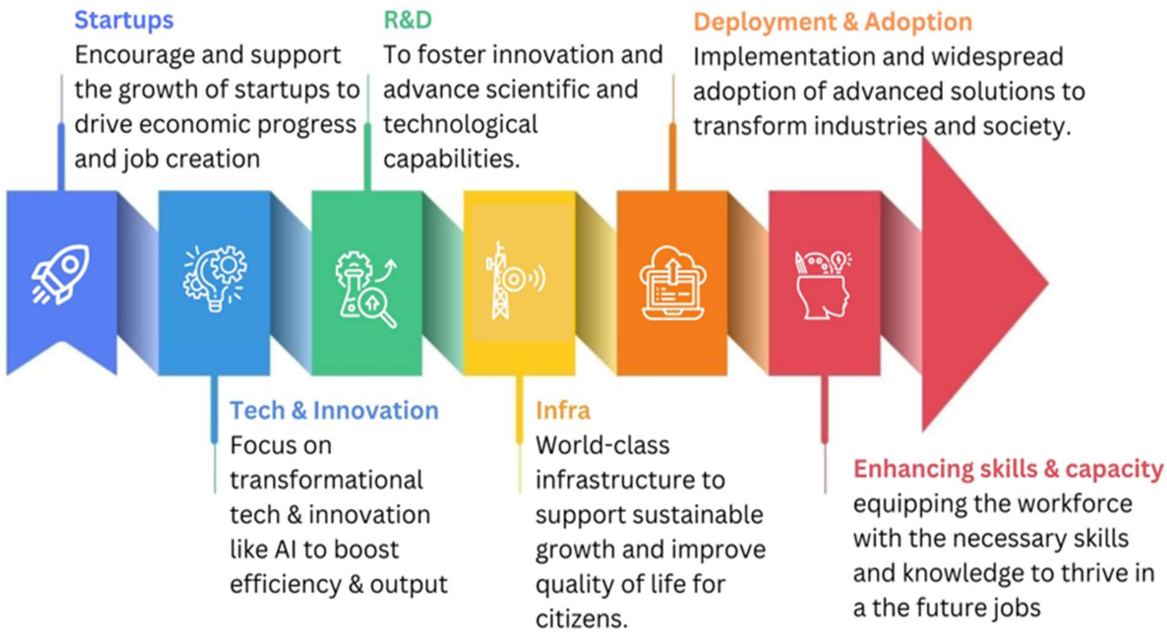


Figure : STRIDE model of transformation that will help India achieve the 2047 Viksit Bharat vision by Dr. Subi Chaturvedi

In order to realise the goal of a Viksit Bharat by 2047, a comprehensive plan for revolutionary development is offered through the STRIDE model. By promoting both economic growth and the general well-being of our citizens, this integrated approach would pave the way for India's ascent to prominence in the world economy by 2047, where both development and growth go hand in hand, taking inspiration and being propelled from the Prime Minister's *Panch Pran* which include, above all, throwing away the subservient, conformist mindset, asking the right questions, leaving the baggage from the past behind while learning from history, embracing tradition with modernity, and dreaming to our fullest potential while doing right by our nation, putting our fellow Indians first and our country above all

Asset Based Community Development (ABCD) approach

As per the traditional approach to development, poor people see themselves as people with special needs that can only be met by outside supporting agencies. But Asset Based Community Development (ABCD) approach intends for the development of community based on the principle of identifying and mobilizing individual and community 'assets', rather than focusing on problems and needs. It is an extension approach in which a community's micro-assets are linked with its macro environment. It believes that communities can initiate and sustain the process of growth and development themselves by recognizing and harnessing the existing, but often unrecognized assets, and thereby promoting local economic potential to drive its development process (Rans & Green, 2005). The approach is optimistic in nature, because the focus is on *'what is possessed by the community, rather than the problems of the community."*

Five Key Assets in ABCD

As per ABCD approach there are 5 categories of asset inventories such as individuals, associations, institutions, physical assets and connections

Individuals: Every individual has got certain assets, gifts and qualities; such individual is at the center of ABCD approach.

Associations: Groups of people working with a common interest are critical to community mobilization.

Institutions: The assets of institutions help the community capture valuable resources and establish a sense of civic responsibility.

Physical Assets: Physical assets such as land, buildings, space, and funds are other assets that can be used.

Connections: These are the exchange between people sharing their assets by various methods.

Rural advisory services (RAS)

Rural Advisory Services (RAS) refer to all the different activities that provide the information and services needed and demanded by farmers and other actors in rural settings, to assist them in providing their livelihoods by developing their technical, organizational and management skills and practices (GFRAS, 2011; FAO, 2010). RAS designers and implementers must recognize the diversity of actors in extension and advisory fields (public, private, civil society); the need for extending support to farmers' producer organizations (FPO) and rural communities (beyond technology and information sharing) including advice related to farm, organizational and business management; and explaining the role of facilitation and brokerage in rural development and value chains.

Model Village System of Extension (MVSE) approach

MVSE is an integrated and holistic extension approach where *community participation* is prioritized for suitable technological interventions in the fisheries to bring all-round development in fisheries sector in terms of *socio-economic upliftment, technological empowerment, self-governance* thereby enhancing the futuristic knowledge base and skills through *participatory framework.* MVSE emphasizes on involvement of all stakeholders in the process to converge their activities with a stake in the food value chain *linking producer to consumer.* Nevertheless, MVSE is an action research taken up in fishers' farm based on the principle of leveraging the activities, investments and resources from outside agencies/ externally aided projects resulting higher productivity, ensuring food security and sustainable improvement in overall quality of life by promoting leadership, self-dependency of the community in food chain. Economically viable, ecologically compatible and socially acceptable suitable technologies are successfully intervened in a cluster approach through participatory mode by integrating the multi-disciplinary research. The cluster of villages is adopted as model village, the success of which is later replicated to other villages. The village is developed as a commodity village branding for a particular commodity in the market.

MVSE approach works on the following principles:

- Promotes self -governance among the fishers
- Skill improvement and leadership development among the fishing community.
- Establishing linkage through pluralistic convergence of various stakeholders associated in the sector.

- Encouraging the market opportunities through commodity-based village development (CBVD).

Farmers Field School (FFS) approach

The FFS extension approach is an alternative to the top down extension approach which was evolved as a method to solve complex field level issues in fisheries sectors. FFS aims to build fishers' capacity to analyzed their production systems, identify problems, test possible solutions, and eventually encourage the participant member to adopt the practices most suitable to their farming systems (FAO, 2003c). This is a learning-by-doing approach which emphasizes group observation, discussion, dissection, modification, and promotes field-based experimentation, analysis for collective decision making followed by actions. The FFS approach is an innovative, participatory and interactive learning approach that emphasizes problem solving and discovery based learning. FFS also provides an opportunity to fishers to practice and evaluate sustainable resource use technologies, and adoption of new technologies by comparing with their conventional technologies developed in congruent with their own tradition, culture and resource use pattern. The goal of FFS approach is such that, after observing and comparing the results of field level experimentation fishers will eventually "own" and adopt improved practices by themselves side-lining the conventional ones without any external compulsion. Field day is being organized at the end of the season to give visibility to the entire activities to convince the non-adopters. Exchange visits with other FFS is also encouraged to learn by association and comparison A group of 20-25 fishers can form a Farm School under the guidance of a FFS facilitator. Extension workers, NGO workers, fishermen co-op members or previously trained fishers can become Farmer Field School (FFS) facilitators. The facilitators are trained by master trainers, who have expertise in the particular subject matter. FFS is a time bound activity usually covering one production cycle or a year.

It is also significant to note that irrespective of the merits of the technology, the acceptance to technologies is influenced by the extension method. Farmer Field School (FFS) model has been accepted as a good methodology because it is exclusively participatory. A special feature of this extension approach was that it reached poor and female-headed households and lower-caste households much better than the regular extension services (Tiwari et al. 2010). FFS was also found to be effective in avoiding barriers like socio- economic constraints, infrastructure problem and incompatibility of technology for the adoption of sustainable fishery practices.

The basic component of FFS is setting up of a Participatory Comparative Experiment (PCE), commonly referred to as Participatory Technology Development (PTD), whereby the fishers put the FFS concept into practice under close monitoring and supervision by the FFS members. A PCE can be developed in the field of agriculture, livestock, fishery, forestry, agro-forestry, livelihood system and others.

Principles of Farmer Field School (FFS)are as follows: -

- Field is the learning place.
- Emphasizes hands on and discovery based learning.
- Farmers become experts.
- Integrated and learner defined curriculum.
- Doing is better than learning/ seeing.
- Experiences are the start of all learning.
- Link to actual field situations and should be relevant to local needs and problems.
- Participatory monitoring and evaluation.
- Fishermen are decision makers.

Digital Extension approach

Extension reforms brought a transformation in fishery extension system through introduction of Information and Communication Technologies (ICTs). The ICT-enabled extension system referred to as Digital Extension has the potential for enabling the empowerment of fishing communities by improving their access to information and sharing knowledge with innovative e-agriculture initiatives (Saravanan, 2010a).

With the phenomenal growth in information and communication technology, use of IT application in agriculture will bring remarkable change in the attitude and knowledge level of user. Basic requirement is to provide most appropriate information in such a capsule that can be easily understood and used by them. This approach will strengthen the extension system for better dissemination of technology. As a case study the contribution of Digital Green, a NGO that uses an innovative digital platform for community engagement to improve lives of rural communities across South Asia and Sub-Saharan Africa is remarkable. Digital Green associate with local public, private and civil society organizations to share knowledge on improved farmers practices, livelihoods, health, and nutrition, using locally produced videos and human mediated dissemination. As per the study, the Digital Green project (participatory digital video for agricultural extension) increased the adoption of certain farm practices seven times higher compared to traditional extension services and the approach was found to be 10 times more cost-effective per dollar spent. Hence, along with ICT-based advisory services, input supply and technology testing need to be integrated for greater impact and content aggregation from different sources require to be sorted in granular format and customized in local language for rapid adoption of technologies (Balaji et al., 2007 & Glendenning and Ficarelli, 2011).

The effectiveness of this innovative extension approach depends on capacity building, people's participation along with government initiative to provide strong infrastructure to be worked with the cutting edge technologies. The farmer friendly technology dissemination process needs to be handled with careful planning by the incorporation of information communication technology. The use of ICT application can enhance opportunities to touch the remote farmers to live in close proximity of the scientific input. The computer based web portals namely aAQUA, KISSAN Kerala, TNAU AGRITECH Portal, AGRISNET, DACNET, e-Krishi, ASHA, India Development Gateway (InDG) portal, Rice Knowledge Management Portal (RKMP), Agropedia, KIRAN, AGMARKNET, ITC-e-Choupal, Indian commodities.com, Mahindra Kisan Mitra, IFFCO Agri-Portal, Agrowatch Portal, iKissan, etc. along with some mobile based Apps like mKRISHI® Fisheries, riceXpert, Pusa Krishi, Krishikosh, m4agriNEI CIFT Lab Test, CIFTraining etc. launched in India are some of the successful digital intervention for technology dissemination.

The use of internet, mobile and video- conferencing assists the IT enabled farmers to utilize the facilities for their favours for which the most suitable permanent infrastructure is the basic requirement. Strong linkages need to be established between direct ICT interventions and it should be part of the national level program on holistic agricultural development.

Disruptive Extension approach

Recently, a new extension approach christened as 'disruptive extension' comes into limelight which is considered as an innovative extension approach that creates a new paradigm of extension that eventually disrupts an existing approach followed by extension professionals in the field of agriculture and allied sectors. It is an entrepreneurial oriented sustainable extension system that can able to transform every link in the food chain, from farm to fork. It is a cost-recovery extension approach the fulcrum of which lies between resource exploitation on one side and resource conservation on another side that influence the livelihood security and technology sustainability for small scale farm holders. It deals with the following principles:

- ✓ Importance of good governance in agriculture (and allied fields) that considers the resource rights of the farmers.
- ✓ Emphasis on growing interest among the stakeholders by explicit analysis of field level issues for technology adoption.
- ✓ Potential to resolve the social conflicts for equal access to community resources through Memorandum of Understanding (MOU).
- ✓ Based on cost recovery mechanism.
- ✓ Ensure commitment to optimum resource management and maximum economic benefit to improve food security.
- ✓ Provision of community based social insurance.
- ✓ Maintaining the sustenance of the technology supports through custom hiring approach.
- ✓ Focus on pluralistic convergence of different partners to build a network of linkage with various entities around the farm households.
- ✓ Encouraging the farmers-scientist interaction for technology development, assessment and application through Farmers' FIRST approach.

Global agriculture embraces diverse actors in its endeavour to feed about 10 billion people in the planet by the end of 2050. The small, marginal & landless farmers are extremely vital for food security due to shrinking of resource day by day. The contribution of women fishers also cannot be ignored particularly in on-farm operations, harvesting, post-harvest management, processing etc., especially in fishery and animal husbandry sector. Hence, in today's scenario innovation in agriculture extension is the key to address the growing challenges, which need to be validated, integrated and scaled up and further recommended for large scale implementation by the policy makers. The innovative extension approach should be based on capacity building, skill development, people's participation along with government initiative to provide policy support to be worked with the cutting-edge technologies. Much effort has been initiated in going beyond the farm and the fishers and focus on beyond the technology to a wider innovation system.

Conclusion

From the above discussion, it can be concluded that the world population is slated to grow to about 9 billion by 2050. The challenge is to find ways and means to produce enough to feed it. The challenge of reducing acreage under agriculture and food wastage in production and distribution is having a major impact on the world. Public agricultural extension system is one of the largest knowledges and information dissemination institution. Extension approach is like doctrine for the system, which informs, stimulates and guides such aspects of the system as its structure, its leadership, its program, its resources and its linkages. Various extension approaches completed successfully by giving satisfactory results in past to improve the farmers knowledge regarding newly developed agricultural technologies. Some of them are continuously running in present along with newly developed extension approaches and requires little modifications in future to increase the agricultural potential of country. The use of innovative extension approaches to increase coverage is, therefore, a concern for all involved in agriculture extension and advisory services. Participatory, partnership of government and non-government organizations (NGO's), farmer's cooperative approaches are running successfully in present. In the future, the social media, agricultural education, off-line initiation of ICT could be helpful for effective extension of agricultural information to the grass-root level. Technology in agriculture has the potential to truly lead India to be "Atmanirbhar Bharat" in all respects, and be less dependent on extraneous factors.

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LP 1.2

Synergizing institutional innovations with technological interventions for sustainable development

Nafees Ahmad, R. N. Padaria, A. K. Singh, Nishi Sharma, Pratibha Joshi, P. Punitha and P. P. Maurya

Agriculture has made a great stride in the last two to three decades primarily owing to advent of advanced technologies. Innovations and technologies are exclusively credited for bringing about the sea change in the system productivity as well as the profitability in the Agriculture sector. The technologies and innovative practices have not only improved the system productivity but also developed sustainable production system. Undoubtedly, Agriculture sector in past remained backward and poorly developed owing to poor application and adoption of the technological know-how. The application and use of traditional crop technologies; in particular the old/local varieties season after season has led to decline in production whereas cereal based cropping system predominantly paddy-wheat crop rotation has poorly affected the sustainability of the system.

Indian Agriculture has been lately facing an uphill task to retain and restore the falling productivity of major crops. The major reason behind the poor agriculture production has been traditional cropping pattern of rice-wheat system, lack of diversification, poor natural resource management, and poor access to improved agricultural technologies. This has resulted not only in loss of production per unit area but also aided in perpetuating a plethora of pathogens in the soil detrimental to the health of the crops. The way out is to augment production by resorting to changes in prevailing cropping system. There is a need to diversify the cropping system through integrating pulses, oilseeds, vegetable crops etc. in the production system.

Transfer of improved agriculture technologies to the farmers' fields is the cornerstone for bringing about improvement and transformation in the farming sector. The sound transfer policy makes it imperative to assess and test the technologies repeatedly in the local farmers' fields. It calls for a systematic and planned programme of development, creating an enabling environment for all the stakeholders to participate as well as the change agencies to converge and collaborate in the process of change.

Pluralistic Extension System

In order to serve the large farming community in a country like India having diverse socio-economic conditions and dwelling in varied agro-climatic situations, alongside facing divergent issues and problems, singular and monopolistic public extension with formalized and fixed approaches to reach the farmers and deliver them the goods and services will not suffice in the face of vast population with humongous nature of farm problems. Under this backdrop, there is pressing need to transform and overhaul the whole extension system in the country with a need to have a fresh look and include different other perspectives and with a vision to chart a new pathway of development in the milestone year of 2050. Under the changing socio-economic and agro-ecological situations, there is a dire need to move towards pluralistic extension approaches which also finds its echo in the concurrent Extension policies of the present day Government. The pluralistic extension will not mean only with the multiplicity of the agencies deployed whether it is private agency, Non-Govt. organization, corporate bodies, Farmers organizations, marketing agencies etc. rather strategy has to be reformulated in terms of Agricultural Extension but it will also employ various strategies, convergence and collaborations, utilization of modern digital media, beneficiary participation.

IARI in the service of Agriculture Development

In a vast and diverse country like India, different strategies and approaches have been deployed from time to time to tackle the problems and issues plaguing the growth and development in Agriculture sector. The Green Revolution in the 1960s addressed the critical situations of food scarcity and widespread hunger. The diffusion and percolation of the GR technologies to the large number of farmers in various parts of the country was made possible through the innovative extension approaches such as National Demonstration, Community farming approach, Integrated Whole Village Development Approach, Effective Utilization of Mass Media in Agricultural Development, Single Window System, Farmer-to-farmer Quality Seed Production Program, Indigenous Knowledge System, Farming System Research and Extension, Institute Village Linkage Program, Post Office Linkage Program, IARI Partnership Program, Seed Production Hub, Networking with innovative farmers, to name a few. These have immensely contributed to transfer of technologies leading to development of the farming community in general and the small and marginal farmers in particular.

Partnership Approach of IARI

India is a vast country with divergent agro-climate, farming pattern/systems, problems and needs of its people at large and the farming community, in particular. Public organizations working in isolation, cannot reach the huge masses of farmers spread across the country and achieve the sustainable development goals. The agriculture technologies developed by the Institutions wouldn't either get wider distribution for want of local/regional support base. Public private partnership model may be the mainstay of development in the present circumstances as Public Institutions are well equipped for development of innovations/technologies whereas, the NGOs/VOs can reproduce and multiply these technology at local level and out-scale it among masses as they have presence at grass root level and can access to the remotest of the area.

Institutional Innovations and Technological Interventions for Sustainable Development

(1) Developing Model Village through Integrated Technology Approach

The need for developing and evolving model Agricultural village has been felt since a long time as it can play a crucial and potent role in the village development by replicating and adopting the model in the region overwhelmingly by the farming community. The present study was carried out in this backdrop with the following twin objectives; (1) to identify and assess suitable technologies for enhancing farm income and (2) to evolve a cropping pattern for sustainable production system.

Research Methodology:

The approach of 'Integrated Village Development model' was adopted in this study. The location of the study being the village Rajpur, block Khair, district Aligarh in Uttar Pradesh. The village Rajpur was purposively adopted for a period of five years (20015-20) as the village presented divergent agro-climatic situations, the low land area having clay loam soil type whereas the upland region with sandy loam soil. Integrated development model approach implied testing and demonstrating diversified crop technologies such as field crops, pulses, oilseed and even vegetable crops in kharif, rabi and zaid seasons during the study period. Local cultivars of grain crops (paddy and wheat), pulses (green gram, arhar and lentil) and oilseed (mustard) were replaced with improved varieties of the crops developed by the Institute which were demonstrated in the farmers' fields. Technological interventions like improved varieties of paddy (PB 1121), wheat (HD 2967), green gram (Pusa Vishal), pigeon pea (Pusa 991), lentil (L 4076) and mustard (Pusa Vijay) were integrated into various crop rotations followed in the area and it has been tested to evolve and establish sustainable production system. In general, around 10-20 demonstrations were conducted for each of the crops/ varieties in every season on the farmers' fields, selected purposively in the project study.

The table 1 below presents an account of various technological interventions taken in the adopted village in an integrated manner.

Table 1: Interventions of crop technologies in village Rajpur, district Aligarh (2015-2020)

S. No.	Crop Rotations			Yield of Demo (qt/ha)			Avg. Net Return (Rs./ha)		
	Kharif	Rabi	Zaid	Kharif	Rabi	Zaid	Kharif	Rabi	Zaid
1.	Paddy PB 1121	Wheat HD 2967	-	44.87	59.71	-	76828	91393	-
2.	Paddy PB 1121	Wheat HD 2967	Green gram P Vishal	46.30	56.40	15.75	80540	85438	52500
3.	Maize Pioneer	Potato 3797	Green gram P Vishal	66.50	342.0	12.50	40000	155000	48480
4.	Arhar P 991	Wheat HD 3059	Green gram P Vishal	12.63	45.50	11.50	36780	55650	45650
5.	Paddy PB 1121	Lentil L 4076	Bajra 86M11 &86M20	42.35	15.63	25.00	86250	53776	32500
6.	Maize Pioneer	Mustard P Vijay	Water melon Namdhar i	55.00	23.33	325.0	46500	70750	102500
7.	Paddy PB 1509	Potato 3797	Green gram P Vishal	52.67	342.0	12.50	94976	152000	45752

(*Colour code in blue indicates the crop varietal interventions given under the project in the adopted village*)

Results and Implications:

The intervention of improved paddy variety PB 1121 led to an increase in the productivity level of 10-15% over the existing farming practice. Likewise, Introduction of high yielding wheat variety HD 2967 augmented the productivity level up to 15-18% higher as compared to the local cultivars. The intervention with early maturing paddy variety PB 1509 has enabled the farmers to take potato and other vegetable crops timely in rabi season. Short duration pigeon pea P 991 has made it feasible to take late wheat crop variety HD 3059 followed by green gram (Pusa Vishal) as summer crop in a year-round rotation. Green gram intervention has benefitted farmers as an additional crop in the zaid season. In the most widely practiced rotation of paddy-wheat in the region, green gram as summer crop has proved to be an additional source of income with farmers getting an average net income of Rs 52500/ha from this crop alone. Improved lentil variety L 4076 and mustard Pusa Vijay proved to be a profitable intervening rabi crops in paddy and maize based rotations in which farmers were able to take either bajra or water melon as the third crop in summer season.

These technological interventions have made possible to accommodate three crops in a year-round rotation and alongside have improved the productivity and income of the farming community of the village. The major thrust is given in the project to diversify cropping with improved cereals, pulses and oilseed crops which has resulted into sustainable utilization of natural resources and evolution of model Agricultural village. The following benefits are accrued from the interventions.

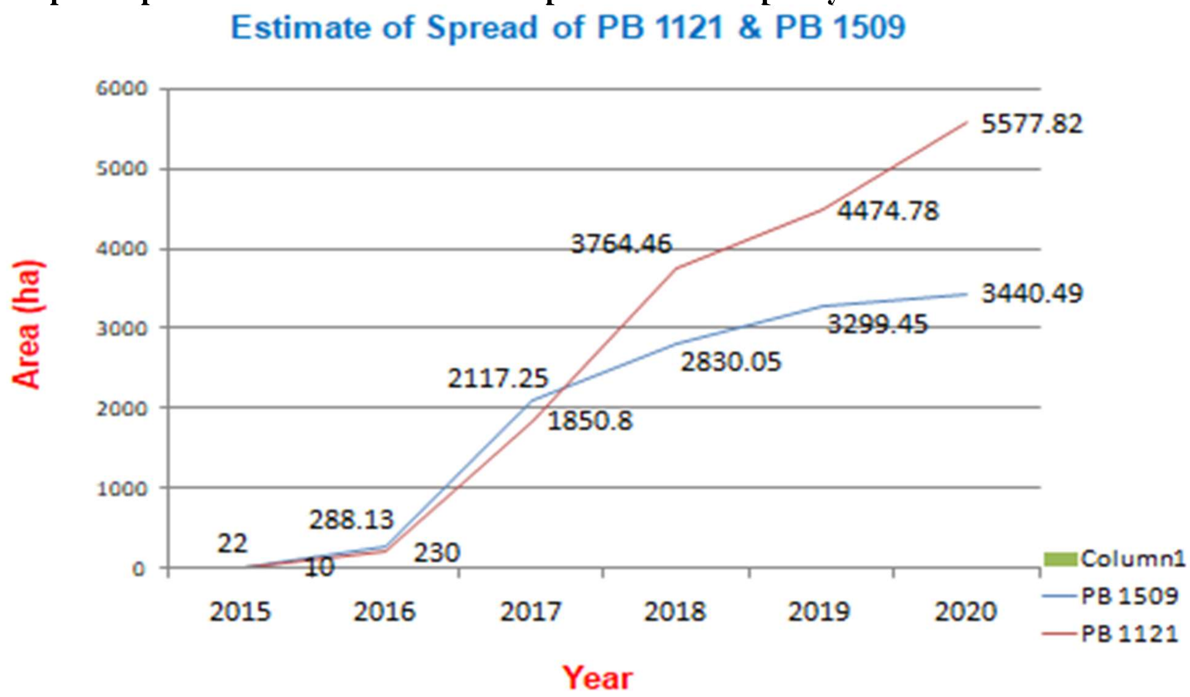
- Improved technologies played important role in increasing cropping intensity.
- Trials with improved varieties of pulses and oilseed led to increase in fertility of soil and sustainable production system.

- It also contributed to higher land productivity and maximization of farm income.

(2) Out-scaling of Paddy Varieties

The spread of varieties in terms of production and acreages is an important indicator of their growing popularity among the farming community. It has been estimated that almost 75-80% of the area in project village is saturated by the two leading paddy varieties PB 1121 and PB 1509. An estimate of spread of paddy varieties PB 1121 and PB 1509 has been depicted in the following graphical presentation. The presented estimate of spread of the two paddy varieties in terms of increase in acreages is purely based on the input seed materials of the two varieties supplied yearly from 2015 to 2020 for demonstrations in the farmers' fields. The graphic representation is cited below;

Graphic representation of an estimate of spread in area of paddy PB 1121 and PB 1509



The above graph shows that starting with the coverage of 10.0 ha area under demonstrations in the initial year 2015 in the project village, the area under paddy PB 1121 has spread to a mammoth 5572.82 ha in 2020. In case of paddy PB 1509 the demonstrations were started on a meager 22.0 ha area in 2015 and it spread to 3440.49 ha area in the corresponding period. The estimation of spread is based on the assumption that in case of improved and high potential varieties, farmers save and retain almost 6% seeds of the total produce for sowing in the following year and further almost 2% of the produce in the second year for sowing in the subsequent year.

(3) Collaborative National Extension Programme for promoting higher cropping intensity

Land resources being limited, the overall production is largely governed by productivity of the crop which in turn is determined by the land resource use efficiency spatially and temporally. The cropping intensity is an important yardstick of the efficient land use pattern of a piece of farming land. Sound technological interventions are imperative to improve cropping intensity. North India presents three clearly defined farming seasons annually i.e., rabi, kharif and zaid. The present research study has been taken up with the objectives to assess the suitability and viability of improved IARI technologies in increasing cropping intensity under rice-wheat production system.

IARI has been implementing National Extension Programme in collaboration with

KVK Kathua (Shere Kashmir University of Agril. Science & Tech. Jammu) for assessing and promoting IARI technologies in far flung areas of Jammu & Kashmir. Said-Sohal village of district Kathua has been adopted by Krishi Vigyan Kendra, Kathua under NICRA project to demonstrate and facilitate adoption of climate resilient technologies for sustaining and increasing agricultural productivity under rainfed ecology. The present study has been undertaken in the adopted village with the focus on the cropping system followed in the area i.e. paddy, toria and wheat. The table 2 below represents economic performance of improved crop cultivars which promotes crop intensification with three crops in one year cycle; paddy in kharif, toraia in zaid and wheat in rabi season.

Table 2: Economic Performance of Cropping System (2020-21) under the adopted crop rotation; Paddy (P-1509)-Toria (RSPT-2)-Wheat (HD-3059)

Crop/ Variety	No. of demos	Crop Yield Av. q/ha		Increase in yield (local) %	Net Return Av. (Rs./ha)		BC Ratio	
		Demo	local check		Demo	local check	Demo	local check
Paddy 1509	35	37.5	27.5	36.3	48800	30800	2.60	1.64
Toria RSPT-6	15	8.9	5.7	56.14	35580	19460	3.32	1.81
Wheat 3059	22	24.50	19.50	25.64	33650	24150	2.60	1.87

Suitability and viability of improved IARI varieties was assessed for increasing cropping intensity under the paddy-wheat production system. The crops selected for three seasons were late sown wheat HD 3059, short duration basmati PB 1509 and intervening oilseed crop Toria RSPT 6. Farmers were purposively selected for laying out demonstrations on the three crops each year, consecutively for a period of 3 years, from 2018-19 to 2020-21.Assessment trials were conducted during 2020-21;35 on paddy PB 1509, 15 on toria, RSPT 6 and 22 on wheat HD 3059. The demonstrations were regularly and closely monitored by the KVK scientists for which the quality seeds were provided from IARI, the host organization.

Conclusion

Suitable technological interventions in the form of improved crop varieties of paddy (short duration PB 1509) and wheat (late sown HD 3059) provided a suitable window, paving the way for accommodating toria RSPT 6, an intervening crop leading to increased cropping intensity of the farm field. This has made possible optimum utilization of land resources, thereby increasing land use efficiency. The increased cropping intensity augmented the land productivity, accruing higher income to the farmers in a year cycle.

(4) Development of Seed Production Hubs in Partnership Mode

Sustainability of the production system is the key objective of any extension programme. In Agriculture, sustainability can be ensured by multiplication and up-scaling of technological inputs. The Institute established two Seed Hubs, one in Northern India (Young Farmers Association, Rakhra, Patiala) and another in the Eastern part (Participatory Rural Development Foundation, Gorakhpur) of the country under the IARI-VO partnership programme. The two centers served to multiply and produce large quantity of quality seed materials of improved crop varieties developed from IARI. This has resulted in large scale dissemination of technologies among the farming communities in the Northern and Eastern part of the country. The following tables 3 & 4 present an account of seed production of wheat and paddy crops at the two seed hubs.

Table 3: Wheat Crop Rabi 2020-21

Partners	**Variety**	**Seed Produced (q)**
YFA, Rakhra, Punjab	HD 3226	55.00
	HD 3086	55.00
	HI 1628	56.20
	HI 1620	61.20
PRDF, Gorakhpur	HD 2967	352.00
Total		**579.40**

Table 4: Paddy Crop Kharif 2021

Partners	**Variety**	**Seed Produced (q)**
YFA, Rakhra, Punjab	PB 1718	50.00
	PB 1509	122.00
	PB 1401	94.00
	PB 1121	34.00
	Puse 44	322.00
Total		**523.00**

The Institute collaborated with PRDF Gorakhpur to conduct 8 production/demonstration trials of improved wheat variety HD 2967 in 35.0 ha area during the successive rabi seasons from 2016-17 to 2020-21 on the selected farmers' fields in project villages of districts Gorakhpur, Maharajganj and Siddharthnagar in the Eastern Uttar Pradesh. This resulted in production of 352.0 q of foundation seeds of the high yielding wheat variety HD 2967 in the reference year 2020-21. Likewise, the Institute in partnership with YFA Patiala conducted 21 production/demonstration trials on improved wheat variety HD 3086, in an area of 19.9 ha in project villages in Northern India during the last five years i.e. rabi 2016-17 to 2020-21. It resulted in production of 227.4 q of foundation seeds of the wheat varieties (HD 3086, HD 3226, HI 1620 and HI 1628) in the year 2020-21 alone.

YFA Patiala, the collaborative partner under this programme has also the interventions in paddy crops, producing quality seeds of improved basmati (1718, PB 1509, PB 1401 and PB 1121) and non-basmati grade varieties (P 44) during kharif seasons. During the five years 2017-2021, YFA Patiala conducted 13 demonstration trials on PB 1121 and 25 demonstrations on P 44. In the year 2021 alone, it resulted in production of 50.0 q of foundation seeds of PB 1718, 122.0 q of PB 1509, 94.0 q of PB 1401,34.0 q of PB 1121 and 322.0 q of P 44 which also happens to be one of the highest producing non-basmati variety in the region.

(5) Public Private Partnership Extension Model

Indian Agricultural Research Institute has been the pioneer in developing improved and high yielding varieties of different crops on a regular basis. IARI has initiated IARI-VOs model extension programme, collaborating with Voluntary Organizations from across the country for assessment and promotion of improved paddy crop variety Pusa 1850 in different regions of the country. The following table 5 shows the yield and economic performance of paddy Pusa 1850 in participatory mode with Voluntary organizations.

Table 5: Performance of Paddy Crop (Pusa 1850) Kharif 2023 (PPP Program)

Crop	Demo	Ave. Yield of the crop in q/ha.		Increase in yield %	Av. Net Return (Rs./ha)		BC Ratio	
		Demo	local check		Demo	local check	Demo	local check
FAARD Foundation	4	52.00	49.50 (Saba Masori)	5.05	76016	70558.50	2.02	1.88
ISHARA Deoria	15	46.00	39.40 (BPT 5204)	16.75	45750	38300	1.99	1.95
MGKVK Gorakhpur	20	49.50	42.40 (Sarju 52)	16.75	71259	54859	2.93	2.45
Shamayita Math Bankura	08	49.14	46.85 (MTU 7029)	4.9	43552	37580	1.98	1.80

The table depicts that Institute technology paddy Pusa 1850 is tested at multiple locations across the country under Public Private Partnership mode. The tested variety proved its potential in productivity and profitability at FAARD Foundation (Uttar Pradesh), ISHARA Deoria (Uttar Pradesh), MGKVK Gorakhpur (Uttar Pradesh) and Shamayita Math Bankura (West Bengal). It has registered increase in yield in the range of 4.9 to 16.75 percent at Shamayita Math Bankura and ISHARA Deoria/MGKVK Gorakhpur, respectively. The highest net income of Rs. 70558.50 per ha was realized at FAARD Foundation (Uttar Pradesh).

(6) Public- Private and Public-Public Partnership Programme

Some of the technologies developed by the Institute have been tested under both the Public- Private as well as Public-Public Partnership mode which made it possible to establish their potential in the respective regions. The Institute has tested improved wheat variety HI 1634 in partnership with multiple organizations such as Deen Dayal Upadhyay Research Institute, Chitrakoot; Navsari Agricultural University, Navsari; Vidya Bhawan KVK Udaipur; Rani Laxmibai Central Agricultural University, Jhansi and Maharana Pratap Univ. of Agril. &Technology, Udaipur. The table 6 below shows economic performance of improved wheat variety HI 1634 in partnership mode.

Table 6: Performance of wheat Crop (HI 1634) rabi 2022-23 (IARI-Partnership Program)

Crop	Demo	Ave. Yield of the crop in q/ha.		Increase in yield %	Av. Net Return (Rs./ha)		BC Ratio	
		Demo	local check		Demo	local check	Demo	local check
DRI Chitrakoot	10	43.36	35.5 (GW-273)	22.14	49881	39388	2.32	2.21
NAU Navsari	05	35.12	31.86	10.23	38754	30956	1.91	1.72
VB KVK Udaipur	05	52.63	40.78	29.79	60523	40638	2.21	1.61
RLBCAU Jhansi	02	42.5	36.5	16.4	60875	48400	1.86	1.52
MPUA&T Udaipur	06	42.2	35.5	18.87	66250	49450	2.15	1.73

The assessment trial of wheat HI 1634 clearly shows that the variety has performed well overwhelmingly across the zone, registering yield increase from 10.23% at NAU Navsari to as high as 29.79% at VB KVK Udaipur. The variety is found suitable for Central as well as Western region of the country. This was a case of successful intervention under partnership

Location	Crop	Variety	No. of Demo	Area (ha.)	Av.yield (q/ha)	local Check q./ha	(%) Increase in yield	Net Return Rs/ha)	BC Ratio
KVK, Dharwad	Pea	Pusa Pragati	1	0.20	38.50	32.14 (Arkel)	19.79	46875	2.60
AEEC, Dharwad	Pea	Pusa Pragati	1	0.10	52.50	44.00 (Arkel)	19.30	41100	2.20
AEEC, Dharwad	Pea	Pusa Pragati	1	0.10	52.00	43.00 (Arkel)	20.90	39200	2.05

programme, yielding the highest net income at MPUA&T Udaipur (Rs. 66250 per ha) and the lowest at NAU Navsari (Rs. 38754 per ha).

(7) Crop Diversification for Sustainable Horticulture Development under Collaborative NEP programme

Table 7: Performance of Pea Pusa Pragati at UAS Dharwad Rabi 2015-16

IARI, New Delhi, a premiere institution in crop technologies is implementing National Extension Programme in partnership with University of Agricultural Sciences, Dharwad for promotion of improved horticulture crop technologies in the jurisdiction area of UAS Dharwad for higher productivity and income to the regional farmers. As per a study estimate, only 30% of the scientific knowledge reaches the actual field. The present study has been carried out to assess the efficacy of technologies in promoting higher productivity and income from the farm sector.

IARI, New Delhi has been assessing and promoting some of the diversified crop technologies such as pea and carrot in the jurisdiction area of UAS Dharwad. Improved varieties of pea have been tested at the farmers' fields at multiple locations, Agriculture Extension Education Center Dharwad and KVKs (Dharwad) under UAS Dharwad regularly for three rabi seasons during 2014-2015 to 2016-17. Likewise, high yielding varieties of carrot (Pusa Rudhira, P. Yamadagni and P. Nayanajyoti) were demonstrated at select locations during 2013-14 to 2015-16. Farmers were purposively selected for laying out demonstrations and it was regularly monitored by the experts from UAS Dharwad and IARI, New Delhi. Review workshops were organized regularly before each season to discuss the crop performance and plan subsequent activities. The tables 7&8 given below present the economic performances of pea (Pusa Pragati) and carrot (Pusa Rudhira, P. Yamadagni and P. Nayanajyoti) at UAS Dharwad.

As per the feedback received from the multi-location trials growers revealed that pea (Pusa Pragati) had a higher productivity than the Arkel, the old variety and recorded around 19-20% more yield as compared to the check with an net income in the range of around Rs. 39000-46000 per ha. The variety was preferred for bold pods and uniform and bigger pod size. It tasted sweeter as compared to Arkel variety. It was found suitable for adoption in the region as it fetched better price in the market.

Table 8: Performance of carrot varieties at UAS Dharwad rabi 2013-14

S. No	Name of the TOT Center	Variety	No. of Demos.	Average Yield (q/ha)	Local Check (q/ha)	Increase in yield (%)	Net Return (Rs/ha)	B:C Ratio
1.	Carrot (EEU, Arabhavi)	Pusa Rudhira	01	194.60	163.40	19.09	94430.00	2.54
		P. Yamadagni	01	224.50	186.70	20.24	118350.00	2.93
		P. Nayanajyoti	01	265.20	186.70	42.04	150910.00	3.46

Different varieties of carrot tested for the yield performance and were found to perform comparatively better than the local varieties that farmers are practicing. The length (16 - 9.8 cm) and colour were preferred. Sweetness and rough natured having fibrous roots were mentioned by the farmers. All the carrot varieties gave good yield with high net returns and profitable cost benefit ratios. There was no incidence of pests and diseases. The varieties used for demonstration indicated good response for fertilizers and micronutrients.

(8) Model Village Programme in NCR Delhi Region

Improved vegetable crop varieties were assessed and promoted in the NCR Delhi region with an aim to have to diversify cropping pattern and attain an integrated development of the villages. In this regard, three villages were selected in NCR Delhi representing diverse agro-climatic conditions; village Nidana in district Rohtak (Haryana), village Maholi in district Palwal (Haryana) and village Bhagwanpr in district Meerut (Uttar Pradesh). Vegetable crop interventions such as Bhindi (Pusa 5), Bottle gourd (Pusa Naveen), Cowpea (Pusa Sukomal), Sponge gourd (Pusa Sneha) and Brinjal (Pusa Uttam) were taken in the adopted villages. The following table 9 presents the average yield performances of the tested vegetable crops.

Table 9: Performance of vegetable crop varieties in adopted villages (NCR Delhi) Kharif 2021

Crop / Variety	Av. Yield (q/ha)		
	Vill. Nidana, Distt. Rohtak	Vill. Maholi, Distt. Palwal	Vill. Bhagwanpur Chittawan, Distt. Meerut
Bhindi (Pusa – 5)	118.00	125.00	132.50
Bottle gourd (Pusa Naveen)	225.00	220.00	242.00
Cowpea (Pusa Sukomal)	115.00	122.00	105.00
Sponge gourd (Pusa Sneha)	-	155.00	172.00
Brinjal Pusa Uttam	265.00	315.00	-

All the vegetable crop varieties have shown good yield performances across the village locations. The feedback gathered from the growers is summarized as below;

1. Bhindi (Pusa 5): High yielding, no symptoms of YMV, Fruit medium size and tasty, colour - dark green, farmers liked the variety for these good traits.
2. Bottle gournd (Pusa Naveen): High yielding variety, market friendly size & shape.
3. Cowpea (Pusa Sukomal): Pod longer and tender. Good taste.
4. Sponge gourd (Pusa Sneha): Medium size fruit, colour dark green and suitable for transportation.
5. Brinjal (Pusa Uttam): High yielding, good round shape and size, Good quality for Bharta, liked

by farmers.

Conclusion

The study has proved that Institutional innovations can remarkably be a potential mechanism for transfer of technology among the farming community in the far flung regions of the country and reach especially the poor in the remotest of the area. Innovative Institutional arrangements such as Model Village approach, public-private partnership, public-public partnership, Seed hub development under collaborative arrangements etc. can create a positive impact on the farming community through faster and efficient dissemination and delivery of goods and services in the rural areas. The Institutional innovations coupled with improved and advanced Agricultural technologies have contributed immensely in augmenting not only productivity but also the profitability of the system. It has shown that the socio-economic condition of the tillers can be improved largely through varietal intervention, diversification, crop intensification, seed production hub, integrated Agriculture approach etc. It can be finally concluded that in order to redress the problems, there is a need to adopt versatility, flexibility and synergistic approach whether it is convergence, integration, partnership and collaboration among the public and private institutions and their innovations.

LP 1.3

Extension approach for Indian Agriculture in present scenario

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Introduction

Extension approaches must be need-based and client-oriented in order to make the system more appropriate. Currently, efforts are made to strengthen the linkage between research institutions, extension agencies and farmers. Extension approaches contributes significantly to the growth and sustainability of the agriculture sector and bringing the nation's food security. The early approaches of extension work were mere voluntary efforts of enlightened few. Later extension work had changed approaches of working during past one century due to various experiences in different socio-political situations. But with growing new media and AI technology, the extension approach must be transformed to AI extension approach.

Extension approaches

Extension work is done through many ways to bring about transformation in rural areas. Depending on the socio-economic and political situations, diverse approaches have been adopted to respond to particular needs.

Depending on the nature of intervention, approaches of extension have been classified as below:

- Generalized Extension Approach
- Commodity Specialized Extension Approach
- Project Extension Approach
- Training and visit Extension Approach
- Farming systems development Extension approach
- Privatized Extension Approach
- Participatory Extension Approach.
- Educational institution Extension approach

General Extension Approach: This approach is considered as a top to bottom approach. This is basic approach of extension work which assumes that technologies appropriate for local people are available but not being used. Success is measured through the adoption rate of recommendations and increases in national production.

Commodity Specialized Extension Approach: The commodity specialized approach assumes that the right way to increase productivity and production of a particular commodity is to group all functions relating to it under one administration. The success is usually measured on the basis of total production of the particular crop. Limitation is that There is need to consider many different aspects of agricultural production including food secutity, poverty alleviation and sustainability.

Project Extension Approach: A project is designed to solve a particular problem of a specific area in predetermined time. This approach concentrates on a particular location, for a specific time period, often with outside resources. Example: Intensive Agricultural District Project (IADP).

Training and visit Extension Approach: Training and Visit Approach was brain-child of Israeli scientist Daniel Benor, which was propagated by the World Bank in many developing nations of the world. It was based on assumption that research-based agricultural messages need to continuously communicated to farmers. Thus, the extension agents need to be updated regularly for effective performance. This is very intensive approach based on a rigorously planned schedule of visits to farmers and training of extension agents and subject matter specialists. Close links are maintained between research and extension. Extension agents are exclusively involved in technology transfer. Success is related to increases in the production of particular crops or commodities. It has novel approach of choosing contact farmer, who have leadership traits i.e., contact farmers.

Farming systems approach: A key characteristic of this type of extension is its systems or holistic approach at the local level. The farming systems approach considers the farm, farm household and off-farm activities in a holistic way to take care of not only farming but all aspects of nutrition, food security, sustainability, risk minimization, income and employment generation, which make up the multiple objectives of farm households. Success is measured by the extent to which local people adopt and continue to use technologies developed by the programme.

Privatized Extension Approach: With increasing pressures on the government due to budgetary constraints and international agreements, certain reforms in public sector have become inevitable. There are instances that private firms have played significant role in agricultural extension if polices are favourable.

This approach assumes that technologies have become very complex and extension work by the government is becoming too costly and unsustainable because of large number of farmers to be served. Extension workers are less in number and not very competent. Large and commercial farmers will require more sophisticated technological knowledge and skills not possessed by grassroots extension workers. So to serve them professionally payment will have to be made. Small and marginal farmers may be given subsidized services or free coupons for services. This will change the role of public extension service and more with local people (who do not have the means to pay the full cost) will promote a programme that is more likely to meet local situations and where extension agents are more accountable to local interests. In changing situations, there are many organizations available, whose services can be used for providing extension service.

Participatory Extension Approach: It is a new concept that indicates community ownership and involvement in extension process. This new approach is farmer oriented and non-prescriptive. It gives equal importance to farmers along with other professionals. Farmer to farmer extension is also being encouraged through this approach. This approach ensures that the extension response become community driven and assist village communities implement their planned activities with routine monitoring and evaluation of activities. Success is measured by the numbers of farmers actively participating and the sustainability of local extension organizations.

Educational institution Extension approach: This approach uses educational institutions which have technical knowledge and some research ability to provide extension services for rural people. The emphasis is often on the transfer of technical knowledge. Implementation and planning are often controlled by educationist. The emphasis is often on the transfer of technical knowledge. State agricultural universities in India have responsibilities of extension besides teaching and research. This is also called as First Line extension system of the country. The scientists are able to improve technologies for better performance based on their experiences.

Market-led Extension Approach: Farmers are sensitized on the production aspects like (i) what to produce (ii) when to produce (iii) how much to produce (iv) when and where to sell. Besides this, farmers are also sensitized on consumer preference, market intelligence, processing and value addition and market information system. The market-led extension deals with all these parameters from production to marketing of agricultural produce. Thus, important roles of market led extension are as follows:

- Advice on product planning: Product planning in terms careful selection of crops with market situation in view calls for specific advice to enable farmers to stay competitive.

- Marketing information: Farmers need advice on current price and forecasting of market trends. Information are needed on transportation, location of appropriate market, storage, post-harvest handling and manner of tranjection. Such information should be crop specific, area specific and buyer specific.
- Advice on alternate marketing: In case of glut in the local market, farmers may seek benefit of warehousing. Thus, a planned marketing strategy can help in raising farmers' income.

Cyber extension approach: Cyber extension is defined as extension over cyber space, the imaginary space behind the interconnected telecommunication and computer networks. Cyber extension approach includes effective use of Information Communication Technology (ICT), internet, expert systems, information kiosks and computer based training systems to improve information access to the farmers, extension workers, research scientists and extension managers. Internet communications technologies (ICT), particularly mobile phones, are commonly considered a means of improving small holder agricultural development. ICT have aided farmers in:

- Raising awareness of market rates to ensure a fair price for produce;
- Sending orders for goods, especially for livestock and perishable goods;
- Providing up to date weather forecasting;
- Improving access to land records, to support credit applications;
- Increased efficiency / reduced costs of access to extension services

Extension approaches in current scenario: AI Extension approach

Farmer-centric approaches, farmer field schools, and participatory rural appraisals have gained prominence. There is paradigm shifts observed in agricultural extension in India and AI extension approach could play vital role.

Artificial Intelligence (AI) has begun to play a major role in daily lives, extending our perceptions and ability to modify the environment around us (Kundalia et al., 2020; Gandhi et al., 2020; Ahir et al., 2020). Plessen (2019) gave a method for harvest planning based on the coupling of crop assignment with vehicle routing is presented.

Artificial Intelligence can revolutionize agriculture by P-P-A-A: Predictive analysis (weather, soil), Precision farming (irrigation, pest control) and Automated crop monitoring (drone and satellite) and Advise (Chabot)

Panpatte (2018) said that artificial intelligence makes it possible for farmers to assemble large amount of data from government as well as public websites, analyse all of it and provide farmers with solutions to many ambiguous issues as well as it provides us with a smarter way of irrigation which results in higher yield to the farmers.

Artificial Intelligence extension approach will make farmer-scientist interaction more efficient and effective. This will enhance knowledge sharing, real time advisory service would be possible. This may improve decision-making process.

The technologies which are AI-based help to improve efficiency in all the fields and also manage the challenges faced by various industries including the various fields in the agricultural sector like the crop yield, irrigation, soil content sensing, crop- monitoring, weeding, crop establishment (Kim et al., 2008).

NITI Aayog has decided to focus on five sectors that are envisioned to benefit the most from AI in solving societal needs: a) Healthcare: increased access and affordability of quality healthcare, b) Agriculture: enhanced farmers' income, increased farm productivity and reduction of wastage, c) Education: improved access and quality of education, d) Smart Cities and Infrastructure: efficient and connectivity for the burgeoning urban population, and e) Smart Mobility and Transportation: smarter and safer modes of transportation and better traffic and congestion problems. Examples:

- **Chatbots** (Farmbot, Agribot): A chatbot is a computer program that simulates human conversation with an end user. Not all chatbots are equipped with artificial intelligence (AI), but modern chatbots increasingly use conversational AI techniques such as Natural Language Processing (NLP) to understand user questions and automate responses to them.
- **Agriculture Virtual Assistant** (AVA) (Alexa, google assistant) for assisting farmers in technical guidance.
- **Application for soil care:** Berlin-based agricultural tech startup PEAT has developed a deep learning application called Plantix that reportedly identifies potential defects and nutrient deficiencies in the soil. The analysis is conducted by software algorithms which correlate particular foliage patterns with certain soil defects, plant pests and diseases. The image recognition app identifies possible defects through images captured by the user's smartphone camera. Users are then provided with soil restoration techniques, tips and other possible solutions.
- AI sowing app Microsoft in collaboration with ICRISAT, developed an AI Sowing App powered by Microsoft Cortana Intelligence Suite including Machine Learning and Power BI. The app sends sowing advisories to participating farmers on the optimal date to sow. The best part – the farmers don't need to install any sensors in their fields or incur any capital expenditure. All they needed was a feature phone capable of receiving text messages. The advisories contained essential information including the optimal sowing date, soil test based fertilizer application, farm yard manure application, seed treatment, optimum sowing depth, and more. In tandem with the app, a personalised village advisory dashboard provided important insights into soil health, recommended fertilizer, and seven-day weather forecasts. In 2017, the program was expanded to touch more than 3,000 farmers across the states of Andhra Pradesh and Karnataka during the Kharif crop cycle (rainy season) for a host of crops including groundnut, ragi, maize, rice and cotton, among others. The increase in yield ranged from 10% to 30% across crops.
- AI for herbicide optimisation Blue River Technology has designed and integrated computer vision and machine learning technology that enables farmers to reduce the use of herbicides by spraying only where weeds are present, optimising the use of inputs in farming – a key objective of precision agriculture.
- AI for Precision Farming NITI Aayog and IBM have partnered to develop a crop yield prediction model using AI to provide real time advisory to farmers. IBM's AI model for predictive insights to improve crop productivity, soil yield, control agricultural inputs and early warning on pest/disease outbreak will use data from remote sensing (ISRO), soil health cards, IMD's weather prediction and soil moisture/temperature, crop phenology etc. to give accurate prescriptions to farmers. The project is being implemented in 10 Aspirational Districts across the States of Assam, Bihar, Jharkhand, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.

Conclusion:

Research suggests that digital agriculture could boost the agricultural GDP of low and middle income countries by more than $450 billion, or 28% per annum. (World Economic

Forum, 2024). Extension approaches must be need-based and client-oriented in order to make the system more appropriate. Currently, efforts are made to strengthen the linkage between research institutions, extension agencies and farmers. Recognising AI's potential to transform economies and the need for India to strategize its approach to AI Extension approach.

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LP 2.1

Climate resilient practices in arid ecosystem for sustainability in agricultural production

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Abstract

Arid ecosystems are characterized by low rainfall, high temperatures, and limited water resources, with significant challenges to agricultural production. Arid regions are vulnerable to climate change and experience to extreme events like droughts, heatwaves, cold waves, frost, low soil fertility and wind erosion. As climate change magnify these vulnerabilities, it becomes crucial to adopt climate-resilient practices that enhance sustainability in agriculture production in Arid-ecosystem.This review paper assess the key climate resilient practices adopted in arid ecosystems to ensure sustainability in agricultural production. These practices includes water conservation, soil management, crop selection, agroforestry, and the use of other suitable innovative technologies. It also explores the role of policy, community engagement, and research in supporting the adoption of these practices. This review further explores how these practices can be integrated into climate adaptation strategies to ensure long-term sustainability in agriculture production in the context of climate change.

Key words: Climate resilient practices, arid-ecosystem, sustainability

1. Introduction

Agriculture in arid regions faces considerable challenges, including water scarcity, erratic rainfall, high temperatures, hot winds, frost and limited soil fertility. As global temperatures continue to rise due to climate change, these challenges are expected to intensify, exacerbating the already precarious situation for farmers in these regions. However, with the adoption of right climate resilient practices, these ecosystems can be managed efficiently, ensuring agricultural productivity while conserving natural resources. In arid ecosystems, such practices include water conservation techniques, soil management strategies, crop diversification, agroforestry, and the use of drought-tolerant crop varieties (Thornton *et al.,* 2011; Eitzinger *et al.,* 2014).

This review paper provides a comprehensive assessment of climate-resilient practices in arid ecosystems, focusing on their role in ensuring sustainable agricultural production. The discussion highlights various techniques, strategies, and technologies that are being employed in arid ecosystem.

2. Challenges in Arid Ecosystems

Arid ecosystems, characterized by low and highly uncertain rainfall, extreme temperature fluctuations, and very limited vegetation, face various environmental and socio-economic challenges. These challenges are becoming more pronounced due to the effects of climate change, unsustainable land use, and human interference. The major challenges in arid ecosystems comprises:

2.1. Water insufficiency/Scarcity

Water insufficiency is the most significant challenge in arid regions. The lack of freshwater resources, combined with uncertain monsoon patterns and high evaporation rates, severely limits the yield potential for agriculture in arid regions. Irrigation systems often depends on depleting groundwater resources, exacerbating the problem. Water scarcity is perhaps the most pressing concern in arid regions, where the efficient and judicious management of water resources is crucial for sustainable agricultural production and farmer livelihood. Techniques such as rainwater harvesting, use of drip irrigation, and the use of treated wastewater are critical to improving water-use efficiency (Falkenmark *et al.,* 2019).

Similarly, soil fertility management, including the use of organic mulches, conservation tillage, and aggro-ecological approaches, helps to preserve soil moisture, prevent soil erosion, and improve soil structure, which is vital in maintaining crop production in arid areas (Pender *et al.*, 2006; Verhulst *et al.,* 2015).

2.2. Soil Degradation

Soil degradation, including soil erosion, salinization, compaction and loss of soil structure and nutrient depletion, is another major challenge in arid regions. Poor soil management practices, combined with low organic matter content and low moisture retention capacity, lead to depleted soil fertility and lower agricultural productivity in these regions. Wind and water erosion are significant challenges to arid soils. With little vegetation to anchor the soil, arid regions are susceptible to the removal of the topsoil, which contains essential nutrients and organic matter required for plant growth. Wind erosion is particularly dominant in areas with sparse vegetation cover, leading to the formation of dust storms and loss of productive soil layers (Zhao *et al.,* 2020). In arid ecosystems, nutrient recycling is slower due to lower biological activities. Without proper replenishment or soil conservation techniques, these areas experience a decline in soil fertility, making it increasingly difficult to maintain sustainable agricultural productivity (Lal, 2001).

2.3. Climate Change and Temperature Extremes

Rising temperatures and increased frequency of extreme weather situations *viz.,* droughts, frost, cold waves and heatwaves make agricultural systems in arid ecosystems more vulnerable. Such climatic shifts further reduce the reliability of rainfall patterns and threaten to crop yields. Arid ecosystems are highly prone to climate change, which can intensify droughts, increase temperature extremes, and reduce precipitation, further accelerating soil degradation processes like erosion and salinization (Schlesinger *et al.,* 2012).

2.4. Food and Livelihood Security

The combination of water scarcity, soil degradation, and climate change directly threatens the food security and livelihoods of populations living in arid regions. Agriculture in these ecosystems is highly dependent on seasonal rainfall and limited groundwater resources, making crop production unpredictable and challenging. Additionally, as temperatures rise, the growing seasons for crops may become shorter, and yield potential may decrease. This has significant socio-economic consequences for communities reliant on farming, grazing, and other natural resource-based activities in these areas (Lal, 2001; Thomas *et al.,* 2007).

2.5. Human and Ecological Vulnerability

The vulnerability of human populations in arid ecosystems is compounded by poverty, limited access to technology, and inadequate infrastructure facilities. Communities in arid regions often face health risks from heatwaves, cold waves, waterborne diseases, and malnutrition. At the same time, ecosystems are at risk of collapse, with reduced biodiversity and a diminished ability to provide essential ecosystem services, such as water purification, soil fertility, and carbon sequestration (Reynolds *et al.,* 2007; Schlesinger *et al.,* 2012).

3. Climate-Resilient Agricultural Practices

As climate change continues to exacerbate the challenges faced by arid ecosystems, adopting climate-resilient practices is crucial for enhancing their sustainability and mitigating negative impacts of various vulnerabilities. These practices focus on improving water management, restoring soil health, conserving biodiversity, and ensuring the livelihoods of people who depend on these ecosystems. Here are some key climate-resilient practices adopted in arid ecosystems:

3.1. Water Conservation and Efficient use of Irrigation water

Water scarcity is one of the most prevailing challenges in arid regions. Implementing efficient water use and conservation strategies can help mitigate the impact of droughts and reduced rainfall are:

3.1.1. Use of Drip Irrigation System

Drip irrigation is a highly efficient water-saving technique that delivers water directly to the roots of plants, minimizing evaporation losses. It has been successfully implemented in arid regions, of India, where water is scarce or limited. The adoption of drip irrigation can improve crop yields while reducing water consumption by up to 60%-70% compared to traditional flood irrigation methods (Ghanem *et al.,* 2021).

3.1.2. Ex-situ moisture conservation by rainwater Harvesting: Rainwater harvesting is a practice of Ex-situ moisture conservation that involves capturing and storing rainwater for agricultural use. In arid areas, where rainfall is infrequent, this practice can provide a reliable critical irrigation during dry periods. The construction of rainwater harvesting systems, such as cisterns, Farm ponds or check dams, has been successfully implemented in regions like Tunisia and India (Burt *et al.,* 2020).

3.1.3. Soil Moisture Retention by In-situ moisture conservation techniques: In-situ moisture conservation is techniques to enhance soil moisture retention, such as pre-monsoon deep ploughing, sowing against slops, pre sowing tillage, post sowing tillage, post harvest tillage, use of bio fertilizers, mulching and the use of organic amendments, can significantly improve the water-holding capacity of soils. Organic mulches, such as straw, grass, or compost, can reduce evaporation and help maintain soil moisture for longer periods. This is particularly important in regions with unpredictable rainfall and prolonged dry spells experiences (Khan *et al.,* 2019).

3.1.4. Desalination: In coastal arid areas, desalination of seawater can provide an alternative source of freshwater, though energy-intensive, it is increasingly being used to address water scarcity (Verma & Bahuguna, 2018).

3.2. Soil Management Practices: Soil health plays a vital role in the resilience of arid ecosystems. Soil degradation due to erosion, salinization, and nutrient depletion is a significant challenge. Several practices can help restore and protect soil in these environments are:

3.2.1. Conservation Tillage: Conservation tillage, including no-till and reduced-till systems, is a practice that minimizes soil disturbance and preserves soil structure. It helps reduce erosion, increase water infiltration, and improve organic matter content. In arid regions, conservation tillage has been shown to enhance soil moisture retention and promote healthier soils (Lal, 2021).

3.2.2. Agroecological Approaches: Agroecology emphasizes the use of diverse and sustainable farming systems that copy natural ecosystems. Practices such as crop rotation, inter-cropping, and the use of cover crops can improve soil fertility, increase biodiversity, and reduce dependency on external inputs such as fertilizers and pesticides (Altieri, 2018). These techniques are especially effective in arid environments where soils are often less fertile.

3.2.3. Use of Organic Fertilizers: The use of organic fertilizers, such as rotten compost and manure, improves soil structure and soil fertility by adding organic matter to soil. In arid regions, organic fertilizers can also help enhance soil water retention and provide a slow release of nutrients, which is crucial for crop growth in areas with limited water availability (Singh *et al.,* 2020).

3.3. Crop Selection and Genetic Improvement

3.3.1. Drought-Resistant Crops: The development and adoption of drought-resistant crop varieties are critical for improving agricultural productivity in arid regions. Crops such as drought-tolerant wheat, maize, and barley, as well as traditional varieties of millet, sorghum, and cowpea, are better suited to survive prolonged dry spells and high temperatures. Genetic modification and traditional breeding techniques are being used to enhance the drought resilience of crops (Araus *et al.,* 2020).

3.3.2. Growing of indigenous Crop Varieties: Indigenous crop varieties that have evolved to withstand harsh conditions in arid ecosystems are often more resilient to climate variability.

These crops are typically well-adapted to local environmental conditions, and their cultivation can help improve food security in arid regions. (Davis *et al.*, 2021).

3.3.3. Water-Efficient Crops: The selection of water-efficient crops, such as drought-resistant legumes and certain species of millet and quinoa, can significantly reduce water consumption in agriculture in arid regions. These crops are adapted to low-water conditions and can thrive even with limited irrigation facilities (Ayele *et al.,* 2022).

3.4. Agroforestry and Landscape Management: Silvopasture integrates trees, livestock, and forage in a sustainable system that enhances both biodiversity and agricultural productivity. In arid regions, the use of drought-tolerant tree species such as Acacia and Prosopis has been shown to improve soil fertility, increase water retention, and provide shade for livestock (Schroeder *et al.,* 2023). The establishment of windbreaks or shelter belts, consisting of rows of trees or shrubs, can protect crops from wind erosion and reduce evaporation losses. These systems are particularly effective in arid areas prone to high winds and desertification (Huxley, 2022).

3.5. Use of Technology and Innovation:

3.5.1. Precision Agriculture: Precision agriculture uses advanced technologies such as satellite imaging, remote sensing, and Agri-drones to optimize the judicious use of resources, including water, fertilizers, and pesticides. These technologies enable farmers to monitor and manage crops more effectively, resulting in improved water use efficiency and reduced environmental impact on farming (Liu *et al.,* 2020).

3.5.2. Climate-Smart Agriculture (CSA): Climate-smart agriculture involves the integration of those practices that increase productivity, enhance resilience, and reduce greenhouse gas emissions. CSA includes strategies like crop diversification, improved irrigation technologies, and the use of climate information systems to guide decision-making process.. These approaches are vital for adapting resilient agricultural systems to minimize the impacts of climate change in arid regions (Lipper *et al.,* 2014).

Conclusion

Agriculture in arid ecosystems is facing unprecedented challenges due to climate change. However, climate-resilient agricultural practices, including efficient water management, sustainable soil practices, crop diversification, and technological innovations, offer viable solutions to enhance productivity and sustainability in agriculture production in arid ecosystem. The successful implementation of these practices will require the integration of local knowledge, government support & policies and cooperation. As the impacts of climate change continue to unfold, these resilient practices will be crucial for maintaining agricultural viability and ensuring food security in arid regions.

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LP 2.2

Extension services for climate smart livestock systems and Sustainable Development Goals

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Abstract

Food security, livelihoods in agriculture, and economic growth all depend on the livestock sector, but climate change is posing serious problems for it in the form of decreased production and greenhouse gas emissions. A solution is offered by Climate-Smart Livestock Systems (CSLS), which use environmentally friendly practices to strengthen resilience, increase productivity, and lower emissions. By increasing capacity, sharing knowledge, and providing farmers with advising support, extension services are essential to the advancement of CSLS. The adoption of climate-smart practices, like better feed management, the use of renewable energy, and climate-resilient breeding, is facilitated by these services. However, its efficacy is hampered by issues including scarce resources, knowledge gaps, and farmers' resistance to change. This study makes recommendations for tactics like bolstering public-private collaborations, offering rewards for environmentally friendly behavior, and fusing scientific advancements with traditional knowledge. In order to accelerate up the commencement of CSLS, cooperation between cooperatives, farmer organizations, and research institutes is crucial. The cattle industry can support sustainable agricultural development, food security, and climate action by aligning with the Sustainable Development Goals (SDGs).

Keywords: Climate-Smart livestock systems, climate change , extension services, Sustainable Development Goals

Introduction:

A crucial element of global agriculture, livestock significantly improves nutrition, livelihoods, and food security. For approximately 1.3 billion people globally, especially in rural and marginalized communities, it serves as their main source of income by supplying meat, milk, eggs, and other animal products that are necessary for a healthy diet. The value of livestock in integrated agricultural systems is further reinforced by the fact that it provides organic manure, draft power, and other ecosystem services. However, sustainable livestock management has emerged as a major worldwide challenge because to the rising demand for animal-based products brought on by urbanization and population expansion. The primary indirect effects of climate change on livestock production were reduced feed and water availability, abrupt disease outbreaks, and declining pasture grounds (Sejian et al., 2022).

According to the FAO and the New Zealand Agricultural Greenhouse Gas Research Centre (2017), the climate-smart livestock approach is an integrated approach meant to promote sustainable livestock production systems that actively support efforts to mitigate and adapt to climate change, ensure food security, enable sustainable incomes, improve animal welfare, and mitigate environmental impact. However, livestock systems are both a cause and an effect of climate change. They are mostly accountable for enteric fermentation, manure management, and feed production, which account for about 14.5% of global greenhouse gas (GHG) emissions. On the other together, issues in livestock production such as heat stress, water scarcity, lower feed availability, and increased vulnerability to diseases are made worse by climate change. In line with climate adaptation and mitigation measures, these dynamics underscore the urgent need for climate-smart livestock systems (CSLS), which seek to increase productivity, boost resilience, and lower GHG emissions.

The Sustainable Development Goals (SDGs) are directly impacted by climate-smart livestock systems. For example, by maintaining sustainable food production and eliminating nutritional deficiencies, they promote SDG 2 (Zero Hunger). SDG 12 (Responsible Consumption and Production) is promoted by encouraging resource-efficient livestock value chains, while SDG 13 (Climate Action) is tackled through adaptation and mitigation efforts. Additionally, CSLS promotes SDG 15 (Life on Land) by preserving biodiversity and regenerating ecosystems.

By strengthening farmers' skills, sharing knowledge, and advocating adoption of sustainable practices, extension services are fundamental to the advancement of CSLS. These services ensure that livestock production is in line with the twin objectives of sustainability and global development by bridging the gap between scientific innovation and grassroots implementation. Extension services have an impact on how farmers respond to, recover from, grab possibilities, and cope with climate change (Christoplos, 2010; MoFA, 2007; MoFA, 2010).

Concept of Climate-Smart Livestock Systems:

A key element of Climate-Smart Agriculture (CSA), Climate-Smart Livestock Systems (CSLS) is meant to tackle the interrelated issues of raising production, enhancing resilience, and lowering greenhouse gas (GHG) emissions from livestock systems. In alongside assisting with climate change adaptation and mitigation initiatives, these systems seek to guarantee sustainable livestock production. Climate-induced disasters directly impact farmers' livelihoods, which depend on agriculture and animal husbandry (Singh *et al.,* 2012).

Major CSLS Features:

1. Enhancing Productivity and Profitability: By optimizing inputs including feed, water, and healthcare, CSLS aims to increase the effectiveness of livestock production systems. Farmers can generate more with a smaller expenditure through improved productivity, which will boost profitability.

2. Strengthening Climate Variability Resilience: CSLS promotes methods that assist livestock systems in coping to climate shocks such floods, droughts and extreme temperatures. This entails adopting climate-resilient breeds, diversifying feed sources and creating water-efficient systems.

3. Reducing GHG Emissions per Unit of Animal Product: CSLS cuts the carbon footprint of livestock systems while preserving or raising output levels through better feed efficiency, manure management and a decreased dependency on high-emission inputs.

Climate-Smart Livestock Practices:

• **Improved Feed and Nutrition Strategies:** Utilizing silage, urea-treated straw and balanced diets improve feed conversion efficiency and lowers enteric fermentation-related methane emissions.

• **Effective Manure Management Techniques**: Techniques like composting, biogas production and better storage reduce emissions of nitrous oxide and methane while producing renewable energy.

• **Breeding Programs:** To maintain sustainable production in the face of changing climate circumstances, livestock breeds with increased resistance to heat stress and illnesses are developed and promoted.

• **Adoption of Renewable Energy:** Including biogas plants, solar-powered pumps, and other renewable technologies in livestock operations improves sustainability and lessens reliance on fossil fuels. By combining these methods, CSLS offers a technique to produce livestock sustainably, supporting international objectives for food security, climate adaptation and mitigation.

The Role of Extension Services in Climate-Smart Livestock Systems: By bridging the gap between research advancements and real-world farm applications, extension services play a critical role in advancing Climate-Smart Livestock Systems (CSLS). They play a crucial role in enabling farmers adopt sustainable methods, increase resilience, and boost output in the face of shifting climate circumstances.

1. Capacity Building for Farmers: The goal of extension services is to increase the knowledge of farmers and competency in climate-resilient livestock management. Farmers receive information on methods like better feed use, water conservation, and disease control that are suited to particular climatic difficulties through training programs. Furthermore, extension initiatives encourage the use of precision livestock farming technology that improve productivity and lessen environmental effects, such as climate-controlled shelters, smart sensors, and automated feeding systems. Developing countries like India must invest in financial, human, and infrastructural resources to enhance livestock extension services, ensuring well-funded programs, trained manpower, and effective delivery of Extension and Advisory Services (EAS) to promote higher productivity and sustainability in livestock farming (Chander & Rathod, 2013; Chander & Rathod, 2020)

2. Information Dissemination: The effective implementation of CSLS depends on the appropriate distribution of information. Extension services give real-time advisories, weather forecasts, and market information by utilizing information and communication technology (ICT) tools like digital platforms, social media, and mobile apps. Through collaborative learning, participatory methods such as Farmer Field Schools (FFS) empower farmers to evaluate and put into effect climate-smart practices in a peer-supported context.These approaches provide realistic, locally relevant solutions that meet the needs of farmers. The extensive coverage provided by mass extension campaign methods is quite appealing (Wassajja, 2017).

3. Advisory Support : In context of climate variability, extension services provide farmers with ongoing advising support addressing animal health, nutrition, and breeding. To enhance cattle productivity during droughts or floods for example they can suggest climate-resilient breeds or nutritional additives. Furthermore, extension workers help farmers access climate adaptation money, rewards and technical assistance for the use of renewable energy sources such as biogas plants. By providing advisory support, exchange of knowledge and capacity building, extension services help farmers make the shift to climate-smart livestock systems. In addition to improving farm sustainability this shift supports global efforts to bring down climate change and meet food security targets.

Livestock and Sustainable Development Goals (SDGs):

Livestock and Sustainable Development Goals (SDGs): By promoting economic growth, addressing the issues of climate change, and ensuring food security, livestock systems are essential to reaching a number of SDGs.

SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth): For rural communities, livestock systems are the main source of income, creating jobs in distribution, processing, and farming. By increasing productivity and profitability, climate-smart methods enable smallholder farmers to overcome poverty. Furthermore, livestock investments boost rural economies by creating fair employment opportunities and promoting equitable growth. Livestock systems' sustainability and resilience are essential for global development because of their close correlation with the SDG aims.

SDG 2 (Zero Hunger): By boosting the production of milk, meat, and eggs essential sources of high-quality protein and micronutrients livestock systems greatly improve food security. By optimizing feed, enhancing breeding and implementing effective health management, climate-smart livestock operations minimize environmental effects while ensuring sustainable productivity.

SDG 13 (Climate Action): Livestock systems are crucial to climate change adaptation and mitigation. Greenhouse gas emissions are reduced by methods such as better manure management, methane reduction techniques, and effective feed usage. Concurrently, water-efficient methods and robust breeds assist livestock producers in adjusting to climate unpredictability, ensuring that their means of subsistence will continue to be viable in the face of unpredictable conditions.

SDG 12 (Responsible Consumption and Production): Waste and resource consumption are reduced by promoting sustainable livestock value chains. Efficient production methods, like enhanced feed efficiency and biogas from waste, support the objective of minimizing environmental effects while maintaining moral and sustainable animal husbandry.

Challenges in Promoting Climate-Smart Livestock Systems through Extension Services:

These are several barriers to overcome in the promotion of Climate-Smart Livestock Systems (CSLS), especially when it deals with extension services, which serve as the vital conduit between farmers and innovations.

1. Limited Knowledge of CSA Practices among Extension Workers:

An in-depth knowledge of climate-smart agriculture (CSA) strategies that relate to livestock systems is frequently lacking amongst extension agents. They may locate it difficult to provide farmers with beneficial guidance on implementing sustainable practices if they are not sufficiently trained in innovative techniques like precision feeding, manure management, and climate-resilient breeding.

2. Inadequate Financial and Technical Resources:

Implementing livestock-related CSA initiatives requires substantial investment in infrastructure, tools, and technologies. Due to resource and budgetary limitations, many extension agencies are unable to set up demonstration farms, provide training or encourage the use of renewable energy and other climate-smart technology.

3. Farmers' Reluctance to Shift from Traditional Practices:

Due to cultural attachment to standard methods, perceived hazards, or inexperience, smallholder farmers frequently hesitate to adopt new strategies. Furthermore, even if climate-smart actions provide long-term advantages, adoption may be hampered by the initial expenditures of items like precision agricultural equipment or biogas units.

4. Data Gaps on GHG Emissions and Adaptation Potential:

There is periodically a dearth of precise, regional data on greenhouse gas (GHG) emissions and climate adaption tactics for livestock systems. Evidence-based planning, policymaking, and extension agents' capacity to suggest context-specific solutions are all hampered by this. To overcome these obstacles, specific expenditures in infrastructure, research, and capacity building are needed, along with stakeholder collaboration to enhance the contribution of extension services to the advancement of CSLS.

Strategies for Effective Extension Services in the Livestock Sector:

To promote Climate-Smart Livestock Systems (CSLS) and sustainable livestock practices, extension services must adopt innovative, inclusive, and context-specific strategies.

1. Enhancing Public-Private Partnerships (PPPs):

Innovation in livestock management can spread more quickly whenever public institutions, private enterprises, and cooperatives work together. PPPs can make it easier to obtain advanced technologies including climate-resilient breeding tasks, energy from renewable sources, and precision feeding systems. While public organizations make sure that everyone has fair access to resources and expertise, private organizations can also help with capacity building by providing technical training.

2. Focusing on Gender-Sensitive Extension Services:

In many rural regions, women are crucial to the care of livestock but their contributions are sometimes disregarded. Women can be empowered as important players in sustainable livestock production by receiving gender-sensitive extension services that cater to their unique requirements, such as specialized training, financial access, and assistance with decision-making. In addition to increasing household output, this strategy supports more general objectives for gender equality.

3. Leveraging Digital Technologies:

Extension services could undergo a revolution with the introduction of digital tools like automated messaging systems, online advising platforms, and smartphone apps. These technologies give farmers access to market connections and pricing patterns while offering real-time advisories on weather forecasts, feed availability, and animal health. Peer-to-peer learning and virtual training sessions are also made possible by digital platforms, which get over geographical restrictions.

4. Integrating Indigenous Knowledge with Scientific Innovations:

Technological advances can be reinforced by farmers' traditional understanding of regional breeds, feeding systems, and disease control. In order to create context-specific solutions, extension services ought to encourage collaborative methods that integrate conventional methods with contemporary technology. For instance, pasture resilience can be increased by combining rotational grazing models with conventional grazing systems. By implementing these tactics, extension services may encourage the broad adoption of climate-smart livestock practices, improving the livestock industry's resilience, sustainability, and productivity.

Policy Recommendations :

To effectively promote Climate-Smart Livestock Systems (CSLS), targeted policies must address capacity building, farmer incentives, infrastructure development, and stakeholder collaboration.

1. Strengthening Training Programs for Extension Personnel:

Comprehensive training programs for extension workers should be given top priority by policymakers so they may acquire the information and abilities necessary for livestock-specific climate-smart agriculture (CSA). This includes proficiency in resilient breeding, effective waste management, precise feeding, and the integration of renewable energy sources. At the local level, these skilled workers can act as advocates for the adoption of climate-resilient practices.

2. Providing Incentives for Farmers:

To encourage farmers to adopt sustainable livestock techniques, governments should create both monetary and non-monetary incentives. Large-scale adoption can be encouraged by providing incentives for biogas units, better feed, and climate-resilient infrastructure, as well as by recognizing model farmers. The financial risks associated with switching from conventional approaches can be further mitigated by insurance plans and financing facilities designed for climate-smart technologies.

3. Establishing Climate-Smart Livestock Demonstration Farms:

At the regional level, demonstration farms that demonstrate the effective implementation of CSLS principles ought to be established. These farms can act as hands-on training grounds where farmers can observe the advantages of technology such as renewable energy applications, rotational grazing, and silage production.

4. Enhancing Collaboration among Stakeholders:

Innovation and scalability can be accelerated by encouraging collaborations between farmer organizations, cooperatives like AMUL, and research institutions. In order to promote equitable and sustainable livestock development, cooperative initiatives can guarantee the creation of locally relevant technology and expedite their transmission through cooperative networks. By supporting the shift to sustainable livestock systems, these policy initiatives will bring the industry into line with more general development and climate goals.

Conclusion

Achieving global food security, enhancing rural livelihoods, and promoting economic growth all depend heavily on the livestock industry. Climate change, however, presents serious obstacles, such as heightened susceptibility to environmental stressors, decreased production, and its role in greenhouse gas emissions. Making the switch to Climate-Smart Livestock Systems (CSLS) is essential to tackling these issues and guaranteeing resilience and sustainable growth. By facilitating communication between farmers and scientific developments, extension services play a critical role in advancing CSLS. The adoption of climate-resilient practices, including enhanced feed strategies, the integration of renewable energy, and resilient breeding programs, is ensured by their participation in capacity building, information dissemination, and advisory support.Tailored solutions must be implemented for overcoming the obstacles that these services confront, which include a lack of resources, knowledge gaps, and farmers' resistance to abandoning old methods. Livestock systems help achieve Zero Hunger (SDG 2), Climate Action (SDG 13), Responsible Consumption (SDG 12), and Poverty Alleviation (SDG 1), all of which require a multifaceted strategy to achieve the Sustainable Development Goals (SDGs). This can be accomplished through creative legislative initiatives like climate-smart demonstration farms, incentives for sustainable practices, and training programs for extension staff. Progress will be further accelerated by strengthening public-private collaborations, utilizing digital tools, and fusing scientific advancements with indigenous knowledge. Livestock systems can be made resilient, sustainable, and in line with international initiatives to tackle climate change and accomplish sustainable development by using a comprehensive and inclusive approach.

LP 2.3

Carbon farming in India: Issues, opportunities and challenges

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Abstract

Climate change poses significant challenges, with greenhouse gases (GHGs) such as carbon dioxide, methane and nitrous oxide driving global warming. Agriculture accounts for over 22% of India's GHG emissions, primarily from enteric fermentation in livestock and rice cultivation. Carbon farming offers a transformative opportunity to mitigate emissions and enhance carbon sequestration in Indian agriculture. By adopting practices such as optimized livestock management, sustainable rice cultivation, soil carbon sequestration and crop residue management, the sector can transition into a net carbon sink while contributing to food security and rural livelihoods. The article discuss the potential of carbon farming in India, the framework for carbon credit markets, and the roles of corporate and institutional stakeholders. It highlights key carbon farming initiatives and emission reduction projects, their impact on climate goals and challenges such as farmer awareness, market instability and policy alignment. The article underscore the importance of integrating carbon farming into India's climate action strategy, supported by robust frameworks, technological innovation and capacity-building efforts.

Keywords: Climate change; carbon farming; greenhouse gas emissions; carbon credit framework; sustainable agriculture

Introduction:

Climate change significantly affects various aspects of human life, with greenhouse gases (GHGs) like carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) driving global warming (Jeffry et al., 2021). Research data show that global surface temperatures have already risen by about 0.74°C over the past century, and further increases of 0.3–2.5°C in the next fifty years and 1.4–6.4°C by 2100 are anticipated (Filonchyk et al., 2024). Rising GHG levels, largely due to industrial and agricultural activities since the Industrial Revolution, have accelerated these warming trends at an unprecedented rate. In 2022, the distribution of GHG emissions in India by sector underscores the diverse contributors: power generation accounted for 31.55%, followed by agriculture at 22.37%, manufacturing at 19.65%, transportation at 8.36%, waste at 5.84%, and buildings at 5.47% (Fig. 1). In 2021, enteric fermentation accounted for around 51 percent of greenhouse gas emissions in India’s agricultural sector, making it the primary contributor. This process occurs in the digestive systems of ruminant animals like cattle, sheep, and buffalo and results in significant methane emissions—a greenhouse gas with far greater warming potential than carbon dioxide—making it a key contributor to climate change. Rice cultivation follows closely, contributing approximately 17 percent of emissions due to methane release from waterlogged paddy fields (Fig. 2). These findings have driven climate policies and the emergence of carbon (C) as a tradable asset to support emission reductions across sectors, particularly in agriculture, which represents a substantial portion of India’s emissions.

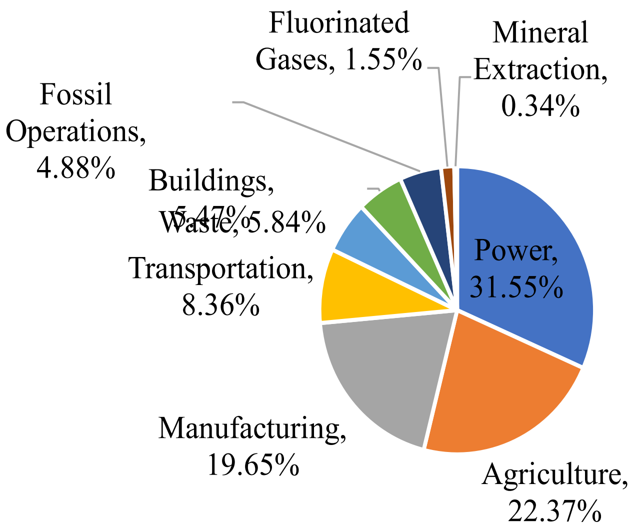

Fig. 1: Sector-wise distribution of greenhouse gas emissions in India in 2022 (Source: Statista, 2024)

In the agricultural sector, adopting carbon farming could play a critical role in mitigating emissions while enhancing carbon sequestration, transforming agriculture into a net carbon sink. The concept of carbon farming promotes management practices that lower emissions and maximize carbon storage, supporting both environmental and economic goals (Shaw and Mukherjee, 2022). Given that agriculture is the second-largest contributor to India's GHG emissions, implementing best management practices (BMPs) tailored to regional needs could yield substantial reductions. Additionally, creating a carbon trading market that includes soil-sequestered carbon could provide farmers with incentives to adopt sustainable practices, improving soil health, enhancing crop yields, and supporting the carbon economy.

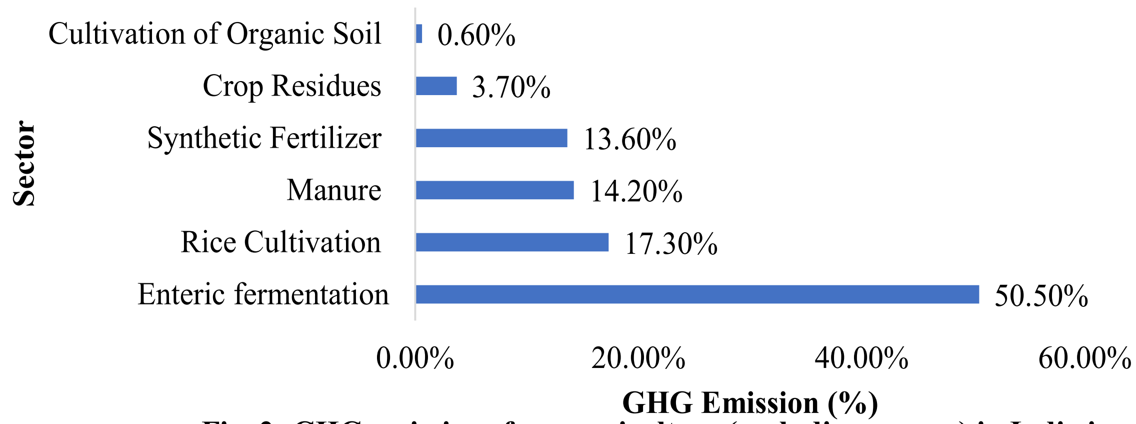

Fig. 2: GHG emissions from agriculture (excluding energy) in India in 2021 (Source: Tiseo, 2023)

Scope for Carbon Economy in Agriculture

The scope for transforming India's agricultural sector into a more carbon-efficient economy lies in two primary approaches: reducing greenhouse gas (GHG) emissions and enhancing carbon (C) sequestration (Kumara et al., 2023). Indian agriculture, which contributes over 22% of national emissions, presents significant opportunities to implement practices and technologies that can substantially mitigate GHG emissions (Fig. 1). Key areas of focus include the management of enteric fermentation in livestock, manure management, rice cultivation practices, soil carbon sequestration, and crop residue management. Together, these offer pathways to reduce emissions at both production and operational levels while improving soil health and productivity.

One of the largest contributors to agricultural emissions in India is enteric fermentation in ruminant livestock, which accounts for about 51% of the sector's emissions (Tiseo, 2023). The methane produced through microbial fermentation in the digestive systems of livestock can be managed through dietary changes and enhanced feed quality, aiming to improve digestion and reduce methane release (Królіczewska et al., 2023). Additionally, manure management practices can prevent methane and nitrous oxide emissions through composting, biogas generation, and the use of manure as organic fertilizer (FAO, 2022). In rice cultivation, another significant source of methane emissions, alternate wetting and drying techniques, direct seeded rice and optimized irrigation practices can help reduce methane production from waterlogged paddy fields, which is particularly vital as rice is widely grown on over 44 million hectares in India. These strategies align with a holistic approach to emission reduction that also considers animal welfare, productivity enhancement, and sustainable crop management practices to support carbon economy improvements in Indian agriculture (Chen et al., 2024; Islam et al., 2020).

Beyond emission reductions, there is a substantial scope for carbon sequestration through soil and crop management practices. Soil carbon sequestration—by enhancing soil organic matter—holds the potential to remove CO_2 from the atmosphere, which can significantly mitigate climate change impacts (Minasny et al., 2017). This involves strategies like the restoration of degraded lands, agroforestry, conservation tillage, and crop rotation. Moreover, reducing field burning of crop residues, a prevalent practice in parts of India, can limit the release of large quantities of CO_2 and methane while preserving soil health. Utilizing crop residues for biofuel or biogas production further supports a circular carbon economy and offers a sustainable alternative to fossil fuels in agriculture (Hannam, 2024). Through these combined strategies, Indian agriculture can move toward a more sustainable, low-carbon future while also addressing pressing food security and rural livelihood goals (Rodrigues et al., 2023; Don et al., 2024).

Carbon Credit Framework for Agriculture in India

It is an emerging system designed to incentivize sustainable farming practices that reduce greenhouse gas (GHG) emissions while enhancing carbon sequestration in soils and crops. Given agriculture's significant role in India's emissions profile, this framework is seen as a critical step in meeting national climate goals under the Paris Agreement and supporting rural economic development (Chen et al., 2024; Khatri-Chhetri et al., 2022). Key elements of this framework include:

i. **Emission Reduction Programs for Agriculture:** Agriculture contributes to GHG emissions through activities like rice cultivation, enteric fermentation in livestock, and the use of synthetic fertilizers. Under the carbon credit framework, programs are being developed to reduce emissions from these sources by promoting practices such as alternative wetting and drying in rice fields, improved livestock feed, and better manure management practices. Farmers who adopt these practices can potentially earn carbon credits based on verified reductions in methane and nitrous oxide emissions.

ii. **Soil Carbon Sequestration Initiatives:** Soil management practices like no-till farming, crop rotation, agroforestry, and the use of organic fertilizers are encouraged to increase carbon storage in soils. This "carbon farming" approach sequesters carbon dioxide and improves soil health, creating a dual benefit of reduced emissions and enhanced agricultural productivity. Carbon credits can be awarded for the amount of carbon sequestered, with these credits then available for sale in domestic or international carbon markets.

iii. **Carbon Market Access and Verification Standards:** India's national carbon market, launched in 2023, provides a platform for trading carbon credits, including those generated by agricultural projects. Standards like the Verified Carbon Standard (VCS) and the Gold Standard offer protocols for measuring, reporting, and verifying emission reductions and sequestration in agriculture (Balaji, 2024; Ghosh and Yeong, 2023). Verified agricultural projects can generate credits, which can be sold to industries seeking to offset emissions, providing an income stream for farmers and cooperatives.

iv. **Integration with Government Schemes and NDCs:** The carbon credit framework for agriculture is being aligned with India's Nationally Determined Contributions (NDCs) under the Paris Agreement, aiming to lower emissions intensity across sectors, including agriculture. Government programs like the National Mission on Sustainable Agriculture (NMSA) and Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) can support farmers in adopting carbon credit-generating practices by offering subsidies, technical assistance, and financial resources.

v. **Corporate and Institutional Participation:** Corporations seeking to fulfill sustainability commitments are increasingly investing in agricultural carbon credits as part of their offsetting strategies. Institutions are also supporting project financing, technology transfer, and capacity building, which enhance the scalability and impact of carbon-reducing agricultural practices.

vi. **Co-Benefits and Sustainable Development:** The agricultural carbon credit framework promotes sustainable practices that deliver co-benefits beyond emission reductions. These include improved soil quality, increased biodiversity, better water retention, and enhanced resilience against climate-related impacts, directly benefiting rural communities and fostering sustainable agricultural development.

The framework, still in development, is positioning Indian agriculture to play a vital role in climate action while opening new economic opportunities for farmers and rural areas through carbon trading. As the regulatory environment evolves, this framework is expected to become a cornerstone of India's low-carbon agricultural strategy.

Key Projects and Companies for carbon credit in India

The data on carbon farming initiatives in India highlights the country's expanding involvement in large-scale carbon sequestration and emission reduction projects, particularly within the agricultural sector (Cariappa and Krishna, 2024). Companies such as Varaha ClimateAg and Grow Indigo stand out for their extensive projects, covering millions of hectares and yielding significant annual emission reductions of over 4 million metric tons CO_2 equivalent each (Table 1). These organizations leverage partnerships, innovative farming practices, and investments in technology, such as satellite-based soil carbon measurement by Sagri Bengaluru, to improve carbon sequestration accuracy and effectiveness. New players like Mahanadi Compressed Biogas and Nurture Agtech further diversify India's carbon farming landscape by focusing on methane and N_2O reduction, addressing additional greenhouse gases often neglected in carbon-centric frameworks. Overall, this comprehensive participation from diverse players illustrates a strong foundation for India's evolving carbon market.

The cumulative estimated emission reductions of over 10 million metric tons of CO_2 equivalent from these initiatives underscore the potential impact of India's agricultural sector on national climate goals. The geographical distribution of these projects, spanning urban centers like Mumbai to rural areas like Wayanad, signifies a nationwide commitment to emission reduction. Additionally, the role of joint ventures, as seen with Grow Indigo, reflects a synergy between Indian firms and international stakeholders, fostering an exchange of agricultural expertise and advanced methodologies. This collaborative framework aligns with India's Paris Agreement commitments and the transition to a low-carbon economy. As these projects continue to expand, they not only contribute to climate mitigation but also promote sustainable agricultural practices, improve soil health, and generate economic opportunities for farmers across India.

Table 1: Key Carbon Farming Initiatives and Emission Reduction Projects in India

Company Name	Year Established	Head Office Location	Summary	Project Area (Hectares)	Estimated Annual Emission Reductions (Metric Tons of CO_2 Equivalent)
Varaha ClimateAg Private Limited	2022	New Delhi, India	Has the largest estimated emission reduction project in India. Recently raised $4 million in seed funding for further expansion.	20,00,000	47,96,219
Grow Indigo Private Ltd	2018	Mumbai, India	Joint venture of Indigo Agriculture (US) and Mahyco (India). Engages in large-scale carbon farming and GMO seed distribution.	15,34,000	42,67,622
Boomitra Inc.	2016	USA	Operates in India, Latin America, and East Africa. Partnered with Carbon Farming India (Kirishitan) to promote carbon farming in India.	2,00,000	7,50,000
Suminter India Organics	2003	Mumbai, India	Focuses on organic practices to achieve emission reductions through carbon farming projects.	52,031	2,75,748
Greneity	2013	Bangalore India	Manages projects that reduce emissions through carbon farming initiatives in India.	40,000	1,73,250
Mahanadi Compressed Biogas (CBG) Private Limited	2022	Chhattisgarh, India	Focuses on methane emission reduction through biogas initiatives, adding to carbon credit generation.	-	64,457

Landmark Agri Exports Private Limited	2020	Bhopal, India	Contributes to carbon credit efforts through agricultural exports.	8,085	58,722
Multiple Proponents	-	India	Multiple smaller projects across various regions, collectively reducing emissions.	1,15,654	52,520
Biowin Agro Research	2015	Wayanad, India	Engages in carbon farming activities aimed at emission reductions through agricultural methods.	11,560	26,639
Sagri Bengaluru Private Limited	2019	Bengaluru, India	Japanese subsidiary specializing in satellite-based soil carbon measurement, enhancing accuracy in non-visible spectrum data.	-	-
Nurture Agtech Private Limited (nurture.farm)	2020	Mumbai, India	A subsidiary of UPL, submitted India's first methane avoidance project for rice. Aims to prevent methane and N_2O from field burning.	-	-
Total Emission Reductions: 10,465,177 metric tons CO_2 equivalent across 3,961,330 hectares. (**Source**: Compiled from Verra (2023) and company information)					

Challenges in the Adoption of Carbon Farming in India

The adoption of carbon farming initiatives (CFI) in India is hindered by multiple socio-economic, institutional, and practical barriers. One key challenge lies in aligning farmers' interests with the complex designs and implementation of agro-environmental policies aimed at promoting sustainable farming practices. Often, these schemes are not farmer-centric, leading to low participation rates. For instance, conflicting priorities between policymakers and farmers can exacerbate this gap, as many farmers lack the knowledge or skills to implement such advanced practices effectively. Inadequate awareness and limited access to clear information about the benefits and mechanisms of carbon farming further undermine its adoption. A 2022 survey by the National Bank for Agriculture and Rural Development (NABARD) revealed that most of Indian farmers were unaware of carbon farming opportunities, while those familiar with it expressed skepticism due to unclear benefits and apprehensions about productivity impacts (NABARD, 2023).

Additionally, structural and operational challenges discourage participation. High input costs, lack of approved methods and certification standards, and difficulties in securing recognition as carbon offset providers are significant barriers. Farmers often struggle with uncertainty surrounding the environmental and economic benefits of carbon farming, compounded by instability in carbon credit markets. For example, fluctuating carbon credit prices, which ranged between \$10 and \$25 per metric ton in 2023, create financial unpredictability for farmers (Asian Development Bank, 2024). Moreover, traditional farm management practices are often incompatible with carbon farming, requiring substantial capital investments for necessary transitions. For instance, adopting methane-reducing practices in rice paddies or transitioning to agroforestry systems requires upfront costs that many small-scale farmers cannot afford.

Political instability and institutional inefficiencies further complicate the situation, as farmers face challenges in securing loans or financial assistance for carbon farming projects. In some cases, the policies are perceived as rewarding poor land management, deterring responsible farmers from participating. Farmers have also raised concerns about the difficulty of monitoring progress and the saleability of carbon farming products, particularly in remote regions where access to markets remains limited. For example, farmers engaging in agroforestry often find it challenging to sell timber or plantation products due to logistical barriers and poor market integration.

To address these barriers, there is a need for robust institutional frameworks that offer clarity on financial returns, carbon abatement potential, and the broader benefits of carbon farming, such as improved soil health and water quality. For instance, the Australian carbon farming initiative demonstrated how integrating biodiversity conservation with carbon sequestration can yield economic benefits for farmers while restoring ecosystem functions. Drawing from such examples, Indian policymakers need to provide targeted financial incentives, streamline certification processes, and develop region-specific strategies to ensure the successful implementation of carbon farming initiatives.

Future Directions to Enhance Carbon Farming in India

I. Educating farmers about the benefits and mechanisms of carbon farming is crucial. Future efforts should focus on region-specific outreach programs, leveraging digital tools and integrating carbon farming concepts into existing agricultural extension services. For example, mobile apps and SMS-based advisory services can disseminate information about carbon markets, best practices and potential financial returns.

II. Establishing farmer-friendly policies that align with local agricultural practices can encourage wider adoption. Policies should include simplified certification processes, subsidies for initial investments and assured minimum carbon credit prices to mitigate market fluctuations. Lessons can be drawn from successful international models like Australia's Emissions Reduction Fund.

III. Advancing the use of satellite-based soil carbon measurement, AI and IoT for precise monitoring can reduce operational complexities and costs. Companies like Sagri Bengaluru are already pioneering such technologies, which could be scaled up through public-private partnerships.

IV. Encouraging the formation of farmer cooperatives and FPOs focused on carbon farming can provide collective bargaining power for accessing markets and negotiating carbon credit prices. These cooperatives can also serve as platforms for knowledge exchange and collective investment in technologies.

V. Promoting agroforestry and mixed farming systems that combine carbon sequestration with other income-generating activities can make carbon farming more appealing. For instance, integrating tree crops like teak or bamboo with traditional crops can enhance both biodiversity and economic resilience.

VI. Establishing reliable and transparent carbon credit platforms, supported by government-backed guarantees, can reduce uncertainties for farmers. These markets should offer seamless interfaces for carbon trading, ensuring timely payments and minimal bureaucracy.

VII. Encouraging research to develop low-cost, high-impact carbon farming techniques tailored to India's diverse agro-climatic conditions is essential. Collaboration between academic institutions, agritech companies, NGOs and government agencies can foster innovation.

VIII. Financial incentives such as low-interest loans, grants and insurance schemes tailored to carbon farming projects can mitigate risks for farmers. Initiatives like NABARD's credit support schemes could be extended to include carbon farming-specific programs.

IX. Partnering with global entities engaged in carbon farming can bring in technical expertise and financial investments. For instance, partnerships with organizations like Indigo Agriculture or Boomitra could help scale up successful models and technologies.

X. Engaging local communities in carbon farming efforts can amplify its impact. Programs should integrate traditional knowledge systems, involve women and marginalized groups, and prioritize sustainable livelihood options to ensure inclusivity.

By addressing these areas, India can significantly enhance the adoption of carbon farming, contributing to sustainable agriculture, economic growth and net zero emission commitment.

Conclusion

Carbon farming presents a vital pathway for India to achieve its climate goals while addressing agricultural sustainability and rural economic development. By reducing greenhouse gas emissions and enhancing soil carbon sequestration, carbon farming transforms agriculture from a major emission source to a solution for climate mitigation. The integration of a robust carbon credit framework, improved awareness among farmers, and alignment with national climate policies can unlock substantial benefits, including enhanced productivity, economic incentives, and environmental resilience. Despite challenges like inadequate awareness and market instability, the active participation of corporations, institutions, and government initiatives positions Indian agriculture as a critical player in the global transition to a low-carbon economy. By addressing these barriers and scaling sustainable practices, India can establish a resilient agricultural sector that contributes to both climate action and sustainable development.

Conflict of Interest

The author/s declare no conflict of interest.

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LP 2.4

Agricultural extension services for advancing Sustainable Development Goal 2 in India

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Sustainable Development Goals (SDG): an introduction

United Nation's Millennium Development Goals (MDGs) 2000-2015 have been replaced by Sustainable Development Goals (SDG) also known as The Agenda 2030. On 25th September 2015, the 193 member countries of the United Nations, including India, adopted the Sustainable Development Goals (SDGs). The Agenda 2030 has 17 Sustainable Development Goals, 169 targets and 231 indicators.

Among the 17 SDGs, **SDG 2** aims to **end hunger, achieve food security and improved nutrition and promote sustainable agriculture** by 2030**.** This SDG focuses on the development of rural infrastructure, promotes agricultural research and extension services, encourages technology development and creates plant and livestock gene banks to enhance agricultural productive capacity among developing countries.

Table 1: Targets and Indicators of Sustainable Development Goals (SDG) 2

Targets	**Indicators**
2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	**2.1.1** Prevalence of undernourishment **2.1.2** Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES)
2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons	**2.2.1** Prevalence of stunting (height for age <-2 standard deviation from the median of the World Health Organization (WHO) Child Growth Standards) among children under 5 years of age **2.2.2** Prevalence of malnutrition (weight for height >+2 or <-2 standard deviation from the median of the WHO Child Growth Standards) among children under 5 years of age, by type (wasting and overweight) **2.2.3** Prevalence of anaemia in women aged 15 to 49 years, by pregnancy status (percentage)
2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-	**2.3.1** Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size **2.3.2** Average income of small-scale food producers, by sex and indigenous status

farm employment	
2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, help maintain ecosystems, strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and progressively improve land and soil quality	**2.4.1** Proportion of agricultural area under productive and sustainable agriculture
2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels. Promote access to fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed	**2.5.1** Number of plant and animal genetic resources for food and agriculture secured in either medium or long-term conservation facilities **2.5.2** Proportion of local breeds classified as being at risk of extinction
2.a Increase of investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks to enhance agricultural productive capacity in developing countries, particularly in least developed countries	**2.a.1** The agriculture orientation index for government expenditures **2.a.2** Total official flows (official development assistance plus other official flows) to the agriculture sector
2.b Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, following the mandate of the Doha Development Round	**2.b.1** Agricultural export subsidies
2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, to help limit extreme food price volatility	**2.c.1** Indicator of food price anomalies

(Source: https://sdgs.un.org/goals/goal2#targets_and_indicators)

According to FAO discussion paper of 2016 on SDGs, SDG 2 is materially connected, inter alia, to SDGs 1 (ending poverty), SDG 3 (target 3.9 child and maternal care, and target 3.4 diet and food system-related non-communicable diseases), SDG 5 (women's empowerment, especially target 5.a ensure women's right to own land), SDG 6 (water and sanitation for all), SDG 7 (access to modern energy a prerequisite of inclusive rural poverty reduction), SDG 12 (sustainable consumption and production, especially target 12.3 on food losses and waste), SDG 16 (peaceful and inclusive societies and effective, accountable and inclusive institutions, especially targets 16.1 reduce all forms of violence and 16.6 develop effective, accountable and transparent institutions). Thus, it is important to take cognizance of this interrelatedness while devising a response for achieving the targets under SDG 2. Most of the targets of SDG 2 are addressed by Agricultural Research and Extension Services, which will impact on interconnected targets of SDGs.

Role of Agricultural Research and Extension Services in Achieving SDG 2

Agricultural extension systems are at the center to unlock the potential of agricultural innovation and achieve SDG 2. Agricultural extension advisory services are essential to increase productivity and promote sustainable agricultural growth along with alleviating poverty. There is a close relationship between extension and sustainability, which are intertwined with social and farm life. Sustainability refers to the continuation of life and extension teaches how life can be sustained

Knowledge Dissemination (foundational role of extension): Extension workers provide training and education to farmers about modern agricultural techniques, crop management and pest control leading to informed decision-making for better crop production and sustainability.

Advisory Support (personalized guidance): This supportive role is essential, particularly for small and marginalized farmers who may lack access to vital resources and information.

Facilitating Access to Resources: Extension services assist farmers in acquiring the necessary inputs for sustainable farming, such as quality seeds, fertilizers and irrigation technologies to improve agricultural productivity.

Enhancing Agricultural Productivity and Sustainability: Extension services promote advanced farming techniques and sustainable practices to increase crop yields, thereby addressing food shortages. Extension services also educate farmers on sustainable agricultural practices that increase productivity and protect the environment.

Table 2: Initiatives of the Ministry of Agriculture and Farmers Welfare to achieve SDG 2

SDG Target	Nodal Ministry: Agriculture & Farmers Welfare
2.1 to 2.4	National Food Security Mission (NFSM) (Core) Mission for Integrated Development of Horticulture (MIDH), National Oilseed and Oil Palm Mission (NOOPM), National Mission on Agriculture Extension and Technology (NMAET), Rashtriya Krishi Vikas Yojana (RKVY) (Core)
2.4	National Mission on Sustainable Agriculture (NMSA), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)
2.1 to 2.5	National Livestock Mission (NLM) (Core), Livestock Health and Disease Control (Core), National Programme for Bovine Breeding and Dairy Development
2.1 and 2.2	Targeted Public Distribution System (TPDS), National Nutrition Mission (NNM) (Core), National Food Security Act (NFSA) 2013, Mid-Day Meal Scheme
2 c	e-NAM
2.4 and 2.5	ICAR

(Source:https://www.niti.gov.in/sites/default/files/2019-01/Mapping%20-SDGs%20V12%20-%208%20delinked%20schemes%20%20110116_1_0.pdf)

Achieving SDG 2 requires efforts from multiple ministries such as the Ministry of Health and Family Welfare to achieve SDG Targets 2.1 and 2.2. However, this paper focuses on the role of agricultural extension services in advancing SDG 2. The various initiatives and schemes play a vital role in addressing the targets of SDG 2. Following are initiatives of ministry of agriculture and farmers welfare alongwith their relevant targets under SDG 2.

National Food Security Mission (NFSM)

The NFSM is aimed at increasing the production of food grains, enhancing the income of farmers and ensuring food security.

Target 2.1	Ensures increased food production and availability, aiming to end hunger and provide sufficient food to vulnerable populations.
Target 2.3	Supports small-scale farmers by improving agricultural practices, directly enhancing their productivity and incomes. This ultimately contributes to alleviating poverty and ensuring food security.

Mission for Integrated Development of Horticulture (MIDH)
The MIDH focuses on the holistic development of the horticulture sector, covering various horticultural crops.

Target 2.3	By promoting horticulture, the MIDH increases agricultural productivity and improves the income of farmers, which is crucial in reducing hunger.
Target 2.4	MIDH supports sustainable practices by emphasizing organic farming and resource conservation, thereby contributing to sustainable agricultural systems.

National Oilseed and Oil Palm Mission (NOOPM)
The NOOPM aims to increase domestic oilseed production and reduce import dependence, benefiting oilseed farmers.

Target 2.2	The initiative helps reduce malnutrition by improving access to quality edible oils.
Target 2.4	Focuses on integrating sustainable farming techniques for oil palm cultivation, promoting ecological balance and food security.

National Mission on Agriculture Extension and Technology (NMAET)
NMAET focuses on improving agricultural extension services and technology dissemination to farmers.

Target 2.3	Facilitates knowledge transfer regarding best practices in farming, which increases agricultural productivity and farmers' incomes.
Target 2.4	Supports sustainable agriculture by promoting eco-friendly practices and innovation among farmers.

National Mission on Sustainable Agriculture (NMSA)
The NMSA emphasizes sustainable agricultural practices, including conservation of natural resources. Promotes climate-resilient and sustainable farming practices, focusing on soil health, water use efficiency and crop diversification.

Target 2.4	Promotes sustainable agricultural practices that ensure resilience against climate change and enhance productivity.
Target 2.5	Maintaining biodiversity and genetic diversity of seeds and crops, which is critical for food security.

Rashtriya Krishi Vikas Yojana (RKVY)
The RKVY is a major initiative aimed at developing the agricultural sector holistically. Enhances public investment in agriculture and allied sectors, supporting sustainable growth and rural development.

Target 2.1	Enhances food security by providing financial and technical support for agricultural development.
Target 2.3	By promoting increased agricultural productivity, RKVY improves the livelihoods of farmers.

National Livestock Mission (NLM)
The NLM aims to enhance livestock productivity and promote sustainable livestock

development.

Target 2.1	By improving livestock production, this initiative directly contributes to food security and nutritional availability.
Target 2.3 & 2.5	Supports sustainable livestock practices that enhance incomes for small-scale farmers while preserving genetic diversity and environmental health.

National Programme for Bovine Breeding and Dairy Development

This program focuses on enhancing the productivity of bovine populations in India.

Target 2.1	Increases the availability of milk and dairy products, which are vital for nutrition.
Target 2.3	Contributes to higher incomes for dairy farmers through improved breeding practices and productivity.

Targeted Public Distribution System (TPDS)

The TPDS provides subsidized food to low-income households.

Target 2.1	Directly addresses hunger by ensuring that vulnerable populations have access to essential food commodities.
Target 2.2	Helps reduce malnutrition by providing dietary staples at affordable prices.

National Nutrition Mission (NNM) and National Food Security Act (NFSA)

Both programs aim to address malnutrition and ensure food security across populations.

Target 2.1	By expanding access to nutritious food, they help meet the needs of the most vulnerable, thereby supporting SDG 2.
Target 2.2	Specifically targets malnutrition by improving nutrition for children and vulnerable groups.

Mid-Day Meal Scheme

This scheme provides free meals to schoolchildren.

Target 2.1 & 2.2	Tackles classroom hunger and malnutrition, significantly improving children's nutritional status.
Target 2.3	Promotes higher school attendance, which ultimately contributes to better educational and economic prospects.

e-NAM (National Agricultural Market)

e-NAM facilitates direct trading of agricultural commodities between farmers and buyers.

Target 2.3	Improves the income of farmers by enhancing their market access and reducing dependency on middlemen.
Target 2.4	Encourages sustainable practices by providing farmers with better pricing information, allowing them to make informed decisions.

ICAR (Indian Council of Agricultural Research)

ICAR plays a vital role in advancing agricultural research and education.

Target 2.4 & 2.5	Facilitates the implementation of sustainable practices in agriculture through research and technology dissemination. It encourages the conservation and sustainable use of agricultural biodiversity.

Progress of the Ministry of Agriculture and Farmers Welfare in achieving SDG 2

The Ministry utilizes the National Indicator Framework to assess the progress towards SDG 2. However national indicator to assess target 2.b is under development.

Table 3: SDG progress in target 2.3.1, 2.3.2 and 2.3.3

Targets	**2.3.1**: Agriculture productivity of wheat and rice		**2.3.2**: Gross Value Added in agriculture per worker (in Rs.)	**2.3.3**: Ratio of institutional credit to agriculture to the agriculture output
Year	Wheat (Kg/ha.)	Rice (Kg/ha.)		
2015-16	3034	2400	61427	0.76
2016-17	3200	2494	65603	0.83
2017-18	3368	2576	69936	0.87
2018-19	3533	2638	71402	0.95
2019-20	3440	2722	75801	1.01
2020-21	3521	2717	78837	1.10
2021-22	3537	2798	82482	1.28
2022-23	3521	2838	86365	1.40
2023-24	3525	2742	87609	-

(*Data_snapshot_on_SDG-NIF-Progress-Report_2024.pdf)

There is an increase in productivity (for wheat and rice) and the Gross Value Added per worker indicates improvements in the agricultural sector. An increase of GVA in agriculture per worker signifies that each agricultural worker is producing a higher value of goods or services. Agricultural workers are becoming more productive and contributing more to the overall economic output within the agricultural sector. An increasing ratio of institutional credit to agricultural output indicates that more credit is available to agricultural stakeholders (Table 3).

Table 4: SDG progress in target 2.4.1, 2.4.2 and 2.4.3

Targets	**2.4.1**: Proportion of Net Sown Area to Cultivable Land (Value %)	**2.4.2**: Percentage of farmers issued Soil Health Card	**2.4.3**: Percentage of net area under organic farming
Year			
2015-16	76.62	100.00	0.9740
2016-17	76.83	98.54	1.1041
2017-18	76.75	100.00	1.3929
2018-19	76.64	98.00	1.5892
2019-20	77.73	-	2.0220
2020-21	78.52	-	2.3843
2021-22	78.29	-	3.9151
2022-23	-	-	4.4293

(*Data_snapshot_on_SDG-NIF-Progress-Report_2024.pdf)

An increase in the proportion of Net Sown Area (NSA) to cultivable land indicates that a larger percentage of land that could potentially be used for agriculture is actively being used to grow crop. However, the Soil Health Card scheme is now integrated into the Rashtriya Krishi Vikas Yojana (RKVY) as a component called "Soil Health & Fertility" since 2022-23, making it difficult to track separate statistics for the Soil Health Card. There is increase in the proportion of net area under organic farming highlights a shift towards sustainable agricultural methods (Table 4).

Table 5: SDG progress in target 2.5.1, 2.5.2 and 2.5.3

Targets	**2.5.1**: Number of plant and animal genetic resources for food and agriculture secured in either medium- or long-term conservation facilities		**2.5.2**: Proportion of local breeds classified as being at risk of extinction	**2.5.3**: Conservation of fish genetic resource, (in number)
Year	Plant	Animal		
2015-16	444607	146364	-	50

2016-17	449702	156276	-	53
2017-18	454841	181128	-	58
2018-19	461832	200549	-	63
2019-20	464517	220649	-	67
2020-21	475054	239954	-	81
2021-22	479823	262104	-	91
2022-23	482633	294504	17.92	100
2023-24	486452	316214	17.27	101

(*Data_snapshot_on_SDG-NIF-Progress-Report_2024.pdf)

The data indicates positive trends in the conservation of both plant and animal genetic resources over the years, with consistent increases in their secured numbers. Additionally, there is rise of the proportion of local breeds at risk, particularly in recent years. However, more data is required to assess the progress. Also, there is an increase in the number of fish genetic resources (Table 5).

Table 6: SDG progress in target 2.a.1, 2.a.2 and 2.c.1

Targets	**2.a.1**: The agriculture orientation index for government expenditures	**2.a.2**: Percentage share of expenditure in Intellectual Property Product (R&D) in agriculture to GVA in agriculture	**2.c.1**: Percentage of agriculture mandis enrolled in e-market
Year			
2015-16	-	0.044	-
2016-17	0.399	0.052	6.49
2017-18	0.443	0.041	3.10
2018-19	0.458	0.041	-
2019-20	0.456	0.039	-
2020-21	0.382	0.021	15.10
2021-22	0.419	0.028	14.40
2022-23	0.451	0.033	19.21

(*Data_snapshot_on_SDG-NIF-Progress-Report_2024.pdf)

The Agriculture Orientation Index (AOI) is a currency-free measure that compares the share of government spending on agriculture to the sector's contribution to a country's GDP. It reflects governments' commitment to allocating resources toward the agricultural sector relative to its contribution to the economy. It can vary due to Govt. policy and its investment priorities, economic factors and external influences. Based on this AOI may vary. The GVA in agriculture is in increasing trend from 2015 to 2023 However, the percentage share of expenditure in intellectual property product (R&D) in agriculture to GVA in agriculture increased up to 2019, in contrast, it declined in recent years which requires further investigation. There is a positive trend in enrolment in e-markets within agricultural mandis (Table 6).

Conclusion

Agricultural extension systems are playing a pivotal role in achieving Sustainable Development Goal (SDG) 2 by driving productivity, sustainability and food security via various initiatives. These systems disseminate critical knowledge, provide advisory support and facilitate resources to farmers for enhancing their capacity for sustainable and climate-resilient practices. Progress indicators of SDG 2, such as increased productivity, Gross Value Added (GVA) per worker and adoption of organic farming highlight positive strides in the agricultural sector. Despite advancements in conserving genetic resources and promoting innovative practices, challenges such as declining investments in agricultural R&D require attention. Strengthening agricultural extension services through fair and firm futuristic policies are need of the hour to ensure sustainable agricultural growth, alleviate poverty and secure food systems for future generations.

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LP 2.5

Natural Farming: A way forward towards sustainable agriculture

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Introduction

World food production needs to increase 70 per cent in order to keep up with the growing global population. Under such condition, ensuring food security for the growing population would be one of the biggest concerns. In mid 1960s 'Green Revolution' technologies adopted in the country promotes intensive use of HYV seeds, chemical fertilizer and irrigation helped in overcoming the food shortage. However, intensified agricultural practices led to considerable adverse environmental impacts on soil, air, land, water and biodiversity (Smith et al., 2013; Pingali, 2012). However, increase in input costs and expenditures for managing and preserving the health of natural resources, farmers' real income is significantly reduced. Because of inadequate agricultural productivity, distress within the agrarian community is so acute and pervasive that many farmers throughout the country have committed suicides. Contrastingly, Natural Farming (NF) is a unique chemical-free farming method that is considered to be agroecology-based diversified farming system, which integrates crops, trees and livestock, allowing functional biodiversity (Rosset and Martinez-Torres, 2012).

This farming approach was introduced by Masanobu Fukuoka, a Japanese farmer and philosopher, in his 1975 book 'The One-Straw Revolution'. In India Zero Budget Natural Farming (ZBNF) was originally promoted by an agriculturist Sh. Subhash Palekar in mid-1990s. In this farming natural laws are used in production and productivity of agricultural practices. According to this method needed nutrients are available in the soil, but in unavailable form. These can be converted into available form by the microorganisms, which are available in plenty in the indigenous cow dung and uncultivated soil. Natural farming is an art that collaborates science with nature to attain a sustainable aim of agricultural development. In this agricultural method, use of locally available resources and traditional indigenous practices, such as biomass mulching, year-round green cover, multi-species green manuring, and on-farm desi cow dung and urine formulations to increase the nutrient availability in soli and to control diseases in plants. One gram of local cow dung contains about 300 to 500 crore beneficial microbes, these microbes decompose the dried biomass (mulch) on the soil and make the nutrients available to the plants. It also increases earthworm population in the field. So, because this method drastically cut down production costs by replacing the chemical fertilizers and pesticides with home-grown products. Nothing to be purchased from the market and production cost becomes zero, therefore, it is named as 'Zero Budget'. Natural farming provides solutions to a variety of challenges, including nutritional security, farmer poverty, migration of youth, global warming, health issues caused by pesticides residue in food and water. It is considered as regenerative agriculture a prominent strategy to save the planet.

Components of natural farming

1. Jivamrita: Microorganisms convert inaccessible nutrients into available forms in the plant root zone. The bacteria present in inoculating Jivamrita into soil converts it from non-available to dissolved form. It also acts as an antagonism against pathogens.

2. Bijamrita: The mixture of 20 liters of water, 5 kg of cow dung, 5 liters of urine, 50 kg of lime, and a little amount of soil is properly mixed and stored in a tank. Bijamrith protects crops from soil-born infections, as well as early seedling roots from fungus and diseases.

3. Mulching: Mulching comes in three types: straw, dirt, and live mulch. Growing cover crops such as legumes reduces weeds and improves water penetration. It conserves soil moisture by minimizing evaporation and retaining water for longer periods.

4. Waaphase: The process involves activating earthworms in the soil in order to create water vapour concentration**.**

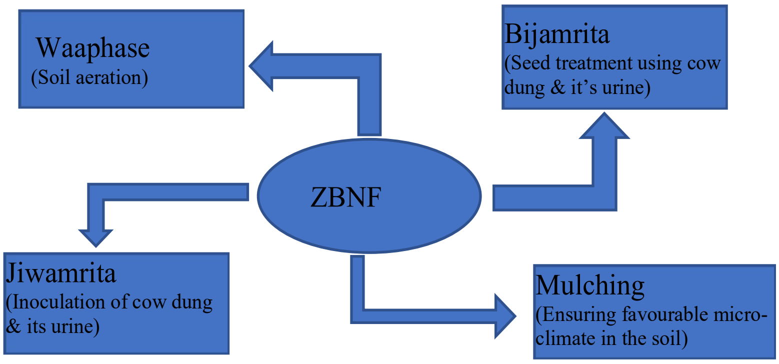

Fig:1 Components of ZBNF

Benefits of Natural Farming

A) Environmental Benefits

- **Increases Soil Health:** Natural farming techniques like composting and mulching enhance soil fertility by promoting beneficial microorganisms and organic matter. This leads to improved water retention, increased nutrient availability, and better crop yields.
- **Helps to Conserve Water:** Natural methods like mulching and drip irrigation helps to retain moisture in the soil, reducing the need for excessive water usage. This is crucial for sustainable water management and combating drought conditions.
- **Decreases Pollution:** By substituting chemical fertilizers and pesticides with natural alternatives, natural farming significantly reduces the pollution of soil, water bodies, and the atmosphere. This protects ecosystems and human health from harmful chemicals.
- **Supports Climate Change Mitigation**: Natural farming practices generally have a lower carbon footprint compared to conventional agriculture. Additionally, healthy soil acts as a carbon sink, capturing greenhouse gases and contributing to climate change mitigation.
- **Promotes Resilience in Agriculture:** The changes in soil structure with the help of organic carbon, no/low tillage and plant diversity are supporting plant growth even under extreme situations like severe droughts and withstanding severe flood and wind damage during cyclones. This farming impacts many farmers positively by imparting resilience to the crops against weather extremities.
- **Environment Conservation:** With all these activities helps to conserve the environment over a period of time.

B) Farmer Benefits

- **Reduced Costs:** Natural farming relies on locally available resources and on-farm inputs, like compost and bio-pesticides, leading to lower dependence on expensive external inputs like chemical fertilisers and pesticides. This reduces the overall cost of production and improves farmer profitability.
- **Improved Farm Resilience:** Natural farming techniques make farms more resilient to extreme weather events like droughts and floods by promoting soil health and biodiversity. This leads to greater stability and reduces risks for farmers.

- **Enhanced Farmer Health:** By eliminating exposure to harmful chemicals, natural farming protects farmers' health and well-being.

C) Consumer Benefits

- **Safer Food**: Natural farming produces food free from harmful chemical residues, leading to safer and healthier consumption for consumers.
- **Improved Food Quality:** Studies suggest that naturally grown food can have higher level of antioxidants & other beneficial nutrients, potentially leading to improved health of consumers.
- **Support for Sustainable Agriculture:** Consumers who choose natural food products indirectly support a more sustainable and ethical agricultural system that benefits the environment and farmers.

Challenges Related to Natural Farming

- **Decrease in yields:** According to studies ZBNF decline the yields at the beginning of the adoption process. Ex: Sikkim faced difficult situations before converting an organic state. ICAR agriculture scientists identified that wheat and rice yields were decline in ZBNF in the beginning of adoption process.
- **May adversely impact food supply:** Agriculture and food experts have their reservations surrounding a large-scale transition from chemical farming to natural farming in a country like India. This is because it is a challenging task to meet the demands of expanding food needs in a country with a population as huge as India.
- **Lack of readily availability of natural inputs:** Farmers often cite the lack of readily available natural inputs as a barrier to converting to chemical-free agriculture. Not every farmer has the time, patience, or labour to develop their own natural inputs.
- **Pest and disease threat:** Natural farmers may have more difficulty in controlling pests and diseases compared to conventional farmers, who can use synthetic chemicals to treat these problems. This can make natural farming riskier and more challenging.
- **Limited Resources and time constraint:** Natural farming often requires more labour and other resources compared to conventional farming methods. For example, natural farmers may need to spend more time and effort on tasks like composting, crop rotation, and intercropping. This can be a challenge for farmers in India who are already stretched thin and may not have the time or manpower to devote to these tasks.
- **Lack of awareness and training:** Many farmers lack knowledge and practical skills in natural farming techniques, making them hesitant to switch. Limited access to training programs and extension services further exacerbates the problem.

Government incentives towards natural farming

Sustainable agriculture is the one of the biggest incentives of the government. ZBNF supports for sustainable agriculture development. In this government implemented different programs for the in support in of natural farming.

- **Paramparagat Krishi Vikas Yojana (PKVY):** It was launched in 2015, as an extended component of Soil Health Management (SHM) under the Centrally Sponsored Scheme (CSS), National Mission on Sustainable Agriculture (NMSA). PKVY aims at supporting and promoting natural farming, in turn resulting in improvement of soil health.

- **Bharatiya Prakritik Krishi Paddhati (BPKP)/ZBNF:** It is a sub-scheme of the PKVY and was launched with a total outlay of ₹4,645.69 crore for six years (2019-20 to 2024-25). It aims at promoting traditional indigenous practices, which give freedom to farmers from externally purchased inputs. Under BPKP, financial assistance of Rs 12200/ha for 3 years is provided for cluster formation, capacity building and continuous hand holding by trained personnel, certification and residue analysis. Its vision is to cover 12 lakh ha in 600 major blocks of 2000 hectares in different states.
- **National Mission on Natural Farming (NMNF):** The Union Agriculture Ministry has been preparing to launch the Mission to motivate farmers to adopt chemical-free farming and draw them towards adopting natural farming willingly on the system's merit. The success of the NMNF will require a behavioural change in farmers to shift from chemical-based inputs to cow-based, locally-produced inputs.

Successfully leading states /stories of natural farming

Along with the challenges, advantages of natural farming are more important to considered for the sustainable agriculture in this climate changing scenario. Some of the states like Andhra Pradesh, Chattisgarh, Kerala, Himachal Pradesh, Madhya Pradesh, Odisha, Gujarat, Tamil Nadu and Jharkhand are gradually started to implement natural farming by convincing farmers with the support of Paramparagat Krishi Vikas Yojan. Results and opinions of the farmers are magnificent towards natural farming practices. By looking in to these success stories, the government can't take further incentives to promote natural farming.

Conclusion

Some agriculture experts feel that it is early to recommend widespread adoption of natural farming as it may lead to massive damage to the hard-earned knowledge and benefits of agricultural research and development over the last 70 years. The world's population is predicted to expand to approximately 10 billion by 2050. It is expected that agricultural demand will increase up to 50%, in comparison to 2013. To meet this demands a balanced approach should be adopted while promoting Natural farming. The experience of Sri Lanka must be kept in mind where the Government at once prohibited the use and import of chemical fertilizers leading to massive drop in production and shortage of food. Some of the successful experiences in natural farming at Andra Pradesh and Karnataka etc. shows that a natural farming transformation can be done by convincing farmers gradually, a process that can takes longer period of time. Hence, the government should provide adequate time, promote awareness campaigns with practical examples to motivate the farmers. Government policies focus should be shifted from food to nutrition security, looking beyond yields. Government can support the transition and bear short-term losses. Instead of input-based subsidies for fertilizer and power. The Government focus should be to incentivize outcomes like nutrition output, water conserved or desertification reversed.

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LP 3.1

Transforming agricultural extension through strategic Public Private Partnership: Scaling impact and sustainability

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Introduction

Many farmers in developing countries have not fully developed their skills and they cannot process information for use in the different agricultural value chains they are involved in. Agricultural extension plays a key role in supporting farmers to access timely and relevant information which can help them improve their production and productivity (Feder *et al*., 2011; MAAIF, 2016). Following the Green Revolution, technology development and diffusion in Indian agriculture underwent a paradigm shift. A basket full of goods and services is now available for the Indian farmers to use. However, the conventional agricultural extension system, which was created to provide the farming community with information and services, is unable to meet expectations. Due of the disparity between supply and demand, the private sector has been enticed to enter and take advantage of the numerous opportunities. Private extension organizations have been highly active in capturing the largest farming community in the globe thanks to the economic policies. Despite being driven by financial gain, they are meant to address the unmet requirements of Indian farmers. The purpose, policy, products, and intended audience have all been called into question by this circumstance.

The government's only choice at this point is to continue working closely with the commercial extension system. However, it plays a part in keeping an eye on and managing the caliber of products and services. Agriculture shouldn't be completely privatized. Therefore, it is necessary to decrease redundancy and repetition, as well as to facilitate convergence and better connectivity in this Public-Private Partnership, in order to better utilize the limited resources. This essay will concentrate on a few crucial elements that must be taken into account. PPP in extension is a promising model for achieving sustainable agriculture and rural development outcomes by harnessing the strengths of both public and private sectors (Debashish and kumari, 2024).

Public Private Partnership

Public-Private Partnerships (PPPs) are collaborations between public and private sector entities for the purpose of developing, preparing, funding, building, delivering, and running infrastructure and facilities (Nischitha, 2021). The technology and management gaps embedded in the public agricultural extension system call for a broader lens beyond provision of technical information. It requires developing innovative ways in technology transfer, organizing farmers in groups, and access to credit, and marketing (Kokate *et al*., 2016; Poulton and Macartney, 2012). PPPs are being utilized more and more in agricultural innovation to increase efficiency, enhance public money, and better adapt innovation to demand in order to promote faster and wider dissemination.

A PPP exists where the public sector contracts a private sector for the implementation of a public sector good or service for longer periods of time such as the provision of agricultural extension services and other infrastructural projects (Mouraviev and Kakabadse, 2017). FAO (2016) defines an Agriculture Public Private Partnership (agri-PPP) or a PPP for agribusiness development as: a formalized partnership between public institutions and private partners designed to address sustainable agricultural development objectives, where the public benefits anticipated from the partnership are clearly defined, investment contributions and risks are shared, and active roles exist for all partners at various stages throughout the PPP project life cycle.

We can create a more resilient agriculture industry that not only increases productivity but also advances social justice and environmental sustainability by encouraging cooperation and creativity. Transparency is one of the keys to PPP success. Partners must be aware of and considerate of one another's communication needs (*Rao et al.,* 2024).

Public-Private Partnerships: A Framework for Innovation

In the context of agricultural extension, PPPs serve as a framework for innovation by combining resources, expertise, and technology from both sectors to enhance service delivery and improve outcomes for farmers.

Key Elements of PPPs in Agricultural Extension

1. Shared Objectives

Both public and private partners must align their goals. The development of programs that successfully meet the requirements of farmers and advance the interests of agriculture as a whole depends on this shared vision.

2. Resource Allocation

PPPs enable the effective use of resources by combining money, technology, and human resources. The private sector can contribute investment and innovation, while the public sector can provide regulatory support and access to farmers.

3. Stakeholder Engagement

All parties involved in a successful PPP are actively involved, including local governments, farmers, and community organizations. This involvement guarantees that the services are pertinent and customized to meet the unique requirements of the farming community.

Benefits of PPPs in Agricultural Extension

1. Resource Optimization

- **Shared Investment:** By utilizing funds from the public and private sectors, PPPs can ease the strain on public finances and provide room for larger-scale initiatives.
- **Efficient Use of Resources:** Partnerships can result in a more strategic distribution of resources, reducing waste and guaranteeing that money is allocated to areas with the greatest potential for effect.

2. Transfer of technology and innovation

- **Access to Advanced Technologies:** Private sector partners often have access to cutting-edge technologies and research, which can be shared with farmers to improve productivity.
- **Promoting Research and Development:** Partnerships can help R&D projects that concentrate on regional agricultural problems, resulting in customized solutions.

3. Capacity Building

- **Training Programs:** PPPs can help farmers participate in extensive education and training initiatives that improve their knowledge of sustainable farming methods, crop management, and pest control.
- **Knowledge Dissemination:** By creating networks for exchanging best practices and lessons discovered, partnerships can promote a continuous improvement culture.

4. Market Access

- **Linking Farmers to Markets:** Farmers can more efficiently contact customers thanks to private partners' extensive distribution networks.

- **Market Intelligence:** Through partnerships, farmers may obtain important data on customer preferences, pricing, and market trends, empowering them to make well-informed decisions.

5. Risk Sharing

- **Mitigating Financial Risks:** PPPs can persuade private organizations to take part in initiatives that might otherwise be considered too hazardous by sharing the financial risks related to agricultural investments.
- **Adapting to Climate Change:** By working together, measures to deal with climate-related issues can be developed, protecting against market instability and crop failures.

6. Improved Infrastructure

- **Facility Investment:** PPPs can result in the construction of vital infrastructure, including storage facilities, roadways, and irrigation systems, all of which are necessary for effective agricultural production.
- **Technology in Infrastructure:** These collaborations can be used to deploy cutting-edge infrastructure solutions, such intelligent irrigation systems.

7. Better Service Delivery

- **Service Quality:** By combining corporate efficiency with public accountability, agricultural extension services can become more responsive to the requirements of farmers.
- **Timeliness and Reach:** PPPs can guarantee that services more efficiently reach underprivileged areas, enhancing access to essential data and resources.

8. Sustainability

- **Encouraging Sustainable Practices:** Partnerships might concentrate on sustainable agriculture, promoting methods that preserve the environment and save resources.
- **Long-Term Viability:** PPPs can support the long-term well-being of agricultural ecosystems and guarantee food security for future generations by placing a high priority on sustainability.

9. Local Adaptation

- **Tailored Solutions:** Private partners can create culturally and environmentally suitable treatments because they frequently have knowledge of local agricultural environments.
- **Community Engagement:** By involving local stakeholders, extension services can become more effective and pertinent, meeting the requirements of the community.

10. Policy Influence

- **Informed Policy Development:** Public-private sector partnerships can give decision-makers important information that results in better agriculture policies.
- **Advocacy and Support:** PPPs have the ability to promote laws that help the agriculture industry and guarantee that farmers' interests are taken into account when making decisions.

Challenges and Considerations

Public-Private Partnerships (PPPs) in agricultural extension can be highly beneficial, but they also come with their own set of challenges and considerations. Here’s a detailed look at some of these issues:

1. Alignment of Objectives

- **Divergent Goals:** The priorities of the public and private sectors may differ. Private businesses may put profit ahead of rural development and food security, whereas the public sector may concentrate on these issues.
- **Conflict Resolution:** To successfully align goals, it is imperative to set up clear communication and conflict resolution procedures.

2. Resource Disparity

- **Capacity Gaps:** Unbalances in the collaboration may result from public agencies' lack of infrastructure or technical expertise compared to private partners.
- **Funding Difficulties:** It can be problematic to obtain consistent and sufficient funding from both sectors, particularly during hard economic times.

3. Regulatory and Legal Framework

- **Complex Regulations:** Because various industries may be subject to disparate rules and regulations, navigating the regulatory environment can be challenging.
- **Policy Stability:** Partnerships may find it challenging to plan long-term investments because to uncertainty caused by changes in regulations or policy fluctuations.

4. Trust and Transparency

- **Building Trust:** Trust is a prerequisite for forming a trustworthy partnership, but it can be challenging to develop, particularly if prior collaboration experiences have been unfavourable.
- **Transparency Issues:** Partners and stakeholders may become distrustful if operations, finances, or decision-making are opaque.

5. Sustainability of Partnerships

- **Long-Term Commitment:** It might be difficult to guarantee that public and private partners will stay dedicated over the long run, especially if the early advantages take time to materialize.
- **Exit Strategies:** When partnerships end, it's important to have well-defined exit strategy to prevent detrimental effects on farmers and communities.

6. Monitoring and Evaluation

- **Measuring Impact:** Determining success indicators and assessing PPPs' effects can be challenging, necessitating in-depth data gathering and analysis.
- **Accountability:** It can be challenging to hold both partners accountable, particularly when it comes to performance and the provision of promised services.

7. Stakeholder Engagement

- **Inclusive Participation:** Although it can be logistically difficult, it is essential to involve all pertinent stakeholders, such as farmers, local communities, and NGOs.
- **Power Dynamics:** Differences in influence and power among stakeholders may cause some groups to be marginalized, which could have an impact on benefit equity.

8. Cultural Differences

- **Diverse Perspectives:** There may be conflict between the public and private sectors due to their frequently disparate organizational cultures and methods of operation.
- **Adaptation to Local Contexts:** It can be difficult to make sure that both partners adjust to the local agricultural context and community requirements.

9. Market Dynamics

- **Fluctuating Markets:** Partnership viability may be impacted by external economic conditions and the unpredictability of agricultural markets.
- **Competition:** Local producers may face competition from private partners, creating conflicts of interest and jeopardizing the partnership's objectives.

10. Technological Challenges

- **Technology Access:** Although technology might improve farming methods, unequal access can make already-existing inequalities among farmers worse.
- **Training and Capacity Building:** It might take a lot of resources and careful preparation to provide farmers with the necessary training to employ new technologies.

Strategies for Implementing Effective PPPs

Implementing effective Public-Private Partnerships (PPPs) in agricultural extension requires careful planning, clear communication, and strategic execution. Here are detailed strategies to enhance the success of these partnerships:

1. Establish Clear Objectives

- **Joint Visioning:** Collaborate with all stakeholders to define a shared vision and specific goals that align with both public interests (e.g., food security, rural development) and private interests (e.g., profitability, market expansion).
- **SMART Goals:** Ensure that objectives are Specific, Measurable, Achievable, Relevant, and Time-bound to facilitate clear assessment and accountability.

2. Engage Stakeholders Early and Often

- **Broad Stakeholder Inclusion:** Involve a diverse range of stakeholders, including farmers, local communities, NGOs, and academic institutions, in the planning process to ensure that all voices are heard.
- **Regular Communication:** Maintain open lines of communication throughout the partnership to foster trust and ensure that all partners are informed about progress and challenges.

3. Develop a Comprehensive Legal Framework

- **Clear Agreements:** Create comprehensive contracts that specify each partner's obligations, roles, and expectations, including resource sharing, financial contributions, and decision-making procedures.
- **Regulatory Compliance:** To stay out of trouble with the law, make sure the partnership complies with all applicable local, state, and federal laws.

4. Establish Governance Structures

- **Steering Committees:** To supervise project execution and promote communication, form governance groups with members from the public and private sectors.
- **Conflict Resolution Mechanisms:** To stop problems from getting worse and jeopardizing the collaboration, establish explicit procedures for handling disagreements and conflicts.

5. Make Good Use of Resources

- **Resource Mapping:** To maximize their use, thoroughly evaluate the financial, human, and technological resources that are available from both sectors.
- **Funding Strategies:** To guarantee sustainability and reduce risk, investigate a range of funding options, including grants from the government, corporate investments, and donor contributions.

6. Encourage Innovation and Technology Transfer

- **Innovation Hubs:** Establish venues for private partners to present new methods and technologies to farmers and other interested parties.
- **Pilot Programs:** Before a larger rollout, conduct small-scale pilot initiatives to evaluate novel concepts and technology, allowing for modifications in response to input.

7. Capacity Building and Training

- **Training Programs:** Develop tailored training programs for farmers and extension workers that focus on the latest agricultural practices and technologies.
- **Knowledge Sharing:** Facilitate knowledge exchange through workshops, seminars, and field demonstrations to enhance the skills and capabilities of all stakeholders.

8. Implement Monitoring and Evaluation Systems

- **Performance Metrics:** Establish clear metrics for evaluating the success of the partnership, including indicators for productivity, sustainability, and social impact.
- **Regular Reporting:** Create a framework for regular reporting and feedback among partners to assess progress and make necessary adjustments.

9. Promote Sustainability and Resilience

- **Sustainable Practices:** Promote the use of sustainable farming methods that improve long-term profitability and reduce their negative effects on the environment.
- **Risk Management:** To guarantee resilience, create plans to handle possible hazards including resource scarcity, market volatility, and climate change.

10. Evaluate and Adapt

- **Continuous Learning:** Foster a culture of learning within the partnership, encouraging feedback and adaptation based on experiences and outcomes.
- **Iterative Improvement:** Use evaluation findings to refine strategies, practices, and goals, ensuring that the partnership evolves to meet changing needs and contexts.

Conclusion

In conclusion, Public-Private Partnerships (PPPs) hold significant promise for revolutionizing agricultural extension in India by effectively combining the resources and expertise of both sectors. By addressing the complexities of modern agriculture, these partnerships can significantly enhance service delivery and foster innovation, leading to improved productivity and sustainability. However, realizing the full potential of PPPs necessitates careful planning and strategic execution. Overcoming challenges related to alignment of goals, transparency, and stakeholder trust is crucial for their success. By setting clear objectives, engaging diverse stakeholders, and implementing strong governance frameworks, PPPs can be made more effective and adaptive to the needs of farmers. Ultimately, embracing this collaborative approach can result in a resilient agricultural ecosystem that not only boosts economic outcomes but also prioritizes social equity and environmental stewardship. This holistic framework is vital for ensuring food security and fostering sustainable development, ultimately benefiting farmers and communities across India for years to come.

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LP 3.2

Entrepreneurial stress and its management

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Introduction

Stress is a part of life. Life today is complex and it is impossible to avoid stress. One finds stress everywhere – in the family, business organization/enterprise or any other social or economic activity. Right from the birth till the last breath drawn, an individual is invariably exposed to various stressful situations. If not properly managed, stress can prove to be dangerous to one's mental and physical health. Thus, stress management is has become a crucial issue nowadays.

Stress, in general, is the body's response to pressures or threats, manifesting in physical, emotional, and behavioral ways. Stress is the reaction people have to excessive pressure or other types of demand placed upon them. It arises when they worry that they can't cope. According to Selye (1976), any external event or internal drive which threatens to upset the organismic equilibrium is stress. This denotes that every individual has his own equilibrium status within, and if this status gets disturbed because of any external or internal factor, then stress is felt. Robins (1998), defined stress as a dynamic condition in which an individual is confronted with an opportunity, constraints or demands related to what he or she desires and for which the outcome is perceived to be both uncertain and important. This definition outlays two important conditions for stress to be felt: First, the outcome or result of the event/issue must be important for the individual and second, this outcome must be uncertain.

Entrepreneurial stress

Entrepreneurship has long been regarded as a cornerstone of economic development and innovation. Entrepreneurs play a pivotal role in driving growth, creating jobs, and transforming industries through innovative ideas and ventures. However, the entrepreneurial journey is not without its challenges. While entrepreneurship offers independence and the potential for significant rewards, it also demands relentless effort, risk-taking, and resilience. These demands can lead to a phenomenon known as entrepreneurial stress, a condition that significantly impacts the mental and physical well-being of entrepreneurs.

The Nature of Entrepreneurial Stress

Stress is defined as the body's response to external demands or pressures that exceed an individual's perceived ability to cope. It is a natural physiological reaction, which, in moderation, can serve as a motivating force, enhancing focus, energy, and problem-solving abilities. However, chronic or excessive stress, which is common among entrepreneurs, can have detrimental effects on mental and physical health.

Entrepreneurs, unlike employees in structured organizations, assume a high degree of responsibility for their ventures' success or failure. This sense of responsibility, combined with the constant uncertainty that accompanies entrepreneurship, can lead to heightened levels of stress. Entrepreneurs often experience the weight of financial pressures, time constraints, and decision fatigue, all of which contribute to a state of persistent stress.

The nature of entrepreneurial stress is rooted in the continuous juggling act that entrepreneurs must perform between multiple roles: leader, manager, investor, marketer, and sometimes, even the sole employee. This multi-role burden can lead to overwhelming stress, as entrepreneurs may feel they are expected to excel in all areas of business operation. The relentless pursuit of success, coupled with the fear of failure, creates a unique psychological environment where stress becomes a constant companion.

Sources of Entrepreneurial Stress

Entrepreneurial stress arises from a variety of sources, each contributing to the overall strain experienced by entrepreneurs. These stressors are deeply embedded in the unique nature of entrepreneurship, where individuals take on multiple roles and responsibilities, often in uncertain and rapidly changing environments. Understanding the sources of entrepreneurial stress is crucial for identifying strategies to mitigate its effects. The sources of stress can be broadly categorized into personal, professional, and external factors, with each having its own set of challenges that entrepreneurs must navigate.

1. Personal Factors Contributing to Entrepreneurial Stress

Personal factors are often at the root of many of the challenges faced by entrepreneurs. These factors include psychological traits, personal circumstances, and individual expectations that either directly or indirectly contribute to stress.

- **Perfectionism and Self-Imposed Expectations**: One of the most significant personal sources of entrepreneurial stress is perfectionism. Many entrepreneurs set exceedingly high standards for themselves and their businesses, driven by the desire for success, recognition, or validation. This perfectionism can result in stress when entrepreneurs feel that their efforts are never enough, leading to dissatisfaction and frustration. The constant pursuit of perfection can cause decision paralysis, burnout, and feelings of inadequacy, as entrepreneurs struggle to meet their own expectations.
- **Self-Doubt and Fear of Failure**: Entrepreneurs often face the fear of failure, especially when their businesses are in their early stages or struggling to stay afloat. The weight of this fear can manifest as a lack of confidence, self-doubt, and anxiety. Entrepreneurs may constantly worry about making the wrong decisions, leading to inaction or over analysis, further exacerbating stress. Additionally, entrepreneurs may worry about their reputation, relationships, and financial security, which increases the overall sense of pressure.
- **Work-Life Imbalance**: The constant drive to succeed in business can interfere with an entrepreneur's personal life. The long hours, unpredictability of work schedules, and demands of managing a business can erode time spent with family, friends, and self-care activities. Entrepreneurs may feel torn between their work and personal lives, leading to stress and guilt. This work-life imbalance is a significant cause of emotional strain, as entrepreneurs often feel that they are neglecting personal relationships or their own health in the pursuit of business success.
- **Lack of emotional Resilience**: Entrepreneurs who lack emotional resilience may find themselves overwhelmed by setbacks, rejections, and challenges. Without effective emotional regulation strategies, entrepreneurs may struggle to manage the daily stresses of running a business.

2. Professional Factors Contributing to Entrepreneurial Stress

Professional factors encompass the day-to-day operational challenges that entrepreneurs face in managing their business activities. These stressors arise from the demands of running a business, handling finances, making strategic decisions, and dealing with employees and clients.

- **Financial Pressure**: One of the most significant stressors for entrepreneurs is the constant pressure to maintain cash flow and meet financial obligations. Entrepreneurs often invest their personal savings into their ventures and are responsible for securing funding, managing expenses, and keeping the business financially viable. The fear of running out of funds, not being able to pay employees or creditors, or failing to meet sales targets can lead to intense stress.
- **Decision-Making Overload**: Entrepreneurs are required to make numerous decisions each day, ranging from mundane operational tasks to major strategic choices that can affect the future of the business. Decision-making is an inherently stressful process, and the cumulative effect of constant decision-making can lead to cognitive overload and decision fatigue. Entrepreneurs may become overwhelmed by the sheer volume of decisions they need to make, resulting in procrastination, anxiety, or poor decision-making.
- **Uncertainty and Risk**: Entrepreneurs operate in environments filled with uncertainty and risk. The volatility of markets, changing consumer preferences, and external economic factors create an unpredictable business landscape. This uncertainty can be a significant source of stress, as entrepreneurs are often unsure about the future of their business or the success of their strategies. Entrepreneurs may experience anxiety when faced with risk, as they are responsible for determining the best course of action in the face of uncertainty, whether it's launching a new product, entering a new market, or scaling the business.
- **Human Resource Challenges**: Managing employees is another source of stress for entrepreneurs. Small business owners, in particular, often take on the responsibility of hiring, training, and managing a team. The pressure to maintain productivity, resolve conflicts, and ensure that employees are motivated and satisfied can be overwhelming. Additionally, the need to balance performance expectations with the well-being of employees can create emotional strain. When facing staff shortages, high turnover, or performance issues, entrepreneurs may feel stressed about meeting business goals while addressing human resource challenges.
- **Customer Expectations and Client Demands**: Entrepreneurs must constantly meet the expectations of their customers or clients, who often have high demands regarding product quality, service speed, and responsiveness. Dealing with customer complaints, ensuring satisfaction, and maintaining a positive brand reputation can be stressful. The pressure to meet these expectations, especially when dealing with difficult or demanding clients, can lead to stress and frustration.

3. External Factors Contributing to Entrepreneurial Stress

External factors are external pressures and challenges that entrepreneurs face, including societal, economic, and regulatory influences. These factors often lie beyond the control of the entrepreneur, yet they significantly contribute to stress levels.

- **Economic and Market Conditions**: The broader economic environment plays a major role in shaping the success or failure of a business. Economic downturns, inflation, changes in interest rates, and fluctuations in demand for products and services can all create external stressors. Entrepreneurs must continuously adapt to these changing conditions, which may require difficult decisions such as downsizing, restructuring, or changing the business model. In times of economic instability, entrepreneurs often face heightened stress due to the uncertainty surrounding their business's future.

- **Regulatory and Legal Challenges**: Entrepreneurs must comply with a range of regulations, including tax laws, labor laws, industry-specific rules, and international trade regulations. These legal and regulatory requirements can be complex, time-consuming, and costly. Failing to comply with regulations can result in penalties, legal disputes, or reputational damage causing stress.
- **Competition**: In nearly every industry, entrepreneurs face competition from other businesses, both large and small. The pressure to differentiate the business, attract customers, and stay ahead of competitors can be a constant source of stress.
- **Social Media and Public Perception**: In the age of social media, entrepreneurs are more visible than ever before. The public nature of their businesses, coupled with the constant scrutiny from customers, investors, and the media, can create stress. Entrepreneurs must be constantly vigilant about their online presence, ensuring that they maintain a positive reputation and address any public relations issues promptly. Negative feedback or criticism, whether from customers or the media, can be especially stressful for entrepreneurs trying to maintain their brand's image.
- **Family and Personal Expectations**: External pressures from family and friends can also contribute to entrepreneurial stress. Entrepreneurs often face expectations from loved ones to succeed, make money, or achieve recognition. This pressure can add to the emotional burden they already experience from their business. In some cases, family members may not fully understand the demands of entrepreneurship, leading to friction in personal relationships.

Consequences of stress

Stress is the most debilitating medical and social problem of the present century (Nurenberger, 1990). In fact, stress is unique in the category of diseases. It has no biological carrier, but it is psychosomatic in the true sense of the word psyche meaning mind and soma meaning body. Mehta (2007) says that very high per cent of diseases afflicting mankind are psychosomatic.

(a) Physiological symptoms of stress: Stress could create changes in metabolism, increase heart and breathing rates, increase blood pressure, bring on headaches and induce heart attacks.

(b) Psychological symptoms of stress: Entrepreneurial stress can cause dissatisfaction, tension, anxiety, irritability, boredom, procrastination, etc.

(c) Behavioural symptoms of stress:

- Changes in productivity
- Changes in eating habit
- Increased smoking or consumption of alcohol
- Rapid speech, fidgety, sleep disorder

Management of Entrepreneurial Stress

Entrepreneurial stress, a persistent and often overwhelming challenge faced by entrepreneurs, can significantly affect both the individual and the business. While stress is an inevitable part of the entrepreneurial journey, effective stress management strategies can help entrepreneurs cope with these pressures, maintain their mental and physical health, and ultimately succeed in their ventures. Managing stress requires a multifaceted approach, combining individual strategies, organizational solutions, and external support systems.

1. Individual Stress Management Strategies

Effective stress management begins at the individual level. Entrepreneurs can implement several personal techniques to reduce their stress levels, improve resilience, and enhance their overall well-being. These strategies aim to provide individuals with the tools to manage the pressures of entrepreneurship and maintain their productivity and focus.

A. Time Management and Prioritization

One of the most important strategies for managing entrepreneurial stress is effective time management. Entrepreneurs are often required to juggle numerous tasks and responsibilities, from day-to-day operations to long-term strategic planning. Without proper time management, this can lead to feelings of overwhelm, procrastination, and burnout.

- **Task Prioritization**: Entrepreneurs should prioritize their tasks based on urgency and importance. The Eisenhower Matrix, a tool that divides tasks into four categories (urgent, not urgent, important, and not important), can help entrepreneurs focus on what truly matters and avoid distractions. By identifying high-priority tasks, entrepreneurs can allocate their time more efficiently and reduce stress caused by feeling overwhelmed.
- **Delegation**: Delegating tasks to employees or outsourcing work to professionals can alleviate pressure on entrepreneurs. Many entrepreneurs take on too much work themselves, believing they need to oversee every aspect of the business. However, by delegating non-core tasks (such as accounting, social media management, or customer service), entrepreneurs can free up time for strategic decision-making and focus on the areas of the business that require their unique expertise.
- **Time Blocking**: Time blocking involves dedicating specific blocks of time to different tasks or activities. By scheduling specific times for meetings, work, and breaks, entrepreneurs can reduce distractions, enhance focus, and ensure they stay on track..

B. Mindfulness and Meditation

Mindfulness practices, including meditation, deep breathing exercises, and yoga, can be powerful tools for managing entrepreneurial stress. These practices help entrepreneurs stay grounded in the present moment, reduce anxiety, and enhance mental clarity.

- **Mindfulness Meditation**: Mindfulness meditation involves paying attention to the present moment without judgment. Research has shown that mindfulness can reduce stress, improve emotional regulation, and enhance cognitive performance. Regular mindfulness practice helps improve focus, reduce anxiety, and foster a sense of calm, even in the face of challenging circumstances.
- **Breathing Exercises**: Deep breathing exercises, such as diaphragmatic breathing or the 4-7-8 technique, can activate the parasympathetic nervous system, which helps to counter the body's stress response. Entrepreneurs can take short breaks during their workday to practice deep breathing, helping to reduce tension and refocus their energy.
- **Yoga**: Yoga is the way of life. Yogic meditation is the scientific and systematic process through which one can erase the deep rooted past impressions from the mind. It is the way of purification and sublimation of mind. Yoga and meditation can be much helpful in relieving the stress of a practitioner.

C. Physical Health Practices

Physical health plays a critical role in managing stress. Regular exercise, healthy eating, and proper sleep are fundamental to maintaining the energy levels and mental resilience necessary to cope with the demands of entrepreneurship.

- **Exercise**: Regular physical activity helps release endorphins, the body's natural mood boosters. Exercise is proven to reduce symptoms of anxiety and depression, both of which are common among entrepreneurs under stress. A simple exercise routine, such as walking, jogging, swimming, or strength training, can help entrepreneurs improve their mood, reduce stress, and boost energy levels. Exercise also improves cognitive function, making it easier for entrepreneurs to make sound decisions under pressure.
- **Sleep**: Entrepreneurs often sacrifice sleep to meet deadlines or work long hours. However, lack of sleep negatively affects decision-making, cognitive performance, and emotional regulation. Research has shown that adequate sleep is crucial for stress management, as it allows the body and mind to recover. Entrepreneurs should prioritize sleep by creating a healthy sleep routine and setting boundaries around work hours to ensure sufficient rest.
- **Nutrition**: A balanced diet plays an essential role in managing stress. Entrepreneurs should focus on a diet rich in fruits, vegetables, whole grains, lean proteins, and healthy fats to support their mental and physical health. Avoiding excessive caffeine, sugar, and processed foods can prevent energy crashes and mood swings that contribute to stress. Hydration is also important for maintaining focus and reducing fatigue.

2. Organizational Strategies for Stress Management

While individual strategies are crucial, organizations can also implement systems and processes that help reduce stress at the workplace. A supportive organizational culture, clear communication, and effective team management can help create an environment in which stress is minimized, and entrepreneurs can thrive.

A. Delegation and Team Building

Delegation is not only an individual stress management strategy but also an organizational one. As businesses grow, entrepreneurs must build a strong team to handle different aspects of the business. Having the right people in the right roles can significantly reduce stress by allowing the entrepreneur to focus on high-level tasks rather than micromanaging.

- **Hiring and Outsourcing**: Entrepreneurs should focus on hiring employees or outsourcing tasks to professionals who can manage specialized areas of the business. Having a reliable team in place reduces the burden on the entrepreneur, allowing them to focus on strategic decision-making. Outsourcing certain functions, such as marketing, accounting, or legal services, can provide the expertise needed without overwhelming the entrepreneur.
- **Effective Leadership**: As a leader, an entrepreneur's role is to provide direction, set goals, and motivate the team. Clear communication and setting realistic expectations are key to reducing workplace stress. When employees feel supported and clear on their roles, the overall workload is more manageable. Entrepreneurs should foster an open, collaborative culture where team members are encouraged to share ideas, ask for help, and address concerns before they escalate into problems.

B. Clear Goal Setting and Process Optimization

Setting clear, achievable goals and streamlining business processes can significantly reduce stress. By breaking down larger tasks into smaller, manageable steps, entrepreneurs can reduce the feeling of being overwhelmed and improve focus.

- **SMART Goals**: The SMART (Specific, Measurable, Achievable, Relevant, Time-bound) framework is a powerful tool for goal setting. Entrepreneurs should establish clear goals for both the short and long term, ensuring that each goal is measurable and achievable within a set timeframe. Regularly tracking progress towards these goals can help maintain motivation and prevent feelings of failure or inadequacy.
- **Process Automation**: The use of technology can help reduce stress by automating repetitive tasks. Entrepreneurs should explore tools and software that can automate functions such as invoicing, inventory management, customer relationship management (CRM), and social media marketing. Automating these processes can save time and reduce the mental load on entrepreneurs, allowing them to focus on strategic tasks.

3. External Support Systems for Stress Management

Entrepreneurs should not hesitate to seek support from external resources to manage stress effectively. Mentorship, networking, therapy, and counseling can provide valuable guidance, encouragement, and emotional relief.

A. Mentorship and Peer Support

- Mentorship is one of the most valuable resources for entrepreneurs under stress. Experienced mentors can provide advice, share personal experiences, and offer reassurance during difficult times. Knowing that someone has faced similar challenges and overcome them can help entrepreneurs feel more capable and less isolated in their journey.
- **Peer Networks**: Networking with other entrepreneurs can also provide a sense of community. Peer support groups or entrepreneurial associations can offer opportunities to share experiences, exchange coping strategies, and offer mutual encouragement. These networks help entrepreneurs realize they are not alone in facing challenges and provide a platform for collaboration and problem-solving.

B. Counseling and Therapy

Mental health professionals, such as therapists or counselors, can play a crucial role in helping entrepreneurs manage stress. Therapy provides a safe space for entrepreneurs to discuss their challenges, gain perspective, and develop coping strategies. Cognitive-behavioral therapy (CBT) and other forms of therapy have been shown to reduce stress and anxiety by helping individuals identify and change negative thought patterns. Entrepreneurs who invest in their mental health through counseling are more likely to maintain resilience and focus during stressful times.

Conclusion

Entrepreneurial stress arises from a combination of personal, professional, and external factors, each contributing to the pressures entrepreneurs face as they navigate the complexities of running a business. Personal factors such as perfectionism, self-doubt, and work-life imbalance set the stage for stress, while professional factors such as financial pressure, decision-making overload, and human resource challenges further exacerbate the situation. External factors like economic conditions, competition, and regulatory requirements add additional layers of complexity to the entrepreneurial experience. Understanding the sources of stress is the first step toward developing effective strategies to manage and reduce its impact, allowing entrepreneurs to thrive both personally and professionally.

Entrepreneurial stress is an unavoidable aspect of the entrepreneurial journey. However, by implementing a combination of individual, organizational, and external strategies, entrepreneurs can effectively manage and mitigate stress. From time management and mindfulness practices to building strong teams and seeking mentorship, there are numerous ways to reduce the negative impact of stress. By prioritizing stress management, entrepreneurs can safeguard their well-being, maintain their productivity, and ultimately increase the likelihood of success in their ventures. The key lies in recognizing the sources of stress and proactively implementing

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LP 4.1

Fueling the future: Hydrogen for a sustainable and cleaner World

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Abstract

Two major concerns worldwide at present include depleting resources and environmental pollution. Hydrogen is an ideal energy carrier which is considered for future transport, such as automotive applications. In this context, storage of hydrogen is a major obstacle in developing hydrogen economy. Several ways of storing hydrogen have been discussed in the paper. The relatively advanced storage methods such as high pressure gas or liquid cannot fulfill future storage goals. Chemical or physically combined storage of hydrogen in solid state form has potential advantages over other storage methods.

Keywords: Hydrogen energy, metal hydrides, complex hydrides, hydrogen storage, hydrogen economy

Introduction

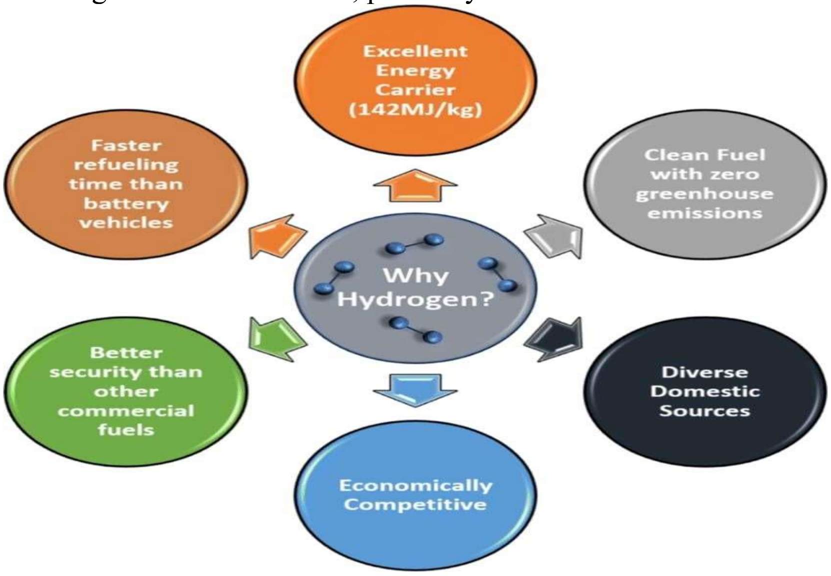
India's economy has been growing at an average growth rate of 8.8 per cent in the last four fiscal years (2003-04 to 2006- 07), with the 2006-07 growth rate of 9.6 per cent being the highest in the last 18 years. Resources are the backbone of every economy. Lack of access to energy hampers economic and social development in many regions and is an obstacle to the achievement of the social, environmental and economic progress worldwide. The energy is a vital ingredient for growth and sustainable development, and for the vast majority of economic activities.

No doubt energy demand has grown astonishingly in recent years with primary energy demand increasing by more than 50% since 1980. This growth is forecast to continue- at an annual average rate of 1.6% between 2008 and 2030. Over 70% of this growth rate is from developing countries [1]. Oil provides 35% of global energy consumption and more oil is used today than ever before. Demand for oil will continue to grow, primarily owing to rapid growth in vehicle ownership. Energy security concerns in the oil sector are increasing, owing to the issues of resource availability, supply security, political instability and infrastructure difficulties. Oil prices are expected to remain high.

The assessment report from the Intergovernmental Panel on Climate Change concludes that the globally averaged net effect of human activities since 1750 has contributed to global warming with a probability above 90% [2]. Furthermore, global warming is projected to continue in the future, its magnitude being strongly dependent on future emissions of greenhouse gases. Projections of the future supply and demand situation for oil shows increased dependency on oil imports [3]. The problem of global warming combined with the security of supply problems of oil faced by many countries has led to strong interest in renewable energy solutions:

Human activities result in emissions of four long-lived GHGs: CO_2, methane (CH_4), nitrous oxide (N_2O) and halocarbons (a group of gases containing fluorine, chlorine or bromine). The global atmospheric concentration of CO_2 increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005. The annual CO2 concentration growth rate was larger during the last 10 years (1995-2005 average: 1.9 ppm per year) than it has been since the beginning of continuous direct atmospheric measurements (1960-2005 average: 1.4 ppm per year), although there is year-to-year variability in growth rates. The global atmospheric concentration of CH_4 has increased from a pre-industrial value of about 715 ppb to 1732 ppb in the early 1990s, and was 1774 ppb in 2005. Growth rates have declined since the early 1990s, consistent with total emissions being nearly constant during this period. The global atmospheric

N_2O concentration increased from a pre-industrial value of about 270 ppb to 319 ppb in 2005. Many halocarbons (including hydro fluorocarbons) have increased from a near- zero pre-industrial background concentration, primarily due to human activities.



In the last 150 years' global average temperature has increased by 0.8°C. Out of the total energy consumption about 20-25% is utilized in transportation sector and it is the major contributor to CO_2 emissions.

Awareness of the disastrous consequences of environmental pollution and climate change is growing rapidly. Addressing these global concerns is dictating the need to reduce the present reliance on fossil fuels, and to increase the use of sustainable and environmental friendly energy alternatives. This is resulting in increased recognition for the significance of renewable energy for satisfying future energy demands.

There is an increasing consensus that hydrogen will replace fossil fuels as future energy carrier. The depleting and polluting fossil fuel makes it imperative to find renewable and clean 21st century fuel. Decades of R&D efforts have revealed that hydrogen is indeed such a fuel.

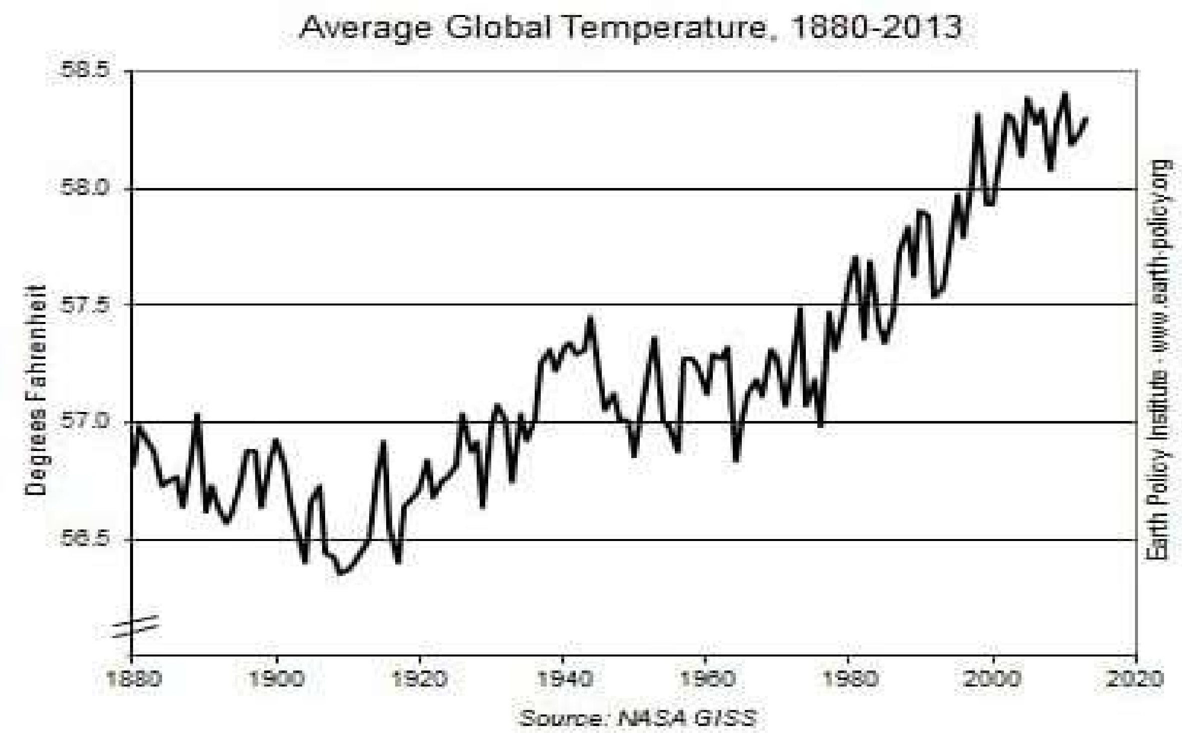
Hydrogen as an energy carrier

The major obstacle to the widespread use of hydrogen as a renewable fuel, especially on-board passenger vehicles, is hydrogen storage. Three options exist for storing hydrogen: as a highly compressed gas, a cryogenic liquid, or in a solid matrix. However, because hydrogen is the lightest element known, the gravimetric and volumetric densities of any storage system will necessarily be very low, especially compared to carbonaceous fuels.

Hydrogen is the most abundant element on Earth, but less than 1% is present as molecular hydrogen gas H_2. The overwhelming majority is chemically bound as H_2O in water and some is bound to liquid or gaseous hydrocarbons. The clean way to produce hydrogen from water is to use sunlight in combination with photovoltaic cells and water electrolysis. Other forms of primary energy and other water-splitting processes are also used: the hydrogen consumed today as a chemical raw material (about 521010 kg per year worldwide) is to a large extent produced using fossil fuels and the reaction of hydrocarbon chains ($-CH_2-$) with H_2O at high temperatures, which produces H_2 and CO_2. Direct thermal dissociation of H_2O requires temperatures higher than 2,000°C (>900 °C with a Pt/Ru catalyst).

The chemical energy per mass of hydrogen (142 MJ kg^1) is at least three times larger than that of other chemical fuels (for example, the equivalent value for liquid hydrocarbons is 47 MJ kg^1). Once produced, hydrogen is a clean synthetic fuel: when burnt with oxygen, the only exhaust gas is water vapor, but when burnt with air, lean mixtures have to be used to avoid the formation of nitrogen oxides. Whether hydrogen can be considered a clean form of energy on a global scale depends on the primary energy that is used to split water.

There are essentially two ways to run a road vehicle on hydrogen. In the first, hydrogen in an internal combustion engine is burnt rapidly with oxygen from air. The efficiency of the transformation from chemical to mechanical through thermal energy is limited by the Carnot efficiency and is slightly higher for hydrogen-air mixtures (around 25%) than for petrol-air mixtures. When a lean mixture is used, the exhaust gas contains nothing but water vapor; richer mixtures also produce NOx. In the second method, hydrogen is 'burnt' electrochemically with oxygen from air in a fuel cell, which produces electricity (and heat) and drives an electric engine. Here, the efficiency of the direct process of electron transfer from oxygen to hydrogen is not limited by the Carnot efficiency; it can reach 50-60%, twice as much as the thermal process.



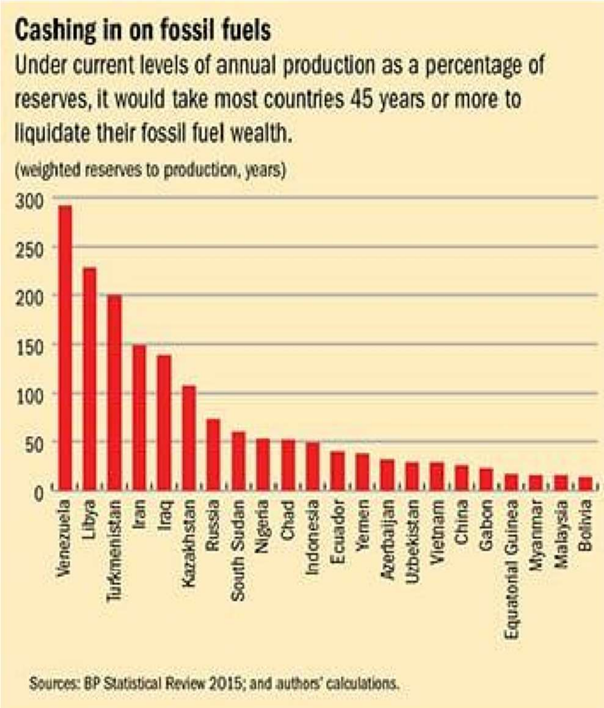
For on-board energy storage, vehicles need compact, light, safe and affordable containment. Hydrogen is an energy carrier, not a primary energy form. The storage cycle therefore involves both the production of hydrogen from primary energy sources and the retrieval of the energy form demanded by a second conversion process.

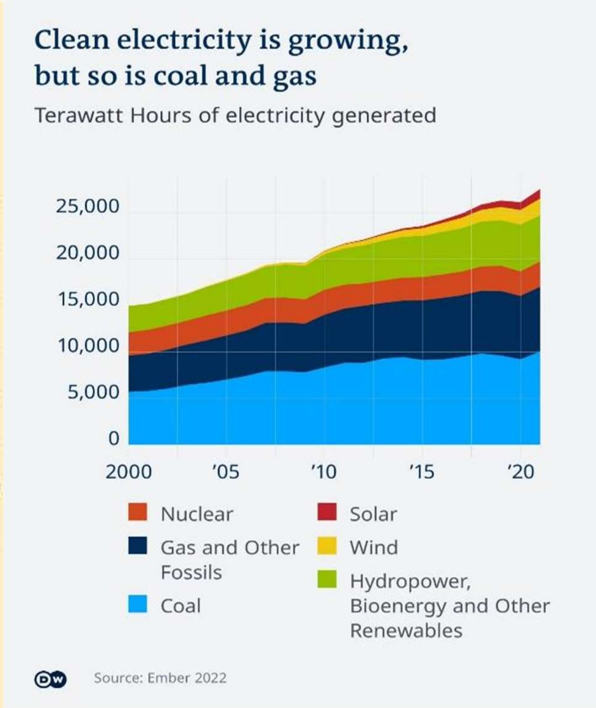
A). Hydrogen production

Conventional hydrogen production is by catalytic steam reforming of methane (natural gas) or gasoline with water vapor. The process which typically takes place at 850°C and 2.5 x 10^6 Pa, is

$C_nH_m + nH_20 \rightarrow nCO + (n+m/2)H_2$ Followed by the catalytic shift reaction $CO + H_2O \rightarrow CO_2 + H_2$ Finally, CO_2 is removed by absorption or membrane separation.

- Production of hydrogen from biomass may be achieved by biological fermentation or by high-temperature gasification similar to that of coal. Production of hydrogen from (wind- or solar produced) electricity may be achieved by conventional electrolysis or by reversible fuel cells, with current efficiencies of about 70% and over 90%, resp. [4]. Processing of the hydrogen produced involves removal of Sulphur, plus other impurities depending on the source material (e.g. CO_2 if biogas is the source).





B.) Hydrogen Storage Forms:

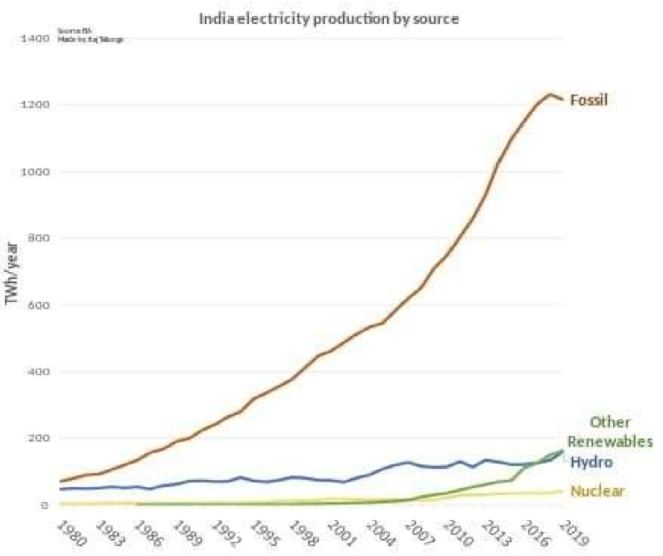
Thus, the major obstacle in transition towards hydrogen economy is the absence of practical means of hydrogen storage.

C). Compressed storage in gaseous form

The low volume density of hydrogen at ambient pressure makes compression necessary for energy storage applications. Commercial hydrogen cylinders presently use pressures of 20-30MPa, with corresponding energy densities of 1900- 2700 MJm^3, which is still less than 10% of that of oil. With the development of novel high pressure tanks made of carbon reinforced composite materials with hydrogen tested up to 60MPa. These high pressure containers when full would contain about 4% hydrogen by mass, but with significant disadvantages: the fuel would be available at a pressure dropping from say 45MPa to zero. High pressure vessels present a considerable risk, while the compression itself is complicated and not safe.

D). Liquid hydrogen storage

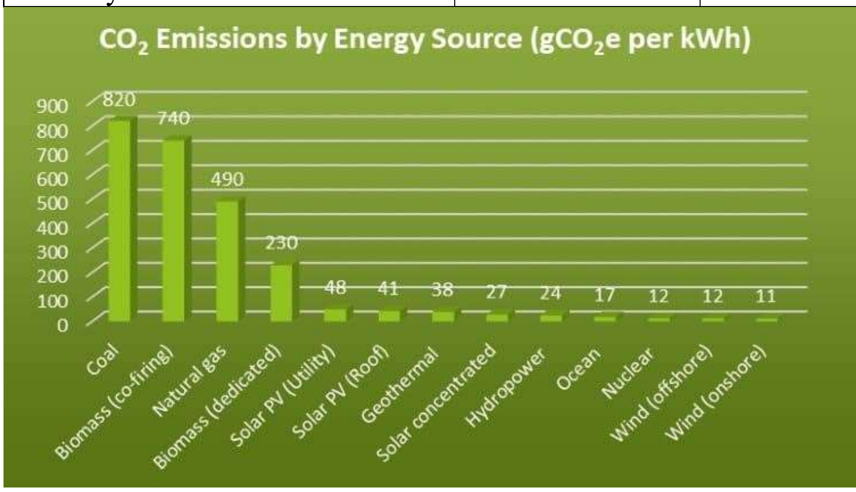
Condensation into liquid or even solid hydrogen is, particularly attractive from the point of view of increasing the mass per container volume. The density of liquid hydrogen is 70.8 kg m^3 (70.6 kg /m^3 for solid hydrogen). But the condensation temperature of hydrogen at 1 bar is -252°C and the vaporization enthalpy at the boiling point amounts to 452 kJ/kg. As the critical temperature of hydrogen is -241°C (above this temperature hydrogen is gaseous), heat transfer through the container leads directly to the loss of hydrogen. Larger containers have a smaller surface to volume ratio than small containers, so the loss of hydrogen is smaller. Thus liquid hydrogen requires the addition of a refrigeration unit to maintain a cryogenic state thus adding weight and energy costs, and a resultant of 40% loss in energy content.



Electricity production by sources

Table 1: Physical and chemical properties of hydrogen, methane and petrol

Properties	Hydrogen	Methane	Petrol
Lower heating Value (kWh/kg)	33.33	13.9	12.4
Self-ignition temperature (ºC)	585	540	228-501
Flame temperature (ºC)	2.045	1875	2,200
Ignition limits in air (Vol%)	4-75	5.3-15	1.0-7.6
Minimal ignition energy (mWs)	0.02	0.29	0.24
Flame propagation in air (m/s)	2.65	0.4	0.4
Diffusion coefficient in air (cm^2s^{-1})	0.61	0.16	0.05
Toxicity	No	No	High



CO2 Emissions by energy Source (g CO2e / kW

E). Solid State Storage

Chemically or physically combined storage of hydrogen in other materials has potential advantages over other storage methods. Storage by absorption as chemical compounds or by adsorption on carbon materials have definite advantages from the safety perspective such that some form of conversion or energy input is required to release the hydrogen for use. A great deal of effort has been made on new hydrogen-storage systems, including metal, chemical or complex hydrides and carbon nanostructures. Carbon materials such as activated carbons, carbon nanotubes, and carbon nanofibers have been the subject of intensive research. The hydrogen-storage capacity for carbon materials is reported between 0.2 and 10 wt.%. The experiments to date claiming very high values could not independently be reproduced in different laboratories. In view of today's knowledge although they have good reversibility properties, carbon nanostructures cannot store the amount of hydrogen required for automotive applications.

Hydrogen forms metal hydrides with some metals and alloys leading to solid-state storage under moderate temperature and pressure that gives them the important safety advantage over the gas and liquid storage methods. Metal hydrides have higher hydrogen-storage density (6.5 Haltom's/cm³ for MgH_2) than hydrogen gas (0.99 Haltom's/cm³) or liquid hydrogen (4.2 Haltom's/cm³) [5]. Hence, metal hydride storage is a safe, volume-efficient storage method for on-board vehicle applications. The reaction involved is:

$M + x/2H_2 \leftarrow\!\text{-}\!\rightarrow MH_x$

where M represents the metal.

Metal hydrides compose of metal atoms that constitute a host lattice and hydrogen atoms. Metal and hydrogen usually form two different kinds of hydrides, α phase at which only some hydrogen is absorbed and β phase at which hydride is fully formed. Hydrogen storage in metal hydrides depends on different parameters and consists of several mechanistic steps. Metals differ in the ability to dissociate hydrogen, this ability being dependent on surface structure, morphology and purity. The light metals such as Li, Be, Na, Mg, B and Al, form a large variety of metal-hydrogen compounds. They are especially interesting due to their light weight and the number of hydrogen atoms per metal atom, which is in many cases are of the order of H/M = 2. Heavier ones may enter the multiple component system only as a low abundant additive, most likely for alteration of properties or as a catalyst. There is enduring research both on modifying and optimizing the known hydrogen-storage materials, and new resources.

There is considerable research on magnesium and its alloys for on-board hydrogen storage due to their high hydrogen storage capacity by weight and low cost [6]. Besides, the Mg based hydrides possess good-quality functional properties, such as heat-resistance, vibration absorbing, reversibility and recyclability. Magnesium hydride, MgH_2, has the highest energy density (9 MJ/kg Mg) of all reversible hydrides applicable for hydrogen storage. MgH_2 combines a high H_2 capacity of 7.7 wt.% with the benefit of the low cost of the abundantly available magnesium with good reversibility [7,8]. The main disadvantages of MgH_2 as a hydrogen store is the high temperature of hydrogen discharge, slow desorption kinetics and a high reactivity toward air and oxygen. High thermodynamic stability of MgH_2 results in a relatively high desorption enthalpy, which corresponds to an unfavorable desorption temperature of 300°C at 1bar H_2.

The different families of intermetallic compounds classified on the basis of their crystal structures, such as AB_2 type (Laves phase), AB_5, type phases and Ti-based body centered cubic, BCC, alloys are well known as hydrogen-storage materials. Intermetallic compounds are often obtained by combining an element forming a stable hydride with an element forming a no stable hydride. As for the metallic hydrides, the dissociative chemisorption's of hydrogen is followed by hydrogen diffusion into the interstitial sites. Among the AB, type alloys, $LaNi_5$ absorbs about 1.0 H/$LaNi_5$(1.5 wt.%), however, its cost is relatively high and the plateau pressure is low. The P-C-T diagram shows a flat plateau, low hysteresis, but unfortunately the hydrogen capacity is degraded after a few cycles. Therefore, these materials are still far from meeting the US DOE goal of 6.5 wt% reversible hydrogen capacity.

The AB_2 type compounds are derived from the Laves phases crystal structures. The potential AB_2 types are obtained with Ti and Zr on the A site. The B elements are represented mainly by different combinations of 3d atoms, V, Cr, Mn and Fe. The hydrogen-storage capacity can reach up to 2 wt.% in Laves Phase V-7.4%Zr-7.4% Ti-7.4%Ni [9]. The Laves phase series of compounds has attracted large attention in the last decade due to their good hydrogen-storage capacity. Most of Laves phases show relatively high capacities faster kinetics, longer life and a relatively low cost in comparison to the LaNis related systems. However, their hydrides are too stable at room temperature.

Table No. 2: Possible Storage Forms of Hydrogen

Storage Form	Advantages	Disadvantages
Compressed Gas	Reliable Indefinite storage Time Easy to Use	High Capital and Operating Cost Heat can cause container rupture
Liquid	High density at low Pressure	High Cost Low temperature needed Escape can cause fire or asphyxiation
Metal Hydride	High Volume Efficiencies Easy Recovery Very safe	Expensive Materials Heavy storage Tank

FeTi is a well-known hydrogen-storage compound with a total hydrogen capacity of around 1.90 wt.% with inexpensive elements. Hydrogen capacity of FeTi can be accomplished to 1.90 wt.% by the catalytic effect of 1 wt.% Pd addition [10]. However, the activation process of FeTi is troublesome due to the formation of titanium oxide layer. Both high-pressure and high temperature are required to achieve a reproducible absorption/desorption of the maximum amount of hydrogen in the compound [11].

Another class of light-weight storage materials is complex hydrides. Complex hydrides are known as "one-pass" hydrogen-storage systems which mean that H_2 evolves upon contact with water. Sodium, lithium and beryllium are the only elements lighter than magnesium that can also form solid-state compounds with hydrogen. The hydrogen content reaches the value of 18 wt.% for LiBH4. Use of complex hydrides for hydrogen storage is challenging because of both kinetic and thermodynamic limitations.

Intense interest has developed in low weight complex hydrides such as atlantes [AlH4], amides [NH2], imides and borohydrides [BH_4]. In such systems, the hydrogen is often located at the corners of a tetrahedron. The atlantes and borates are especially interesting because of their light weight and the capacity for large number of hydrogen atoms per metal atom. Borates are known to be stable and decompose only at elevated temperatures. Alanates are remarkable due to their high storage capacities; however, they decompose in two steps upon dehydrating.

Conclusion

Hydrogen storage is a key issue in the success and realization of hydrogen technology and economy. According to US-DOE, the hydrogen storage capacity target for commercialization is 6.5 wt.% at the decomposition temperature between 60° and 120°C with high cycle life. Need is for better hydrogen storage materials as well as technological improvements in vehicle design and system integration along with the cost efficiency. Thus to develop a sustainable future energy policy requires a focused progress on the scientific and technological challenge. Other than that there is a strong need of the adaptations of the socioeconomic system and a change in attitudes to energy. Sustainability and humanity will profit if the price paid for energy includes costs of long term production, transport, and distribution of energy, materials, and restoration of the damaged environment.

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LP 4.2

Investments in capacity edifice & mentorship for exploring the extension professionals towards *Viksit Bharat*

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Abstract

Values or what we value in our life determine the way we live, as they play an important role in prioritization of our interests in decision making. The agricultural sector is under increasing pressure to bridge a growing concern for hunger and economic deprivation. At the centre of discussion is increase in agricultural productivity at a scale increasingly complex. This complexity challenges the capacity of all - extension workers, farmers, farming systems and even the environment. This means that what matters for agricultural development and achieving the above situation is the capability of people to be effective and productive economic agents. It is here that capacity building comes in. Therefore, building and strengthening organizational and institutional capacity is seen as the heart of development practice. There is hardly anybody who is a fully-fledged adviser having completed a technical school, college or university course. The work of an extension worker demands the particular values of dedication, humility and hard work. Extension administrators should ensure that extension workers are thoroughly prepared with various dimensions of before they begin the activities. The work of extension professionals requires in-depth knowledge of the processes of effective formal and informal education and the subject matter discipline in which he / she specializes. The extension policy makers seem to continue with an intuition that “All Is Well” & to justify this, improvements in any discipline, continued focus on research and quest for advancement are necessary. Extension research differs significantly from other social science research in terms of its content and methods.

Introduction

Capacity Building can be defined as "activities which strengthen the knowledge, abilities, skills and behavior of individuals and improve institutional structures and processes such that the organization can efficiently meet its mission and goals in a sustainable way. Training is one of the essential components of capacity building. Capacity building is a process of building capabilities in individuals, groups, institutions, organizations and societies at the local, national and international level to more effectively prepare for and respond to developments in the field of agriculture and allied aspects in a sustainable manner. It has no flat parameter to judge exactly but it roughly it can be measured in terms of “performance”. Where we can equate the term Performance = f [(Knowledge) (Attitude) (Skill)]. It depends on function of knowledge, attitude & skill about task.

Extension education basically deals with bringing about desirable changes in the behavior of human beings, through various strategies and programs, focusing more on education and information exchange. It is educational in content and purposive in approach. Its main aim is to assist rural communities in gaining a livelihood, improve the level of living (both physical and psychological), and foster welfare. The success of the extension process requires an atmosphere of mutual trust, helpfulness and respect on the part of both extension workers and rural people. This calls for a great deal of understanding on the part of extension workers, which is possible only when they possess sound knowledge of the subject. To successfully achieve this core objective of extension education, the teachers in extension education must be proficient enough, not only to teach but also to attract and orient people towards making them competent extension professionals. The discipline of extension education largely draws subject matter, methods and tools from various areas of social science, such as: sociology, psychology, anthropology, administration, communication etc. It is an independent, fully fledged discipline like any other discipline in agriculture, veterinary sciences, fisheries & home sciences such as agronomy, entomology, agricultural economics, veterinary medicine, human nutrition.

There is increasing evidence and recognition that what matters for development, more than natural resources and man-made physical capital, is the capability of people to be effective and productive economic agents, in short, human capital. It is noted that many dimensions of the human resources development issue are final end-objectives of development, e.g. literacy, betterhealth and nutrition, etc. Although this is concerned with policies to upgrade the quality of people to become more productive and more energetic economic agents, the need to make progress in literacy, health, nutrition, etc., as objectives in their own right, should not be lost sight of. This is important, since it implies that evaluation of returns to investment in these areas must take into account the value of improvements in literacy, as increasing the welfare of individuals directly and not only indirectly through making them more productive economically. These considerations can influence the criteria for making decisions concerning the allocation of scarce resources, e.g. between promoting basic education versus creation of more directly productive values to acquire agricultural extension skills.

Why Values are Important for Extension Professionals….?

In the case of public servants, it is becoming increasingly difficult to maintain moral standards and human values in the conduct of public affairs. This is because of the glamour the society is attaching to material prosperity. Although it is the responsibility of the government to provide a clean administration by inculcating ethics and human values in administration, it hasn't been able to do so in several cases (Sukhwinder, 2012).

Values are important in all walks of life irrespective of the profession and position in the hierarchy. "These values communicate 'what we stand for' and 'what is important to us' then the value is the soul of the organization" (Hitt, 1988). One sign of a healthy, productive organization is agreement between the organization's values and the daily behaviors of its members. This behavior is determined both by individuals' personal experiences as well as their experiences in a specific profession. All professions develop their own self-image based on their member's attitudes, and an external image that depends on how they are seen by non-members. Neither can be considered without referring to moral and ethical questions.

Values and attitudes such as faith in rural people, commitment to agricultural development, and concern for the whole community are important for all extension personnel. Although some of the old Agricultural Extension scripts do mention about some of these values as commandments for extension professionals, these are either ignored or not given the prominence they deserve. In the United States of America, Epsilon Sigma Phi (ESP), an independent not-for-profit organization of extension professionals has developed a creed for extension professionals.

Extension Professionals' Creed -

In this context extension professionals should self-assured about -

- I believe in people and their hopes, their aspirations, and their faith; in their right to make their own plans and arrive at their own decisions; in their ability and power to enlarge their lives and plan for the happiness of those they love.
- I believe that education, of which Extension is an essential part, is basic in stimulating individual initiative, self determination, and leadership; that these are the keys to democracy and that people when given facts they understand, will act not only in their self- interest, but also in the interest of society.
- I believe that education is a lifelong process and the greatest university is the home; that my success as a teacher is proportional to those qualities of mind and spirit that give me welcome entrance to the homes of the families I serve.
- I believe in intellectual freedom to search for and present the truth without bias and with courteous tolerance toward the views of others.
- I believe that Extension is a link between the people and the ever-changing discoveries in the laboratories.
- I believe in the public institutions of which I am a part.
- I believe in my own work and in the opportunity I have to make my life useful to humanity.

Efforts for Value Education –

Values in School / College Curriculum:

Although values are very important in building a healthy and peaceful society, enough attention has not been paid to inculcate values among students. The fact that moral science which speaks of moral values are taught in the schools only up to 9th standard, reflects upon the importance we have been giving to values. New Education Policy tends to modify this context.

IGNOU's Programme on Value Education:

IGNOU has embarked upon a certificate programme to inculcate values among all those associated with education under distance education mode. CPVE is a six months certificate programme designed to inculcate the importance of value education in teaching learning process among teachers, teacher educators, graduates, NGO'S and professionals from the corporate and other sectors.

MANAGE:

National Institute of Agricultural Extension Management, (MANAGE) Hyderabad has started organizing a four day training programme on 'Work Ethics for Development Personnel'. This programme delves on ethics in Public service, understanding and maintaining ethical values in the Public sector, how to developing strong work ethics, how to improve employee work ethics, etc.

Competence Development through Education and Capacity Development -

While the concept of capacity development through technical cooperation is much hyped in the international development literature, including agricultural extension, this body of literature fails to make a connection with the literature on competence development. To address this gap, we argue for a need to differentiate technological competence from other types of competence, and suggest that while the focus on input and output indicators of innovation are relevant to assess technological innovation competence development, outcome indicators of innovation, such as measures of positive changes in habits and practices, would better serve the purpose of assessing and developing organizational and institutional learning and innovation competence.

Learning & Innovation Competence Development Framework

Crossing the conventional boundaries of competence development and capacity development serves as a way to renew the role of education within the innovation systems thinking. However, such an attempt to enhance human capabilities and functioning through education should focus on transformation at the systems level. Thus our research demonstrates the value of crossing the conventional boundaries of the two seemingly unrelated fields — competence development through education and capacity development through extension – to provide new directions to operationalize innovation systems thinking in agricultural education and extension.

Needed Areas of Competence for Extension Workers -

Communication: The extension worker must be able to convey agricultural information to all categories of farmers rich and poor, learned and illiterate, as well as possess the disposition to mildly persuade them to adopt innovations.

Farming: The change agent must be able to demonstrate new technologies to the farmers even if involves physical work and practice.

Science: The ability to read and understand professional literature as well as the ability to carry out field experiments is needful assets for the extension worker.

Economics: The change agent must be able to analyze and recommend cost-benefit strategies based on knowledge of prevailing market situations, agricultural policies, availability of credit, cost-benefit ratio, interests, etc.

Social: The extension worker must be familiar with the customs, values and ways of thinking of the farming population as to work in tandem with the realities of the people and thus avoid socio-cultural conflict.

According to Byrne, the extension worker must possess the basic disposition and attitude (congruency, empathy and appreciation), content competence (credible and knowledgeable in the subject matter), methodological competence (must know how to use specific communication techniques, appropriate media and communication aids) and managerial and organizational competence (able work within the framework of facilitation and guidance) Information Communication Technologies (ICTs) is improving and changing how extension work is carried out. The use of electronic media for extension teaching can assist extension agents reach their clientele across different location with agricultural information. Entrepreneur extension agents can record and produce videos in local dialects with local farmers featuring in the videos thereby making it easier for farmers to understand. Farmers on their own can identify the practices as authentic and replicable in their context and package same in Double Video / Compact Disc or uploaded online for farmers and other users of agricultural information achieve these and other uses of ICTs, capacity is therefore needed in computer multimedia production, video production, E-journalism, photo journalism, etc, in order to bring the earlier barriers of research information dissemination through electronic media collapsing. Gender mainstreaming in extension, entertainment education for extension work, climate change, among other evolving issues in extension also offer need dimensions to capacity building in extension.

Why Capacity Building Is Important For Rural Extension -

Building the capacity of rural extension staff is central to making extension services effective in helping poor farmers. However extension capacity building is often overlooked in the rush to get the results of research and development products out the door and taken up by rural communities. Public and private agricultural extension plays a major role in the capacity building of rural people. Their mandate is to facilitate farmer learning and decision making regarding changes to farming systems including trying out of new technology and overcoming problems such as food security, poverty reduction, environmental management and marketing of products. However, extension services often have some weaknesses such as lack of timely information and input supply, less accountability of public extension personnel, the blanket nature of recommendations, and the absence of extension personnel during office hours, which make clientele, become less committed to the service.

Building the capacity of rural extension staff is important because they can help poor farmers. Extension is concerned with building capacity for change through improved communication and information flow between industry, agency and community stakeholders. Dwarakinath explained that extension is a major vehicle for rural development because it transfers new technical knowledge to farmers and then farmers can feedback problems from the field to extension staff and researchers to consider. There is a need for a capacity building role for extension that includes farmer training but that also includes strengthening the innovation process and building linkages between farmers and other agencies to support the bargaining position of farmers.

Karbasioun, Biemans & Mulder found that information sources such as governmental extension agents and farmers' own experiences are the most important information for farmers. Van Linh and Martinez believed that "capacity building opportunities should focus on young people who are not burdened with administrative or other duties and have more time to drive developments from the bottom up." Supporting younger extension staff that has just finished Agriculture Colleges and Universities is necessary because young extensionists will run extension in the future; however, not all young people are suited to extension roles, as they depend on personality and commitment.

Capacity building methods used for extension professionals -

Capacity building methods may include conferences, workshops, consultations, study tours, participatory research and extension, demonstration plots, coaching, on-the-job training, cross visits, staff meetings, mentoring, farmer field schools, on-site training, using the internet for formal study. Providing formal and informal training, on-the-job training, workshop/meeting, seminars and conferences, cross visits/study tours are the main methods to build the capacity of extension staff to guarantee a good mix of theory and practice. Workshops.

Harnessing MOOCs for Large Scale Capacity Development -

The MOOC (Massive Open Online Course) is a recent development in the area of technology mediated learning. It is, in its fundamentals, an internet technology. It combines a host of online content management techniques with a host of workflows, and further provides components of social networking. An important advantage of the MOOC is its scale: a single course offering can be availed with the course duration by literally hundreds of thousands of people. With the MOOC, a handful of people- the instructor and a group of teaching assistants - can offer a course to thousands of learners in a single offering. The media coverage and scholarly analysis tend to create a broad view that MOOCs are branded services, requiring elite research universities and venture capital-driven Internet companies to organize and offer them. Secondly, these analyses have tended to look at the MOOC as a development affecting only the Higher Education sector, that too, only in North America. However, MOOC has huge potential in other sectors too.

Thrust areas of knowledge and skills for extension professionals are -

Knowledge of extension methods, subject matter knowledge, communication skills, technological proficiency, demonstration ability, organizational control, technical expertise, training approaches, diagnostic handiness, acquiring competency, line of command, inclusive loom & bottom up consideration for grass root level improvement of rural community as whole.

Conclusion and recommendation

The needs of farmers are constantly changing with time and farmers' socio-economic attributes. The implication of this is that extension needs to periodically upgrade in knowledge, skills and attitudes in order to keep pace with the emerging challenges and dynamics of extension work. Capacity building is essential in ensuring that the initial extension job training is provided as well as ensuring coping to the job changes and the varied needs of the clients. The overhead cost and demands of follow-up session should be embedded in the training programme such that the same training facilitators are engaged to carry out the follow-up session in order to ensure stability and continuity.

Funding of extension training programmes by the government, organizations intervention agencies & private extension organizations should be made adequate & steady.

Existing training facilities across institutions and centers teaching extension should be upgraded and seemingly nonexistent ones, such as audio-visual studios should be setup to create adequate environment where materials and tools used to reinforce or facilitate extension teachings are found.

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LP 4.3

Strengthening Farmer-Market Linkages: Issues, approaches and implications for extension professionals

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Abstract

Economic development, urbanisation, liberal trade policies and consumer requirements of safe and quality food has led to increased opportunities in agricultural sector. Farmers are expected to respond to these opportunities by shifting their focus from production oriented to market oriented agriculture. Despite significant progress in production of various agri-commodities, the farmers' income remains low owing to market imperfections and infrastructure bottlenecks in agricultural marketing and supply chains. Market linkages in agriculture play an important role in the progress of the farmers. With the changing business and policy environment, various approaches and interventions facilitating linkage of farmer with market have emerged such as Cooperatives, direct marketing, organised retailing, contract faming, export-oriented marketing, FPO's, E-marketing etc. Extension workers can adopt any of these strategies to mobilise farmers to leverage market opportunities. Effective development of market linkages for farmers hinges on a multifaceted approach that combines knowledge, strategy, and support from extension services. Fostering collaboration, utilizing technology, and strengthening farmer organizations are key to building sustainable market connections. By addressing farmers' unique needs and promoting value chain development and integration, these linkages can drive long-term success and support farmers in becoming self-sufficient and competitive in the marketplace.

Keywords: Market linkage, farmers, extension, strategies

Introduction

The changes experienced in the economy and agricultural sectors have made marketing important for overall development of the agriculture and welfare of the farmers. Due to the technological breakthrough, the marketable surplus of crops has become more visible in recent years leading to the requirement to follow a market-oriented approach to agriculture. Diversification towards high value horticultural crops which are perishable in nature which require proper handling to maintain their quality all through the food supply chain till it reaches the final consumer. Economic development, urbanisation, liberal trade policies and consumer requirements of safe and quality food has led to increased opportunities in agricultural sector. Farmers are expected to respond to these increased opportunities by shifting their focus from production oriented to market oriented agriculture to increase their income. Small and marginal farmers play a key role in meeting the food requirements of the growing population. The earning potential of such smallholders can be greatly improved by adopting a market-oriented approach.

Majority of agricultural marketing in India takes place through traditional spot markets. Marketing of agricultural produce is serviced through a network of regulated wholesale markets (APMCs). The regulated marketing system revolves primality around wholesale physical markets to facilitate mainly buying and selling of agri-commodities. In some of the markets some of the functions like storage but it is confined to only a limited number of markets. Despite significant progress in production of various agri-commodities, the farmers' income remains subdued owing to market imperfections and deficiency of infrastructure in agricultural supply chains. These predominantly unorganized markets with limited infrastructure cannot meet the quality requirements and specifications of changing demand and this has increased the need for establishing alternative market linkages for agricultural products. In order to overcome these limitations, government has introduced a number of policy initiatives to help evolve an integrated marketing system not only in-terms of physical markets but also in terms of various marketing functions like storage, banking and assaying.

Issues in Agricultural Markets

Farmers and other stakeholders face several issues in marketing of farm produce in these traditional wholesale markets and mandies. Some of them are as below:

- Lack of proper storage facilities – Lack of proper storage facilities leads to post-harvest losses and compels the farmers to sell the produce at low price as it cannot be retained until the availability of right price in the market The Government has taken various initiatives to promote e-NWR negotiable warehouse receipt, pledge finance and warehouses to operate as market yard. However, there is need to create awareness among farmers and other stakeholders to avail the benefits to facilitate adoption of these changes.
- Inadequate transportation facilities –There is an increase in farm produce wastage because of inadequate transportation facilities. Government introduced application like Kissan Rath during Covid to improve the availability of transportation facilities in rural areas.
- Lack of awareness on standardization and grading – The absence of grading and standardization of agricultural produce at farm level makes it difficult to fix the price for farm produce and farmers receive average prices even for the quality produce.
- Lack of market Information – Farmers need information to make decision at each stage of production and marketing. Farmer need market related information like price and arrival, quality standards, buyers, market fee etc. however farmers have limited access to market information which limits their capacity to bargain and avail better prices. Though many initiatives under public and private sector like Agmarknet , IFFCO Kisan Sanchar, etc have been introduced yet it is a challenge to provide real time market information to farmers in a user friendly manner.
- Lack of credit – Farmers adoption of technologies and improved inputs and practices is influenced by the availability of funds. Many times, farmers are compelled for distress sale of their produce for need of money. There is need for farmers to be linked with institutional credit. There is need to create awareness among farmers and other stakeholders on measures like NWR and eNWR to promote pledge finance so that farmers are not compelled to sell their produce immediately after harvest at low price.
- Long chain of intermediaries –The presence of long chain of intermediaries lead to inefficiency in the system and unfavourable prices at both the ends, i.e. producer and consumer. Monopoly and political clouting of agents and traders in Mandis leads to lack of transparency in auctions as well as absence of real-time, truthful market information. Long marketing chains result in substantial value and physical loss.
- Small land holdings- More than 85 percent of the farmers are small and marginal leading to low marketable surplus at individual farmer level as well as issues in achieving economies of scale.
- Variability in quality: Business processes in Mandis and APMC’s are generally insensitive to perishable nature of fresh produce. Buyers like exporters, processors and

retailers do not get desired quality and quantity for their business. Maintaining traceability which is an important requirement for export markets is also quite difficult.

- Huge Post harvest losses: India stores only two per cent of its horticulture products in temperature-controlled conditions, as compared to China (15 per cent) and Europe and North America (85 per cent). Adequate cold storage facilities are available for just about 10 per cent of India's horticulture production. Food and Agriculture Organization (FAO) of the United Nations, state that 1.3 billion tonnes of food loss and waste takes place globally with the highest share in case of fruits, vegetables and tuber crops. As per study by CIPHET in 2015, Harvest & Post Harvest losses including losses during storage for fruits and vegetables were in the range of 5% to 16%.

The net result of all these issues in marketing and supply chain is much lower realization of income by the farmer.

Market Linkage Approaches and Strategies

With the changing business and policy environment various approaches and interventions facilitating linkage of farmer with market have emerged. Linkage of farmers to markets needs either the "top-down" strategy, which involves identifying demand in the market and then seeking farmers or farmers group to satisfy it or the "bottom-up" strategy involving identification of farmers/ farmers group to work with and then finding suitable market that they can be linked to for supplying the produce. They may be selected depending on the needs of individual farmers or farmer groups. Extension workers need to adopt any of these approaches to mobilise farmers to leverage market opportunities. Various types of market linkage strategies that may be utilised by extension workers for mobilising farmers are discussed as below:

Cooperative Marketing

Cooperative Marketing helps in lowering transaction costs in marketing and purchase of inputs and increasing bargaining strength. This helps in aggregation of market surpluses and value addition and development of forward linkages with exporters/Suppliers/Processors/future market. It also facilitates access to technical services and credit and can help in managing and owning marketing /processing facilities.

Some Horticultural Cooperatives such as Mahagrapes in Maharashtra is a partnership firm of sixteen grape growers' co-operatives and exports its members produce in international markets. It acts as facilitator, quality controller, input supplier as well as service provider to its member societies. Mahagrapes exports its member societies produce. It negotiates for better prices and arranges the logistics for its members. Mahagrapes does not buy or sell but just facilitates the export. It has an excellent traceability system, so that everyone gets paid as per the quality.

HOPCOMS in Karnataka, Valsad Jilla Fal Ane Shakbhaji Sahakari Sangh Limited in South Gujarat, Co-operatives marketing banana in Jalgaon district and various Vegetables co-operatives in Gujarat are some successful examples of cooperatives in horticultural sector.

Farmer Producer Organizations

The FPC registered under Company Act allows the farmer cooperatives to function as a corporate entity. The objective of the FPC is related to the production, harvesting, procurement, grading, handling and marketing of primary produce. The FPC provides a direct network for the marketing of food products and helps in sustaining agricultural value chain. It is an effective approach through collective action.

Sahyadri Farmer Producer Company is an example of 100% Farmer owned and operated Company based in Nashik, Maharashtra formed in 2011 to find solutions to the problems of small and marginal farmers and to make farming a profitable venture with sustainable development. Today they are impacting more than 18,000 registered farmers covering 31,000 acres and 9 crops. Sahyadri Farms is India's largest grapes exporter company providing integrated value chains to agriculture. Besides 18 exquisite varieties of table grapes, its farmers also grow tomato, pomegranate, banana, sweet corn, mango, orange, sweet lime and cashew. Their technology-led interventions ensure reduced production costs and improved fresh produce quality led to better rates to farmers. Their global consumers also benefit from hygienic, healthier and residue-free fruits and vegetables. They use the latest technologies to reinvent, democratize and optimize the supply chain. They are acting as a single-point destination offering many agri-products and services useful to farmers such as farm machinery, agri inputs, infrastructure and processing facilities with globally accepted certifications and quality.

Direct Marketing

Direct marketing by farmers is being encouraged as an innovative channel. These channels are mostly adopted in sales transactions of fruits, vegetables and flowers, which are highly perishable. In this channel, the produce moves quickly from farmers to consumer due to lack of middlemen. If farmers directly sell their produce to the consumers, it will not only save losses but may also increase farmers' share in the price paid by the consumer. Hadaspar Mandi in Pune, Rythu Bazars in A.P., Uzhavar Sandies in Tamilnadu , Krushak Baazars in Odisha and Apni Mandi in Punjab are examples of Farmers market facilitating direct marketing of farmers produce.

Export oriented Supply chain and marketing

Export of major horticulture produce from India has recorded a rising trend in the last decade. Success in table grapes, mangoes and floriculture, pomegranate, banana and gherkins. Production of critical quantity of export-quality horticulture produce has facilitated their exports. The success has been possible due to concerted effort by farmers' organizations, public and private sector initiatives. India's share of Agricultural export in global trade is significantly lower than other producer countries. Major issues are increased reliance on use of private standards at individual firm level and collective national/regional level. The stringent standards prescribed by developed countries for *maximum residue limits* (MRLs) for pesticides are a challenge for the producers and processors. Adoption of Global GAP standards by farmers for cultivation of grapes and pomegranate has led to increased market acceptance and higher price realization.

A large volume of our exports are limited to SAARC and ASEAN Nations and countries in Gulf where buyers not very quality conscious so export price may not necessarily be attractive enough. Limited exports experience of EU and other developed Countries for exports limits our export potential. Use of cluster-based approach like Varanasi cluster for fresh vegetables, Nagpur cluster for oranges and Krishna and Chitoor clusters in Andhra Pradesh for mangoes have solved transportation/logistics issues of these land-locked production areas. Exports took place from many clusters with produce finding their way from farms to supermarkets in the Middle East and even South Korea.

"Traceability" means the ability to track any food, feed, food-producing animal or substance that will be used for consumption, through all the stages of production, processing and distribution. Increasing global focus on food safety, especially on residue monitoring, product standardization, etc., are the key issues that Indian agricultural and processed food products face in the penetration in major markets like European Union, USA, Japan, etc.

Export of grapes from India to the European Union was adversely impacted after higher amounts of pesticide residue than the permissible limit was reported. The highly fragmented grape industry, with manual supply chain processes lacked visibility in the movement of grapes. The Agricultural and Processed Food Products Export Development Authority (APEDA) built an internet based, traceability system Grapenet, to integrate the grape export industry stakeholders on a single platform for full chain visibility. With the implementation of the traceability solution, which brought all the stakeholders on a single platform, the organisation reported a rise in farmers' earnings by 40%. The traceability solution enhanced the brand equity of India in the export of grapes benefitting 40,000 farmers and more than100 exporters.

Contract Farming

Contract Farming can be defined as a system for the production and supply of Agricultural/ horticulture produce by primary producers under advance contracts. It basically involves four things Pre-agreed price, Pre-agreed quality. Pre-agreed quantity and Pre-agreed time.

Some of the private players such as PepsiCo, Reliance Life Sciences, ITC (agri-business division) and McDonalds have modified their sourcing channels to include contract farming. This firm –farm linkage offers several advantages like sharing production and market risks with farmers, lowering transaction costs, increased productivity, value addition, technology and know-how to grow high value crops and better infrastructural facilities. Ramaswami et al. (2006) have shown that through contract farming farmers could shift as much as 88 per cent income risk to the firms. In a study, Birthal et al. (2005) have estimated 58 per cent reduction in marketing and transaction costs and 13 per cent increase in net profits due to contract farming.

Rise of organised food retailers such as McDonald's, Wendy's, Subway, KFC, Burger King and Dominos etc. raised an opportunity for Gujarat farmers. In 2007, Gujarat had only 16 acres area under the Santana & Frysona varieties desired for French fries, today it's over 6000 acres. Gujarat has the processing plants of three companies - McCain Foods, Iscon Balaji Foods and HyFun Foods with an investment of about 1000 Cr, which produce frozen potato products and exports them. India used to import 6,000 metric tonnes of French fries in 2007 while in 2019, India exported around 30,000 metric tonnes of the same.

Organized Retailing of Agricultural Produce

Organized Retail chains provide a new market linkage for agricultural produce. It is also called *contact farming* model which lacks formal commitment to buy and sell unlike contract farming. Retail chains bring quality culture and more commercial nature of production and marketing at the farmer level. Logistics and infrastructure investments by these organized players as mandated by the Government would help in improving the overall system and go way ahead in ensuring the quality, reinventing the supply chain.

Co-operative (HOPCOMS, Karnataka; Mother Dairy, Delhi), Farm to Fork -- Complete Chain (Reliance, ITC), Wholesaling (Adani AgriFresh, Metro, Ninja cart), Online retailing (Bigbasket,Grofers) and Omni channel retailing (Sorted) are some emerging models and formats of organised retailing. Urban consumer prefer to shop as they offer quality, value, variety and convenience.

Ninjacart is a tech-driven supply chain company for fresh produce. They connect producers of food directly with retailers, restaurants, and service providers using in-house applications that drive end to end operations. Founded by in June 2015, Ninjacart started as a B2C hyper local food delivery startup. It was transformed into a B2B agritech startup in order to solve the fresh agricultural produce supply chain problem for the farmers and the retailers. So far, Ninjacart's supply chain is equipped to move 1400 tonnes of perishables from farms to businesses, every day, in less than 12 hours.

Processing and Value addition

Value addition is the process of adding value to agricultural products through various means, such as processing, packaging, and labelling. Value addition can make agricultural products more marketable and increase farmers' incomes. It can also create jobs and contribute to economic development in rural communities. Value addition can make a big difference to the profitability of farmers and the quality of food available to consumers. It can also help to reduce post-harvest losses, and encourage the growth of subsidiary industries. Seasonal production, highly perishable nature of raw materials and variable quality of raw materials are the major issues hindering processing and value addition of agriculture produce.

In the farm sector, value addition can be plugged into various aspects of the value chain, such as storing, drying, and cooling, agro-processing, food processing, transport etc. To tackle market and infrastructure limitations, agricultural value chains may be developed to ease smallholders' access to markets and services and help fetch a better price. Efforts are required to link farmers with processors and develop these value chains through appropriate capacity building initiatives, infrastructure and organisational interventions such as FPO's.

E Marketing:

E-Marketing, also known as Internet marketing or online marketing, is the process of selling a product or service through virtual shops. India's e-commerce market is expected to reach US$ 188 billion by 2025 and US$ 200 billion by 2026 and US$ 350 billion by 2030. Agri e-commerce presents significant opportunities for the agricultural sector, wider society and economy. It has the potential to generate significant social and economic benefits, from improving the livelihoods of farmers and boosting productivity to reduction in wastage and driving digital and financial inclusion in rural areas. Increase in use of internet, mobile and social networks among farmers and agricultural extension officers, increasing digital skills among the rural population and a culture which encourages digital agripreneurship and innovation are the factors responsible for the growth of E commerce and digital marketing of agriculture and will influence the future growth.

Private players launched online platforms such as Big Basket, Grofers, Amazon fresh, and Godrej's Nature basket to facilitate buying and selling over internet. Many start-ups also connect farmers to wider markets to help farmers realize a higher price for the produce. Many of these e-commerce platforms offer integrated services to shorten the supply chain like logistics, financing, certification and traceability solutions etc. Start-ups are increasingly identifying potential FPOs who have strong growth potential and linking them to the market. Kalgudi, eFresh and AgroStar partner with FPOs and make available high-quality agricultural inputs.

eNAM is a pan-India electronic trading portal set up by the government to connect APMC mandis across the country. Over 585 mandis across the country are connected on eNAM .eNAM digitalizes entire operations from the arrival of stock at a mandi, quality grading of the farm produce, weighing of produce, participation in e-auction, generation of invoice and deposit of money into farmers' bank accounts and produce is sent to the buyer using eNAM connected logistic chain.

Government has also launched pan India e-commerce platform Open Network for Digital Commerce (ONDC). 2168 FPO's have sold 3100 varieties of agri products in 28 states after joining ONDC. Food items being sold include varieties of rice, honey and pollen. The target is to bring 7500 FPO's on the platform in recent times. ONDC supports FPOs in developing and the digitization of product catalogues, generating shipping labels and facilitating digital payments so that they leverage the platform for the marketing of their products.

Need for Market led extension and implications for Extension professionals

The approaches outlined above can empower extension workers to find new ways to assist smallholder farmers, through market-oriented approaches that encourage self-sufficiency. From the above discussed approaches and strategies, agricultural extension workers can develop market linkages for farmers keeping in mind below mentioned important aspects:

1. Extension services managers and field agents must shift from a focus on production to a broader set of skills, with a greater focus on marketing, business and financial services.
2. Identification of market is important and this should be followed by bringing farmers in a position to select the right products and markets to meet their needs and bring the quality produce at right time. Farmers should Extension workers can help in identifying buyers and arranging for them to meet with farmers.
3. Whatever strategy is adopted, awareness of the markets and marketing requirements among farmers is essential for successful market linkage development. Farmers must become adept in basic business methods such as assessing market opportunities, developing business plans, and negotiating with value chain partners.
4. Participants also need to be ensured of greater net incomes from entering into a new linkage than they obtain through their existing activities. In the beginning of the linkages itself, farm profitability must be accounted for by making realistic assumption of production and distribution**.**
5. The entire process of "Linking" farmers with market can be facilitated with the application of ICT to enable the monitoring and sharing of information on the quality and pricing of produce, transaction volumes to promote the trade of competitive, quality produce.
6. Extension services must help smallholder farmers become organized, upgrade their financial and business skills so that they can gain from economies of scale through demand driven collective marketing. Extension workers can help organize farmers into groups where they can learn new technologies and produce a specific level of surplus for sale. Farmer groups also need support to develop group management, financial and marketing skills, innovation, technology and sustainable production and natural resource management.
7. Leadership plays an important role in the success of the collectives. A well-defined marketing strategy will help these agriculture collectives evolve better and succeed in this competitive world.
8. The focus should not only revolve around the farmer or producer but also the other actors of production that have an equal and importantrole to play in the upscaling of variou s agricultural market functionaries.Therefore, the concept of value chain development has gained precedence which facilitates networking among farmers, producers, and stakeholders within a value chain. Integrating market linkage work with strong farmer organizations, sustainable production methods, and access to business services and infrastructure with the support of policy initiatives is integral to success of these market linkages.
9. Extension and advisory providers designing and investing in market linkage projects must understand the factors that affect market access and farmers' prospects, such as location, farm size, resources, access to roads and transport; determine whether to use an approach that targets farmer groups or individual farmers; consider farmers' goals and aspirations, as well as characteristics such as age, gender and skills, local production conditions, the business environment to find effective approach for each farmer or group of farmers.

Conclusion

It is high time we brought out significant strategies in agricultural marketing with innovative and creative approaches to bring fruits of labour to the farmers. Various market linkage strategies such as cooperative marketing, direct selling, e-commerce etc offer significant opportunities for smallholder farmers to access better markets and increase profitability. By leveraging collective action, value addition, and technology, farmers can overcome market barriers and enhance sustainability. Extension workers play a crucial role in facilitating these linkages, fostering growth, and ensuring long-term success. By broadening the skill set of extension workers beyond traditional production techniques to encompass marketing, business, and financial services, farmers are better positioned to navigate markets successfully. Building awareness, facilitating access to relevant resources, and fostering collective action through farmer groups are essential components of this process. Furthermore, integrating information technology and fostering strong leadership within farmer organizations can enhance the sustainability of these linkages.

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Empowering India's agricultural value chain through Farmer Producer Organizations

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Abstract

India's agricultural sector, dominated by smallholder farmers, faces numerous challenges, including fragmented landholdings, limited market access, inadequate infrastructure, and low bargaining power. These barriers hinder farmers' economic growth and productivity. Farmer Producer Organizations (FPOs) have emerged as a potential solution to empower smallholder farmers by enhancing their market position, improving value chain management, and providing access to better resources, training, and financial services. FPOs, formed as collective organizations, enable farmers to pool resources, reduce costs, and increase bargaining power, thereby improving income. Through collective action, FPOs eliminate middlemen, directly link farmers to larger markets, and help reduce post-harvest losses by investing in infrastructure like storage and processing units. This paper explores the role of FPOs in strengthening India's agricultural value chain, highlighting their functions across input supply, production management, post-harvest handling, value addition, and marketing. It also highlights the impact of FPOs on the empowerment of marginalized groups, such as women and youth, and their contribution to sustainable agricultural practices. Despite their potential, FPOs face significant challenges, including governance issues, limited access to credit, and insufficient infrastructure, which hinder their scalability and long-term sustainability. The paper further discusses the current state of FPOs in India, with an emphasis on government and private sector support, and reviews various models of FPOs ranging from cooperatives to producer companies. In conclusion, while FPOs hold promise in transforming the agricultural sector, their success depends on overcoming key challenges such as inadequate professional management, access to finance & the dominance of middlemen, requiring sustained institutional support and capacity-building initiatives.

Keywords: Smallholder farmers, Farmer Producer Organizations (FPOs), agricultural value chain, collective action

Introduction

India's agricultural sector is vital to its economy, employing over 50 percent of the workforce and contributing to food security (Kumar & Yadav, 2020). However, smallholder farmers, who make up the majority of the farming community, face significant challenges, including poor infrastructure, limited access to services, lack of economies of scale, and insufficient bargaining power (Misra, 2008). These farmers also struggle with competitiveness and compliance with food safety standards (Narrod & Roy, 2007). In this context, Farmer Producer Organizations (FPOs) have emerged as a key model to support smallholders. FPOs empower farmers by providing access to information, technology, inputs, and markets, helping them achieve economies of scale, improve bargaining power, and access capital (FAO, 2007; Markelova *et al.*, 2009). This paper examines the role of FPOs in strengthening India's agricultural value chain, particularly in improving market access, financial services, and sustainable farming practices.

Current Context of India's Agriculture

India's agriculture is predominantly marked by small-scale, subsistence farming. The country has around 118 million farm households, with more than 80 percent owning less than 2 hectares of land (NSSO, 2014). These small, fragmented landholdings hinder farmers' ability to achieve economies of scale, adopt modern technologies or secure favorable prices for their produce (Sharma, 2019). The sector is also highly dependent on seasonal monsoon rains, making it vulnerable to the impacts of climate change. Despite technological advancements, challenges persist, including low productivity, limited access to quality inputs like seeds and fertilizers and insufficient post-harvest infrastructure (Kumar & Yadav, 2020). As a result, many farmers, particularly in remote areas, remain trapped in a cycle of poverty.

Challenges faced by Indian Farmers

The farmers in India face several critical challenges that hinder their ability to thrive economically and socially. These challenges include:

- **Fragmented Landholdings**: The predominance of small landholdings reduces the ability of farmers to invest in efficient production practices, adopt advanced technologies, or access bulk discounts on inputs (Chand, 2020).
- **Low Bargaining Power**: Farmers are often at the mercy of middlemen in the supply chain who exploit their lack of market access and bargaining power. This results in farmers receiving a lower share of the final price of their produce (Chand & Kumar, 2020).
- **Limited Access to Credit and Insurance**: Despite initiatives by the government, many smallholders struggle to access affordable credit and insurance, which hinders their ability to invest in inputs or mitigate risks associated with climate change (Mishra & Das, 2021).
- **Inadequate Post-Harvest Infrastructure**: A lack of modern storage facilities, cold chains, and processing units leads to significant post-harvest losses, estimated at up to 30 percent in some cases, thereby reducing the profitability of farming (Sharma, 2019).

Role of Farmer Producer Organizations (FPOs)

Farmer Producer Organizations (FPOs) provide a viable solution to the challenges faced by smallholder farmers. As by pooling resources, FPOs enhance farmers' bargaining power, reduce transaction costs, and help secure better prices for their produce (Kumar & Yadav, 2020). They also facilitate direct negotiations with buyers, eliminating middlemen and increasing profits. FPOs improve market access by enabling smallholders to reach larger markets and institutional buyers (Chand & Kumar, 2020). Additionally, FPOs offer training in modern farming, post-harvest management, and financial literacy, boosting productivity and risk management (Mishra & Das, 2021). Beyond economic benefits, FPOs promote social cohesion, empower marginalized groups, including women, and foster leadership opportunities, contributing to more resilient and sustainable agricultural practices (Sharma, 2019).

Definition of FPOs

A Farmer Producer Organization (FPO) is a collective of farmers formed to improve their economic and social welfare through collective action. By pooling resources like labour, land, and capital, FPOs help reduce production costs, improve market access, and enhance bargaining power. This collective approach allows farmers to achieve economies of scale, access better input prices, negotiate better deals, and increase their share of the agricultural supply chain.

Key Features of Farmer Producer Organizations (FPOs)

1. **Farmer-Centric Approach:** FPOs focus on improving farmers' livelihoods by enhancing bargaining power, reducing costs, and improving market access.
2. **Democratic Governance:** FPOs operate on democratic principles, where each member has equal voting rights, ensuring decisions are made in the collective interest.
3. **Collective Action:** Farmers pool resources to achieve economies of scale, reduce production and marketing costs, and strengthen market position.

4. **Legal and Institutional Framework:** FPOs in India often operate as Producer Companies under the Companies Act, 2013, allowing access to government schemes and funding.
5. **Member Equity and Profit Sharing:** Members contribute equity capital and share profits based on their contribution, ensuring equitable benefits.
6. **Market Linkages:** FPOs link farmers to larger markets, reducing reliance on intermediaries and improving pricing transparency.
7. **Capacity Building and Training:** FPOs offer training on modern farming, financial management, and leadership to boost productivity and organizational skills.
8. **Access to Financial Services:** FPOs help farmers access credit, insurance, and subsidies, improving their financial stability.
9. **Post-Harvest Management and Value Addition:** FPOs engage in storage, grading, packaging & value addition activities like processing, helping farmers achieve higher returns.
10. **Sustainability and Environmental Practices:** FPOs promote sustainable farming techniques such as organic farming and water conservation to ensure long-term productivity and environmental health (Kumar & Yadav, 2020).
11. **Inclusivity & Social Empowerment:** FPO support women, youth & marginalized groups, offering leadership roles & empowering vulnerable sections of society (Chand, 2020).

Various forms of Producer organization

A Producer Organization (PO) can be registered as a cooperative society, producer company, section company, society and trust (Kumar *et al., 2024*) as below:

1. **Cooperative Society:** A Producer Organization (PO) can be registered as a 'Cooperative Society' where individual farmers and cooperatives can become its members. Cooperatives operate under government control and the level of autonomy is also low.
2. **Producer Company:** A PO can be registered as a 'Producer Company (PC)' where individuals, groups and associations can avail its membership. Government interference is minimal and limited which gives it a high level of autonomy.
3. **Section Company:** The main objective of a 'Section Company' is to carry out non-profit activities and the formation procedure is time-taking and complex. Although the objectives are not intended for profit-making, a PO as Section company enjoys full legal status.
4. **Society:** A Producer Organization can also be registered as a 'Society' where the objectives of the PO as a society will be charitable, literary or scientific. The formation procedure is comparatively simpler than the above form.
5. **Trust:** A PO as a 'Trust' can be formed through a relatively simpler process and in less time. Trusts usually incur nominal statutory provisions and enjoys its legal status with limitations.

Whatever the form of the organization, some characteristics hold farmer organizations together a common interest, rules, regulations, mandatory membership and discipline, unique quality standards in production, and shared roles and responsibilities on a rotation basis among the members (Sahu, 2014)

Functional Types of Farmer Producer Organisations

The following are the different functional types of Farmer Producer Organisations:

1. Classification by Focus of Service Provision:

a) **Diverse Service Providers:** Offer a range of services to various crops.
b) **Focused Service Providers:** Offer specific services tailored to particular crops.

2. **Classification by Nature of Services Provided:**
   a) **Market-oriented:** Focused on market-related activities such as marketing and value chain development.
   b) **Input Oriented:** Primarily provide inputs such as seeds, fertilizers, and machinery.
   c) **Extension Oriented:** Offer agricultural extension services including training & education.
   d) **Policy and Advocacy Oriented:** Engage in advocacy efforts and policy influencing related to agriculture.

3. **Classification by Degree of Integration into the Market:**
   a) **Integrated Sector FPOs:** Engaged in sectors crucial for the national economy or food security, such as export products or strategic food crops.
   b) **Non-Integrated Sector FPOs:** Work in less strategically important or fragmented sectors like animal husbandry, market gardening, or rain-fed agriculture.

4. **Classification by Degree of Structuring:**
   a) **Grassroots FPO:** Local organizations formed by small farmers, addressing local agricultural challenges and enhancing incomes through collective action.
   b) **Regional Federation:** Coordination bodies of multiple grassroots FPOs within a region, facilitating collaboration, resource-sharing, and advocacy.
   c) **National Association:** Represent FPOs nationally, advocating for policies, facilitating networking, and engaging with stakeholders to promote the FPO sector.

5. **Classification based on the nature of relations and linkages:**
   a) **Traditional Organization**: It is based on cooperative models, operate under democratic governance structures. They prioritize collective activities such as procurement and marketing to uplift farmers' socio-economic status.
   b) **New Organization:** Recent trends reveal a shift in FPOs towards adopting business-oriented approaches, often registering as producer companies under the Companies Act.

Current Indian Status of FPOs

The Farmer Producer Organizations (FPOs) in India primarily consists of small and marginal farmers, who make up 70–80 percent of the membership. As of recent estimates, there are around 7,000 FPOs, including Farmer Producer Companies (FPCs), established over the last 8–10 years through initiatives by the Indian government, NABARD, and SFAC (Sharma, 2020). Out of these, about 4,800 are registered as FPCs under NABARD and SFAC, while the rest are cooperatives or other societies (Kumar & Yadav, 2020). The highest concentration of FPOs is in Karnataka, Maharashtra, Madhya Pradesh, Telangana, and Uttar Pradesh, which account for 40 percent of the total. Another 40 percent are spread across Odisha, Tamil Nadu, West Bengal, Andhra Pradesh, Bihar, Gujarat, Rajasthan, and Jharkhand. Approximately 60 percent of registered FPOs have around 500 members, while 10–15 percent have more than 1,000. Nearly half of these FPOs have an authorized capital close to ₹1 lakh. These figures highlight the growing role of FPOs in improving farmers' livelihoods but also underscore challenges in scaling and achieving financial sustainability (Kumar *et al., 2024*).

Value Chain Management through Farmer Producer Organizations (FPOs)

Value Chain Management (VCM) in agriculture refers to the process of managing and optimizing the full cycle of agricultural production, from input sourcing, production, processing, and marketing, to final consumption. By organizing farmers into collectives, FPOs help streamline the value chain, improve efficiencies, and ensure better returns for farmers. Effective value chain management ensures that each stage of this process adds value to the product, optimizes the use of resources, and meets market demand efficiently.

It includes activities like:

- **Production**: Cultivation of crops or rearing of livestock.
- **Post-Harvest Handling**: Sorting, grading, storage, and packaging.
- **Processing**: Converting raw materials into processed goods.
- **Marketing and Distribution**: Selling and distributing the final product to consumers.

Role of FPOs in Strengthening Agricultural Value Chain Management

FPOs play a central role in managing & improving agricultural value chain by organizing farmer into collectives, facilitating resource pooling, improving economies of scale and enhancing their market access. FPOs contribute to value chain management through following aspects:

a. Input Supply and Bulk Procurement- Farmer Producer Organizations (FPOs) benefit farmers by reducing per-unit costs through bulk purchasing, ensuring quality control to protect productivity, and providing access to new technology and training to enhance farm efficiency.

b. Production and Farm Management-FPOs enhance farming through training on best practices and sustainable methods, provide shared resources like machinery and irrigation to lower costs, and offer timely updates on weather, market prices, and farming techniques via digital platforms.

c. Post-Harvest Management- FPOs support farmers with storage solutions to reduce losses, quality control and grading to meet market standards, and packaging technology to improve product appeal and shelf life.

d. Processing and Value Addition-FPOs add value by setting up agro-processing units, opening niche markets for processed products, and using branding and certification to help farmers earn higher prices.

e. Marketing and Distribution-FPOs improve market access by negotiating directly with buyers, selling through digital platforms or farmer markets, and securing contracts with processors or exporters for price stability and guaranteed sales.

f. Financial Services and Credit Access- FPOs facilitate access to credit, enable bulk purchasing to reduce costs, and provide crop insurance and risk management tools to mitigate financial risks.

FPOs and the Agricultural Value Chain: Benefits to Farmers

- **Better Price Realization**: By aggregating produce and negotiating collectively, FPOs enhance the bargaining power of farmers and help them secure better prices.
- **Reduced Post-Harvest Losses**: FPOs can invest in storage facilities, reducing losses from spoilage, pest attacks, and other factors. This allows farmers to sell their produce when market prices are favorable.
- **Diversification**: FPOs can help farmers diversify their crops, ensuring a stable income across seasons and reducing the risk of crop failures due to unpredictable weather patterns.
- **Value Addition**: FPOs provide opportunities for farmers to add value to their products through processing and packaging, resulting in higher profits.
- **Improved Productivity**: Through access to better technology, knowledge & resources, FPOs enable farmers to increase their productivity, leading to more significant output and income.

Role of Extension Agencies in Promoting Value Chain Ecosystem in FPO's

A. Government Agencies

1. SFCA ((Small Farmer Agribusiness Consortium): It is the nodal agency promoting Farmer Producer Organisations (FPOs) across India. It aims to increase the incomes of small and marginal farmers through aggregation and agribusiness development. SFAC has pioneered the formation and growth of FPOs/Farmer Producer Companies (FPCs) nationwide, striving to create a sustainable ecosystem for them. It offers schemes like e-NAM, NAFPO, equity grants, and credit guarantee funds to enhance FPCs' viability and access to working capital.

2. e-NAM: It integrates FPOs with the platform to provide end-to-end connectivity and market information. This integration aims to help FPOs sell their produce at better prices. So far, 1,942 Farmer Producer Organizations from various states have been onboarded onto the e-NAM platform.

3. NAFPO (National Association for Farmer Producer Organization): The platform is a registered non-profit organization and a multi-stakeholder-owned entity. It supports the institutional development and business stabilization of Farmer Producer Organizations (FPOs).

4. NABARD (National Bank for Agriculture and Rural Development): It focuses on the rural sector, offering incentives and collateral-free loans to FPOs with specified repayment terms. It supports FPOs through funds like PODF and the Produce Fund, promoting them via schemes such as the Central Sector Scheme for FPOs.

5. NCDC (National Cooperative Development Corporation): It plans, promotes, and finances cooperative activities, including direct lending to cooperatives. As an Implementing Agency for the Central Sector Scheme, NCDC aims to form and promote 10,000 FPOs as cooperatives, targeting small and marginal farmers.

6. NRLM (National Rural Livelihood Mission): It receives support from the World Bank. Its goal is to establish effective institutional frameworks for rural communities, empowering them for self-sufficiency and sustainable livelihoods. The objective is to create an enabling environment for rural poor to access resources and opportunities.

7. NAFED (National Agricultural Cooperative Marketing Federation of India Ltd): It is designated as one of four implementing agencies by the government, it aims to establish 10,000 Farmer Producer Organizations (FPOs) to foster self-reliance in agriculture.

8. APEDA (Agricultural and Processed Food Products Export Development Authority): It introduced the Farmer Connect Portal to link FPOs, FPCs, cooperatives, and exporters, facilitating online visibility and trade interactions. It streamlines licensing for FPOs and appoints them as procurement agents for MSP operations.

B. Major Private Agencies:

1. Ambuja Cement Foundation (ACF): The initiative focuses on forming and strengthening FPOs, and prioritizing management and governance.

2. Reliance Foundation (RF): The initiative facilitates market linkages and offers technical inputs for improved farm practices and technologies. It establishes digital platform linkages for enhanced accessibility.

3. SELCO foundation: Engaging with FPOs and local institutions, this initiative focuses on ecological resilience. It deploys Decentralised Renewable Energy (DRE) cold storage in Odisha.

4. SM SEHGAL Foundation: The initiative strengthens and builds institutional capacities of existing FPOs in Uttar Pradesh and Karnataka.

5. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT): The initiative supports FPOs on member centrality and risk management, designing training programs, exposure visits, and module development for the Agribusiness and Innovation Platform (AIP). It provides technical support to NABARD and assists in developing FPO policy in Andhra Pradesh.

Challenges in Empowering Value Chain Management Through FPOs in Indian Agriculture

The important challenges and confronting issues in building a sustainable FPO ecosystem are as follows:

- **Limited Professional Management:** FPOs lack skilled professionals, especially in rural areas, leading to inefficient management and operational difficulties.
- **Financial Weakness:** Small and marginal farmers often have limited resources, making it difficult for FPOs to offer robust services or products.
- **Credit Access Constraints:** FPOs struggle to access affordable credit due to lack of collateral, credit history, and limited coverage under credit guarantee schemes.
- **Risk Mitigation Needs:** Existing insurance schemes often only cover production risks, leaving FPOs vulnerable to business risks.
- **Market Access:** Navigating complex market systems and accessing infrastructure for secure and remunerative prices remains a challenge.
- **Infrastructure Deficits:** Inadequate transport, storage, and processing facilities hinder value addition, aggregation, and market access.
- **Skills and Awareness Gaps:** Limited awareness of collectivization benefits and a shortage of agencies supporting FPOs exacerbate challenges.
- **Governance and Leadership Issues:** FPOs often face governance challenges, including leadership conflicts, inefficient decision-making, and lack of inclusive leadership.
- **Inadequate storage & processing facilities:** Many FPO lack modern storage & processing capabilities, leading to post-harvest losses and missed value-added opportunities.
- **Logistics and Transportation Challenges:** Poor infrastructure and high transportation costs limit FPOs' ability to get products to markets efficiently and economically.
- **Limited Technological Access:** Many FPOs lack access to modern agricultural technologies and digital tools that could improve productivity and market engagement.
- **Dependence on External Funding:** Many FPOs rely heavily on government grants or external funding, hindering long-term financial sustainability.
- **Limited Access to Credit and Loans:** FPOs often struggle to secure loans from traditional financial institutions due to lack of collateral and a poor credit history.
- **Dominance of Middlemen and APMCs:** The prevalence of middlemen and APMCs in the market structure reduces FPOs' ability to secure better prices for farmers.
- **Competition from Larger Corporations:** FPOs face stiff competition from large agribusinesses, which often have more resources, better market access, and stronger bargaining power.
- **Regulatory and Policy Challenges:** Regulatory complexities, inconsistent policy implementation, and state-level variations create barriers for FPOs in accessing formal markets and competing effectively.
- **Institutional and Bureaucratic Barriers:** Regulatory issues, such as food safety standards, packaging requirements, and licensing procedures, hinder FPOs' ability to scale and access premium markets.
- **Lack of Long-term Financial Viability:** After initial government support or grants end, many FPOs face difficulties becoming self-sustaining without a consistent revenue stream.
- **Limited Market Linkages:** FPOs often struggle to build strong market linkages, hindering their ability to secure better prices and access wider markets.

Case study of strengthening value chain in agriculture through FPO's: Sahyadri Farms

Sahyadri Farms was founded in 2011 in Maharashtra, is a leading FPO with 24,000 registered farmers transforming India's agricultural value chain. By empowering smallholder farmers, it focuses on sustainable practices, increasing income and connecting farmers directly with consumers. It offers a platform for collective action, ensuring better market access, fair prices, and improved farming practices. Through technology, effective supply chain management & a focus on farmer welfare, it has become a benchmark model for FPOs.

Key Features of Sahyadri Farms for Value Chain Management

1. **Farmer-Centric Model-** It connects farmers directly to consumers, eliminating middlemen and ensuring fair prices. It also provides access to quality seeds, fertilizers, and expert advisory on crop management and pest control.
2. **Technological Integration-** It utilizes a digital platform to track the supply chain, providing real-time market and weather updates through mobile apps. It also invests in cold storage and transport infrastructure to preserve produce quality and reduce post-harvest losses.
3. **Value Addition and Branding-** It processes crops into value-added products (e.g., jams, juices) to increase farmer income, while building a strong brand identity focused on quality, sustainability, and eco-friendly produce.
4. **Sustainable Practices-** It supports farmers in adopting organic farming to reduce chemicals and improve soil health, while also implementing water conservation methods like rainwater harvesting and drip irrigation to optimize water use.
5. **Access to Finance and Credit**- It offers micro-financing options, including working capital and crop loans through financial partnerships, and facilitates crop insurance to safeguard farmers against climate risks and unforeseen losses.
6. **Market Linkages and Sales:** It connects farmers directly to consumers, bypassing middlemen to ensure fair prices for their produce. The FPO also partners with retail chains, wholesalers, and export markets to expand the reach of farmers' products both domestically and internationally.

Suggested Value Chain Model for FPO's

The Fig.1 depicts the value chain model for Farmer Producer Organizations (FPOs) for strengthening agricultural growth includes phases as Input Supply, where FPOs could aggregate agricultural inputs like seeds, fertilizers, and machinery, securing lower prices through bulk purchasing. In the Production phase, FPOs could provide training on advanced farming practices, improving quality, yields, and consistency to the farmers. During Post-Harvest Management phase, FPOs handle sorting, grading, and storage to reduce losses and maintain quality, often adding basic value like packaging. In Aggregation & Marketing phase, FPOs pool member produce for collective marketing, creating market linkages and using market intelligence to secure better prices.

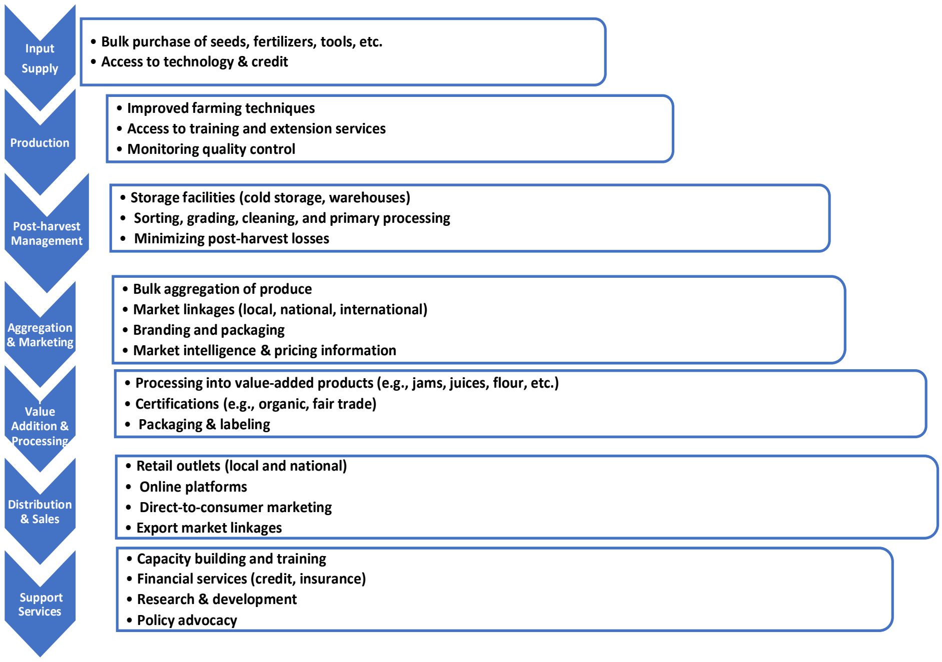

Fig.1 Value Chain Model for FPO's Strengthening

Value Addition & Processing phase involves converting raw products into higher-value items, increasing profitability. FPOs then distribute the final products through retail outlets, online platforms, and direct sales in the Distribution & Sales phase. Throughout all stages, FPOs offer Support Services like financial aid, training, and research, helping improve efficiency and farm income. The continuous Market Intelligence flows back into the input supply phase to inform purchasing decisions based on changing market conditions. This integrated value chain model could help the farmers improve their productivity, access to better markets, and increase income, ensuring the long-term success of the FPO.

Conclusion

The challenges faced by Indian farmers are multifaceted, encompassing fragmented landholdings, low bargaining power, limited access to credit and insurance, and inadequate post-harvest infrastructure. These issues hinder farmers' economic stability and growth. However, Farmer Producer Organizations (FPOs) present a promising solution. By pooling resources, enhancing bargaining power, and offering collective support, FPOs help farmers reduce costs, improve productivity, and access larger markets. They also play a critical role in post-harvest management, processing, and value addition, which boosts farmers' income. FPOs are essential in addressing the specific challenges of smallholder farmers, from ensuring quality inputs and training to providing access to credit and insurance. Moreover, they help farmers navigate complex market systems and secure better prices by eliminating intermediaries. Through collective action, FPOs not only improve the financial stability of farmers but also promote social cohesion and inclusivity, empowering marginalized groups, including women and youth. Despite their potential, FPOs face challenges such as limited professional management, inadequate infrastructure, and reliance on external funding. To maximize their impact, there is a need for improved governance, enhanced access to credit, better market linkages, and consistent support from both government and private agencies. With continued efforts, FPOs can significantly contribute to the long-term sustainability and growth of Indian agriculture, improving the livelihoods of smallholder farmers and fostering rural development.

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LP 4.5

Role of value chain in farmers livelihood

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Abstract

In the modern era, agriculture faces several challenges like climate change, instable prices, poor soil quality *etc.* In the country like India, agricultural industry has to transform its technology to meet the customer expectations, food security *etc.* Value chain is used to describe the activities that start from the conception to final disposal of the produce. Value chains can act as an effective medium for poverty alleviation and for increasing farmers income. In a developing country like India, value chains in agriculture have a major role in increasing farmers income but it also faces many challenges. This paper addresses the importance of value chains in agriculture along with the challenges its possess in farmers livelihood.

Keywords: Value chain, poverty alleviation, challenges, livelihood

Introduction

Agriculture is the major contributing factor for human existence. In a developing country like India majority of the population is dependent upon agricultural income which contributes to approximately 14.8 per cent of total GDP of the country. In the modern era, agriculture is faced with several challenges like climate change, instable prices, poor soil quality *etc.* In the country like India, agricultural industry has to transform its technology to meet the customers expectations, food security *etc.* The concept of "value chain" was introduced by Porter (1985) to describe the full range of activities, which are required to bring a product or service from conception, through the different phases of production, distribution to consumers, and final disposal after use. As the product moves from one player in the chain to another, it is assumed to gain value (Hellin and Meijer, 2006). As such, the value chain can be used as a tool to disaggregate a business into major activities, thereby allowing the identification of sources of competitive advantage (Brown, 1997).

The importance of value chain is felt in different fields in examining and evaluating different industries as well as individual firms. The concept of value chain and supply chain are entirely different even though they seem like one. According to Fearne *et al.*, supply chain thinking is suitable for commodities and commodity markets, whereas value chain thinking is more applicable to differentiated products and segmented markets. The goal of supply chain management is to reduce costs, increase margins, and increase market share; that of value chain management is to add value and segment the market with differentiated products designed to increase profitability at all stages in the chain. Moreover, while the focus of supply chain management is on efficiency, market access, and increased distribution. The emphasis of value chain management is on quality, service, and agility with distribution determined by consumer demand rather than capacity utilization.

Value Chain in Agriculture

In the modern era, the emergence of agriculture supply chains and value chains is one of the remarkable progress made in agriculture sector in India. The traditional way of food production is being replaced by practices more similar to manufacturing processes, with greater co-ordination across farmers, processors, retailers, exporters and other stakeholders in the agriculture value chain (Kumar *et al.*, 2011).

Growth and development of agricultural value chains in India was not given much importance. Indian farmers can gain from increased knowledge, data, and information and communication technologies with the development of modern agriculture value chains. The consumers can also get quality products as per their preferences at the same time. The costs and losses which the intermediaries in the marketing chain will also go down with the better value addition. Agriculture value chain is an effective solution for the farmers for getting higher income along with employment generation thus helping them to overcome challenges of food security. The rise in income and stress on quality has influenced the demand side while new technologies and trade agreements have the potential to influence the supply side of products. But it is also noteworthy that in India, due to lack of technologies related to quality seeds, fertilisers, irrigation and good agricultural practices farmers find it very difficult to enhance their productivity. There is urgent need to develop innovative technologies related to agricultural inputs, such as quality seeds mainly climate-resilient varieties, fertilisers and improved irrigation equipment (Kumar and Sharma, 2016).

Within the conventional sales framework, farmers typically encounter a state of isolation from the majority of end consumers, thereby possessing limited authority over input expenses and the prices they obtain for their agricultural products. In the majority of conventional sales systems, farmers and producers typically receive minimal profits. Within the framework of a Value Chain marketing system, farmers establish a connection between the demands of consumers, engaging in close collaboration with suppliers and processors to generate the precise goods that align with consumer requirements. By employing this methodology and fostering a continuous cycle of innovation and feedback across various stages within the value chain, it is possible to augment the market power and profitability of farmers (Ammani *et al.*, 2015). It has been argued that value chains that operate effectively (Bammann, 2007) are more proficient in delivering products to consumers, resulting in various stakeholders, including small-scale producers and impoverished consumers, reaping the benefits of value chain development.

There are different agribusiness value chain models in India like PepsiCo, PRAN, Mahagrapes *etc.* which link the farmers to national and international markets. These value chain models have been able to provide new and modern technologies to the farmers. These agri-business models have the potential to connect small and marginal farmers to the markets.

The key actors within the value chain include:

1. Farmers, who engage in the cultivation of crops, rearing of livestock *etc*. who undertake the primary stages of processing which encompass activities such as harvesting, drying, sorting, and other related tasks. They directly sell their products to traders.
2. Collectors refer to small-scale, localised traders who engage in direct purchasing from individual farmers. They sell the produce to a larger trader or processor.
3. Processors encompassing various industries such as milling, feed manufacturing, butchery, leatherworking, coffee roasting, juice production, canning, and frozen food packaging play a pivotal role in transforming the initial product.
4. Wholesalers who handle significantly larger quantities of goods compared to collectors and they procure from smaller traders or processors, farmers *etc*.
5. Retailers who sell the products directly to consumers. They operate on a smaller scale, handling lower volumes of goods except the supermarkets.
6. Consumers are at the end of the value chain and the most important stakeholders of the value chain (Arulmanikandan *et al*., 2023).

The most important problems faced by the farmers are the lack of control over the price they receive for their produce and the cost incurred by them for the inputs. Farmers also didn't possess much knowledge regarding the prices which they will receive. In the realm of agricultural produce, a sequential process is adhered to, spanning from the initial production stage to the ultimate point of consumption. The value chain activities have been identified as a crucial element in promoting economic empowerment, as they have been observed to enhance both income and livelihood security (Prema and Lisma,2010).

The most important advantage of participating in a value chain is that it helps to meet the unmet market demands and helps in the formation of associations, cooperatives, and companies that can help to acquire the inputs at a lower prices compared to the individual level. This can be achieved through various means, such as investing in new technologies, constructing infrastructures, engaging in joint ventures, and developing the capabilities of the actors involved in the value chain (Arulmanikandan *et al*., 2023).

The value chain has given a greater scope of partnership between the public and private sector for the enhancement and development of agriculture; thus, it gives an opportunity to the farmers to get the best of both worlds where the public sector/govt agencies set the regulations whereas the private sector aces its delivery mechanism (Quader *et al*., 2023).

High value chains can contribute to decreasing poverty primarily by increasing productivity, adding value to products, increasing income, employment opportunities, reducing transaction cost and mobilizing the economy and social capital of rural territories. (Bandara *et al*., 2014)

Cases Pertaining to Agricultural Value Chain

Innovative technologies, institutions and policies could help in developing a value chain. Sinha & Kumar have analyzed NCDEXSPOT market in Gulbarga district of Karnataka, and have found that with the help of NCDEX SPOT, tur grower-farmers were able to reduce the marketing cost by 50-70 per cent, incurred small charges for warehousing and realized about 5-10 per cent higher price for their produce as compared to the traditional APMC market.

Dayakar Rao *et al.* have studied the impact of innovations in value chain on sorghum farmers. The technological backstopping of sorghum cultivation with end-product specific improved cultivars realized 51 per cent rise in incremental net income (Rs. 16098/ha) for the participating farmers. The benefit-cost ratio worked out in favour of *rabi* sorghum (1:7.5) vis-à-vis *kharif* sorghum (1: 4.2).

Shinoj *et al.* have carried out economic assessment of the upcoming jatrophabased biodiesel value chain in the country. They have found jatropha cultivation to be an economically viable proposition in the long-run provided initial government support is available till attaining the break-even point to sustain famers' interest.

Shrivastava *et al.* studied the successful dairy value chain developed by SHG in Seoni district of Madhya Pradesh. The process of farmers' group formation and the economic impact of developing a dairy value chain have been highlighted by them. They have demonstrated that farmers could get better returns on developing value chain through a self-help group.

Singh *et al.* studied the fodder value chain in Bihar. The study estimated the producer's share in end-users' price for different fodder marketing chains. The constraints of fodder marketing and suggestions for their management were also discussed.

Sahoo in his paper on global markets and local players — a value chain system of collaborative strategies—has made an attempt to integrate small farmers and corporate sector and has tried to establish a link between small farmers and global market through an effective value chain system. He has debated on the role of various players in the value chain and how the government, keeping the interests of the farmers in view, can facilitate greater participation of the corporate sector through appropriate policy framework. The paper has highlighted that infrastructure, credit flow, marketing facilities, insurance cover, price structure and information flow are the constraints to such integrations.

Indira Devi *et al.* have looked into the concept of value chain system in a different perspective, viewing farm worker capacity building similar to human resource development, by empowering the educated unemployed work force in the state. The intervention to organize, train and assure the supply of labour in the agricultural sector has resulted in better living conditions to the members. Apart from the better socio-economic upliftment, the intervention could facilitate an increase in the coverage of paddy cultivation in Kerala (Kumar *et al*., 2011).

Challenges Involved in Agricultural Value Chain in India:

- **Lack of access to finance**

  Most of the Indian agricultural value chain firm's focusses on local market and they need more resources and capacity to compete in the external markets (Raju 2014). They are not given any incentives or credit relaxations throughout the process of value chain.

- **Non-tariff barriers**

  Most of the value chains in India are oriented towards export markets which require the products to have desirable quality standards, certificates *etc.* which have been mandated by the importing countries. This type of infrastructure is lacking in some of the ports of our country which creates non-tariff barriers for these value chains.

- **Market access**

  Lack of information and existence of middlemen creates problems in improving the efficiency of value chains in our country. Marginal and small farmers are unable to reap the benefits of agricultural value chains due to the lacking of infrastructure in collection and storage of the produce.

- **Capacity building**

  Most of the small and marginal farmers do not realise how to produce, store and preserve agricultural products in a modern and more sophisticated era and how to constantly check the quality. Even many cold storage and godown owners do not know the exact details to preserve and store agricultural products (Raju, 2014). Government and extension agencies should equip the farmers with the needed infrastructure so that they can store and preserve their produce as per the quality standards desired for the export.

- **Transfer of Technologies**

  Transfer of technologies are important for the farmers to increase their income through operating in an efficient value chain by reducing the post harvest losses and by adding more value addition.

Conclusion

Agricultural value chain has several benefits in a developing country like India. But even after the benefits like economic empowerment of the farmers and quality produce delivery to the consumers farmers mostly opt for the traditional supply chain. The reluctance of the farmers towards opting the agricultural value chain is due to many factors like lack of finance, infrastructural setbacks, lack of information, technologies *etc*. Government should give more focus on giving incentives to the farmers, set up infrastructures needed by the marginal and small farmers, providing transparent information to all the stakeholders involved in the value chain so that farmers can go for adopting the value chain which will lead to the economic prosperity and wellbeing of the farming community.

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LP 5.1

Application of Information and Communication tools for agriculture: Empowering farmers through social media

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Abstract

The use of Information and Communication Technology (ICT) in agriculture is becoming increasingly significant in handling issues like low productivity, climate change, proper resource management, market access & marketing issues. Farmers & agricultural stakeholders may enhance efficiency, sustainability & profitability by using ICT into agriculture. The target audience of agribusiness can be easily contacted through ICT tools. Adequate infrastructure, digital literacy, access to affordable technology, supportive environment for innovation & technology adoption are major drivers for use of ICT in agriculture. Social media has an important & growing role in revolutionizing agriculture by allowing farmers, agribusinesses & stakeholders to access information, communicate and promote agricultural practices and agricultural produces. The present paper discusses the current state of agriculture, development opportunities in digital agriculture, social media for agriculture & social media marketing for farm.

Keywords: Social media in agriculture, digital agriculture, ICT application in agriculture, facebook agriculture, youtube

Indian agriculture in Viksit Bharat

Agriculture is the backbone of the country's economy. Agriculture accounts for around 17 percent of India's GDP and more than 50 percent population engaged in agriculture as an employment. India has celebrated Aazadi ka Amrit Mahotsav and in last 75 years India has achieved several milestones transforming country form traditional to vibrant modern economy and one of the most important driving factor is agriculture sector (Patra, Kaur and Satyasai, 2023). India's population increased from 35.9 crore to 136.9 crore and food production increased from 106 million tonnes to 936 million tonnes between 1951 to 2021 thus the increase in food production was more than double the increase in human population during the last seven decades (Chand and Singh, 2023). As the fig 1 Agriculture's Share in Income and Workforce depicts that there is decline in Gross Value added (GVA) over the time but the decline in workforce is not equal. Still large population of country engaged in agriculture.

India has transformed in all sectors in last 75 years including agriculture. One of the transformative initiatives is digital India. Application of digital technologies in the agriculture field brought significant changes. By integrating information and communication technologies (ICT) tools into agriculture production and marketing process leads to growth and better efficiency. The use of digital technology brought paradigm shift in the way farmers access information manage resources, connect with market and address challenges (Abiri et.al 2023 ; Balkrishna et.al. 2023).

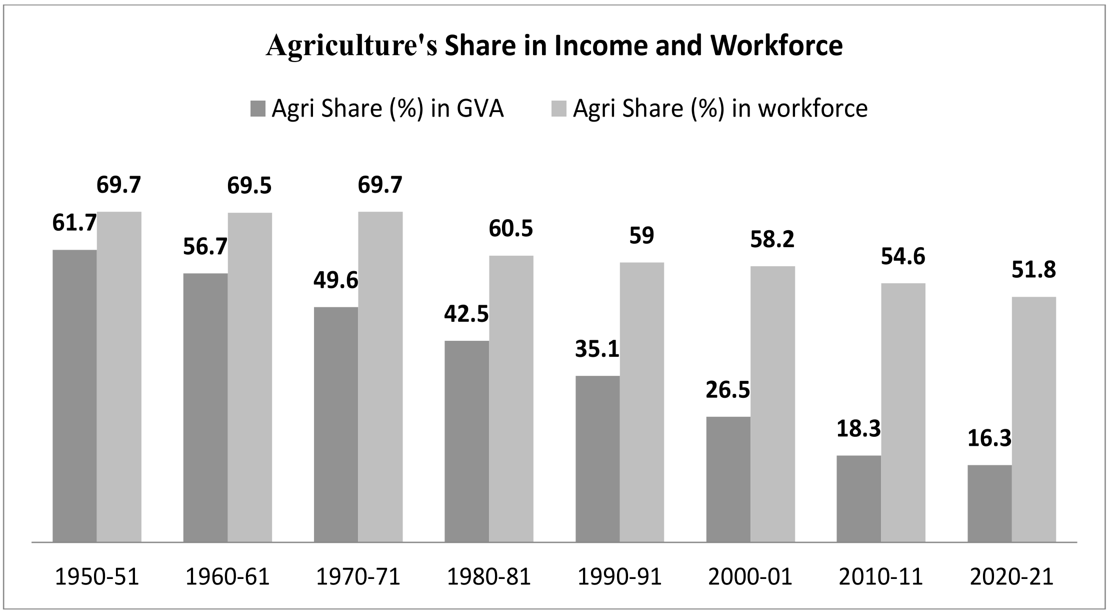

Fig. 1- Agriculture's Share in Income and Workforce
Source: MoAFW, Agricultural Statistics at a Glance and (Patra, Kaur and Satyasai, 2023)

Digital Agriculture in Viksit bharat

The Smartphone penetration, increased internet connectivity and starts up in the digital platforms for agriculture foster the digital reach to farmers (Abiri, 2023). Digital Platforms provide farmers access to agriculture experts, weather updates crop, production information, pest management and market related information through mobile phones (Shrivastava, 2023). ICT initiatives such as web-based portals like AGMARKNET, AGRISNET etc.. , call based service like Kisan call center, Kiosks like e-chopal and mobile applications government as well as private players help to reach out the remote farmers in the country (Datta and Anand, 2023). Aadhaar-enabled Direct Benefit Transfer (DBT) has significantly transformed India's welfare landscape by enhancing transparency and ensuring the efficient delivery of services (PIB, 2024). Direct payments to farmers' bank accounts have been implemented, which results in cutting out middlemen and minimizing leaks and Millions of small and marginal farmers have been reached by schemes like PM-KISAN, which provide financial assistance directly to farmers (Paswan, 2023). Platforms such as the Unified Payments Interface (UPI), mobile banking, and digital wallets empower farmers to conduct transactions digitally, removing the reliance on cash and enhancing financial transparency (Meganathan, 2024). Digital agriculture is transforming agricultural extension by enhancing the accessibility, efficiency, and customization of services for individual farmers (Awad, 2021). By utilizing digital tools, farmers can enhance decision-making for various farm operations, obtain real-time data of weather, market linkage and increase productivity and sustainability. By facilitating direct communication between farmers and buyers, digital channels increase market accessibility and lessen reliance on middlemen. Extension services can help farmers use these platforms to market their goods at reasonable prices, increasing their profitability and financial inclusion.

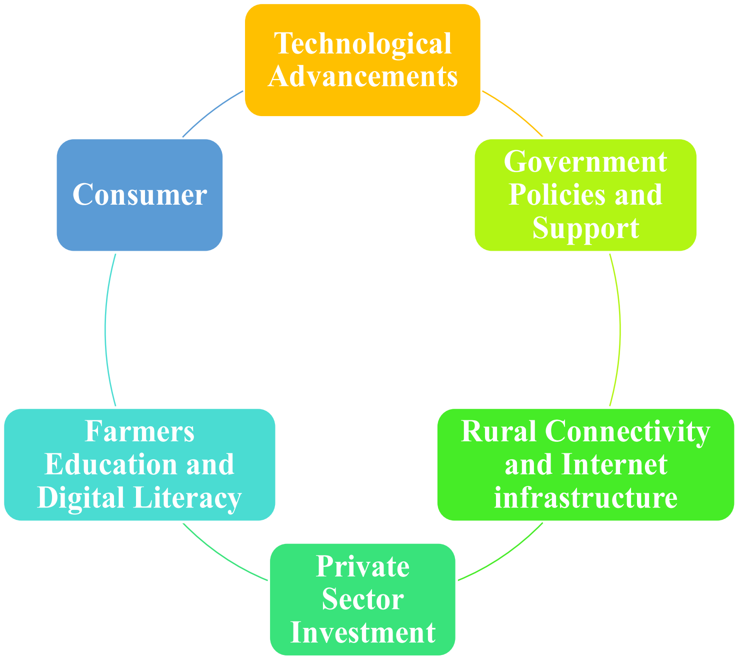

Fig. 2: Growth Drivers for Digital Agriculture

Growth Drivers for Digital Agriculture

Technology Advancement

Technology advancement refers to the process of developing new and superior technologies that displace older ones leading to better performance (Baum, 2001). Devices based on internet and sensor based technology are increasingly being used to monitor, manage and improve farm conditions in real-time. Sensors may helpful in detecting soil moisture, temperature, humidity, and other factors, offering farmers valuable data for proper decision-making and efficient resource management. Artificial Intelligence (AI) algorithms and machine learning models help in predictive analytics by forecasting weather patterns, pest infestations, and crop diseases (Gul and Banday, 2024). These tools assist farmers in making informed decisions, optimizing resources, and minimizing waste. Drones outfitted with cameras and sensors offer aerial perspectives of agricultural lands, allowing farmers to evaluate crop health, determine irrigation requirements, and identify issues such as pest infestations or nutrient deficiencies (Kumar et.al, 2023). Blockchain technology is utilized for traceability, promoting transparency within the agricultural supply chain

Government Policies and Support

The Indian government's Digital India initiative and its promotion of e-Governance have fostered a supportive environment for the implementation of digital technologies in agriculture (PIB, 2024). Further, the support to the innovations and startups in agriculture and allied sectors helps in fostering digital agriculture

Rural Connectivity and Internet infrastructure

As mobile phone adoption rises and internet connectivity advances in rural regions, farmers can access a diverse array of digital services. Improved connectivity enables farmers to utilize mobile applications for weather forecasting, market pricing, and pest management guidance, as well as participate in e-commerce for selling their products.

Private sector Investment

There is substantial investment entering the digital agriculture sector from industrialists, venture capitalists, and corporate giants. Collaboration between agri-tech companies and traditional agribusinesses or cooperatives has intensified, facilitating the more effective implementation of digital solutions throughout the farming community. The major players in other markets are also expanding into agriculture-related businesses.

Farmers Education and Digital Literacy

India is the country with the largest young population. The young population engaged in agriculture and related businesses is technologically adept. Digital literacy programs are enabling farmers to enhance their confidence in using technology. Numerous organizations and NGOs provide training programs, webinars, and online courses to educate farmers on digital tools, applications, and modern farming techniques (Lal and Sharma, 2020).

Consumer Demand

Consumer is the key player in the market. They are becoming more knowledgeable about the origins of their food, its production methods, and concern for safety standards. Additionally, there is an increasing worldwide demand for sustainable food production systems that reduce environmental impact. The integration of Blockchain, IoT, and smart sensors enhances transparency and traceability within the food supply chain, thereby increasing demand for digital tools in agriculture (Xiong et.al 2020). Digital agriculture technologies assist farmers in implementing more sustainable practices by optimizing resource utilization and minimizing emissions, among other benefits.

Importance of Social media in Agriculture

According to Investopedia Social media refers to a digital technology that facilitates the sharing of ideas, thoughts and information through virtual networks and communities. As per the OOSGA 2023 survey, there are around 470.111 million social media users (log in at least once in a month) in 2022. Further the WhatsApp is most used social media platform followed by Instagram and Facebook in India. As per the study published by the oxford university there is around 54 % of Indian go to social media channels to find "truthful" information whereas the global average is 37 % which shows trustworthiness of social media in India. According to prediction of Bain & company India will witness a compound annual growth rate of 55-60 % between 2020-2025 expanding the current market size from $1.5-2 billion to $16-20 billion.

Benefits of Social media for Agriculture

Creating Awareness

Social media platforms allow businesses to connect and communicate with current and future customers. The ability to receive live feedback and facilitate discussions with customers is a powerful tool for increasing brand awareness and affinity (Tran, 2024). Facebook Instagram, Pinterest etc.. Referred as Organic social media is widely use by individuals as well as business to reach to their target customers and creating awareness. Players in agriculture sectors may use social media platform to create awareness of their product among potential buyers.

Fig: Benefits of Social Media for Agriculture

Consumer engagement and Education

Social media can be used for increasing consumer interaction and brand exposure for agricultural companies and businesses. Farmers may build a devoted following and personalize their brand by regularly posting engaging material, such as product images, stories details and testimonials. Using live sessions, messages, and comments to interact with followers build community and improve relationships with customers. To engage their audience, farmers and agribusinesses can use polls, quizzes, and live Q&A sessions. Producers and consumers can come closer by social media as a result of this connection, which increases brand trust. Social media is an excellent platform for disseminating information on sustainable practices, food production, and farming methods (Yadav et. Al, 2023; Jijina & Raju,2016). Brands can establish themselves as authorities in their industry by producing and disseminating instructional films on platforms like Facebook and YouTube.

Product Promotion and Sales

Agricultural firms can reach target groups, such local consumers, those interested in organic food, or even wholesalers and bulk buyers, by utilizing social media's ad targeting features. Selling agricultural goods like seeds, equipment, or even fresh food might benefit from the shopping features of social media sites like Facebook and Instagram, which let consumers buy products directly through advertisements or store links (webfx).

Showcasing Sustainability and Innovation

Growing numbers of customers are curious about the origins and production methods of the food they eat. Social media gives you a chance to promote organic farming, crop rotation, water conservation, sustainable agricultural practices, and more. Innovations in agricultural technology, such as drones, AI-powered tools, or new farming equipment, can also be effectively promoted on social media. Investors and tech aficionados may be interested in seeing these ideas demonstrated.

Real time update

Social media is often used to provide real-time updates about farm conditions, crop harvests, or changes in weather patterns that affect production. This is useful for both the farm's internal audience and customers waiting for product availability. Further, In times of crisis (like droughts, floods, or pest outbreaks), social media can be a direct communication channel for explaining challenges, offering solutions, or keeping the public informed.

Data Collection and Analytics

Social media platforms provide valuable insights and analytics about consumer behavior, engagement rates, and demographics. This helps agribusinesses to tailor their marketing strategies and content to meet the specific interests and needs of their target audience. Social media can also be used to gather feedback through surveys, likes, share and comments, providing insights into consumer preferences, challenges, or emerging trends in agriculture. For example, consumers become more health-conscious and environmentally aware, social media has played a role in promoting local, organic, and sustainably produced food items. Many agricultural businesses are using social media to create transparency in their operations.

Examples of Social Media Use in Agriculture:

Indian government is focusing on development of the agricultural marketing by intervening in it for the past several decades. The ICT applications may help to the small farmers to find the multiple buyers for the agriculture products who are willing to pay high prices as the products are fresh. Further they also find out ways for purchasing input from various sources (through E-commerce operators such as Agrostar, Contacting Company through Social media platforms like Facebook, WhatsApp and Instagram) leads to less relay on the local retailers. Thus the bargaining power of farmers will improved. For agriculture produce, earlier the small farmers deal with only less number of buyers who pickup agriculture produces directly from home or nearby market. The digital & internet based applications in smart phones provides the market information to the farmers which can decrease the market distortions, logistics / transportation losses & products' wastage & damage such as E-nam. Farmers can create webpage on facebook, can create YouTube channels and upload produce information and aware about unique selling preposition which will helpful them to connect with potential buyers directly. The collective efforts such as SHGs, FPOs etc can have their own webpage, channels, domain etc which may helpful to processors who wants to buy in bulk.

Best Practices for Social Media Marketing in Agriculture

Consistency: Consistency is a key for success in social media, it helps in recognize the brand by audience, its reach and engage customers, by focusing on consistent content, consistent posting and consistent aesthetics (Payne, n.d.). Thus, the consistency is crucial for social media.

Quality content: The quality content may refer to well written, interesting and organized writing that accomplishes a specific purpose (Haun, 2023). Quality content may lead to more engagement of customers in terms of likes, share, tweet, retweet etc. which leads to brand awareness (Eckstein, 2024).

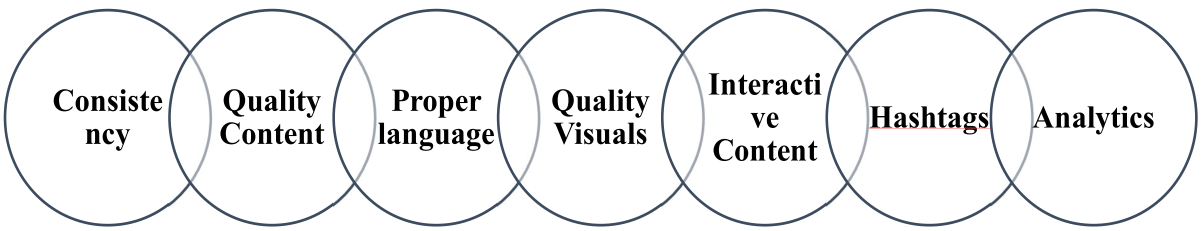

Fig: 3 Social media messages

Proper language: Proper language refers to use of adequate words and grammar which are easy to digest by viewers further local language can be utilized for better targeting. local language is extremely important an issue for the countries in developing world, especially in India where 22 languages are there, and as many cultures, the local language content may be tuned to meet the requirement of particular society of origin (Manzar, 2010).

Quality Visual: Quality visuals refer to High-quality images and videos, showing farm operations, products, or customer success stories, can greatly enhance engagement of audience.

Interactive content: Sharing industry news, insights, and trends can position organization as a brand's authority. Telling stories can help to establish a deeper connection with audience. Stories can be use to showcase customer success stories, promote brand's vision and values, or provide an inside glimpse of farm. Customer reviews, testimonials, and user-submitted images and videos are examples of user-generated content that can successfully increase audience confidence and authenticity.

Hashtags: Hashtags are one of the most powerful social media tools for increasing the visibility to the content. It can help users find your content and attract new customers interested in what your business offers. Use trending or niche hashtags to increase the discoverability of your posts (e.g., #SustainableFarming, #FarmToTable, #AgTech) (Sutherly, 2023)

Analytics: Regularly analyze performance data to refine your social media strategy and ensure reaching the right audience.

Conclusion

Agriculture is a significant sector of the Indian economy since independence to present. Information and communication technology (ICT) tools have transformed numerous industries, including agriculture and allied fields. Social media being strong and widely available communication channel is playing an important role in empowering farmers. It enables them to acquire knowledge, network with experts and other farmers, and increase productive farming techniques. India has the largest young population. The young people involved in agriculture and agribusiness, Government support, Investment from private players, Infrastructural developments and Consumer demands are major growth drivers. Social networking and other ICT tools empower farmers to overcome many of the conventional constraints they face, such as limited access to information, markets access, and resources. Farmers are being empowered by social media and ICT to gain knowledge, relationships, better reach to target market opportunities, and resources that will allow them to increase production, sustainability and income.

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LP 5.2

Viksit Bharat's digital vision; extension agent's extended arm

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Abstract

Digital innovations have the potential to significantly reshape agri-food systems, addressing critical challenges in productivity, sustainability, and food security, particularly in developing nations like India. With the country's growing population and increasing food demand, agricultural growth must accelerate to meet future needs. However, the sector faces numerous barriers, including limited access to digital technologies, inadequate extension services, and low digital literacy among farmers. Integrating digital tools into the extension system is essential to overcome these challenges, enabling farmers to access real-time information, market insights, and personalised advisory services. While promising, the successful implementation of digital agriculture requires overcoming infrastructural gaps and ensuring equitable access to technology. This approach will primarily benefit smallholder farmers, extension agents, and other stakeholders, advancing India's vision of a Viksit Bharat through enhanced agricultural productivity and sustainability.

Keywords: Digital agriculture, agricultural extension, sustainability, smallholder farmers, digital literacy

Introduction

Digital innovations are reshaping agri-food systems by addressing critical challenges in productivity, sustainability, and food security in the Global South. As the Indian population is projected to reach 1.6 billion by 2030, the food demand will increase to 400 million tonnes by 2050. According to the report, agricultural growth should be at least 4 per cent (to the current level of 3.6 per cent) to meet food and fodder needs and keep the country's economy at its pace (Vision 2050, 2013).

Digital innovations can contribute to shaping more sustainable and resilient agri-food systems. It increases productivity, increases farm resilience and reduces environmental footprints (E. Mabaya & Jaron Porciello, 2022; Finger, 2023). India has the world’s second-largest mobile phone market, with 1.2 billion mobile phone subscribers as of December 2021. The internet penetration in rural India is 41% as opposed to 71% in the cities and towns. The study estimates that India will be home to 900 million net users by the end of 2025 and that 56% of the 141 million new netizens will be from rural India.

Many farmers lack a reliable source of up-to-date knowledge about the occurrence of extreme climate events such floods, storms, droughts, and other natural disasters .Effective information delivery is achieved through the use of digital tools and services in digital agriculture extension. Extension workers typically use Short Message Service (SMS), Interactive Voice Response (IVR), interactive radio, and low-cost video to quickly reach a large number of farmers in order to provide extension services such as timely reminders and alerts, as well as best practices for weather forecasting that help farmers increase productivity. The conventional method of extension, which involves exchanging information with individuals, is expensive and time-consuming and could not benefit the farming community. However, the extent of extension can be expanded with the use of digital technologies. For them to make an informed choice and reach their full potential, the right information must be given. The information supplier needs to have a strong relationship with farmers at every stage of the agricultural cycle. As a result, digital technologies make it possible for farmers to establish networks and stay in touch with service and advising providers.

Disruptive technologies like AI, cloud computing and big data can shape the future of agri-food systems by enhancing efficiency in farming, resource management and sustainable development (I. Mustapha et al., 2022; Marcjanna Wrzecińska et al., 2023; N. Misra et al., 2020). Integrating digital tools in agri-food systems optimises operations and management and leads to better decision-making by farmers (Carlos Cambra-Baseca et al., 2019; Marcjanna Wrzecińska et al., 2023).

Role of extension in the digital agriculture

Extension services are crucial to increasing the capacity of the farmers. They play an instrumental role in promoting innovations, ensuring they reach the last mile (Rivera & Sulaiman, 2009). The effective agricultural extension programmes have improved rural livelihood, impacting farm production. It facilitates the development of agriculture(Hamasalih & Layeeq, 2023).

However, the public extension is devoid of challenges. It faces challenges in reaching all farmers due to its limited funds in some cases and understaffing. (Maiangwa et al., 2011; Simelane et al., 2019). The more significant objective is to mitigate the challenges to meet the challenges that the public extension system faces. Integrating digital solutions into the current extension system will rampantly boost its effectiveness in India. It will poise the country for a Viksit Bharat.

Digital agriculture as an extended arm of digital agriculture

The benefit that a digital system brings to the extension is unparalleled. The studies argue that even basic phones and inexpensive text or voice messages can change farmer behaviour (Larochelle et al., 2019; Mwalupaso et al., 2019). Digital tools have the potential to overcome the significant challenges faced by extension workers, such as meeting the information needs of the farming community (Xu et al., 2023). For instance, farmers can now access real-time market prices, diagnose diseases, and get tailored advice through mobile phones (Bhattacharjee & Raj, 2014).

The digital agriculture extension is handicapped if it is aimed to function independently. Agriculture is a system. An ecosystem approach will be essential to meet the current information of the farmers. The stakeholders include farmers, government, extension workers, NGOs, Research Institutes, policymakers and technology enablers. Each component should be lifted together to enable farmers to achieve sustainable livelihood.

The digitally enabled extension system will positively impact smallholder agricultural performance. It will reduce the workload of the extension agents while enhancing the effectiveness of reaching the farmers context-specific (Fabregas et al., 2019; Ortiz-Crespo et al., 2020; Rajkhowa & Qaim, 2021). There is a significant stride in developing such tools to assist farmers. Despite their potential, integrating digital innovations in agri-food systems is challenging. Issues such as the digital divide, unequal access to technology, and concerns regarding data privacy and governance pose significant barriers to widespread adoption (David Mhlanga & E. Ndhlovu, 2023; L. Barreto & A. Amaral, 2018; Nametshego Gumbi et al., 2023; Shruti Samadder et al., 2023). Furthermore, the varying levels of digital literacy among farmers, especially smallholders, hinder the effective utilisation of these technologies, potentially exacerbating existing inequalities in the agricultural sector(David Mhlanga & E. Ndhlovu, 2023; F. Anastasiadis et al., 2018; Pooja Jena et al., 2023).

Overall, the ongoing digital transformation in agriculture is both an opportunity and a challenge, with the potential to significantly enhance productivity and sustainability in food systems while also necessitating concerted efforts to address the barriers to adoption and equity. The advantages of digital innovation make it worthwhile to explore ways to meet some of the challenges. Digital agriculture has the potential to boost productivity and cost efficiency substantially. Farmers can optimise resource use by leveraging technologies, leading to significant cost savings—estimated to be between $40 billion and $60 billion by 2030(Goedde et al., 2020).

Advancements in digital agriculture

Farmers can make better decisions about planting, irrigation, fertilization, pest control, harvest, and post-harvest management of agricultural products by using digital tools, equipment, software, and processes to monitor their crops, orchards, animals, aquaculture systems, soil, water, weather, and post-production management of produce in real-time. This can save money, increase yields and quality, and lessen waste.

Sensors: To increase output, cut waste, and maximize resource utilization, sensors are being utilized more and more in Indian agriculture. In order to optimize irrigation techniques, soil moisture sensors are utilized to assess soil moisture levels in real time. Real-time data from nutrient sensors can be used to improve fertilization techniques. Real-time weather data can be obtained using weather sensors. Crop growth and health are tracked using crop health sensors. Reducing post-harvest losses, improving quality, and boosting farmer profitability are all possible using sensor-based post-harvest management that makes use of temperature, humidity, ethylene, and quality sensors of agricultural products. By keeping an eye on quality, producers may see possible problems and fix them before the fruit is sent to markets. GPS sensors can track the location of harvested product throughout transportation, allowing farmers to monitor temperature, humidity, and other quality-related parameters.

Drones: Drones, also known as unmanned aerial vehicles (UAVs), have grown in popularity in agriculture due to their capacity to collect data rapidly and efficiently from an object without making personal contact with it. Drones are used extensively in agriculture for crop monitoring using high-resolution cameras, as well as to construct detailed maps of agricultural land, soil quality, terrain, and drainage patterns. Spray crops with accurate pesticide and fertilizer applications, in conjunction with other precision agricultural technology; assess crop damage caused by natural catastrophes; and monitor water and ecological conditions, including fish health and biomass. However, it is critical to guarantee that drones are used safely and responsibly, and that farmers are trained in their operation. Additionally, regulations around the use of drones in agriculture should be put in place to ensure that they are used legally and ethically.

Artificial intelligence (AI): AI has the potential to transform Indian agriculture by allowing farmers to make data-driven decisions and improve crop production. It can be used for (i) predictive analytics, (ii) precision agriculture, (iii) pest and disease control, (iv) soil health management, (v) livestock herd management and dairy automation, (vi) aquaculture automation and management, and (vii) market prediction. In predictive analytics, AI can be used to analyze historical weather and crop data to forecast future crop yields. Farmers can use this to plan planting and harvesting times, as well as enhance crop management procedures. AI assists in identifying pests and diseases early on and recommending relevant treatment solutions. This can lessen crop losses and the requirement for chemical treatments for farmers. AI is capable of analyzing soil data and making suggestions for improving soil health. Farmers may benefit from improved water retention, decreased soil erosion, and higher crop yields as a result.

Cloud Computing: Among the intelligent agricultural solutions enabled by cloud computing are scalable computations, software, data access, and storage services. Cloud computing can store large amounts of data for low investment costs, and it is now possible to retrieve this data quickly. Cloud computing makes it possible to watch, control, and intervene in agricultural production operations quickly. Instantaneous weather and other climatic data that may be needed during agricultural operations can be captured via cloud computing through connected devices and used immediately in decision-making. The objective of cloud-based farm management platforms such as Agrivi and SmartFarm is to integrate data from several sources and create decision support systems. Farmers can now gain information for dynamic management strategies that used to be only available to commercial megafarms.

Preparing for digital agriculture: Steps towards readiness

Here are the steps envisioned to prepare the Indian extension system to leverage digital agriculture to increase farm productivity, promote sustainability and ensure food security, making it realise the vision of Viksit Bharat.

Upskill farmers to use digital tools: to meet the challenge of digital literacy, there is a need to build capacity among the farmers to use digital tools effectively and derive their benefits.

Leverage extension by integrating digital tools: extension services can continue leveraging digital tools like mobile technologies to disseminate information to farmers. They can also work alongside technical enablers to design digital solutions to complement and enhance the capacity of human extension agents.

Foster multi-stakeholder collaboration: facilitate the partnerships and collaborative environment that include the actors in the ecosystem like farmers, government, extension workers, NGOs, research institutes, policymakers and technology enablers to come together and innovate.

Address the digital divide: ensuring that the medium of technology minimises the digital divide and that farmers have equitable access to the technology, addressing the regional disparities in infrastructure, affordability, and availability.

Monitor and evaluate digital impact: regular review and update of the digital tools from the feedback of the farmers and extension agents will enhance the quality of the digital tools, making them more user-friendly and updated. The mechanism to assess the effectiveness of these tools will help gauge their effect on farm productivity.

Promote capacity development of extension personnel: continuous training will increase digital literacy. This will enable extension personnel to support the farmers in adopting new technologies.

Conclusion

Integrating digital innovations holds tremendous potential for India's growing food demand. By leveraging the use of digital technologies by extension agents, India can bridge the gap between technological advancements and the farming community by improving farm productivity and sustainability. However, realising the potential is no less a challenge—critical challenges like digital literacy and infrastructure disparities. A multi-stakeholder, ecosystem-driven approach focused on continuous capacity building, equitable technology access, and collaborative innovation is essential for ensuring digital agriculture becomes a key driver of India's vision for a Viksit Bharat.

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LP 5.3

Information and communications technology in agriculture

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Information Communication Technology tools are digital infrastructures such as; computers, laptops, desktops, data projector, software programs, printers, scanners and Interactive teaching box. A set of technological tools used, for example, to store, manage or communicate information.

ICT in agriculture, also known as e-agriculture, is a subset of agricultural technology focused on improved information and communication processes. More specifically, e-agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICTs) in the rural domain, with a primary focus on agriculture. ICT includes devices, networks, mobiles, services and applications; these range from innovative Internet-era technologies and sensors to other pre-existing aids such as fixed telephones, televisions, radios and satellites. Provisions of standards, norms, methodologies, and tools as well as development of individual and institutional capacities, and policy support are all key components of e-agriculture.

Many ICT in agriculture or e-agriculture interventions have been developed and tested around the world to help agriculturists improve their livelihoods through increased agricultural productivity and income, or by reducing risks. Some useful resources for learning about e-agriculture in practice are the World Bank's e-sourcebook ICT in agriculture – connecting small holder farmers to knowledge, networks and institutions, ICT uses for inclusive value chains, ICT uses for inclusive value chains and Success stories on information and communication technologies for agriculture and rural development have documented many cases of use of ICT in agriculture.

Global Positioning System (GPS)

In agriculture, the use of the Global Positioning System provides benefits in geo-fencing, map-making and surveying. GPS receivers dropped in price over the years, making it more popular for civilian use. With the use of GPS, civilians can produce simple yet highly accurate digitized map without the help of a professional cartographer.

Wireless technologies

Wireless technologies have numerous applications in agriculture. One major usage is the simplification of closed-circuit television camera systems; the use of wireless communications eliminates the need for the installation of coaxial cables.

Geographic information systems (GIS)

GIS are extensively used in agriculture, especially in precision farming. Land is mapped digitally, and pertinent geodetic data such as topography and contours are combined with other statistical data for easier analysis of the soil. GIS is used in decision making such as what to plant and where to plant using historical data and sampling.

Smartphone mobile apps in agriculture

The use of mobile technologies as a tool of intervention in agriculture is becoming increasingly popular. Smartphone penetration enhances the multi-dimensional positive impact on sustainable poverty reduction and identify accessibility as the main challenge in harnessing the full potential in agricultural space. The reach of smartphone even in rural areas extended the ICT services beyond simple voice or text messages. Several smartphone apps are available for agriculture, horticulture, animal husbandry and farm machinery.

Computer-controlled devices (automated systems)

Auto milking systems are computer-controlled standalone systems that milk the dairy cattle without human labor. The complete automation of the milking process is controlled by an agricultural robot, a complex herd management software, and specialized computers. Automatic milking eliminates the farmer from the actual milking process, allowing for more time for supervision of the farm and the herd. Farmers can also improve herd management by using the data gathered by the computer. By analyzing the effect of various animal feeds on milk yield, farmers may adjust accordingly to obtain optimal milk yields. Since the data is available down to individual level, each cow may be tracked and examined, and the farmer may be alerted when there are unusual changes that could mean sickness or injuries.

E-commerce

Online purchasing order of agri-inputs and agri-equipments is a subset of E-commerce.

RFID for animal identification

RFID tags for animals represent one of the oldest uses of RFID. Originally meant for large ranches and rough terrain, since the outbreak of mad-cow disease, RFID has become crucial in animal identification management. An implantable RFID tag or transponder can also be used for animal identification. The transponders are better known as PIT (Passive Integrated Transponder) tags, passive RFID, or "chips" on animals. The Canadian Cattle Identification Agency began using RFID tags as a replacement for barcode tags. Currently CCIA tags are used in Wisconsin and by United States farmers on a voluntary basis. The USDA is currently developing its own program. RFID tags have also been proposed as a means of monitoring animal health. One study involved using RFID to track drinking behavior in pigs as an indicator of overall health.

Sensing technologies

Various image sensor technologies provide the data, in the most common case from a visible light digital camera.

FAO E-agriculture Strategy Guide

The FAO-ITU E-agriculture Strategy Guide provides a framework to holistically address the ICT opportunities and challenges for the agricultural sector in a more efficient manner while generating new revenue streams and improve the livelihoods of the rural community as well as ensure the goals of the national agriculture master plan are achieved. The e-agriculture strategy, and its alignment with other government plans, was intended to prevent e-agriculture projects and services from being implemented in isolation. It was developed by the Food and Agriculture Organization (FAO) and the International Telecommunication Union (ITU) with support from partners including the Technical Centre for Agricultural and Rural Cooperation (CTA) as a framework for countries in developing their national e-agriculture strategy/master plan.

The E-agriculture in Action series of publications, by FAO-ITU, that provides guidance on emerging technologies and how it could be used to address some of the challenges in agriculture through documenting case studies.

- E-agriculture in Action: Big Data for Agriculture
- E-agriculture in Action: Blockchain for Agriculture
- E-agriculture in Action: Drones for Agriculture
- E-agriculture in Action

History

In 2008, the United Nations referred to e-agriculture as "an emerging field", with the expectation that its scope would change and evolve as our understanding of the area grows.

ICT in support of rural poverty elimination and food security

In August 2003, the Overseas Development Institute (ODI), the UK Department for International Development (DFID) and the United Nations Food and Agricultural Organization (FAO) joined in a collaborative research project to look at bringing together livelihoods thinking with concepts from information and communication for development, in order to improve understanding of the role and importance of information and communication in support of rural livelihoods.

The policy recommendations included:

- Building on existing systems, while encouraging integration of different technologies and information sharing
- Determining who should pay, through consensus and based on a thorough analysis of the costs
- Ensuring equitable access to marginalised groups and those in the agricultural sector
- Promoting localised content, with decentralised and locally owned processes
- Building capacity, through provision of training packages and maintaining a choice of information sources
- Using realistic technologies, that are suitable within the existing infrastructure
- Building knowledge partnerships to ensure that knowledge gaps are filled and a two-way flow of information allows knowledge to originate from all levels of the network and community.

The importance of ICT is also recognized in the 8th Millennium Development Goal, with the target to "...make available the benefits of new technologies, especially information and communications technologies (ICTs)" to the fight against poverty.

WSIS process

E-agriculture is one of the action lines identified in the declaration and plan of action (2003) of the World Summit on the Information Society (WSIS). The "Tunis Agenda for the Information Society", published on 18 November 2005, emphasizes the leading facilitating roles that UN agencies need to play in the implementation of the Geneva Plan of Action.

FAO hosted the first e-agriculture workshop in June 2006, bringing together representatives of leading development organizations involved in agriculture. The meeting served to initiate development of an effective process to engage as wide a range of stakeholders involved in e-agriculture, and resulted in the formation of the e-Agriculture Community, a community of practice. The e-Agriculture Community's Founding Partners include: Consultative Group on International Agricultural Research (CGIAR); Technical Centre for Agriculture and Rural Development (CTA); FAO; Global Alliance for Information and Communication Technologies and Development (GAID); Global Forum on Agricultural Research (GFAR); Global Knowledge Partnership (GKP); Gesellschaft fur Technische Zusammenarbeit (now called Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ); International Association of Agricultural Information Specialists (IAALD); Inter-American Institute for Cooperation on Agriculture (IICA); International Fund for Agricultural Development (IFAD); International Centre for Communication for Development (IICD);

United States National Agricultural Library (NAL); United Nations Department of Economic and Social Affairs (UNDESA); the World Bank.

Advantages of ICT in Agriculture

ICT can provide farmers with access to real-time information on weather, market prices, and crop management, which can help them make more informed decisions about their crops and increase their productivity.

Disadvantages of ICT in Agriculture

The disadvantages of agriculture are stated below.

- High Initial Costs
- Technical Complexity
- Limited Access to Infrastructure
- Digital Divide
- Dependency on External Support
- Data Security and Privacy Concerns
- Risks of Technology Obsolescence
- Resistance to Change
- Unreliable Connectivity
- Weather-Dependent Limitations
- Economic Viability

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360-degree insights into digital agriculture for empowering the farmers

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Introduction:

Technology can increase yield and productivity, but only public policy can increase the income of farmers. There has to be a synergy between technology and public policy – M. S. Swaminathan

Agricultural extension is a vital component of agricultural development, encompassing the dissemination of information, technology transfer, and capacity-building to enhance the productivity and livelihoods of farmers (Rahman and Pal, 2021; Sahoo *et al.* 2023).

Recent advancement in mobile technologies have been particularly influential the realm of digital agricultural extension. With the increasing penetration of smartphones and internet connectivity in rural areas, mobile applications have become a popular medium for delivering real-time agricultural advice, weather updates, market information, and pest management strategies directly to farmers' hands. Moreover, web portals and online resources have facilitated easy access to vast repository of agricultural knowledge, research findings and best practices. Social media platforms have also emerged as powerful tools for knowledge exchange, enabling farmers to connect, share experiences, and learn from each other (Ouma and Birner, 2021; Billah et al. 2021; Nandi *et. al.* 2022). As the digital agricultural extension continuous to evolve, it is essential to keep abreast of the latest updates and innovations to harness its full potential in sustainable agriculture and rural development.

The Indian government has created "Vikshit Bharat 2047", agenda which aims to transform India into a developed a nation by 2047. One important aspect of this plan is the role of agriculture in India's development strategy. The aim of agricultural extension is to bridge the knowledge gap between research institutions and farmers, enabling them to adopt innovative and sustainable farming practices. Over the years, agricultural extension services have evolved significantly with the emergence of digital technology revolutionizing the way information is disseminated and accessed by farmers.

- **Role and Importance of Agricultural Extension Services**

Agricultural extension services play a vital role in modern agriculture by acting as intermediaries between agricultural research and farmers. These services facilitate the transfer of knowledge, technologies, and innovations to farmers, helping them to enhance their productivity, adopt sustainable practices, and improve their socio-economic conditions. It can be simplify in three types:

(i) Enhancing Knowledge Transfer to Farmers
(ii) Facilitating Technology Adoption in Agriculture
(iii) Strengthening Farmer-Extensionist Interactions

- **Characteristics of Digital Agriculture**

Digital agriculture leverage technology to revolutionize the way information is delivered to farmers. These services possess unique characteristics that enhance their effectiveness in reaching a wider audience, customizing information, providing real-time support, and fostering interactive communication with farmers. Below are the key characteristics of digital agriculture:

(i) Accessibility and Reach

Digital extension services have the advantage of being accessible to a larger number of farmers, including those in remote and underserved areas. The widespread availability of smartphones and internet connectivity enables farmers to access agricultural information and advisory services from the comfort of their homes (Qamar and Ahmad, 2021). This increased accessibility breaks down barriers related to distance and geographical constraints, reaching farmers who may have been traditionally difficult through conventional extension methods.

(ii) Customization and Personalization

Digital agricultural extension services have the capability to customize information and recommendations based on individual farmer needs and preferences. By collecting data on farmers' locations, crop choices, and specific challenges, digital platforms can provide personalized advice tailored to each farmers' circumstances (Van Etten *et al.* 2020).This personalized approach enhances the relevance and applicability of the information received, increasing the likelihood of technology adoption and improved farming practices.

(iii) Real-Time and On-Demand Information Delivery

Digital extension services excel in providing real-time and on-demand information to farmers. Mobile applications, web portals, and social media platforms enable instant access to weather updates, market prices, pest outbreaks, and best practices (Gomez et al. 2019). Farmers can obtain timely information to make informed decisions, respond to rapidly changing conditions, and take preventive measures to mitigate risks promptly.

(iv) Two Way Communication and Feedback Mechanisms

Digital agricultural extension services facilitate interactive communication between farmers and extension agents, fostering a feedback loop that enhances the effectiveness of advisory services. Through chat features, phone calls, or online forums, farmers can seek clarification, share their experiences, and ask questions directly to extension agents (Islam et al. 2021). Extension agents, in turn, can receive real-time feedback on the challenges faced by farmers, enabling them to tailor their responses and support accordingly.

- **Technologies and Platforms in Digital Agricultural Extension**

The digital revolution has brought forth a wide array of technologies and platforms that have transformed agricultural extension services. These innovations cater to the needs of farmers, offering them easy access to information, expert advice, and relevant resources. Two prominent technologies in digital agricultural extension are mobile applications for farmer engagement and web portals with online resources.

(i) Mobile Applications for Farmer Engagement

Mobile applications, commonly known as agricultural apps, have become game-changer in delivering extension services to farmers (Nasr and Ahmed, 2022). These apps are designed to run on smartphones and provide farmers with a wealth of agricultural information at their fingertips. They cover diverse topics, including crop cultivation practices, pest and disease management, and weather forecasts, market prices, and financial advice. One key advantage of mobile apps is their offline functionality, enabling farmers in areas with limited or no internet connectivity to access stored information anytime. Additionally some apps use location- based services to offer region- specific advice, taking into account factors like soil type and climate.

(ii) Web portals and online resources

Web portals and online resources are comprehensive platforms that aggregate agricultural information and extension services in one place (Rahman and Rasul, 2021). These websites provide access to research papers, extension materials, videos, and e-learning modules on various agricultural topics. Farmers can browse through a wide range of content to find solutions to specific challenges and access the latest agricultural practices. Furthermore, web portals often facilitate interactive features, such as discussion forums and live chat support, allowing farmers to engage with agricultural experts and extension personnel. These platforms foster knowledge-sharing among farmers and empower them with the information they need to make informed decisions.

The integration of mobile applications and web portals in digital agricultural extension has significantly improved farmers' access to valuable information and expert guidance. These technologies cater to different user preferences and technological capabilities, ensuring that farmers across diverse settings can benefit from the wealth of agricultural knowledge available online. As technology continues to advance, the potential for further innovations in digital agricultural extension remains promising, contributing to sustainable agricultural practices and rural development.

(iii) Social Media and Farmer Networks

In recent years, social media has emerged as a powerful platform for digital agricultural extension, facilitating knowledge exchange, networking, and information dissemination among farmers and agricultural stakeholders. Social media platforms provide unique opportunities for farmer engagement, peer learning, and collaboration, making them an essential tool in modern agricultural extension efforts.

(a) Social media for knowledge exchange

Social media platforms, such as Facebook, Twitter, Whats App and Instagram have become virtual spaces where farmers can connect with experts, extensionagents, and fellow farmers to share experiences and seek advice. These platforms foster an open and inclusive environment, allowing farmers to ask questions, discuss challenges, and access real-time information from a diversecommunity of users.

(b) Networking and peer learning

Social media enables farmers to form online networks and groups based on shared interests, geographical locations or specific agricultural practices (Ngwenya *et al*. 2020). These networks facilitate peer learning, enabling farmersto learn from each other's successes and failures, exchange tips, and collaborateon joint projects. This form of crowd-sourced knowledge empowers farmers with practical insights and solutions that are contextually relevant to their own farming situations.

***(c)* Information dissemination**

Extension agencies, research institutions, and NGOs utilize social media asa platform to disseminate agricultural information and best practices to a wider audience (Fotouhi Ghazvini et al. 2021). Timely updates on weather forecasts, market prices, and pest outbreaks can be efficiently shared through social media channels. Furthermore, visual content, such as info-graphics and instructional videos, makes complex agricultural concepts more accessible and easier to understand for farmers

- **Recent Initiative by Government to Promote Digital Agriculture in India**

The Union Cabinet Committee chaired by the Prime Minister Shri Narendra Modi approved the Digital Agriculture Mission dated on 02 SEP 2024 6:30PM with an outlay of Rs. 2817 Crore, including the central share of Rs. 1940Crore. The Mission is conceived as an umbrella scheme to support digital agriculture initiatives, such as creating Digital Public

Infrastructure, implementing the Digital General Crop Estimation Survey (DGCES), and taking up other IT initiatives by the Central Government, State Governments, and Academic and Research Institutions.

In recent years, India's digital revolution has transformed governance and service delivery by creating digital identities, and secured payments and transactions. This has spurred a thriving digital ecosystem in finance, healthcare, education, and retail, positioning India as a leader in citizen-centric digital solutions.

For a similar transformation of the Agriculture Sector, in the Budget 2024-25, the augmentation of the Digital Public Infrastructure (DPI) initiative for the agricultural sector has also been announced. The Digital Public Infrastructure (DPI) for Agriculture aims to provide comprehensive and useful data on farmers comprising of authenticated demographic details, land holdings and crops sown. It will include cultivators & tenant farmers, as per the policy of the State Government. It would also connect to relevant Digital Public Infrastructure of the State Governments and Ministries of the Government of India to use data of farmers on livestock, fisheries, soil health, other vocations, family details and schemes and benefits availed, leading to innovative farmer-centric digital services in the agriculture sector. Aligned with the vision of Viksit Bharat@2047, the DPI for Agriculture forms the core of the Digital Agriculture Mission. The three DPIs to be built under the Mission are Agri stack, Krishi Decision Support System, and Soil Profile Mapping. Besides enabling farmer-centric digital services, these DPIs will make timely and reliable information available for the agriculture sector. Agri Stack is a farmer-centric DPI that will enable efficient, easier, and faster services and scheme delivery to farmers. It is being built in a federated structure as a collaborative project between the various agencies of the Central and State Governments. It consists of three foundational registries or databases in the agriculture sector, i.e., the Farmers' Registry, Geo-referenced village maps and the Crop Sown Registry, all created and maintained by the State Governments/ Union Territories. Under Agri Stack, farmers will be given a digital identity (Farmer ID) similar to Aadhaar, which will be a trusted 'Kisan ki Pehchaan'. This 'Farmer ID' will be linked dynamically to the State's land records, livestock ownership, crops sown, demographic details, family details, schemes and benefits availed etc. Crops sown by farmers will be recorded through mobile-based ground surveys i.e. Digital Crop Survey to be conducted in each season.

A Memorandum of Understanding (MoU) is being signed between the Centre and State Governments to create and implement the DPI for Agriculture. So far, 19 States have signed MoUs with the Ministry of Agriculture, Government of India. The basic IT infrastructure for implementing Agri Stack has been developed and already tested on a pilot basis, as follows:

(i) For the creation of Farmer IDs, pilots have been conducted in one district each across six States: Uttar Pradesh (Farrukhabad), Gujarat (Gandhinagar), Maharashtra (Beed), Haryana (Yamuna Nagar), Punjab (Fatehgarh Sahib), and Tamil Nadu (Virudhnagar). It is targeted to create digital identities for 11 crore farmers: Six crore farmers in FY 2024-25, three crore farmers in FY 2025-26, and two crore farmers in FY 2026-27.

(ii) For the development of the Crop Sown Registry, a pilot on the Digital Crop Survey was conducted in 11 States in 2023-24. Further, it is targeted to launch the Digital Crop Survey across the nation within two years, with 400 districts covered in FY 2024-25 and all the districts covered in FY 2025-26.

The Krishi Decision Support System will create a comprehensive geospatial system to unify remote sensing-based information on Crops, Soil, Weather, water resources, etc. Under the Mission, detailed Soil Profile Mapson a 1:10,000 scale of about 142 million ha of the country's agricultural land are envisaged to be completed. A detailed soil profile inventory of about 29 million ha has already been completed. The Digital General Crop Estimation Survey (DGCES) will provide yield estimates based on scientifically designed crop-cutting experiments. This initiative will prove very useful in making accurate estimates of agricultural production. The Mission will have a catalytic effect in creating both direct and indirect employment in the agriculture sector. Further, the digital crop surveys, collection of ground-truthed data for remote sensing, etc., under the Mission, are expected to provide employment opportunities to about 2.5 lakh trained local youth and Krishi Sakhis.

Various components of the Mission will be implemented at the grassroots level, and the ultimate beneficiaries are farmers. By leveraging trustful data on farmers, farmlands and crops and using modern digital technologies, such as data analytics, artificial intelligence, and remote sensing, the Mission aims.

To cite some examples:

i) A farmer would be able to digitally identify and authenticate himself/herself to access benefits and services, obviating cumbersome paperwork and with little or no need to physically visit various offices or service providers. Some examples include availing Government schemes and crop loans, connecting to agri-input suppliers and buyers of agricultural produce, accessing personalized advisories in real time, etc.

ii) The trustful data would help government agencies make schemes and services more efficient and transparent, such as paperless MSP-based procurement, crop insurance, and credit card-linked crop loans, and develop systems for the balanced use of fertilizers, etc. Further, the 'digitally captured data on crop-sown area', along with 'Digital General Crop Estimation survey-based yield' and remote-sensing data, will help in accurate crop production estimation. It will also help facilitate crop diversification and evaluate irrigation needs according to the crop and season

iii) The information available on Krishi-DSS would support crop map generation for identifying crop sown patterns, drought/flood monitoring and technology/model-based yield assessment for settling crop insurance claims by farmers.

iv) The Digital Public Infrastructure for Agriculture developed under the Mission will enable the stakeholders in the agriculture ecosystem to establish efficient value chains for agricultural inputs and post-harvest processes, as also in developing solutions for customized advisory services to farmers relating to crop planning, crop health, pest and disease management, and irrigation requirements, ensuring that our farmers receive the best possible and timely guidance and services.

- **e- National Agricultural Market (e- NAM):**

Realizing the urgent need to address the challenges of the existing agricultural marketing system the union government has introduced a Central Sector Scheme for Promotion of National Agriculture Market through a common electronic market platform, called the electronic National Agricultural Market or e-NAM. The e-NAM aims to integrate all the agricultural markets of the country and envisages a common national market for agricultural commodities with seamless movement across state boundaries. This is envisioned as a solution to marketing issues of all stake holders - farmers, traders, retailers, consumers and logistic providers. The NAM Portal provides a single window service for all APMC related information and services, including commodity arrivals, prices, bids & offers. The physical movement of agriculture produce takes place through the mandis while the online trading is expected to reduce transaction costs and information asymmetry.

E-commerce platforms: One of the easiest way of marketing

E-platforms are set to be instrumental in the modernization of the agricultural sector in by bridging market gaps, enhancing access to information, and streamlining procedures. These platforms streamline transactions by allowing farmers to bypass middlemen and directly sell their products to customers, merchants, and wholesalers, thus boosting prices and reducing expenses. They offer comprehensive supply chain management systems, incorporating features such as storage, real-time tracking, logistics, and financial services like microloans, insurance, and subsidy management accessible via mobile apps. Additionally, e-platforms provide farmers with timely market information, weather updates, pest alerts, and tailored guidance on best practices and sustainable farming techniques tailored to specific regions and crops. They also serve as educational hubs, offering training modules and resources on topics ranging from organic farming to cutting-edge technologies. By fostering connections among farmers, experts, and institutions, these platforms nurture social networks, community cohesion, and knowledge exchange. Some platforms aid farmers in obtaining organic farming certifications, ensuring product quality meets consumer expectations and assisting in accessing government policies, programs, and subsidies through integration with official portals, thus keeping farmers informed.

Conclusion:

Digital tools and platforms have reformed the way of dissemination of technology, exchange of knowledge, and ability of decision-making is boosted for farmers. From the development of digital technology in agriculture to the role and importance of agricultural extension services, we delved into the evolution and current landscape of digital extension. The characteristics of digital agricultural extension services, such as accessibility, customization, real- time information delivery, and two-way communication has created the powerful platforms for the farmers, In this paper it has been explored various technologies and platforms in digital extension, including mobile applications, web portals,social media, and IVR systems, each catering to unique user preferences and technological capabilities. While these digital extension services hold great promise, this also examined the challenges and barriers that may hinder their implementation.

Looking forward, the future of digital agriculture are truly exciting. Moreover, the initiative of Government i.e. e- NAM, the integration of digital extension with e-commerce and market platforms will create a comprehensive ecosystem for farmers, providing end-to-end solutions for their agricultural needs. The seamless convergence of these technologies will contribute to sustainable agriculture, improved productivity, and rural development in 360 degree.

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LP 5.5

Digital marketing in India: Scope and opportunities

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Abstract

Digital marketing for agricultural produce provides a unique platform for the farmers to understand the need of the customers and make the customers free from the time and place. It also reduces cost by omitting unnecessary transaction cost. The government and many companies are investing in agriculture marketing solution for the welfare of farmers. Despite all efforts made by Government for Digital marketing platforms, it is worthwhile reinforcing the fact that there is no single best solution for all conditions. Therefore, this study tries to find out more refined Digital marketing solutions needed for efficient agricultural marketing. To encourage digital agribusiness entrepreneurship, Government should emphasize to create a pool of digitally skilled employees who will disseminate the market information to the farmers at the right time. Digital Agricultural Marketing will play a vital role in the years to come in doubling the farmers' income.

Introduction

Efficient markets provide competent price discovery of agricultural produce. This study systematically reviews developments in Indian agricultural Digital marketing and emphasizes on addressing the challenges in implementation of digital platforms to achieve the goal of doubling farmer's income. The study also incarcerates various challenges in the implementation of e-NAM. Digital marketing is very similar to marketing in the agriculture era but with much more decreases in cost (Sheth and Sharma 2005). Digital Marketing or e-marketing uses information technology which applied to traditional agricultural marketing practice. Digital Marketing tries to hasten the marketing efficiency and its effectiveness in the way of traditional marketing was undeveloped in them. Consequently, electronic marketing and all its strategies added customer value further than what traditional marketing could gain. Digital Marketing in point of view of e-business begun to enhance and reinvent the mean of traditional business beside the internet played a vital role in this process. Marketing through electronic devices lied at the main part of integrating information technology and marketing attributes. The phenomenon of doing business using electronic interface add value to products, increase the quality of services, facilitate relationships between firms and customers and have better concepts about the market place. Several studies pointed out that the digital Marketing platforms are very powerful electronic communication media which provides producer farmers for direct marketing as an alternative channel. Digital marketing allows to transmit messages to a potentially buyers without costly advertising expenses. (Sheth and Sharma 2005; Kaur et al. 2015; Satinder 2015; Sathya 2015; Kedar & Sathe 2016; Singhal 2016; Sangeetha 2016; Bhargav & Bansal 2017; Humagain 2018; Pradhan et al. 2018)

In a global view, Electronic Marketing (Digital marketing) mostly defines as a new attitude and modern realistic involvement with the marketing of goods, services, information, and even ideas via internet and other electronic means (El-Gohary 2010). Internet and e-commerce are closely wrapped towards developed countries. (Ohidujjaman, et al. 2013). Hasan, 2010 pointed out that nowadays e-commerce industries have increasingly become a necessary component of business strategy and a strong catalyst for economic development. Minton, Lee, Orth, Kim, and Kahle (2012) did this very interesting research on sustainable marketing and social media, involving cross-culture populations (subjects) to analyze the motives for sustainable behaviors. Social media offer different values to firms, such as enhanced brand popularity (de Vries et al. 2012), facilitating word-of-mouth communication

(Chen et al. 2011), increasing sales (Agnihotri et al. 2012), sharing information in a business context (Lu & Hsiao 2010) and generating social support for consumers (Ali 2011; Ballantine & Stephenson 2011).

Several regional studies on various aspects were done by different scientists (Mehta & Sivadas (1995); Kiang et al. (2000); Kalyanam & McIntyre (2002); Ainin & Noor (2003); Bauer et al. (2006); Lu et al. (2010); Gruzd et al. (2011); Bostanshirin (2014); Sharif & Butt (2017)

Development and scope of Digital marketing:

Digital marketing has universal application. It penetrates all kinds of business namely, agricultural, industrial, medical tourism, governance, education and so on. Some of the commonly used applications of e- marketing are: Document automation, payment systems, content management, group buying, online banking, teleconferencing, electronic tickets which have become common with large and small businesses alike.

Several studies have been conducted pertaining to online marketing, Digital marketing and internet marketing for commercial products but few studies or paper highlights the digital marketing of agricultural produce. Scanty literature is found in digital marketing of agriculture produce at national and international level. Digital marketing has also been emphasized by several papers but there has not been so far any research which has investigated impact of digital marketing on marketing strategies of farmers with special reference to product strategies, promotion strategies, pricing strategies and distribution strategies of farm households.

Many attempts have been made to study e-NAM as well as e-tendering of agricultural commodities, its mode of operation and its benefits to various stakeholders in the marketing of agricultural produce but at the same time some of studies have also shed light on hiccups in implementation of e-NAM across the country.

Growth of Online Marketing in India:

Digital marketing or E-Commerce industries were rising at an astonishing rate in India which is expected to grow about 1.61 per cent of the global GDP. India is set to become the highest emergent market in the Asian region with an expected growth rate of over 57 per cent between 2012 and 2016 (Suginraj, 2017). Fig-1 shows forecasted growth of internet users in India during the year 2015 to 2023. The following are the key drivers of ecommerce;

• Majority of customers subscribed high speed Internet, rapidly increasing 4G internet users across the country.
• Growth of Smartphone users increasing day by day.
• Rising in employment level and standards of living results in online purchases.
• Online marketing provides wider range of products.
• Digital marketing provides competitive prices compared offline sellers.
• Buying and selling second hand goods were increases.

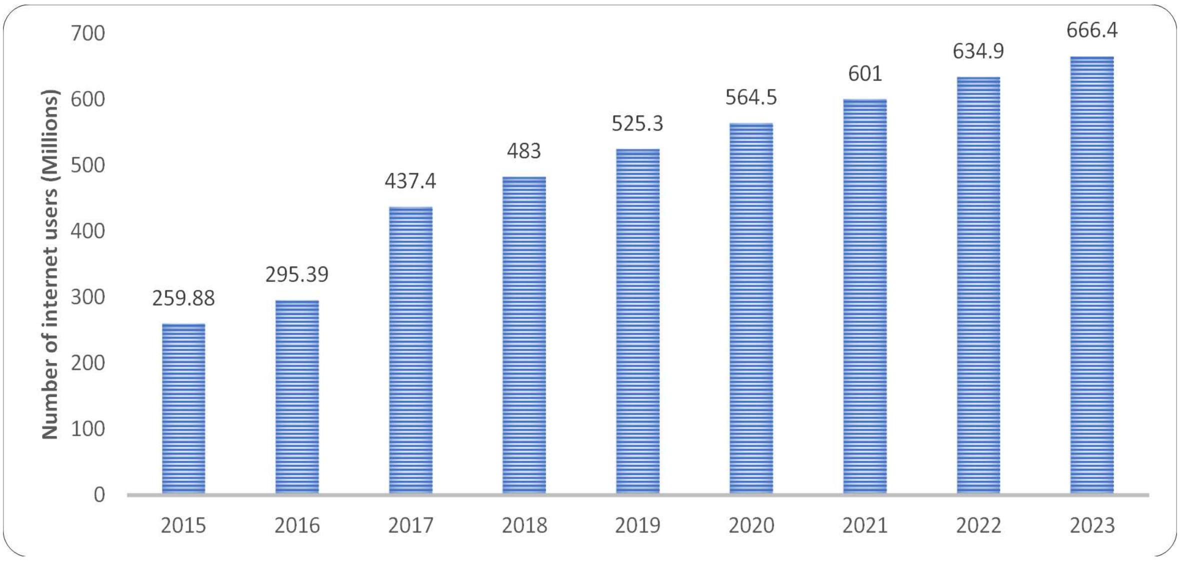

Fig. 1: Number of internet users in India from 2015 to 2023 (in Millions)
Source: www.statista.com

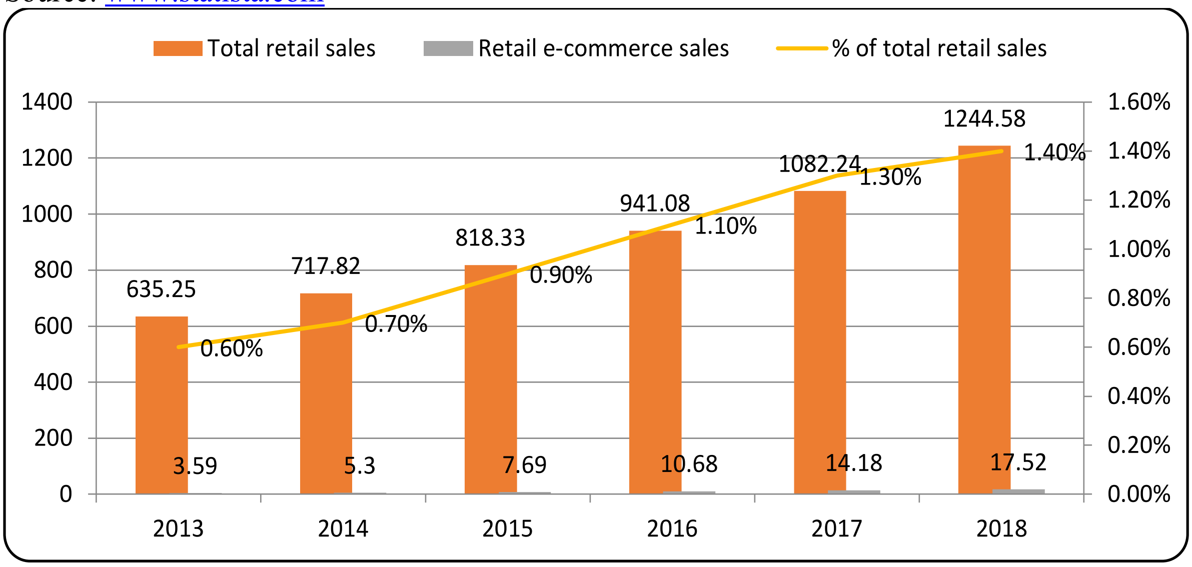

Fig. 2: Total retail & retail e-commerce sales in India 2013-2018
Source: www.statista.com

The Growth of digital marketing or online marketing during Covid-19 during the year 2020 and 2021 has seen sweeping growth. When we think of the key indicators of success of online marketing, the first thing we think of is the number of people reached through digital marketing practices. The internet's infiltration has reached stupendous numbers. India reaches 2nd largest number of internet users in the world. By 2023, online or digital marketing in India reaches around 666 millions. The Indian online business market is pushing to 7 trillion rupees by 2023 as a result of lockdowns.

Challenges for Digital marketing platforms:

Followings are challenges for digital marketing of agricultural produce in India

1. Illiteracy rate in India is a barrier to growth of digital marketing. Computer education is a major challenge.
2. Lack of vocational education centres and training of digital marketing limits the growth of online tradings.
3. Training in English and other languages to market online in global markets is necessity.
4. Communication skills of salesmen is not upto the mark.
4. There is calamitous need for laws and special jurisdictions to address high levels of fraud in

product quality, sale and actual delivery, and use of credit/debit cards.

5. Various users still don't trust on online trading methods of paying. Software programmes need to be developed which prevent hacking, phishing and misuse of credit/debit card details.
6. There is a risk of fake sites operation in markets. There is a lack of laws and software security systems to avoid hacking of websites and burglary important data from systems is the need of the time.

National electronic trading platforms in India:

1. e-NAM: Introduction of electronic trading platform at national level, Government of India, launched electronic National Agricultural Market called as e-NAM was established on 14th April 2016 with an objective of one price in one market in one nation. Looking the need to address the problems of the existing agricultural marketing system the Union Government has introduced a Central Sector Scheme for Promotion of National Agriculture Market through a common electronic market platform. The e-NAM aims to integrate all the agricultural markets of the country and envisages a common national market for agricultural commodities with seamless movement across state boundaries. This is envisaged as a solution to various marketing issues of farmers, traders, retailers and consumers. The e-NAM Portal provides a single window service to APMCs related information and services which includes commodity arrivals, and prices, bids & offers. The physical movement of agriculture produce takes place through the APMCs while the online trading is expected to reduce transaction costs and information unevenness. Under the e-NAM, about 1000 regulated wholesale markets in various states and UTs were covered (Table 1 &2).

Expected Benefits of e-NAM to the farmers:

Expected benefits from e-NAM which includes; accessibility of farmers to a common agriculture market; real time price discovery; transparency in the agriculture marketing system; reduce the transaction costs of buyers and sellers; real time information on prices, market arrivals etc; bidding on quality parameters of commodities; online bidding for more transparency; online payment system to reduce the payment risk and ensure timely payments to farmers, cleaning, sorting, grading and weighing facilities and additional services such as soil testing laboratories at the e-NAM (Nuthalapati et al.,2020).

Table 1: Stakeholders position of e-NAM (upto October, 2024)

State	27
Traders	2,62,195
Commission Agents (CAs)	1,14,366
Service Provider	79
FPOs	4,252
Farmer	1,78,29,925
Total	1,82,10,844

Source: https://enam.gov.in/web/

Table 2: Status of electronic trade of agricultural produce by APMCs during 2024

State	**No. of APMC**	**Mandis doing Online Trade**
Andaman And Nicobar Islands	1	0
Andhra Pradesh	33	21
Assam	3	0
Bihar	20	6
Chandigarh	1	1

Chhattisgarh	20	15
Goa	7	1
Gujarat	144	37
Haryana	108	85
Himachal Pradesh	38	9
Jammu And Kashmir	17	15
Jharkhand	19	0
Karnataka	5	2
Kerala	6	0
Madhya Pradesh	139	62
Maharashtra	133	56
Nagaland	19	1
Odisha	66	37
Puducherry	2	1
Punjab	79	15
Rajasthan	145	129
Tamil Nadu	157	66
Telangana	57	34
Tripura	7	1
Uttar Pradesh	125	97
Uttarakhand	20	18
West Bengal	18	14
Total	1389	723

Source: https://enam.gov.in/web/

3. ReMS: Rashtriya e-Market Services Private Limited a PPP model which was initiative of the Government of Karnataka to take reforms in agricultural marketing system. The company was set up as the first joint venture company in the country to implement the Agricultural Marketing Policy within the state; with Government of Karnataka and the NeML having shareholding of 50% each. The reason of the formation of ReMS is to carry efficiency and transparency in the agricultural marketing system for benefit of the farmers and other market stake holders with efficient price discovery mechanism and fair competition by "Leveraging technology and creating a hassle-free market for agricultural produce to help out Farmer's obtain the best price for their produce (http://www.remsl.in).

4. Agriota: Agriota a new technology-driven Agri-commodity trading launched by UAE and sourcing e-market platform that will bridge the gap between millions of rural farmers in India and the Gulf nation's food industry. The marketplace allows the farmers to surpass the intermediaries involve in trading of agricultural commodities which optimizing the supply chain and ensuring traceability to create value for all stakeholders.

5. BEAM: BSE, India's premier and most diversified exchange and the world's fastest Stock

Exchange launched an electronic spot platform for agricultural commodities i.e. BSE E-Agricultural Markets Ltd. (BEAM) - through its subsidiary BSE Investments Ltd. The BSE platform function as a national level, institutionalized, electronic, transparent commodity spot trading platform in line with the Prime Minister's vision to create a "single market". The BSE e-market platform facilitates spot agricultural produce transactions across value chain consisting of producers, middlemen, ancillary services and consumers. The platform commences operations effective December 11, 2020.

Suggestions for strengthen e-market platforms in India:

The various digital marketing initiatives in the field of agricultural may not be wider. The farmers are not aware of them. There is a need to generate awareness among the rural farmers so that they can take benefits. The existing digital marketing initiatives basically focus on output marketing and limited efforts were made on input marketing. There is a need to have fully equipped digital marketing initiatives that provide strong backward and forward linkages to the farmers for better realization of farm income is well recognized. The farmers need information not only current marketing parameters but also on the future trends of these marketing parameters. There is a need to develop a system that provides the up to date information on various marketing parameters to enable the farmers to take the right decision on the selection of crops, enterprises, and marketing of their produce.

Conclusion

This paper discussed the growth and the challenges in the ever-mounting area of digital marketing for agricultural produce. This field needs constant erudition. One cannot overlook the fact that it is a technological driven approach. There is esteem need to keep abreast of the latest in the field of computer science and information technology. Poorly created and executed programs create mistrust between clients and market players. Spam, identity theft, intrusive advertising, technical snags, not keeping terms with agreements, gap between ordered products and actual deliveries have created deep mistrust in digital marketing. The growth of digital marketing will depend on the development of business ethics on the one hand and initiation of consumer protection laws on the other. In other words, the relevance of 'credibility' in business in general and digital marketing in particular can be addressed with skill development in the field of information technologies.

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LP 6.1

ICT - A tool for women empowerment

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Introduction

The development of the nation depends upon the development of human resources and ICT plays a very crucial role in the development of human resources. Human resources mean not only men but women also. As we know that India is still man dominant country and women have fewer resources as compared to men but ICT destroying all the gaps and provides a great opportunity for the development of women. Empowering women through ICT means providing economic power to reduce poverty, develop new opportunities for distance learning and education, bring improvement in the health of women, and finally increase the literacy rate among women.

What is ICT?

Information and Communication Technologies (ICTs) are a diverse set of technological tools and resources to create, disseminate, store, bring value addition and manage information. The ICT sector consists of segments as diverse as telecommunications, television and radio broadcasting, computer hardware, software and services and electronic media, for example, the internet and electronic mail ICT is a broader term that includes all the communicational devices, cell phones, radio, television, and computer along with satellite systems. Various services and appliances such as video conferencing and distance learning programmes are also included in ICT with analogue technology.

Kamala *et.al.* Studied that Majority (94 per cent) of the respondents have television as it is the cheapest and most common source of entertainment. Next most available ICT hardware was mobile (52 per cent) since in the present period a mobile has become necessity to everyone in day to day life. Radios were available only to 37 per cent respondents as they are also available in inbuilt form of mobiles. Only a negligible number of respondent's i.e 1 per cent is not having availability of internet and e-mail.

Need for ICT

Women need technology for the same reason as men

- ✓ To development their marketable skill
- ✓ Enhance their economics opportunities
- ✓ Participate in information decision making
- ✓ Promote themselves as an individual
- ✓ To participate in modern world
- ✓ The use of technology is totally related with economic development
- ✓ ICTs is playing an important role in changing the attitude and behaviour perspective of society towards women
- ✓ It is creating a psychological comfort level of women at their workplace by providing them knowledge and skill
- ✓ Women increased access to job, market and improve entrepreneurship
- ✓ Increase of average household income in villages

Role of ICTs in gender empowerment

Empowerment of women in the context of knowledge societies entails building up the abilities and skills of women to gain insight into the issues affecting them and also building up their capacity to voice their concerns. In this context ICTs are emerging as a powerful tool for gender empowerment in many developing countries. There has been a rapid growth in the ICT sector since the late 1980s and the use of ICT has dramatically expanded since the 1990s.

ICT and gender equality:

ICT is considered as a device for the promotion of gender equality and women's empowerment. ICT gives the chance to men as well as women of awareness and technical education. With the help of ICT women work side by side with men. ICT is proved helpful to reduce the gender gap. Hence, interpretation the connection with other area will help schedule makers to apprehension why some policies are failed though of an increase in physical, economic and political scope. Al though ICT in rural Bangladesh is not much affected for the women in rural areas but they helping to deliver the required information which finally changes their thinking point of view and develop their self respect and self confidence.

The following are some of the advantages offered by ICT to women:

- ICT has given women the opportunity to work from home. It has given the freedom to people to operate from the comfort of their own houses.
- It is helping in knowledge dissemination and enables women to know about the day-to-day happenings of the country as well as in other countries.
- The quality of education has increased. Literacy levels, awareness and confidence levels among women have improved significantly. Learning has become hassle-free and enables women to learn in their comfort after finishing household chores. E-governance initiatives have made the life of women easy. It is now easy to get services like birth certificates, income certificates and all necessary certificates online. Loss of wages and bribes and the requirement to travel long distances to get the certificates are all eliminated.
- Emails, chat and Voice over Internet Protocol (VoIP) have connected people in rural areas to connect with their kith and kin abroad and in faraway places. Some people use these services to get job opportunities abroad.
- Timely information through facilities like video conferencing for getting information from experts in different fields like agriculture, eye care, astrology, nutritional information, and prenatal care is available to women especially

Challenges

- ✓ Women fall into the category of less informed who have poor access to information and information on many matters is restricted for cultural, social, economic and geographic reasons. The main hurdle that prevents women from accessing information is illiteracy.
- ✓ Civil society and government have not still utilized the full potential of ICT in women's empowerment. Hence, they are not very much in creating enabling frameworks and spaces for the growth of ICT infrastructure.
- ✓ ICTs come at a financial cost. This is the major hurdle for the penetration of ICT at the community as well as at the individual level. This is compounded by the fact women in India have an average meager income and do not have decision-making power in the household to invest in these technologies.
- ✓ *P*enetration of ICTs also depends upon the physical infrastructure requirements like electricity, telephone lines, internet gateways etc.
- ✓ Linguistic barriers prevent knowledge available on the internet to get disseminated to the poorest and illiterate sections of society.
- ✓ Lack of trained human resources to handle technology and networking issues.

Realizing the challenges allows us to address the barriers better and devise strategies that consider the complex dimension of women's lives.

Some of the strategies suggested for women's empowerment through ICTs.

- Improving access to women's entrepreneurs' relevant ICTs and the climate remaining socio-cultural constraint that may act as barriers to their use of ICTs.
- Creating an environment where women feel welcome and comfortable learning with others getting trained on using ICT and participating in community development activities, including community advocacy efforts.
- Establishing an ICT education centre for women where women can receive basic courses: Internet use, MS-Excel, MS-PowerPoint, and computer basic.
- Content in the local language is extremely important if ICTs are to make a difference in women's lives. It is therefore important to develop content that addresses local/regional/national needs, to provide information relevant to local/regional/national issues and disseminate that information in appropriate language.
- Increasing opportunities for women in supervisory and management-level leadership positions in ICTs companies.
- Developing ICT-based programs that address women's specific needs and that are run by women e.g. literacy programs, business planning courses, ICT training, access to health information and services, access to market and trading information services and e-commerce initiatives.
- Enabling women's participation in e-governance and building gender awareness among women and men participants.
- Engendering projects requires participatory processes that involve men and women in the community, inputs from gender experts and organizations that work on gender issues and gender sensitization of project staff.

Conclusion

Information and Communication Technology is also playing an important role. Television is the cheapest and most common source of entertainment next most available ICT hardware radio. Through ICT women are getting security, awareness, knowledge, employment, confidence, popularity *etc.* ICT provides resources, information and opportunities for development. Women need access to the educational and training opportunities necessary to equip them for the rapidly changing skill requirements. Women need access to the educational and training opportunities necessary to equip them for the rapidly changing skill requirements. Civil society actors, administrator including NGOs need to develop advocacy strategies to address the role of ICTs in the promotion of their equality in decision-making and accountability. To make women independent, powerful and strong in all fields with the help of ICT necessary actions are to be taken at regional, national and international levels.

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LP 6.2

Role of gender in agriculture and allied sector

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Introduction

Swaminathan, the famous agricultural scientist describes that it was woman who first domesticated crop plants and thereby initiated the art and science of farming. While men went out hunting in search of food, women started gathering seeds from the native flora and began cultivating those of interest from the point of view of food, feed, fodder, fiber and fuel. Women have played and continue to play a key role in the conservation of basic life support systems such as land, water, flora and fauna. They have protected the health of the soil through organic recycling and promoted crop security through the maintenance of varietal diversity and genetic resistance. That women play a significant and crucial role in agricultural development and allied fields including in the main crop production, livestock production, horticulture, post-harvest operations, agro/ social forestry, fisheries, etc. Studies on women in agriculture conducted in India and other developing and under developed countries, all point to the conclusion that women contribute far more too agricultural production than has generally been acknowledged.

Recognition of their crucial role in agriculture should not obscure the fact that farm women continue to be concerned with their primary functions as wives, mothers and homemakers. Despite their importance to agricultural production, women face severe handicaps. They are in fact, the largest group of landless labourers with little real security in case of break-up of the family owing to death or divorce; inheritance laws and customs discriminate against them land reform and settlement programmes usually give sole title and hence the security needed for obtaining production credits to the husband. It may not be out of place to mention here that considering their dual responsibilities within and outside the home, it would be in the fitness of things that more and more in the village training is organized for rural farm women to suit their convenience with due realization that institutional training is important in its own place. (Jayasheela, G. 2015)

Common Gender Stereotypes

Women are:	***Men are:***
Dependent	Independent
Weak	Powerful
Emotional	Logical
Implementers	Decision-makers
Cautious	Adventurous
Soft-spoken	Out-spoken
Nurturing	Assertive

Women in agriculture and allied sectors

The operations regarding agriculture and its allied sectors carried out by women are discussed in details as follows:

1. Agriculture

More specifically, rural women are employed in many agrarian activities in three major ways depending upon the socio-economic condition of their family as well as the regional issues. They are engaged as:

- ✓ Paid or unpaid labourers on other farms and agricultural enterprises
- ✓ Farmers on their own account, as unpaid workers on family farms
- ✓ Managers of certain aspects of agricultural production by means of labour supervision and participation in post-harvest operations also.

The types of numerous labour-intensive agricultural activities taken up by rural women include: Sowing, Nursery management, Transplanting, Hoeing, Grass cutting and weeding, Picking, Irrigation, Fertilizer application, Plant protection, Harvesting, winnowing, storing etc.

. **2. Horticulture sector**

Small scale production of vegetables, fruits, flowers, mushroom, vermin, seeds, seedlings in the village farms served as a source of employment. Women are found to play a role in racing and nursing the crop and selling them in the weekly market. Horticulture as an industry is management oriented requiring immediate post harvest processing due to its perishability and women are found to participate in inter-culture and harvesting. Gender issues in horticulture involves drudgery of inter-culture operations and harvesting.

3. Livestock

Livestock is an elementary livelihood activity for fulfilling household food demands as well as supplements farm incomes also, and it is documented that rural women can earn additional income from the sale of milk and animals. An estimated two-thirds of poor livestock keepers, totalling approximately 400 million people, are women (Thornton *et al*., 2002). It is evident that predominantly women play a dominant role in livestock production and perform management activities such as Cleaning of animal and sheds, Watering of cattle, Milking the animals, Milk processing, Fodder collection, Preparing dung cakes and Collection farmyard manure

4. Poultry

Poultry farming is one of the major sources of the rural economy, and the rate of women participation at the household level is central in the poultry industry.

5. Fisheries and aquaculture

They are more commonly occupied in

- Subsistence and commercial fishing from small boats and canoes in coastal or inland waters.
- Processing and marketing stages, in both artisanal and industrial fisheries
- Fish processing as entrepreneurs and provide labour before, during and after the catch.

6. Forestry

Women contribute to both the formal and informal forestry sectors in many remarkable ways. They play active roles in Agroforestry, Watershed management, Tree improvement, and Forest protection and conservation, Maintenance of nurseries to plantations, and from logging to wood processing.

Gender Issues in Agriculture

1. Over-burden of Work

Rural women are much more over-burdened than men owing to their multiple occupations. Researches on women in agriculture have revealed that on an average women work for 15-16 hours a day.

2. Impact of Technology

Some of the new agricultural technologies are reported to have affected farmwomen adversely. Green revolution had led to the dispossession of small women land-holders, who have been forced to join the ranks of wage earners. Wherever the new agricultural technology led to multiple cropping, the work load of women has increased. While a number of tasks performed by males have been mechanized, the tasks usually allotted to women continue to be manual and suffer from drudgery.

3. Facilities and Support Services

There is rigidity for female labourers in terms of working hours, place and duration of work. Because of this, children are neglected and health of women is also adversely affected. Lack of adequate support services like child care services-creche, balwadi, adequate maternity and health care- lack of safe drinking water etc. further add to their problems.

4. Development Bias

Despite the contribution of women in the production process, persistent bias of development planners in treating them primarily as consumers of social services rather than producers, kept them away from the development programmes in agriculture and allied sectors. Women suffer from a statistical purdah because of which their contribution is not recognized. They often have heavier workloads than men and bear virtually sole responsibility for family welfare and household management. However, they have limited control over productive resources. Gender discrimination, rooted in law and custom, is pervasive and impedes socio-economic development.

Conclusion

Rural women are the major contributors in agriculture and its allied fields. Her work ranges from agriculture, horticulture practices, fisheries practices, livestock production and cottage industry. From household and family maintenance activities, to transporting water, fuel and fodder. Despite such a huge involvement, her role and dignity has yet not been recognized. Their involvement differs across the regions, socio-cultural and agro-production systems also. Such gender issue like as; over burden of work, impact of technology, support services and development bias.

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LP 6.3

Sensitization of women about various women empowerment programme

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Introduction

Women empowerment refers to the process of enhancing the social, economic, political, and educational strength of women to enable them to lead independent and fulfilling lives. It is about equipping women with the resources, skills, and opportunities necessary to overcome social and systemic barriers, ensuring they have equal rights and a voice in decision-making processes. Empowering women is not just a matter of equity but also a critical factor in driving societal progress. When women are educated, financially independent, and confident, they contribute significantly to the development of their families, communities, and economies. In a world where gender inequalities persist, promoting women's empowerment is essential for achieving sustainable development, reducing poverty, and fostering inclusive societies. This empowerment is achieved through various means, including education, access to healthcare, economic opportunities, legal rights, and protection against discrimination and violence. As a cornerstone of gender equality, women empowerment lays the foundation for a fair and just society where everyone, regardless of gender, can thrive. Achieving women empowerment involves collective efforts by governments, NGOs, communities, and individuals to create a world where every woman has the freedom and opportunity to reach her full potential.

The sensitization level of women about women empowerment programs refers to their awareness, understanding, and engagement with initiatives aimed at enhancing their rights, opportunities, and socio-economic status. This level often varies based on factors like education, geography, cultural norms, and access to information. Assessing and improving the sensitization level is critical for the success of empowerment programs. Improving the sensitization level of women about empowerment programs requires a multifaceted approach involving grassroots efforts, media, technology, and consistent government support. Tailored strategies that consider cultural and regional contexts can ensure that women from all walks of life are informed, engaged, and able to take advantage of opportunities designed to uplift them.

Factors Influencing Sensitization Levels

1. **Education**
    - Higher literacy rates increase awareness about rights and available programs.
    - Women with limited access to education may be less informed about their entitlements.
2. **Geographic Location**
    - Urban women are generally more aware of empowerment programs than their rural counterparts due to better access to media and resources.
    - Remote areas often lack outreach programs, leaving many women uninformed.
3. **Socio-Cultural Norms**

- Patriarchal norms in some communities limit women's exposure to information.
- In contrast, progressive communities encourage awareness and participation.

4. **Access to Media and Technology**
    - Women with access to smartphones, social media, and the internet are more likely to learn about government schemes and empowerment opportunities.
5. **Community Engagement**
    - Areas with active self-help groups (SHGs), NGOs, and women's organizations have better sensitization levels.
    - Peer networks play a significant role in spreading awareness.
6. **Government and NGO Outreach**
    - Regular workshops, campaigns, and events organized by governments and NGOs improve awareness.
    - Lack of follow-through or poor implementation can hinder sensitization efforts.

Challenges in Sensitization

1. **Lack of Awareness Mechanisms**
    - Many women remain unaware of programs due to insufficient information dissemination.
    - Government campaigns may not reach the grassroots level effectively.
2. **Language Barriers**
    - Materials not available in regional languages make it difficult for some women to understand program details.
3. **Social Restrictions**
    - Cultural or familial restrictions may prevent women from accessing or acting on the information.
4. **Inadequate Engagement Methods**
    - Passive approaches like distributing pamphlets may not engage women effectively compared to interactive workshops.
5. **Digital Divide**
    - Limited digital literacy and internet access in rural areas hinder awareness.

Improving Sensitization Levels

1. **Community-Based Approaches**
    - Organize village meetings, self-help group discussions, and local workshops.
    - Involve community leaders to endorse and advocate for programs.
2. **Leverage Technology**
    - Use mobile apps, SMS alerts, and social media campaigns tailored for women.
    - Provide digital literacy training to rural women.
3. **Language and Cultural Customization**
    - Translate materials into local languages and use culturally appropriate content.
    - Utilize storytelling and role-playing to explain complex topics.
4. **Media Outreach**
    - Engage radio, TV, and newspapers, especially in regional languages, to reach wider audiences.

- Create relatable advertisements highlighting success stories of empowered women.

5. **Capacity Building**
   - Train women in leadership, advocacy, and rights awareness through regular workshops.
   - Collaborate with NGOs for sustained follow-ups.
6. **Involve Schools and Colleges**
   - Introduce programs for adolescent girls to create awareness early on.
   - Encourage family participation to support their daughters' empowerment.

Indicators of Successful Sensitization

- Increased participation of women in empowerment programs.
- Rise in the number of women accessing government schemes.
- Growth in women joining SHGs or starting entrepreneurial ventures.
- Enhanced representation of women in local governance and decision-making roles.

Government's Role in Women Empowerment

Governments play a pivotal role in advancing **women empowerment** by creating policies, implementing programs, and fostering an environment that promotes gender equality. Their initiatives are aimed at addressing economic, social, educational, health, and political barriers that women face.

Below are the key areas where governments contribute significantly to women empowerment:

1. Policy Frameworks and Legislation

- **Equal Rights and Opportunities**:
  - Enacting laws to ensure gender equality, such as the *Equal Remuneration Act* for pay parity.
  - Guaranteeing legal protection against discrimination in workplaces and educational institutions.
- **Protection from Violence**:
  - Laws like the *Protection of Women from Domestic Violence Act (2005)* and *Sexual Harassment of Women at Workplace (Prevention, Prohibition, and Redressal) Act (2013)* aim to safeguard women.
  - Stricter penalties for crimes such as trafficking, harassment, and gender-based violence.

2. Economic Empowerment

- **Financial Inclusion**:
  - Promoting programs like *Jan Dhan Yojana* to encourage women to open bank accounts.
  - Offering easy access to loans for women entrepreneurs under schemes like *Mudra Yojana*.
- **Skill Development**:
  - Training initiatives under *Skill India Mission* to help women gain employable skills in various industries.
- **Microfinance and SHGs**:
  - Supporting Self-Help Groups (SHGs) through credit schemes and subsidies under the *National Rural Livelihood Mission (NRLM)*.

3. Educational Initiatives

- **Access to Education**:
    - Programs like *Beti Bachao Beti Padhao* aim to improve the education of girls and reduce dropout rates.
    - Scholarships and free education initiatives for girls, especially in rural and marginalized areas.
- **Digital Literacy**:
    - Campaigns such as *Digital Saksharta Abhiyan (DISHA)* promote digital literacy among women.

4. Health and Well-being

- **Maternal Health**:
    - Schemes like *Janani Suraksha Yojana* provide financial aid for institutional deliveries to reduce maternal and infant mortality.
    - Free distribution of sanitary napkins under initiatives like *Menstrual Hygiene Scheme*.
- **Nutrition Programs**:
    - *Integrated Child Development Services (ICDS)* ensure nutrition for pregnant women, lactating mothers, and children.
- **Awareness Campaigns**:
    - Promoting awareness about family planning, reproductive health, and preventive care.

5. Political Empowerment

- **Reservation Policies**:
    - Reservation of seats for women in local governance through *Panchayati Raj Institutions*.
    - Efforts to increase women's representation in state and national legislatures.
- **Leadership Training**:
    - Programs to train women leaders in governance, administration, and grassroots activism.

6. Safety and Security Measures

- **One-Stop Centres**:
    - Establishment of *One-Stop Centres* under the Nirbhaya Fund to support women facing violence.
- **Helplines**:
    - Dedicated 24/7 helplines for reporting crimes against women, like *181 Women Helpline*.
- **CCTV and Public Safety**:
    - Installing surveillance systems in public spaces for enhanced safety.

7. Social Empowerment

- **Awareness Campaigns**:
    - Campaigns like *Sukanya Samriddhi Yojana* encourage parents to invest in the education and future of their daughters.
- **Combating Social Evils**:

   - Strict laws and awareness against practices like child marriage, dowry, and honor killings.

Challenges for Governments

Despite these efforts, challenges persist:

- Deep-rooted cultural and societal norms often hinder the implementation of policies.
- Lack of awareness among women about their rights and available programs.
- Inequalities in rural vs. urban access to resources and opportunities.

Key Women Empowerment Programmes to Promote

1. **Central Government Schemes:**
   - Beti Bachao Beti Padhao (BBBP): Focus on improving child sex ratio and promoting girl child education.
   - Sukanya Samriddhi Yojana (SSY): Savings scheme for the girl child.
   - Ujjwala Yojana: Provision of free LPG connections to women in rural areas.
   - PM Mudra Yojana: Loans for women entrepreneurs to start small businesses.
   - Mahila E-Haat: Online platform to support women entrepreneurs.
2. **State-Specific Initiatives in Gujarat:**
   - Kanya Kelavani Yojana: Scholarships for girl students.
   - Vahli Dikri Yojana: Financial support for the birth of a girl child.
   - Mission Mangalam: Focus on empowering women through Self-Help Groups (SHGs).
   - Gaurav Nari Niti: Skill development and employment opportunities for women.
   - Shramik Mahila Vikas Yojana: Welfare measures for women laborers.
3. **Legal Rights Awareness:**
   - Domestic Violence Act, 2005.
   - Equal Remuneration Act, 1976.
   - Maternity Benefit Act, 2017.

Strategies for Sensitization

1. **Community Outreach Programs:**
   - Organize village-level workshops and seminars.
   - Utilize Anganwadi centers and local NGOs for information dissemination.
   - Collaborate with Panchayats to identify and reach marginalized groups.
2. **Media Campaigns:**
   - Leverage local radio stations, newspapers, and social media in Gujarati.
   - Share success stories of empowered women in Saurashtra to inspire others.
3. **Educational Initiatives:**
   - Conduct school and college awareness drives about scholarships and educational opportunities.
   - Partner with universities to encourage youth participation in sensitization activities.
4. **Capacity Building:**
   - Form and train women Self-Help Groups (SHGs).
   - Provide skill development workshops in trades like handicrafts, tailoring, and IT.
5. **Helplines and Support Centers:**
   - Promote helpline numbers for women’s safety and assistance (e.g., 181 Abhayam).
   - Set up help desks in block offices to assist women with scheme applications.

Challenges

- Resistance from patriarchal norms in rural areas.
- Illiteracy and lack of digital access among women.
- Limited awareness of the programs at the grassroots level.

Monitoring and Evaluation

- Track participation rates in empowerment programs.
- Assess changes in women's socio-economic status through surveys.
- Gather feedback to improve outreach and implementation strategies.

Collaboration and Partnerships

- Collaborate with NGOs like SEWA (Self Employed Women's Association).
- Involve corporates under CSR initiatives for skill training and awareness campaigns.
- Engage local influencers and religious leaders to gain community trust.

Conclusion

Sensitizing women about various empowerment programmes is a pivotal step toward fostering gender equality and socio-economic development in the Saurashtra region. Through targeted awareness campaigns, community engagement, and capacity-building initiatives, women can gain access to resources, education, and opportunities that enable them to improve their livelihoods and contribute meaningfully to society. By overcoming challenges such as patriarchal norms and lack of access to information, this effort can transform lives, building a society where women are active agents of change rather than passive recipients. Collaboration among government, NGOs, and local communities is essential to ensure that these initiatives reach the grassroots level, creating a sustainable ecosystem for women's empowerment.

Ultimately, the sensitization process is not just about informing women but empowering them with the confidence and knowledge to claim their rights and take charge of their future, paving the way for an equitable and progressive society in the Saurashtra region.

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LP 6.4

Strategies for holistic empowerment of farm women for Sustainable Agriculture Development

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Abstract

India has celebrating and commemorating the progressive 75 years of India after independence with 'Azaadi Ka Amrit Mahotsav' and promulgating mission of warranting women as "Empowered women Empowered Nation". Women are extensively engaged in the activities pertaining to agriculture and allied sector. Agriculture, the single largest production endeavor in India, contributing to 16% of the GDP is increasingly becoming a female activity. Agriculture sector employs 80% of all economically active women; they comprise 33% of the agricultural labour force and 48% of self-employed farmers. Holistic empowerment of women farmers will play a key role in achieving the sustainable agriculture development. When women are engaged and can guarantee their privileges and admittance to land, authority, openings, and decisions, economies develop, food security is upgraded and prospects are improved for current and people in the future. This can be achieved through employing appropriate strategies appropriate strategies for holistic empowerment of farm women for sustainable agriculture development consist of financial empowerment of women farmers, enhancing decision making abilities, enhancing skill and capacity building, promotion of Sakhi Mandal and SHGs in empowering women farmers, r**e-imagine traditional approaches to farming, ensuring food and nutritional security, fostering entrepreneurship, ge**nder-specific interventions can boost the process of holistic empowerment of farm women for sustainable agriculture development.

Keywords: Holistic Empowerment, Women Farmers, Sustainable Agriculture development

Introduction

India is celebrating and commemorating the progressive 75 years of India after independence with 'Azaadi Ka Amrit Mahotsav' and promulgating mission of warranting women as "Empowered women Empowered Nation". India is an agrarian economy with about 54.6 percent of total workforce engaged in agricultural and allied sector activities. Women are extensively engaged in the activities pertaining to agriculture and allied sector. The workforce participation rate for rural females is significantly higher at 41.8 percent against urban women participation rate of 35.31 percent.

Rural women are torchbearers for social, economic and environment transformation for the 'New India'. In India, Agriculture employs about 80 percent of rural women. Empowering and mainstreaming rural women workforce in agriculture can bring paradigm shift towards economic growth. It will enhance food and nutrition security and alleviate poverty and hunger. It's a win win strategy for achieving Sustainable Development Goals by 2030. Rural women form the most productive work force in the economy of majority of the developing nations including India. Agriculture, the single largest production endeavour in India, contributing to 16% of the GDP is increasingly becoming a female activity. Agriculture sector employs 80% of all economically active women; they comprise 33% of the agricultural labour force and 48%

of self employed farmers. About 18% of the farm families in India, according to NSSO Reports are reported to be headed by women. Beyond the conventional market – oriented, narrower definition of ‘productive workers’, almost all women in rural India can be considered as ‘farmers’ in some sense, working as agricultural labourers, unpaid workers in the family farm enterprises or combination of the two.

Women are the foundation of the agricultural labor force and are a crucial piece of the Indian economy. When women are engaged and can guarantee their privileges and admittance to land, authority, openings, and decisions, economies develop, food security is upgraded and prospects are improved for current and people in the future.

Employing appropriate strategies for holistic empowerment of farm women for sustainable agriculture development will help in achieving the enhancement in the participation and productivity of women in agriculture. This will help them in ensuring food and nutrition security at the household and the community level. It will enable women to have better access to inputs and services of the government and other agencies. This will open up sustainable agricultural livelihood opportunities forwomen in agriculture by improving the skills and capabilities of women in agriculture tosupport farm and non-farm-based activities. Strategies i.e. financial empowerment of women farmers, enhancing decision making abilities, enhancing skill and capacity building, promotion of Sakhi Mandal and SHGs in empowering women farmers, r**e-imagine traditional approaches to farming, ensuring food and nutritional security, fostering entrepreneurship, g**ender-specific interventions can boost the process of holistic empowerment of farm women for sustainable agriculture development.

Harnessing the benefits of women empowerment programmes

Several government flagship schemes and programmes are initiated to improve rural and farm women stature in society by creating livelihood opportunities and engagements in paid employments. Various schemes, such as the Prime Minister’s Employment Generation Program (PMEGP), National Livelihoods Mission, Deen Dayal Upadhayay Grameen Kaushalya Yojana (DDU-GKY), Pradhan Mantri Kaushal Vikas Yojana (PMKVY), Beti Bachao Beti Padhao, Pradhan Mantri Matru Vandana Yojana I (PMMVY), etc. has made significant contributions in creating gender parity and socio-economic empowerment of women in India. Now, rural women have availing access to education, productive resources, capacity building, skill development, healthcare facilities and diversified livelihood opportunities through government beneficiary schemes.

Pradhan Mantri Kaushal Vikas Yojana (PMKVY) implemented by Ministry of Skill Development and Entrepreneurship provides several short duration skill training programmes viz. Short-Term Training (STT) and Recognition of Prior Learning (RPL), etc. for rural youth and women to earn their livelihood. Farm women should make aware of these schemes so that they can harness the benefits and move forward for empowering themselves.

Financial empowerment of women farmers

Financial empowerment of farm women can help improve their economic opportunities and contribute to overall economic development. Value addition of local crops, entrepreneurship and profitable management of income will boost up the total per capita income and financial empowerment of farm women. Microfinance and digital banking are the successful initiatives help women invest in their farms and businesses. India has taken a significant initiative in extending banking outreach to rural areas. The financial inclusion and accessibility to banking through Pradhan Mantri Jan-Dhan Yojana (PMJDY) has boosted confidence and prospects of farm women participation in economic activities. Jan Dhan campaign has ensured access to financial services, viz, banking/ savings and deposit accounts, remittance, credit, insurance, pension in an affordable manner to farm women. These financial accessibility measures have ensure the transparent mode of transaction and timely access to financial services through direct benefit transfer (DBT) facility provided under various

Government of India schemes. Over 7 years of the implementation of this scheme, 43.04 crore accounts has been opened in the country.

Further, this constitute 55.47 percent (23.87 crore) women account holders and 66.69 percent (28.70 crore) are Jan Dhan accounts in rural and semi-urban areas (Ministry of Finance, 2021, Other initiatives like Pradhan Mantri MUDRA Yojana (PMMY), Stand-Up India Scheme, Prime Minister's Employment Generation Programme (PMEGP) are the additional supporting steps towards financial empowerment and entrepreneurship development of rural women. Over 9 crore women have benefitted jointly from Mudra and Stand-Up India. Pradhan Mantri MUDRA Yojana (PMMY), Stand-Up India Scheme, and Prime Minister's employment Generation Programme (PMEGP) supports the financial empowerment and entrepreneurship development of rural women.

Enhancing decision making abilities

To enhance the decision-making ability of farm women should be provided by resources including access to finance, training, and other resources. Gender champions can promote social dialogue, advocate for women, and help challenge gender roles. Local role models and successful farm women can motivate them in building confidence in decision making activities. Social networks can help spread agricultural knowledge. Promoting the cultivation of high-value and cash crops can help women farmers. Encouraging women to use more and better quality fertilizer and seeds can help.

Enhancing skill and capacity building

Tailor training to women's needs and provide technical training in agriculture. This can include training in sustainable farming techniques, climate-resilient agricultural practices, and post-harvest management. Utilizing indigenous knowledge and skill, development of entrepreneurial skills in agribusiness, food processing, and value addition, easy accessibility to resources with help of financial literacy programs and encourage the formation of self-help groups (SHGs) and cooperatives, strengthening the market linkages, incorporate innovative and technology-driven agriculture into agricultural education and training programs helps in enhancing skills and capacity building of farm women.

For skill development and capacity building amongst women farmer, various skill-training are being imparted under schemes of Ministry of Agriculture and Farmers' Welfare and Ministry of Rural Development. These include Support to State Extension Programmes for Extension Reforms (ATMA Scheme) under Sub-Mission on Agriculture Extension (SMAE). Skill training courses in agriculture and allied areas (of minimum 200 hours duration) are also being conducted for women farmers through National Training Institutes, State Agricultural Management and Extension Training (SAMETIs), Krishivigyan Kendras (KvKs) and State Agricultural Universities (SAUs), across the country (Ministry of Agriculture and Farmers Welfare, 2021).

The Ministry of Agriculture and Farmers' Welfare and Ministry of Rural Development through various schemes have encouraged participation of rural women farmer. The primary objective of the MKSP is to empower women in agriculture by making systematic investments to enhance their participation and productivity, as also create and sustain agriculture based livelihoods of rural women. This scheme was introduced as a subcomponent of DAY-NRLM (Deen dayal Antyodaya Yojana — National Rural Livelihoods Mission)and implemented through State Rural Livelihoods Mission (SRLM) across India. Under DAY-NRLM scheme, trainings on use of latest agriculture, allied techniques, agro-ecological best practices are being imparted to women farmers through the community resource persons and extension agencies. Specific women farmer training programmes on topics like household food security by kitchen gardening and nutrition gardening; design and development of low/minimum cost diet; designing and development for high nutrient efficiency diet; Processing and cooking; Gender mainstreaming through SHGs; Storage loss minimization techniques; value addition; Women empowerment; Location specific drudgery reduction technologies; Rural Crafts; and Women and child care are organized through extension bodies (Ministry of Agriculture and Farmers' Welfare, 2021). These training programmes have opened avenues for new livelihood opportunities for rural women.

Promotion of Sakhi Mandal and SHGs in empowering women farmers

Sakhi Mandal and SHGs lead farmers in the areas of production, credit and marketing. SHG membership enables farmers access to credit, training and to technical advice from the Council staff, but benefits have gone beyond production related aspects. Sakhi Mandal and SHGs lead women farmers in the areas of production, credit and marketing. SHG membership enables farmers access to credit, training and to technical advice from the Council staff, but benefits have gone beyond production related aspects. The government of India provided the scheme – "Self Help Groups" to enable women to achieve economic independence through self-employment, entrepreneurial development, etc. Self Help Groups plays an important role in the empowerment of women in our country and also poverty alleviation in the rural area. It is reported that the SHGs have a role in accelerating a country's economic development.

The Government is implementing Deendayal Antyodaya Yojana – National Rural Livelihoods Mission (DAY – NRLM) across the country in a mission mode with the objective of organizing the rural poor women into Self Help Groups (SHGs) and continuously nurturing and supporting them till they attain appreciable increase in incomes over a period of time and improve their quality of life and come out of abject poverty.

Re-imagine traditional approaches to farming

Re-imagine traditional approaches to farming explore new possibilities in farming involves re-evaluating farming practices and transforming conventional norms in farming. Farmers should be trained in new farming techniques such as modern irrigation methods, crop rotation, crop protection methods and crop diversification. They should be encouraged to plant a variety of fruits, vegetables and millet. Millet farming requires considerably less water than rice farming. Additionally, planting trees has proven to be beneficial in creating a healthy ecosystem. It can improve green cover, reduce soil erosion and maintain soil quality. Plantation of high-value trees at the periphery of the farms can be harnessed to provide a sustained income. Teak and bamboo trees can be lucrative sources of income. Another area that deserves attention is the creation of water bodies and trenches in rural areas. Conserving rainwater will help meet the agricultural requirements throughout the year. Rainwater harvesting provides farmers with immeasurable benefits - it saves water resources, reduces soil erosion, improves yield and drives sustainable growth. There should also be awareness building on the effects of climate change and how they can navigate this shift.

Nutritional Empowerment of farm women

Farm women in particular are responsible for half of the world's food production and produce between 60 and 80 percent of the food in most developing countries but still malnutrition is the biggest problem among this group. Nutritional status of farm women plays an important role in improvement of overall health and quality of life of farm women. Unfortunately, malnutrition among farm women is still largely prevailing in our country. Women's health affects the household economic well being. They further noted that a woman with poor health would be less productive in the labour force as perform the majority of the drudgery prone work. It's important to consider women's nutritional status in its own right, as women face specific risks that men don't, such as pregnancy. Nutrition-sensitive policies and programs can help improve the diets and well-being of mothers and children. ICDS is providing nutritious foods during special physical conditions of women i.e. pregnancy and lactation. Value addition and preservation of locally grown crops and making the farm women aware about low cost recipes will help in uplifting the nutritional status of farm women.

Establish nutri-gardens is a very beneficial to ensure food and nutritional security of farm women especially combating the micro-nutrient deficiencies. Provide farm women with seed kits, scientific knowledge, and other inputs to help them grow vegetables and fruit. This can help them earn money by selling excess produce and improve their nutritional security.

If sharing technical know-how with women farmers will increase crop yield then providing them with information on how to understand the supply chain and access the market can have a far-reaching impact. It's important that rural women look at farming from the point of view of profitability and not only survival. One way to approach this is by developing smallholder collectives that will facilitate aggregation and give the women farmers bargaining power. It will also help them have a more straightforward link with the market. These vital adjustments will improve conditions in the farms, reduce migration to the cities, create local jobs and revitalize the economic landscape of rural India.

Gender-specific interventions

Gender specific interventions enable women to access technologies to increase agricultural efficiency and productivity; increase yields of female farmers, reducing global hunger; and raise income levels for female farmers and women-run farms, contributing to economic growth and alleviating poverty.

Special beneficiary-oriented schemes are laid by Department of Agriculture and Farmers' Welfare to mainstream the participation of rural women. These special schemes provide for States and other implementing agencies to incur at least 30 percent expenditure on women. With increased feminization and pro-women initiatives, the percentage of female operation a holdings in the country has increased from 12.78 percent during 2010-11 to 13.78 percent during 2015-16. Several farm women's food security groups, undertaking macro/micro level studies in critical thrust area related to women in agriculture, delivery of Gender Sensitization Module on Gender Learning through training programmes at National/Region/State Level, compilation and documentation of gender friendly tools/technologies, Farm Women Friendly Handbook and compilation of best practices/success stories of the women farmers, etc are undertaken by Ministry of Agriculture and Farmers Welfare.

Farmer Gender-specific interventions and its adoption are encouraged through these trainings and awareness camps. About 58,295 Krishi Sakhi were trained by 735 State Level Resource Persons under Deendayal Antyodaya Yojana-National Rural Livelihoods Mission (DAY-NRLM) and 1.23 lakh women farmers participated in special women farming training conducted by KVK.

Fostering entrepreneurship and agripreneurs for farm women

Entrepreneurship for farm women can be a way to increase income, self-sufficiency, and gender equality. Women in agriculture are key players in the global food system, but they are underrepresented in agribusinesses. Sharing technical know-how with women farmers will increase crop yield then providing them with information on how to understand the supply chain and access the market can have a far-reaching impact. It's important that rural women look at farming from the point of view of profitability and not only survival. One way to approach this is by developing smallholder collectives that will facilitate aggregation and give the women farmers bargaining power. It will also help them have a more straightforward link with the market. These vital adjustments will improve conditions in the farms, reduce migration to the cities, create local jobs and revitalize the economic landscape of rural India.

Conclusion:

Employing appropriate strategies for holistic empowerment of women farmers for sustainable agriculture development will help in achieving the enhancement in the participation and productivity of women in agriculture. This will collectively aggravate sustainable agriculture development and overall development of country.

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LP 6.5

Gender equity in agriculture: Challenges and pathways forward

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Introduction

Gender equity in agriculture is a critical issue that affects not only individual livelihoods but also the broader goals of food security, economic development, and sustainable growth. Women play a vital role in the agricultural sector, contributing to food production, resource management, and rural economies. Despite their significant contributions representing nearly half of the agricultural workforce in many developing regions women often encounter systemic barriers that limit their access to resources, decision-making power, and opportunities for advancement. Cultural norms, discriminatory legal frameworks, and economic disparities create challenges that hinder women's full participation in agriculture. These inequities not only restrict women's potential but also impede the overall productivity and resilience of agricultural systems. Addressing these challenges is essential for unlocking the full potential of the agricultural sector.

Women represent a substantial segment of the agricultural workforce worldwide, yet they often encounter significant barriers that restrict their participation and access to resources. In many societies, men and women have distinctly different roles in agriculture and food production roles that are influenced by the social and economic context. Today, urbanization and outmigration of men and youth are changing roles and responsibilities. Women are increasingly taking on greater and more varied responsibilities in farming—including irrigation, managing labor and procuring inputs. The importance of women in agricultural production is increasing in most regions (FAO 2017).

The rural women comprise a quarter of the world's population. The United Nations Food and Agriculture Organization (FAO) estimates that at least 80 per cent of rural smallholder farmers worldwide are women. They produce as much as 50 per cent of the world's food and 90 per cent of the food grown in Africa but many of them go hungry, Action Aid (2011). In Indian scenario around 84 per cent of rural women are depending on agriculture for their livelihood. Women make up about 33 per cent of cultivators and about 47 per cent of agricultural labourers. Women's participation rate in the agricultural sectors is about 47 per cent in tea plantations, 46.84 per cent in cotton cultivation, 45.43 per cent growing oil seeds and 39.13 per cent in vegetable production (Rao, 2006, Women in agriculture, 2023).

❖ Current Status of Gender Equity in Agriculture

The agricultural sector plays a critical role in global food security and economic development, with women comprising a significant portion of the workforce. However, despite their vital contributions, women often experience systemic inequalities that hinder their full participation and access to resources. The current status of gender equity in agriculture is examined in this section, with particular attention paid to the responsibilities played by women, their access to resources, and the persistent inequities.

1. Women’s Role in Agriculture

Women are essential contributors to agriculture, particularly in developing countries:

- **Labour force participation**: Women make up about 43 per cent of the agricultural labour force in developing regions, engaging in various activities such as crop production, livestock management, and food processing. Their involvement is crucial for household food security and rural livelihoods.

- **Diverse contributions**: In addition to direct farming activities, women are involved in post-harvest processing, marketing, and value addition. Their roles often encompass a range of tasks, from managing household gardens to running small agribusinesses.
- **Economic impact**: The economic contributions of women in agriculture are significant. For instance, women's participation in agriculture can lead to increased productivity, improved food security, and enhanced community resilience.

2. Access to Resources

Despite their crucial roles, women face significant barriers in accessing essential resources:

- **Land ownership**: Women often have limited rights to land ownership. Globally, women hold only about 13% of agricultural land, despite being responsible for a substantial portion of food production. This lack of ownership limits their access to credit, inputs, and markets.
- **Credit and financial services**: Women face greater challenges in accessing financial resources. Studies show that women are often excluded from formal financial institutions, with only 9% of women in low- and middle-income countries having access to credit. This lack of financial support restricts their ability to invest in agricultural activities and technologies.
- **Training and extension services**: Agricultural extension services are critical for improving productivity, yet women frequently receive less training than men. Reports indicate that women receive only about 5% of agricultural extension services globally, limiting their access to knowledge and innovative practices.

3. Gender Disparities in Productivity

Gender disparities in productivity and income remain pronounced:

- **Productivity gaps**: Research indicates that women farmers are often less productive than their male counterparts, producing up to 30% less than men. This disparity is primarily due to unequal access to resources, inputs, and training.
- **Income inequality**: Women in agriculture typically earn less than men, which can exacerbate poverty and food insecurity. On average, female farmers earn 20% to 30% less than their male counterparts for similar work.

4. Decision-Making Power

Women's lack of decision-making power significantly impacts their roles in agriculture:

- **Household decisions**: Women often have limited authority in household decisions related to agriculture, finance, and resource management. Men typically dominate decision-making processes, which can marginalize women's perspectives and needs.
- **Community leadership**: In agricultural leadership positions and groups, women are underrepresented. Their lack of representation in decision-making bodies can result in policies and programs that do not adequately address gender-specific challenges.

5. Impact of Climate Change

Additional obstacles to gender parity in agriculture are brought on by climate change:

- **Increased vulnerability**: Women, particularly those in rural areas, are disproportionately affected by climate change impacts, such as droughts and extreme weather events. Their limited access to resources and information exacerbates their vulnerability.

- **Role in resource management**: Women are often key managers of natural resources in agriculture. However, they frequently lack access to climate adaptation resources and training, which can hinder their ability to respond to environmental changes.

6. Policy and Institutional Frameworks

The current policy landscape often fails to address the specific needs of women in agriculture:

- **Lack of gender-sensitive policies**: Many agricultural policies are not gender-sensitive, resulting in programs that do not effectively support women's needs. This oversight perpetuates existing inequalities and hinders progress toward gender equity.
- **Institutional barriers**: Agricultural institutions often lack mechanisms to incorporate gender perspectives into their operations, leading to inadequate support for women farmers.

❖ **Challenges to Gender Equity in Agriculture**

Achieving gender equity in agriculture is fraught with numerous challenges that stem from cultural, economic, and institutional factors. These barriers not only hinder women's participation in agriculture but also limit their contributions to food security and economic development. The key challenges include:

1. Cultural Norms and Gender Roles

Cultural beliefs and traditional gender roles significantly shape women's experiences in agriculture:

- **Traditional expectations**: In many societies, women are primarily viewed as caretakers and homemakers, which limits their opportunities to engage in agricultural production. This perception often relegates women to less visible roles, such as subsistence farming or unpaid labor within family farms.
- **Decision-making power**: Women often lack decision-making authority over agricultural practices and resources, with men typically occupying leadership roles in households and communities. This power imbalance restricts women's ability to influence agricultural policies and practices that affect their livelihoods.
- **Social stigmas**: Women who attempt to assert their rights or pursue leadership roles in agriculture may face social stigmas, backlash, or even violence. This creates a hostile environment for those seeking to challenge traditional gender norms.

2. Legal and Institutional Barriers

Legal frameworks and institutional practices often perpetuate gender inequities:

- **Discriminatory laws**: In many countries, laws governing land ownership and inheritance are biased against women. Women may not have the right to own or inherit land, making them dependent on male relatives for access to agricultural resources.
- **Lack of gender-sensitive policies**: Many agricultural policies fail to consider the specific needs and challenges faced by women. This oversight can lead to the implementation of programs that do not effectively address the barriers women encounter in the agricultural sector.
- **Limited access to agricultural services**: Institutions often overlook women in agricultural extension services, training programs, and access to credit. This lack of targeted support exacerbates the gender gap in productivity and income.

3. Economic Disparities

Economic inequalities are a major barrier to achieving gender equity in agriculture:

- **Income inequality**: Women farmers often earn significantly less than their male counterparts, primarily due to limited access to resources, markets, and credit. Studies indicate that closing the gender gap in agriculture could increase agricultural output and reduce hunger.
- **Access to credit**: Women often face challenges in accessing financial services, such as loans and credit, which are crucial for investing in agricultural inputs and technologies. Financial institutions may require collateral that women cannot provide, further limiting their economic opportunities.
- **Market access**: Women frequently encounter barriers when trying to access markets to sell their products. Social norms, lack of transportation, and inadequate market information can prevent women from reaching lucrative markets, leading to lower incomes.

4. Knowledge and Technology Gaps

Knowledge disparities and limited access to technology further hinder women in agriculture:

- **Educational barriers**: Women often have less access to formal education and agricultural training compared to men. This knowledge gap limits their ability to adopt innovative farming practices and reduces their productivity.
- **Digital divide**: The rise of digital agriculture has created new opportunities, but women often lack access to technology and the internet. This digital divide excludes them from valuable information on market trends, weather forecasts, and best agricultural practices.
- **Limited research focus**: Agricultural research often neglects gender-specific issues, resulting in a lack of data and insights that address the unique challenges faced by women farmers.

5. Climate Change and Environmental Challenges

The impacts of climate change disproportionately affect women in agriculture:

- **Increased vulnerability**: Women, particularly in rural areas, are more vulnerable to the effects of climate change, such as droughts, floods, and food insecurity. Their limited access to resources and decision-making power exacerbates their vulnerability.
- **Resource management**: Women often play a crucial role in managing natural resources, yet they lack access to the necessary training and resources to adapt to environmental changes. This gap can hinder sustainable agricultural practices and environmental conservation efforts.

6. Social and Institutional Support Systems

The absence of robust support systems can hinder women's advancement in agriculture:

- **Lack of networks**: Women often have fewer networking opportunities compared to men, limiting their access to information, resources, and markets. Establishing strong support networks is essential for sharing knowledge and building resilience.
- **Inadequate social services**: The lack of social services, such as childcare and healthcare, can restrict women's ability to engage fully in agricultural activities. Balancing domestic responsibilities with farming can be particularly challenging for women.

❖ **Pathways Forward**

A diversified strategy is needed to promote gender equity in agriculture. This involves policy reforms, capacity building, promoting leadership, leveraging technology, and fostering collaboration among various stakeholders. Below are key pathways forward:

1. Policy and Legal Reforms

1.1 Implement gender-sensitive policies

Develop and enforce agricultural policies that specifically address the needs and challenges faced by women. This involves providing women's equal rights to inheritance, land ownership, and resource access.

1.2 Strengthen legal protections

Reform legal frameworks to eliminate discriminatory practices that hinder women's rights. Laws should guarantee women's access to and control over agricultural resources by promoting their rights to inheritance and land ownership.

1.3 Monitor and Evaluate Gender Policies

Establish mechanisms to monitor and evaluate the impact of gender-sensitive policies on women’s participation in agriculture. Regular assessments can help identify gaps and inform future policy adjustments.

2. Capacity Building and Education

2.1 Provide targeted training programs

Design agricultural training programs that cater specifically to women’s needs. Training should cover various aspects of farming, including production techniques, financial management, and marketing.

2.2 Enhance access to education

Expand rural women's and girls' access to education. Education initiatives should focus on agricultural sciences, business skills, and technology to equip women with the knowledge necessary for success.

2.3 Foster mentorship and networking opportunities

Create mentorship programs that connect women with experienced agricultural leaders and professionals. Networking can help women in agriculture by promoting cooperation, knowledge exchange, and support.

3. Promoting Women’s Leadership

3.1 Encourage participation in decision-making

Encourage the participation of women in agricultural governance and decision-making organizations. Ensuring women have a seat at the table can lead to more equitable policies and practices that reflect their needs.

3.2 Develop leadership programs

Implement leadership development initiatives specifically for women in agriculture. These programs should focus on building confidence, negotiation skills, and strategic thinking to prepare women for leadership roles.

3.3 Highlight successful female role models

Showcase the achievements of women leaders in agriculture through media and community programs. Highlighting successful role models can inspire others and demonstrate the potential of women in agricultural leadership.

4. Strengthening Networks and Partnerships

4.1 Build support networks

Establish networks that connect women farmers to share experiences, resources, and market opportunities. These networks can empower women and enhance their capacity to overcome challenges collectively.

4.2 Collaborate with NGOs and private sector

Partner with non-governmental organizations and the private sector to implement gender equity initiatives in agriculture. Collaborative efforts can enhance resource mobilization and create impactful programs.

4.3 Engage men as allies

Men should be included in conversations about gender parity in agriculture. By enlisting males as allies, we can promote an inclusive atmosphere and subvert gender stereotypes that restrict women's involvement.

5. Utilizing Technology

5.1 Utilize digital tools

Encourage women farmers to access markets, information, and agricultural services through the use of digital platforms. Women's productivity and decision-making skills can both be improved by technology.

5.2 Develop gender-responsive agricultural technologies

The development of agricultural technologies tailored to women's needs should be encouraged. This includes equipment that women farmers may easily reach and utilize.

5.2 Enhance digital literacy

Promote initiatives that raise agricultural women's level of digital literacy. Training women to use technology can bridge the digital divide and empower them to utilize digital tools effectively.

6. Addressing Climate Change and Sustainability

6.1 Promote climate-smart agriculture

Encourage the use of climate-smart farming methods that strengthen climate change resilience and empower women. Food security and environmental sustainability can be enhanced by teaching women sustainable farming practices.

6.2 Facilitate access to resources for adaptation

Give women the tools and training they need to cope with the effects of climate change. This can include details about sustainable land use methods, water management, and agricultural diversity.

6.3 Involve women in environmental management

Recognize and enhance the role of women in managing natural resources. Involve women in neighbourhood-based environmental management projects to take advantage of their skills and experience.

Conclusion

Achieving gender equity in agriculture is vital for social justice, economic development, and food security. Women contribute significantly to agricultural productivity but face systemic barriers such as limited access to land, credit, education, and decision-making power. These disparities not only hinder women's empowerment but also impact the overall effectiveness of the agricultural sector. To address these challenges, stakeholders must implement gender-sensitive policies, enhance capacity building, promote women's leadership, and harness the technology. Collaborative networks and engaging men as allies can foster a more inclusive environment. Additionally, addressing the impacts of climate change through sustainable practices is crucial for enhancing women's resilience. Ultimately, advancing gender equity in agriculture is essential for creating a more equitable and prosperous future. By valuing and harnessing the contributions of all individuals, we can build a sustainable agricultural sector that benefits everyone.

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LP 7.1

Artificial Intelligence (AI) in Indian agriculture: Transforming the path to sustainable growth and *Viksit Bharat*

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Introduction

The world's population is assumed to be nearly 10billion and that of India’s to be nearly 1.7 billion by 2050 inviting increasing the demand for food and employment (United Nations' World Population Prospects, 2022). At present, about 51.95% of total land surface is used for crop production In India. As a result, new automated methods are being introduced to meet food requirements because traditional methods used by farmers are insufficient to meet these requirements while also providing employment opportunities to billions of people worldwide. Farmers are forced to seek new solutions due to a labour shortage, stricter legislation, an increasing global population, and a declining number of farmers. Technologies such as the Internet of Things, Big Data & Analytics, Artificial Intelligence (AI), and Machine Learning (ML) make inroads into almost every industry.

AI-driven technologies such as remote sensing, IoT sensors, and drones enable precision farming by offering insights on crop health, soil conditions, and moisture levels. This data allows for precise input application—such as water, fertilizer, and pesticides—leading to more efficient use of resources and minimizing waste. Machine learning models can process data from past crop cycles, weather patterns, and soil quality to predict crop yields accurately. This information helps farmers and policymakers plan for upcoming seasons, manage supply chains, and stabilize market fluctuations. AI tools, including image recognition technology, can identify early signs of pest infestation and diseases. Through smartphone apps and drones, farmers can capture images of their crops and receive real-time advisories on potential threats. This targeted approach not only reduces crop loss but also minimizes the indiscriminate use of pesticides, contributing to more sustainable agricultural practices. Further, AI also provides invaluable insights into weather forecasting, enabling farmers to make timely decisions. Predictive analytics can help farmers adapt to changing conditions by recommending optimal planting and harvesting times, which reduces the risk of crop loss due to unexpected weather patterns. With a gradual decline in rural labor availability, AI-powered automation presents solutions to manage agricultural tasks. Autonomous tractors, harvesters, and robots for weeding and planting can supplement human labor, helping farmers maintain productivity despite labor shortages. AI-powered mobile applications and chatbot-based platforms offer farmers instant access to agricultural advice, aligning with traditional extension services. These AI systems can provide personalized recommendations, real-time alerts, and training materials, bridging knowledge gaps and improving decision-making at the farm level.

AI holds transformative potential in Indian agriculture by enabling data-driven, responsive, and adaptive farming practices. Its applications across crop management, pest control, climate resilience, market intelligence, and extension services offer sustainable pathways to address the core challenges of agriculture. As India aspires toward “Viksit Bharat,” AI’s integration into agriculture aligns with the nation’s goals for sustainable growth, food security, and farmer prosperity.

Contextualizing Role of Artificial intelligence within "Viksit Bharat" and Sustainable Development Goals

The "Viksit Bharat" (Developed India) vision reflects India's aspiration to become a developed and self-reliant nation. Central to this vision are sustainable development goals (SDGs) that emphasize inclusive growth, environmental sustainability, and improved livelihoods. Agriculture, which employs nearly half of India's population and is a primary livelihood source in rural areas, plays a pivotal role in achieving this vision. Artificial Intelligence (AI) is emerging as a crucial technology to propel India's agriculture sector toward this goal, driving efficiencies, resilience, and sustainable practices across the industry.

Table 1: **AI's Role in Meeting Sustainable Development Goals**

Sr. No.	**Sustainable Development Goal (SDG)**	**Role of AI**
1	*SDG 1: No Poverty*	Poverty reduction is a core objective of "Viksit Bharat," and AI can play a transformative role in improving rural incomes. AI tools help small and marginal farmers enhance productivity, reduce production costs, and access better market prices. AI-powered market intelligence provides farmers with insights into crop prices, demand trends, and consumer preferences, which help them make informed decisions and avoid exploitation by intermediaries. Additionally, automated systems can reduce labor dependency, allowing farmers to increase productivity without proportionate increases in labor costs.
2	*SDG 2: Zero Hunger*	AI in agriculture can contribute significantly to reducing hunger by enhancing food production and ensuring food security. Through AI-driven predictive analytics, farmers can optimize crop yields, minimize crop losses, and increase food availability. Precision agriculture—leveraging data from sensors, drones, and satellites—supports optimal input use, allowing smallholders to produce more with fewer resources. By helping farmers predict and plan around weather patterns, pests, and diseases, AI also minimizes crop loss, directly contributing to the goal of ending hunger.
3	*SDG 8: Decent Work and Economic Growth*	AI-driven mechanization and automation in agriculture can help address labor shortages, creating opportunities for rural growth without over-relying on manual labor. By introducing AI-powered tools and automation, agriculture can become less labor-intensive, safer, and more productive. Moreover, AI empowers rural youth and agricultural extension workers to pursue skilled jobs in data analytics, drone operation, and agri-tech services, contributing to decent employment and economic growth in rural areas.
4	*SDG 12: Responsible Consumption and Production*	AI can streamline the agricultural supply chain, reducing food waste and ensuring that perishable goods reach consumers faster. With AI-based supply chain optimization, farmers and distributors can make data-driven decisions on transportation and storage, reducing losses during transit. Moreover, AI-powered insights on consumer demand enable farmers to grow crops that align with market needs, avoiding excess production and subsequent waste. Responsible production also includes using AI to optimize resource inputs, reducing environmental impact and promoting sustainable consumption patterns.
5	*SDG 13: Climate Action*	As climate change increasingly impacts Indian agriculture, AI helps farmers adopt climate-resilient practices. AI models use historical data and real-time environmental monitoring to predict extreme weather events, enabling farmers to take preventive

		actions. In regions prone to droughts or floods, AI-driven water management and resource allocation systems support sustainable farming. By reducing water, pesticide, and fertilizer use, AI not only protects natural resources but also reduces greenhouse gas emissions, contributing to climate action goals.
6	*SDG 15: Life on Land*	Sustainable land use and biodiversity conservation are crucial for the health of India's agriculture. AI supports better soil management practices and promotes biodiversity by helping farmers make eco-friendly choices for pest management and crop rotation. AI technologies like remote sensing and soil health mapping help maintain the soil's health and fertility, which are essential for sustainable land management and long-term productivity.

AI's Role in the "Viksit Bharat" Vision

The "Viksit Bharat" vision emphasizes self-reliance, equity, and innovation in agriculture to foster a prosperous, resilient, and developed India. By integrating AI in agriculture, India can build a sector that supports national aspirations for modernization and social equity. The following aspects underscore AI's relevance within this vision:

- **Farmer Empowerment and Knowledge Dissemination**: AI can democratize access to information, ensuring that farmers at all levels of literacy and resource access can benefit from technology. AI-powered apps and advisory platforms deliver real-time, location-specific information, empowering farmers to make better decisions and control their productivity.
- **Enhanced Agricultural Competitiveness**: As AI enhances productivity and efficiency in agriculture, it strengthens India's competitive advantage in the global market. This contributes to economic growth and strengthens India's export potential, helping the country transition to a developed economy.
- **Sustainable and Inclusive Growth**: For "Viksit Bharat" to be truly inclusive, rural communities must benefit from the technological advancements reshaping agriculture. AI promotes sustainable growth that uplifts rural populations by creating new job opportunities, raising income levels, and enhancing agricultural resilience to climate change.
- **Efficient Resource Use and Environmental Protection**: AI aligns with "Viksit Bharat" by advancing sustainable farming that respects the environment and conserves resources. Through precision farming and data-driven decision-making, AI reduces the ecological footprint of agriculture, helping preserve India's natural resources for future generations.
- **Policy Support and Innovation Ecosystem**: Integrating AI into the agricultural sector aligns with government efforts to promote digital transformation under initiatives like Digital India and Atmanirbhar Bharat. By fostering an innovation ecosystem around AI in agriculture, India can build a sector that serves as a model for sustainable development and food security worldwide.

The Artificial Intelligence for Agriculture Innovation (AI4AI)

The Artificial Intelligence for Agriculture Innovation (AI4AI) initiative was launched in August 2020 by the World Economic Forum's Centre for the Fourth Industrial Revolution India, in active collaboration with the Government of Telangana and support from the Ministry of Agriculture, the National Institution for Transforming India (NITI) Aayog and the Ministry of Electronics and IT. The initiative now has 60-plus partners across the agriculture industry and emerging technology ecosystem, actively collaborating through weekly workshops from October 2020 to March 2021.

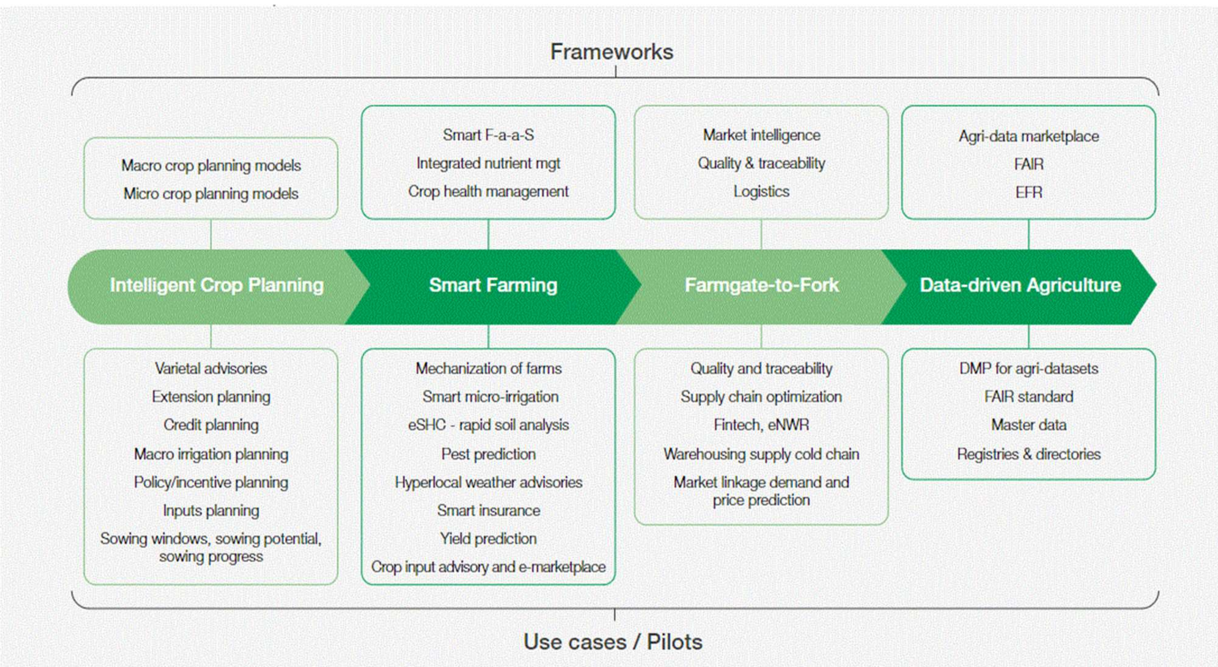

Figure 1: AI4AI- The Emerging Big Picture

AI for agriculture can support everything from planning to selling crops. Image: AI4AI Community Paper, March 2021

Led by the Centre for the Fourth Industrial Revolution (C4IR) India, this initiative brings together government, academia and business representatives to develop and implement innovative solutions in the agriculture sector. One of the most successful implementations of the AI4AI initiative is the 'Saagu Baagu' pilot, developed in partnership with Telangana state government, in its Khammam district, supported by the Bill and Melinda Gates Foundation and implemented by Digital Green. The project has substantially improved the chili value chain for more than 7,000 farmers. The state government of Telangana has played akey role in this transformation by creating enabling infrastructure and policies including India’s first agriculture data exchange and agri data management framework.

Saagu Baagu has demonstrated remarkable results in its first phase of implementation. Farmers participating in the programme saw a 21% increase in chili yields per acre, a 9% reduction in pesticide use, a 5% decrease in fertilizer usage, and an 8% improvement in unit prices due to quality enhancements. As a consequence of these improvements, farmers have seen their incomes soar by more than INR 66,000 (around 800 USD) per acre per crop cycle, effectively doubling their earnings. These figures not only highlight the effectiveness of Saagu Baagu but also its contribution to sustainable and efficient agricultural practices.

Building on these successes, in October 2023, the Telangana government expanded Saagu Baagu’s scope. The project now aims to impact 500,000 farmers, encompassing five different crops across ten districts. This expansion is a strategic move to maximize the benefits of innovative agricultural technologies, potentially transforming the agricultural landscape of the region.

Case Studies and Success Stories in AI-Driven Agricultural Development in India

1. Microsoft and ICRISAT’s Intelligent Cloud pilot for Agriculture in Andhra Pradesh

In collaboration with ICRISAT, Microsoft has developed an AI-Sowing App powered by Microsoft Cortana Intelligence Suite including Machine Learning and Power BI. The app sends sowing advisories to participating farmers on the optimal date to sow. The best part - the farmers don't need to install any sensors in their fields or incur any capital expenditure. All they need is a feature phone capable of receiving text messages. In order to calculate the crop-sowing period, historic climate data spanning over 30 years - from 1986 to 2015 - for the Devanakonda area in Andhra Pradesh was analysed using AI. For determining the optimal sowing period, the Moisture Adequacy Index (MAI) is calculated. MAI is the standardised measure used for assessing the degree of adequacy of rainfall and soil moisture to meet the potential water requirement of crops.

2. IBM and NITI Aayog's Collaboration for Precision Agriculture

IBM has partnered with NITI Aayog to develop AI-driven agronomic solutions for India's farming communities, focusing on precision agriculture. This collaboration uses IBM's Watson Decision Platform for Agriculture to analyze weather data, soil conditions, and crop health, providing localized advisories to help farmers make data-driven decisions on irrigation, nutrient management, and pest control. The project's pilot phase in the states of Maharashtra and Madhya Pradesh has shown promising results, with farmers reporting a 15% increase in crop productivity and improved water-use efficiency by 20%. This partnership exemplifies how government agencies and global technology firms can collaborate to bring AI's benefits to rural farming communities.

3. Fasal: AI for Real-Time Crop Monitoring and Precision Irrigation

Fasal is a state-of-the-art IoT-based precision farming platform designed specifically for horticulture. By leveraging real-time data from on-farm sensors, Fasal provides actionable insights tailored to each farm's unique conditions, enhancing productivity and sustainability. This platform helps farmers optimize water usage, reduce pesticide costs, and significantly increase crop yields.

Fasal's irrigation management system ensures that crops receive the exact amount of water needed at each growth stage. This precise irrigation technique helps prevent over- and under-irrigation, leading to significant water savings. Fasal has reportedly saved up to 82.8 billion liters of water through its precision irrigation recommendations. The platform's advanced AI algorithms predict potential pest and disease outbreaks by analyzing micro-climatic conditions. This predictive capability allows farmers to take preventative measures, reducing the need for pesticides and lowering associated costs by up to 60%. Fasal optimizes every stage of the crop growth cycle, improving both yield and quality. For instance, farmers using Fasal have seen up to a 40% increase in crop yields while maintaining high-quality produce. This is achieved through precise management of irrigation, fertilization, and pest control, all guided by real-time data and AI-driven recommendations.

4. DeHaat: AI-Powered Agri-Solutions for Supply Chain and Market Access

DeHaat is one of the fastest-growing start-ups in the Agri-Tech sector & one of the very few companies providing end-to-end solutions & services to the farming community in India. They are building AI-enabled technologies to revolutionize supply chain & production efficiency in the farming sector. Currently, they are operating in 12 Indian agrarian states with an extensive network of 11,000+ DeHaat Centers & 503 FPOs, serving 1.8 million+ farmers. Company also provides AI-enabled crop advisory to farmers for 30+ crops in regional languages.

Challenges in AI Adoption in Indian Agriculture

While AI holds considerable promise for transforming Indian agriculture, its widespread adoption faces several challenges, including inadequate infrastructure, high costs, a shortage of skilled professionals, and complex policy and ethical issues. These challenges limit the accessibility and effectiveness of AI-driven solutions, especially for smallholder farmers, who constitute the majority of India's farming community. Addressing these barriers is essential to realize AI's full potential for agricultural development in India.

1. **Data and Infrastructure: Limited Digital Infrastructure and Quality Data**

The foundation of effective AI implementation in agriculture is access to high-quality data, yet data collection and digital infrastructure in India are insufficient for widespread AI deployment. Rural areas often lack reliable internet connectivity, which is essential for cloud-based AI services and IoT devices that provide real-time data. Additionally, agricultural data – including soil health, climate conditions, and crop yields – is either unavailable or inconsistently gathered, making it difficult for AI models to deliver accurate and location-specific recommendations.

2. **Cost and Accessibility: High Costs and the Challenge of Reaching Smallholder Farmers**

The cost of AI technology, including sensors, IoT devices, drones, and data analysis software, remains a significant barrier for smallholder farmers. Smallholder farmers, who manage farms typically less than two hectares, have limited financial resources, and many are unable to afford AI-driven equipment. Additionally, financing options for such technologies are often unavailable or difficult for farmers to access, especially in rural areas where credit access is limited.

3. **Skilled Workforce: Need for Trained Professionals to Manage AI Technologies**

AI systems require skilled professionals for implementation, maintenance, and analysis. However, there is a shortage of trained agricultural and technology professionals with expertise in AI applications, particularly in rural areas where AI tools are most needed. AI technologies, especially in precision farming and predictive analytics, require knowledge in both agriculture and data science, creating a specialized skill gap.

4. **Policy and Ethical Concerns: Data Privacy, Ethics in AI Use, and Regulatory Support**

The use of AI in agriculture raises several policy and ethical concerns, particularly regarding data privacy and the ethical implications of automation. Farmers may be hesitant to share their data due to privacy concerns, particularly as AI systems often require sensitive information about land holdings, crop yields, and input usage. Without clear regulations on data privacy and ownership, farmers may remain reluctant to adopt AI-based services.

Future Prospects and Recommendations

The future of AI in Indian agriculture holds significant promise, but realizing its full potential requires strategic investments, collaborations, and a supportive ecosystem. The following recommendations outline key areas for growth and development, which can help scale AI adoption, ensuring that it reaches smallholder farmers and contributes to sustainable agricultural practices.

1. **Enhancing R&D: Need for Targeted Research to Make AI Solutions More Accessible to Farmers**

One of the most crucial steps for AI adoption in Indian agriculture is enhancing research and development (R&D) efforts to tailor AI technologies to the specific needs of Indian farmers. Much of the current AI research focuses on urban or high-tech farming, which may not always be directly applicable to the small-scale, resource-constrained contexts of rural India. Therefore, it is necessary to focus R&D on creating affordable, scalable, and easy-to-use AI solutions that are accessible to farmers in remote and underserved areas.

2. **Public-Private Partnerships: Encouraging Collaboration for AI-Based Innovations**

Public-private partnerships (PPP) are essential for the large-scale adoption of AI in agriculture. These partnerships can combine the strengths of the public sector's reach and regulatory framework with the private sector's technological expertise and innovation. By collaborating with tech companies, research institutions, and startups, the government can create an ecosystem conducive to the development of AI solutions that benefit farmers.

An example of successful collaboration is Microsoft's AI initiative in Andhra Pradesh, where the company worked with the state government to develop AI-driven solutions for improving agricultural practices, including precision farming and pest management. Public-private collaboration can also help address the cost barriers associated with AI adoption. Governments can offer subsidies or incentives to private companies for developing low-cost AI tools, thereby making the technology more affordable and accessible to smallholder farmers.

3. **Capacity Building: Training Farmers and Extension Workers on AI Applications**

The success of AI in agriculture is heavily dependent on the capacity of farmers and extension workers to use and manage these technologies. While AI solutions can automate tasks, farmers must understand how to use these tools effectively to benefit from their capabilities. Therefore, capacity building initiatives should be a priority in the coming years. Training programs must be designed not only for farmers but also for agricultural extension workers, who are the primary link between technology providers and rural communities. These extension workers can play a crucial role in disseminating knowledge about AI applications and providing hands-on support to farmers.

4. **Policy Frameworks: Suggesting Guidelines for Responsible AI Use in Agriculture**

A clear and robust policy framework is necessary to govern the ethical use of AI in agriculture. While AI can bring numerous benefits, there are also concerns related to data privacy, ethical AI use, and environmental impact. Policymakers must create guidelines that ensure AI technologies are used responsibly and do not negatively impact farmers or the environment.

Firstly, data privacy is a critical issue. Farmers' personal and financial data must be protected, and they should have control over how their data is collected and used. AI systems should be transparent in how data is processed, and farmers must be informed about the types of data being collected. Secondly, AI applications in agriculture should be designed with sustainability in mind. The government can encourage the development of eco-friendly AI technologies that optimize resource use and minimize waste. Lastly, policymakers should focus on fostering a regulatory environment that encourages innovation while ensuring safety, fairness, and accountability. Developing AI-specific regulations and frameworks will be crucial for scaling AI solutions across the agricultural sector.

5. **Extension Services: Integrating AI with Traditional Extension Models to Improve Decision-Making and Dissemination**

Agricultural extension services have long been an essential part of Indian agriculture, helping farmers make informed decisions based on the latest agricultural practices and market trends. However, traditional extension methods often struggle with scalability and timely information dissemination. AI can enhance traditional extension systems by delivering personalized, real-time advisory services to farmers.

Conclusion

The integration of Artificial Intelligence (AI) in Indian agriculture holds transformative potential to revolutionize the sector by addressing long-standing challenges and enabling more efficient, sustainable, and inclusive agricultural practices. AI's capacity to optimize resource use, improve crop management, enhance productivity, and reduce environmental impact positions it as a key enabler for agricultural development in India. By leveraging AI technologies such as precision farming, remote sensing, and predictive modeling, Indian agriculture can move towards a future that is not only more productive but also resilient to climate change, resource scarcity, and market volatility.

However, the full benefits of AI can only be realized through inclusive, farmer-centric strategies that ensure equitable access to these technologies. It is imperative that AI solutions are designed to meet the diverse needs of Indian farmers, particularly smallholder and resource-poor farmers, who form the backbone of the agricultural sector. This requires tailored AI applications that are affordable, accessible, and user-friendly, alongside initiatives to build digital literacy and technical capacity among farmers, extension workers, and rural communities.

As India moves towards achieving the vision of "Viksit Bharat" (Developed India), AI can play a crucial role in aligning agricultural practices with sustainable development goals (SDGs). By promoting climate-resilient farming practices, optimizing water and resource management, enhancing market access, and improving overall productivity, AI can help India transition to a more sustainable and prosperous agricultural system. Additionally, it can empower farmers by providing them with data-driven insights that improve decision-making and increase incomes, thereby contributing to rural development and poverty alleviation.

Ultimately, for AI to drive sustainable agricultural growth in India, it is essential that government policies, private sector innovation, and research efforts focus on creating an enabling environment for technology adoption, ensuring that AI-based solutions are integrated into the fabric of India's agricultural extension systems. Moreover, strong public-private partnerships, capacity building, and robust policy frameworks will be key to addressing the challenges and ensuring the responsible and ethical use of AI in agriculture. By following these strategies, India can unlock the full potential of AI in agriculture, supporting its vision of a developed, self-reliant, and sustainable agricultural economy in line with the broader goals of "Viksit Bharat."

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LP 7.2

AI-Driven extension services: Transforming farmer outreach and decision support

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ABSTRACT

Artificial Intelligence (AI) is reshaping agricultural extension services, offering farmers innovative ways to access guidance, make data-driven decisions, and enhance resource management. As global population growth drives the need for food security, traditional extension systems face challenges, especially in developing regions with smallholder farms that are often remote and underserved. AI tools, including drones, sensors, and satellite imagery, support precision farming by providing real-time monitoring and optimized resource use, helping farmers increase yields and minimize waste. AI-powered crop surveillance also allows for early detection of diseases, pests, and nutrient deficiencies, delivering timely recommendations that boost productivity. Additionally, chatbots and virtual assistants make information more accessible, bridging gaps in geographic and personnel limitations.

AI's use of data analytics, natural language processing, and market insights empowers farmers and extension workers to make informed decisions, adapt to climate change, and improve resilience. However, challenges remain in the form of high implementation costs, limited digital literacy, and occasional technical issues. Additionally, the human element remains important for building trust and understanding local farming contexts. Despite these challenges, AI has tremendous potential to increase the reach, efficiency, and impact of agricultural extension services, establishing a more accessible, precise, and sustainable model for the future of farming.

Keywords: Artificial Intelligence, precision farming, sustainable agriculture and extension system

INTRODUCTION

In India, Artificial Intelligence (AI) is gradually reshaping agriculture, offering solutions to challenges faced by smallholder farmers and helping to enhance productivity, sustainability, and resilience in farming. The adoption of AI-driven technologies in India, supported by government initiatives and collaborations with private tech firms, focuses on addressing issues like unpredictable weather patterns, water scarcity, and limited access to timely market information. Precision agriculture is gaining traction, with drones, IoT sensors, and satellite imagery being used for soil analysis, monitoring crop health, and optimizing resources. The Indian government's push for digital agriculture under initiatives like the Digital Agriculture Mission and partnerships with companies like IBM, Microsoft, and various startups have fostered AI-based solutions that are accessible even to small-scale farmers.

Several AI-powered tools and platforms tailored to Indian agriculture are proving transformative. For example, AI apps such as Plantix and BharatAgri assist farmers in diagnosing crop diseases, managing pest control, and receiving guidance on best practices. Chatbots and virtual advisors in local languages help break down information barriers, allowing farmers to receive timely, location-specific advice on crop management and market prices.

Initiatives like M-Velanmai, which offers mobile-based extension services, illustrate AI's potential in rural outreach. However, challenges remain, including high costs of AI technologies, digital literacy barriers, and connectivity limitations in remote areas. To address these, there is an increasing emphasis on government subsidies, training programs, and infrastructure development, making AI in agriculture more inclusive and adaptable to the Indian context.

What is Artificial Intelligence (AI)?

Artificial intelligence (AI) is the capability of machines to perform cognitive functions traditionally associated with human thought, such as learning, decision-making, and problem-solving. As a specialized field within computer science, AI focuses on creating technologies that can operate independently, making choices and performing tasks on behalf of humans. In today's context, AI generally refers to systems that respond to inputs or stimuli in ways similar to human reactions, integrating human-like reasoning, judgment, and intentionality.

AI systems are designed to make decisions with an expertise level often comparable to that of humans, helping to predict issues or solve problems in real-time. The field is inherently multidisciplinary, combining elements from computer science, data science, statistics, engineering, linguistics, neuroscience, and even philosophy and psychology. By developing machines capable of reasoning and acting on complex data at a scale beyond human capability, AI continues to expand its potential to replicate and enhance human intelligence.

The Need for AI in Agricultural Extension

Geographical difficulties in accessing distant farming villages, a lack of staff, and resource limitations all limit agricultural extension services in many areas. Furthermore, farmers need prompt, precise, and knowledgeable advice as farming grows more complicated as a result of climate change, market instability, and the drive for sustainability. Here, artificial intelligence (AI) holds great promise for expanding the scope and effectiveness of extension services by enabling real-time data analysis, automating repetitive operations, and producing customised insights.

AI can enhance agricultural extension services amid various challenges, along with relevant examples:

1. **Real-Time Data Analysis for Timely Guidance**
   - **Challenge**: Traditional agricultural extension services often rely on periodic data, which can become outdated quickly, especially with climate variations.
   - **AI Solution**: AI can analyze data in real-time, leveraging satellite imagery, weather data, and soil sensors to offer farmers timely insights on weather, soil health, and crop needs.
   - **Example**: AI-based platforms like IBM's Watson Decision Platform for Agriculture use satellite data and IoT sensors to monitor fields, alerting farmers about potential threats (like pests or diseases) before they escalate, allowing preventive actions.
2. **Automating Repetitive Tasks to Increase Efficiency**
   - **Challenge**: Extension workers often spend significant time on data collection, administrative tasks, and report generation, reducing the time available for field support and farmer interaction.

- ❖ **AI Solution**: AI can automate data collection and processing, freeing up extension workers to focus on direct farmer support and problem-solving.
- ❖ **Example**: In some regions, drones equipped with AI-powered cameras automate crop monitoring, assessing plant health, soil moisture, and growth patterns, which speeds up reporting and enhances accuracy.

3. **Personalized Recommendations for Diverse Farming Needs**
   - ❖ **Challenge**: Each farm and farmer has unique needs based on crop types, soil conditions, climate, and available resources, making blanket recommendations ineffective.
   - ❖ **AI Solution**: AI can generate tailored advice for individual farms based on their unique conditions and goals, leading to better outcomes.
   - ❖ **Example**: Digital Green, an AI-driven platform, provides personalized advice to Indian farmers by analyzing farm-specific data, which helps improve yields and resource efficiency.
4. **Enhanced Reach to Remote Farmers with Limited Connectivity**
   - ❖ **Challenge**: Remote and underserved regions often lack reliable internet and frequent in-person support, hindering farmers' access to timely information.
   - ❖ **AI Solution**: AI-based mobile apps can deliver information offline or through basic SMS, making them accessible even in low-connectivity areas.
   - ❖ **Example**: The Kenyan SMS platform 'Sokopepe' provides market prices, weather forecasts, and farming tips via SMS, which farmers access without needing smartphones or the internet.
5. **Predictive Analytics for Anticipating Climate and Market Risks**
   - ❖ **Challenge**: Farmers are increasingly exposed to climate variability and market volatility, but most lack predictive tools to plan accordingly.
   - ❖ **AI Solution**: Predictive models can forecast weather events, pest outbreaks, and price fluctuations, helping farmers make proactive decisions on planting, harvesting, and selling.
   - ❖ **Example**: Climate AI’s platform offers climate-related risk assessments, enabling farmers to adjust planting schedules or select resilient crop varieties based on predicted conditions.
6. **Resource Optimization through Precision Agriculture**
   - ❖ **Challenge**: Many farmers struggle with optimizing input use (e.g., water, fertilizer), leading to waste, increased costs, and environmental impact.
   - ❖ **AI Solution**: AI-powered precision agriculture tools recommend the right amount of inputs, reducing waste and improving productivity.
   - ❖ **Example**: John Deere’s AI-based Field Analyzer provides insights into when and where to plant, irrigate, or fertilize, significantly reducing resource use and maximizing yield.
7. **Supporting Sustainable Practices and Environmental Goals**
   - ❖ **Challenge**: Farmers need to balance productivity with sustainability, but lack guidance on sustainable practices suitable for their specific farm conditions.

- **AI Solution**: AI can guide farmers on sustainable methods, like crop rotation, organic pest control, and soil conservation, helping them achieve both productivity and environmental goals.
- **Example**: India's SatSure platform uses AI to analyze soil and crop data, offering recommendations on regenerative agriculture practices to sustain soil health and reduce environmental impact.

8. **Overcoming Language and Literacy Barriers**
   - **Challenge**: Farmers who are not fluent in major languages or have low literacy often find it difficult to access technical information.
   - **AI Solution**: AI-powered chatbots and voice assistants, available in local languages, can simplify technical guidance, making it accessible and understandable.
   - **Example**: The FarmRise app from Bayer has a voice assistant that provides information on crop care in regional Indian languages, ensuring accessibility for rural, non-literate farmers.

By enabling data-driven decisions and making advanced agricultural knowledge accessible, AI is transforming how extension services operate, increasing their impact, and enabling farmers to make more informed, resilient choices.

Case Studies: AI Transforming Extension Services

A number of global programs demonstrate how AI is already improving agricultural extension:

I. **eKutir in India**: eKutir uses AI and data analytics to provide tailored recommendations to smallholder farmers on topics such as crop planning and pest management. With the help of AI, eKutir has been able to reach more farmers, offering precise and timely guidance.

II. **Hello Tractor in Africa**: Hello Tractor employs AI-powered sensors on tractors, helping farmers access mechanized services and guiding tractor owners on when and where their equipment is needed. This not only optimizes resource use but also improves productivity among smallholder farmers.

III. **Plant Village Nuru in Kenya**: Nuru, a chatbot developed by Plant Village, uses AI and image recognition to diagnose diseases in crops like cassava and maize. Farmers take a photo of the affected plant, and Nuru provides an instant diagnosis and treatment options, allowing for timely intervention.

IV. **M-Velanmai in India**: This mobile-based extension platform uses AI to deliver personalized farming recommendations to smallholder farmers, empowering them to make informed decisions about crop management and improving overall productivity.

V. **Plantix App from Germany**: The Plantix app uses AI-driven image recognition to help farmers diagnose crop diseases instantly. Farmers take photos of affected plants, and the app provides a diagnosis and suggested treatments, reducing reliance on chemical interventions and supporting sustainable practices.

VI. **Pest Management Early Warning Systems**: AI-based early warning systems analyze data to predict pest outbreaks, allowing extension services to notify farmers proactively. Such systems have shown success in regions prone to pest invasions, enabling farmers to take preventive measures and minimize crop damage.

The Challenges and Limitations of AI in Extension Services

I. **High Cost of AI Technologies**: Installing and maintaining AI systems can be costly, especially for smallholder farmers with limited resources. Extension services must explore subsidized models or partnerships to make AI more accessible and affordable.

II. **Resistance to Change and Digital Literacy**: Many farmers may be hesitant to adopt new technologies, particularly those who lack digital literacy. Education programs are essential to ensure farmers feel comfortable using AI tools and understand their benefits.

III. **Technical Glitches and Dependence on Connectivity**: AI systems depend on stable internet connectivity and infrastructure, which can be challenging in remote areas. Interruptions or technical failures can disrupt data flow and compromise service delivery.

IV. **Maintaining the Human Element in Extension**: While AI offers efficiency, it cannot fully replace the human touch. Extension workers play a crucial role in building trust and understanding the local context, factors that are essential for effective advisory services.

A recent study in *Nature Food* explores the potential of generative AI, like ChatGPT, to enhance agricultural extension services by simplifying scientific information and providing personalized advisories. LLMs can distill complex research into easily understandable language for farmers and tailor recommendations to address specific challenges. However, real-world testing in Nigeria highlighted limitations, as AI-generated advice was often too generic or impractical for smallholders with limited resources. The study recommends a collaborative approach to improve LLM-assisted advisories by involving AI and agricultural experts, making agricultural data more accessible, designing user-centered tools, and enhancing digital literacy among farmers and extension agents.

Conclusion

AI-driven extension services are revolutionizing farmer outreach and decision support, making agricultural extension more efficient, data-driven, and accessible. By enabling personalized recommendations, predictive analytics, virtual assistance, and real-time diagnostics, AI is helping farmers make informed, timely decisions, ultimately fostering more sustainable and profitable farming practices. While challenges remain, continued investment in infrastructure, training, and ethical practices will ensure that AI in agricultural extension reaches its full potential, empowering farmers and transforming the agricultural landscape.

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LP 7.3

Predictive analysis for crop yield: Machine Learning Techniques

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➢ ***Importance of Crop Yield Prediction:***

Agriculture is one of the most crucial fields contributing to the development of any nation. It not only affects the economy of nation but also has impact on the world food grain statistics. In Agriculture, crop yield prediction used to optimizing agricultural practices, allowing farmers and policymakers to make informed decisions regarding resource allocation, planting schedules and overall production planning. Demand for crop yield prediction is crucial and faces challenges such as climate variability, soil degradation and limited resources. Accurate yield predictions enable farmers, governments and agricultural organizations to more effectively production outcomes.

➢ ***Overview of Machine Learning in Agriculture:***

Machine learning (ML) is revolutionizing agriculture by enabling more data-driven, precise and efficient farming practices. By analysing big data from diverse sources, such as soil sensors, weather stations, satellite imagery and historical crop data, ML algorithms can uncover complex patterns and insights. These insights help in tackling critical challenges like optimizing crop yield, reducing waste, enhancing resource efficiency and improving sustainability. ML applications in agriculture range from predictive analysis for yield and pest outbreaks to automated systems for irrigation, fertilization and even harvesting. ML is set to become an integral part of sustainable and precision agriculture, enhancing both productivity and resilience.

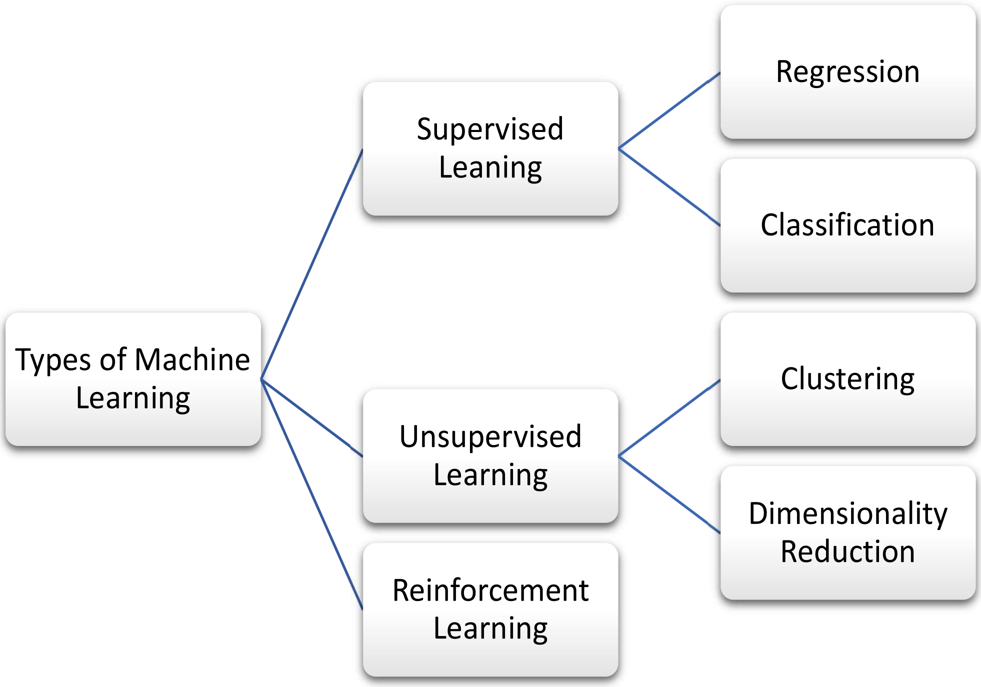
➢ ***What is Machine Learning:***

Machine learning term was first described by **Arthur Samuel** in 1959. He is pioneer in the field of Machine Learning (ML), according to him Machine learning term defined as “the study that gives computers the ability to learn without being explicitly programmed”. ML is subset of Artificial Intelligence.

➢ ***Types of Machine Learning:***

Machine learning mainly have three types of algorithms

- Supervised machine learning
- Unsupervised machine learning
- Reinforcement machine learning



1) **Supervised Learning**: In supervised learning, the model is trained on labelled data, where input-output pairs are provided. This technique is widely used for predictive analysis, classification and regression tasks.
   Common algorithms: Support vector machine, Decision tree, Random Forest
2) **Unsupervised Learning**: This type involves training models on unlabelled data to uncover hidden patterns, groupings or associations. It is used in data exploration and clustering.
   Common algorithms: k-mean clustering
3) **Reinforcement Learning**: Reinforcement learning is an approach where learns by interacting with an environment and receiving feedback in the form of rewards or penalties. It's widely used in optimizing resource usage.

➢ ***Popular and Common Machine Learning Algorithms:***

1) **Support Vector Regression:** SVR is used to predict a continuous value based on input data. SVR can use both linear and non-linear kernels. A linear kernel is a simple dot product between two input vectors, while a non-linear kernel is a more complex function that can capture more intricate patterns in the data. SVMs try to find the hyperplane in a high-dimensional space that maximally separates different classes or output values.

   Features:

   a) **Support Vectors:** These are the data points that are closest to the predicted model or the margin that the model creates.
   b) **Epsilon:** Parameter that controls the width of the margin around the predicted value.
   c) **Margin:** The margin in SVR is the tube around the regression line within which errors are allowed. The data points lying within this tube do not contribute to the error term in the loss function.
   d) **Kernel**: SVR can use different types of kernels to transform data into a higher-dimensional space, making it easier to find non-linear relationships in the data. Common kernel functions: Linear, Polynomial and Radial Basis Function

e) **Loss Function**: loss function includes both the regularization term and the error term. The regularization term controls the flatness of the regression line, while the error term penalizes the points that lie outside the margin.

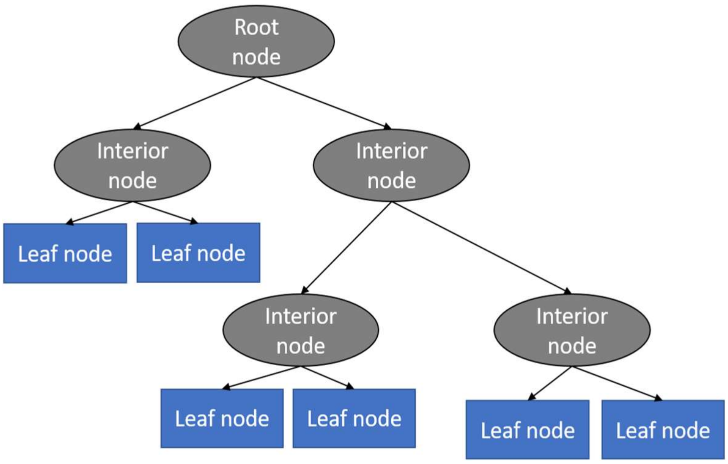
2) **Decision Tree Regression:** Decision trees are used to discover feature and extract pattern in large databases/big data that are mostly important for discrimination and forecasting modelling. The main motive behind decision trees is that divide dividing the data into sets based on the characteristics' values such that each subset contains similar target values.

Features:

a) Root Node: The tree starts with a root node, which contains all the training data.

b) Splitting: The algorithm selects the best attribute to split the data at the root node. This split creates two or more child nodes based on mean squared error.

c) Leaf node: leaf node is the terminal node where the decision-making process ends. It represents the final outcome or prediction for a particular set of conditions.



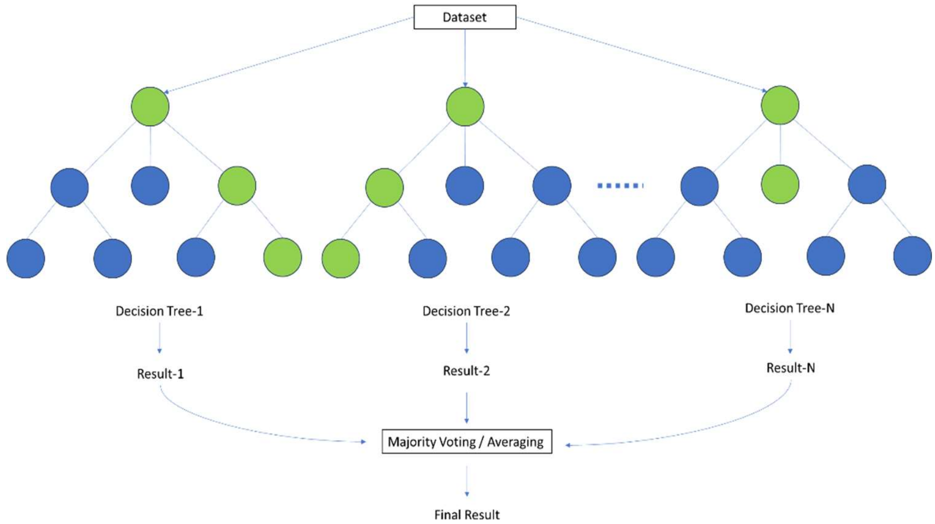
3) **Random Forest:** Random Forest Regression is a powerful machine learning technique that combines multiple decision trees to make accurate predictions for continuous numerical values.

Features:

a) **Bootstrapped Sampling:** Random Forest creates multiple decision trees by using a technique called bootstrapped sampling. This involves creating random subsets of the original training data by sampling with replacement. Each decision tree is trained on one of these bootstrapped samples.

b) **Feature Randomness:** Additionally, Random Forest introduces feature randomness by only considering a random subset of features when splitting each node in the decision tree. This helps to decorrelate the trees and makes the final predictions more robust.

c) **Averaging for Regression:** The individual trees' predictions are averaged to get the final regression output.



➢ ***Challenges in Crop Yield Prediction:***

Crop yield prediction, despite its immense value, presents several challenges that can complicate accurate and reliable forecasting.

Key challenges:

- **Data Availability and Quality**: Crop yield prediction relies on vast amounts of data, including weather conditions, soil properties, crop genetics and farming practices. However, in many regions, especially in developing areas, this data is either unavailable or incomplete, leading to gaps that can reduce prediction accuracy. Even when data is available, inconsistencies in data quality such as missing values, measurement errors etc.
- **Climate Variability and Unpredictability**: Climate change lead uncertainty, as unexpected weather events like droughts, floods and extreme temperatures become more frequent.
- **Temporal and Spatial Dependencies**: Crop growth varies across locations and over time. Seasonal variations, soil types and microclimates all affect crop yields differently, creating challenges for generalized models.
- **Changing Agricultural Practices:** Farmers frequently adopt new farming techniques, crop varieties or technologies, which may be affected to model.

➢ ***Use of machine learning in different field in agriculture***

1) Pest and Disease Detection
2) Precision Agriculture and Resource Management
3) Soil Health Monitoring and Analysis
4) Weed Control
5) Farm Equipment Automation
6) Climate and Weather Forecasting
7) Irrigation Management

➢ ***Different Software to perform Machine Learning Algorithms***

TensorFlow	TensorFlow
Scikit-learn	scikit learn
Keras	K Keras
jupyter	jupyter

➢ ***Future Trends and Innovations***

- **Integration of Big Data and Real-Time Analytics:** The future of crop yield prediction will increase on the integration of big data from multiple sources such as satellite imagery, drones, IoT devices, weather stations and historical crop data.
- **Advanced Deep Learning Models:** While machine learning techniques like regression and decision trees are effective, the future will see more widespread use of deep learning models, particularly Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), for better handling of complex, unstructured data such as satellite images, drone footage, and sensor data.
- **Increased Use of Remote Sensing:** The future of crop yield prediction will involve increased use of remote sensing technologies like satellites and drones that can capture high-resolution images of crops. These sensors can monitor crop health, detect nutrient deficiencies, pest and even early-stage diseases, all of which contribute to more accurate yield predictions.
- **Precision Agriculture and Autonomous Systems:** Precision agriculture will become more automated, with machine learning-powered robots, autonomous tractors and harvesters making decisions in real time. These systems will work on continuous data inputs and ML algorithms to adjust to varying soil conditions, weather patterns and other factors.
- **Climate Change Adaptation Models:** Machine learning algorithms will be used to develop models that can simulate how different crops will perform under various future climate scenarios.

Conclusion

Machine learning techniques have great in a new era of innovation, empowering machines to learn, adapt and make intelligent decisions. ML has powerful tools to predict crop yields with increasing precision and adaptability. Through predictive analysis, ML techniques help to the agricultural sector from farmers to policymakers to make decisions about optimize resource usage and improve crop management. Algorithms like Support Vector Regression, Decision Trees and Random Forests give more accurate yield forecasts by analysing complex, multi-source data. Its play role in crop yield prediction signifies a pivotal step towards sustainable agriculture and food security in agricultural sector equipped to meet the challenges of a changing climate.

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LP 7.4

Empowering Indian agriculture through advanced technology

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Abstract

Agriculture is one of the most significant sectors that stay in demand in the age of global prosperity as well as global crisis and the majority of the stakeholders in the developing countries depending on it. For increasing the efficiencies of agricultural production the entire value chain is important. Throughout history, technological innovations have had a significant impact on agriculture. Hence the global bodies and governments are increasingly advocating the technology driven farming. There are many challenges for increasing the production by traditional approaches hence advanced technologies played the prominent role and show positive impact in terms of increased productivity, enhanced farmer livelihood, better market linkage, informed decision-making, efficiency policy-making and implementation etc. The advanced technology like farm mechanization, crop sensors, GPS, IoT, Biotechnology, precision agriculture, remote sensing technology, automation and robotics, blockchain traceability, AI & Big data, digital platforms & mobile apps, vertical farming technology are playing the pivotal role for increasing production and productivity ultimately empowering the Indian agriculture.

Keywords: Advance technology, empowerment, digital, precision agriculture, SMART agriculture

Introduction

Agriculture is the backbone of India's economy as two-third of the population lives in rural areas and directly or indirectly depends on agriculture for their livelihood. It is one of the market-driven industries that employ a large segment of the country's population. India's food production has improved significantly during the last three decades due to all-round efforts but Indian agriculture is still facing a multitude of problems to maximize productivity to feed the continuously increasing population. Now-a-days advanced technology plays a vital role in every sector of development. India is experiencing a new wave of change in agritech, powered by technology enabled devices and application. Digital farming is much required in the Indian context as by 2050, India will have an estimated 1.64 billion population and will need 333 million tonnes of annual food grain production. Farmers are now using cutting edge tools to forecast weather, increase crop yields and detect pests early. This wave is now metamorphosing into a powerful movement that will redefine agriculture in the country. It is an empowered and progressive story where technologies like automated machinery, drones, sensors, AI are the tools and catalyst for the new agricultural revolution.

Access to advanced technology is a prerequisite for sustainable agricultural development. Today's in the 21st century, agriculture uses emerging technologies such as Internet of Things (IoT), robots, drones, Artificial Intelligence (AI), Machine Learning (ML), Remote Sensing, Cloud computing, temperature and moisture sensors, aerial images and GPS technology. These advanced technologies and precision agriculture allow businesses to be more profitable, efficient, safer and more environmentally friendly. Adoption of advanced technologies has shown an unambiguous positive impact on agricultural productivity and agricultural production.

Importance of Agricultural Technology

Agriculture is a very important factor in generating income and food for many people around the world. In the past few years, the sector has undergone many changes and advancements in various agricultural methods and technologies. The methods of modern agriculture and agricultural operations are very different from decades ago, mainly due to technological advancements, including sensors, equipment, machines and information technology. The modern day agricultural operations and farms work drastically different from what they used to a few decades ago. Agricultural technology aims to make work in the field more efficient and convenient. At the back of the new technology in agriculture with elements like sensors, GPS, AI powered devices etc the space is able to redefine its list of importance of agricultural technology.

- Increased crop productivity
- Reduced use of pesticide, water and fertilizer thus lowering the food prices
- Reduced impact on natural ecosystems
- Lesser runoff of chemicals in the ground waters and rivers
- Better worker safety
- Robotic technologies offering reliable management of natural resources

Use of Advanced Technology in Agriculture

The use of advanced technology in the agriculture sector is widespread. It has helped the farmers in many ways and increasing the production and productivity of crops. This has also helped in reducing the production cost. The use of technology has also made the process of farming easier and more efficient. The major advanced technologies used in agriculture sector are as follows.

❖ **Farm Mechanization**

Farm mechanization is the use of machines to replace human and animal labour in agricultural processes. It can improve agricultural productivity, reduce manual labour, and ensure efficient farm practices. One of the challenges facing farmers today is the need to meet labour demand. Labour costs continue to increase, which requires better methods to ensure reduced labour costs. The introduction of combine harvesters and planters simplifies the process. Yield and time are some important factors in agriculture. Therefore, it is important to sow as early as possible, harvest at the appropriate time, and ensure that the yield is stored at the correct time. The use of advanced technology in agriculture can ensure that farmers grow large quantities of food in the shortest possible time.

❖ **Crop Sensors**

Crop sensors are the tools that detect physical or chemical changes in the environment and convert them into electrical signals to provide real-time data on crops, fields, and equipment. This data helps farmers make informed decisions to improve productivity, reduce losses, and save energy. The effective application of chemical fertilizers and pesticides remains a major challenge in agriculture, especially to determine which fertilizers work best under different scenarios, when to apply and how much. The use of crop sensors can make it easier for farmers to effectively apply fertilizers and pesticides, as much as the amount needed for crops. This technology gives the opportunity to feel the sensation of plants and then helps reduce the chance of leaching or runoff. The crops sensor is designed to specify the amount of resources required for a given crop and when to apply.

❖ **Global Positioning Systems (GPS)**

GPS is becoming a common technology in agriculture. GPS allows farmers to accurately navigate to specific locations in the field, year after year, to collect soil samples or monitor crop conditions. Location information is collected by GPS receivers for mapping field boundaries, roads, irrigation systems, and problem areas of crops such as weeds or disease.

Through the GPS, it is easy to determine and document the yields from a given farm, as well as record the application rates. Such technologies are useful in that the farmers can rely on the collected and recorded data for reference when making any decisions. The recommendable documentation technology is the yield map, which can be used to offer a summary of entire year's activities. Such maps are highly useful as they can give a wide range of information about just anything such as the status of the drainage system in your field.

❖ **Internet of Things (IoT)**

The Internet of Things (IoT) refers to the rapidly growing network of connected objects that are able to collect and exchange data in real time using embedded sensors. The IoT has enabled the connectivity of various devices and sensors on the farm. Farmers can collect real-time data on soil moisture, temperature, humidity, and crop growth, among other parameters. This information can be analysed to make data-driven decisions, such as adjusting irrigation schedules, applying fertilizers, or predicting yield outcomes.

❖ **Biotechnology and Genetic Engineering**

Biotechnology is also known as genetic engineering, which is the process of improving the genes of cultivated plants. Advances in biotechnology and genetic engineering provide solutions for improving crop resilience and productivity. In general, genetic engineering uses the understanding of DNA to identify and work with genes to increase crop resistance to pests. The development of high-yielding varieties also improves livestock. Genetically modified crops can be engineered to withstand pests, diseases, and extreme weather conditions, reducing dependence on chemical inputs and increasing yields. India has seen success with Bt cotton, which has significantly boosted cotton production while reducing the use of pesticides. Biotechnology promises great benefits for both producers and consumers of agricultural products, but its applications are also associated with potential risks. The risks and benefits may vary substantially from one product to the next and are often perceived differently in different countries.

❖ **Precision Agriculture**

Precision agriculture utilizes data and technology to optimize field-level management regarding crop farming. Using soil sensors, satellite imagery, and drones, farmers can monitor crop health, soil moisture, and nutrient levels in real-time. This enables precise application of inputs such as water, fertilisers and pesticides, reducing wastage and increasing crop yields. For example, adopting precision irrigation systems can significantly conserve water, which is a vital resource in drought-prone areas. Precision agriculture boosts productivity by ensuring crops receives the right amount of inputs at the right time. This reduces waste and increases yields. By monitoring soil health and crop conditions, farms can make informed decisions, leading to more efficient use of water, fertilizers, and pesticides. The introduction of computers, sensors, and GPS technology led to the development of precision agriculture.

❖ **Remote Sensing Technology**

It involves using satellites to collect data on crop health, soil conditions, and weather patterns. Remote sensing technology allows farms to monitor large areas efficiently, identifying problems such as pest infestations or water stress early. This enables timely interventions, reducing crop losses and improving yields. By providing detailed insights into field conditions, remote sensing supports precise irrigation and fertilization, optimizing resource use. Additionally, it aids in long-term planning and risk management by offering data on weather patterns and soil health trends.

❖ **Automation and Robotics**

It involves using machines and robots to perform repetitive and labour-intensive farming tasks. The integration of automation and robotics has had a transformative impact on farming. Robotic systems are now employed in various agricultural tasks, such as harvesting, pruning, weeding, and milking. These robots can perform repetitive tasks with precision, speed, and consistency, reducing labour requirements and improving overall productivity. Automation and robotics reduce the labour burden and increases efficiency by performing tasks faster and more accurately than manual labour. Automated systems can operate around the clock, boosting productivity. Additionally, robots minimize human error and reduce the physical strain on labourers, improving safety and working conditions.

❖ **Blockchain in Traceability**

Blockchain technology confirms security, transparency and traceability in the agricultural supply chain from farm to table. By recording every transaction on a decentralized ledger, blockchain can verify the authenticity and origin of products, thereby reducing fraud and ensuring fair trade practices. This builds consumer trust by ensuring the authenticity and safety of food products. Smart contracts streamline transactions and reduce administrative costs by automating agreements and payments. Traceability systems help in identifying and addressing issues such as contamination or fraud quickly, minimizing risks and ensuring food safety. By promoting transparency and accountability, blockchain supports sustainable and ethical farming practices. This is especially beneficial for organic and fair trade products, where consumers demand greater transparency. Blockchain can also streamline logistics, reducing delays and losses in transit.

❖ **Artificial Intelligence (AI) and Big Data**

AI and big data analytics transform vast amounts of data into actionable insights for better farming decisions. AI and machine learning are increasingly being used in agriculture to predict crop yields, detect diseases, and optimize supply chains. AI-powered solutions are bringing the power of predictive analytics to weather patterns, soil health monitoring and even precision farming methods. Such advancements are doing more than just increasing crop yields; they are strengthening cropping systems against environmental stresses. AI-powered tools can analyze large datasets from a variety of sources, providing information about planting schedules, pest control, and harvesting times. AI and big data allow predictive analytics, helping anticipate and mitigate risks such as pest infestations and adverse weather conditions. Decision support systems offer personalized recommendations, improving crop management and boosting yields. By making use of data, AI improves precision and accuracy in farming operations, promoting sustainability and reducing costs.

❖ **Digital Platforms and Mobile Apps**

Digital platforms and mobile apps are revolutionizing access to information and services for farmers. A mobile digital platform is a group of technologies and services that let people use mobile devices like smartphones and tablets to view digital content, make transactions, or interact with apps. Apps like ***Kisan Suvidha app*** mainly for Farmers, APMC Brokers and staff as its providing Marketing Yard online. ***Megh doot weather app*** Meghdoot, a joint initiative of India Meteorological Department (IMD), Indian Institute of Tropical Meteorology (IITM) and Indian Council OF Agricultural Research (ICAR) aims to deliver critical information to farmers through a simple and easy to use mobile application. ***e-NAM app*** National Agriculture Market (eNAM) is a pan-India electronic trading portal which networks the existing APMC mandis to create a unified national market for agricultural commodities.

❖ **Vertical Farming Technology**

Vertical farming technology involves growing crops in stacked layers or vertically inclined surfaces, often in controlled environments. It represents an innovative approach, providing a sustainable solution to meet the growing demand for fresh produce. Vertical farming maximizes space usage by growing crops in stacked layers, making it ideal for urban areas with limited land. It allows for year-round production in controlled environments, ensuring consistent yields and quality. Hydroponics and aeroponics reduce water usage significantly compared to traditional farming, promoting sustainability. Vertical farming also minimizes the need for pesticides, as controlled environments reduce pest and disease risks. By bringing food production closer to consumers, it reduces transportation costs and carbon footprint.

Challenges of Integrating Technology in Agriculture

There are many challenges and problems of integrating technology in agriculture. Some of them are given below.

- **Lack of knowledge and skills:** Farmers are lacking in the knowledge and skills in using the advanced technology because of unavailable resources, financial support.
- **Lack of technological infrastructure:** Lack of necessary technological infrastructure, such as internet connectivity and electricity, in rural areas hinders the widespread use of AI. Without proper infrastructure, effective use of AI based technologies is not possible.
- **High capital cost:** The initial cost of technology-based equipment and techniques is high. It may be difficult for small and medium farmers to afford these costs, which prevents them from taking advantage of this technology.
- **Fragmented land holdings:** Most farmers in India have small and fragmented land holdings, making it difficult to adopt large-scale mechanization solutions, which are more cost-effective. As a result, there has been a sharp decline in the amount of land cultivable land during the past few years, raising concerns about an impending crisis in food security.
- **Inadequate Government policies:** The government's policies and programs for promoting agri-tech are often inadequate, inconsistent, or poorly implemented, hindering their effectiveness.
- **Data privacy:** Privacy and security of farmers' data is a major concern, especially when data collection and analysis happens on a large scale.
- **Lack of collaboration:** The lack of collaboration between stakeholders, including farmers, private sector players, and the government, can limit the development and adoption of effective agri-tech solutions.
- **Limited market access:** Even if farmers adopt agri-tech solutions, they may face challenges accessing markets to sell their produce due to a lack of market linkages and limited market information.
- **Issue with regulation of drones:** Privacy is a major concern that looms over the trajectory of this sector since aerial vehicles come equipped with sophisticated sensors and cameras.

Conclusion

Agriculture is one of the most important parts of our life, and advanced technology plays an important role in increasing productivity. Traditional agriculture is giving way to modern farming practices. Technology in agriculture has the potential to really push the country towards independence in every way so that it is less dependent on external factors. Technology can help in increasing profits and reducing costs in farming. By exploiting data and advanced technologies, farmers can make informed decisions that enhance productivity and reduce environmental impact. Hence, the emphasis needs to be on harnessing technology in unison as the greatest tool that can create new possibilities for India's farmers and over time, the rest of the country. Technology in agriculture has the potential to truly lead India to be "Atmanirbhar Bharat" in all respects, and be less dependent on extraneous factors.

Overall, the future of advanced technology in agriculture holds great promise in revolutionizing farming practices, enhancing productivity, sustainability, and addressing the challenges faced by the agricultural industry.

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LP 7.5

Gender Issues in Agriculture and Allied Sectors

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Gender: Concept

Gender is generally confused with sex. Sex is a biological term which refers to the functional differences between males and females and their reproductive potentials. Male and female are biological term. According to Word Development Report (2012), Gender refers to the Social, behavioural and cultural attributes, expectations and norms associated with being a woman or a man. The gender is defined as socially constructed phenomenon of deciding the relative role and status of men and women in any given society, because of their being men and women. Example: Gender role is classified by sex, where this classification is social, and not biological. It child bearing is classified as a female role, it is a female gender role, not a female sex role (Sagar Mondal, 2014).

In recent era, we are conscious about women's contribution and their importance in our society. We have developed the attitude of 'ladies first' besides celebrating 'International Women Day' on 8th March every year. Marching towards women empowerment has helped us achieve many milestones but our journey is not still over. There is a lot that has still to be worked upon to help women get their due place in society for equity and social justice.

Mainstreaming Women in Agriculture

Women account for over half the food produced to the developing world. There is a growing phenomenon of "feminization of agriculture" in Asia. Women are already fully involved in the agricultural economy. Food and Agricultural Organisation (FAO) document therefore, concludes, "Most farmers in India are women". Feminization refers to a rise in female labour force participation in agriculture with low wage, low level of skills and the traditional pattern of women's employment (Sagar Mondal, 2014).

Gender Issues in Agriculture and Allied Sectors

Gender issue is not same as women's issue. To comprehend gender issue, there is a need to have clarity about the term gender that refers to the socially constructed roles, behaviour, activities and attributes that a particular society considers appropriate for men and women. Traditionally, men were considered as bread winner of the family and women were seen as nurturer and care taker of the family. Women are discriminated in the male dominating society. The distinct role and behavior prescribed by the society give rise to gender discrimination. Gender discrimination/ gender bias is the prejudicial treatment of an individual or group. To reduce this inequality, gender equality and equity are two strategies that can be used in an effort to produce fairness.

Gender issues interdisciplinary and cross-national in scope focusing on gender and gender equity. It is defined as concern determined by gender-based and/or sex-based differences between women and men. Gender issues include all aspects and concerns related to women's and men's lives and situation in society, to the way they interrelate, their differences in access to and use of resources, their activities and how they react to changes, interventions and policies. Various Gender Issues in Agriculture and Allied Sectors discussed below.

1. Access to and Control over Land & Resources

Farm women play crucial role in agricultural activities from seed to feed. In spite of playing a pivotal role in food production, women farmers have significantly less access to, control over, and ownership of land and other productive assets compared to their male counterparts. For example, less than 15.00 per cent of agricultural landholders globally are women, although this varies widely across countries. Access to land affects women decision-making and long-term planning. Women who do not own land are less inclined to invest their time and resources such as irrigation or drainage systems, tree planting and other activities to maintain soil health. Moreover, without own land women are usually denied agricultural support services such as credit, training, irrigation etc. Kumar Mahato *et al.* (2023) revealed that the gender of individuals being female has adversely affected their likelihood of owning land. In rural households, the likelihood of females being a landowner in rural households is 7 to 8 per cent less than males. Even in urban households, females are 4 to 7 less likely to own land as compared to their male counterparts. In other words, despite having reform laws that provide equal ownership rights to both females and males in all property, a small fraction of females own land in rural and urban households. One of the plausible reasons for the low percentage of female landownership is the prevalence of patrilineal society in major parts of India, which limits the ownership rights of females and encourages females to transfer their land rights to male members of the household.

2. Gender gap in wage rates

Women are paid less than men. All India annual average wage rate during 2022-23 for male and female for field labour has reported at ₹ 394.64/day and ₹ 328.59/day respectively. Hence, the male workers were paid 20.10 per cent more than that of female workers. Gender gap among the states, in case of field labour wage, has reported vary adverse in Tamil Nadu. In Tamil Nadu daily wage rate for female is less than halved and reported ₹ 328.99 against that of male reported at ₹ 681.22. Gujarat has achieved unique status of egalitarian State and there is mere 8.00 per cent difference based on sex as far as wages are concerned. This is true both for field wage rate as well as other agriculture wage rate. In case of other agricultural labourers too, male laborers average daily wages have been 21.29 per cent more in comparison to the female labourers.

Table 1: Annual Average Daily Wage Rates in 2022-23: Male and Female

Sr. No.	State	Field (Agriculture) Labour Wage			Other Agriculture Labour Wage		
		Male	Female	Ratio of Female to Male in %	Male	Female	Ratio of Female to Male in %
1	Andhra Pradesh	512.27	362.05	70.68	509.36	360.59	70.79
2	Assam	437.72	396.77	90.64	437.08	398.36	91.14
3	Bihar	361.98	318.67	88.04	361.43	327.54	90.62
4	Chhattisgarh	270.68	199.71	73.78	239.75	200.76	83.74
5	Goa	683.13	499.67	73.14	654.79	457.71	69.90
6	Gujarat	270.28	250.42	92.65	181.82	181.39	99.76
7	Haryana	544.76	463.45	85.07	497.73	454.55	91.32
8	Himachal Pradesh	441.51	419.25	94.96	398.53	389.60	97.76
9	Jharkhand	305.81	273.86	89.55	292.13	260.00	89.00
10	Karnataka	475.1	298.87	62.91	446.19	317.66	71.19
11	Kerala	876.18	615.68	70.27	766.16	654.47	85.42
12	Madhya Pradesh	324.37	268.55	82.79	338.36	288.96	85.40
13	Odisha	381.17	312.25	81.92	386.06	318.07	82.39

14	Punjab	488.67	425.95	87.17	476.69	409.23	85.85
15	Rajasthan	412.59	331.73	80.40	398.53	281.74	70.69
16	Tamil Nadu	681.22	328.99	48.29	655.58	341.38	52.07
17	Telangana	465.56	328.28	70.51	422.79	337.08	79.73
18	Tripura	369.97	303.33	81.99	302.81	250.63	82.77
19	Uttar Pradesh	333.15	310.57	93.22	327.03	311.20	95.16
20	Uttarakhand	496.81	409.24	82.37	482.4	425.76	88.26
21	West Bengal	372.09	306.38	82.34	356.36	289.08	81.12
All India Average		394.52	328.51	83.27	401.88	331.27	82.44

Source: https://desagri.gov.in/wp-content/uploads/2024/09/Final-Publication-2022-23.pdf Department of Agriculture and Farmers Welfare, *GoI* (2024). Report on Agricultural Wages in India: 2022-23

3. Employment

Women are slightly more likely to be unemployed than men but experience a much larger jobs gap. In 2022, global unemployment rates for women and men stood at 5.70 per cent and 5.80 per cent respectively. This is projected to remain relatively unchanged in 2024. In 2022, the jobs gap rate for women was 15.00 per cent compared with 10.50 per cent for men, meaning an additional 153 million women have unmet need for employment compared with 115 million men. In the agricultural sector, women are overrepresented in seasonal, informal, part-time, and low-wage work with limited access to social protection. Globally, 36.00 percent of working women compared to 38.00 percent of working men work in agrifood systems as of 2019, but this may exclude self-employed and unpaid family workers. Differences across countries and regions are striking. In sub-Saharan Africa, 66.00 per cent of women's employment is in agrifood systems, compared with 60.00 per cent of men's employment while in southern Asia, 71.00 per cent of women workers are engaged in agrifood systems, compared with 47.00 per cent of men workers.

From an industry perspective, gender gaps in representation are present across all economic sectors. While there is variability in the shares of women in STEM employment across industries, women are systematically underrepresented in science, technology, engineering and mathematics (STEM) employment in comparison to men. Furthermore, women are overrepresented in non-STEM occupations across all industries. This configuration gives women a double disadvantage with regards to technological and workforce transitions, as they continue to occupy the lower growth, lower-paying jobs that are likely to be negatively affected in the short term.

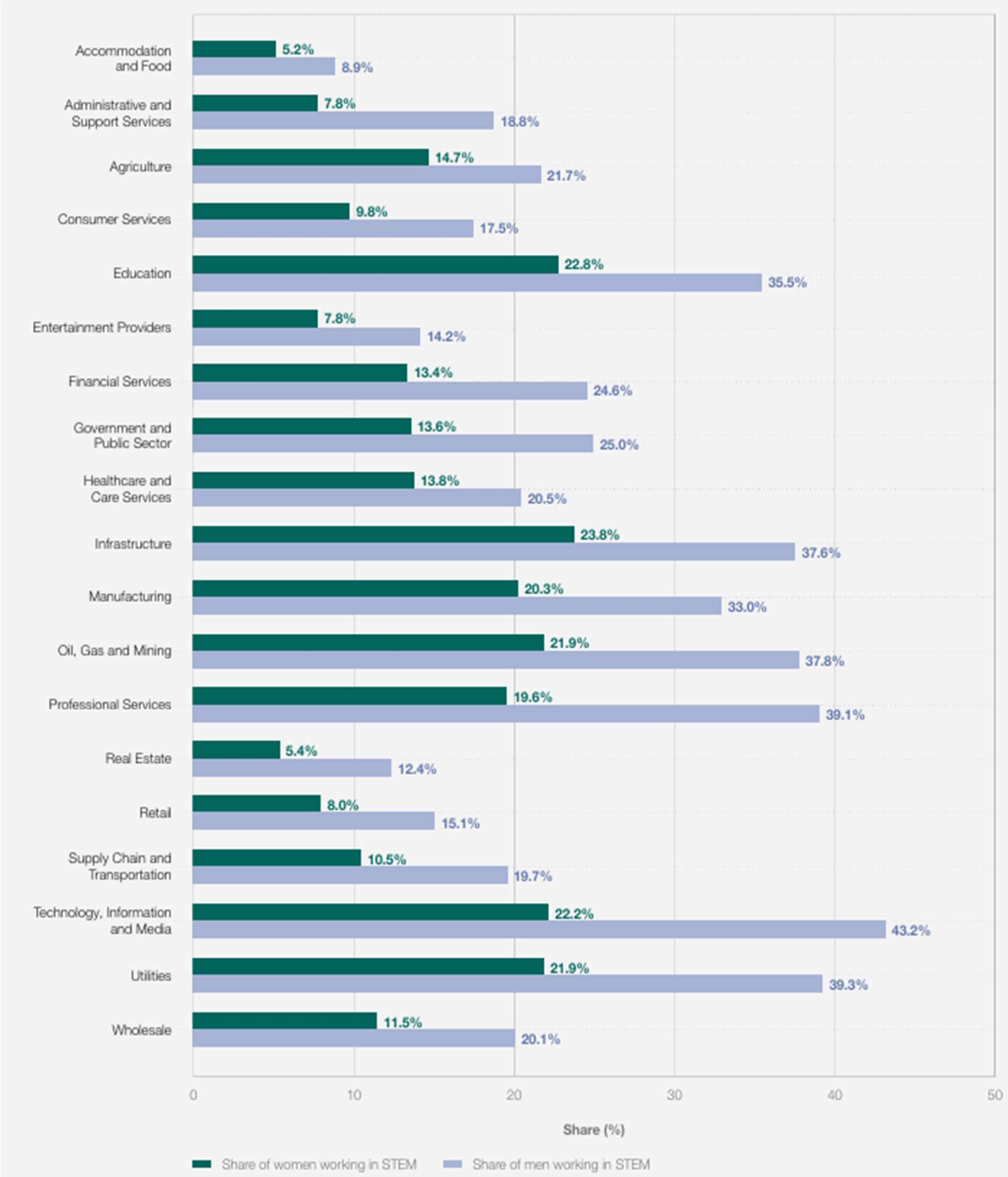

Fig.1 Shares of women and men in STEM occupations, by industry
Source: Global Gender Gap Report 2024, https://www3.weforum.org/docs/WEF_GGGR_2024.pdf

4. Extension Service and Research

Development Women only benefit from agricultural support programs if the information, technology and methods imparted are relevant to their production activities. Delivery of agricultural services still have gender bias. Women's contribution remain invisible to extension functionaries, researchers and the policy makers. Hence, limited research and extension support is available on technologies appropriate for women's multiple tasks. It is also assumed that men are the family heads and hence require extension information at the household level. Although male migration has increased gradually, leading to an increase in women headed households, still the required technological support has yet not reached to them. Most of the time in villages, group discussions and meetings are usually held involving men only. Further, the venue and timing of the meetings are inconvenient for women to attend. Sometimes the duration, content and methodology of the trainings are not appropriate for women. Extension workers aim their services and efforts primarily at men. They often overlook the constraints faced by women due to lack of resources, time, excess burden, cultural factors, children's responsibility, which prevent women from attending demonstrations and trainings. Agricultural research is generally very less oriented towards adapting technology to women's physical capabilities or towards addressing their tasks. Women's low productivity stems mainly from lack of appropriate technology.

5. Credit

Women face challenges in obtaining financial resources and credit facilities due to strict collateral requirements, insufficient financial knowledge, mobility constraint and inadequate representation in official banking organizations. This impedes their capacity to allocate resources towards agricultural inputs, technology, land and infrastructure. Women have limited access to and control over productive resources e.g. land, technology or financial services (FAO, 2006).

6. Capacity Building

In order to increase knowledge level and adoption of new technology by women farmers, their capacity building is of utmost priority. Capacity building enables farm women to attain self-reliance and sustainability of profitable micro enterprise to generate additional income for their families. But, it has been experienced that women have always been surpassed by extension workers during trainings. Mostly they prefer male participants for training programs due to which women are neglected , many a times, affecting their progress and success. Hence, farm women should be involved in skill oriented trainings for setting up of agro-enterprises in areas of mushroom cultivation, floriculture, backyard poultry rearing, vermin compost, nursery raising, value addition (secondary agriculture), fish cultivation, fish fry production, bee keeping, dairy farming, goat/sheep farming, etc.

7. Market Access

Women have limited access to marketing facilities and services due to which they could not expand their income generating activities. Although women are contributing as traders, hawkers and street vendors, still the gender issues in marketing are not being addressed effectively. Women engaged in agriculture, forestry and fishery tend to produce small quantities and have poor access to marketing boards and cooperatives. Therefore, women sell mainly to private traders and have low bargaining power. Institutions which promote women's group access to market should be strengthened. Successful examples are of SEWA, Gramin Bank, SHG Federations etc.

8. Education

Globally, nearly 98 million girls do not go to schools. Due to illiteracy, women are forced to work as unskilled laborers. It is more pronounced in rural areas due to high school drop-outs due to attainment of puberty, preference for educating a son, financial restrictions, parental attitudes towards educating sons as an investment but educating daughters a waste of money, dowry expenses, etc. One Indian proverb goes that, 'raising girls is like watering someone else's lawn'. Right from the birth, girl children are seen as burdens rather than blessings. The result is low literacy rate among women. A cost benefit analysis carried out by the World Bank indicated that if women received the same amount of education as men, farm yields would rise by 7.00 to 22.00 percent, while increasing women's primary schooling alone could increase agricultural output by 24.00 percent. It also enables women to earn higher wages. At present, As per the All India Survey on Higher Education 2020-21, the total enrolment in higher education has increased to nearly 4.14 crore in 2020-21 from 3.85 crore in 2019 20. The Female enrolment has increased to 2.01 crore from 1.88 crore in 2019-20. The percentage of female enrolment to total enrolment has increased from 45.00 per cent in 2014-15 to around 49.00 per cent in 2020-21. India registered improvement in the Gender Parity Index (GPI), the ratio of female Gross Enrolment Ratio (GER) to male GER, has increased from 1 in 2017-18 to 1.05 in 2020-21 (Employment Statistics in Focus-April 2023).

9. Men Migration

Feminization of agriculture in India is evident from the out-migration of male for better job opportunities to abroad or city areas. It has increased burden for women to sustain the agriculture sector inputs the household chores. Many scholars have shown that women´s work load has been increasing as compared to men counterpart in agriculture sector. Women headed households are much more likely to work for wages in agriculture than other women due to the resource constraint. It has been observed that extension services, cooperatives and credit support are less available to women headed households than men. On the other hand, in the absence of their husbands, women show their potentiality in terms of decision making, mobility and participation in political activities.

10. Over Burden of Work

Women play triple responsibilities like agricultural production, reproduction and nurturing. Rural women are much more over-burdened than men owing to their multiple occupations. Researches on women in agriculture have revealed that on an average women work for 15-16 hours a day. Women involved in farm activities, which are time and labor intensive, monotonous, repetitive, hazardous and drudgery prone work are generally performed by women. Since these operations are done manually, they cause considerable physical and mental fatigue and health problems.

11. Drudgery

Women tend to bear the brunt of drudgery since they continue to be most affected by illiteracy, malnutrition and unemployment. Women usually perform their economic tasks with traditional tools, which were designed mainly for men keeping in mind their physical features (height, weight bearing etc.). The daily work schedule of rural women is very demanding and drudgery prone. The high drudgery prone activities for farm women are: transplanting, weeding, rice parboiling, harvesting crops, carrying head loads of farm produce, water supply to their homes and cattle, get the firewood for cooking they need to collect and store crop waste, need to make cow dung cake for cooking and store and protect it from seasonal disruptions cooking on chulhas by using old traditional methods like firewood, coal, cow dung cake etc. Women friendly and gender appropriate tools are either unavailable or insufficient in number or unused due to lack of awareness. Such tools, coupled with often hazardous, unhealthy work conditions and long work hours create and accelerate many health problems for women farmers. Women having to invest a lot in both agricultural and household work with dismal returns is supposed to be a source of extreme drudgery on them. The migration of men has also led to a massive increase in the number of households headed by women in the villages. On the other hand, poor income, lack of credit facilities, training and socio-cultural barriers hinder women in adopting improved tools and equipment.

Conclusion

Despite having reform laws that provide equal ownership rights to both females and males in all property, a small fraction of females own land in rural and urban households. Women are paid less than men. Women are slightly more likely to be unemployed than men. Women are overrepresented in non-STEM occupations across all industries. Women's contribution remain invisible to extension functionaries, researchers and the policy makers. Women face challenges in obtaining financial resources and credit facilities. Women have limited access to marketing facilities and services due to which they could not expand their income generating activities. In case of Education, total enrolment of women in higher education has increased. The daily work schedule of rural women is very demanding and drudgery prone.

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ABSTRACTS

Novel Extension Approaches for Reshaping Indian Agriculture

NEA 1

A study on adoption pattern of post-harvest techniques by the Mango growers/leasers

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ABSTRACT

Post-harvest techniques (PHT) generated by the scientists are not use unless adopted by the farmers. There are many constraints that affect the adoption pattern of a technology. The present study was concentrated on studying adoption pattern of PHT by the mango growers / leasers in Junagadh district. It was found that the bamboo basket was use for carriage in field area of mango garden used temporary storage under shadow of mango trees, cent per cent of the respondent used 10 kg size card board boxes for packaging, less adoption of grading practices, used open rickshaw for transportation and select nearest market for selling of mango. The lack of information about production, demand and fluctuation of market price, reduce quality and production due to uncertain rainfall at maturity time, less price from sales agent and lack of knowledge about PHT led to non-adoption. The respondents viewed need to give priority of value-added production, disseminate latest PHT and rapid transport and export facilities.

Keywords: Post-harvest techniques; mango growers

NEA 2

Motivational factors and constraints faced by beneficiary tribal farmers in obtaining benefits of agricultural technology management Agency

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ABSTRACT

The National Agricultural Technology Project (NATP) has framed for pilot testing new institutional arrangements for technology dissemination at the district level and below, through establishment of Agricultural Technology Management Agency (ATMA) as an autonomous organization providing flexibleworking environment. In Gujarat State, all districts have been selected for ATMA project as a part of the Innovations in Technology Dissemination (ITD) component of the project. Since the past fifteen years, the ATMA has been running in Gujarat. There should be some motivations to attract farmers to involve in ATMA activities. It is fact that to get benefits of ATMA projects, the farmers must have to join in FIGs and keeping in mind above fact it is crucial to study motivational factors to join FIGs and constraints faced by beneficiary tribal farmers in obtaining benefits of Agricultural Technology Management Agency. The present study was carried out in middle Gujarat. The four tribal Districts Dahod, Panchmahals, Mahisagar and Chhotaudepur of middle Gujarat were selected purposively for present study. From each selected district two talukas were selected purposively.

From each selected talukas, two villages were selected randomly. Thus, total sixteen villages were selected. Fifteen respondents from each selected village were selected. Thus, total 240 respondents were selected randomly from those four Districts. The result of study revealed that motivational factor to join FIG were;for getting the latest information of agril. & allied fields ranked first among all the motives. It was reported by the (90.00%) respondents of FIGs. The next motives in order of priority were, for getting supplement income (81.66%). Major constraints faced by the ATMA beneficiary tribal farmers were; the demonstrations should not be supplied in enough numbers and with larger unit areas (89.50%), Major suggestion given by the ATMA beneficiary tribal farmers were; the demonstrations should be supplied in enough numbers and with larger unit areas (90.00%).

NEA 3

Relationship between psychological characteristics of beneficiary tribal farmers and their socio-techno-economic change

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ABSTRACT

The Agricultural Technology Management Agency (ATMA) has significantly improved the lives of tribal farmers by promoting socio-techno-economic transformations through efficient technology dissemination. Keeping in view, the present study entitled "relationship between psychological characteristics of beneficiary tribal farmers and their socio-techno-economic change" was carried out in middle Gujarat. The four tribal Districts Dahod, Panchmahals, Mahisagar and Chhotaudepur of middle Gujarat were selected purposively for present study. From each selected district two talukas were selected purposively. From each selected talukas, two villages were selected randomly. Thus, total sixteen villages were selected. Fifteen respondents from each village were selected. Thus, total 240 respondents were selected randomly from those four Districts. The results reveals that more than half (56.67%) of the respondents exhibited good to excellent cohesiveness, slightly more than half (52.50%) of the respondents had medium to high level of innovativeness, nearly three-fifth (58.75%) of the respondents had medium to high level of achievement motivation, majority (74.17%) of the respondents displayed medium to very high level of economic motivation, majority (60.41%) of the respondents exhibited medium to very high level of scientific orientation, slightly more than two-third (64.16%) of the respondents had medium to high level of risk orientation, slightly less than three-fifth (59.16%) of the respondents had favourable to strongly favourable attitude towards Agricultural Technology Management Agency. Among the selected psychological variables innovativeness, cohesiveness, achievement motivation, economic motivation, scientific orientation, risk orientation and attitude towards Agricultural Technology Management Agency had established positive and highly significant relationship with socio-techno-economic change.

NEA 4

Development and standardization of the scale to measure the consequences of agricultural technology management agency on socio-techno-economic change of beneficiary tribal farmers

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ABSTRACT

The Agricultural Technology Management Agency (ATMA) was established to advance agricultural practices by promoting the dissemination of innovative technologies at the district level. Its goal is to bridge the gap between research institutions and farmers, enhancing productivity and sustainability. To effectively evaluate ATMA's impact on the socio-techno-economic changes experienced by beneficiary tribal farmers, it is crucial to develop and standardize a measurement scale. This scale would assess various dimensions, such as improvements in agricultural productivity, income levels, socio-economic status, access to education and healthcare, and overall quality of life. By systematically quantifying these outcomes, the scale will provide valuable insights into the effectiveness of ATMA's interventions and guide future efforts to further support and enhance the well-being of tribal farming communities. Keeping in mind above fact that it is crucial to develop a scale to measure the consequences of Agricultural Technology Management Agency on socio-techno-economic change of beneficiary tribal farmers. The present study was carried out in middle Gujarat. The four tribal Districts Dahod, Panchmahals, Mahisagar and Chhotaudepur of middle Gujarat were selected purposively for present study. From each selected district two talukas were selected purposively. From each selected talukas, two villages were selected randomly. Thus, total sixteen villages were selected. Fifteen respondents from each selected village were selected. Thus, total 240 respondents were selected randomly from those four Districts. A standardized scale to measure the consequences on socio-techno-economic change of respondents was developed by using the Normalized Rank Order Method recommended by Guilford (1954) was found to be reliable and valid.

NEA 5

Consequences of Agricultural Technology Management Agency on beneficiary tribal farmers in terms of socio-techno-economic change

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ABSTRACT

The consequences of ATMA's initiatives are profound, as they embody a "Bottom-Up" approach that significantly transforms agricultural development strategies and redefines the role of farmers. Rather than being passive recipients, farmers become active contributors, shaping their agricultural destinies through participation. This model leverages their local knowledge and addresses their specific needs in project planning and implementation. Since the past fifteen years, the ATMA has been running in Gujarat. Hence, it is now absolute need to study consequence of ATMA which are reflected in terms of socio-techno-economic change among farmers. The present study was carried out in middle Gujarat. The four tribal Districts Dahod, Panchmahals, Mahisagar and Chhotaudepur of middle Gujarat were selected purposively for present study. From each selected district two talukas were selected purposively. From each selected talukas, two villages were selected randomly. Thus, total sixteen villages were selected. Fifteen respondents from each selected village were selected. Thus, total 240 respondents were selected randomly from those four Districts. The result of study revealed that majority (70.00%) of the respondents exhibited a medium to high level of change in adoption of improved agricultural technologies, majority (60.00%) of the respondents showed medium to high levels of change in adoption of improved technologies in horticulture, majority (70.83%) of the respondents demonstrated a medium to high level of change in adoption of improved technologies in animal husbandry, majority (77.49%) of the respondents experienced a medium to very high level of change in their social relationship, majority (77.49%) of the respondents experienced a medium to very high level of change in their social relationship, majority (74.16%) of the respondents experienced a medium to high level of overall socio-techno-economic change due to the Agricultural Technology Management Agency.

NEA 6

Relationship between personal, socio-economical and communicational characteristics of beneficiary tribal farmers and their socio-techno-economic change

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ABSTRACT

The Agricultural Technology Management Agency (ATMA) was established across India as part of the National Agricultural Technology Project (NATP) to enhance the dissemination of agricultural technologies at the district level and below. This autonomous organization provides a flexible working environment, facilitating efficient technology transfer to farmers. Keeping in mind above fact that the present investigation to study the relationship between personal, socio-economical and communicational characteristics of beneficiary tribal farmers and the consequences of the Agricultural Technology Management Agency which are reflected in terms of socio-techno-economic changes was carried out in middle Gujarat. The four tribal Districts Dahod, Panchmahals, Mahisagar and Chhotaudepur of middle Gujarat were selected purposively for present study. From each selected district two talukas were selected purposively. From each selected taluka, two villages were selected randomly. Thus, total sixteen villages were selected. Fifteen respondents from each selected village were selected. Thus, total 240 respondents were selected randomly from those four Districts. The result of the study revealed that majority (87.50%) of the respondents belonged to the middle age to young age group, majority (74.59%) of the respondents had 11 to above 21 years of farming experience, majority (68.75%) of the respondents had three to more than four exposure

visit attended, majority (70.00%) of the respondents had participated in one or two organizations, majority (63.33%) of the respondents had possessed farming and farming + animal husbandry as their occupation for livelihood, among the selected personal, socio-economic and communicational variables education, training received, extension contact and farm mass media exposure had established positive and highly significant relationship with socio-techno-economic change. Farming experience, experience as a member of FIG, number of exposure visit attended, social participation, occupation, had established positive and significant relationship with socio-techno-economic change. Age had negative and non-significant relationship with socio-techno-economic change.

NEA 7

Relative importance of independent variables in explaining socio-techno-economic change among tribal farmers

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ABSTRACT

The Agricultural Technology Management Agency (ATMA) has greatly benefited tribal farmers by facilitating socio-techno-economic changes through effective technology dissemination. By providing access to innovative farming techniques and resources, ATMA has empowered these farmers to enhance their productivity and income levels. This initiative has led to significant improvements in their socio-economic status, enabling better education, healthcare, and overall quality of life. Keeping in mind above fact, The present investigation to study the relative importance of independent variables in explaining socio-techno-economic change among tribal farmers was carried out in middle Gujarat. The four tribal Districts Dahod, Panchmahals, Mahisagar and Chhotaudepur of middle Gujarat were selected purposively for present study. From each selected district two talukas were selected purposively. From each selected talukas, two villages were selected randomly. Thus, total sixteen villages were selected. Fifteen respondents from each selected village were selected. Thus, total 240 respondents were selected randomly from those four Districts. The result of study revealed that attitude of ATMA beneficiary farmers towards ATMA, training received, risk orientation and innovativeness accounted for 69.80 per cent variation in socio-techno-economic change of respondents. Thirteen variables exerted direct positive effect on socio-techno-economic change of the respondents out of thirteen variables attitude of ATMA beneficiary farmers towards ATMA exerted maximum positive effect on socio-techno-economic change of respondents, followed by training received.

NEA 8

Awareness of farmers of the Panchmahals district about government scheme of farm mechanization related to agriculture

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ABSTRACT

Farm mechanization is to enhance the overall productivity and production with lowest cost of production. In I-khedut portal, there are many Govt. Schemes likes Sub mission on Agricultural Mechanization scheme (SMAM), Mukhy mantra krushiyantrikikarnyojana, AGR 2 (General category farmers), AGR 3 (ST Farmers), AGR 4 (SC farmers) which are under various farm mechanization (agricultural tools).The present study was conducted in Panchmahals District of Gujarat. 300 farmers was selected randomly for the study. The data was collected through personal interview method. more than half (50.33 per cent) of the farmers were found in the middle age group, nearly half (48.67 per cent) of the farmers had secondary to higher secondary level of education, more than half (54.00 per cent) of the farmers had a medium to high level offarming experience, more than half (54.33 per cent) of the farmers had medium to high level of extension contact, two-third (67.00 per cent) of the farmers had medium to high level of mass media exposure, two-third (66.00 per cent) of the farmers possessed marginal to small size of land holding, Cent per cent (100.00 per cent) of farmers were aware about in farm mechanization scheme, tractor, cultivator, rotavator, seed drill, zero till seed cum fertilizer drill, thresher/ multi crop thresher/paddy thresher and winnowing fan, In I-khedut portal registration of agricultural tools are target based (88.33 per cent), lack of financial resources /lack of credit facilities (81.33 per cent), Inadequate knowledge about schemes (78.33 per cent), Increase of subsidy portion to purchase the machinery (85.00 per cent), farm machinery tools target increase so farmer can purchase (78.33 per cent).

NEA 9

Examining the socio-economic impacts of contract farming: Insights from Northern West Bengal

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ABSTRACT

This study analyses the intra-level and inter-level relationships between the socio-economic profiles of contract farmers and their perceived impacts on employment generation and poverty reduction in Cooch Behar district, West Bengal. Utilizing an ex-post-facto research design, data were collected from 100 potato contract farmers across ten villages through a purposive multistage random sampling method. The study examines the relationships between nineteen predictor variables and the dependent variable-perceived impacts of contract farming on employment and poverty alleviation by using statistical tools such as Pearson’s correlation coefficient and multiple linear regression analysis. Findings reveal that variables such as age ($r = 0.221$, $p < 0.05$), experience in contract farming ($r = 0.445$, $p < 0.01$), personal assets ($r = 0.205$, $p < 0.05$), communication skills ($r = 0.281$, $p < 0.01$), and extension contact ($r = 0.210$, $p < 0.05$) are positively associated with these perceived impacts. Conversely, annual family expenditure ($\beta = -0.334$, $p < 0.05$) and innovation proneness ($\beta = -0.249$, $p < 0.05$) negatively influence these perceptions, while experience in contract farming ($\beta = 0.482$, $p < 0.05$) and communication skills ($\beta = 0.311$, $p < 0.05$) contribute positively. Experience in contract farming emerged as the most influential predictor, accounting for 48.20% of the variance in the perceived impacts of contract farming.

Keywords: Socio-economic profile, ex-post-facto research, Pearson's correlation coefficient, employment generation, poverty reduction

NEA 10

Comparative study of Cotton yield in conventional and closer spacing systems in Amreli district

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ABSTRACT

This study investigates the impact of conventional and closer spacing systems on the yield performance of cotton in the Amreli district. Cotton production plays a vital role in the region's economy, and optimizing planting density is crucial to improving productivity. The research compares two approaches—conventional spacing, typically practiced by local farmers, and closer spacing, which increases plant density per unit area. Data were collected through field experiments conducted during the Kharif season. The results demonstrated that closer spacing led to a 13.1% increase in yield compared to conventional spacing, maximizing resource utilization. However, an extension gap of 6.97 quintals per hectare was observed between the experimental plots and farmer practices, indicating the need for further extension efforts to improve adoption. Demonstration plots achieved a maximum potential yield of 14 quintals per hectare, but a technology gap of 0.90 quintals per hectare suggests there is still room to enhance yields through better practices. The technology index of 6.43% reflects moderate success in transferring improved agricultural technologies to farmers. While the closer spacing system improved productivity, it also introduced challenges, such as higher input costs and increased susceptibility to diseases due to denser planting. This study provides valuable insights for farmers and policymakers on the importance of adopting optimal spacing strategies to improve cotton productivity sustainably. By narrowing the yield and technology gaps, the region can further enhance cotton production and profitability.
Keywords: Closer spacing, cotton, productivity. kharif season

NEA 11

Role of information management behaviour of trained input dealers

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ABSTRACT

The private sector plays a major role in the dissemination of knowledge about new technologies and new recommendations. The input dealers are one of them. Agricultural input dealers provide seeds. chemical fertilizer, bio-fertilizers, agricultural chemicals, types of machinery, implements, plant protection appliances, animal feed, poultry hatchery, veterinary medicines, landscaping, agricultural credit, custom service, bio-control units, and biotech units, bio-pesticides, etc. for the cultivation of crops, input dealers provide mainly seeds, pesticides, and fertilizers to the farmers. Trained input dealer serves as an important link between the

manufacturers and the farmers. So, he/she has the responsibility to disseminate the latest farm technology up to the field level, especially in the era of the free economy and world trade organization. Getting the right fertilizers to the farmers at the right place, at the right time and price, in a good condition, and in sufficient quantity is the responsibility of trained input dealers. The action of individual trained input dealers is governed by personal, socio-economic, communicational and psychological factors involved in situation. This present study entitled "Role of Information Management Behaviour of Trained Input Dealers" was conducted in the year 2022 in Gujarat state of India. A sample of 230 trained input dealers was selected from these states. The ex-post facto research design was used for the research study. The result observed that vast majority of the trained input dealers had very high information management behaviour.

Keywords: Trained input dealers, information management behaviour, knowledge, agricultural and technologies

NEA 12

Factors affecting information seeking behaviour of trained input dealers

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ABSTRACT

This present study entitled "Factor Affecting Information Seeking Behaviour of Trained Input Dealers" was conducted in the year 2022 in Gujarat state of India. A sample of 230 trained input dealers was selected from these states. The ex-post facto research design was used for the research study. The private sector plays a major role in the seeking of information about new technologies and new recommendations. The trained input dealers are one of them. Information needs may be realized from the trained input dealers or from the data expert on behalf of this information seeker. Thus, it may be stated that the information seeking behaviour differs with such characteristics. Hence, considering the importance of these characteristics and review of past research studies, an attempt has been made in this investigation to ascertain the relationship if any, between profile of trained input dealers and their information seeking behaviour. The result found that vast majority of the trained input dealers had very high information seeking behaviour and out of twenty independent variables thirteen variables viz. education, social participation, extension contact, cosmopoliteness, mass media exposure, input supply ability, innovativeness, economic motivation, scientific orientation, risk orientation, achievement motivation, planning orientation and market orientation were found to be positive and highly significantly correlated with information seeking behaviour.

Keywords: Trained input dealers, information, behaviour, correlation

NEA 13

Knowledge level of trained input dealers about the different modules of training

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ABSTRACT

This present study entitled "Knowledge level of trained input dealers about the **different** modules of training" was conducted in the year 2022 in Gujarat state of India. A sample of 230 trained input dealers was selected from these states. The ex-post facto research design was used for the research study. Input dealers serves as an important link between the manufactures and the farmers. So, he/she has the responsibility to disseminate latest farm technology up to the field level especially in the era of the free economy and the world trade organization technical qualifications in agriculture are mandatory to overcome potential adverse effects, to sell farm inputs as well as to issue dealership licenses to provide farm-advisory services. Most of these input dealers do not have formal agricultural education. If these input dealers are made para-extension professionals by providing the necessary knowledge, they can commercialize extension services and contribute to the paradigm shift in Indian agriculture and thereby help the farming community. The action of individual trained input dealers is governed by personal, socio-economic, communicational and psychological factors involved in situation. Trained input dealers show knowledge level of trained input dealers about the **different** modules of training. Thus, it may be stated that the knowledge level of trained input dealers about the **different** modules of training differs with such characteristics. Hence, considering the importance of these characteristics and review of past research studies, an attempt has been made in this investigation to ascertain the relationship if any, between profile of trained input dealers and their knowledge level of trained input dealers about the **different** modules of training. The result indicated that majority of trained input dealers had very high-level of agro ecological situation, soil health management, Crop Production Technology, Peat, Disease and Weed control in Agriculture, Farm Implements and Machinery, **Irrigation Techniques and their management**, Seed & Seed Production, Extension Management and Personal Development and overall knowledge and out of twenty independent variables ten variables viz. social participation, extension contact, cosmopoliteness, input supply ability, economic motivation, achievement motivation, planning orientation and market orientation were found to be positive and highly significantly and scientific orientation and risk orientation had positive and significant correlated with **overall knowledge level of the different modules of training**.

Keywords: Trained input dealers, knowledge, modules, training

NEA 14

Reshaping agricultural extension: The role of action research in empowering rural communities

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ABSTRACT

Farmers in developing countries face increasing challenges, including unpredictable markets, resource scarcity, and rising input costs, which require a re-evaluation of agricultural research methodologies. This advocates for Action Research (AR) as a critical approach to enhance agricultural extension and rural development. Unlike traditional research, which often maintains a detached stance, AR emphasizes collaborative problem-solving and active

participation, enabling farmers and researchers to work together to address real-world issues. The distinctive attributes of AR, includes its focus on empowering stakeholders as co-researchers and its commitment to addressing social dimensions within agricultural contexts. By acknowledging biases and integrating local knowledge, AR fosters a deeper understanding of complex agricultural challenges, facilitating more relevant and impactful solutions. We argue that existing research methodologies in agricultural extension often lack practical significance and fail to engage effectively with the realities faced by farmers. Current curricula emphasize theoretical knowledge at the expense of practical application, leading to a disconnect between research outputs and field needs. To address this gap, a shift towards praxis-oriented framework that integrates development-focused AR methodologies is needed, thereby aligning academic research with the imperative of solving farmers' problems. As there is a need for stronger collaboration among researchers, extension professionals, and farmers, by embracing AR, the agricultural sector can cultivate a more dynamic, responsive approach to research and extension that empowers communities and fosters sustainable development. Institutional backing to foster action research aimed at enhancing livelihoods and securing food safety in evolving agricultural environments.

NEA 15

Area wide management of fruit fly pest through farmer’s participation

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ABSTRACT

Pest control and pest management are the most common terms used in agriculture where control is complete elimination of a particular pest whereas management is reduction of the pest level below the economic threshold level. Here, managing the pest is beneficial as natural population will survive without losing biodiversity of particular environment. Integrated pest management is the method of pest management where the natural population is also maintained by keeping the pest below the economic threshold level. IPM also differs from conventional approaches of pest management in avoiding the use of loads of pesticides. But IPM also have some constraints as it is managing only in the fields by individual farmers but not managing in a geographic area which makes the population to re-establish. So, a new approach has been initiated which manages in a geographical area completely called but AW-IPM. To manage the notorious fruit fly pest the area wide approach for the management through farmer’s awareness programme with mass trapping ultimately reduce the population of the male individuals and there will be no offspring. The approach favours the export in the fruit growing area which gives higher returns.

Keywords: Area Wide IPM, surveillance, fruit fly traps

NEA 16

Performance assessment of Pigeon Pea variety GJP 1 through cluster frontline demonstrations in Amreli district, Gujarat

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ABSTRACT

This study was conducted in Amreli district, Gujarat, to evaluate the yield performance and technological impact of the improved pigeon pea (var. GJP 1) under demonstration trials, compared with local farmer-cultivated varieties over three years: 2018-19, 2020-21, and 2021-22. Fifty demonstrations were carried out each year to assess the benefits of improved practices. The results indicate that the demonstration plots using GJP 1 consistently outperformed the farmer-cultivated varieties. The average yield for the demonstration plots was 14.72 q/ha, compared to 12.40 q/ha for the farmer's plots, with an average increase in yield of 18.26%. The extension gap was observed to be 2.32 q/ha. Across all three years, the potential yield of GJP 1 was 21.00 q/ha, but the technology gap decreased from 13.60 q/ha in 2018-19 to 1.40 q/ha in 2021-22, showing significant improvement in adoption over time. The technology index improved from 64.76% in 2018-19 to 6.67% in 2021-22, with an overall mean of 29.89%. This study demonstrates that the adoption of GJP 1 with improved practices significantly enhances pigeon pea productivity and reduces the technology gap. The findings emphasize the importance of continued extension efforts to improve awareness and adoption of advanced agricultural technologies for sustainable crop production in the region.

Keywords: Demonstration, Pigeon Pea, technology gap, GJP 1

NEA 17

Efficiency of KVK beneficiaries about the influence of Krishi Vigyan Kendra (KVK)

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ABSTRACT

Efficiency is the ability to do or produce without wasting materials, time, or energy. Efficient if it satisfies the motive of the aim and effective if it accomplishes specific aims. According to Clark and Gottfried (1957), efficiency in general usage means the quality of competence, capability, effectiveness or productivity, the ability to produce the desired result. [1]. Efficiency is the convergence of potential in the real and the potential of farmers may be changed after the influence of KVK (Farm Science Center). This study was conducted about KVK-benefited farmers who are advantaged by KVK activities like training, OFTs and FLDs. The research was conducted in 30 KVKs in Gujarat state of India. A random sampling method was used to select 300 KVK benefited farmers from all purposive selections of 30 KVKs in Gujarat state of India. Of these KVK-benefited farmers, 150 were trained, 90 conducted FLDs and 60 administered OFTs on their farms. Most KVK-benefited farmers had moderate to higher efficiency regarding the influence of KVK.

Keywords: Efficiency, KVK beneficiaries, influence, OFTs, FLDs

NEA 18

Performance evaluation of Wheat varieties GJW 463 with farmer cultivation of GW496 under demonstration trials in Amreli district, Gujarat

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ABSTRACT

This study was conducted in Amreli district of Gujarat to compare the productivity, profitability, and technological performance of two wheat varieties—GJW 463 (demonstration plots) and GW 496 (farmers' practice)—over two consecutive years, 2022-23 and 2023-24. A total of 50 demonstrations were conducted each year to assess the impact of improved cultivation practices under real-field conditions. The results revealed that the demonstration plots (GJW 463) achieved higher average yields (57.25 q/ha) compared to farmers' plots (GW 496), which recorded an average yield of 53.20 q/ha. The average yield improvement was 7.61%, with an extension gap of 4.05 q/ha. However, the technology gap increased from 8.66 q/ha in 2022-23 to 11.76 q/ha in 2023-24, with a mean technology index of 15.13%. Economic analysis showed that the cost of cultivation in demonstration plots remained slightly lower. Net returns for demonstration plots decreased from ₹149625.70 in 2022-23 to ₹123168.20 in 2023-24, possibly due to market price variations. Despite this, the benefit-cost (B:C) ratio for demonstration plots was higher (6.33 and 5.36) compared to farmers' plots (5.71 and 4.85). This study concludes that adopting improved practices for the GJW 463 variety in Amreli district can significantly enhance wheat yield and profitability. However, efforts are needed to reduce the widening technology gap and ensure better dissemination of advanced farming practices for sustainable agricultural development.

Keywords: Demonstration, Wheat, technology gap

NEA 19

Evaluation of frontline demonstration and yield gap analysis of Isabgol in Banaskantha district, Gujarat

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ABSTRACT

The present study was conducted to assess the performance of Isabgol variety GI-4 (Gujarat Isabgol 4) with the improved production practices and to identify yield gap and constraints of isabgol cultivation in the district. Total thirty demonstrations over 12 ha areas were conducted in two consecutive years during rabi seasons of 2018-19 and 2019-20 under the operational area on KVK Banaskatha II. The results revealed that the no. of tillers/ plant 24.39 cm, no. of spikes/plant 12.11, seeds spike/plant 6.99 and spike length 4.38 recorded higher in the improved practices compare to the farmer's practices. Further the average yields were recorded 8.35 q/ha across the two years with a 24.01% increase compare to the farmers practices. The mean extension gap, technology gap and technology index were 1.61 q/ha, 4.66 q/ha and 35.81 percent respectively. Which indicates the needs of enhance extension services, effective dissemination of knowledge and better adoption of improved technology to the farmers. In term of economics improved practices obtained the highest average net income of

Rs 47899 /ha and B: C ratio 1.71 as compared to farmers practices Rs 33428 ha and 1.09 respectively. Therefore, the higher B: C ratio indicates economic feasibility of the improved practices demonstrated in the district.

NEA 20

Bypass fat supplementation for high-yielding crossbred cows in Navsari district: Insights from the Farmer First Program

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ABSTRACT

A study was conducted under the Farmer First Program (FFP), Navsari Agricultural University, funded by ICAR, to evaluate the effects of bypass fat supplementation on the production performance and health of dairy animals. The study involved 80 beneficiary farmers across the villages of Kesali, Changa, and Vadsagar in Navsari District. Seventy animals were divided into two groups: 60 animals received bypass fat (treatment), while 10 served as controls. Bypass fat was supplemented at 100 g/day from 15 days pre-partum to 90 days post-partum. Various performance indicators were monitored, including calf birth weight, milk yield, milk composition (fat and SNF), body condition score (BCS) and calf mortality. Results indicated a significant increase in calf birth weight in the treatment group (31.96 kg) compared to the control group (27.30 kg). Milk production also improved significantly, with treated animals yielding 15.10 kg/day compared to 12.19 kg/day in the control group, a 35.53% increase. Additionally, the milk fat percentage in the treatment group was significantly higher (5.69%) than in the control group (4.85%), while SNF levels showed no significant difference. Calf mortality was notably reduced in the treatment group (1.66%) compared to the control group (10%), indicating improved animal health and management. Furthermore, the treated animals showed better body condition scores (3.68) compared to controls (3.09), reflecting improved overall health. The findings underline the benefits of incorporating bypass fat into the diets of lactating dairy animals, leading to improved productivity, calf health and overall farm profitability.

Keywords: Bypass fat, dairy performance, milk yield, calf birth weight, body condition score, calf mortality

NEA 21

Extension strategies for addressing farmers' distress

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ABSTRACT

Agriculture is the backbone of Indian economy, contributing 18.20 per cent to national GDP in 2023-24. In today's agricultural landscape, farmers face an array of challenges that threaten their livelihoods and well-being. The challenges and hardships faced by farmers are referred to as farmers distress. The Working Group on Distressed Farmers constituted by RBI in 2006 defined distressed farmer as one, who has suffered repeated

income/ psychological shocks due to failure of investment, weather, crop production or markets, and has crippled his ability to meet his financial and other family obligations; and feels humiliated by the castigations of the lenders and, in the absence of coping mechanisms, contemplates/takes the extreme step of voluntarily ending his life. Agricultural extension services can play a crucial role in addressing the farmers' distress by adopting different strategies. Key strategies include promotion of sustainable farming practices such as crop rotation and diversification, water conservation techniques, climate smart agricultural practices, Integrated Farming System (IFS) through training and education, workshops, Farmers Field School (FFS), Frontline demonstration (FLD) and On-farm Trail (OFT) by KVKs. Additionally, financial literacy and awareness campaigns can inform farmers about farm credit facilities, crop insurance schemes, income diversification and digital financial services. Rural skill development programs through agricultural training centres, vocational training, digital literacy, and entrepreneurship training can empower farmers with new skills. Market diversification through Farmer Producer Organizations (FPOs), e-markets and enhanced market intelligence can improve farmers access to markets and stabilize their incomes. Lastly, agro-advisory services can provide timely guidance on crop management, pest control, and climate adaptation strategies to support farmers' decision-making and productivity. By adopting these extension strategies, Indian agriculture can better support farmers, reduce distress, and strengthen rural communities.
Keywords: Extension strategies, farmers distress, sustainable farming practices, financial services, skill development, market diversification

NEA 22

Constraints faced by the Date Palm in adoption of recommended Date Palm cultivation practices

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ABSTRACT

Launch of National Horticulture Mission has spurred the production and productivity of horticultural crops. Increase in demand for horticultural produce due to greater health awareness, rising income, export demands and increasing population poses the challenge for further increasing the production and productivity of horticultural crops. The study was conducted to find out relationship of selected characteristics of date palm growers with adoption of recommended date palm cultivation practices. The present investigation was purposefully carried out in Kachchh district of Gujarat state. From Kachchh district, four talukas and from each taluks six villages were purposively selected based on area and production of date palm. Total 300 date palm growers were selected proportionately for this study. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result indicated that Major constraints faced by the date growers were; no surety about improved variety of date palm, unavailability of sufficient labour in time, high price of tissue culture plant, short shelf life and fluctuation in prices.

NEA 23

Assessment of frontline demonstration on yield enhancement and economics of Chickpea (gg-5) in Morbi district of Saurashtra region of Gujarat

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ABSTRACT

Frontline demonstrations on improved variety of chickpea-GG-5 with recommended practices were conducted on 10 farmer's fields by Krishi Vigyan Kendra, JAU, Morbi, Gujarat on 04-hectare area in different villages of Morbi district during Rabi season of 2019-20 to 2022-23. The results revealed that improved variety of chickpea-GG-5 with recommended practices recorded significantly higher average grain yield of 2185 kg/ha, which was 11.36% higher than conventional variety with farmers' practice (1962 kg/ha). The overall average extension gap of 223 kg/ha with technology gap 382 kg/ha and technology index 15.35 was recorded. The higher net return of Rs. 68111 /ha was obtained under the demonstration fields than farmers' practice (Rs. 57635 /ha) with additional return of Rs. 10484 /ha. Benefit cost ratio was also higher in demonstration plot (2.73) than farmer's practice (2.50). So, improved variety of chickpea-GG-5 with recommended package of practices should be adopted in Saurashtra region of Gujarat for gaining higher yield and profit from chickpea cultivation.

Keywords: Frontline demonstration, yield gap, technology gap, extension gap, technology index

NEA 24

Assessment of frontline demonstration on yield enhancement and economics of *Metarhizium anisopliae* technology in groundnut in Surendranagar district of Saurashtra region of Gujarat

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ABSTRACT

Frontline demonstrations on groundnut with Metarhizium anisopliae technology for the control of white grub with recommended practices were conducted on 40 farmer's fields by Krishi Vigyan Kendra, JAU, Surendranagar, Gujarat on 16-hectare area in different villages of Surendranagar district during Kharif season of 2019-20 to 2022-23. The results revealed that groundnut with Metarhizium anisopliae technology recommended practices recorded significantly higher average seed cotton yield of 1608 kg ha-1, which was 14.35% higher than

conventional practices with farmers' practice (1402 kg ha-1). The overall average extension gap of 208 kg ha-1 with technology gap (353 kg ha-1) and technology index (17.98) was recorded. The higher net return of Rs. 59124 ha-1 was obtained under the demonstration fields than farmers' practice (Rs. 48870 ha-1) with additional return of Rs. 10254 ha-1. Benefit cost ratio was also considerably higher in demonstration plot (3.00) than farmer's practice (2.72). So, Metarhizium anisopliae 5.0 kg before sowing mixed with 300 kg castor cake and 30 days after germination through water for the control of white grub in groundnut with recommended package of practices should be adopted in Saurashtra region of Gujarat for gaining higher yield and profit from groundnut cultivation.

Keywords: Frontline demonstration, yield gap, technology gap, extension gap, technology index.

NEA 25

Correlation between independent variables of farm youth and their aspirations

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ABSTRACT

Farm youth are the precious human assets who can play an important role in the developmental activities as well as in agriculture because of their family and community background in agriculture and allied activities. The study was confined to "ex-post facto" research design as the independent variables already operated in the study area. Four taluka viz., Deesa, Palanpur, Vadgam and Dhanera of Banaskantha district were randomly selected for the study. Five villages from each Taluka and ten farm youth from each village randomly selected for the study. Thus, total 200 farm youth were selected for the study. The data of this study were collected by arranging personal interview with 200 farm youth of twenty selected villages. The data collected through interview schedule were classified, tabulated and subjected for statistical analysis. The results of correlation analysis indicated that out of the ten independent variables five variables viz., education, social participation, annual income, attitude and innovativeness had highly significant association with their aspirations whereas, sources of information and extension participation had positive and significant association with their aspirations, while size of family, occupation and land holding of farm youth had non-significant association with their aspirations.

Keywords: Aspiration, farm youth, agriculture, employment opportunities

NEA 26

Relationship between profile of the inland fish farmers and their knowledge regarding fish farming management practices

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ABSTRACT

The study was carried out in eight talukas of Anand district of Gujarat state with 150 randomly selected inland fish farmers. Ex-post facto research design was used. A pre-tested interview schedule was prepared in light of the objectives and respondents were interviewed either at their home or work place. For measurement of variables included in study, different scales and scoring techniques were used. The result designated that amongst the fifteen selected variables of the of inland fish farmers in the study participation in training, risk orientation, self-confidence, achievement motivation, scientific orientation, annual income, exposure to agricultural mass media and innovation proneness had establish positive and significant relationship with the knowledge regarding fish farming management practices of inland fish farmers, whereas social participation and education had establish negative and significant relationship with the knowledge regarding fish farming management practices of inland fish farmers and pond size, economic motivation, age, contact with extension agency, and caste failed to show any significant influence on the knowledge regarding fish farming management practices of inland fish farmers.

Keywords: relationship, fish farmers, knowledge

NEA 27

Relationship between profile of the inland fish farmers and their planning ability

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ABSTRACT

The study was carried out in Anand district of Gujarat state with 150 randomly selected inland fish farmers. A pre-tested interview schedule was prepared in light of the objectives and respondents were interviewed either at their home or work place. Ex-post facto research design was used. For measurement of variables included in study, different scales and scoring techniques were used. The result designated that amongst the fifteen selected variables of the of inland fish farmers in the study annual income, participation in training, exposure to agricultural mass media, risk orientation, achievement motivation, scientific orientation, innovation proneness and self confidence had establish positive and significant relationship with the planning ability of inland fish farmers, whereas age, education, social participation, caste, contact with extension agency, pond size and economic motivation failed to show any significant influence on the managerial efficiency of inland fish farmers.

Keywords: Relationship, fish farmers, planning ability

NEA 28

Relationship of selected characteristics of Date Palm growers with adoption of recommended Date Palm cultivation practices

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ABSTRACT

Launch of National Horticulture Mission has spurred the production and productivity of horticultural crops. Increase in demand for horticultural produce due to greater health awareness, rising income, export demands and increasing population poses the challenge for further increasing the production and productivity of horticultural crops. The study was conducted to find out relationship of selected characteristics of date palm growers with adoption of recommended date palm cultivation practices. The present investigation was purposefully carried out in Kachchh district of Gujarat state. From Kachchh district, four talukas and from each taluks six villages were purposively selected based on area and production of date palm. Total 300 date palm growers were selected proportionately for this study. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools.The result indicated that relationship of extent of adoption was observed significant and positive relationship with ten independent variables viz., education, land holding, orchard size, annual income, method of irrigation, extension contact, source of information, risk preference, decision making ability and management orientation. While, the independent variable age was found negatively and non-significantly relationship with extent of adoption.

NEA 29

Relationship of selected characteristics of Date Palm growers with linkage of recommended Date Palm cultivation practices

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ABSTRACT

Horticulture has established its credibility in improving income through increased productivity, generating employment and in enhancing exports. Resultantly, horticulture has moved from rural confines to commercial venture. Horticultural development had not been a priority area in India until the post-1993 period, when focused attention was given to horticultural development through enhancement in plan allocations and knowledge-based technology. The study was conducted to find out relationship of selected characteristics of date palm growers with linkage of recommended date palm cultivation practices. The present investigation was purposefully carried out in Kachchh district of Gujarat state. From Kachchh district, four talukas and from each taluks six villages were purposively selected based on area and production of date palm. Total 300 date palm growers were selected proportionately for this study. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result showed that relationship of linkages was observed significant and positive relationship

with all the independent variables viz., education, land holding, orchard size, annual income, method of irrigation, extension contact, source of information, risk preference, decision making ability and management orientation. While the independent variable age was found negatively and significantly relationship with linkages.

NEA 30

Impact of front-line demonstrations on productivity of Cumin in Jamnagar & Devbhumi Dwarka district

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ABSTRACT

A study conducted under the ATIC scheme during 2017-18 to 2021-22 on the impact assessment of Frontline Demonstrations on use of technology and productivity enhancement of cumin was conducted in different villages of Jamnagar and Devbhumi dwarka District by KVK, Jamnagar. Observation on yield attributes of both demonstrations and farmer practices were recorded and per cent yield enhancement, technology gap, extension gap and technology index, were analyzed. The five-year data revealed that the average yield of demonstration plots was obtained 8.214 q/ha over the farmer practices (7.38 q/ha) and there in an increase in average yield by 11.22 per cent. The net returns and B:C ratio on the demonstration plot were higher Rs.127111/ha and 2.84, respectively as compared to farmers' practices Rs.66823 and 1.47. The respondent satisfaction index (RSI) revealed that the majority of respondent farmers expressed a high (59.39 %) level of satisfaction with Front Line Demonstration. The study suggests strengthening linkages with line departments and converging the demonstration with Government schemes for large-scale adoption of farmers' fields. This can be a good option for enhancing farmers' income.

NEA 31

Role of multimedia in agriculture

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ABSTRACT

The role of mass media devices in agriculture enhances information dissemination, increases awareness, and improves farmers' knowledge and productivity. There are mainly three types of multimedia namely print media such as newspaper, newsletter, leaflets etc., electronic media such as radio, television, telephone etc., new age media such as smartphone and various agriculture web portal etc. Print media such as newspaper, agriculture magazines, pamphlets plays a very important role in information dissemination. Initiatives regarding print media are Krishi Samachar, Krishi Go Vidya, e-newsletter etc. help farmers to get new information

regarding improved agricultural practices. Radio remains the most widely used medium for communication in rural areas. It can broadcast a variety of agriculture related programmes. New recent initiatives regarding broadcasting are mainly through community radio stations and programmes promoting agriculture are Kisan Bani-Voice of farmers and Mann ki Baat promoted by our Honorable PM Narendra modi as well as Television programmes such as Gram Jagat and Doordarshan Kisan (AI Bhoomi and AI Krishi) had played the important role in the spread of the agriculture knowledge in India 24/7. Recent developments in the mobile and internet has provided new ways of technology transfer. Tremendous increase in mobile subscriptions has further increased the use of web-based services and various applications like WhatsApp, YouTube, Facebook and other mobile apps. The fast growing use of social media and mobile technologies create opportunity for dissemination of technologies which can facilitate creating, sharing, preserving and dissemination of knowledge and skills to transform the agriculture. Recent Initiatives regarding new age media are various mobile apps such as mKisan and Kisan Suvidha apps etc, social media platforms, web portals such as I-khedut portal, Kisan mitra and mango portal etc and the most recent initiatives are Krishi Chaupal, Digital Agriculture Mission and Gujarat Kisan Mufta Mobile Phone Yojna. So, it can be concluded that with technological advancement, multimedia tools like print media, electronic media, new age media plays an important role in disseminating agricultural information to the farmers, connecting farmers to scientific resources and information and helps farmers to share their indigenous knowledge and experiences.

Keywords: Information and Communication Technologies, mass media and smartphones

NEA 32

Profile of Cotton growers in Saurashtra region of Gujarat state

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ABSTRACT

Cotton is one of the most important commercial crops cultivated in India and accounts for around 23 per cent of the total global cotton production. It plays a major role in sustaining the livelihood of an estimated 6 million cotton farmers and 40-50 million people engaged in related activity such as cotton processing and trade. Cotton Growers are the backbone of the cotton industry. Thus the present study was conducted to know the profile of cotton growers in Saurashtra region of Gujarat. A study was conducted in Surendranagar, Amreli and Bhavnagar districts of Gujarat state. Two talukas were selected purposively from each of the selected districts by considering highest area under cotton cultivation. From each selected taluka, two villages were selected. Total twelve villages from six talukas were selected randomly and fifteen farmers were randomly selected from each village. Thus, a sample of total 180 cotton growers was considered for the study. The result revealed that more than half (54.45 per cent) of the respondents belonged to middle age group, slightly more than one third (35.55 per cent) of the respondents belonged to middle or secondary school level of education, slightly more than one third (36.11 per cent) of the respondents had semi medium size of land holding. More than half (60.56 per cent) of the respondents had medium farming experience, slightly less than one-third (31.12 per cent) respondents had annual income ₹ 1,56,001 to ₹ 2,04,000, about (40.56 per cent) respondents had medium material possession. About 46.12 per cent of respondents had medium social participation, more than two fifth (42.24 per cent) of respondents had medium mass media exposure, then slightly less than half (49.45 per cent) of respondents had medium extension participation, a little more than one third (35.56 per cent)

of respondents had medium level of source of information. About 36.67 per cent of respondents had medium level of innovativeness, then 37.78 per cent of respondents had high scientific orientation and 34.45 per cent of respondents had high level of risk orientation.
Key words: Cotton growers, Gujarat, profile, Saurashtra region

NEA 33

Novel fungicides efficacy for the management of sheath blight of Rice caused by *Rhizoctonia solani* (Kuhn.)

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ABSTRACT

In the present studies eight fungicides were evaluated against the sheath blight disease of rice during *Kharif*-2021-23. Among the different fungicides evaluated, two sprays of azoxystrobin 18.2 + difenoconazole 11.4 (29.6 SC) at 0.03 per cent (10 ml/10 l. water) or trifloxystrobin 25 + tebuconazole 50 (75 WG), 0.03 per cent (04g/10 l.water) for effective management of sheath blight. First spray should be applied at appearance of disease and second spray at booting stage. PHI 31 days for azoxystrobin 18.2 + difenoconazole 11.4 (29.6 SC) or 21 days for trifloxystrobin 25 + tebuconazole 50 (75 WG). The other effective fungicides were viz., fluxapyroxad 62.5g/l FS + epoxiconazole 62.5 g/L EC, tebuconazole 25.9 EC, Flusilazole 12.5 + carbendazim 25 (37.5 SE), Kresoxim methyl 44.3 SC, Zineb 68 + hexaconazole 4 (72 WP) and Propiconazole 25 EC.

NEA 34

Assessment of farmers' sensitivity towards Junagadh Agricultural University

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ABSTRACT

The study assessed farmers' sensitivity towards Junagadh Agricultural University (JAU) in terms of their attitude, awareness, and utilization of JAU resources across four districts in the university's jurisdiction: Junagadh, Porbandar, Rajkot, and Jamnagar. Using an ex-post-facto research design, as recommended by Kerlinger (1976), the researchers analysed the established influence of independent variables. A multistage random and purposive sampling method was used to select 160 farmers from 16 villages across eight talukas. Results indicated that 63.75% of farmers held a favourable attitude toward JAU, 47.50% had a high level of awareness of JAU's agricultural information services, and 49.38% actively utilized its resources. Overall, 67.50% of the farmers exhibited a good level of sensitivity toward JAU, while 16.87% were rated as excellent, 13.13% as average, and only 2.50% fell below average. Importantly, none of the farmers displayed a poor level of sensitivity. These findings suggest that a majority of farmers positively engage with JAU, indicating the institution's substantial

impact on local agricultural practices and knowledge dissemination in the region.
Keywords: Assessment, sensitivity, awareness, attitude, farmer

NEA 35

Impact of high yielding Niger varieties on area maximization in tribal belt of South Gujarat

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ABSTRACT

Niger although considered a minor oilseed crop, is important in terms of its 32 to 40% content of quality oil with 18 to 24% protein in the seed. The states contributing primarily to the niger production of the country are Madhya Pradesh, Odisha, Maharashtra, Karnataka and Chhattisgarh. Besides, the crop is also cultivated to some extent in hilly areas of Andhra Pradesh, Bihar/Jharkhand, Gujarat, Uttar Pradesh, Rajasthan, Tamil Nadu, West Bengal, Assam and Arunachal Pradesh in North Eastern Hill region.In Gujarat, it is mainly grown in tribal district of Valsad, The Dangs andTapi on an area of around 0.120 lakh ha with the production of 0.033 lakh MT and productivity is 275kg/ha which shows very low productivity of Niger due to lack of high yield potential niger varieties in recent years. Genotype of niger play an important role in determining the yield of a crop, the potential yield of varieties within its genetic limit is set by its environment. The release of new varieties of niger is major break through in achieving its increased production per unit area. Yield of these varieties can be further improved by providing optimum environment by manipulating agronomic practices. In this context, Niger Research Station, Vanarasi, under the Navsari Agricultural University has developed and refined the improved production technology for enhancing productivity and profitability of niger, especially in South Gujarat heavy rainfall zone. The tribal farmers of South Gujarat zone were adopted newly developed varieties of niger GNNIG—3 and GNNIG-4 through line demonstrations under FLD's and TSP schemes for since decades.
Keywords: Area, improved Niger variety, GNNIG-3, GNNIG-4

NEA 36

Relationship between socio-economic characteristics of farmers with adoption of polyhouse cultivation technology

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ABSTRACT

Polyhouse is a renowned modern method of farming that is gaining a lot of popularity in India as well as in the state of Rajasthan. Polyhouse is designed to evolve the traditional strategy of farming that can bring more new opportunities for better yield & profit while using lesser resources. Polyhouse or greenhouse is a structure made-up of translucent materials like polyethylene or shade nets, where the plants are grown under controlled climatic conditions. The knowledge for the present study was operationalized as the level of adoption about polyhouse technology in the Jaipur division of Rajasthan. A total sample of 220 polyhouse

farmers was selected from two districts (Jaipur & Alwar) of Jaipur division. After this the relationship between socio-economic characteristics of farmers with Polyhouse adoption was calculated. The results showed that education, annual income, sources of farm information, extension contacts and economic motivation had significant correlation with the adoption of farmers at 1 per cent level of significance ($P \leq 0.01$), followed by age that had significant correlation with the adoption of farmers at 5 per cent level of significance ($P \leq 0.05$). It meant that higher the level of education, annual income, source of farm information, extension contacts & economic motivation resulted into higher adoption of Polyhouse cultivation technology. The independent variables like caste, occupation, land holding and farm mechanization had non-significant correlation with the adoption of farmers.

Keywords: Adoption, polyhouse cultivation technology, socio-economic characteristics, respondents, sample

NEA 37

Adoption level of farmers towards JAU recommended Cotton production technologies

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ABSTRACT

The adoption of modern agricultural technologies plays a critical role in enhancing productivity, improving livelihoods, and ensuring sustainable agricultural practices. It is vital to improve yield, reduce costs, and enhance the overall efficiency of the farming system. Junagadh Agricultural University has a research station for crop related research and its reach recommendation for farmers. Keeping this in view, the study was carried out on to know adoption level of farmers towards JAU recommended cotton production technologies. The study was conducted in Junagadh and Rajkot of Saurashtra region which was having highest area under cotton cultivation. Five talukas from each district were selected randomly for the study. Total 20 villages and two villages were selected from each selected taluka and fifteen farmers from each village were selected randomly. Thus, total 300 respondents were selected as sample size.The result of the research indicated that total 12 recommendations were used know an adoption level of cotton growers about JAU recommended cotton production technologies. On basis of mean score, detopping the cotton plant at 75 DAS for balance growth (84.17 mean score), followed by 80.33 mean score, to apply three sprays of Carbendazim 12%+Mencozeb 63% WP@20g/10 lit of water to manage fungal foliar diseases, to apply 20 kg P_2O_5, 40 kg K_2O and 20 kg sulphur (150 kg gypsum/ha) along with recommended dose of nitrogen (80 kg N /ha) for obtaining higher yield (77.50 mean score), to apply recommended dose of nitrogen in form of urea only (76.67 mean score), to sow cotton crop timely (20th June) for increasing chlorophyll content, leaf area, specific leaf weight, higher heat use efficiency, reduce pink bollworm damage (72.50 mean score), to give three application of Sawaj Pheromone based Mating Disruption Paste (Sawaj MDP) technology @ 400g paste per application per hectare (uniformly distributed in 1000 dots between two branches) against pink bollworm (70.83 mean score). For effective and economical management of aphid, jassids, whitefly and thrips, to apply three sprays of Flonicamid 50 WG 0.02% (4.0 g/10 l of water) OR Diafenthiuron 50 WP 0.06% (12.0 g/10 l of water) OR Dinotefuran 20 SG 0.008 % (4.0 g/10 l of water) with mean score 67.50, to apply five spray of *Beauveria bassiana* 1. 15 WP (Min. 2

x 10^6cfu/g) 0.009 % (80 g/10 litre of water) with 65.83 mean score, to apply Lamdacyhalothrin 2.5 EC, 0.0025 % (10 ml/10 lit. of water) or Deltamethrin 2.8 EC, 0.0028% (10 ml/10 lit. of water) insecticides for effective and economical management of pink bollworm (60.83 mean score) and to spray growth promoter Naphthalene Acetic Acid (NAA) @ 30 ppm (0.39 g /10 lit. water) at 50 DAS & 70 DAS for better growth (55.00 mean score).

Keywords: Cotton growers, recommended cotton production technology

NEA 38

Characteristics of the Cotton growers in adoption of Cotton production technology recommended by JAU

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ABSTRACT

The development and dissemination of cotton production technologies have long been central to agricultural research and extension efforts, particularly in regions where cotton is a key cash crop. The successful adoption of the technologies is not solely determined by their technical merits; the characteristics of the cotton growers themselves significantly influence how and whether they adopt these innovations. Keeping this in view, the study was conducted on characteristics of the cotton growers in adoption of cotton production technology. The study was conducted in Junagadh and Rajkot of Saurashtra region. Which were selected purposively considering highest area under cotton cultivation. Five talukas from each district were selected randomly for the study. Two villages were selected from each selected taluka. Total 20 villages and fifteen farmers from each village were selected. Thus, total 300 respondents were selected as sample size. The result from the research study indicated that less than half (45.33 per cent) of the respondents were from middle age group, had attained primary and middle school education (63.00 per cent) and belonged to the medium size of land (41.00 per cent). More than half (62.33 per cent) of the respondents had medium social participation, medium annual income (45.00 per cent), used sources of information at medium level (50.00 per cent), medium level of mass media exposure (75.67 per cent) and farmers received training from the Krushi Vigyan Kendra (34.67 per cent).

Keywords: Cotton growers, characteristics and cotton production technology

NEA 39

Constraints faced and their suggestions offered by Cotton growers in adoption of Cotton production technologies

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ABSTRACT

The adoption of advanced cotton production technologies is essential for enhancing productivity, reducing costs, and promoting sustainable farming practices. However, cotton growers often face various constraints that hinder the full adoption of these technologies.

Cotton growers, who are directly engaged in the production process, can provide valuable insights into the practical challenges they encounter and offer suggestions for improving technology dissemination, training, and support systems. The study was carried out in Junagadh and Rajkot of Saurashtra region which was having highest area under cotton cultivation. Five talukas from each district were selected randomly for the study. Total 20 villages and two villages were selected from each selected taluka and fifteen farmers from each village were selected randomly. Thus, total 300 respondents were selected as sample size. The research study reflected that major constraints faced by cotton growers in adoption of cotton recommended technologies of JAU, Junagadh were; minimum support price decided by Government is very low for cotton crop, high prices of critical inputs like seed, fertilizer and insecticide/ pesticides. The heavy infestation of pink ball worm in cotton, followed by infestation of polo wilt disease in cotton, lack of knowledge about pests and diseases of cotton, information about pests and diseases of cotton is not provided by any agency in villages. Also they offered the major suggestions were; minimum support price of cotton should be increased, followed by subsidies for purchasing critical inputs should be increased by government, maximum field demonstrations should be provided by government agency for the control of pink boll worm, full time and during day time electricity should be provided, training should be provided to the farmers on pest and diseases management of cotton.
Keywords: Cotton growers, constraints and suggestions

NEA 40

Constraints and suggestions perceived by the Potato growers in use of cold storage facility

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ABSTRACT

Potato cold storages are one of the important links between producers to consumers that create another choice of market and price discovery. Cold storage is very important to reduce post-harvest losses. The cold storage facilities for potato crop are available to the potato growers. The potato growers are utilizing the cold storage facilities. There are number of factors which affect the potato production, but post-harvest management is very important factor. Without proper storage facility farmers faces many problems. By using cold storage facility farmers may face some constraints and they do have suggestions to overcome the constraints face by them. Considering these facts, constraints and suggestions perceived by the potato growers in use of cold storage facility were studied. The potato growers were asked to express the constraints and suggestion. Frequency and percentage of each constraints and suggestion were the computed and ranked accordingly. Major constraints faced by the potato growers were, inadequate transportation (85.00%), keeping charges high (81.67%) and inadequate finance (74.67%). Whereas, Cold storage owner should provide transportation and insurance facility were the most important suggestions given by the potato growers.
Keywords: Potato growers, cold storage, constraints, suggestions

NEA 41

Knowledge and adoption of Oyster mushroom production technologies by farmers in Tapi district of South Gujarat

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ABSTRACT

In Gujarat state, South Gujarat and Middle Gujarat are the main regions for growing mushroom. Paddy crop is main crop of Tapi district and paddy straw is use as raw material for oyster mushroom growing. KVK-Tapi provided training to many farmers on Oyster mushroom cultivation. Therefore, the present study was undertaken with title "Adoption of Mushroom production technologies by Farmers in Tapi district of South Gujarat". Among the seven talukas of Tapi district, five talukas *namely* Vyara, Songadh, Uchchhal, Nizar, Dolvan were purposively selected for the study because beneficiaries of training provided by KVK on Mushroom cultivation were belongs to same talukas. For the investigation, 60 respondents were purposively selected from each taluka, so total 300 respondents were selected for the study. Structured interview schedule was developed and collect data by personal interview method. From the present study it can be concluded that majority of respondents belongs to young to middle age group. More than two third respondents had illiterate to primary level of education. Majority of respondents had occupation Agriculture + Animal husbandry, possessed small to medium size of land holding, low to medium level of annual income, had small family size. Medium to high level of farming experience, Majority of the respondents had medium to low level of economic motivation, medium to high level of scientific orientation and medium to high level of risk orientation. Majority of respondents had medium to high level of Knowledge about Oyster Mushroom production technologies. Majority of respondents had medium to low level of adoption about Oyster Mushroom production technologies. Mushroom is highly perishable and high production cost were the major constraints faced by mushroom farmers While main suggestions obtained from Mushroom growers were Value addition in mushroom can increase its storage duration and Use locally available resources.

NEA 42

Knowledge of dairy farmers in South Gujarat about zoonotic diseases

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ABSTRACT

This study assessed the knowledge of dairy farmers in South Gujarat regarding zoonotic diseases by focusing on three districts viz. Dangs, Navsari, and Surat. Data were collected over three years from 300 dairy farmers with at least five years of experience in cattle or buffalo rearing. The study aimed to evaluate their understanding of zoonotic disease transmission, routes of infection, specific diseases and the control measures they practice. Results showed that 86% of the respondents were aware of zoonotic disease transmission from humans to

animals, while 78% recognized the risk of transmission from animals to humans. However, only 61% of the dairy farmers understood the role of arthropod bites in disease transmission, and awareness of less common zoonotic diseases like Crimean Congo Hemorrhagic Fever (CCHF) was particularly low. Furthermore, 67% were informed about diseases like rabies and brucellosis. The study also identified key constraints, such as lack of formal training and difficulty in accessing veterinary services, emphasizing the need for targeted educational interventions to improve disease prevention and control among dairy farming communities.

Keywords: Zoonotic diseases, dairy farmers, South Gujarat, disease transmission, knowledge

NEA 43

Constraints and suggestion of urban people regarding the awareness and adoption about kitchen gardening

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ABSTRACT

Kitchen gardening is a challenging task for people who are not involved with farming and have no contact with farming community. Information available on internet is very helpful for developing kitchen garden but the practical problems which are faced in the process of developing kitchen garden remain unsolved. Frequent failure in the problem solving may disappoint. To understand constrains faced by people while developing kitchen garden, this study was conducted. Under the study, 300 owners of kitchen garden were selected randomly from the trained group by KVK, Surat. The data was collected by personal interview through structured schedule. They were asked about the constrains they faced and their suggestions were recorded to solve the constrains. Results stated that lack of knowledge about pest and diseases problems in kitchen garden is major constrain followed by unavailability of quality planting materials, shading of big building on kitchen garden area, availability of bio-pesticides, lack of interest among rural youth, lack of scientific knowledge about kitchen garden. These were the major constraints faced by the respondents. People have made few suggestions to increases the adoption and development of kitchen garden. First suggestion was to made frequent visits of experts for advising regarding kitchen garden management, second suggestion was to increase training for scientific and efficient management of kitchen garden. Third suggestion was to provide quality HYVs seeds of vegetables and fourth was to disseminate indigenous knowledge about pest and disease control.

Keywords: Constraints, suggestions, knowledge, kitchen garden, adoption

NEA 44

Impact of frontline demonstration of new variety (var. "Gnib 21/Nps 1"), use of bio fertilizers and novel organic liquid nutrient on yield of Indian Bean in the Dangs district of Gujarat

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ABSTRACT

To create awareness regarding new variety of Indian bean, use of bio fertilizers and novel organic liquid nutrient in Indian bean, total 25 demonstrations in 5 hectare area were conducted during the year 2017-18 in waghai block of the Dangs district. Due to the adoption of GNIB 21/NPS 1 variety of Indian bean along with use of bio fertilizer in soil and foliar spray of novel organic liquid nutrient resulted in higher yield (29.00 q/ha) compared to check plots (25.80 q/ha). The yield increase compared to check field plots was 12.40 % in Indian bean crop. The extension gap was recorded in Indian bean was 3.2 q/ha. The benefit-cost ratio was recorded higher in the demonstrated plot of Indian bean (3.68) compared to the check plot (2.90). Moreover, net return in Indian bean was also recorded in demonstrated plot (Rs.84500/ha) compared to check plot (Rs. 64240/ha).

NEA 45

Horizontal spread of Gujarat Anand Rice 13 among the Rice growers in Anand district

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ABSTRACT

Paddy is an important cereal crop of Gujarat. Many rice varieties of private companies as well as SAUs are popular among the farmers. Gujarat Anand Rice-13 was released by AAU in 2009. This variety has competent character and horizontal spread among the farmer is needed to be known in comparison with private varieties and offer SAUs varieties and hence it is necessary to know horizontal spread, feedback of Gujarat Anand Rice-13. Total 450 demonstrations of GAR-13 were given by Krushi Vigyan Kendra, AAU, Devataj during 2009 to 2015 in 50 villages of anand district among them 300 farmers selected who cultivate the GAR-13 variety under 120 ha of land. After viewing their result on farmers field, 1450 farmers of the same village adopted GAR-13 variety and cultivated this variety under 900 ha of land. While, 372 farmers from the outside the village adopted GAR-13 variety cultivated under 270 ha of land. Therefore, total 1272 number of farmers had adopted this variety and cultivated under the 1170 ha of land. Thus, number of farmers from within the village and outside the village who had adopted GAR-13 variety was increased 483.3 and 124 per cent respectively. While, in the case of area under the cultivation of GAR-13 paddy cultivar it was increased with 750 per cent within the village and 225 per cent outside the village. Thus, total number of farmers increased up to 424 per cent and the total area under GAR-13 paddy variety increased up to 975 per cent. Thus, horizontal spread in terms of number of farmers and in terms of area was 4.24 times and 9.75 times, respectively in Anand district. , total GAR-13 Paddy variety share in percentage within and outside the village is 27.42 per cent, 3.82 per cent, respectively. Overall, among all varieties of paddy in Anand district GAR-13 paddy variety share is 4.57 per cent.

NEA 46

System of Rice Intensification (SRI): A holistic approach to sustainable Rice cultivation

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ABSTRACT

The world is facing multiple challenges, with climate change being one of the most urgent. Rice, a staple food for over half of the global population, requires vast amounts of water to grow. However, the growing water crisis in rice-producing countries has become a critical concern. As demand for rice increases, coupled with the shrinking availability of water resources, many rice-cultivating regions are experiencing severe water shortages. The System of Rice Intensification (SRI) offers a promising solution. This climate-smart agricultural methodology provides a holistic approach to sustainable rice production. SRI is particularly advantageous over conventional methods because it requires fewer inputs, saves water, improves soil health, reduces methane gas emissions and results in higher yields. This sustainable approach not only help farmers to cope with the immediate impacts of climate change but also contributes to long-term environmental sustainability by reducing greenhouse gas emissions and conserving water resources. By adopting SRI, we can ensure a more sustainable future for both rice farming and the planet.

Keywords: Sustainable rice cultivation, SRI, climate change

NEA 47

Constraints in adoption of farm mechanization and suggestions to overcome the constraints

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ABSTRACT

Farm mechanization has been helpful in bringing significant improvement in agricultural productivity. Thus, there is a need for mechanization of agricultural operations, especially crop like cotton which provides livelihood to millions. The timeliness of operations has assumed greater significant in obtaining optimal yields from different crops, which has been possible through mechanization. Therefore, the present study was carried out to know the constraints in adoption of farm mechanization and seek suggestions from cotton growers to overcome the constraints. *Ex-post facto* research design was followed for carrying out the study. For drawing the sample for the study multistage simple random sampling technique was used. The study was conducted in Surendranagar, Amreli and Bhavnagar district of Gujarat state because this district has highest area under cotton cultivation. Two talukas from each district were selected on the basis of highest area and two villages from each taluka were selected randomly. Fifteen respondents from each village were selected. Thus, a sample of total 180 respondents from twelve villages was considered for the study. The data was collected by personal interview through structured schedule. The simple statistical tools were used to analyze the data. The results revealed that important constraints given by respondents were high initial cost & maintenance cost of farm machineries, lack of credit facilities to purchase farm machineries and less government subsidies for purchase of farm machineries; in case of

suggestions proper credit facilities should be provided and government should provide more subsidies on farm machineries.
Keywords: Constraints, cotton growers, farm mechanization, suggestions

NEA 48

Mastitis management practices adopted by dairy farmers

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ABSTRACT

The present study was conducted in North Gujarat to find out Mastitis management practices adopted by dairy farmers. Three districts namely Banaskantha, Sabarkantha and Mehsana were purposively selected. From each district two talukas, from each selected taluka three villages and from each selected village 20 farmers were randomly selected. Thus total six talukas, 18 villages and 360 dairy farmers constituted the sample size. The research findings revealed that 79 per cent respondents were with medium to high level veterinary services in their areas, 90 per cent were small, marginal and semi-medium farmers, 62 per cent with good literacy rate and 81.4 per cent had small sized herd. Of the respondents 54.2 per cent were in medium to small milk producer category, 85.6 per cent had low level of social participation but 60 per cent were with good extension participation and extension contact, 70.0 percent were in no literature use category. With regards to prevalence of mastitis, 86.7 per cent reported no incidence of mastitis in their animals in time period covered and 60 per cent with low incidence of mastitis in their animals in last five years, more than two-third (65.6 per cent) of the dairy farmers had medium to high level of knowledge regarding mastitis management practices and 65 Per cent had medium to high level of adoption of mastitis management practices. Regarding knowledge and adoption of mastitis management practice, the dry cow therapy, washing udder and teat after milking, cleaning udder with dry clean cloth after washing were almost not practiced by farmers. The correlation coefficient of three variables the extension contact, knowledge and adoption of mastitis management practices was found to be negative and significant, while that of caste was positive and significant with incidences of mastitis. The non-availability of input and services for regular testing of milk were the major constraints while provision for milk testing and timely expert services to treat mastitis were some of the major suggestions of farmers.

NEA 49

Knowledge level of the Groundnut growers towards Integrated Pest Management

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ABSTRACT

Groundnut is one of the major crop in cropping system of north Gujarat region. It has been

observed that farmers are following the traditional practices in kharif groundnut. Many farmers have adopted recommended package of practices of groundnut. It was necessary to know the fact that up to what extent farmer's had the knowledge about various aspects of integrated pest management in groundnut crop. Thus, the study was conducted to know the knowledge level of the groundnut growers towards integrated pest management. The present study was carried out in three purposely selected districts of North Gujarat region *viz.,* Banaskantha, Sabarkantha and Arvalli. From each selected district two talukas were selected purposely. Two villages from each selected talukas were selected randomly. Thus, total 12 villages were selected for the study. Twenty groundnut growing farmers from each village were selected randomly making a sample of 240 groundnut growing farmers. The study revealed that slightly less than two third (60.42%) of the groundnut growers were having medium level of knowledge, followed by 22.91 and 16.67 per cent of groundnut growers who had high and low level of knowledge about integrated pest management, respectively.

NEA 50

Adoption of plant protection practices of Paddy crop in Valsad district of Gujarat state

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ABSTRACT

Paddy is one of the most important staple crops in India, and its cultivation faces significant challenges due to various pests and diseases. Effective plant protection practices are crucial for minimizing yield losses and ensuring food security. However, there is wide adoption gap among farmers regarding the latest plant protection techniques and their adoption in paddy cultivation. Non-adoption of plant protection practices for paddy crops in India contribute to increased vulnerability to pests and diseases, resulting in lower crop yields and economic losses for farmers. Addressing this problem requires enhancement of the adoption of plant protection practices by the paddy growers by dissemination in information, transferring technologies, capacity building, and promoting sustainable and cost-effective plant protection practices. This study had examined the extent of adoption of plant protection practices of paddy crop by the paddy growers of Valsad district of Gujarat state. For the study, a sample of 150 paddy growers was drawn by using multistage random sampling. Thirteen independent and adoption as dependent variable were studied. Data were collected by personal interview with help of the interview schedule prepared by incorporation the scales of dependent and independent variables. It can be concluded that majority of respondents belonged to middle age group with primary school level of education, possessed medium size of land holding with medium annual income, risk orientation, mass media exposure, scientific orientation, management orientation, decision making ability, innovativeness, economic motivation and fatalism. Most of the respondents had membership in one organization. Results also shown that majority of the respondents had medium adoption of plant protection practices of paddy crop. Results also indicated that education, land holding, annual income, risk orientation, social participation, management orientation, decision-making ability, economic motivation, mass media exposure, scientific orientation, and innovativeness were found positive and highly significant co-relation with adoption of plant protection practices of paddy crop, while, age had negative but

significant relationship and fatalism had non-significant relationship with adoption of plant protection practices of paddy crop.

Key words: Paddy crop, Adoption, Plant Protection practices, Valsad, Gujarat

NEA 51

Knowledge of growers about plant protection practices of paddy crop in Valsad district of Gujarat state

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ABSTRACT

Paddy, a crucial cereal crop, is essential to the global diet, serving as a staple for over 50% of the world's population. India is the largest area under paddy cultivation and the second-largest producer globally. Within India, Gujarat is a prominent paddy-growing state, where both irrigated and unirrigated paddies are cultivated extensively. In Gujarat, Valsad district recorded the highest cultivation area and production among the seven southern Gujarat districts. This study examines the knowledge of plant protection practices among paddy growers in the Valsad district of Gujarat. This research also examines the socio-economic profiles and its relationship between their knowledge of plant protection practices. *Ex-post-facto* research design was employed for the study. A total of 150 respondents from three talukas within Valsad district were randomly selected for this study. Data were collected using an interview schedule covering thirteen independent variables-age, education, landholding, risk orientation, social participation, management and scientific orientation; and knowledge as dependent variable. The findings revealed that most respondents were middle-aged, with primary-level education, medium landholding size, and moderate annual income. They showed medium levels of risk orientation, mass media exposure, and decision-making ability, alongside moderate levels of innovativeness, economic motivation, and scientific orientation. A significant majority had at least one organizational membership. The respondents exhibited moderate knowledge of plant protection practices. Key factors such as education, landholding, income, risk orientation, social participation, management orientation, economic motivation, scientific orientation, and mass media exposure showed positive and highly significant relationships with knowledge of plant protection practices. In contrast, age showed a negative but significant correlation with knowledge, while fatalism was non-significant. This study’s insights are valuable for policymakers, extension workers, and agricultural scientists aiming to enhance paddy production in India through the promotion of efficient plant protection practices, thereby contributing to food security and rural development.

Keywords: Paddy crop, Knowledge, Plant Protection practices, Valsad, Gujarat

NEA 52

Level of adoption the tribal farmers about improved maize production technology in Narmada district

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ABSTRACT

The study reports measure of adoption about improved maize cultivation practices and it was conducted in Narmada district of the year 2023-2024 with 300 tribal farmers were measure of adoption about improved Maize production technology. Majority of the respondents (34.00 per cent) had medium level of adoption about improved Maize production technology, While 37.67 and 28.33 per cent of them had highly and lower level of adoption, respectively. Majority of the tribal farmers reported that improved variety (94.66 per cent) was as higher adoption by maize tribal farmer's highest rank and second rank seed rate (93.00 percent), Seed treatment (91.00 percent) Sowing time of seed (83.33 per cent) spacing (86.00 per cent), Manure & fertilizers (82.00 per cent) and Inter culturing and weeding (79.00 per cent), respectively.

Keywords: Adoption, Maize growers, Improved technology

NEA 53

Adoption index between different categories of Date Palm growers

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ABSTRACT

Horticulture is a priority sector in agriculture by virtue of its vast potential in improving the socio economic condition of the farmers. Considerable growth in area coverage and production has been observed. State contributes 9.20 % share in national fruit production and 6.60 % in national vegetable production (Horticulture statistics at a glance- 2018) that has been increased from 6.20 % and 3.70 % respectively in comparison to year 2001-02. Gujarat is fourth leading state in the fruit production.The study was conducted to find out adoption index between different categories of date palm growers. The present investigation was purposefully carried out in Kachchh district of Gujarat state. From Kachchh district, four talukas and from each taluks six villages were purposively selected based on area and production of date palm. Total 300 date palm growers were selected proportionately for this study. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools.The result showed there was significant difference (836.781**) in the mean adoption index between small, medium and big orchard date palm growers which was greater than the CD value (2.99) at 5 per cent.

NEA 54

Adoption of recommended production technology adopted by the Date Palm growers

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ABSTRACT

Horticulture crops perform a vital role in the Indian economy by generating

employment, providing raw material to various food processing industries, and higher farm profitability due to higher production and export earnings from foreign exchange. The need for diversification to horticulture sector was acknowledged by the Government of India in mid-eighties by focusing its attention on investment in this sector. The study was conducted to find out adoption of recommended date palm production technology adopted by the date palm growers. The present investigation was purposefully carried out in Kachchh district of Gujarat state. From Kachchh district, four talukas and from each taluks six villages were purposively selected based on area and production of date palm. Total 300 date palm growers were selected proportionately for this study. The data were collected through personal interviews and it was compiled, tabulated and analyzed to get proper answers with the help of various appropriate statistical tools.The result showed majority (62.67 %) of the date palm growers were having medium level of adoption. On the other hand, 22.00 per cent of date palm growers had low level of adoption whereas only 15.33 per cent of date palm growers were having high level of adoption regarding recommended date palm production technology.

NEA 55

Awareness of buffalo owners about causes of infertility in Anand district

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ABSTRACT

Infertility is major cause of economic loss in dairy farms. Various causes and different diseases are identified which related to infertility in dairy animals. Study was conducted in Anand district of middle Gujarat with 300 dairy farmers. in time and length of estrus period great majority of buffalo owners had awareness about length of estrus and Ideal time for breeding after coming in heat. regarding general breeding & breeding methods all the buffalo owners aware of various symptoms of heat and benefit of AI upon natural services. 62.67 per cent aware of AI should be repeated if clean discharge continuous even on next day of previous AI followed by 25.00 per cent aware of discharge of buffalo considered as normal discharge. Very few aware of (19.33 per cent) ideal weight of heifer at first oestrous and corpus lutum. In regarding health and disease majority of aware of Consult veterinarian if retention of placenta persists for 12 hrs and brucellosis is one of the reasons behind irregular heat / repeat breeding. Less the one fourth of buffalo owners aware of following Problematic to conceive buffalo having kinked cervix, Pyometra in buffalo, Correlation between mastitis and reproduction, Brucellosis infected buffalo even if conceived may abort. Very few aware of Physio-anatomical disorder in reproductive organs lead to fertility failure and Irregular heat due to endocrinological problems. In relationship between independent variable like dairy farming experience annual income and occupation had significant relationship with awareness about causes of infertility.

NEA 56

Adoption of scientific breeding management practices by tribal goat keepers of Tapi district

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ABSTRACT

A field study was conducted in Tapi district of south Gujarat to study the scientific breeding management practices followed by the tribal goat keepers. Data was collected from two selected blocks and 100 goat keepers were decided through personal interview with the help of pre-tested structured interview schedule. The study revealed that majority of respondents adopt dual purpose goat breed (77.00 per cent), all the respondents followed natural breeding methods, bred their goats after attaining one year of age (73.00 per cent) and diagnosed pregnancy in goat by them self (74.00 per cent), 65.00 per cent of respondent take care during kidding at night time, prepared a soft bedding material (78.00 per cent) and less than fifty per cent of respondents provide separate kidding space for their kids. None of goat keepers adopted ideal breeding ratio for their maximum production. Major constrain faced by tribal people was lack of knowledge regarding identification of particular goat breeds through their characteristics. Family size (0.2415*), Size of land holding (0.0303), No. of goat possessed (0.0983) and goat rearing experience (0.0981) found positively correlated with adoption about scientific breeding management practices in goat, while Age (-0.0437), Education (-0.0373) and Family income (-0.0329) were negatively correlated with adoption about scientific breeding management practices in goat.

NEA 57

Prevalence of fish diseases and financial losses due to incidence of diseases in village pond fish culture of Anand district

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ABSTRACT

The study was carried out to know the present status of fish diseases and financial losses due to incidence of disease in Anand district of Gujarat using questionnaire interview. They adopted a polyculture approach by stocking their ponds with Indian major carps along with Chinese carps, using their personal savings as funding. A total of 300 fish farmers were interviewed. The most prevalent Diseases like Epizootic ulcerative syndrome (EUS) (80.33%) in winter season and infection of ectoparasitic crustaceans like *Argulus* (67.00%) was observed in most of the fish ponds. In order to control diseases farmers are using Disinfectants, Environmental modifiers, Antiparasitic agents and mixture of lime + turmeric + salt into their village ponds. The average disease control cost was Rs. 2743/ha/yr. The estimated financial loss due to fish disease varied from farm to farm based on the intensity of infection and the management practices adopted by farmers. The present study indicated that the average financial loss was estimated Rs.25271.54/ha/yr (15.33%) in the district. These findings underscore the critical necessity of spreading awareness regarding fish diseases and health management to prevent significant financial losses in village pond aquaculture.

NEA 58

Knowledge of farm mechanization among Cotton growers in Saurashtra region

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ABSTRACT

Cotton is one of the most widely used and popular fabrics around the world. It has been a staple crop for centuries and has played a significant role in shaping the world economy and global trade.Cotton (Gossypium hirsutum L.) “the king of fibres” is one of the most important sources of fibre in the world. Cotton is a major cash crop in India whose production and market controls finances and lives of millions of small farmers and workers linked to cotton industry. Saurashtra region of the Gujarat state is major cotton producer of the state. India got first place in the world in cotton acreage with 130.61 lakh hectares area under cotton cultivation but in terms of productivity, India is on 39th rank with yield of just 447 kg/ha.The low yields of cotton are attributed to inadequate inputs, untimely field operation, lack of irrigation (around 70 per cent area under rainfed conditions) and inefficient crop production technologies. In dryland areas of India, cotton farmers still use traditional farm implements that have low field capacity and demand lot of energy. Several operations like planting, weeding and picking are labour intensive and during these operations shortage of labour frequently occurs. The delay in completion of operations leads to loss of yield. The intercultural machinery operated by tractors is rarely used. With this consideration, study was carried out to know the knowledge of farm mechanization among cotton growers in Saurashtra region” was undertaken. A study was conducted in Surendranagar, Amreli and Bhavnagar districts of Gujarat state. Two talukas were selected from each district. From each selected taluka, two villages were selected. Total twelve villages from six talukas were selected randomly and fifteen farmers were selected from each village were selected as respondents. Thus, a sample of total 180 cotton growers was considered for the study. The data were classified, tabulated and analyzed with respect to objective. The result revealed that more than one third 36.12 per cent of the respondents were from high level of knowledge about farm mechanization followed by 33.89, 15.55, 11.11 and 03.33 per cent of respondents had medium, low, very high and very low level of knowledge about farm mechanization, respectively.

Keywords: Cotton Growers, Farm Mechanization, Knowledge, Saurashtra Region, Etc

NEA 59

Adoption of farm mechanization among cotton growers in Saurashtra region

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ABSTRACT

Farm mechanization is the application of engineering and technology in agricultural operations to do a job better and enhance production and productivity. Farm mechanization implies the use various power sources, improved farm tools and equipment, with a view to reduce the drudgery of the human beings and draught animals, thereby increasing crop production and productivity. Keeping this in view, the study on adoption of farm mechanization among cotton growers in Saurashtra region was carried out. A study was conducted in Surendranagar, Amreli and Bhavnagar districts of Gujarat state. Two talukas were selected purposively from each of the selected districts by considering highest area under cotton cultivation. From each selected taluka, two villages were selected. Total twelve villages from six talukas were selected randomly and fifteen farmers were randomly selected from each

village. Thus, a sample of total 180 cotton growers was considered for the study. The data was collected by personal interview through structured schedule. The statistical tools frequency, mean, and arbitrary method were used to analyze the data. The result indicated that slightly more than half (50.56 per cent) of the respondents had medium level of extent of adoption about farm mechanization followed by 28.89 per cent, 10.55 per cent and 10.00 per cent of respondents had high, low and very high extent of adoption about farm mechanization, respectively, whereas none of the respondents had very low extent of farm mechanization.
Keywords: Adoption, cotton growers, farm mechanization, Saurashtra region, etc

NEA 60

Constraints and suggestions by the farmers in adoption of Paddy production technology

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ABSTRACT

Paddy is one of the most important staple crops and cultivated in large area of Narmada district in the South Gujarat. The present study was conducted in Naramda district of Guajrat to identify the constraints faced by the famers in adoption of recommended paddy production technology. Total 100 respondents were randomly selected from 10 selected villages, among which 5 villages were from Dediapada and 5 were from Sagbara taluka of the Narmada district and data were collected through personal interview. It was found from the study that, lack of knowledge regarding recommended dose of fertilizers, shortage of labourers at the time of transplanting and harvesting, lack of knowledge regarding identification of pests and diseases, high cost of input, high labour charges, shortage of fertilizers, low market price of paddy and lake of market facilities were the major constraints faced by the respondents. Organizing more training on scientific cultivation of paddy, remunerative market prices of paddy through minimum support price and more emphasis on farm mechanization were some of the important suggestions made by the respondents to overcome the constraints in adoption of paddy production technology.
Keywords: constraints, suggestions and paddy growers

NEA 61

Attitude of farmers towards advisory services in KVKs of Saurashtra region

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ABSTRACT

Attitude is a settled perspective or feeling towards something, shaping behavior and responses. The success of any program hinges on the attitudes of its participants. This study aimed to examine farmers' attitudes toward the advisory services provided by KVKs in the Saurashtra region. A sample of 180 farmers, selected through multistage and purposive sampling, who regularly sought information and advisory services from KVKs, was surveyed. The study revealed that significant proportion (63.89 per cent) of respondents had medium

favourable attitude towards advisory services of KVKs in Saurashtra region. It also found that out of thirteen independent variables viz. education, social participation, extension participation, source of information, risk orientation, economic motivation, scientific orientation, self-confidence and innovativeness were found significant, while age had negative and significant relationship with attitude of farmers. Farming experience, size of land holding and annual income had non- significant relationship with attitude of farmers.

NEA 62

Constraints faced by Potato growers in getting benefits from Krushi Vigyan Kendra

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ABSTRACT

The progress in agriculture depends to a large extent on the quick and effective dissemination of new agricultural practices among the farmers and the reciprocal receiving of farmers problems at the research stations for their solutions. Looking into these facts, it is necessary to undertake impact assessment study of Krushi Vigyan Kendra. The present study was undertaken in KVK at Deesa of Banaskantha district. Out of 14 talukas of Banaskantha District seven talukas falls under the jurisdiction of KVK, Banaskantha-I (Deesa). Among the seven talukas four taluka and from each selected talukas three villages were selected purposively. From the list of KVK beneficiary, ten beneficiary potato growers from each village were selected randomly. To know the impact of KVK, the same numbers of non-beneficiary potato growers were selected randomly from same villages. Thus, altogether 120 beneficiary and 120 non-beneficiary potato growers were selected. The findings of the study revealed that constraints faced by the beneficiary potato growers in getting benefits from KVK were; shortage of time to visit KVK and attend its activities frequently followed by the place of training organized by the KVK is so far, unavailability of the improved tubers from KVK, training period of KVK is not sufficient to cover all the aspects of potato production technology in details, the time between two trainings is not appropriate and lack of feed-back received from KVK staff.

Keywords: Constraints, beneficiary & non-beneficiary potato growers, KVK, potato production technology

NEA 63

Quantifying transformative learning outcomes in Farmers Farm School participants

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ABSTRACT

This study investigates the transformative learning experiences of farmers engaged in a one-year Farmers Farm School (FFS) program, using a specially designed Transformative Learning Experience Index. The study was conducted in Karnal district of Haryana with randomly selected 60 beneficiary farmers who had completed the one-year program of Farmers farm school. Transformative learning, defined by disorienting dilemmas, self-reflection, critical discourse, actionable change and satisfaction, was prominently evident among participants. The study revealed an overall high level of transformative learning with a weighted mean score of 85.23 per cent, showcasing the program's significant impact. The "Satisfaction" dimension recorded the highest farmer score at 89.79 per cent, indicating strong positive participant engagement. The "Action" category also showed substantial learning, with mean scores of 87.92 per cent for farmers and 87.22 per cent for the environment, highlighting the program's effectiveness in promoting real-world application of new knowledge. Despite this, differences in the "Disorienting Dilemma" scores (85.00% for farmers and 78.47% for the environment) suggest variations in internal and external learning triggers. The results demonstrate that the FFS program's focus on experiential learning, critical dialogue, and reflective practices fosters meaningful and sustainable changes in agricultural practices. These findings emphasize the potential of targeted agricultural education to facilitate deep, transformative learning experiences that empower farmers and contribute to long-term improvements in farming communities.

Keywords: Transformative Learning, Disorienting Dilemma, Self-Reflection, Critical Discourse, Farmers Farm School

NEA 64

A comparative study between the profile of demonstrator and non demonstrator Groundnut growers in Saurashtra region of Gujarat

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ABSTRACT

The present study was conducted Saurashtra region of Gujarat State using ex-post facto research design. In order to realize socio-economic characteristics of groundnut growers, a sample of 160 groundnut growers, representing 16 villages of 12 talukas of Junagadh Jamnagar, Amreli, Bhavnagar, Gir-somnath and Rajkot of Saurashtra region of Gujarat state were drawn by multistage random sampling techniques. The beneficiaries of front line demonstration given by Krishi Vigyan Kendra under National Mission on Oilseeds and Oil palm Project (NMOOP) ware selected for the study. The present study was carried out to know the compression between socio-economic characteristics of demonstrator and non demonstrator groundnut growers. The data was collected by personal interview through structured schedule. The simple statistical tools were used to analyze the data. The results revealed that majority of the groundnut growers were in middle aged group, educated up to middle school, had medium social participation, medium size of land holding, annual income Rs. 1,00,001/- to Rs. 1,50,000/-, medium extension participation, mass media exposure and medium extension contact.

Key words: Demonstrator and Non demonstrator groundnut growers, Front line demonstration, Krishi Vigyan Kendra, NMOOP, Saurashtra region, Socio-economic characteristics.

NEA 65

Economic impact of bypass fat supplementation in high yielding crossbred cows

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ABSTRACT

This study aimed to assess the economic impact of bypass fat supplementation in dairy animals under the Farmer First Program, ICAR, at Navsari Agricultural University. The study involved 70 crossbred cows across Kesali, Changa, and Vadsagar villages in Navsari District with 60 receiving bypass fat (treatment) and 10 acting as controls. Bypass fat was provided at 100 g/day/animal from 15 days pre-partum to 90 days post-partum. The cost analysis included input costs such as bypass fat (Rs. 2100 per animal) and additional concentrate feed required for the increased milk yield (Rs. 2070 per animal), totaling Rs. 4170 per animal in the treatment group. The intervention resulted in significantly higher milk yields (15.10 kg/day in treated animals vs. 12.19 kg/day in controls), translating into an increased income of Rs. 60312.42 per animal over 90 days, compared to Rs. 41468.40 in the control group. The additional income from the treatment group was Rs. 18844.02 per animal, leading to a benefit-cost ratio (BCR) of 5.91, indicating that for every rupee invested in bypass fat supplementation, the return was Rs. 5.91. This substantial economic return demonstrated the profitability of bypass fat supplementation in dairy farming, with significant improvements in milk yield, fat percentage, and overall economic gain for dairy farmers.

Keywords: Economic analysis, bypass fat, dairy farming, cost-benefit ratio, milk production, farm profitability

NEA 66

Knowledge level of farmers about grain storage practices in Navsari district

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ABSTRACT

Grain storage is critical for ensuring food security and maximizing profits for producers. In India, grain storage plays a vital role in maintaining the availability of staple foods, such as cereals, millets, and pulses, but farmers often lack access to advanced storage technologies. This study explores the knowledge of grain storage practices among farmers in Navsari District, Gujarat. This study aims to examine farmers' personal, socio-economic, communicational and psychological characteristics, along with their knowledge of grain storage practices. The research was conducted in four talukas of Navsari district, involving 120 farmers randomly selected from 12 villages. Data were gathered through personal interviews and analyzed to derive meaningful conclusions. Results revealed that the majority of the farmers (55.83%) were middle-aged, with a medium level of education (51.66%) and a family size of five to six members (34.16%). Most farmers had medium levels of experience in grain storage (54.17%), landholding size (61.66%), and annual income (50.83%). The farmers also showed medium levels of participation in social and extension activities, media exposure, scientific orientation, and risk-taking ability. It is found that the majority 73.33 per cent of the farmers had from medium level knowledge about grain storage practices, followed by 17.50 and 09.17 per cent of respondents was in high and low knowledge about grain storage practices, respectively. Further study revealed that out of twelfth independent variables, education, size of family and mass media exposure had positive and highly significant association with knowledge of farmers, whereas experience in grain storage, annual income, social participation, quantity of grain storage, extension participation, scientific orientation and risk orientation had positive and significant association, while age had negative and significant association and size of land holding had positive and non-significant with knowledge of farmers about grain storage practices.

Keywords: Grain storage, farmers knowledge, storage technologies, significant, non- significant

NEA 67

Adoption of grain storage practices by the farmers of Navsari district

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ABSTRACT

Grain storage plays a crucial role in ensuring food security and fetching higher market prices. However, farmers are often excluded from advanced storage technologies. The research aimed to evaluate the socio-economic, communicational and psychological characteristics of farmers and their impact on adoption of grain storage practices. The study focused on grain storage practices among farmers in Navsari district, Gujarat, assessing their adoption level and additionally, the study explored the constraints faced by farmers and gathered their suggestions to improve grain storage methods. Findings highlight the need for better access to modern storage technologies. The study employed an ex-post facto research design and multistage simple random sampling to select 120 farmers from 12 villages in Navsari district, Gujarat. It focused on farmers' adoption of grain storage practices, measuring both dependent and independent variables like age, education, landholding size and social participation. Statistical analysis included percentage, mean and correlation. Study indicated that majority (65.83%) of the farmers had a medium level of adoption of grain storage practices. The most commonly adopted practices included sun drying of grains, the use of castor oil, fumigation and various grain storage structures. The data on practice wise adoption revealed that the level of adoption was found highest in practice like appropriate method of sun drying for grains, followed by use of castor oil, fumigation, use of different structure of grain storage, use of galvanized iron bin and RCC structure, use of custard apple seed powder, use of wood ash, use of cow dung slurry or mud for plug of the earthen pot, use of gunny bag, use of stand and ventilator. The study identified key constraints such as a lack of modern storage facilities, inadequate information on chemical control for stored pests and limited awareness of improved storage technologies. Major suggestions offered by respondents were; subsidy should be provided by government to construct new storage structure, storage facilities should be created by government and guidance should be made available by extension agency regarding management of stored grains.

Keywords: Grain storage, farmers adoption, constraints, suggestions, modern storage technology, Ex-post facto design

NEA 68

Relationship between selected characteristics of Mango growers with knowledge of recommended production technology in Surat district

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ABSTRACT

Mango (*Mangifera indica L.*) is the premier fruit of India. Mango fruit is rightly known as 'National fruit of India' and is known as 'King of Fruits. Higher temperature during fruit development and maturity gives better quality fruits. The Gujarat Mango Hybrid-1 (GMH-1) was released in the year 2000 from Agriculture Experimental Station, Paria by giving the name Sonpari. Sonpari is heavy yielder and regular in bearing. The present study was conducted in South Gujarat region. Surat district have ten talukas. Out of ten talukas, mahuva and Bardoli taluka were selected purposively by considering mango production technology. Five villages were randomly selected from selected taluka. Thus, the total number of villages for the study was ten. From each village, 5 mango growers will be randomly selected. Thus the sample size will be 50 respondents for this studied. Ex-post facto research design was used. The study reveal that, out of fourteen independent variables scientific orientation, innovativeness, education, social participation, mass media participation, innovativeness, extension contact, risk orientation, market orientation and farming experience were found positive significant relationship with level of knowledge. While age, land holding and land holding was found positive but non-significant relationship with level of knowledge.

Keywords*:* Mango, Knowledge, Technology

Extension Services for Climate - Smart Agriculture and Sustainable Development Goals

ESC 1

Farmers awareness regarding agricultural pollution in Banaskantha district

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ABSTRACT

The study explores the awareness of farmers of Banaskantha district about agricultural pollution. High fertilizer consumption is a notable concern of the district. The study conducted on 200 farmers across four randomly selected talukas of the district namely, Dantiwada, Deesa, Palanpur, and Dhanera—using a multi-stage random sampling method. The study revealed that most of the farmers had medium to high awareness of pollution sources, especially sewage water and irrigation-related pollution. Factors like education, training, income, and media contact were positively correlated with awareness, while age showed a negative correlation. Farmers generally practicing methods like using organic fertilizers, safer pesticides, and soil testing to manage pollution, and they suggested some solutions of agricultural pollution such as composting crop waste and adopting drip irrigation systems.

ESC 2

Millets in sustainable agriculture: Building a Climate -Resilient future

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ABSTRACT

Millets, a group of small-seeded grains, are increasingly recognized for their potential as climate-resilient crops. Their ability to thrive in diverse agro-climatic conditions and withstand environmental stresses such as drought and heat, positions them as a sustainable alternative to more water-intensive cereals. The paper examines the role of millets in enhancing food security and nutrition, particularly in regions vulnerable to climate change. Rich in essential nutrients—including proteins, vitamins, and minerals—millets contribute significantly to combating malnutrition, thereby aligning with the United Nations Sustainable Development Goals (SDGs) particularly Goal 2 (Zero Hunger). Additionally, millet cultivation promotes sustainable agricultural practices by reducing reliance on chemical fertilizers and pesticides supporting Goal 12 (Responsible Consumption and Production). Their cultivation not only helps improve soil health but also enhances biodiversity, aligning with Goal 15 (Life on Land). Moreover, millets foster economic resilience for smallholder farmers by diversifying income sources and enhancing livelihood security, reducing vulnerability to market fluctuations and climate-related risks. It highlights the importance of integrating millets into food systems and agricultural policies to achieve a sustainable and resilient future for global food security. Emphasizing the multifaceted benefits of millets including their nutritional value, environmental sustainability and economic potential, can significantly contribute to addressing the challenges posed by climate change and food insecurity. As such promoting millet cultivation and consumption is essential for achieving sustainable development goals, improving nutrition and enhancing agricultural resilience. This paper advocates for renewed focus on millets in agricultural strategies, ensuring their pivotal role in fostering a sustainable and resilient food system in the face of global challenges.

Keywords: Millets, Climate-resilient, Sustainable agriculture, Food security, Nutrition, Economic resilience, Sustainable Development Goals (SDGs)

ESC 3

Carbon sequestration as a pillar of climate action: Synergies with the Sustainable Development Goals

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ABSTRACT

The 17 Sustainable Development Goals (SDGs) form the core of the 2030 Agenda for Sustainable Development, fostering global cooperation and mobilizing urgent actions worldwide to achieve a sustainable future. Among the strategies to fulfil these goals, carbon sequestration plays a pivotal role in combating climate change and fostering climate resilience. It intersects climate change mitigation and agriculture, reducing greenhouse gas emissions and focusing on sequestering carbon in the agricultural landscape. It directly contributes to SDG 13 (Climate Action) and indirectly advances multiple other SDGs. It ensures using sustainable farming methods through conservation agriculture, ratoon cropping, residue management, resource utilisation and also residue, drainage and irrigation management. It tries to improve agroecology and land restoration. In the agricultural sector, carbon sequestration not only reduces greenhouse gas emissions but also improves soil health, biodiversity, and resource efficiency elements in promoting sustainable farming practices. These methods strengthen agricultural management by enhancing systems for monitoring, reporting, and verification, forming a robust foundation for resilient farms and sustainable policies and creating significant interest among the countries and corporate firms with net-zero emission targets. It can be a potent strategy not only to compensate for their greenhouse emissions but also the deployment of negative emission technologies.

Keywords*:* Sustainable Development Goals, Carbon Sequestration, Climate Action, Net-zero emissions

ESC 4

Effect of agricultural modernization on sustainable livelihood among the tribal and non-tribal farmers of Sabarkantha district of Gujarat state

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ABSTRACT

The Sustainable Livelihood links with security to basic human needs, food security, sustainable agricultural practices and poverty as an integrating concept. A large number of tribal communities are bereft of stable livelihood and thus they fall in the category of the vulnerable section of Indian society. Considering this fact, the study was conducted in Sabarkantha district of North Gujarat region of Gujarat state, as the economy of the district is basically dependent on agriculture. The farmers of Sabarkantha district are also innovative as well as enthusiastic in modern agriculture. Secondly the districts rank first with respect to the tribal population. Looking to the common situation of the in habited villages for the tribal and non-tribal farmer, 11 villages of Bhiloda and Meghraj talukas, having scheduled tribal population of 41-50 range of percentage were selected purposively. Total 220 farmers were selected from these villages (20 farmers in each village). For measuring the agricultural modernization and sustainable livelihood of the tribal and non-tribal farmer's teacher made tests were developed. The thirteen major criteria of agricultural modernization and 12 sub indicators of sustainable livelihood were determined and total 200 score of agricultural modernization and total 300 score of sustainable livelihood was determined by conference method. The results showed that in case of tribal group, there was positively and significant association between the sustainable livelihood and seven criteria for agricultural modernization viz., extent of use of organic fertilizers, farming pattern, seed selection, available modern sources of energy equipments, extent of use of chemical fertilizers, use of plant protection measures and extent of use of improved dairy practices. While in case of non-tribal group, all the 13 criteria of agricultural modernization studied were possessed positive and significant association with sustainable livelihood. It was indicated the impact of the agricultural modernization on the extent of sustainable livelihood among the non-tribal respondents, while it was very low in tribal farmers.

ESC 5

Effect of tillage practices in growth and yield of Green Gram of South Gujarat

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ABSTRACT

Green gram is important pulse crop grown throughout the Gujarat state. Under broadcast sowing, the seed emergence and plant stand are uneven results due to its direct effect on crop productivity. Therefore, it is necessary to evaluate suitable planting method to obtain more plant growth yield. This study aim to determine the effect planting method on crop stand and yield of Rabi session green. The results of study revealed that the minimum, and maximum of plant growth parameters green gram were also observed under Irrigation + Rotavator + Manual line sowing and Irrigation + Machine sowing, respectively. The green gram yield was significantly influenced by the different tillage practices. The grain yield was recorded

highest 1260 kg/ha under Irrigation + Machine sowing+ spraying per-emergence herbicide (Pendimethalin 30EC Dose: 1.0 lit/acre) followed by Irrigation + Rotavator+ Machine sowing, which was statistically higher than Irrigation + Rotavator + Manual line sowing and Irrigation + Broadcast sowing + Rotavator and rest treatments were at par. Maximum and minimum stover yield were recorded under Irrigation + Rotavator+ Machine sowing and Irrigation + Rotavator+ Manual line sowing, respectively. So, we are recommended that the farmers of South Gujarat intended to grow green gram are advised to sowing by Irrigation + Machine sowing+ spraying per-emergence herbicide (Pendimethalin 30EC Dose: 1.0 lit/acre) for getting higher yield.

Keywords: Green gram; sowing methods; herbicide; Irrigation and Yield

ESC 6

Risk management practices adopted by vegetable farmers in South Gujarat

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ABSTRACT

Fruits and vegetables account for nearly 90 per cent of the total horticulture production in the country. The vegetable growers face different types of risk like pests and diseases, weeds, poor quality of inputs, natural calamities, price fluctuations, lack of infrastructure, lack of capital, change in government policies etc. Present study focused on the identification and analysis of risk sources for vegetable farmers and the risk management strategies adopted by vegetable farmers of South Gujarat. Three districts of South Gujarat i.e. Surat, Navsari and Tapi were selected purposively having highest area under vegetable cultivation. Talukas, villages and 100 farmers from each district were selected randomly thus making a total sample size of 300 vegetable farmers. The study showed that farmers in the study area were affected by production risk, financial risk, market or price risk and technological risk sources. Study indicated that pest and diseases, weather, damage by animals, erratic rainfall, yield variations, labour unavailability and labour cost are considered major risk sources by vegetable farmers. Vegetable farmers mainly adopt risk mitigation and coping strategies such as pest and disease management, use of family labour, improved inputs, crop and enterprise diversification and use of market information. However, farmers' adoption of formal risk management approaches such as crop insurance, personal insurance, use of formal credit and government schemes and subsidy was found to be low. Applying low risk technologies, diversification, agricultural insurance, hedging, contracting, information support, effective use of natural resources and professional training can play an important role in the risk management by the farmers.

ESC 7

Role of Indigenous Traditional Knowledge (ITK) in promoting tuber crops sustainability in Gujarat

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ABSTRACT

Tuber crops hold a significant position in the dietary practices of small and marginal farmers in tropical and subtropical countries, ensuring food security and nutritional well-being, especially among vulnerable tribal populations. Indigenous Traditional Knowledge (ITK) plays a vital role in sustaining tuber crop cultivation in Gujarat, ensuring food security and ecological balance. Indigenous knowledge can be described as knowledge which has been accumulated by a people over generations by observation, experimentation and by handing on old people's experience and wisdom in any particular area of human endeavour. This survey based study explores the significance of ITK practices, passed down through generations of tribal and rural communities in promoting sustainable tuber crop management. Through extensive field research and community interactions, we document and analyses local ITK practices, such as: Traditional seed selection and preservation methods, Crop rotation and intercropping strategies, Organic pest management techniques, Soil conservation and fertility enhancement practices *etc*. Results shows that ITK-based approaches enhance tuber crop yields, improve resilience to climate change and reduce environmental degradation. Furthermore, ITK promotes biodiversity conservation, supports local livelihoods and preserves cultural heritage. This survey-based research underscores the importance of integrating ITK into modern agricultural extension services, policy frameworks and sustainable development initiatives. By recognizing and valuing indigenous knowledge, we can foster inclusive, resilient and sustainable tuber crop production systems in Gujarat, contributing to a food-secure and environmentally conscious future.

ESC 8

Association between profile of crop growers and their level of knowledge about crisis and its management practices in crops

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ABSTRACT

The present study was carried out in six districts of South Gujarat. Paddy, Mung, Tomato and Banana crops were taken under the present study. Out of six districts, 360 crop growers and 48 researchers were selected. Thus, total sample size was 408 respondents for the present study. The study discloses that out of twenty independent variables; Education, occupation, farming experience, source of information, social participation, risk orientation, economic motivation, innovativeness, overall modernity and market orientation were positively and highly significantly correlated while, annual income, scientific orientation, management orientation and cropping pattern were positively and significantly correlated with the knowledge of farmers about crisis and its management practices in crops. In case of researchers, the age, source of information, economic motivation, management orientation and overall modernity were positively and highly significantly correlated while, risk orientation, scientific orientation, material possession and market orientation were positively and significantly correlated with the knowledge of researchers about crisis and its management practices in crops

Keywords: Crisis and its Management Practices, Crop Growers, Knowledge and Association

ESC 9

The role of PM-KUSUM in reducing carbon footprint and promoting Climate-Smart Agriculture

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ABSTRACT

The Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) Yojana aims to empower farmers by promoting renewable energy adoption through solar irrigation systems and decentralized energy production. This study explores the scheme's role in mitigating carbon emissions and fostering climate-smart agriculture practices. It assesses how the replacement of diesel and grid-powered pumps with solar alternatives contributes to reducing the agricultural sector's carbon footprint. Additionally, the study examines the scheme's impact on sustainable farming by ensuring water-use efficiency, enhancing crop productivity, and improving farmers' resilience to climate change. Using primary data from participating farmers and secondary data on energy savings, the research evaluates environmental benefits such as emission reductions and water conservation. Challenges related to the adoption of solar pumps—such as high initial costs, technical barriers, and policy limitations—are also analyzed. The findings highlight the potential of PM-KUSUM to align agricultural practices with national climate goals by promoting low-emission technologies and sustainable irrigation. The study concludes with policy recommendations to scale the initiative and foster broader participation, contributing to India's commitments under the Paris Agreement.

Keywords: PM-KUSUM, carbon footprint, climate-smart agriculture, solar irrigation, water-use efficiency

ESC 10

Awareness and sustainable strategies for managing agricultural pollution among Mango growers in South Konkan, Maharashtra

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ABSTRACT

The study on "Awareness of Mango Growers Regarding Agricultural Pollution" was conducted with a focus on innovation and strategies for sustainable development in the Ratnagiri and Sindhudurg districts of South Konkan, Maharashtra. By assessing the awareness levels of 120 mango growers, selected through random sampling from high mango cultivation areas, the study highlights key environmental concerns and sustainable practices in agriculture. Using an Ex-post-Facto research design, it was found that all respondents were fully aware of crucial pollution-related issues, such as the persistence of pesticides in soil, the eco-friendly potential of bio-fertilizers, and the detrimental effects of open burning of waste and excessive

noise on human and environmental health. Additionally, the study revealed widespread awareness of sustainable practices like the safe use of FYM and biogas slurry for soil health, and the recycling of food processing waste to enhance soil fertility. A significant portion (71.67%) of respondents demonstrated medium to very high awareness of agricultural pollution, showcasing a strong understanding of the importance of sustainable farming techniques. This research underscores the need for continued innovation in pollution management and strategic educational efforts to promote sustainable agricultural practices among mango growers. The findings offer valuable insights for formulating policies and practices that align with sustainable development goals, ensuring long-term environmental and economic viability in the mango-growing sector.
Keywords: Sustainable development, agricultural pollution, awareness, mango growers, eco-friendly practices, innovation.

ESC 11

Adoption of natural farming practices by the farmers in Anand

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ABSTRACT

Natural farming is a one-of-a-kind chemical-free farming method that helps preserve and protect valuable natural resources by minimizing the use of synthetic fertilizers, pesticides and chemicals. It is one of the current approaches that are popular among the farming community of the country. In this context, the present study was conducted in Anand district. Total 300 farmers were selected for the study in Anand District. Exploratory research design and multistage random sampling technique were used. The study revealed that majority of the farmers were found middle age group, primary to secondary level of education, had 20 years of experience in farming, had up to 5 years of experience in natural farming, had 5 to 8 members in family, had possession up to 5 animals, marginal size of land holding and great majority of the farmers had marginal size of land holding under natural farming. Majority of the respondents had annual income up to ₹ 2 lakh and annual income from natural farming had up to ₹ 0.5 lakh, had received 2 to 3 training, had membership one to two organization and medium to low level of extension participation. In case of adoption of natural farming practices, Jeeevamrut received the highest rank with mean score 1.85 followed by sour butter milk with mean score 1.57. While, Bijamrut, Inter cropping, Neemastra, Ghan Jeevamrut and Mulching practices adopted by the farmers with ranked 3rd, 4th, 5th, 6th and 7th, respectively.
Keywords: Natural farming, socio-economic condition, adoption, natural farming practices, Farmers

ESC 12

Association between profile of respondents and their awareness about agricultural hazards

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ABSTRACT

Agricultural has been identified as one of the most hazardous sectors in the world, and it is estimated that of 335,000 fatal work-related accidents occurring worldwide every year. Large numbers of the world’s agricultural workers also suffer serious work-related injuries and diseases caused by machinery, chemicals, and animals. In first year one district and recent two year every year three

districts was taken and from each district 90 respondents was selected randomly. Three talukas from each district was selected randomly and two villages from than with same procedure. From each selected village, fifteen respondents were selected randomly making the total sample of 630 respondents. Age, education, size of family, occupation, land holding, experience in farming, social participation, extension contact, mass media exposure and training received were correlated with the awareness about agricultural hazards.

ESC 13

Status of organic vegetable cultivation in Palghar district, Maharashtra

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ABSTRACT

The present study on "Status of Organic Vegetable Cultivation in Palghar District" was conducted to evaluate the current practices, challenges, and agro-ecological impacts of organic vegetable farming in the Palghar district of Maharashtra's Konkan region. The study focused on two tahsils with the highest area under organic vegetable cultivation, selecting 90 farmers proportionately from six villages using an Ex-post-Facto research design. The research revealed that 66.67% of the respondents procured seeds from agro-service centers, reflecting a dependency on external inputs for organic farming. A substantial portion (42.22%) of the farmers used bed/ridge planting techniques, aligning with sustainable soil management practices. Labor utilization was moderate, with 75.56% of farmers employing 2 to 4 man-days of labor for harvesting. Marketing practices indicated that the majority (75.56%) sold their organic produce through wholesalers, and 95.56% sold their vegetables in local markets within a 10-20 km radius. The findings also highlighted that 78.89% of the farmers did not pay commissions to middlemen, reducing transaction costs and improving profitability. Post-harvest practices like cleaning vegetables were adopted by 77.77% of the respondents, showing a focus on maintaining quality for local markets. The study found that 62.22% of the farmers had a 'medium' level of use of on-farm inputs such as compost and green manure, reflecting their reliance on natural resources for soil fertility. In contrast, 48.89% reported a 'medium' level of use of off-farm inputs, suggesting moderate integration of externally sourced organic inputs. Furthermore, 52.22% of the respondents observed a 'medium' impact of organic practices on agro-ecological health, indicating positive, though not extreme, benefits to soil health and the local environment from organic cultivation methods. The findings provide valuable insights into the status of organic vegetable farming in Palghar, emphasizing the need for improved input management, market access, and sustainable practices to enhance both ecological sustainability and economic viability.

Keywords: Organic vegetable cultivation, agro-ecological impact, on-farm inputs, off-farm inputs, sustainable farming, local markets, Palghar.

ESC 14

The contribution of agricultural extension services to global SDG targets

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ABSTRACT

Agricultural extension services are essential for advancing multiple Sustainable Development Goals (SDGs) by facilitating the adoption of innovative and sustainable farming practices. This review identifies and analyzes the key SDGs directly impacted by robust extension systems, including SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Extension services support SDG 1 and SDG 2 by improving agricultural productivity and farmers' incomes through the dissemination of advanced techniques, crop diversification, and resource management strategies, which enhance food security and reduce rural poverty. SDG 3 is addressed through promoting safer, sustainable pest control and nutrient-rich crop production, contributing to improved public health. Extension initiatives that target women farmers help achieve SDG 5 by fostering gender inclusivity and economic empowerment, thereby enhancing community-wide agricultural efficiency. Addressing SDG 12, extension services encourage the adoption of sustainable farming practices, such as integrated pest management and efficient water use, reducing environmental degradation and promoting responsible production patterns. To meet SDG 13, extension programs emphasize climate-smart agriculture, including drought-resistant crop varieties and sustainable soil practices, which help farmers adapt to climate variability and reduce greenhouse gas emissions. Challenges such as limited infrastructure, resource constraints, and access disparities are discussed, suggesting a need for increased investment, digital innovations, and collaborative policy frameworks to amplify outreach and impact. Evidence from case studies highlights that strategic enhancement of agricultural extension services can be pivotal in achieving timely progress toward these interconnected SDGs by fostering resilience, sustainability, and inclusivity in agricultural systems.

Keywords: Agricultural Extension, Sustainable Development Goals, Climate-Smart Agriculture, Food Security, Rural Livelihoods

ESC 15

Climate services: A strategic approach to addressing climate change in agriculture

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ABSTRACT

In the context of growing uncertainties, Climate Services (CS) are emerging as a powerful techno-social tool that could create disruptive innovations in adaptation to climate variability and climate change. As climate change increasingly disrupts agricultural productivity through unpredictable weather patterns, temperature shifts, and extreme events, farmers require timely, reliable data to adapt effectively. These services bridge the gap between

scientific knowledge and practical application by delivering location-specific forecasts, early warnings, and crop-specific advisories. Through climate services, farmers gain insights into optimal planting schedules, water management practices, and climate-resilient crop varieties, reducing risks and enhancing productivity. The integration of technology, such as mobile apps, weather stations, and remote sensing tools, ensures that even smallholders can access actionable information. Furthermore, climate services promote sustainable farming by enabling better resource management, reducing crop losses, and fostering resilience to future climatic uncertainties. In conclusion, climate services are essential for empowering farmers to adapt to climate change, ensuring food security, and promoting sustainable agricultural development in the face of environmental challenges.

Keywords: Climate service, climate change, weather

ESC 16

Adoption of natural farming practices by the farmers of Mahesana district

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ABSTRACT

Natural farming is a system where the laws of nature are applied to agricultural practices. This method works along with the natural biodiversity of each farmed area, encouraging the complexity of living organisms, both plants and animals that shape each particular ecosystem to thrive along with food plants. The Agricultural Technology Management Agency (ATMA) at district level played a vital role in dissemination of natural farming practice. The Mehsana district was randomly selected for the study. The Mehsana district has 10 talukas, all the taluks were selected randomly for the study. A list of farmers who were done natural farming obtained from ATMA Office. Five villages were selected from each talukas on the basis of highest number of Natural Farming adopter farmers. Out of these 50 villages form all selected talukas total 300 farmers were selected randomly with the use of snow ball techniques to constitute a sample of 300 farmers. The results revealed that the Knowledge about natural farming practices was found to be high to moderate. Majority of respondents had adopted low to medium level natural farming practices. In practice wise adoption of natural farming shows that cent per cent farmers had adopted Jivamrut, crop rotation, Khati chhas and Gaumutra in their farm. While majority of the farmers had adopted intercropping, neemastra in pest/ disease management. The major constraints were; low yield during conversion period, inadequate marketing facilities, required natural products are not available at reasonable price, and farmers think that chemical fertilizers are more effective than natural products. The major suggestion given by respondents were; more training are necessary for different natural farming practices , government should provide subsidy during conversion period, method demonstration are required for making different natural farming inputs and government should provide regular technical information about Natural farming.

Keywords: Natural farming, Constraints, Global warming, Green revolution

ESC 17

Poshan vatika: A manageable model to improve nutritional security

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ABSTRACT

Poshan vatika is a manageable model for tribal /rural area to solve the nutritional insecurity. In addition, kitchen gardens/nutri-garden when properly managed provide a four-in-one solution to the food and nutrition problem by increasing household food availability, enabling greater physical, economic and social access, providing an array of nutrients, and protecting and buffering the household against food shortages. Thus the study were planned keeping in view to Improved food security, Increased availability of food and better nutrition through food diversity and enhanced rural employment through additional or off-season production in rural areas . The purposive experimental study was planned. The study was conducted in 5 villages under FLDs programme in Narmada District. Total 150 farm families were selected for the study having area around 150 m2 near the house. Total 10 varieties were provided throughout the year in every poshan vatika included fruits and vegetables seeds and saplings. were first time introduced in selected area . It was seen that area available for kitchen garden in most of farm families was cultivated area near the house (39.18%) and unused land near the house (45.81%). It was observed that maximum production was in Rabi season followed by Kharif season respectively, may be due to scarcity of water during summer. Availability of Macro and micro nutrients through consumption of vegetables in daily routine diet was found satisfactory.

ESC 18

Attitude of tribal farmers towards organic farming practices in the Dangs district of Gujarat

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ABSTRACT

Organic farming is a modern and a tenable form of agriculture that provides consumers fresh natural farm products. The popularity of organic product is increases day by day dramatically as consumer seeks the organic foods that are thought to be healthier and safer. Thus, organic food perhaps ensures products safety from farm to plate. The present study was conducted in Dang district of South Gujarat during the year 2020. All of the 3 talukas of the Dangs district were covered under the study. 12 villages were selected through proportionate random sampling. From each village ten tribal farmers were selected through simple random sampling. Hence, the total respondents were 120. The majority of the tribal farmers had favourable attitude of organic farming and annual income and management orientation are positively and highly significantly associated at 1 per cent of probability while, education, herd size, social participation, extension contact, economic motivation, scientific orientation, risk orientation and mass media exposure were found positively and significantly associated at 5 per cent level of probability whereas, size of family, farm experience, land holding, and occupation are negatively but non-significantly associated with their attitude towards organic farming.

Keywords: Ex-post facto design, Attitude, Tribal farmers, Correlation and Organic farming

ESC 19

Knowledge of tribal farmers towards organic farming practices

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ABSTRACT

The present study was conducted in Dangs district of South Gujarat during the year 2020. All of the 3 talukas of the Dangs district were covered under the study. Twelve villages were selected through proportionate random sampling. From each village ten tribal farmers were selected through simple random sampling. Hence, the total respondents were 120. The result was found that tribal farmers had a majority of respondents had medium level of the knowledge of organic farming and extension contact, scientific orientation and mass media exposure was found positively and highly significantly associated at 1 percent level of probability whereas, education, farm experience, annual income, social participation, economic motivation, risk orientation, management orientation and occupation are positively and significantly associated at 5 percent level of probability with their knowledge regarding organic farming.

Keywords: Knowledge, Tribal Farmers, Correlation and Organic Farming

ESC 20

Effect of azolla as feed supplement on milk production in buffaloes

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ABSTRACT

Productivity of dairy animals is largely depends on effective feeding management. Providing a balanced and appropriate diet leads to improved nutrient utilization and optimum milk production. Traditionally, Farmers feed their animal's green and dry fodder, along with concentrates. Concentrates can be costly and may not provide all the necessary nutrients to dairy animals. There is significant potential to enhance livestock productivity through better nutrient balancing and optimized feed resource utilization. Azolla has enormous potential as a livestock feed due to its high content of protein, essential amino acids, vitamins and minerals. Front line demonstration was conducted to study the effect of Azolla as feed supplement in buffaloes. The control group (C) farmers practice was fed wheat straw and green fodder with concentrate. In the treatment group (T) 1.5 kg fresh azolla/animal/day was supplemented over conventional ration. The average daily milk yield was significantly higher in treatment group.

Keywords: Azolla, Milk production, Buffaloes, Feed supplement.

ESC 21

Climate smart IARI technologies for sustainable production and productivity in Bundelkhand region

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ABSTRACT

In India, the estimated degraded land area is about 178 million hectares. Thus, the total arable dryland /rainfed land is under constant degradation process, the degree of variation may be there from moderate level of erosion to severe level. The reasons for soil erosion in dry lands are due to many, varied and complex factors, which includes not only bio-physical factors but also socio-economic factors. The socio-economic factors are totally neglected to improve degraded natural factors such as land, water and vegetation. Rainfed agriculture is the key to sustainable development of water and food. More than 70 per cent of the cultivated area is rainfed and rainfed agriculture produces about 45 per cent of total food grain production in India. The Bundelkhand region of central India has been practicing the local *haveli* system of water harvesting during kharif season since years together and it has worked satisfactorily to cater the needs of farmers' having poor socio-economic status. The rainfall distribution pattern and the kind of land use system have resulted in evolution of water harvesting techniques, such as *in situ* conservation of rainwater through mechanical conservation measures and land use combinations (e.g. Farm Pond and Percolation Tanks). Secondly, drainage of springs and streams for irrigation and domestic water supplies (Loose Bolder Check Dams etc.). In view of this, an effort was made under DST- MRDP funded project on "Agricultural Productivity in Climate Change Scenarios: *impacts and adaption pathways"* to meet the objective for validating the adaptation options and quantify adaptation gains on farmers' fields in Bundelkhand region of central India during 2018-2021. For the purpose of study, a total of 107 demonstrations on IARI wheat varieties (HD-2967, HD-3086 and HD-3059) were laid down on selected farmers' fields in district Jhansi (UP) and Niwadi (MP) of Bundelkhand region. The results showed that the increase in wheat yields varies from 19 to 28 per cent over the local checks at different farmers' fields in 5 selected villages in the region. Further, the B:C ratio was worked out 2.88 in case of HD-3086 variety followed by 2.83, HD-2967 and 2.80, HD-3059 varieties respectively whereas, B:C ratio of local checks varies from 2.00 – 2.15 which clearly showed that the IARI wheat varieties performed better. In addition, the demonstrations of chickpea and mustard varieties of IARI were also laid down at farmers' fields. Hence, these varieties are recommended for wider coverage for enhancing the sustainable production and productivity along with the farmers' income in the region.

ESC 22

Impact of climate change on plant diseases

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ABSTRACT

The impact of climate change on plant diseases is a major concern for agriculture, with the average global temperature increasing by 0.74 °C over the last century and atmospheric CO_2 concentration rising from 280 ppm to 400 ppm in the past decade. These changes are expected to significantly affect the growth and cultivation of various crops and also influence the reproduction, spread, and severity of plant pathogens, posing a threat to food security. Plant diseases result from the interaction between susceptible host plants, virulent pathogens, and the environment. Changes in environmental conditions are linked to variations in disease-related losses because the environment directly or indirectly influences plants, pathogens, and their antagonists. Global warming, characterized by increased temperatures, changes in precipitation patterns, elevated CO_2 and ozone levels, and drought, is likely to impact the incidence and

severity of plant diseases and influence the co-evolution of plants and pathogens.
Keywords: Climate, Disease

ESC 23

Attitude of farmers towards conservation of environment

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ABSTRACT

Conservation of the environment is an urgent necessity in today's world due to the rapid depletion of natural resources, loss of biodiversity, and the escalating impacts of climate change. Environmental conservation is the practice of protecting and managing natural ecosystems, resources, and biodiversity to prevent degradation, ensure sustainability, and maintain ecological balance for future generations. South Gujarat, with its diverse topographies of hilly, coastal, and green landscapes, is particularly vulnerable to the adverse effects of climate change, highlighting an urgent need for environmental conservation to mitigate its impacts across these varied ecosystems. The primary objective of this study was to assess farmers' attitudes toward environmental conservation. The study was conducted in South Gujarat with 350 sample size. The selection of talukas and villages were done purposively from diversified ecosystem, in order to get representation of varied topography and climatic condition. Nearly half (47.00%) of coastal area farmers, around three-fifths (57.60%) of green area farmers, and 54.40% of hilly area farmers showed a positive attitude towards environmental conservation. In South Gujarat, 53.43% of farmers across all three selected areas displayed a positive attitude toward environmental conservation. The profile of farmers plays a crucial role in environmental conservation. The education, innovativeness, social participation, decision-making ability, progressiveness, environmental concern, and eco-friendly behaviour of them had positive and highly significant association with their attitude towards conservation of environment. Only fifty percent of farmers currently exhibit a positive attitude toward environmental conservation, indicating a significant need for improvement in fostering greater awareness and commitment to sustainable practices.

ESC 24

Environmental issues and contributing factors in South Gujarat: An in-depth analysis

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ABSTRACT

Environmental degradation is the major issue confronting agriculture today. Environmental impacts of agriculture and vice versa have raised serious questions about the sustainability of agricultural production systems because of widespread deterioration of soil, water, bio-diversity and air quality. These are likely to threaten the food security and livelihoods of millions of people in India. A total of 37 environmental issues were documented in South Gujarat as part of this study, categorized under climate, soil, water, biodiversity, cultural, and crop-related issues. The Garrett ranking technique was used to identify the key contributing factors. Emission from factories, air pollutants, deforestation and increased felling of tree were ranked first as a major factor for various climatic issues. Indiscriminate use of fertilizers and pesticides, loss of organic matter, heavy rainfall and loss of soil nutrients were ranked first as important factors for soil related issues. Poor recharge mechanism, disorganized state of urban water distribution system, excess application of synthetic chemicals contaminate ground water, human settlement and water salinity were ranked first as a major factor for various water related issues. Clearing forest, faster urbanization, reduction in native forest area and ornamental purpose were ranked first as important factors for bio-diversity related issues. Climatic change, introduction of high-tech practices and more incidences of pest and disease were ranked first as major factors for crop production related issues. Climate change, changing the attitude of people and introduction of modern utensils were ranked first as important factors for cultural change.

Keyword: Environmental issues, Contributing factors, Garret rank, Climate change, sustainable practices, livelihood

ESC 25

Development of a scale to measure the attitude of farmers towards conservation of environment

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ABSTRACT

The study was conducted to develop a valid and reliable scale, to measure attitude of farmers towards conservation of environment. The method suggested by Likert (1932 in developing summated rating scale was followed in the construction of this scale. This scale has been standardized and found to be reliable and valid. In order to know the attitude of extension personnel farmers towards conservation of environment, a comprehensive list of 76 statements was prepared. The statements were selected and edited on the basis of the criteria suggested by Edward and Kilpatruck (1948) and at last, 59 statements were selected as they were found to be non-ambiguous. These components along with the statements were sent to 200 experts for the judge's opinion with (five-point continuum). Out of the 200 judges, 100 judges were responded in time by sending their judgements. Based on the scale (median) and Q values, 18 statements were finally selected to constitute the attitude of farmers towards conservation of environment. The split-half method developed by Brown prophecy was employed to measure the reliability. The reliability co-efficient (0.93) and content validity also worked, indicating higher reliability and validity of the scale. The standardized scale would have practical applicability in discovering the intensity of attitude of extension personnel and thus it facilitates to take right decisions by policymakers.

Keyword: Attitude, Scale, Environment, Conservation, Farmer

ESC 26

Constraints faced by the farmers in practicing organic farming

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ABSTRACT

The research was conducted in the Gujarat. A total of 160 farmers practicing organic farming and also registered with the Gujarat Organic Products Certification Agency (GOPCA) were randomly chosen for the study. The perceived constraints were enlisted and the responses from the farmers practicing organic farming were elicited in three-point continuum according to their intensity, *viz*. important, less important and not important and scores of 2, 1 and 0 were assigned, respectively. For each constraint, mean score was calculated and based on that, ranks were assigned to the constraints in order of significance. 8. Major important constraints faced by the farmers in practicing organic farming were: difficulty in managing weed, pest & insect damage in organic farming, inadequate availability of labour or higher labour costs for essential/critical farm operations in organic farming, certification procedure is lengthy and very complicated and no premium price in local market for organic farm produce.

ESC 27

Constraints experienced by the farmers in adoption of natural farming

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ABSTRACT

Natural farming is a broader term which not only covers agro ecological science but involves the other transdisciplinary fields encompassing socio-cultural, technological, economic and political dimensions of food systems from production to consumption. Natural farming, therefore involves all aspects of living in harmony with nature based on the foundation of agro-ecological principles in the context of setting up universal sustainable food systems and healthy life. The study was conducted to find out constraints experienced by the farmers in adoption of natural farming practices. A multistage sampling method was followed for the selection of the respondents. The study was conducted in North Gujarat. From North Gujarat, two districts and from each selected district three talukas were purposively selected based on a higher number of farmers practicing natural farming. Five villages from each taluka and each village, ten farmers were selected randomly. Thus, a total of 300 natural farming practicing farmers were selected as the sample size. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result showed that major constraints experienced by the insured farmers in adoption of natural farming in the order of priority were; “Farmer did not get remunerative price of natural products in local market” with first ranked, followed by “Lack of specialized markets for natural farming produce” (80.33%), “High risk in adoption of natural farming practices” (77.00%), “Government is not giving due weightage for starting natural farming” (75.67%) and “Lack of technical knowledge of natural farming practices” (70.00%). with second, third, fourth and fifth rank, respectively.

ESC 28

Constraints faced by farmers for application of rainwater harvesting and groundwater recharge structures on field

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ABSTRACT

Water and soil are the most important inputs essential for crops. Both shortage and excess of water affects the growth and development of the plants, yields and quality of produce. There are numerous methods to reduce such losses and to improve soil moisture like mulching, cropping pattern, planting of trees and water harvesting etc. The present paper was an attempt to know the Constraints faced by respondents in adoption of rainwater harvesting and groundwater recharge. The result of present study shows that majority of the respondents (98.33 per cent) faced lack of training programme was the main constraints followed by lack of awareness (95 per cent), whereas more than half of the respondents (52.66 per cent) faced financial constraints and nearly half of the respondents 48.66 per cent faced location and site constraints. One third of the respondents (30.00 per cent) and one fourth of the respondents (22.00 per cent) had faced constraints like land availability and social constraints respectively. However very few of the respondents 11.33, 9.66 and 3.66 faced constraints like possibility of submergence of agricultural land, conflicts with neighbors and loss of land for construction of water harvesting sites like farm pond etc.

ESC 29

Coriander growers' knowledge about coriander production technology

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ABSTRACT

To measure the coriander growers' knowledge about recommended coriander production technology a teacher made knowledge test was developed and used. The data were collected with the help of structured schedule by personal interview method. The data were compiled analyzed and interpreted in the light of specific objectives.About one half (48.50 per cent) of the coriander growers belonged to middle age group, while more than one half (66.00 per cent) of the coriander growers were from medium education group, medium size of family (62.00 per cent), medium irrigation potentiality (68.50 per cent), joint family (76.00 per cent) and medium size of land holding (66.00 per cent).Whereas, (55.00 per cent) and (72.00 per cent) respondents had medium social participation and extension contact respectively. Medium coriander crop intensity (67.00 per cent), medium extension participation (70.00 per cent), medium exposure to information source (62.00 per cent), medium economic motivation (59.00 per cent), medium risk orientation (57.00 per cent), medium innovativeness (38.00 per cent) and medium annual income (18.00 per cent). A majority (62.00 per cent) of the respondents had medium knowledge level about the recommended coriander production technology, followed by 22.00 per cent high and 16.00 per cent low level of knowledge about recommended

coriander production technology. There was no significant association of the knowledge of coriander growers about recommended coriander production technology with their size of family, annual income, size of land holding and type of family. Remaining all the characteristics like education, social participation, extension contact, irrigation potentiality, coriander crop intensity, risk orientation, extension participation, innovativeness, economic motivation and exposure to information source were positively and significantly associated with the knowledge of the coriander growers While, age was negative and significantly associated with the knowledge of the coriander growers.

ESC 30

Demographic characteristics of farmers practicing organic farming

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ABSTRACT

The study was carried out in Gujarat state. Total 160 farmers practicing organic farming and registered under Gujarat Organic Products Certification Agency were selected randomly for the study. Ex-post facto research design was used. The independent variables were measured using appropriate scales with modifications wherever felt necessary. A standardized scale was developed and used for the measurement of perception towards organic farming. The data were gathered through personal interviews and then assembled, tabulated, and analysed to obtain adequate answers for the specific objectives of the study using various appropriate statistical tools. The study reveals that majority of the farmers were from middle to old age group, educated up to higher secondary, and had medium level of experience in organic farming, medium to small size of total land holdings and semi medium to marginal size of land holdings under organic farming. Majority of the farmers were found with annual income up to 5,00,000/- and had up to six animals, medium cropping intensity and medium to more access to training. Majority of the farmers had low to medium exposure to the different agricultural mass media, medium to low level of extension participation, medium to high level of scientific orientation, medium to high level of risk orientation, high to medium level of market orientation, high to medium level of achievement motivation and very high to high level of knowledge about organic farming.

ESC 31

Difference in different indicators which determine the perception of farmers towards organic farming

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ABSTRACT

Total 160 farmers were selected randomly from Gujarat State who were practicing

organic farming and registered by Gujarat Organic Products Certification Agency (GOPCA). One-way analysis of variance was used to study the difference in mean percent score of indicators that determines perception towards organic farming. Comparing the different components individually with critical difference, perception about soil conservation, perception about human health and perception about sustainable agriculture were at par and were significantly superior to all other components. The last component in the ladder was perception about organic products certification process which was significantly inferior to all other components.

ESC 32

Direct and indirect effect of antecedent characteristics of farmers on perception towards organic farming

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ABSTRACT

The study was conducted in entire Gujarat State. 160 farmers were selected through proportionate random sampling method. To know the direct and indirect effect of independent factors on dependent variable, the method of path co-efficient analysis (Wright, 1921) was employed. Out of sixteen independent variables, risk orientation, annual income, land holding, extension participation and knowledge about organic farming were the key variables in exerting considerable direct, indirect and substantial effect on perception of farmers towards organic farming.

ESC 33

Advances in IWM practices of Rabi Maize

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ABSTRACT

A field experiment was conducted during *rabi*-2017, 2018 and 2019 at Instructional farm, Department of N. M College of Agriculture, N. A. U., Navsari, Gujarat. The soil of the experimental site clayey in texture and PH was high (7.8). The soil was low in available nitrogen (199 kg/ha), medium in available phosphorus (52 kg/ha) and high in available potassium (481 kg/ha). The study consisted ten weed management practices *viz.* Weedy free (T_1), Weedy check (T_2), Two HW and two IC at 20 & 40 DAS (T_3), Atrazine 1 kg/ha PE + Hand weeding at 40 DAS (T_4), Atrazine 1 kg/ha PE + Interculturing at 40 DAS (T_5), Atrazine 1 kg/ha PE + 2,4-D amine 0.5 kg/ha PoE at 40 DAS (T_6), Atrazine 1 kg/ha PE + Halosulfuron methyl 65g/ha PoE at 40 DAS (T_7), Atrazine 1 kg/ha PE + Halosulfuron methyl 130 g/ha PoE at 40 DAS (T_8), Atrazine 1 kg/ha PE + (Halosulfuron methyl 65 g/ha + 2,4-D amine 0.5 kg/ha PoE as tank mixture at 40 DAS) (T_9), Atrazine 1 kg/ha PE + (Halosulfuron methyl 130 g/ha + 2,4-D amine 0.5 kg/ha PoE as tank mixture) at 40 DAS (T_{10}). These treatments were replicated three times in a randomized block design. Based on the results of three years experimentation

for effective management of weeds in *rabi* maize, treatment Two hand weeding (HW) and interculturing (IC) at 20 & 40 DAS) produced higher yields (4966 kg/ha) along with higher weed control efficiency (95.88%) followed by application of atrazine 1.0 kg/ha as pre-emergence and interculturing at 40 DAS reduced weed competition and obtained better growth and produced higher yields (4793 kg/ha) along with higher weed control efficiency (91.55%).

ESC 34

Farmer's attitude towards natural farming practices

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ABSTRACT

Natural Farming emphasizes on use of chemical-free practices and easily available farm resources which are manageable for a better economy and conservation of nature in the long term. It considers the principles of agro ecology at its centre integrating crops, trees and livestock with functional relationships fulfilling the needs of all living organisms. It helps to reduce dependency on purchased inputs and will help to ease smallholder farmers from the burden of the high cost of inputs and promote sustainable life. The present study carried out to measure farmer's attitude towards natural farming practices. A multistage sampling method was followed for the selection of the respondents. The study was conducted in North Gujarat. From North Gujarat, two districts and from each selected district three talukas were purposively selected based on a higher number of farmers practicing natural farming. Five villages from each taluka and each village, ten farmers were selected randomly. Thus, a total of 300 natural farming practicing farmers were selected as the sample size. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result showed that Slightly more than half (51.00%) of the farmers had moderately favourable attitude towards natural farming followed by 31.67 per cent, and 17.33 per cent of the farmers who had highly favourable and less favourable attitude towards natural farming practices, respectively.

ESC 35

Importance of Indigenous Traditional Knowledge (ITK) on climate smart agriculture and sustainable agriculture

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ABSTRACT

Indigenous traditional knowledge (ITK) plays a critical role in promoting climate-smart agriculture (CSA) and sustainable agricultural practices worldwide. This knowledge, developed over generations through direct interaction with local ecosystems, encompasses invaluable insights into sustainable land management, biodiversity conservation, and climate resilience. The importance of ITK lies in its holistic understanding of local environmental

conditions, which can enhance adaptive strategies for agriculture amid climate change challenges. For instance, indigenous practices often include crop diversification, agroforestry, and soil conservation techniques that have proven effective in improving soil health and increasing agricultural productivity while reducing dependency on chemical inputs. Moreover, ITK emphasizes the sustainable use of natural resources, which aligns with the principles of CSA aimed at improving productivity and resilience while minimizing greenhouse gas emissions. Recognizing and integrating ITK into modern agricultural frameworks can enhance food security and empower local communities by validating their cultural heritage and ensuring their active participation in decision-making processes. This review paper highlights the significance of indigenous traditional knowledge in fostering climate-smart agriculture and sustainable practices, examining case studies where ITK has successfully contributed to environmental sustainability and resilience. By bridging the gap between traditional practices and contemporary agricultural innovations, ITK provides a pathway for developing adaptive, resilient agricultural systems that can withstand the uncertainties posed by climate change, ultimately promoting sustainable livelihoods and preserving biodiversity.

Keywords: Indigenous traditional knowledge, climate-smart agriculture, sustainable practices, food security, resilience

ESC 36

Information seeking behaviour of the farmers about natural farming in Tapi and Narmada districts of South Gujarat

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ABSTRACT

Natural Farming is a chemical-free and livestock based diversified farming system that integrates crops, trees and livestock, allowing the optimum use of functional biodiversity. Information plays a vital role when any go for new enterprise. Timely and credibility of information & sources of information are directly and indirectly influencing to farmers. Keeping this in view, it was felt worthwhile to study information seeking behavior of the farmers about natural farming. The present study was conducted in Tapi and Narmada districts of South Gujarat. The two talukas from each district and two villages from each taluka was randomly selected thus, total 4 villages selected. The 11 farmers were randomly selected from each village as respondents and thus, 44 farmers have been selected from each district as respondents. Total 88 respondents were interviewed from two districts of South Gujarat. The data were collected by following the personal interview method with the help interview schedule already developed after due consultation with the faculty members of the discipline. The data so collected were tabulated and analysed with appropriate statistical tools/techniques to formulate the inferences. From the study it was concluded that information need of farmers related to soil health management (2.92 Mean Score), management of plant diseases & Bio inputs for insect pest management (2.85 Mean Score), weather forecasting (2.80 Mean Score) and marketing of natural farming produce (2.74 mean score) got ranked I, II, III and IV respectively. In case of effectiveness of collected information, 64.77% of the respondents were apply the collected information in their field while 92.05% of the respondents needed information in form of print.

Keywords: Training, Information seeking behaviour, Natural farming, Farmers

ESC 37

Knowledge of farmers about organic farming

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ABSTRACT

The research was conducted in the Gujarat. A total of 160 farmers practicing organic farming and also registered with the Gujarat Organic Products Certification Agency (GOPCA) were randomly chosen for the study. Knowledge level of the farmers refers to the information they possess in respect of organic farming practices. The teacher made test was applied for measuring the level of knowledge of respondents about organic farming practices. A structured schedule was developed with 24 questions. The questions were formed on the basis of practices of organic farming with the help of agronomists and experts of organic farming. The questions included in the test were objective type and multiple choices in nature. To measure knowledge level of the farmers, they were asked to reply different questions about concept of organic farming, use of organic manures and crop residues, bio-fertilizers, vermi-compost, weed management, pest management, organic certification, diversification *i.e.* crop rotation, intercropping, trap cropping, etc. With the score of 1 and 0 for each right and wrong answer respectively, the possible total score that a respondent could obtain ranged from 0 to 24. The total score obtained by each of the respondents was calculated separately. The study reveals that more than two-fifth (42.50 per cent) of the farmers had very high level of knowledge about organic farming, while 35.00 per cent and 21.25 per cent of them had high and medium level of knowledge, respectively. The low level of knowledge was observed only among 01.25 per cent of the farmers, while none of them was found in very low category of knowledge about organic farming.

ESC 38

Knowledge level of farmers regarding natural farming practices

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ABSTRACT

Natural farming is a chemical-free eco-friendly method of farming which does not require any credit or purchasing input and eco-friendly system of farming. In recent years, concerns have been raised over the effect of the overuse of agricultural pesticides, fertilizer and other chemicals on the environment and human health natural farming can be used as an alternative to modern-day chemical-intensive farming. The use of this type of farming method can result in reduced synthetic chemical usage. This will reduce the environmental and human health hazards problems. Therefore, the present study carried out to measure knowledge level of farmers regarding natural farming practices. A multistage sampling method was followed for the selection of the respondents. The study was conducted in North Gujarat. From North Gujarat, two districts and from each selected district three talukas were purposively selected based on a higher number of farmers practicing natural farming. Five villages from each taluka and each village, ten farmers were selected randomly. Thus, a total of 300 natural farming practicing farmers were selected as the sample size. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result found that two-fifth (39.66%) of the respondents were having high knowledge level followed by 21.67 per cent, 18.00 per cent and 16.00 per cent of them who had medium, very high and low level of knowledge, respectively. Only a few (04.67%) of the respondents had very low level of knowledge regarding natural farming.

ESC 39

Extension strategies for sustainable secondary agriculture development

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ABSTRACT

India has made significant strides in primary agriculture, but the shift to secondary agriculture is essential to double farmers' income and enhance value addition of produce. Currently, only 8-10% of agricultural produce undergoes value addition, with milk at the highest (35%) and fruits and vegetables at the lowest (2.2%). Key challenges include limited processable varieties, inadequate post-harvest infrastructure, and insufficient farmer knowledge. Secondary agriculture, emphasizing village-level value addition, can improve rural livelihoods by redirecting economic benefits from urban to rural areas. Research reveals that while 100% of tribal farm women are aware of sorting and grading technologies, only 41.67% have adopted these practices. Training programs, however, significantly improved their knowledge (76%) and management efficiency (69.17%) in post-harvest handling. Education, economic motivation, risk orientation, and market exposure were found to positively influence the adoption of value addition techniques. Major barriers include lack of technical knowledge, equipment, and infrastructure for storage and transportation. Respondents suggested addressing these constraints through technical training, improved marketing channels, and better access to tools and facilities. The study highlights the need for targeted interventions to raise awareness, enhance infrastructure, and provide training, especially for farm women in tribal regions, to promote value addition and rural economic growth.

Keywords: Value addition, Secondary agriculture, Extension strategies

ESC 40

Perception of farmers towards organic farming in Gujarat

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ABSTRACT

The study was carried out in Gujarat state. Total 160 farmers practicing organic farming and registered under Gujarat Organic Products Certification Agency were selected randomly for the study. Ex-post facto research design was used. A standardized scale was developed and used for the measurement of perception towards organic farming. The study revealed that

majority of the farmers had high to very high level of perception towards organic farming. As for almost all the components like: perception about sustainable agriculture, perception about human health, perception about soil conservation, perception about marketing, perception about organic products certification process, perception about relative advantage, perception about environmental betterment, and perception about self-reliance in input, majority of farmers were found in high category and that is reflected in their overall perception towards organic farming.

ESC 41

PM-PRANAM yojana: Paving the path for sustainable agriculture and soil health in India

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ABSTRACT

The PM-PRANAM Yojana, launched by the Government of India in June 2023, addresses pressing issues in Indian agriculture, specifically the dependency on chemical fertilizers and its negative impacts on soil health and the environment. Developed to foster sustainable agricultural practices, the scheme prioritizes balanced fertilizer use, promoting biofertilizers and organic alternatives alongside chemical fertilizers. With a unique funding mechanism, PM-PRANAM redirects savings from reduced fertilizer subsidies to states and stakeholders committed to decreasing chemical input use. The scheme includes substantial grants for local production infrastructure and incentivizes awareness initiatives to engage farmers and panchayats. Challenges include farmers' resistance to shifting from traditional chemical fertilizers and the need for significant investment in biofertilizer production units. However, PM-PRANAM provides significant opportunities, such as promoting self-reliant communities, aligning with global sustainability goals, and potential long-term cost savings for farmers. Through strategies such as awareness campaigns, strengthening organic fertilizer supply chains, and transparent monitoring via the Integrated Fertilizer Management System (iFMS), PM-PRANAM aims to reduce agricultural emissions, enhance soil health, and support India's climate commitments. With sustained government support, this scheme could lead to a transformative shift in India’s agricultural practices, making them more sustainable and resilient for future generations.

Keywords: PM-PRANAM, sustainable agriculture, soil health, biofertilizers and chemical fertilizers

ESC 42

Relationship between selected characteristics of farmers with their knowledge level regarding natural farming

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ABSTRACT

Indian agriculture changed from the state of subsistence to commercial and the production of food grains increased rapidly to meet the requirements of growing population needs. A substantial increase in the production of food grains was achieved through the use of improved crop varieties and higher levels of inputs, fertilizers and plant protection chemicals. It has now been realized that the increase in production was achieved at the cost of soil health. Therefore, the present study carried out to find out relationship between selected characteristics of farmers with their knowledge level regarding natural farming. The study was conducted in North Gujarat. A multistage sampling method was followed for the selection of the respondents. From North Gujarat, two districts and from each selected district three talukas were purposively selected based on a higher number of farmers practicing natural farming. Five villages from each taluka and from each village, ten farmers were selected randomly. Thus, a total of 300 natural farming practicing farmers were selected as the sample size. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result showed that out of twelve independent variables, eight variables viz., education (0.631**), size of land holding (0.236**), social participation (0.294**), mass media exposure (0.390**), extension contact (0.311**), training received (0.397**), economic motivation (0.385**) and risk orientation (0.362**) had positive and significant relationship with their knowledge level regarding natural farming. Among the remaining four independent variables, age was found negative and significant relation (-0.201**) and other three independent variables namely annual income (0.110), herd size (-0.113) and size of family (-0.056) were found non-significant correlation with knowledge of farmers regarding natural farming.

ESC 43

Relationship between the selected characteristics of the farmers and their attitude towards natural farming

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ABSTRACT

Natural Farming emphasizes on use of chemical-free practices and easily available farm resources which are manageable for a better economy and conservation of nature in the long term. A multistage sampling method was followed for the selection of the respondents. The study was conducted in North Gujarat. From North Gujarat, two districts and from each selected district three talukas were purposively selected based on a higher number of farmers practicing natural farming. Five villages from each taluka and each village, ten farmers were selected randomly. Thus, a total of 300 natural farming practicing farmers were selected as the sample size. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result showed that out of twelve independent variables, nine variables viz., education (0.356**), size of land holding (0.198**), annual income (0.297**), social participation (0.284**), mass media exposure (0.239**), extension contact (0.321**), training received (0.285**), economic motivation (0.737**) and risk orientation (0.364**) had positive and significant relationship with their attitude towards natural farming. From the remaining three independent variables, age (-0.150**) was found negatively and significantly related and herd size (-0.092) and size of family (-0.030) were found non-significant correlation with their

attitude towards natural farming.

ESC 44

Relationship between profile of farmers and their perception about organic farming

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ABSTRACT

The study was carried out in Gujarat state. Total 160 farmers practicing organic farming and registered under Gujarat Organic Products Certification Agency were selected randomly for the study. Ex-post facto research design was used. The coefficient of correlation was computed to find out the relationship between the variables and the step-wise regression (multiple regressions) analysis was employed to envisage the extent of variation caused by independent variables on perception towards organic farming. Amongst the sixteen selected variables in the study, education, agricultural mass media exposure, scientific orientation, risk orientation, achievement motivation and knowledge about organic farming had positive and highly significant relationship with the perception of farmers towards organic farming. Out of sixteen independent variables, five variables viz. risk orientation, knowledge about organic farming, cropping intensity, annual income and agricultural mass media exposure were found to be influencing on perception towards organic farming which were together contributing 28.70 per cent variation.

ESC 45

Status of natural farming in India and Gujarat: Current trends and challenges

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ABSTRACT

Agriculture is a crucial sector in India, supporting the livelihoods of nearly 47% of the population. India's population has been rapidly growing over the years, as of May 2024, India's current population is 1.44 billion, making it the most populous country, surpassing China. Keeping in view the population of our country, agriculture practices of the present day should be able to provide food and nutritional security to the nation while addressing issues related to sustainable agriculture, the preservation of natural resources and climate change. Natural farming, or Prakritik Krishi, is an eco-friendly, low-input agricultural system that eliminates synthetic chemicals, focusing on agro-ecological practices. This approach promotes climate resilience, cost-effectiveness, and environmental sustainability. In India and Gujarat, natural farming is gaining attention as a viable solution to achieve the Sustainable Development Goals by enhancing income, supporting gender equality, and fostering sustainable agricultural production. This overview examines the status, potential, and challenges of natural farming in

India and Gujarat, highlighting its role in transforming agriculture towards sustainability.
Keywords: Natural Farming, sustainable development goal, climate change

ESC 46

Poverty in India and Gujarat: Status and solutions for achieving sustainable development

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ABSTRACT

India is one of the fastest-growing economies in the world but lags in terms of human development, ranking 134th and falling into the medium human development category. This indicates that India is still a developing economy facing numerous challenges, with poverty being one of the most critical issues. Poverty prevents individuals from achieving a standard of living, signifies a lack of financial resources and a minimum quality of life. This paper explores the current state of poverty in India, with a particular focus on Gujarat, aiming to provide a comprehensive understanding of its causes, scope, and the potential solutions necessary for sustainable development. Out of India's 1.44 billion population, 16.5 million people live in extreme poverty, representing 1.15 per cent. There is, however, a significant disparity between rural and urban areas, with 94 per cent of the poor residing in rural regions compared to just 6 per cent in urban areas. The distribution of poverty was relatively equal between males and females. Over recent years, India's Head Count Ratio has declined, dropping from 14.96 per cent in 2019-21 to 11.28 per cent in 2022-23. Poverty is more prevalent in the northeastern and eastern states, with Bihar having the highest Multidimensional Poverty Index (MPI) value at 0.160, while Kerala has the lowest at 0.002. Gujarat ranks 14th with an MPI value of 0.050 and a Head Count Ratio of 9.03 per cent (NITI Aayog, 2023). Reducing poverty is a critical step toward achieving sustainable economic development. By addressing this issue, India can stimulate market demand, enhance job creation, and expand its consumer base, thus fostering a more inclusive, resilient, and sustainable economy. This paper aims to provide a framework for addressing poverty in India and Gujarat, identifying actionable solutions that can contribute to sustainable development goals and long-term economic prosperity.
Keywords: poverty, headcount ratio, sustainable economic growth, MPI

ESC 47

Enhancing agricultural productivity through optimal resource use efficiency: A review of practices and insights

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ABSTRACT

Resource Use Efficiency (RUE) is crucial in agriculture to maximize crop yield while minimizing resource inputs and environmental impacts. This review provides an in-depth examination of various studies assessing the efficiency of resource use in agriculture, with a focus on water, energy, nutrients, and labor across different crops and regions. Key findings

highlight that while efficient use of resources like water and fertilizer can enhance productivity and sustainability, suboptimal practices are common due to economic constraints, limited technical knowledge, and inadequate access to technology. Numerous studies reveal that water use efficiency (WUE) is vital in arid and semi-arid regions, as observed in Gujarat's initiatives that promote micro-irrigation. Similarly, nutrient use efficiency (NUE), particularly with nitrogen and phosphorus, is essential to reduce input costs and prevent environmental degradation. Studies from Punjab, Maharashtra, and Karnataka underline how targeted nutrient application improves crop health and yield, though challenges like overuse or underuse of fertilizers remain prevalent. Energy use efficiency (EUE) is another focal area, where sustainable energy inputs, such as reduced reliance on fossil fuels, have shown promising results in optimizing productivity. Despite these advancements, reviews across regions, including Gujarat and Maharashtra, show persistent inefficiencies. For example, the marginal value product (MVP) to input cost ratios often reveal overuse of labor and certain fertilizers, while essential nutrients and irrigation resources are underutilized, pointing to a need for balanced resource allocation. This review emphasizes that fostering RUE requires a multifaceted approach—policy support, farmer education, technology adoption, and efficient resource management practices. The findings underscore the potential of RUE not only to improve economic returns for farmers but also to contribute to environmental conservation and sustainability.
Keywords: Resource Use Efficiency, Water Use Efficiency, Nutrient Use Efficiency, Energy Use Efficiency, Agricultural Productivity, Environmental Sustainability, Marginal Value Product, Input Optimization

ESC 48

Nexus between socio-contextual factors and crisis management behaviour of sugarcane growers of Southern Karnataka

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ABSTRACT

Despite crucial role in country's agricultural economy, sugarcane crop has faced a decline in both cultivation area and production due to various crisis. The crisis significantly affecting sugarcane farmers psychologically, financially and socially, impacting their crisis management behaviour. Therefore, a study was conducted in 2022-23 to find out the association between various socio-contextual factors of the sugarcane growers of southern Karnataka with their crisis management behaviour to navigate ongoing crises. The Mandya and Mysore districts were selected purposively due to their leading sugarcane production in southern Karnataka. The two talukas from each district, two villages from each taluka and 15 sugarcane farmers from each village with minimum five years of experience in sugarcane cultivation were randomly selected constituting a sample size of 120 respondents. The data was collected with structured interview schedule through personal interview method. Statistical tools like Karl Pearson's correlation and stepwise regression were used for data analysis. The findings revealed that farming experience, annual income, information seeking behaviour, scientific orientation and attitude towards crisis are having significant association with their crisis management behaviour at 1 per cent significance level. Whereas age, innovativeness, farming commitment and deferred gratification was significantly associated with their crisis management behaviour at 5 per cent significance level. Cosmopoliteness, annual income, farming experience, scientific orientation and attitude towards crisis contributes to 40.00 per cent of the variance in crisis management behaviour underlining the multifaceted nature of the factors affecting crisis management behaviour. The study recommends to facilitate exposure programs that connects farmers to diverse agricultural networks to broaden perspectives, financial assistance programs to boost income level, developing educational workshop and training sessions focused on scientific agricultural practices to encourage farmers to adopt evidence-based methods and finally fostering a proactive mindset in farmers, emphasizing the importance of preparation, resilience and adaptive strategies in crisis management.

Keywords: Crisis, crisis management behaviour, sugarcane

ESC 49

A path analytic study of profile characteristics of sugarcane growers on their crisis management behaviour

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ABSTRACT

Despite sugarcane's crucial role in the country's agricultural economy, the crop has experienced a decline in both cultivation area and production due to various crisis. The present study was conducted in 2022-23 to find out the correlation and effect of various profile characteristics of the sugarcane growers of southern Karnataka with their crisis management behaviour by using path analysis. The Mysore and Mandya districts were selected purposively because of leading producers in southern Karnataka. Two talukas from each district, two villages from each taluka and 15 sugarcane farmers from each village with minimum five years of experience in sugarcane cultivation were randomly selected constituting a sample size of 120 respondents. Data was collected with structured interview schedule through personal interview method. Path analysis was used as statistical tool to analyse the data using OPSTAT and MS Excel software. The study revealed that the antecedent variables like cosmopoliteness, innovativeness and age of the sugarcane growers were the key variables in exerting considerable direct, indirect and substantial effect on the crisis management behaviour of the sugarcane growers. Annual income, cosmopoliteness and attitude towards crisis are having significant relationship at 1% significance level, whereas scientific orientation is 5% significance level with the direct effect on the crisis management behaviour of sugarcane growers. The higher income equips growers with more resources, cosmopoliteness fosters diverse ideas and solutions, proactive attitude towards crisis engages in mitigation and recovery effects and finally developing educational workshop and training sessions focused on scientific agricultural practices to encourage farmers to adopt evidence-based methods enabling stronger crisis management strategies.

Keywords: Crisis management behaviour, direct effect, indirect effect, substantial effect, sugarcane cultivation

ESC 50

Perception and adaptability of cotton growers towards climate variability

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ABSTRACT

The present study entitled “Perception and Adaptability of cotton growers towards climate variability” was conducted in Beed district of Marathwada region of Maharashtra which was purposively selected for the study. The study was conducted in ten villages selected from two taluks namely Beed and Georai, which included 10 farmers from each of the selected villages. A sample of 100 farmers was selected for the study. Ex-post facto research design was adopted in the study. The results of the study are majority of the respondents had medium (55.00%) level of perception followed by high (35.00 %) and low (10.00 %) level of perception on climate variability. Further it could observe that majority of the respondents had medium (52.00%) level of adaptability followed by high (30.00%) and low (18.00%) level of adaptability. The correlation analysis indicated that the profile of the cotton growers namely Education, Annual income, Extension contact, Source of information found to be had positive and highly significant relationship with perception of cotton growers towards climate variability. While Age, Farming experience, Land holding and Risk orientation found to be had positive and significant relationship with cotton growers towards climate variability at 0.05 percent probability whereas family size didn’t show any significant relationship. Whereas variable like, Annual income found to be had positive and highly significant relationship with adaptability of cotton growers to climate variability. To increase the level of perception, there is a need for a new role for extension institutes to be under taken to serve farmers information need of climate and weather for better crop management with a location specific approach and use of farmer-to-farmer extension strategy to promote awareness and adaptation of best practices in climate variability based on the micro situation.

Keywords: Perception, Adaptability, Cotton growers, Climate variability

ESC 51

Suggestions of farmers for enhancing adoption of organic farming

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ABSTRACT

The suggestion is an idea or plan put forward for consideration to solve the problem or improve the situation. The study took place in Gujarat. A sample of 160 farmers engaged in

organic farming and registered with the Gujarat Organic Products Certification Agency (GOPCA) were selected at random for the study. The suggestions were elicited in open end mode from the respondents to improve and enhance organic farming. The responses received from the respondents with different wordings, but similar meanings were clubbed and then frequency and percentage for each suggestion were calculated. Major important suggestions endorsed by the farmers for enhancing adoption of organic farming were: separate marketplaces should be developed and marketing networks/linkages for selling organic farm produce should be strengthened, there should be a provision of minimum support price for organic farm produce and more industries should be established for processing and value addition of organic farm produce.

ESC 52

Assessment of management practices, resource availability and production performance of Gaushalas in South Gujarat

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ABSTRACT

The Gaushala movement in India has significantly contributed to cattle welfare, conservation, and protection, especially in rural areas. This study focused on assessing the management practices, resource availability, and production performance in Gaushalas across South Gujarat. A total of 80 Gaushalas were surveyed, covering seven districts in the region to provide a detailed analysis of their operational dynamics. The findings revealed that most Gaushalas in South Gujarat have been established within the last 50 years, with a large number operating under trust-based governance. Key resources such as land and water are fundamental to their functioning. About 50% of the Gaushalas reported optimal water availability year-round, while 55% had access to adequate grazing land or cultivable space for livestock. Regarding livestock management, the majority of Gaushalas specialize in rearing Gir cattle, with herd sizes varying from small units (11 animals) to large herds of over 100 animals. However, there is significant scope for improvement in reproductive performance, particularly in the age at first calving and calving intervals. In terms of production, 62.5% of Gaushalas produced between 21 to 50 liters of milk per day, with some facilities exceeding 100 liters per day. The highest-producing cows in these Gaushalas yield between 8 to 12 liters of milk per day, and the average lactation yield ranged between 1001 to 1500 liters. This study highlights the crucial role of Gaushalas in supporting livestock management and conservation in South Gujarat while identifying opportunities to improve reproductive efficiency and overall herd productivity. The findings are intended to guide future improvements in Gaushala operations and inform policies aimed at enhancing sustainable cattle management practices.

Keywords: Gaushalas, cattle conservation, management practices, resource availability, production performance, South Gujarat

ESC 53

Enhancing Agricultural Resilience through Agromet Advisory Services: Case of Amreli, Gujarat

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ABSTRACT

Unpredictable weather events pose significant challenges to Indian agriculture, affecting crop productivity and farmers' incomes. The District Agromet Unit (DAMU) at Krishi Vigyan Kendra (KVK), JAU, Amreli, has been instrumental in mitigating these challenges through Agromet Advisory Services (AAS). This abstract highlights key success stories demonstrating how timely and precise weather forecasts empowered farmers to mitigate risks, prevent crop losses, and improve economic returns. In Dangavadar village, a timely advisory helped save groundnut forage worth ₹60,000 by prompting its transport to a safe location before unseasonal rainfall. Similarly, early threshing based on weather forecasts allowed a farmer in Chamardi to secure ₹3 lakh worth of groundnut produce during adverse conditions. During Cyclone Biparjoy, accurate forecasts helped prevent the loss of 30 quintals of cotton, valued at ₹1.93 lakh, in Barvala Bavishi village. Proactive measures by a soybean farmer in the same village prevented a 20–30% decline in market prices by protecting the crop from unseasonal rainfall. Additionally, in Jasvantgadh, precise rainfall forecasts enabled a farmer to cover groundnut haulms, safeguarding produce worth ₹2.02 lakh. The collective impact of these advisories includes enhanced trust in DAMU services, widespread adoption of weather-based decision-making, and reduced economic losses at the district level. These findings underline the critical role of AAS in fostering sustainable and climate-resilient agriculture.

Keywords: District Agromet Unit, Agromet Advisory Services, weather forecast

ESC 54

Farmers' willingness to adopt solar-powered irrigation pumps for self-reliance

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ABSTRACT

Agriculture plays a significant role in the labour force and GDP of India. On the other hand, inadequate access to electricity and growing fuel costs has an impact on the availability of water for agricultural use and food production. Solar power is an efficient alternative to the current electric and fuel-based pumping techniques. Farmers can easily set up their own private, off-grid electricity generation method with solar-powered irrigation pumps (SPIP). In India, central and state governments are supporting solar technology through various funding and subsidy programmes to promote green energy and make farmers self-sufficient in energy production. This study investigated the possibility of employing solar photovoltaic systems to minimise the negative impacts of diesel pumps on the environment, farmers' dependence on fossil fuels, and the expenses of non-environmentally friendly technologies. Personal interviews and site visits were done to collect primary data. The study evaluates the farmers' awareness, attitude, and willingness to adopt solar-powered irrigation pumps. Factor analysis was conducted to identify the personal, social, economic and psychological determinates

influencing farmers' desire to adopt solar-powered pumps. The study considered six important factors: eco-friendly product, cost, performance, government initiatives, company and product information, and social influence. In addition, farmers perceived constraints of adoption of SPIP were assessed. The outcomes are significant for promotion and examining the adoption of solar energy systems in developing nations.

Keywords: Farmers', Irrigation, Photo-Voltaic Technology, Solar-Powered Pumps, Self-reliance

ESC 55

The Role of Agrometeorological Advisory Services in Climate-Resilient Agriculture

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ABSTRACT

Agriculture is significantly impacted by the variability in weather patterns, which imposes substantial constraints on farmers' ability to make informed tactical and strategic decisions regarding their crops. Seasonal climate projections have the potential to guide agricultural decisions, but the actual adoption of climate information by farmers has been slow and limited. Weather-based agro advisories are increasingly recognized as a climate-resilient practice, offering unique assistance in helping farmers prepare for uncertain weather conditions. Dissemination of agrometeorological advisories through various multi-channel systems, such as All India Radio (AIR), Doordarshan, private TV and radio channels, newspapers, the internet, SMS, and Interactive Voice Response (IVR) technology, is expanding across the country. These services have not only helped farmers increase crop production but also reduced losses caused by adverse weather and other challenges. Integrated Agromet Advisory Services (AAS) provide real-time weather updates and forecasts, along with practical recommendations for mitigating weather-related risks, ultimately improving the productivity of agricultural systems. AAS covers a wide range of agricultural practices, including crop selection, production, protection, harvesting and post-harvest management, all tailored to ensure profitable cultivation. These services help farmers optimize their activities based on weather conditions, thereby enhancing crop yields and reducing losses due to unforeseen weather events. For AAS to be fully effective, governments, non-governmental organizations and agricultural extension services must make a concerted effort to encourage its adoption. This includes involving local stakeholders in the process of climate information production and dissemination, forming farmer groups and improving farmers' literacy in using these advisories. Educating farmers on the benefits and proper use of AAS is essential for fostering long-term adoption. AAS has shown significant potential to improve agricultural productivity and resilience, sustained efforts to enhance accessibility, local relevance and farmer engagement are necessary to maximize its impact and support farmers in adapting to changing climatic conditions.

Keywords: Agromet Advisory Services, All India Radio, Farmers, Interactive Voice Response, post-harvest management, crop production

ESC 56

Suggestions from the farmers to overcome the constraints faced by the farmers in adoption of natural farming

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ABSTRACT

The present study carried out to find out the suggestions from the farmers to overcome the constraints faced by the farmers in adoption of natural farming practices. The study was conducted in North Gujarat. A multistage sampling method was followed for the selection of the respondents. From North Gujarat, two districts and from each selected district three talukas were purposively selected based on a higher number of farmers practicing natural farming. Five villages from each taluka and from each village, ten farmers were selected randomly. Thus, a total of 300 natural farming practicing farmers were selected as the sample size. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The valuable suggestions given by the farmers to overcome the constraints faced in natural farming were; there should be remunerative price of naturally produce (93.66%) with first rank, followed by special administrative setup should be established for the promotion of the natural farming practices (88.33%), providing subsidies and other financial support to adopt natural farming practices (87.00%), developing domestic market for naturally grown agriculture produce (81.33 %), Special recognition should be provided for adopters of natural farming through ATMA and other line departments (75.33%) with rank second, third, fourth and fifth, respectively.

ESC 57

Climate Change and Agriculture: The Urgent Need for Climate-Smart Approaches

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ABSTRACT

Economic losses from natural disasters are increasing globally, with the agriculture sector being especially vulnerable. The United Nations Office for Disaster Risk Reduction (UNISDR) reported in 2018 that disaster-affected countries faced direct economic losses totalling US$ 2,908 billion between 1998 and 2017, with 77 percent of these losses linked to climate-related disasters. In India, major crop yields are expected to decline by up to nine percent between 2010 and 2039 due to climate change, with potential losses of 35 percent for rice, 20 percent for wheat, 50 percent for sorghum, 13 percent for barley, and 60 percent for maize, depending on location and future climate conditions. India's agriculture, heavily reliant on monsoons, faces increasing risks as temperature fluctuations and shifting rainfall patterns negatively affect crop productivity, threatening food security. Between 1901 and 2018, temperatures in India rose by 0.6 °C to 25.1 °C, accompanied by changes in monsoon patterns. Projections suggest that by 2100, crop yields could decline by 10-40% due to rising temperatures, rainfall variability, and reduced irrigation water. Rainfed crops, which account

for nearly 60 percent of India's cropland, are especially vulnerable; a 0.5 °C increase in winter temperatures could reduce rainfed wheat yields by 0.45 tons per hectare. According to the Government of India's Economic Survey (2018), climate change results in annual losses of US$ 9-10 billion. These effects worsen the degradation of already vulnerable environments, further undermining food production and food systems. Given the projected declines in crop yields, there is an urgent need to adopt Climate-Smart Agriculture (CSA). This approach, rooted in sustainable agriculture and rural development, aims to transform the agricultural sector, enhance productivity, and meet Millennium Development Goals such as reducing hunger and improving environmental management.

Keywords: Agriculture, Climate change, Productivity, Sustainability

ESC 58

Assessment of nutritional status of tribal preschool children of Sabarkantha district

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ABSTRACT

The tribe are distinct people, dependent on their land for their livelihood, who are largely self-sufficient, and not integrated into the national society. The tribes are backward, particularly with regard to education and economic standing. India is a home to more than half of the world's tribal population. In 2006, the Ministry of Panchayati Raj named Sabarkantha as one of the country's 250 most backward districts (out of total 640). It is one of the six districts in Gujarat currently receiving funds from the Backward Regions Grant Fund Programme (BRGF). Hence, the present study was conducted in Sabarkantha district of Gujarat. Three talukas of Sabarkantha district viz., Khedbrahma, Poshina and Vijaynagar containing large numbers of tribal population were selected for the purposively study. From each taluka, six villages were selected randomly and from each village tribal preschool children were selected by employing proportionate random sampling. Total 200 tribal preschool children were selected for the study. The data obtained from the study was analyzed statistically by frequency, percentage, 't' test and correlation. Most of the tribal preschool children were coming from poor income families with low level of parental education. The mean height and weight of the tribal preschool children was observed significantly ($p<0.01$) lower as compared to ICMR standard height of the respective age groups, but significant difference was non significant for height and weight of tribal preschool boys and girls of both the age groups (3 to 4 and 4 to 5 years).

Keywords: Tribal preschool children, nutritional status, socio-economic status

ESC 59

A study of opinion of mothers towards outdoor games in relation with health status of preschoolchildren

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ABSTRACT

Play is an important part of the childhood development. Through play childrenlearn about shapes, colors, cause and effect, and themselves. Besides cognitive thinking, play helps the child to learn social and psychomotor skills, it is a way of communicating joy, fear, sorrow and anxiety. Keeping in view of this fact and presentinvestigation and entitled. "A study of opinion of mothers towards outdoor games in relation with health status of preschool children" the random sampling method was applied for the selection of preschooler . A list of children was prepared for each selected class in consultation with respective principal and class teachers. From these lists 100 preschooler (in junior and senior class) were randomly selected for taking information regarding health status by anthropometric measurement and observing common health problems. 100 mother of preschooler were selected from the Gandhinagar and Ahmedabad city by taking the address from pre- school institution and collect the data by direct home visit method. The information recorded through questionnaire and personal interview method. The collected information was analyzed as frequency, percentage and tabulated and also computed for t- analysis and used. The result of the study reveal that majority (73%) of the respondents said that high level influence of outdoors games on healthy physical development of preschool children. More than half (55%) of the respondents said that high level influence of outdoors games on good mental development of preschool children. Significant ($t \geq 0.05$) difference was found for effect of overall development of children by outdoor play.

ESC 60

Impact of junk food on the nutritional level of school going children (6-12 years)

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ABSTRACT

In recent decades, the landscape of childhood nutrition has undergone a significant transformation, with the pervasive availability and marketing of junk food exerting a profound influence on children's dietary habits. This phenomenon, often referred to as the "junk food effect," encompasses the consumption of highly processed, calorie-dense foods that are low in nutritional value but high in sugar, salt, and unhealthy fats. The consumption of junk food among children can have numerous negative effects on their health and development. These include increased risk of malnutrition, type 2 diabetes, cardiovascular disease, and dental problems. Therefore, it's crucial to encourage healthier eating habits in children to promote their overall well-being. An action research study was made in planning and formulating the research work. Study was carried out on age groups (6–12 years) of children studying in schools of Gandhinagar. The stratified random sampling method was applied for collecting the data. 100 school going children between the age group of 6-12 years were selected from various schools of Gandhinagar. The collected information was analyzedas frequency, percentage and tabulated and also computed for t- analysis. Result also indicates that school going children

(Boys) who were habitual of junk food had significantly lower scores in jumping as compared to non-habitual School going children (Boys). The girls who were habitual to junk food also had significantly low scores in jumping, running and other physical activities and significantly take more time in running as compared to less habitual counterparts.

ESC 61

Indigenous traditional knowledge among farmers for environmental sustainability

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ABSTRACT

Indigenous Technical Knowledge (ITK) has enormous creative possibilities. Indigenous communities inhabit India, and the majority of them have developed distinctive traditional knowledge and technological bases of their own. India's population is expanding quickly, and this is driving up food consumption as well. ITK is the whole knowledge and practices derived from people's cumulative experiences in resolving issues in a variety of life situations; these practices and knowledge are unique to a certain culture. Numerous of these technologies and information are on par with the current technological and knowledge systems, and they have given the indigenous communities comfort and self-sufficiency. The general socioeconomic growth of the communities can benefit greatly from the application of these ancient knowledge and skills. The Indigenous Technical Knowledge (ITK) of many communities—many of which are in danger of going extinct—needs to be recorded and preserved immediately. Indigenous knowledge practices and contemporary knowledge are not properly connected. Concerns around intellectual property rights are quite real. The potential benefits to society of a well-considered fusion of old and modern information and technological systems are enormous. These ITKs are able to preserve food and nutritional security in addition to agricultural sustainability. A reduction in agricultural production potential and a reduction in the sustaining and carrying capacity of agriculture result from the depletion of natural resource bases caused by deforestation, overgrazing, desertification, excessive agricultural intensification, overfishing, and agriculture on marginal lands. Improved management is required to stop the depletion of this resource base and create agricultural production systems that support our ecosystem. Natural resources (soil, water, and nutrients) have limits.

Keywords: Indigenous, knowledge, sustainability, resources and technology

ESC 62

Community-based Natural Resource Management: Challenges and Opportunities in Extension Work

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ABSTRACT

In rural and underprivileged communities, community-based natural resource management (CBNRM) has become a viable method of managing natural resourcesThis study examines the opportunities and difficulties of incorporating CBNRM into extension activities, emphasizing how it affects local people' capacity to manage their natural resources responsibly. This study looks at how extension services may help people get involved in the community, take better care of the environment, and embrace sustainable behaviours.Key challenges identified include inadequate training for extension workers, limited community involvement, lack of funding, and competing land-use interests. Opportunities highlighted include the potential for empowering local communities through participatory approaches, strengthening collaboration among stakeholders, and leveraging local knowledge for effective resource management. The research utilizes case studies from various regions to illustrate both successful models of CBNRM and areas where extension efforts have faced barriers. By assessing the role of extension services in CBNRM, this study aims to provide recommendations for improving the effectiveness of extension programs in supporting sustainable natural resource management practices in rural communities. The findings suggest that with improved capacity building, stakeholder engagement, and policy support, CBNRM can significantly contribute to environmental conservation, poverty reduction, and social equity.

Keywords: CBNRM, natural resources, extension activities

ESC 63

Plant Disease Management in Natural Farming

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ABSTRACT

In natural farming, the focus is on the use of bio inputs prepared from farms and local ecosystems. The approach of natural inputs like cow urine and dung, jaggery, lime, neem among others are used to improve soil health, nutrients and reduce input costs, among other benefits. According to the approach natural inputs *viz.*, cow urine and dung, jaggery, soil, lime, and neem among others are used to improve soil health, nutrients and reduce input costs, among other benefits is the elimination of chemical fertilizers and pesticides, the indiscriminate use of which pollutes the environment, and to promote "good agronomic practices", which means using science and technology to manage crops diseases. Government is promoting Natural Farming through a scheme named BPKP, which reduces the cost of cultivation, reduce disease and pest problem, reduces water requirement of crops, climate change resilient, reduces risks in farming and rejuvenation of farm lands, safe and healthy food for citizens. Utilizing the available Desi Cow as valuable resource helps in arresting the growing needs for fertilizer and reducing subsidy burden. In India, natural farming is "Rishi Kheti" . The Rishi Kheti uses cow products *viz.*, buttermilk, milk, curd and its waste urine for preparing growth promoters. It is considered without any usage of chemical fertilizer and pesticides. Natural Farming mainly relies on the adoption of diversified multi-cropping systems, desi cow-based on-farm inputs for nutrient and soil enrichment and various botanical concoctions for plant protection. In this method, the disease is prevented rather than cured. In natural farming, the decomposition of organic matter by microbes. In natural farming, important inputs include an indigenous beneficial microorganism, fermented plant juice, herbal nutrient, lactic acid bacteria, fish amino acid, and water-soluble calcium phosphate, Mulching: to circulate the air in the soil - oxygen is essential to the roots and microorganisms in the soil.

BIJAMRIT is seed treatment reduced seed and soil-borne diseases, JIVAMRUIT- Increase biological activity in the soil and makes the nutrients available to the crop and biological control of soil-borne diseases and increase resistance in plant against diseases, Agniastra, Brahmastra and Neemastra used an insecticide management of insect vector of plant diseases.

ESC 64

Adaptation Strategies Followed by the Farmers of Banaskantha District of Gujarat State regarding Effects of Climate Changein Agriculture

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ABSTRACT

Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions. Climate change is caused by factors such as biotic processes, variation in solar radiation received by earth, plate tectonics and volcanic eruptions. Certain human activities also have been identified as significant causes of climate change and very likely the main causes of the phenomenon known as global warming. Climate plays a dominant role in agriculture having a direct impact on the productivity and physical production factors for example the soil's moisture and fertility. Adverse climate effects can influence farming outputs at any stage from cultivation through the final harvest. Thinking the seriousness of unwanted consequence of climate change problems, everybody should aim to do something. Agricultural production activities are generally more vulnerable to climate change then other sectors. Agricultural extension and advisory services, both public and private, thus have a major role to play in providing farmers with information, technologies and education on how to cope with climate change and ways to contribute mitigation. Support from extension functionaries for farmers in dealing with climate change should focus on mitigation and adaptation.Realizing the importance of the issue it is thought to know how farmers perceive the issue of climate change. It was necessary to study strategies to adapt the changing climatic conditions for sustainable agricultural development. The study was conducted in Banaskantha district of Gujarat state. Erratic rainfall coupled with high temperature and high wind velocity due to arid and semi-arid region creates water shortage in soil of Banaskantha district. Hence, it was selected for the study to understand the adaptation strategies of farmers about effect of climate change in the district. Among 14 talukas of Banaskantha district Vav, Tharad and Suigamtalukas are most affected by varying climatic conditions like lower rainfall and aberrant temperature comparing to other talukas of Banaskantha District. Therefore, these three talukasVav, Tharad and Suigam were selected purposively. Five villages from each taluka were selected randomly. Ten respondents were randomly selected from each village. Hence final sample was constituted with 150 respondents. To assess adaptation strategies the respondents were requested to select the strategy they used by the farmers regarding climate change. Then

strategies were calculated on the basis of frequency and per cent and rank were given to each strategy. It was concluded that the majority of farmers adapted the strategies *viz.* Selection of appropriate crop/varieties (94.00 per cent), Application of farm yard manure (92.00 per cent), Ploughing and sowing across the slope (89.30 per cent), Storethe product at safe place (84.00 per cent) and Weeding at initial stage of crop (80.00 per cent) were ranked first to fifth respectively while, Integrated nutrient management (74.66 per cent), Irrigation during critical stages (71.30 per cent), Interculturing (68.00 per cent), Use of intercropping (61.30 per cent), avoid tree cutting and planting more trees (58.67 per cent) were ranked sixth to tenth.

Keywords: Adaptation strategies, Climate change, Global warming

Entrepreneurship Development & Public-Private Partnership in Agricultural Extension

EDA 1

Attitude of agricultural students towards agrotourism as an enterprise

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ABSTRACT

Agrotourism as an Enterprise leverages the synergy between agriculture and tourism, offering a lucrative business opportunity for rural entrepreneurs. By diversifying farm operations to include tourist activities, agrotourism enterprises can generate supplemental income, create employment, and promote sustainable rural development. Characterized by farm stays, agricultural workshops, and experiential activities, agrotourism fosters community engagement, cultural exchange, and environmental stewardship, while enhancing farm viability and competitiveness. With growing demand for authentic rural experiences, agrotourism enterprises have the potential to revitalise rural economies, preserve agricultural heritage, and ensure long-term sustainability.

Keywords: Agrotourism, agricultural students, attitudes, entrepreneurship, rural development

EDA 2

Entrepreneurial self-efficacy among postgraduate students in state agricultural universities of Gujarat: An analytical study

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ABSTRACT

Entrepreneurship is widely regarded as an attractive career option for young people globally due to its significant contributions to both economic and social development. Promoting and supporting entrepreneurship can help address major challenges such as unemployment, poverty, and economic instability. Entrepreneurial self efficacy among students reflects their confidence in their ability to successfully tackle the challenges of entrepreneurship. These students believe in their capacity to identify opportunities, meet customer needs, overcome obstacles, and implement innovative ideas. Postgraduate students, with their advanced education and specialized knowledge, often demonstrate an increased sense of self efficacy in entrepreneurial efforts. Research Paper, utilizing the published theoretical literature and Communication Approach of the Descriptive Cross-sectional research design, examines the entrepreneurial self efficacy among postgraduate students in the Agriculture and Horticulture faculties across four State Agricultural Universities (SAUs) of the vibrant Gujarat State in India – the state which is known for having business in the blood of people. By utilizing simple random sampling, 300 post graduate students were selected and surveyed through a structured questionnaire. The study revealed that the entrepreneurial self

efficacy of the students is influenced by four significant factors or phases: executing, organizing, seeking, and assembling.
Keywords: Entrepreneurship, self efficacy, social development, postgraduate students, communication.

EDA 3

Assessing the entrepreneurial mindset of girl students in agricultural faculties of Gujarat's state universities

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ABSTRACT

The entrepreneurial mindset plays a crucial role in shaping the future of young women, especially in fields like agriculture, which is integral to India's economy. In Gujarat's state universities, girl students in agricultural faculties are poised to contribute significantly to the sector's growth. However, the extent of their entrepreneurial thinking and potential remains underexplored. This study seeks to assess the entrepreneurial mindset among these students, identifying the factors that encourage or hinder their entrepreneurial aspirations. For the investigation, a sample of 300 girls' students of agriculture faculty, who were completed their graduation in 2022 & 2023 from all ten agriculture colleges of four SAUs by using proportionate random sampling. The result found that less than two third (58.68 per cent) of the girl students of agriculture faculty had medium level of overall entrepreneurial ability, followed by 13.66 per cent of them were with high level of entrepreneurial ability and 13.00 per cent of them were with low level of entrepreneurial ability. The entrepreneurial ability of girl students of agriculture faculty was observed positively correlated with their type of family, father's education, family land holding, mass media exposure, relative owing business and attitude towards agricultural entrepreneurship. Whereas, it was seen negatively significant with their family occupation. The findings aim to provide insights for policy-makers, educators, and institutions to foster an environment conducive to entrepreneurial growth. Understanding these dynamics can empower female students, enabling them to leverage agricultural innovations for economic and social development. Ultimately, this research intends to inspire more women to pursue entrepreneurial ventures in the agricultural sector.
Keywords: Entrepreneur, Behavior, Girl students and Agriculture

EDA 4

Constraints and suggestion in aspiration of educated youths towards agricultural enterprises of Gujarat state

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ABSTRACT

The present research pursuit was undertaken to assess different constraints and suggestion of the aspiration of educated youths towards agricultural enterprises of Gujarat state. The study was conducted in 33 districts of Gujarat state. For the study, 2

agriculture, 2 horticulture and 2 animal husbandry enterprise educated youths were identified from the lists. Simple random sampling methods was use to obtain 6 respondents from each district. So the total 198 respondents from all over district of Gujarat state were selected. The study concluded that major constraint by the enterprises educated youth were lack of skilled labours, low price of produce in APMC, high rate of farming input and seed, fluctuations in market rate and high cost of transportation. The main suggestions from the educated youths to overcome the constraints were proper marketing facilities should be established, technical guidance through skill training, enhanced milk price for the producers, sufficient electric power should be provided regularly and low labor consuming technology should be developed.

EDA 5

Challenges encountered by Mango cultivators to manage Mango production

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ABSTRACT

Mango (*Mangifera indica*) is one of the most nutritious and high-value fruit crops for nutritional security. The mango is also known as the "king of fruit." India is the world's second-largest producer of fruits and holds the first position in producing mangoes. As per the second advance estimate of the National Horticulture Board, mango is growing on 2258.13 thousand hectares and produces 21822.32 thousand MT in India. Mango is one of the well-known fruits for consumers, but it is a seasonal fruit farmer who gets income from it once a year. Keeping in mind study has been done to identify constraints farmers face in mango enterprise and suggestions to overcome them. The research project was undertaken in the Saurashtra region of Gujarat. In the Saurashtra region, Junagadh and Gir Somnath have more coverage on the area & production of mango. This study was conducted by using an *Ex-post facto* research design. Out of these 11 districts, two districts namely Junagadh and Gir Somnath were purposively selected for the study because of the sound production of mango found in these districts. Three talukas were selected from each of the selected districts purposively because of the excellent mango production in these districts. A total of six talukas were chosen for the study. Four villages were selected from each taluka. Out of twenty-four villages, ten mango growers were selected to draw a sample size of two hundred and forty. Open-ended questionnaires are used to measure responses from mango farmers. For analysis, frequency and percentage are used to assign a rank. Major constraints faced by farmers, the majority (75.00%) of the respondents reported that "Fluctuation in market prices" was accorded the first rank, followed by "Crop production affected by climate and environment" and "Difficulty in storage due to perishable crop" was secured second (69.16%) and third rank (66.66%), respectively. Overcome constraints, the majority of respondents suggested "Strengthening information

support through transfer of technology from the concerned department" secured a first rank with 73.33%, followed by "Providing market update by concern agricultural produce market committee" and "Organization of capacity building programmes for farmers for better agro-enterprise" was secured a second (70.00%) and third rank (66.66%), respectively. Addressing these challenges through targeted interventions can improve mango growers' entrepreneurial effectiveness, ultimately boosting the region's productivity and profitability.

EDA 6

Scale to measure entrepreneurial effectiveness of Mango farmers in Saurashtra region

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ABSTRACT

Mango is one of the well-known fruits for consumers, but it is a seasonal fruit farmer who gets income from it once a year. The present study was an attempt to develop a scale to measure the entrepreneurial effectiveness of mango farmers. Likert's summated rating technique was followed for the construction of the scale. The process started with the selection of 75 statements based on Mean Relevancy Weightage (MRW) scores, and the statements were given to 30 farmers in four purposively selected villages. The critical ratio was calculated by t-test. The 't' value measures the extent to which a given statement differentiates the high group from the low group. For item analysis, the respondents were arranged in ascending order based on entrepreneurial effectiveness score. Twenty-five percent of the respondents with the highest total scores and 25 percent with the lowest total scores were selected. These two groups provided the criterion groups in terms of evaluating the individual statements as suggested by Edwards. The scale developed finally consisted of 40 statements that were retained based on t value. Reliability and validity of the scale were computed to find out the entrepreneurial effectiveness of the results. This scale will be useful for researchers and academicians studying farmers' entrepreneurial effectiveness and its impact on generating more income. It would also be useful for policymakers to develop strategies to improve entrepreneurial effectiveness in major fruit crop.

EDA 7

Path analysis of entrepreneurial effectiveness of Mango farmers

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ABSTRACT

Mango is the 'King of Fruit' in India. Mango is deep-rooted in Indian culture and tradition. Mango is one of the most significant fruits produced in the tropics and sub-tropics of the globe. Though mango cultivation is recorded in more than 120 nations, more than 60.00 % of global mango output comes from India, China, Thailand, Indonesia and Mexico. Mangoes are grown all over the world but India ranks first in mango production and is also one of the most exported fruits from India. Mango is one of the important crops but still farmers not getting an income due to post-harvest low, uncertain climate, and as a perishable commodity. Keeping this in mind the study was conducted to measure a factor that are important to developing a strategy for getting income. The study was conducted in Junagadh and Gir-Somnath districts. To draw a sample size of two-forty farmers. A total of six talukas were chosen for the study. Four villages were selected from each taluka. Out of twenty-four villages, ten mango growers were selected to draw a sample size of two hundred and forty. Path analysis revealed that risk orientation had the highest direct effect on the entrepreneurial effectiveness of mango growers, followed by innovativeness, self-confidence, mass media exposure, education, economic opportunity, market perception, training received, annual income, achievement motivation, land holding, extension agency contact, decision-making ability and social participation. Out of nineteen variables, eight, *viz*., education, extension agency contact, mass media exposure, achievement motivation, self-confidence, innovativeness and risk orientation, showed a highly significant functional relationship with the entrepreneurial effectiveness of mango growers.

EDA 8

Entrepreneurial effectiveness of Mango growers in Saurashtra region

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ABSTRACT

Mango (*Mangifera indica L.*) is an ancient fruit in India, dating back approximately 6000 years. Its presence in forests and gardens has been documented and mentioned by authors in the epic tales of "Ramayan" and "Mahabharat." Undoubtedly, mango deserves to be recognised as the national fruit of India, considering its area of cultivation, production, nutritional value, and popularity. three talukas were selected from each of the chosen two districts (Junagadh and Gir somnath) based on their mango production. Twenty-four villages were selected from the six talukas. Ten mango growers were selected from each of the twenty-four villages, making a sample size of two hundred and forty respondents. With respect to profile of mango growers, it was observed that more than two fifth (41.25 per cent) of the mango growers belonged to old age group, more than one-fourth (28.34 per cent) of respondents were categorised in higher secondary school level, 40.83 per cent of respondents had marginal size of land holding, more than one-third (38.75 per cent) of respondents had medium yield index, more than half (57.50 per cent) of respondents had a medium market perception, more than two-fifth (42.51 per cent) of respondents had medium extension agency contact, more than half (50.94 per cent) of respondents not got any kind of training for their mango enterprise, more than one-third (38.34 per cent) had high level of achievement motivation, more than two-fifth (42.09 per cent) shows medium self-confidence, more than one-third (37.92 per cent) exhibited high level of innovativeness, more than half (63.33 per cent) had medium disposition towards self-employment, more than one-third (37.50 per cent) possessed medium level of risk orientation, about 63.33 per cent farmers had a medium level of decision making ability.

EDA 9

Attitude of students towards agriculture as an occupation

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ABSTRACT

This research conducted at Anand Agriculture University in Gujarat aimed to explore the attitudes of students towards agriculture as an occupation, employing a descriptive survey method. A total of 60 respondents from various academic backgrounds participated in the study, selected through simple random sampling to ensure representativeness. with the study objectives and standardized across all respondents. Results indicated a predominantly male representation (78.3 per cent), with 60 per cent pursuing postgraduate education. The majority of respondents reported parental involvement in agriculture (50 per cent) and expressed high levels of self-confidence (60 per cent) and achievement motivation (63.4 per cent). Key challenges identified included the risk of crop failure (90 per cent), fluctuations in market rates (85 per cent), and the high cost of inputs and labor (81.6 per cent). However, participants advocated for interventions such as timely supply of crop loans (95 per cent), implementation of crop insurance schemes (93.3 per cent), and subsidization of agricultural inputs (91.6 per cent) to address these challenges and foster sustainable agricultural practices. These findings offer valuable insights for policymakers, educators, and stakeholders seeking to support the agricultural sector and shape future strategies for agricultural development and sustainability.

EDA 10

Relationship between selected characteristics of the under graduate students and their entrepreneurial attitude

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ABSTRACT

Indian agriculture is known for multi-functionaries of providing employment, livelihood and ecological securities. Unemployment rising particularly among educated people is alarming for the governments. It is necessary before any action, that we evaluate attitude towards entrepreneurship particularly from educated people for offering strategies to enhance this. It will be helpful for economic development, job creation, and prosperity. Consequently, it is necessary for encouraging university graduates to become entrepreneurs, ready for making decision processes and factors that lead to the entrepreneurship. The present study was conducted for third and final year students of B.Sc. (Hons.) Agriculture of Sardarkrushinagar Dantiwada Agricultural University. Total 160 students were selected from third and final year in academic year 2021-22 by proportionate stratified random sampling from two Colleges *viz.* C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University and College of Agriculture, Tharad. Out of ten independent variables, three variables *viz.,*family landholding, participation in extra-curricular activities and source of information were positively and significantly correlated with entrepreneurial attitude of under graduate students further, family income and achievement motivation had positive and highly significant relation with attitude while, rest five had failed to establish significant relationship with entrepreneurial attitude of under graduate students.

Keywords: Relationship, entrepreneurial attitude, Students

EDA 11

Adoption of horticulture based entrepreneurship: A case study of the millionaire farmers of Banaskantha District

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ABSTRACT

Horticultural crops have emerged as a promising avenue for entrepreneurial pursuits among farmers, offering higher yields and returns per unit area, optimizing resource utilization on farms. This study explores the successful adoption of horticulture-based entrepreneurship by a pioneering farmer Mr. Andabhai Patel from village Budhanpur Taluka Tharad, District Banaskantha, who has achieved millionaire status through the strategic cultivation of high-value horticultural crops such as Mango, pomegranate, date palm, guava, and papaya. The region characterized by low and erratic rainfall, deep groundwater levels, low-carbon soil, and extreme summer temperatures, present unique challenges for farmers, particularly in ensuring soil fertility, water conservation, and economic stability. This farmer has effectively harnessed modern horticultural practices and water harvesting techniques to overcome these challenges. His entrepreneurial journey includes the establishment of a horticultural nursery that supplies quality saplings, further enhancing regional adoption of these lucrative crops. By implementing rainwater harvesting systems and micro-irrigation, the farmer has efficiently managed water resources, ensuring crop productivity despite the district's arid conditions. This study examines the practical approaches, crop management strategies, and sustainable practices that led to his success, providing a model for other farmers in semi-arid regions. Key limitations addressed include soil management for low organic content, groundwater scarcity, and temperature resilience, highlighting the transformative impact of targeted horticultural innovations on regional farming. This case underscores the potential for horticultural entrepreneurship to drive economic growth in challenging environments through adaptive techniques and resource-efficient cultivation.

EDA 12

Capital Formation in Indian Agriculture

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ABSTRACT

Capital formation plays a crucial role in fostering inclusive and sustainable growth within the agriculture and allied sectors. The growth rate of gross capital formation (GCF) in agriculture has demonstrated a positive correlation with agricultural output. Public sector investment has been a significant contributor to GCF in agriculture, serving as a vital factor in sustaining agricultural growth. However, the share of GCF in agriculture has declined relative to overall GCF, which is reflected in the decreasing proportion of agricultural GDP to total GDP/GVA. Historical data indicates that public sector investment in agriculture cannot be entirely replaced by private sector investment. Notably, capital formation in the fisheries sector has been growing at a faster rate than in other agricultural sectors, with nearly all capital formation in fisheries being driven by the private sector, while public sector involvement is minimal. Enhancing the development of the fisheries sector could further boost capital formation. In terms of profitability, Gujarat outperforms Punjab in the milk processing sector, consistently achieving higher profits and Net Value Added (NVA) per capita, which contributes positively to overall capital formation.

Keywords: Capital formation, gross capital formation (GCF), private sector investment, Net Value Added (NVA)

EDA 13

Entrepreneurial behaviour of dairy farm women in Bharuch District

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ABSTRACT

The entrepreneur is an economic person, who strives to maximize his profits by innovations. Dairy farming is one of the important enterprises which dominate the economic activities of the woman in the rural areas of India. It is estimated that about 70 million rural households' own livestock. Women constitute about 69% of workforce engaged in livestock. Increasing demand for milk and milk products in recent years intensifies dairy farming as profitable enterprise for rural woman. Gujarat contributes 7.99% to total milk production of India and by occupying third place. In that Bharuch district contribution is 1.30%. At present Bharuch district is having 600 rural milk co-op and more than 59,200 milk producer members affiliated in Bharuch district milk union. For the present investigation, three talukas of Bharuch district were selected randomly, from each taluka 6 villages were selected randomly from each village, 20 dairy farm women were selected randomly with the total sample size for the study is 360. Majority of the dairy farm women having good to moderate level of entrepreneurial behavior and they were regularly participating in training programs and SHGs and cooperative group meetings. Majority for the small and the marginal farm women depending on dairy sector for their regular income it's because this sector provides timely and everyday conform income to the farm women. This helps to manage their daily family expenses easily. Here it's noticed that still 29 percent of the dairy farm women mentioning indigenous cows it's one of the important sources to promote natural farming accrues the farming community. The low price to milk, unavailability of fodder, concentrated nutrient mixture and high charges for the treatment of the animals and ways to improve FAT and SNF content in milk were the major problems faced by the women dairy farmers in dairy enterprise.

Key words: Entrepreneur, Behavior, Farm women and Diary

EDA 14

Constraints faced by the dairy farmers in operating dairy enterprise

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ABSTRACT

Dairying has been practiced as a rural farming enterprise and the country has achieved major breakthrough in milk production in the recent years. But the rural people are not enough competent in dairying. Ex-post facto research design was used for the study. Banaskantha and

Mehsana districts were purposively selected for study. From two district 4 talukas were selected. Thereafter, five villages were randomly selected from selected each taluka. Ten dairy farmers were randomly selected from each selected village. Important constraints in dairy enterprise observed were high price of milch animals, non-availability of remunerative prices of milk and milk products, no extra incentives for clean milk production, lack of supply of high yielding cows, lack of technical know-how about feeding and non-availability of good quality concentrate for high yielders.

EDA 15

Entrepreneurial behavior of the dairy farmers

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ABSTRACT

Entrepreneurial development is one of the ways to make rural people more competent in dairying. Twenty first century is the century of entrepreneurship and every individual can be an agent for innovation and change. Entrepreneurship is regarded as one of the most crucial factors in the economic development of every region of the country. Ex-post facto research design was used for the study. Banaskantha and Mehsana districts were purposively selected for study. From two district 4 talukas were selected. Thereafter, five villages were randomly selected from selected each taluka. Ten dairy farmers were randomly selected from each selected village. Majority (74.50 per cent) of the dairy farmers were found having medium level of entrepreneurial behaviour while 13.00 per cent and 12.50 per cent respondents had high and low level of entrepreneurial behaviour, respectively.

EDA 16

Challenges experienced by the inland fish farmers and the suggestions to overcome the existing challenges

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ABSTRACT

The study was carried out in Anand district of Gujarat state with 150 randomly selected inland fish farmers. A pre-tested interview schedule was prepared in light of the objectives and respondents were interviewed either at their home or work place. Ex-post facto research design was used. For measurement of variables included in study, different scales and scoring techniques were used. Lack of proper training, lack of knowledge/awareness regarding fisheries schemes, non-availability of adequate quantity and quality of seeds were the major challenges experienced by the majority of the inland fish farmers. Major suggestions given by the inland fish farmers were; there is an urgent need for a market system, there should be at

least one govt. shop at block level for the sale of fish feed and inputs and establishment of soil and water testing laboratory at district level.

Keywords: Inland fish farmers, challenges, suggestions, managerial efficiency

EDA 17

Entrepreneurial attitude of under graduate agriculture students

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ABSTRACT

Indian agriculture is known for multi-functionaries of providing employment, livelihood and ecological securities. Unemployment rising particularly among educated people is alarming for the governments. Total 160 third and final year students of B.Sc. (Horns) Agriculture were selected in academic year 2021-22 by proportionate stratified random sampling from two Colleges *viz.* C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University and College of Agriculture, Tharad. It was observed from the study that majority of the under graduate students belonged to the age group of less than or equal to 20 years, belonged to medium size of family, belonged to rural background, students father had farming and government service as their occupation, had medium level of family income, had small and medium size of family land holding, students father had Primary school, high school and under graduate/post graduate level of education, were found having below average and poor level of participation in extracurricular activities, had medium and high level use of source of information, had medium level of achievement motivation. The.majority of the under graduate students had favourable entrepreneurial attitude. Out of ten independent variables, three variables *viz.,* family, land holding, participation in extra-curricular activities and source of information were positively and significantly correlated with entrepreneurial attitude of under graduate students further, family income and achievement motivation had positive and highly significant relation with attitude while, rest five had failed to establish significant relationship with entrepreneurial attitude of under graduate students.

EDA 18

Income generation of women by selected entrepreneurial activity promoted under KVK's Amreli

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ABSTRACT

Women are increasingly seen as an important index for the development of nation. It is necessary to foster economic development among women and encourage them to take up independent income generating activities so that the significant workforce of the country may be utilized more effectively for the progress of the country. Women entrepreneurship needs to

be studied separately as it is well recognized that it is untapped source of economic growth. Right selection from all areas are required for the development of women entrepreneur and their greater participation in the entrepreneurial activities. The present study was conducted to know the participation and income generation by rural women in selected entrepreneurial activities. The study was conducted in Amreli city of Amreli district of Gujarat State. For selection of entrepreneurial activities for the present study a preliminary discussion was done with the official of KVKs of Amreli district as per the discussion three entrepreneurial activities i.e. Animal Husbandry, parlour and stitching were selected purposively having maximum number of beneficiaries involved in the activities. In order to select panchayat samities and get the information regarding selected entrepreneurial activities being performed by rural women official of KVKs were contacted personally. Amreli district consists of 11Taluka. Out of which two panchayat samities were purposively selected i.e; Mota Liliya and Moti Kunkavav for the present study. Out of two panchayat samities four village (each of two) were randomly selected for the study. A separate list of rural women involved in selected entrepreneurial activities were prepared. For each activity 20 women were randomly selected from the list of the women. Hence the total sample of the study constituted of 60 rural women entrepreneur. Data were collected with the help of structured interview schedule. Frequencies, percentage and mean percent score were used for analyzing the data statistically. More than one third of the respondents (41.66%) started the enterprises for the independent identities and to improve family status. Further result shows that nearly half of the respondents (41.66%) average net profit 5,000 to 10,000.

EDA 19

Path analysis of ornamental nursery owners' profile on their entrepreneurial behaviour

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ABSTRACT

The present study was conducted in four talukas of the Navsari district of South Gujarat, namely Khergam, Chikhli, Gandevi, and Vansda, during the years 2022-23. An ex-post facto research design was used. From each selected taluka, 25 respondents were randomly selected; thus, a total of 100 sample size was obtained. For the present study eleven independent variables namely age, family size, education, landholding, farming experience, annual income, occupation, social participation, mass media exposure, material possession and extension contact were included while the dependent variable was entrepreneurial behaviour. The variable education followed by mass media exposure and social participation had exerted the highest positive direct effect. In contrast, the occupation exerted the highest negative direct effect on entrepreneurial behaviour. While mass media exposure followed by material possession and extension contact exerted the highest positive total indirect effect.

EDA 20

Relationship between the profile of ornamental nursery owners and their entrepreneurial behaviour

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ABSTRACT

The present study was conducted in four talukas of the Navsari district of South Gujarat, namely Khergam, Chikhli, Gandevi, and Vansda, during the years 2022-23. An ex-post facto research design was used. From each selected taluka, 25 respondents were randomly selected; thus, a total of 100 sample size was obtained. For the present study eleven independent variables namely age, family size, education, landholding, farming experience, annual income, occupation, social participation, mass media exposure, material possession and extension contact were included while the dependent variable was entrepreneurial behaviour. The study revealed that the independent variable age was negative and significantly correlated to entrepreneurial behaviour. While, education, landholding, annual income, social participation, mass media exposure, material possession and extension contact were positive and significantly correlated with entrepreneurial behaviour. Furthermore, family size, occupation and farming experience were non-significantly correlated. Additionally, the three independent variables namely education, social participation and mass media contact were accounting influences on entrepreneurial behaviour.

EDA 21

Perception of agricultural students towards farming as an occupation

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ABSTRACT

The agricultural sector is the cornerstone of human civilization, crucial for global sustenance, livelihoods, and economic stability. Despite its vital role, agriculture faces shifting perceptions, particularly among graduates in agricultural studies. This study explores the perception of agricultural graduates towards agriculture as an occupation, amidst a trend favouring urban-centric careers. Hence, considering the importance of these characteristics and a review of past research studies, an attempt has been made in this investigation to ascertain the relationship between student's profile and their perception towards farming as an occupation so that this present study entitled "Perception of agricultural students towards farming as an occupation" was undertaken. A sample of 80 students was selected from Anand Agriculture University, Gujarat. The data were collected with the help of a Google form filled out by the students. Nearly three-fifths (59.00 per cent) of the agricultural graduates had a medium level of perception towards farming as an occupation. The result also found that students' interest towards farming was positively and highly significantly associated with the perception of agricultural graduates towards farming as an occupation and that academic performance was negatively significant. The study seeks to inform policies, educational programs, and industry practices to attract and retain talent in agriculture. Examining graduates' perspectives, contributes to strategies for a resilient, innovative, and adaptable agricultural workforce, ensuring the sector's sustainable future amidst global challenges.

Keywords: Agricultural graduates, Perception, Agriculture, Farming, Occupation.

EDA 22

Attitude of girl students towards agricultural entpreneurship

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ABSTRACT

India is one of the most populated country in the world. It has third largest entrepreneurial ecosystem in the world. Agricultural entrepreneurship has wide scope in India. India has around 63 million enterprises, of which 11.4% are agricultural enterprises. Out of total enterprises, only 20% are women-owned. Entrepreneurial activities related to food processing, value addition, custom hiring services can generate employment for youth and reduce unemployment. Agricultural entrepreneurship provides huge scope to women to tap their entrepreneurial potential. It is crucial to enhance their attitude towards entrepreneurship to mainstream them in this sector. With this consideration, the present study was undertaken to investigate the attitude of girl students towards the agricultural entrepreneurship. It was conducted in Anand Agricultural University. 50 undergraduate girl students from final year of agriculture faculty were randomly selected for the study. The responses were collected using specially designed interview schedule. It is found that majority of the girl students had highly favourable attitude towards agricultural entrepreneurship. Academic performance, Annual family income, Family type, agricultural entrepreneurship workshop was found positively significant. Locality was found positively related and academic performance was found negatively significant with the attitude of girl students towards entrepreneurship.

Keywords: Agricultural entrepreneurship, Attitude, Employment, Innovation, Startups

EDA 23

Economic assessment of private horticulture nurseries enterprise in Navsari district of Gujarat

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ABSTRACT

The Southern/ Deccan region of Gujarat state offers enormous opportunities for small scale nurseries enterprise development owing to the increasing demand for the horticultural ornamental plants. It also opens a new self-employment avenue to the youngsters and farmers. Moreover, the institutional support coupled by Navsari Agricultural University and various NGO has led to development of these enterprises. However, local varieties, improper input-mix and traditional practices characterize the present status of agricultural technology in the region. In this background, the study was undertaken for economic profitability of the nursery enterprise in Navsari District. The study was based on the 75 nurseries/ growers selected from Navsari, Gandevi and Vansda taluks. The adequacy and experience of the owners regarding nursery enterprise are quite acceptable which is shown with the probability of the business with an annual Rate on Return over Investment of 15 percent. All the nurseries were found to generate a substantial number of employment and income for the owners. The study suggests that plant nursery emntreprise should be promoted as a major agribusiness in this region for employment generation and adequate support in form of training and credit should be provided to the nursery enterprises.

EDA 24

Economic analysis of the apiculture enterprise in South Gujarat, Gujarat

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ABSTRACT

Beekeeping is an accessible supplementary enterprise for farm households, providing an additional source of income. It not only boosts earnings for the rural poor but also improve nutritional security for rural women and children and ensures yearround employment through various activities.India rank fourth in global honey production, while Gujarat holds the twenty-first position within the country. The South Gujarat region, with its ample forest and hilly areas is well suited for beekeeping. Despite these facts, very few rural residents have taken up commercial beekeeping.The current study was carried out to examine profitability of honey production enterprise. The study was based on primary data gathered from 120 beekeepers in three districts (Valsad, Dang and Tapi) of South Gujarat. A overall gross return of Rs. 5310.64 per hive and the net return over the total cost was Rs. 2620.50 has been reported with with a benefit-cost ratio of 1.97. The study suggests that apiculture entreprise should be promoted as a major agribusiness in this region for employment generation and adequate support in form of training and credit should be provided to the enterprises.

EDA 25

Atmanirbhar Bharat: Opportunities for empowering India challenges for the Atmanirbhar Bharat Abhiyan

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ABSTRACT

The article from *The Indian Express* titled "Atmanirbhar Bharat Abhiyan plays an important role in raising our country's per capita GDP," published on May 18, 2020, discusses the vital role of the Atmanirbhar Bharat Abhiyan (Self-Reliant India Mission) in India's economic growth. It highlights the challenges and objectives related to the government's Rs 20 lakh crore economic stimulus package announced to boost India's economy, especially amid the COVID-19 pandemic. The Atmanirbhar Bharat Abhiyan aims to reduce India's dependency on imports and make the country self-sufficient, fostering economic resilience. The stimulus package was designed to provide direct cash transfers to the poor, acting as a support system for those hit hard by the pandemic. This initiative is not only about addressing immediate needs but also focusing on long-term goals like improving India's manufacturing capabilities and encouraging industries to become more self-reliant. One of the key examples mentioned in the article is the production of Personal Protective Equipment (PPE) kits. Initially, India depended heavily on imports for PPE kits, but as a result of focused efforts and policy changes, India is now manufacturing its own kits, even exporting them to other countries. This shift from being an importer to an exporter reflects the core of Atmanirbhar Bharat—self-reliance in crucial sectors. The article also mentions the current trade imbalance in India, where imports outweigh exports, leading to a drain in foreign reserves. The Atmanirbhar Bharat Abhiyan is thus

designed to tackle such challenges by promoting domestic production, reducing imports, and building industries that can compete globally. Furthermore, India, as the largest growing developing economy, has seen its industries growing despite the pandemic's challenges. The new hope of "Atmanirbhar Bharat" has created optimism in the country, pushing industries to take risks and innovate, contributing to a stronger, self-sufficient India. In conclusion, the article underscores that the Atmanirbhar Bharat Abhiyan is not just about immediate economic recovery, but it is also a long-term vision to make India self-reliant in key sectors, boosting its GDP and economic growth in the global context.

Key Words: Atmanirbhar Bharat Abhiyan, India, self-reliant

EDA 26

Food Entrepreneurship – Scope and Challenges

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ABSTRACT

Food entrepreneurship, a booming and dynamic industry, is driven by customer desire for unique, sustainable, and healthful culinary experiences. With its numerous opportunities for innovation, economic growth, and addressing global food security issues, the food entrepreneurship business has emerged as a lively and rapidly changing subject. As the demand for healthier, more convenient, and environmentally friendly foods grows, so does the opportunity for innovative food processing enterprises. Entrepreneurs can target a wide range of industrial niches, including health-related items, plant-based alternatives, artisanal foods, and ready-to-eat meals. There are other opportunities for developing eco-friendly packaging, waste reduction, and automation technology. In addition, the growing number of working women and nuclear families is driving up demand for ready-to-eat and frozen foods. The state and national governments have proposed numerous plans and programme to develop and support food entrepreneurship. To develop a successful food processing firm, entrepreneurs must stay up to date on changing customer preferences, engage in sustainable techniques, and prioritize food safety and quality standards. Overcoming these challenges needs strategic planning, investment in technology, and a strong grasp of industry trends in order to develop a sustainable and competitive business.

Key words: Entrepreneurship, food processing, food standards, sustainable

EDA 27

Assessment on profitable animal husbandry practices in KVK adopted village of Rajkot district

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ABSTRACT

Livestock production serves as a primary source of income for all livestock owners, encompassing various ventures. Animal husbandry practices, with a particular emphasis on nutrition, play a pivotal role in ensuring optimal animal production and reproduction. In buffalo rearing among rural farmers in the adopted village of Rajkot district, it has been observed that inadequate nutrition significantly contributes to low live weight, infertility, and diminished milk yields. Addressing these issues, a technology demonstration was conducted, focusing on the feeding regimen of combining fodder with concentrate and mineral mixture for buffalo. This initiative aimed to enhance the overall well-being of the livestock and improve the economic prospects for the rural farmers. The identification of low milk production in buffalo was carried out using the Participatory Rural Appraisal (PRA) method in the adopted rural village of Rajkot district, Gujarat. Over the period of three years (2015-2017), three different treatments were tested. Among these, Treatment-3 (T3) emerged as the most beneficial, showcasing positive outcomes in terms of daily milk production (kg/day), milk production per unit, net return (profit) in Rs./local buffalo breed, and a higher benefit-cost ratio (BCR). The feeding method involving a combination of fodder, concentrate, and mineral mixture is recommended to be implemented on a larger scale for improved growth and increased livestock production. The success of implementing these feeding practices in the rural adopted village can be attributed to the exhaustive efforts made by KVK Pipalia. The dissemination of knowledge and effective technology transfer was achieved through various means, including trainings, field-level demonstrations (FLDs), on-farm trials (OFTs), and other extension activities such as field visits, diagnostic visits, and animal health camps. These efforts collectively aim to elevate animal production and enhance the income of dairy farmers in the region.

Keywords: KVK, Animal husbandry, Mineral mixture feeding, Rural village

EDA 28

Economic viability and marketing of dragon fruit cultivation in Gujarat: An emerging future promising crop

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ABSTRACT

This research aimed to assess the economic viability of dragon fruit cultivation in Gujarat, focusing on costs, returns, and marketing efficiency. The study involved 80 farmers selected based on their experience in dragon fruit farming. Primary data were collected for the agricultural year 2023 using structured interview schedules. Results exposed that to established the one-hectare dragon fruit orchard, farmers need to invest about Rs. 937948 per hectare while the maintenance costs emerged from second year onwards, indicated the ongoing

expenses associated with sustaining and managing the dragon fruit crop. These costs escalate over time, reaching Rs. 175542 per hectare in 2-4 years and Rs. 189017 per hectare for those beyond 4 years. Consequently, the total cost increases gradually with the maturity of the plantation, valuing Rs. 285630 for 2-4 years and Rs. 299105 per hectare for those above 4 years, respectively, with annual amortized cost of Rs.110088 per hectare. However, the production also rises significantly as the plantation matures, with around 9806 kg per hectare and 14004 kg per hectare production in the 2-4 years and beyond 4 years, respectively. Further, it was noted that it's a very remunerative crop with net return of Rs. 744000 and Rs. 1171315 per hectare for 2-4 years of plantation and above 4 years, respectively. The benefit-cost ratio which, signifies the profitability and viability of the cultivation, indicating a favourable return on investment with B-C ratio of 3.60 and 4.91 for 2-4 years and beyond 4 years, respectively, this signifying that dragon fruit is an emerging future promising crop in the Gujarat state. Furthermore, majorly two marketing channels were found for the marketing of dragon fruit in the study area. The marketing channel first was direct channel indicating the maximum share in consumers rupee and channel second was sharing less amount to the producer in consumers rupee due to the involvement of intermediaries.

Keywords: Dragon fruit, Establishment cost, Return, B-C ratio, Marketing channel, Marketing cost

EDA 29

Role of FPO in empowerment of farmers

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ABSTRACT

Farmer Producer Organizations (FPOs) play a crucial role in empowering farmers, promoting collective action, and enhancing the sustainability and profitability of the agricultural sector. A majority of small and marginal farmers grapple with limited resources and substantial transaction costs, impeding their involvement in modern agricultural markets. To confront these obstacles and harness the potential of smallholder farmers, Farmer Producer Organizations (FPOs) have emerged as a promising institutional solution. These entities, formed and managed by farmers themselves, aim to collectively undertake farming activities, enhance access to resources, bolster bargaining power, and tap into markets. Guided by democratic decision-making and inclusivity, FPOs empower farmers to pool resources, knowledge, and expertise, overcoming individual constraints to achieve common objectives. They provide a platform for farmers to convene, discuss shared challenges, exchange experiences, and learn from one another. FPOs facilitate knowledge transfer, training initiatives, and capacity-building activities, equipping farmers with skills and information to adopt improved agricultural practices, heighten productivity, and mitigate risks. Comprising

smallholder farmers, FPOs unite to improve farm income through enhanced production, marketing, and local processing endeavors. Moreover, FPOs explore avenues for value addition, establish direct market connections with buyers, and advocate for fair trade practices. They also play a significant role in natural resource management and sustainable agriculture, promoting climate-smart practices and the prudent use of water and land resources. Governmental support and policy frameworks are pivotal for FPO establishment and operation. Financial aid, technical assistance, and capacity-building programs from various government levels foster FPO development. Favorable policies, including improved credit access and conducive business environments, further bolster FPO success. By empowering farmers, enhancing livelihoods, and advocating for sustainable practices, FPOs catalyze agricultural transformation. They serve as a conduit for uniting small farmers, offering the potential to confront their challenges collectively, bolster market participation, and contribute to agricultural development and rural prosperity.

Keywords: Farmer Producer Organizations (FPOs), Empowering farmers, Capacity-building

EDA 30

Role of Public Private Partnerships in empowering farming communities

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ABSTRACT

India's agricultural sector faced with stagnating yields, the depletion of natural resources, and the growing threat of climate change, Indian farmers are under immense pressure. This situation presents a serious risk to farm incomes and the nation's food security. As the country's population continues to rise, with increasing demand for diverse and high-quality food, India's agricultural system must undergo a transformation to meet the needs of its people. In light of these challenges, there is demand for public-private partnerships (PPP) in agriculture. This paper underscores the pivotal role of PPP in addressing key challenges such as low availability of inputs viz. seeds, planning materials, limited access to technology, insufficient market access, and inadequate infrastructure. These partnerships offer a promising way forward by reducing farmer to extension personnel ratio, providing a framework to accelerate innovation thereby increase agricultural exports and agricultural productivity, promote sustainable farming practices, empower farmers with the necessary tools and knowledge, and improve the livelihoods of small and marginal farmers. The future of PPPs in Indian agriculture helps in tapping into new areas such as agri-tech, climate resilience, sustainable water management, post-harvest infrastructure, and financial inclusion. By fostering collaboration between the public and private sectors, India can achieve a more sustainable, efficient, and inclusive agricultural system.

Keywords: Public-Private Partnerships, sustainability, small farmer, marginal farmers

Capacity building for Agricultural Extension Professionals

CBA 1

Sustainability efforts of the Farmer Producer Organizations

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ABSTRACT

The present study entitled “Performance analysis of Farmer Producer Organizations” was conducted in the jurisdiction area of Sardarkrushinagar Dantiwada Agricultural University (SDAU), Sardarkrushinagar of Gujarat state. Out of seven districts of SDAU jurisdiction, six districts viz. Sabarkantha, Patan, Mehasana, Banaskantha, Kutch and Arvalli were selected for the study. An ex-post- facto research design was adopted for the study. Multi-stage sampling technique was used to select a representative sample of 240 FPO members as respondents. Six CEOs of all the six FPOs selected were also interviewed to study the knowledge management aspect of the investigation. Taking into consideration of the objectives. Of the study, a well-structured interview schedule was prepared to get responses from the respondents. To measure the variables under the study, scales and schedules either developed by the past researchers or developed for the present study were used. Willingness to participation received mean score of 68.17, which means it was the most considerable effort perceived by the FPO members for sustainability of the FPO.

CBA 2

Performance evaluation of Agricultural Produce Market Committees (APMCs) of Gujarat

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ABSTRACT

The agricultural situation in India has undergone a rapid change from last two decades. Developments in agriculture and allied sectors in India are of interest to a wide spectrum of people across the country. As a part of agricultural marketing system, the role of APMCs in India is very important one in giving opportunities to rural farmers to sell their agri-products at good prices. But there are several challenges for rural farmers in agricultural marketing. It is observed that the pace of development of markets in terms of infrastructure and its economic performance varied widely across the markets and regions of the state, therefore analysing performance of regulated markets is the main objective of the study. The present study was based on the secondary data collected from annual reports of selected regulated markets. Gujarat is the main producer of two crops viz., groundnut and cotton in India. Therefore, groundnut was taken as major commodity for the selection of the regulated markets. Principal Top ten groundnut markets were selected considering the average market arrivals of groundnut for three years, i.e. from 2015 to 2017. Component analysis was employed to construct the performance indices of selected regulated markets. The results indicated that Rajkot, Gondal and Jamnagar ranked first, second and third, respectively while the Bhavnagar market ranked last and other markets performed medium to poor.

Keywords: Performance analysis, regulated markets, groundnut, Principal Component Analysis.

CBA 3

Evaluating the effect of contract farming on employment and poverty alleviation in northern West Bengal: A path analysis approach

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ABSTRACT

The present study uses a statistical technique i.e., Path Analysis to examine and test hypothesised causal relationships among the perceived sways of contract farming on employment generation and poverty reduction among smallholders with the socio-economic variables. A quasi-experimental ex-post-facto research design was adopted for the present study. The present cross-sectional study was conducted in the northern district of West Bengal, Coochebhar, and followed a purposive, multistage, and random sampling procedure. The Coochbehar II block of the Coochbehar district was selected purposively for the present study. Ten contract farmers from all ten villages of the block were randomly selected, summing up to a hundred respondents. Some socio-economic variables were considered as independent variables and the dependent variable, perceived sways of contract farming on employment generation and poverty reduction were conceptualized for the study. The obtained output indicated that the variable Contract Farming experience (X_4), (0.483), had exerted a maximum direct positive effect, and the least direct effect value was found to be of the variable Family Annual Expenditure (X_{06}), -0.334 on the dependent variable. Out of the nineteen variables under the study, only two variables namely Contract Farming Experience, (X_{04}) were significant at a 1.00% level of significance, and Communication Skills (X_{10}) was significant at a 5.00% level of significance with the dependent variable indicating that variables Contract Farming Experience, (X_{04}) and Communication Skills (X_{10}) is the major causal factors for the predictor variable. Out of a total of nineteen variables, Family Annual Expenditure, (X_{06}), 0.41 had the maximum indirect effect, and the least indirect effect value was found to be of Economically Active Member, (X_{08}), -0.133. Data further revealed that out of the nineteen substantial indirect effects, seven were routed through the variable Communication Skills (X_{10}), five through the variable Family Annual Income (X_5), two through the variable Management Orientation, (X_{19}), two again routed through the variable, Contract Farming Experience, (X_{04}), and one last routed through the variable Age (X_1).

Keywords: Path analysis, Perceived sways, Contract farming, Direct Effect, Indirect Effect

CBA 4

Personal, social, economic and psychological characteristics of the respondents of dairy co-operative societies

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ABSTRACT

The study was conducted for three years. The South Gujarat which has seven districts and all were included for investigation. Every year two districts were taken and from each

district 100 respondents were selected. Thus, the total respondents were 700. Majority of the respondents had middle age category and medium level of income, family size, social participation, faith in people, group motivation and moderate level of perceived benefits of co-operative societies and knowledge about principles of co-operation.

Keywords: Dairy Co-operative societies, Respondents

CBA 5

Comparative analysis of national and international frameworks for capacity building in agricultural extension professionals

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ABSTRACT

Capacity building for agricultural extension professionals is critical for advancing sustainable agricultural practices and achieving development goals. Agricultural extension workers are central to transferring knowledge and innovation to farmers, yet their effectiveness depends heavily on continuous training, knowledge updates, and skill enhancement. Key organizations such as the Food and Agriculture Organization (FAO), the World Bank, World Trade Organization (WTO), and national bodies like India's National Institute of Agricultural Extension Management (MANAGE) offer specialized training programs designed to improve the competency of extension professionals. These programs focus on areas such as climate-smart agriculture, gender-sensitive approaches, rural entrepreneurship, and the adoption of digital technologies in extension services. The review compares global capacity-building frameworks with India's approach, highlighting the critical role of regional and national institutions in tailoring training to local needs. While global organizations like FAO provide broad, standardized frameworks for extension capacity building, India has a more localized approach, focusing on specific agricultural challenges faced by different states and regions. This comparison reveals that while international frameworks emphasize universal standards, national frameworks, particularly in India, play a pivotal role in contextualizing the training to local agricultural systems and socio-economic conditions. The review highlights the importance of aligning national training frameworks with international standards, promoting knowledge exchange, and enhancing digital literacy among extension professionals. The role of international organizations in providing financial support, technical expertise, and global networking opportunities is also examined. Comparative analysis of the Indian context with global best practices reveals that while significant progress has been made, there remains a need for increased collaboration, better resource allocation, and a more integrated approach to capacity building. Strengthening the capacity of extension professionals is essential for addressing emerging agricultural challenges and achieving the goals of food security, rural prosperity, and sustainable development.

Keywords: Capacity Building, Agricultural Extension, International Organizations, Sustainable Development, Training Frameworks

CBA 6

Custom hiring centers: Way to enhance agricultural efficiency

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ABSTRACT

Custom Hiring Centers (CHCs) play a crucial role in modern agriculture by providing farmers with access to necessary machinery and equipment without the burden of high capital investments. As agricultural practices evolve, the demand for advanced technology and efficient farming methods has increased, making CHCs an essential component of agricultural support systems. These centers facilitate the timely availability of various agricultural tools, enabling farmers to optimize their productivity and reduce labor costs. The importance of CHCs is particularly pronounced in regions with small and marginal landholdings, where individual farmers may not afford expensive machinery. By pooling resources, CHCs allow multiple farmers to share equipment, ensuring that all have equal access to technology that enhances crop yields and promotes sustainable farming practices. Furthermore, CHCs contribute to the effective use of resources, minimizing waste and environmental impact while maximizing productivity. Training programs conducted by CHCs also empower farmers with knowledge about best practices in machinery operation and maintenance, leading to improved efficiency and reduced downtime. By fostering collaboration among farmers and providing technical support, Custom Hiring Centers significantly enhance agricultural productivity, promote rural development, and contribute to the overall economic growth of the farming community. In conclusion, Custom Hiring Centers are vital in transforming the agricultural landscape, making modern technology accessible to farmers, and promoting sustainable practices that can lead to increased productivity and profitability.

Keywords: Custom Hiring Centers, farm mechanization, Sustainable practices

CBA 7

Factors affecting participation and constraints encountered by FPO member farmers in South Gujarat

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ABSTRACT

India's agrarian economy supports 55 percent of rural households, but it faces challenges like shrinking land holdings, lack of economies of scale, limited information access, and difficulties in price discovery. This disorganization prevents farmers from securing fair market prices, contributing to debt cycles from low prices and market fluctuations. In this regard organizing into Farmer Producer Organizations (FPOs) could strengthen farmers. So, the present study investigates the socio-economic profile of member farmers in Farmer Producer Organizations (FPOs), identifies factors influencing in their participation, and explores the challenges farmers encounter in the organization. Conducted in South Gujarat, the research utilized a descriptive design and multistage stratified random sampling to select 350 farmers from seven FPOs , gathering data through structured interviews and analysing it with appropriate statistical tools. The findings revealed that the majority of farmers were middle-aged with majority small farmers. Motivations for joining FPOs cantered on enhancing family income, achieving better price realization and benefiting from rapid payment settlements with a significant reliance on government officials for motivation. Factor analysis identified five key areas influencing farmers participation in FPO's i.e. Comprehensive Service and Support, Collaborative Networking, Policy and Stakeholders Support, Inclusivity and Participatory Decision-Making and Accountability. Farmers highlighted the importance of the services offered by FPOs and the collaborative environment among members. However, they faced various constraints categorized into social, economic, technical, managerial and marketing related challenges. FPOs provide significant opportunities for farmers, socio-economic factors and various challenges impede their effective participation. So, addressing these issues through improved support systems and resource management is essential for enhancing the functioning and impact of FPOs in South Gujarat.

Keywords: Farmer Producer Organizations (FPOs), Member Farmers, Participation factors, Constraints

CBA 8

Analysis of marketing status of Cumin seeds in Surendranagar district

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ABSTRACT

Cumin is an important commercial spice crop of India. Major cumin producing states are Gujarat and Rajasthan. In Gujarat state, Surendranagar District has a second rank in cumin area and production in average last 3 years. With the development of new improved cumin seeds coupled with innovative production technology have transformed cumin production. The Surendranagar district is highest cultivation in area and second highest in production so it was purposively selected for the research study. The Surendranagar district has 10 talukas, among them 5 talukas Wadhvan, Muli, Lakhtar, Dhrangadhra and Patdi (Dasada) were purposively selected for the study as these talukas have more area under cumin cultivation. A list of cumin growers who were growing cumin obtained from taluka panchayat office. 10 respondents from each village and 2 dealer from each talukas were selected by using multistage sampling techniques making a sample of 160 respondents. The results revealed that majority of the cumin growers belonged to the 36 to 50 year age, having primary education level, were literate, belongs to joint family, had up to 1 ha land holding among them, 40.66 per cent grow cumin crop land area of their total land holding. It was observed that canal was the main source of irrigation for the cumin growers of Surendranagar district. It was found that majority of cumin growers were got excellent productivity and had 2 to 4 lakh annual income. It was found that cumin growers mostly grown GSSCL cumin seed (70.66%), may be because of ease in availability of seed and higher production and also available with subsidy. Among the cumin growers, (96.00%) were purchased cumin seed directly from the dealers' shop whereas 77.00 per cent dealers were purchased cumin seed directly from the seed companies. It was found that Marketing Channel-II (MC-II) was most prominent channel for purchasing the cumin seeds by cumin growers followed by MC-I, MC-III, MC-IV and MC-V channels were more prominent in the study area. It was observed that cumin growers got awareness from dealers, had no member in organization. Company in large proportion (22.00%) were distribute

Literature like Leaflets, Brochures of product etc. Majority of cumin growers has available seeds timely, spend more than Rs.2000 for seed, has Moderate price opinion, they use of specific brand of cumin seeds, have depend on specific brand, purchased 2 kg size of packet of seeds, purchased seeds by cash. It was observed that 28.88 per cent cumin growers faced the constraint irregular visit of technical staff after purchasing of cumin seeds.

Keywords: Cumin growers, Marketing channels, Dealers, Buying behaviour

CBA 9

Structure of Farmer Producer Organization in India

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ABSTRACT

Unlocking the Potential of Farmer Producer Organizations: A Look at the Structure of FPOs in India. This abstract explores the structure of Farmer Producer Organizations (FPOs) in India, highlighting their key components and how they facilitate the empowerment of farmers. FPOs, as cooperative entities, are structured around a democratic and participatory model, giving farmers a strong voice in decision-making. The structure includes:

• Open Membership: FPOs are open to all farmers, regardless of their scale or specialization, fostering inclusivity and collective action.

• Governance: The general body, composed of all members, holds the ultimate decision-making power. An elected Board of Directors and a Management Committee oversee daily operations.

• Committees: Specialized committees focus on key areas like marketing, finance, and production, enhancing expertise and efficiency.

• Management & Staff: A dedicated staff, led by a CEO or General Manager, implements the board's decisions and manages daily operations.

• Financial Structure: FPOs rely on member contributions, loans, and grants to fund operations and promote sustainable growth.

• Key Functions: FPOs facilitate collective bargaining, market access, input procurement, value addition, capacity building, and collaboration with other stakeholders.

Keywords: Farmer Producer Organizations, FPOs, Structure, India, Governance, Membership, Committees, Financial Structure, Sustainable Agriculture, Empowerment.

CBA 10

Role of FPOs in India

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ABSTRACT

Farmer Producer Organizations (FPOs) are emerging as a critical force in the transformation of Indian agriculture. They are playing a vital role in empowering farmers, enhancing market access, and driving sustainable growth. This abstract explores the multifaceted role of FPOs in

India, highlighting their impact on key areas:
• Collective bargaining power: FPOs enable farmers to negotiate better prices for their produce, ensuring fairer returns and increased income.
• Improved access to markets: FPOs provide a platform for farmers to collectively access larger markets, both domestic and international, reducing dependence on middlemen and enabling better price realization.
• Access to inputs and services: FPOs facilitate access to essential inputs like seeds, fertilizers, and credit at competitive prices, improving agricultural productivity and reducing costs.
• Value addition and processing: FPOs encourage value addition activities like processing, packaging, and branding, leading to increased market value and reduced post-harvest losses.
• Technology adoption: FPOs play a key role in promoting the adoption of new technologies, such as precision farming and climate-smart agriculture, leading to increased efficiency and resilience.
• Financial inclusion: FPOs provide access to financial services like loans and insurance, empowering farmers to manage risk and invest in their farms.
• Sustainable practices: FPOs often prioritize sustainable agricultural practices, including organic farming and water conservation, contributing to environmental conservation and farmer well-being.

Keywords: Farmer Producer Organizations, FPOs, Indian Agriculture, Market Access, Collective Bargaining, Value Addition, Sustainable Agriculture, Financial Inclusion, Rural Development.

CBA 11

Association between personal profile and knowledge of agri input dealers regarding improved Bajra production technology in the Jaipur region of Rajasthan

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ABSTRACT

Bajra, or pearl millet (Pennisetum glaucum), is vital in the agrarian landscape of Rajasthan, India's arid region. This drought-resistant cereal crop has been cultivated for centuries in Rajasthan, serving as a staple food for both rural and urban populations. The investigation was conducted in 2022–23 to know "Association between Personal Profile and Knowledge of Agri Input dealers regarding Improved Bajra Production Technology in Jaipur Region of Rajasthan. The information was accumulated from 120 private and 120 cooperative agri-input dealers in the Jaipur and Tonk districts of Rajasthan. It also found that out of ten independent variables, viz. education, type of dealership, experience, exposure visit, information seeking behaviour, market orientation, social participation, and mass media participation, had a positive significant relationship with knowledge regarding improved Bajra production technology. In contrast, age and annual turnover have a non-significant relationship between knowledge of agri input dealers regarding improved Bajra production technology.

Keywords: Private, Cooperative, Agri input dealers, Association, knowledge, Bajra, Production Technology

CBA 12

Backward linkages of the Date palm growers regarding Date palm with different system

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ABSTRACT

Horticulture crops perform a vital role in the Indian economy by generating employment, providing raw material to various food processing industries, and higher farm profitability due to higher production and export earnings from foreign exchange. The need for diversification to horticulture sector was acknowledged by the Government of India in mid-eighties by focusing its attention on investment in this sector. The study was conducted to find out backward linkages of the date palm growers regarding date palm with different system. The present investigation was purposefully carried out in Kachchh district of Gujarat state. From Kachchh district, four talukas and from each taluks six villages were purposively selected based on area and production of date palm. Total 300 date palm growers were selected proportionately for this study. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result showed in backward linkages, majority date palm growers had good backward linkages with KVK, scientist of DPRS, input dealers and growers association for information on farm operation. In case of input procurement all most all the farmers rely on their own for suckers and offshoots for planting and they have linkages with private input dealers and government companies for tissue culture plants, fertilizers, pesticides and farm machinery. Most of the date palm growers satisfy their credit needs by their own resources further they had developed the linkages for the same with co-operative as well as nationalized banks. The development assistance for date palm cultivation linkages were found with DOH, NGOs and GGRC.

CBA 13

Identify the channels used by Mango growers for marketing kesar Mango

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ABSTRACT

India is the second largest producer of fruits in the world and holds first position in production of mangoes. As per the second advance estimate of National Horticulture Board, mango is growing on 2291 thousand hectares area and produce 20444 thousand MT in India. The share of mango in total fruit production of Gujarat is 15.90 per cent and contributing 06.70 per cent share in the total production of Indian mango., Further, majority of the Kesar mango growers were found to have medium level of marketing behaviour and channels used by Kesar mango growers for marketing the produce was Channel III: - Growers - Commission agents - Processing industries - Retailers – Consumers

Keywords: Kesar mango growers, Channels, Marketing

CBA 14

Constraints faced by the Mango growers in marketing of their produce

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ABSTRACT

The distribution of mangoes involves various intermediaries including growers, contractors, commission agents and wholesalers. The passage underscores the need for cooperative societies to bridge the gap between scattered growers in remote villages and consumers in semi-urban and urban areas. Keeping in the view the present investigation carried out to find constraints faced by the mango growers in marketing of their produce. Multistage random sampling technique was followed for selection of the mango growers. Four talukas of Kachchh districts were selected purposively. From each selected taluka, five mango producing villages and from each village twelve mango growers were selected randomly. Thus, total 240 mango growers were selected as sample size. The data were collected through personal interview and then after it is compiled, tabulated and analysed to get proper answer with the help of various appropriate statistical tools. The result indicated that major constraints faced by majority of the mango growers were; intervention of commission charges, followed by low auction price pleaded by traders/ contractors due to orchard away from the main road, middlemen manipulate the situation / distress sale, inadequate market information, lack of proper storage and cold chain facilities exacerbates post-harvest losses.

CBA 15

Farmers' awareness about e-NAM and their market orientation

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ABSTRACT

In this century Information Technology drives prime attention because of its faster connectivity and easy access. Recognizing this fact Government of India and Department of extension education connecting farmers to Digital platform. One of such connecting dot is e-NAM. National Agriculture Market (NAM) is a Pan-India electronic trading portal which networks the existing APMC market to create a unified national market for agricultural commodities. The NAM Portal provides a single window service for all APMC related information and services. This includes commodity arrivals & prices, buy & sell trade offers, provision to respond to trade offers, among other services. The Awareness of farmers about e-NAM observed, showing low awareness (56.66 %).Extent of awareness shows, rank ordering of statements on extent of awareness about that, majority of the respondents were listen about e-marketing (rank I) followed by awareness about different practices in market (II).while rank (III) shows those participated in awareness session know about different features of scheme like through this scheme prices commensurate with quality, Commodity returns will directly transfer to bank account.

Keywords: e – NAM, Awareness and Market Orientation

CBA 16

Forward linkages of the Date palm growers regarding Date palm with different system

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ABSTRACT

Horticulture crops perform a vital role in the Indian economy by generating employment, providing raw material to various food processing industries, and higher farm profitability due to higher production and export earnings from foreign exchange. The need for diversification to horticulture sector was acknowledged by the Government of India in mid-eighties by focusing its attention on investment in this sector. The study was conducted to find out forward linkages of the date palm growers regarding date palm with different system. The present investigation was purposefully carried out in Kachchh district of Gujarat state. From Kachchh district, four talukas and from each taluks six villages were purposively selected based on area and production of date palm. Total 300 date palm growers were selected proportionately for this study. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result showed in forward linkages, good linkages were found with scientist of DPRS and KVK for technological know-how for post production operations, while for marketing they had strong linkages with private merchants for information on farm operation. In case of PHM apparatus, date palm growers had sound linkages with private companies and dealers for marketing and transportation. Poor linkages were found with respect to value addition and processing. The good linkages for credit were observed among date palm growers with nationalized banks. The date palm growers had linkages with DOH for development assistance in harvesting and fruit care.

CBA 17

Scaling up success: The impact of FPOs on rural livelihoods and profitable farming

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ABSTRACT

Farmer Producer Organizations (FPOs) have emerged as a transformative force in rural agriculture, offering smallholder farmers the collective power needed to access markets, improve bargaining positions, and adopt advanced farming practices. This paper explores the impact of Jafarabad agriculture farmer Producer Company and avirat farmer producer company on enhancing rural livelihoods and promoting profitable farming. By uniting farmers into structured groups, FPOs enable cost-effective procurement of inputs, better access to credit, and improved market linkages, which are critical for scaling up agricultural success. Through case studies and empirical data, this paper examines how FPOs support economic resilience in rural communities, reduce transaction costs, and empower farmers to negotiate fair prices. It also addresses the challenges FPOs face, such as limited infrastructure, need for skilled

management, and regulatory hurdles. Despite these challenges, the positive impact of FPOs on income stability and profitability for rural farmers is significant, positioning FPOs as pivotal players in achieving inclusive agricultural growth and sustainable rural development.
Keywords: Farmer Producer Organizations, cost-effective, economic resilience

CBA 18

Linkages index between different categories of Date palm growers

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ABSTRACT

Horticulture crops perform a vital role in the Indian economy by generating employment, providing raw material to various food processing industries, and higher farm profitability due to higher production and export earnings from foreign exchange. The need for diversification to horticulture sector was acknowledged by the Government of India in mid-eighties by focusing its attention on investment in this sector. The study was conducted to find out linkages index between different categories of date palm growers. The present investigation was purposefully carried out in Kachchh district of Gujarat state. From Kachchh district, four talukas and from each taluks six villages were purposively selected based on area and production of date palm. Total 300 date palm growers were selected proportionately for this study. The data were collected through personal interviews and it was compiled, tabulated and analysed to get proper answers with the help of various appropriate statistical tools. The result showed that, there was highly significant difference was observed (650.059**) in the mean linkages index among small, medium and big date palm growers which was greater than the CD value (3.155) at 5 per cent.

CBA 19

Mapping and assessing factors for stakeholders' perception analysis in dairy cooperatives: Standardized scales for value chain optimization

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ABSTRACT

India, with the world's largest animal and human populations, seeks to enhance nutritional and employment security through dairy farming. However, the sector grapples with low productivity, inadequate extension services, unstable milk prices, and export compliance issues. Revitalizing dairy cooperatives presents a promising strategy to address these issues and foster sector growth. Existing research often focuses primarily on farmers' perceptions, overlooking other key stakeholders within the dairy cooperative value chain. This study addresses this gap by evaluating stakeholders' perceptions across the dairy cooperative value chain. The objectives are to perform stakeholder analysis, identify factors for stakeholders'

perception analysis, and develop standardized perception scales for each stakeholder group. Andhra Pradesh, Haryana, and Maharashtra were selected to represent diverse regions of India. Two dairy cooperative unions and four societies from each state were chosen for analysis. Social network analysis identified key stakeholders, including member farmers (degree centrality 0.596), management committees (highest closeness centrality 0.667), input suppliers (degree centrality 0.556), processing unit members (degree centrality 0.578), distributors (highest betweenness centrality 0.623), retailers (degree centrality 0.530), and consumers (degree centrality 0.512). Discourse analysis involving 30 stakeholders was conducted to identify stakeholder perception factors, analyzed using NVivo software. Factors identified across the dairy cooperatives value chain include operational efficiency, transparency, quality control, processing efficiency, retailer support, and consumer preferences. These factors were integrated to develop tailored perception scales for each stakeholder group. The developed scales provide actionable insights into existing challenges and opportunities within the dairy cooperative value chain, offering guidance for strengthening and optimizing dairy cooperatives across India.

CBA 20

Marketing analysis of soybean crop in North Gujarat region

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ABSTRACT

The aim of the study was carried out to marketing channels, marketing cost, margins, price spread, marketing efficiency and producer's share in consumer's rupee of Soybean of North Gujarat Region. The primary data was collected by using multistage random sampling. Arvalli and Sabarkantha districts was purposively selected for a soybean is important oil seed crop in North Gujarat and which grown in larger area in North Gujarat compare to another region. The study was focused on 120 potato farmers, 24 wholesalers and retailers selected from Idar and Modasa APMC in this study. The findings have revealed that, following three marketing channels were identified in the study viz., Channel I: Producer - Wholesale/Commission agent–Retailer-Consumer. Channel II: Producer – Village trader - Wholesaler – Retailer-Consumer and channel III: Producer – Retailer– Consumer. Moreover, in both markets, the marketing cost in channel II was highest compare to channel I and II. The price spread was lower in channel III as the produces was sold directly retailers. In channel I had the highest marketing efficiency comparing channel II and channel III, it was revealed that, the channel II was lower marketing efficiency due to add one additional intermediary (Village trader).

Keywords: Soybean, Marketing Cost, Marketing Margin, Price Spread, marketing efficiency

CBA 21

Marketing behaviour of the Mango growers

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ABSTRACT

Marketing behaviour for farmers refers to the actions, decisions, and strategies they employ in the promotion, sale and distribution of their agricultural products. This behaviour encompasses a range of activities including identifying target markets, pricing products, selecting distribution channels, promoting goods and managing customer relationships. Keeping in the view the present investigation carried out to find marketing behaviour of the mango growers. Multistage random sampling technique was followed for selection of the mango growers. Four talukas of Kachchh districts were selected purposively. From each selected taluka, five mango producing villages and from each village twelve mango growers were selected randomly. Thus, total 240 mango growers were selected as sample size. The data were collected through personal interview and then after it is compiled, tabulated and analysed to get proper answer with the help of various appropriate statistical tools. The result shows that Slightly more than three-fifths (62.92%) of the mango growers had medium level of overall marketing behaviour, followed by 20.42 per cent and 16.67 per cent of them had high and low level of overall marketing behaviour, respectively.

CBA 22

Attitude of agro input dealers towards certificate course on pesticide management

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ABSTRACT

Agro input dealers serve as an important link between manufacturers and farmers and they have the responsibility to disseminate the latest farm technology at the field level. Therefore, knowledge about pesticides is crucial for these dealers. Farmers tend to trust agro input dealers more because they are localized. There is a significant need for proper recommendations to be communicated for the sustainable use of inputs and to ensure that farmers understand the products and processes involved. Agro input dealers provide information about new varieties, as well as the proper use of fertilizers and pesticides. The attitude of input dealers towards the pesticide management course is essential for obtaining effective and efficient information from the certificate course on pesticide management. This understanding allows for a clearer assessment of the program's success and facilitates necessary improvements at an early stage. The present study was conducted in the districts of Junagadh, Rajkot, Porbandar and Amreli in Gujarat, collecting data from 160 agro input dealers who had completed the certificate course on pesticide management using purposive and random sampling techniques. The study revealed that regarding the attitude of agro input dealers towards the certificate course, more than one-third (35.00 percent) had a favorable attitude, followed by 25.62 percent who had a strongly favorable attitude, 20.00 percent with a moderately favorable and 16.25 percent who had an unfavorable attitude. Only a few (3.13 percent) of the agro input dealers exhibited a strongly unfavorable attitude towards the certificate course on pesticide management.

Keywords: Agro input dealers, Certificate course, Attitude, Pesticide management

CBA 23

Relationship between the profile and marketing behaviour of

the Mango growers

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ABSTRACT

Mango is the national fruit of India. For ages, the mango tree has been described as Kalpavriksha (wish-granting tree). It is known as "the king of fruits". It is the choicest fruit in India and abroad. Its long period of domestication in India is well evidenced by its mention in ancient scriptures. Mango is a part and parcel of the cultural heritage of India. Keeping in the view the present investigation carried out to find relationship between the profile and marketing behaviour of the mango growers. Multistage random sampling technique was followed for selection of the mango growers. Four talukas of Kachchh districts were selected purposively. From each selected taluka, five mango producing villages and from each village twelve mango growers were selected randomly. Thus, total 240 mango growers were selected as sample size. The data were collected through personal interview and then after it is compiled, tabulated and analysed to get proper answer with the help of various appropriate statistical tools. The result indicated that independent variables viz., education, experience in mango cultivation, annual income, social participation, source of market information, extension contacts, mass media exposure, risk orientation and economic motivation had positive and significant relationship with marketing behaviour of the mango growers. While, size of land holding and irrigation status had a non-significant relationship with marketing behaviour of the mango growers.

CBA 24

Attitude of students towards higher education

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ABSTRACT

Education is vital for students as it offers specialized knowledge and skills crucial for career success and personal development. It gives critical thinking, problem-solving abilities and Strength. Additionally, it provides networking opportunities, promotes diversity and encourages research and innovation. Higher education enhances earning potential, facilitates social mobility and contributes to societal progress. Hence, considering the importance of these characteristics and review of past research studies, an attempt has been made in this investigation to ascertain the relationship between profile of students and their attitude towards higher education so that this present study entitled "ATTITUDE OF STUDENTS TOWARDS HIGHER EDUCATION" was undertaken in the year 2024 in Gujarat state of India. A sample of 60 students was selected from Anand agriculture University, Gujarat. The data were collected with the help of google form filled by the students. The result found that majority of the students had high attitude towards higher education and out of seven independent variables one variables viz. academic performance were found to be positive and highly significantly correlated with attitude towards higher education.

Keywords: Agri Anand Agriculture University, Attitude, Higher Education

CBA 25

Performance of Farmer Producer Organisations (FPOs) in South Gujarat

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ABSTRACT

A study was conducted to analyze the performance of FPOs in South Gujarat. Total 10 FPOs and 300 members of FPOs were selected by using proportionate sampling method. Primary data were collected through structured interview schedule. Tabular analysis was used for the analysis of data. It was found from the present study that Karnataka, Madhya Pradesh, Maharashtra and West Bengal were leading state in FPO formation. In Gujarat, Maximum number of FPOs were registered in North Gujarat followed by Saurashtra. In South Gujarat, total 52 FPOs were registered with the share of 15.25 per cent. The selected FPOs focused on diversified products or services. Majority of the selected FPOs were focused on collection/aggregation of produce followed by primary processing, value addition, market linkages, government/corporate tie-up for different activities. Majority of selected FPOs were having more than 10 lakhs & upto 20 lakhs turnover. The major constraints faced by sample farmers were lack of farmers participation in the meetings conducted by FPOs, lack of co-ordination between the members for various group-based activities, members personal interest/objective rather than collective objective. To overcome these constraints farmers were suggested that there should be provision of different facilities like storage, agri-input supply, financial services for each FPOs, awareness programmes should be arranged through different mass media at different locations and procurement of farm produce from member farmers on regular basis.

CBA 26

Agricultural market intellect system in India – Problems and prospects

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ABSTRACT

Agricultural marketing plays a vital role into liberalization and globalisation of markets. In this context agriculture has to be market driven, more cost effective, competitive, innovative and responsive to high tech and ICT application. Training and extension systems in agricultural marketing will have to sensitize and introduce the beneficiaries to respond to these challenges. It is necessary to build capacity of each of the beneficiary group i.e. the farmers, stockholders, market functionaries and other officials involved in the agricultural marketing activities. Knowledge should be imparted at the grassroots level in areas such as market driven production program, postharvest management of agricultural and horticultural crops, availability of marketing funding, information on facilities for quality assurance and standards, grading, sorting, packaging, storage, transportation, contract farming, direct marketing, alternative markets etc. Training and education modules should be prepared in these sector for reaching the region specific farmers in their vernacular languages. The objective of imparting training to marketing functionaries and stakeholders should be to create an ambiance of Good

Marketing Practices in the country to promote the interests of farmers as well as consumers. There is need to create awareness among the farmers through the types of agriculture sciences like the state development of agriculture, Krishi Vigyan Kendra (KVK) so that the marketing information are incorporated in the extension services along with the population.

CBA 27

Study the profile of the Mango growers in relation to marketing behaviour of Mango

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ABSTRACT

The mango tree has been described as Kalpavriksha (wish-granting tree). It is known as "the king of fruits". It is the choicest fruit in India and abroad. Its long period of domestication in India is well evidenced by its mention in ancient scriptures. Mango is a part and parcel of the cultural heritage of India. Keeping in the view the present investigation carried out to study profile of the mango growers. Multistage random sampling technique was followed for selection of the mango growers. Four talukas of Kachchh districts were selected purposively. From each selected taluka, five mango producing villages and from each village twelve mango growers were selected randomly. Thus, total 240 mango growers were selected as sample size. The data were collected through personal interview and then after it is compiled, tabulated and analysed to get proper answer with the help of various appropriate statistical tools. The result indicated that majority (91.67%) of the mango growers belonged to the middle to old age group, educated upto higher school (84.17%), having high to medium level of experience in mango cultivation (82.92%), had semi medium to medium size of land holding (73.33%), had medium annual income ₹2,50,001/- to ₹5,00,000/- (55.42%), were having membership in one or more than one organization (68.75%), had fair to poor irrigation status (80.00%), had medium to high level of sources of market information utilized (89.58%), having medium to low extension contacts (84.16%), had medium to high level of mass media exposure (86.66%), having medium to high level of risk orientation (87.92%), having medium to high level of economic motivation (86.25%) and having medium to high level of overall marketing behaviour (83.34%) in mango production enterprise.

CBA 28

Suggestions from Mango growers to overcome the constraints faced by them in marketing of their produce

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ABSTRACT

The distribution of mangoes involves various intermediaries including growers, contractors, commission agents and wholesalers. The passage underscores the need for cooperative societies to bridge the gap between scattered growers in remote villages and consumers in semi-urban and urban areas. Keeping in the view the present investigation carried out to seek the suggestions from mango growers to overcome the constraints faced by them in marketing of their produce. Multistage random sampling technique was followed for selection of the mango growers. Four talukas of Kachchh districts were selected purposively. From each

selected taluka, five mango producing villages and from each village twelve mango growers were selected randomly. Thus, total 240 mango growers were selected as sample size. The data were collected through personal interview and then after it is compiled, tabulated and analysed to get proper answer with the help of various appropriate statistical tools. The result indicated that major suggestions given by mango growers were; promote low-cost farm mechanization, followed by APMC should monitor and assure charges as per norms to prevent exploitation of farmers and assure fair trade, provide training on post-harvest management, more buyers should be in open auction, Government should establish cold storage units.

CBA 29

Exploring market integration in Saurashtra: A solution to price dispersion

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ABSTRACT

Marketing and trade, as an activity comes at latter part of the value chain for any commodity and yet it is the most important determinant for all other activities. In this line, creation and development of a network of regulated markets across the county has been the most important strategy of the Government of India since independence to ensure remunerative price to farmers and reasonable price for consumers by creating conducive market environment for fair play of demand and supply forces. Gujarat state has adopted a novel pattern of progress with the strategic development of agriculture as a key sector. Nevertheless, the agricultural marketing system in the state remain fragmented and characterized by an inadequate equipped network of markets. The study therefore was undertaken to analyse price effect among selected regulated markets. The study was undertaken using secondary sources. Saurashtra is a major producer of groundnut, therefore, ten regulated markets of Saurashtra were selected on the basis of three years' average groundnut arrivals. The time series data for price of groundnut and cotton were compiled from AGMARKNET. The data were collected for the period from 1997-98 to 2017-18. To assess the long term equilibrium and price integration among selected markets, Augmented Dickey-Fuller test, Johansen co-integration test and Granger Causality test were used. The results of Johansen multiple co-integration test revealed that majority pairs of markets have a long-run equilibrium/co-movement among the groundnut and cotton price series

Keywords: Regulated markets; price integration; groundnut; cotton; Saurashtra

CBA 30

Training needs of the farmers about natural farming in Tapi and Narmada districts of South Gujarat

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ABSTRACT

Training and information plays a vital role when any go for new enterprise. Timely and need based trainings are directly and indirectly influencing to farmers. It was felt worthwhile to study training needs of the farmers about natural farming. The present study was conducted

in Tapi and Narmada districts of South Gujarat. The two talukas from each district and two villages from each taluka was randomly selected thus, total 4 villages selected. The 11 farmers were randomly selected from each village as respondents and thus, 44 farmers have been selected from each district as respondents. Total 88 respondents were interviewed from two districts of South Gujarat. The data were collected by following the personal interview method with the help interview schedule already developed after due consultation with the faculty members of the discipline. The data so collected were tabulated and analyzed with appropriate statistical tools/techniques to formulate the inferences. From the study it was concluded that farmers needed the training related to preparation & use of Jeevamrit and Preparation & use of Dashaparni (3.00 Mean Score), livestock integration in natural farming (2.93 Mean Score) and preparation & use of Ghanjeevamrit and Preparation & use of Beejamrit (2.91 mean score) got ranked I, II and III respectively.

Keywords: Training, Training need, Natural farming, Farmers

CBA 31

Forecasting area, production and price of Banana in Surat district of South Gujarat

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ABSTRACT

Forecasting of area, production, the price trend are used to provide assistance in decision making and planning the future more effectively and efficiently. For achieving the objectives of the study, the time series secondary data on area, production and price of the crop from the year 1994-95 to 2021-22 were utilized for Surat district of the south Gujarat. The suitable statistical tools were adopted to reach the significant outcome on forecasting of area, production and prices of banana in Surat District of Gujarat. For the trend, cubic model approach were best suitable polynomial models for area, production and price. For the instability, cubic model with lower instability index approach most stable compared to the other models of area, production and price. For the SES appropriate value of (α) selected for smoothing constant was 0.9 for the forecasting for area, 0.8 for production, and 0.6 for price. For the statistical forecast model for production 11th SMW model showed good forecast as compare to remaining models in Surat district. Among the ARIMA models, ARIMA (1, 1, 1) model was found suitable to explain the pattern of banana price and showed no evidence of ARCH effects. Based on the study it is expected that the identification of the best forecasting model would help the producers, consumers as well as dealers in taking right decisions.

Key word: ARIMA, ARCH, SES, forecasting, banana

CBA 32

Attitude of input dealers towards enhancement of technical ability

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ABSTRACT

Input dealers are expected to serve as providers of basic extension services to farmers, creating an invaluable source of knowledge and advice to farmers. Agro-input dealers play a major role in ensuring that farmers access some of the important agricultural inputs required to improve agricultural productivity in their respective farms. Considering their importance,

MANAGE, Hyderabad formulates a module to train and upgrade their agricultural knowledge. In south Gujarat NAU, Navsari imparting this training to the input dealers of south Gujarat so, this study was conducted in six districts viz.,Navsari, Surat, Valsad, Bharuch, Narmada and Tapi district of South Gujarat. The list of nominated Input Dealers was collected from ATIC, Directorate of Extension Education The selection of participants was made from the batches started from 2017-18 to 2019-20 i.e. 3 years. By using proportionate random sampling method out of 256 total respondents the sample size was kept 100 as respondents for the present study. Slightly more than half of the respondents were in middle age group and medium size of family. Majority of the respondents were from higher secondary and graduation level of education, joint type of family, medium farming experience, having a marginal land holding. Half of the respondents were found in income ranging from ₹ 1,50,001 to ₹ 2,00,000 and above ₹ 2,00,000. Majority of the respondents were found medium to very high innovativeness, scientific orientation, risk orientation, decision making ability, extension contact, mass media exposure perception of trainee about the training course, perception of trainee about training methodology, perception of trainee about resource persons and training received. Majority of the respondents were found medium to very high attitude towards training.

Key words: Attitude, Input Dealers and Technical ability

CBA 33

Enhancement of technical ability of input dealers

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ABSTRACT

Agro-input dealers are sellers of agricultural inputs that include seeds, fertilizer, crop protection chemicals, farm equipment and machines, veterinary products and animal feeds at right time and right place with affordable price and quality. Agro-input dealers play a major role in ensuring that farmers access some of the important agricultural inputs required to improve agricultural productivity in their respective farms. Considering their importance, MANAGE, Hyderabad formulates a module to train and upgrade their agricultural knowledge. In south Gujarat NAU, Navsari imparting this training to the input dealers of south Gujarat so, this study was conducted in six districts viz.,Navsari, Surat, Valsad, Bharuch, Narmada and Tapi district of South Gujarat. The list of nominated Input Dealers was collected from ATIC, Directorate of Extension Education The selection of participants was made from the batches started from 2017-18 to 2019-20 i.e. 3 years. By using proportionate random sampling method out of 256 total respondents the sample size was kept 100 as respondents for the present study. Slightly more than half of the respondents were in middle age group and medium size of family. Majority of the respondents were from higher secondary and graduation level of education, joint type of family, medium farming experience, having a marginal land holding. Half of the respondents were found in income ranging from ₹ 1,50,001 to ₹ 2,00,000 and above ₹ 2,00,000. Majority of the respondents were found medium to very high innovativeness, scientific orientation, risk orientation, decision making ability, extension contact, mass media exposure perception of trainee about the training course, perception of trainee about training methodology, perception of trainee about resource persons and training received. Majority of the respondents were found medium to very high enhancement in technical ability.

Key words: Attitude, Input Dealers and Technical ability

CBA 34

Efficient supply chain management in agri-produce

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ABSTRACT

Supply chain consists of all links/stages involved directly or indirectly in fulfilling customer's request/order. In a 'supply chain' different actors are linked from 'farm to fork' to achieve a more effective and consumer-oriented flow of products. Supply chain flows include; material flow, information flow, financial flow, risk flow, value flow. Supply chain management (SCM) may be defined as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores, so that merchandise is produced and distributed at the right quantities, to the right locations and at the right time, in order to minimize system- wide costs while satisfying service level requirements. Factors defining supply chain efficiency are higher customer service, capital employed, cost and service leadership, profit, minimum wastage, high quality, short lead time, integration etc. Components of an agriculture supply chain include; procurement or sourcing, logistics management, organizational management, application of efficient consumer response system. Approaches to make an efficient agricultural supply chain are cooperative marketing/FPO's, contract farming, organized retailing, exports, processing and value addition. After studying some research paper regarding supply chain management, it was observed that the fragmented vegetable supply chain in Kerala, dominated by intermediaries, adversely affects both farmers and consumers. Marketing efficiency of nuts is more efficient in Channel III (Farmer – Wholesaler – Retailers – Consumers) than channel I (Farmer – Pre harvest contractor – Wholesaler – Retailers – Consumers), attributed to fewer intermediaries and lower margins. Some suggestions to improve supply chain management in agricultural produce are; aggregation is essential for inducing good practices among small and marginal farmer, urgent need to diversify agriculture to address emerging food demands and habits, need climate smart Agricultural technologies, improve productivity along value chain.

Keywords: Supply chain management, Marketing channel, Marketing efficiency

CBA 35

Group dynamics effectiveness of the members of farmer producer companies

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ABSTRACT

Farmer Producer Company (FPC) registered under Indian Companies Act, 2013 is an organization formed by farmers to collectively improve agricultural practices, access better inputs, enhance marketing, and increase profitability. FPCs promote collective decision-making, reduce middlemen, and provide financial, technical, and market support to members. Group dynamic effectiveness in FPCs foster effective decision-making, collaboration, conflict resolution, and trust. It enhances teamwork, resource sharing, and leadership development, driving the success and sustainability of the organization. The study was conducted in middle Gujarat with ten respondents (3 board members and 7 non board members) were selected randomly from each selected FPC. A sample of 200 respondents were chosen for the study. Group dynamics effectiveness index was calculated with the help of weightage score of 10 indicators and found that less than two-third (62.33 per cent) of the members and less than three-fourths (70.66 per cent) of the board members falls under medium level of overall group dynamics effectiveness. It can be concluding that majority (85.00 per cent) of the FPC member's had medium to high level of group dynamics effectiveness. Efforts should be directed to extend the group dynamics effectiveness through village level trainings for enhancing teamwork, group atmosphere, group cohesiveness, empathy, group leadership *etc.* for obtaining maximum success of Farmer Producer Companies. The policy makers should concentrate more to attract and motivating youngsters for making their participation in FPCs. And also, efforts should be directed to extend all the facilities and benefits of FPC at village level through training, demonstrations, regular extension activities and creating markets.

Keywords: Group dynamic effectiveness, farmer producer company, index, board member

CBA 36

Management Orientation Scale (MOS) for Commercial Production: Scale development and empirical validation

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ABSTRACT

Management orientation (MO) can help commercial mango growers oriented towards scientific management of their orchards to get higher returns. The emerging trend of commercial cultivation of mango crops can generate employment and earn valuable foreign exchange. Thus, it is important to measure the management orientation of commercial mango growers. However, despite an adequate number of instruments on management orientation, no instrument has been rigorously validated for measuring the management orientation of commercial mango growers. Therefore, this study aimed to develop a scale to measure management orientation, where 66 judges participated in the scale validation process. Specifically, relevancy analysis and item discrimination were used to validate this scale. The test-retest method of reliability was used at fifteen days interval. The coefficient of reliability for the overall scale was 0.8533, calculated by using Rulon's formula. The findings showed that the developed MO scale is valid and reliable. The investigation results can help researchers, progressive mango growers, scientists and extension workers in improving the scientific management of orchards by providing a new validated scale that could be used to assess planning, production and marketing inefficiencies, hence providing the needed training on these aspects effectively.

Keywords: Management orientation; commercial mango grower; scale development; validity; reliability

Digital Platforms for Agricultural Extension: Empowering Farmers in *Viksit Bharat*

DPA 1

Agricultural information dissemination using social media by farmers of South Gujarat

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ABSTRACT

Information dissemination is an important aspect in agriculture. Traditionally, agricultural information exchange has been dominated by media such as newspapers, radio, television and magazines. In recent years, the Information Technology transforms the agricultural information dissemination. The increases in technology awareness, computer literacy, smart phones usage and internet have helped social media to reach to far places of the country. In this context the present study was conducted to understand social media usage for agricultural activities. To achieve the objectives the descriptive research design was applied where primary data of 200 farmers from South Gujarat were collected using structured questionnaire. The study found the majority of farmers used Whats app, followed by YouTube, Face book and other social media platform, Majority of farmers use social media for Video Watching, Sharing and Downloading however low number of farmers upload their videos. The farmers use social media to get Information on Price of the commodity, Details of Agriculture inputs, Market information and Information about new crop. The outcome of the study will help stakeholders of the various domains of agriculture to reach to farmers using social media. Further, it will also helpful in designing future technology dissemination strategies.

Keywords: Agricultural Information dissemination, social media, Information Technology, ICT for Agriculture, Agriculture extension

DPA 2

Enhancing farmer outreach and knowledge sharing: An app review of JAU ikrushi Sanhita and Junagadh Janvani 91.2 FM

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ABSTRACT

Digital tools are reshaping agricultural extension in India, and platforms like *JAU iKrushi Sanhita* and *Junagadh Janvani 91.2 FM* are at the forefront, offering accessible, tailored information to farmers. This paper reviews these two online applications, both initiated by Junagadh Agricultural University (JAU) to support rural communities with relevant agricultural knowledge, market trends, and best practices. *JAU iKrushi Sanhita* provides comprehensive, on-demand information on crop management, pest control, weather updates, and market prices, equipping farmers with data-driven insights to enhance productivity and profitability. The app's user-friendly interface and multilingual support make it accessible to a wide range of farmers, including those in remote areas. *Junagadh Janvani 91.2 FM*, a

community radio app, leverages digital broadcasting to reach rural audiences with agricultural advice, live discussions, and expert interviews in regional languages. Through its interactive features, listeners can connect directly with agricultural specialists, gaining insights on seasonal farming practices, local weather forecasts, and government schemes. Both applications contribute significantly to bridging the information gap in rural areas, enhancing the effectiveness of agricultural extension, and supporting informed decision-making among farmers. The review highlights these tools' impact on knowledge dissemination, community engagement, and rural empowerment while also addressing potential areas for improvement, such as expanded content and user engagement strategies.

Keywords: Agriculture App, Community radio, Digital broadcasting

DPA 3

Fostering digital inclusion in agriculture through extension services

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ABSTRACT

The digital divide among farmers remains a significant barrier to inclusive agricultural development, limiting access to critical information, markets, and modern farming technologies. This review examines the role of agricultural extension services in addressing this divide and enhancing the digital literacy of farmers. Specifically, it explores how extension services can facilitate access to digital tools and platforms that provide real-time weather data, crop management advice, market prices, and financial services, which are crucial for enhancing productivity and resilience. This highlights the gap between urban and rural areas in terms of digital infrastructure and education, identifying key challenges such as limited internet connectivity, low digital literacy, and lack of affordable devices. It also discusses the potential of innovative digital solutions, including mobile apps, SMS-based systems, and e-extension platforms, to deliver tailored agricultural information and extension support to underserved farmers. Furthermore, it emphasizes the importance of capacity-building initiatives by extension agents to improve digital skills and ensure that farmers can effectively utilize technology for decision-making. By promoting digital inclusion, extension services contribute to improving agricultural productivity, reducing information asymmetry, and enhancing market access, thereby advancing rural livelihoods and fostering sustainable agricultural practices. It calls for stronger policy support, public-private partnerships, and investment in digital infrastructure to reduce the digital divide and empower farmers. Addressing these challenges through targeted extension interventions is essential for fostering equitable growth and achieving broader developmental goals in agriculture.

Keywords: Digital Divide, Agricultural Extension, Digital Literacy, E-Extension, Rural Development

DPA 4

Assessing farmer awareness of Rythu Bharosa Kendras: Pioneering digital initiatives in agriculture

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ABSTRACT

Rythu Bharosa Kendras (RBKs), or Farmer Assurance Centres, were launched by the Government of Andhra Pradesh in 2020 to provide comprehensive support to farmers through innovative one-stop solutions. RBKs have received international recognition, notably being nominated for the FAO Champion Award for 2022-2023, highlighting their contribution to food security and sustainable practices. By integrating advanced digital technologies, these centres have transformed agricultural service delivery, bringing essential resources directly to farmers' doorsteps. The initiative aims to enhance agricultural productivity via improved access to certified seeds, mechanization through custom hiring services, and modern extension services using ICT tools. They offer a wide range of services, including agri-input shops, weather and market information via digital kiosks, e-crop booking, and mobile applications for crop insurance, alongside technical advisories through smart TVs. The present study was conducted with 120 farmers in Visakhapatnam district aimed to assess their awareness of the services provided by RBKs. Results showed that 76.66% of farmers had medium awareness, while 14.17% were classified as having low awareness, and 9.17% had high awareness. Factors such as education level, interaction with extension agencies, frequency of visits, mass media exposure, social participation, achievement motivation, and innovative proneness significantly correlated with awareness levels. While RBKs have made substantial strides, challenges remain, including limited access to inputs and exclusive market offerings for specific crops. By fostering collaboration among agricultural departments, RBKs exemplify a pioneering approach to delivering quality inputs and services critical for enhancing farmers' livelihoods.
Keywords: RBKS, technology, digital initiatives, services, awareness.

DPA 5

Direct, total indirect and substantial effects between profile of the young practicing farmers and their AIT association

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ABSTRACT

The present study was conducted in Anand, Kheda and Vadodara districts of the Middle Gujarat. Farmers of these districts are comparatively more innovative and have a higher interest in using Agricultural Information Technology in their everyday lives. A total of nineteen variables were subjected to path analysis and the study revealed that education had exerted a maximum direct and substantial indirect effect and achievement motivation had the maximum total indirect effect in the determination of the AIT association of the young practicing farmers.
Keywords: Young practicing farmers, Agricultural Information Technology (AIT), direct-

indirect effect

DPA 6

Relationship between profile of the young practicing farmers and their AIT association

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ABSTRACT

The study was conducted in Anand, Kheda and Vadodara districts of Middle Gujarat using an Ex-post-Facto research design. Farmers in these districts are known to be innovative and have a keen interest in using Agricultural Information Technology in their daily lives. A total of 225 young practicing farmers were randomly selected from these districts. The study found that *independents variables* such as education, languages known, social participation, land holding, herd size, parental occupation, annual income, extension contact, source of information about AIT, agricultural mass media, innovative proneness, achievement motivation, credibility towards AIT tools, scientific orientation, economic motivation and risk orientation were positively and significantly associated with the use of Agricultural Information Technology. On the other hand, age, experience in farming and family size showed a positive but non-significant relationship with their AIT association.

Keywords: Young practicing farmers, Agricultural Information Technology (AIT), relationship

DPA 7

Determining the relationship between profile of the farmers and their utilization behaviour for Information and Communication Technologies

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ABSTRACT

The present investigation was carried out in Vadodara and Kheda district of Gujarat state. From each district three talukas were selected purposively as having a larger area under cultivation. From each selected talukas five villages selected randomly for the study. From each village, five respondents were randomly selected. Therefore, 150 respondents were selected for the study. The study aimed to understand the relationship between various independent variables and utilization behaviour of farmers for Information and Communication Technologies. The findings revealed that 60.00 per cent of the respondents exhibited medium level overall utilization behaviour towards ICTs. The findings also found that variables such as education, annual family income, occupation, extension participation, innovativeness and scientific orientation exhibited positive and highly significant correlation with utilization behaviour for ICTs. Similarly, family size, landholding and sources utilized by the farmers to learn the ICT tools showed positive and significant relationships with utilization behaviour for ICTs. Conversely, age and farming experience highly and negatively correlated with ICT utilization behaviour, while social participation showed a non-significant and positive correlation.

Keywords: Information and Communication Technologies, utilization behaviour, relationship

DPA 8

Sentiment analysis on reviews of agricultural mobile applications

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ABSTRACT

Agriculture plays a crucial role in economic and social development in India. More than half of Indian population is dependent on farming in the country. Acquiring timely information is essential for farmers to make decisions regarding weather, soil conditions, market trends, crop management, etc. However, many farmers are facing problems in getting this information, which can impact income and productivity. The technology interventions may helpful in providing timely and accurate information to the stakeholders. To address these issues, mobile based agricultural applications (apps) have emerged to bridge the information gap between the availability of agricultural inputs and delivery of agricultural outputs. The present study aims to understand the current scenario of agricultural domain related apps. To fulfill objectives, the qualitative research design was adopted. The data related to apps were collected from the Google play store. The popular apps having rating 3.8 and above were selected. User reviews (comments) were collected from 65 popular agriculture mobile apps by using keywords like agriculture mobile apps, best agri apps for farmers, crop management apps, farm advisory apps, farm to market apps and highly shared agri apps from January, 2024 to September, 2024 period. The sentiment analysis using NVivo 15 was carried out on collected data. Sentiment analysis classifies reviews into either positive or negative categories using auto code feature. Reviews (Comments) where no positive or negative sentiments are found are considered to be neutral. The outcome of this study useful for stakeholders concerned with agricultural domain mobile app for taking decisions. Further outcome of study may helpful in development and improvement of agri apps, ensuring that they meet the demands of farmer and facilitate wider adoption.

Keywords: Mobile Apps, Agricultural Apps, Google Play Store, Sentiment analysis, NVivo, Users review, ICT in Agriculture

DPA 9

Constraints experienced by the employees of South Gujarat about ICTs apparatus for exploring agricultural information

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ABSTRACT

ICTs apparatus and applications offer excellent possibilities for strengthening the linkage between research, extension and client system. Further, the ratio of extension agent to farmer can bridge by ICTs apparatus. In present study, the well-established institutions and private stakeholders of south Gujarat were identified who are exploring the agricultural information. The personnel engaged in welfare activities of those firms were identified. Among them, 200 employees were randomly selected for study. Constraints refer as the items of difficulties faced by the employees about used of ICTs apparatus for exploring agricultural information. The employees were asked to mention the constraints. Considering the constraints faced by the employees about used of ICTs apparatus, they were asked to give their valuable suggestion to overcome the constraints. The responses were summed up and converted into frequency and percentages. The rank was given to each constraint and suggestion. Out of all constraints, excessive workload (91.50 per cent) was reported as major constraint by the employees to utilized ICTs apparatus for exploring agricultural information and ranked first followed by lack of training (86.00 per cent), interrupted power supply (79.00 per cent), slow speed of internet (75.50 per cent), illiteracy among farmers (71.00 per cent), high cost of ICTs apparatus and services (67.00 per cent), poor mobile network (60.50 per cent), lack of funds to purchase ICTs apparatus (59.00 per cent), inadequate infrastructural facilities (54.00 per cent) and lack of skill in using various features of ICTs apparatus (52.50 per cent) ranked second, third, fourth, fifth, sixth, seventh, eighth, ninth and tenth respectively.

Key Words: Constraints, Employees, ICTs apparatus

DPA 10

Advancing financial inclusion through digitization: The Impact of India's e-Shakti project on Self-Help Groups

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ABSTRACT

Since the mainstreaming of Self-Help Group (SHG) financing by the Reserve Bank of India in 1996, the SHG-Bank Linkage Program has evolved into the world's largest microfinance initiative, significantly contributing to poverty alleviation, women's empowerment, and social upliftment in India. Despite its successes, traditional challenges persist in enabling seamless credit access for rural SHGs, particularly around manual record-keeping, transparency, and high non-performing assets (NPAs). The digitization of SHGs through NABARD's E Shakti project marks a transformative step toward addressing these barriers by streamlining financial processes and enhancing the inclusion of rural communities, especially women, in the formal economy. Launched as a pilot, E Shakti empowers SHGs with digital tools for efficient e-bookkeeping, credit tracking, and member account management. By 2019, it had partnered with over 300 organizations, reaching nearly 4.4 million SHG members across 22 states. Notable achievements include opening 64,000 Jan Dhan accounts, issuing 3.5

lakh insurance policies, and digitizing financial transactions, which enabled the fast-track disbursement of loans and improved credit access. The project has reduced the percentage of NPAs among SHGs and enhanced loan monitoring, leading to strengthened financial accountability and improved socio-economic outcomes for members. The digital interface also facilitates SHG participation in government welfare schemes, ensuring sustained welfare impact. While COVID-19 briefly affected loan disbursement in 2020-21, the E-Shakti network demonstrated resilience, continuing its growth trajectory. To further enhance financial inclusion, it is recommended to expand E-Shakti to underserved regions, conduct regular training for SHG members on digital finance, and improve credit evaluation systems to minimize NPAs. Through these measures, E-Shakti represents a crucial model for inclusive growth, leveraging digital technology to empower India's rural communities.

Keywords: SHG and E-Shakti

DPA 11

Effectiveness of reliance foundation information services (RFIS) on beneficiary farmers in Saurashtra region

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ABSTRACT

Today, transfer of technology in extension system is done by multiple service providers including both public and private institutions responding to the multifaceted demands, problems and needs of the farmers. Reliance Foundation Information Services (RFIS) is being implemented through modern ICT media and traditional face to face contact methods. The most well-known Information Communication Technology (ICT) today is the mobile phone and internet. Keeping this in view, the study was conducted on effectiveness of RFIS beneficiary farmers of Saurashtra region. The study was conducted in three districts viz., Junagadh, Gir Somnath and Jamnagar Districts of Saurashtra region of Gujarat. Two talukas from each selected district and three villages from each taluka were selected randomly. From each village, ten respondents were selected. Thus, total 180 respondents were selected for the study. The result of the research study indicated that more than three fourth of the respondents perceived information in timeliness and expressed that the mobile voice messages were used on time (77.32 per cent), followed by mobile text messages (75.00 per cent), knowledge on wheels programme (70.61 per cent), field awareness programmes, (67.80 per cent). With regards to Topic of interest of RFIS as perceived by the respondents that majority of the respondents were expressed very interesting in RFIS as perceived viz. pest management (90.00 per cent), selection of varieties (86.12 per cent), followed by sowing time (85.00 per cent), disease management (84.45 per cent), marketing (78.34 per cent), soil test & soil test based information (76.71 per cent), weather related information (75.62 per cent), selection of crops (66.12 per cent) and weed management (65.00 per cent). With respect to adoption of information disseminated by RFIS were fully adopted by the respondents were; weather related information (75.00 per cent), followed by soil testing & soil test-based fertilizer application (63.35 per cent) and disease management (58.38 per cent). While, fully satisfy with RFIS as perceived by the respondents were; field awareness programmes (76.12 per cent), followed by knowledge on

wheels programme (72.23 per cent), toll free number (70.11 per cent), phone in live (70.53 per cent), video conference (69.45 per cent) and veterinary camps (61.49 per cent).
Keywords: RFIS and Effectiveness

DPA 12

Association between profile of student and awareness of using ICTs by the student of agricultural universities

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ABSTRACT

The emergence of ICT has primarily changed the practices of not only business and governance but also education. The advent of Information and Communication Technology (ICT) is considered as one of the driving forces of globalization. ICT in agricultural extension can lead to the emergence of knowledge workers, resulting in the realization of a bottom- up, demand driven paradigm for technology generation, assessment, refinement and transfer. The study was carried out to determine the awareness of using ICTs by the students of Anand Agricultural University. The Study reveals that the relationship of age, education, medium of schooling, family education, job preference, annual expenditure, mass media exposure, information-seeking behaviour and risk orientation with their awareness of using ICT tools/services. The findings of the study revealed that majority of the students were aware about ICT and online agricultural educational portals. The study indicated an urgent need to strengthen the ICT system in the university in terms of infrastructure, facilities, accessibility and connectivity. The study results can be taken into account to make necessary reforms by the policymakers.
Keywords: Awareness; Information and Communication Technologies (ICTs); Student

DPA 13

Digital marketing: A way towards women entrepreneurship

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ABSTRACT

Digital marketing is a novel professional craft which relies on multiple scientific disciplines to create programs designed to influence human behavior on a large scale. It gives opportunity for entrepreneurs to nurture and succeed in the business with vast flexibility. In the world of digitalization, India is clearly seeing a revolution through women entrepreneurs. They are doing extraordinarily well due to their efficiency, hard-work, intelligence and innovativeness. In digital marketing various digital platforms are used for business advertising and product selling. Facebook, WhatsApp, You Tube, Mobile app, email and Instagram have become the main instruments through which women market their businesses and reach new audiences. By

posting pictures, videos, stories, and live videos attract a relevant audience. Benefits of digital marketing includes not requiring specific background education, global reach, cost efficiency, freelance job opportunities, less storage demand, measurable results, effective targeting, increase engagement, improving conversation rate, social currency etc. Digital marketing improves the self-reliance among home makers as well as their working flexibility and they can work from home itself. They do not worry about their responsibilities and may resume her career in the future. Digital marketing requires minimum investment for initiation. The visual nature of social media platforms builds visual identity across vast audiences through direct and indirect lines of communication which gather feedback about products and services. Aggressive promotions, accompanied by attractive offers such as discounts and additional services, have helped women entrepreneurs reduce the risk. Moreover, digital marketing increases the number of women entrepreneurs that enhances the family as well as national economy and wellbeing. Through digital marketing an active, constructive and creative human resource has been developed that boost psychological strength of women entrepreneur in positive direction.

Keywords: Digital Marketing and Women Entrepreneurs

DPA 14

Adoption of digital marketing by farmers: Perceptions and challenges

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ABSTRACT

Agricultural produce marketing is crucial for linking the farming sector with the wider economy, with efficient systems yielding substantial benefits. The Model Agricultural Produce Marketing Act 2003 and subsequent updates through the Model Agricultural Produce and Livestock Marketing (Promotion and Facilitation) Act 2017 represent steps toward improving the efficiency of agricultural markets in India. This paper observes the historical context and current advancements in digital marketing, particularly through the electronic National Agricultural Market (e-NAM), which seeks to unify agricultural markets across India and create a cohesive national commodity market. It analyzes the perceptions regarding e-NAM implementation and reviews its performance across different states. As of November 2023, e-NAM operates in 23 states and 4 Union Territories, encompassing 1,389 APMC markets and facilitating trade in 219 commodities, including grains, oilseeds, fruits, vegetables, and spices, with a trade value of Rs. 3 crores. Despite this progress, there remains resistance from traders and commission agents, who perceive limited advantages in e-auction compared to traditional physical transactions. Balancing the interests of all stakeholders i.e. farmers, traders, and agents presents a significant challenge in e-NAM's implementation. Consequently, this paper also addresses the challenges faced by farmers in adopting digital platforms for marketing which includes lack of trust, online transaction process difficult and lengthy, sale process complicated than before, and delay in receiving online payment. The paper concludes with future research directions, strategic recommendations, and policy guidelines to bolster digital marketing, including infrastructure development, awareness initiatives, and dispute resolution

mechanisms. The findings highlight the urgent need for actions that build trust, improve stakeholder understanding, and develop the infrastructure essential for effectively implementing and adopting digital marketing in agriculture.

Keywords: Digital Marketing, e-NAM, Perceptions, Adoptation, Challenges

DPA 15

Financial inclusion through UPI: A study on Indian farmers' payment systems

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ABSTRACT

UPI transactions in India reached over 10 billion in October 2023, a significant increase from 7 billion in October 2022, over 40% of new UPI users in recent years come from rural area. UPI has been estimated to save the Indian economy approximately $67 billion by reducing transaction costs and improving efficiency. A survey indicated that 91.5% of UPI users reported satisfaction with their UPI usage, and 95.2% found making payments via UPI convenient. The Unified Payments Interface (UPI) has emerged as a transformative force in India's digital payment landscape, significantly impacting various sectors, including agriculture. This research paper delves into the adoption and utilization of UPI by Indian farmers, examining its benefits and broader implications. Through a comprehensive methodology involving surveys, discussions, and transaction data analysis, this study aims to provide a detailed understanding of how UPI is being leveraged by farmers for their financial transactions. The findings indicate that UPI has facilitated a more efficient and transparent payment system for farmers, reducing dependency on intermediaries and ensuring timely payments. This has led to improved financial inclusion, with farmers gaining better access to banking services and credit facilities. The study highlights several key benefits of UPI for farmers, including enhanced transaction security, reduced transaction costs, and increased convenience. Additionally, UPI's role in promoting fair pricing and reducing the risk of fraud is explored. Despite these advantages, the research identifies several challenges that hinder the widespread adoption of UPI among farmers. These include issues related to the integration of UPI with existing agricultural supply chains, the need for continuous technical support, and the adaptation of UPI features to meet the specific needs of the agricultural sector. The paper discusses potential solutions to these challenges, such as developing tailored UPI applications for farmers and providing ongoing technical assistance. The paper concludes with policy recommendations aimed at enhancing UPI adoption among farmers, such as government incentives and support for digital infrastructure development. Future research directions are suggested to further explore the long-term impacts of UPI on rural economies and to identify additional strategies for promoting digital financial inclusion.

Keywords: UPI Adoption, Digital Financial Inclusion, NABARD, MSME, UPI, Agricultural Payments, Internet of Thing, National Payments Corporation of India (NPCI)

DPA 16

Assessing the perceived benefits of Information and Communication Technology for farmers in South Gujarat

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ABSTRACT

Agriculture serves as the backbone of the Indian economy, and the 21st century is often referred to as the "Information Age" and that has significantly impacted this agriculture sector. Access to agricultural information is essential for optimizing production factors such as land, labour, capital, and management. In this the extension services, research institutions, and agricultural organizations play a crucial role in delivering relevant and reliable information that supports farmers' decision-making processes, ultimately boosting productivity. In this context, Information and Communication Technology (ICT) is emerging as a transformative force in agriculture, driving rural development in India. ICT applications provide farmers with timely and accurate information, enhancing their capabilities in areas such as agro-inputs, crop production technologies, market access, and financial management. This study investigates the perceived benefits of ICT usage among the farmers of South Gujarat, focusing on three districts: Navsari, Valsad, and Surat. A total of 300 farmers participated, with data collected through a structured interview schedule. The findings indicated that, among 28 assessed parameters categorized into managerial, operational, technical, and financial benefits, the most significant perceived advantage was the enhancement of decision-making power through modern ICT tools. Additional notable insights include the impact of agricultural information disseminated via television and the usefulness of the Kisan Call Centre's toll-free number for resolving agricultural queries. Overall, the study underscores the need for continued investment in ICT initiatives and infrastructure to further enhance the benefits for farmers.

Keywords: ICT, Perceived Benefits, Agricultural Information, South Gujarat

DPA 17

Utilization of Information and Communication Technology services by farmers

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ABSTRACT

The Information and Communication Technologies (ICTs) facilitate better and rapid communication among researchers, extension officers and farmers ensuring timely access to information. This is helpful for timely and easy transfer of knowledge about new technologies and improved practices related to agriculture and allied fields. The ICTs also provide information about weather forecasts, pest alerts and control measures. The farmers can easily bring their agricultural problems in the attention of researchers and extension officers for further solutions and advisory. The farmers can receive timely information to adopt new technologies and improved practices as well as to mitigate aberrant weather condition. It leads to improvements in agricultural production and their income. The research study was carried out to access the 'Utilization of Information and Communication Technology Services by Farmers" A study was conducted in Junagadh, Rajkot and Amreli districts of Gujarat state. Total twenty-four villages from six talukas of three districts were selected randomly and ten farmers from each village were selected as respondents. Thus, a sample of total 240 farmers was considered for the study. The respondent farmers were personally contacted for data collection. The data were analyzed using statistical methods. The result showed that ICT

services which had higher utilization level were: Mobile (71.76 per cent), TV (65.16 per cent), WhatsApp (64.26 per cent), YouTube (54.00 per cent), Kisan Call Center (51.10 per cent), I-Khedut Web Portal (43.78 per cent), Facebook (32.33 per cent), agri.gujarat.gove.in (29.79 per cent), JAU-AAU-SDAU-NAU website (25.50 per cent), Agri Media App (23.93 per cent) and Radio (19.91 per cent).

Keywords: ICT, Utilization, Communication

DPA 18

Perception of agricultural students towards e-learning

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ABSTRACT

This research investigated Perception of Agricultural Students Towards E-learning. The study was conducted in Gujarat Agricultural University, Gujarat. The study explores with specific objectives such as studying the profile of agricultural students, assessing the perception of agricultural students towards E- learning, ascertaining the relationship between profile of the students & perceptions of agricultural students towards E- learning, eliciting constraints and offering suggestions for E- learning. The "Ex-post-facto" research design and Simple random sampling technique were used for the research. Total 74 respondents were selected for the present study. The data was primarily collected Based on Questionnaires in Google Form. More than half (75.67 per cent) of the respondents had high level of perception towards E- learning, followed by 24.32 per cent respondents had medium and 0 per cent respondents had low level of perception towards E- learning. They were believed that E- learning is beneficial for the Education or study. E- learning is the better learning, and boost learners learning interest. Help in understanding learners' individual preference. The data depicted in table 4 reflected that 98.6 per cent of agricultural students had constrains about Not gaining ideas about field followed by Network issues (94.60 per cent), It could be inferred from the table that free wi-fi allotted to students (97.29 per cent), provided good connection (94.60 per cent), provided good network facilities (93. 24 per cent), respectively.

Key Words: Perception, Agricultural Education

DPA 19

Digital platforms for agricultural extension: Empowering farm women's in Viksit Bharat

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ABSTRACT

Digital platforms are poised to play a transformative role in agricultural extension services, particularly in empowering women farmers in the vision of Viksit Bharat (Developed

India) by 2047. As agriculture remains a cornerstone of India's economy, integrating digital technology into this sector is essential for enhancing productivity and sustainability. Digital platforms provide women farmers with direct access to information, resources, and markets, thereby addressing historical inequalities and fostering economic independence. Initiatives under the Digital India program emphasize the use of artificial intelligence, mobile applications, and e-commerce to facilitate knowledge sharing and improve decision-making. By leveraging these technologies, women can gain insights into best practices in farming, pest management, and market trends, which are crucial for optimizing yields and income. Furthermore, digital platforms can enhance women's participation in agricultural value chains by connecting them with buyers and suppliers, thus reducing dependency on intermediaries. The establishment of agri-innovation hubs and e-commerce platforms tailored to women's needs will ensure that they are not only beneficiaries but also active contributors to agricultural development. This approach aligns with the broader goals of Viksit Bharat, which seeks to create an inclusive and sustainable agricultural ecosystem. Ultimately, empowering women through digital platforms is not just a matter of equity; it is vital for achieving food security and economic growth in India. By 2047, a digitally empowered agricultural sector can significantly uplift rural communities, making them resilient against challenges such as climate change and market volatility. The integration of gender-sensitive policies within these digital frameworks will further enhance their effectiveness, ensuring that women farmers are equipped with the tools necessary for success in a rapidly evolving agricultural landscape.

Key words: Empowerment, Farm Women’s, Viksit Bharat, Digital platform

DPA 20

Ascertain the relationship between YouTube user farmers and their utility perception

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ABSTRACT

The study was conducted in Maharashtra’s Parbhani district, 120 farmers who were users of YouTube were surveyed. The results show that the majority of respondents belonged to middle age group having high school level education belonged to medium family size with small size land holding having low social participation with high extension contact, medium level innovativeness, medium level source of information who possess good network connectivity and medium level for possession of ICT tools. The study aimed to understand the relationship between various independent variables and the utility perception of YouTube. The analysis revealed noteworthy relationships between independent variables and utility perception. The variables namely education, social participation, extension contact, innovativeness, source of information, network connectivity and possession of ICT tools were positively and significantly related to utility perception of YouTube. Whereas, family size and land holding did not show any significant relationship with utility perception of YouTube. However, age of the respondents was significantly negative relationship with utility

perception of YouTube.
Keywords: Utility perception, YouTube, farmers, relationship

DPA 21

Role of technology in agricultural marketing: Prospects and challenges

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ABSTRACT

Before the adoption of technology in agricultural marketing, farmers were primarily relied on traditional channels, which often involved multiple intermediaries and limited access to market information. This traditional structure created significant inefficiencies, with farmers facing information asymmetry, delayed payments, and low bargaining power, often leading to lower incomes. Without timely access to price information and market trends, farmers were at a disadvantage, unable to optimize their marketing decisions or connect directly with buyers. The emergence of technology has fundamentally transformed these dynamics, offering new digital platforms, mobile applications, and data-driven tools that streamline the agricultural marketing process. In agricultural marketing, technology plays a vital role in transforming how products are marketed, sold and distributed from producers to consumers. Agricultural technology offers new opportunities for improving efficiency, enhancing market access, real-time pricing information, make informed decisions and empowering farmers through innovations like e-marketing, ICT, mobile apps, *etc*. However, challenges in agricultural marketing persist, such as limited market access, high costs and a lack of knowledge about new technologies. Understanding both the opportunities and obstacles is essential for leveraging technology to create a more efficient and equitable agricultural marketing system.

DPA 22

Exploring internet usage patterns among students of Anand Agricultural University

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ABSTRACT

The rapid growth of the internet and digital technologies has significantly transformed education, providing students with access to vast amounts of information and learning resources. In recent years, educational institutions have increasingly integrated internet-based tools and platforms to enhance the learning experience, facilitating online courses, research, communication, and collaboration. However, the way students utilize the internet varies based on factors such as personal interests, academic needs, and socio-demographic characteristics. Anand Agricultural University (AAU), located in Anand, Gujarat, is one of India's prominent institutions focused on agricultural education, research, and extension services. With the growing importance of digital tools in education, understanding how the students of AAU use the internet is crucial to assessing both the opportunities and challenges posed by the internet in an academic context. As an institution dedicated to agricultural sciences, AAU students are expected to have specific needs for internet usage, ranging from research on agricultural techniques to staying updated on the latest developments in the field. A sample of 70 students

of Anand Agriculture University were selected randomly for the study. The results found that respondents (72.90 per cent) have used internet for 2 to 5 hours in a day. Web sites or apps are used, mostly (84.29 per cent) of the students uses WhatsApp, followed by 64.29 per cent, 52.86 per cent, 32.86 per cent, 28.57 per cent, 15.71 per cent,14.29 per cent and 08.58 per cent of them uses You tube, Instagram, Google scholar, Slide share, Krishikosh, Linked in and Facebook, respectively. The findings will offer valuable implications for enhancing the digital learning ecosystem and supporting students in optimizing their internet usage for educational success and personal development.
Keywords: Anand Agriculture University, Internet.

DPA 23

Social media platforms used in agriculture

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ABSTRACT

Historically, industrial media like newspapers, radio, and television have been used to spread agricultural information. Individuals, especially farmers are disseminating personal or agricultural information via blogs, YouTube, Facebook, Twitter, and other social media sites. The advantages of social media for farmers are highlighted in this study as follows: it allows for quick coverage of wide geographic areas, lessens social isolation among farmers, expands networking opportunities, mobilizes farmers, keeps them informed, and makes it simple to market agricultural products. Information for the paper was obtained from the University of Limpopo e-library, Google Scholar, Scopus, and Science Direct search engines. This essay outlines the many social media platforms accessible to farmers, explains the advantages of social media, and defines the term. As a result, social media platforms have transformed how information is disseminated in agriculture, offering numerous benefits: Real-Time Communication, Knowledge Sharing, Access to Resources, Market Access, Networking Opportunities, Community Building, Awareness Campaigns, Visual Engagement, Feedback Mechanism, Global Reach, etc. By leveraging social media, the agricultural community can enhance knowledge dissemination, improve practices, and ultimately contribute to more sustainable and productive farming.
Keywords: Social media, Extension officers, Farmers, Information dissemination

DPA 24

Need assessment for programes on community radio station at SDAU

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ABSTRACT

The present study aimed to assess the need and preferences for community radio programs among rural communities.The study was conducted within a 15 kilometer radius around the radio frequency of Sardarkrushinagar Dantiwada Agricultural University (SDAU) in Banaskantha District. Out of 58 villages, 12 villages were randomly selected using the chit method. Age, gender, education, caste, family structure, income, occupation, landholding, and mass media exposure were studied as independent variables and need of program and extent of preferences for varied areas were studied as dependent variables. Personal interviews technique was used for data collection. Statistical tool such as frequency, percentage, correlation coefficient and ANOVA were used in the study.The results indicated the majority of respondents were middle-aged, educated up to the secondary level, primarily engaged in farming and animal husbandry. Most belonged to socially and economically backward classes, lived in joint families, and had low mass media exposure. Agriculture and Animal husbandry was identified as the most preferred topic for radio programs. Age and education were positively and significantly correlated with the need for community radio programs. The findings concludes that community radio stations should prioritize on agriculture and government schemes to meet the most pressing needs of rural listeners.

Keywords: community radio station, agriculture and animal husbandry, need assessment

DPA 25

Kisan credit card: bridging the gap between farmers and financial support in Saurashtra region of Gujarat state

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ABSTRACT

A vital component for agricultural output is financing. India’s economy is based mostly on agriculture. The Kisan Credit Card (KCC) aims to provide farmers with flexible and affordable financing in a timely and suitable manner. A turning point in the history of agricultural lending in India was reached with the launch of the Kisan Credit Card Scheme which was first implemented in 1998–1999. Kisan Credit Card (KCC) enables farmers to meet their production-related demands by withdrawing cash and buying agricultural products like seeds, fertilizer, and insecticides etc. The Kisan Credit Card Scheme was developed to make it easier for borrowers to obtain short-term loans from traditional financial institutions. The KCC also covers post-harvest costs, consumption needs, and financing requirements for agricultural and related industries. The plan's implementation is the responsibility of cooperatives, small finance institutions, and commercial banks. Under the KCC plan, farmers are protected from the outrageous interest rates that traditional banks impose. KCC loans have interest rates ranging from 2% to 4%. Considering the crop's harvesting season and the loan's issuance date, this low interest rate helps farmers repay loans more rapidly. Secondary data was collected and evaluated in this research project to examine the growth and variations of the Kisan Credit Card in terms of number and amount sanctioned from 2019 to 2023 in Saurashtra region. The data was analysed, and a conclusion was reached.

Keywords: Kisan credit card, growth, variations, agricultural products, credit.

DPA 26

Revitalizing Agriculture through Digital Extension: Boosting Productivity and Livelihoods

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ABSTRACT

Digital extension services represent a transformative approach to agricultural outreach, leveraging technology to provide farmers with timely and accurate information. These services encompass a wide range of digital tools, such as mobile applications, SMS services, and online platforms, designed to disseminate critical agricultural knowledge, including best practices, weather updates, market trends, and pest management strategies. Farmers are increasingly

recognizing the value of these digital services as they offer easy access to information, enhance decision-making, and improve productivity. From the farmers' perspective, digital extension services are seen as a means to overcome traditional barriers, such as limited access to expert advice, geographical constraints, and time delays associated with conventional extension methods. By enabling real-time communication and personalized support, these services empower farmers to make informed decisions, ultimately leading to increased yields and income stability. However, challenges such as digital literacy, connectivity issues, and affordability remain concerns that need to be addressed to maximize the reach and effectiveness of these services. Digital extension services are poised to play a crucial role in transforming the agricultural sector. They contribute to the modernization of farming practices by promoting sustainable methods, improving market access, and fostering innovation. As the adoption of these services grows, the agricultural sector is likely to witness a paradigm shift towards more data-driven and resilient farming systems. Looking ahead, the future of digital extension services lies in the integration of advanced technologies such as artificial intelligence, machine learning, and big data analytics. These innovations will enable more personalized and predictive support for farmers, further enhancing productivity and resilience in the agricultural sector. For digital extension services to reach their full potential, efforts must be made to improve digital infrastructure, enhance user training, and build trust among farmers. This will require a collaborative effort among governments, private sector actors, and agricultural organizations to ensure that digital extension services are inclusive, reliable, and sustainable.

Keywords: Revitalizing, extension, dissemination, digital tools, online platform

DPA 27

Improving the effectiveness of m-kisan mobile services: identifying constraints and solutions

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ABSTRACT

The m-Kisan initiative is a government-driven program that aims to provide agricultural information and services directly to farmers through mobile phones. Mobile phones are preferred over other ICT tools due to their widespread accessibility, portability, and ease of use. They are affordable and provide access to services *via* SMS, voice calls, and apps, making them ideal for diverse populations. Farmers can receive crop-specific advisories through SMS in their preferred language. It offers crucial information on a variety of topics such as weather forecasts**,** crop advisories**,** market prices**,** pest management**,** irrigation tips**,** updates on government schemes and subsidies. This helps farmers make informed decisions, optimize crop yield, and manage risks related to weather, pests, and market fluctuations. Farmers can register on the m-kisan portal with their mobile numbers to receive personalized alerts tailored to their region and crop needs. The m-kisan platform also serves as a source of educational content, offering training programs on modern farming techniques, soil health, and sustainable practices. This study conducted in Bhavnagar district with a sample size of 120 m-kisan users provide insights into the constraints faced by them and suggestions to make it more effective. The important constraints found were m-kisan does not have follow-up sessions after providing information, lack of clarification of doubt, limited information availability on logistics and storage. The major suggestions given include multi-crop information must be made available, provision of adequate market information, provide timely and accurate information.

Keywords: m-kisan, users, mobile, extension service, constraints and suggestions

Gender Perspectives in Agricultural Extension: Sensitization and Empowering Women Farmers

GPA 1

Different dimensions of gender inequality in India

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ABSTRACT

Women play an indispensable role in agricultural activities worldwide, yet they often face inequalities in decision-making processes within the sector. It is known that 78 percent of India's employed women work in agriculture. As per the Annual Periodic Labour Force Survey, 2021-2022, agriculture has the highest estimated female labour force participation of 62.9 percent. Women has been playing significant role in home, farm and allied activities. The day of the farm women is starting from early morning to late evening. They remain engaged with home, crops and livestock management throughout the day. Thus, study was conducted in North Gujarat region of Gujarat. The objective of the study also examines the participation of farm women in decision making related to home, farm and animal husbandry practices. The study was based on the primary data of 100 farm women. Results of the study reveals that majority of the farm women's educational status is illiterate and primary education with 35 and 43 per cent respectively. This study also concluded that in process of decision making, food purchasing and meal planning with 93 percent followed by cooking with 90 percent was involved and also concluded that women's role in borrowing money for home management and repayment of loan is very less. Farm women's involvement in the process of decision making for farm management is very low. In animal husbandry sector, women role in decision making is higher than man but in decision of sale and purchase of animal, selection of animal breed, this type of decision is mostly taken by the man. So, this study indicates that farm women role in financial and marketing management is very less. Therefore, it's an uphill task for government, policy makers and for all to empower the farm women from each and every corner.

Keywords: Decision-making, farm women and Management

GPA 2

Bridging the divide: gender insights in the digitization of agriculture

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ABSTRACT

The **gender digital divide** refers to the disparities between men and women in accessing and using digital technologies and information and communication technologies (ICTs). Key dimensions include unequal access to devices and internet services, differences in digital literacy skills, and varying usage patterns influenced by societal norms. Despite being key contributors to agricultural production, women often encounter barriers to accessing digital tools and resources, including limited technical skills, lack of financial resources, and sociocultural constraints which restrict women's engagement with technology. The patriarchal society often suppresses women's voices and expressions, leading to inequality in access to resources such as land, credit, and markets. Digitization in agriculture is vital for empowering farm women, offering numerous benefits that enhance their livelihoods. Digital platforms provide essential information on weather, market prices, and best practices, enabling informed decision-making and increased productivity. Digital financial services like mobile banking and microloans enhance financial inclusion, giving women access to credit and savings, which are crucial for investment in their farms. E-learning and digital training programs help women develop new skills, boosting their confidence and productivity. Additionally, digital tools foster networking among women farmers, facilitating knowledge sharing and collaboration, while precision agriculture technologies streamline farming processes, reducing the physical burden on women. Addressing this divide is crucial for unlocking women's potential in the digital economy and smart agriculture. More efforts through gender responsive extension strategies, digital literacy programmes, knowledge on e-agriculture, innovations in technology, such as low-cost connectivity solutions and user-friendly devices, can contribute significantly to bridging the divide. Bridging digital divide could be attained through strengthening infrastructure, ICT tools, enhancing digital literacy, creating awareness and public-private partnerships.

Keywords: Gender digital divide, digitization, digital tools, digital literacy

GPA 3

The significance of financial literacy in overall women empowerment: a review

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ABSTRACT

Women are at the core of every family, making them an integral part of society and the nation. The socio-economic development of women is essential for the overall economic growth of any society or country, as they serve as key agents of economic progress. In the current Indian context, financial literacy policy is viewed as a crucial tool to increase the demand for banking products and services. Financial literacy can be defined as the competence to understand financial market services and products, along with recognizing the associated rewards and risks to make informed choices. Studies show that women generally have lower confidence in their financial knowledge and skills compared to men, often due to a lack of financial education. Therefore, it is essential to promote financial literacy among women to empower them to make informed and effective decisions regarding the management of their money. Financial literacy can serve as a means of empowering women economically, thereby giving them a central role in society and enhancing their contribution to economic development. This paper provides an overview of financial literacy and discusses how empowering women through financial education can yield significant benefits for the nation through their development and empowerment.

Keywords: Financial literacy, financial decisions, economic progress, women empowerment

GPA 4

A regression analysis – relationship between body composition parameters and biological parameters of farm women working under high temperature

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ABSTRACT

Considering climate change and global warming can exacerbate the temperature and directly or indirectly can increase heat related illness, the present research was planned with the objectives (i) to assess biological parameters of farm women working at farm in summer season and (ii) to assess relationship between biological parameters of farm women while working at farm in summer season with environmental factors and their body composition parameters. Multistage random sampling method was used. Thus, the total sample of the study was 80 farm women who were involved in agriculture, animal husbandry or horticulture activities. Direct association was found between aural temperature of farm women and air temperature at their field. Age of farm women was found directly associated with high oral temperature working at farm. It can be inferred that oral temperature of older farmwomen increases more under the condition of heat stress. Mean skin surface temperature of farm women was found associated with their mass body fat, soft lean mass and air temperature. If the MBF, SLM and air temperature is high, it will significantly affect the mean skin temperature of farm women while working outdoors in hot climate. Heart rate was found associated with height and air velocity.

Keywords: Skin temperature, heart rate, air temperature, air velocity

GPA 5

Economic empowerment of rural woman through SHGs promoted by Krishi Vigyan Kendra of Ambuja Cement Foundation

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ABSTRACT

Self Help Groups play an important role in rural transformation. There are many successful SHGs in Gir Somnath district of Gujarat state. SHGs enhance the dignity and self dependence of many rural women. Many more are the benefits. Rural women play a significant role in the domestic and socio-economic life of the society. Socio-economic empowerment has been considered instrumental for holistic development. This study addresses economic empowerment of women through self help groups in Gir Somnath district of Gujarat State. Krishi Vigyan Kendra (KVK) and Ambuja Cement Foundation (ACF) formed SHGs under women empowerment programme to create an awareness and participation among residing in the rural pockets of Gir Somnath district. The diagnostic study was confined to 14 villages from which 250 SHGs and 250 non SHGs rural woman members selected for study. The selection of villages one of the criteria was the villages having more than 8 SHGs were selected for the study & also conducting their livelihood activities since more than 3 years. A comparative study was taken out between SHG and non SHG rural woman members. The result revealed that the independent sample 'Z' test showed that there was highly significant

difference in the mean values of SHG members and Non SHG members in case of skill development, saving & investment, self sufficiency and knowledge about banking system.
Keywords: Ambuja Cement Foundation**,** economic empowerment, Krishi Vigyan Kendra, Self help groups**,** women

GPA 6

Self-Confidence and Self-Reliance impact of women through Self Help Group with special reference to Gujarat

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ABSTRACT

The main objective of the study is to understand the impact of SHGs in empowering self-confidence and self-reliance of SHG women members in India with special reference to Gujarat. The study is based on the systematic review of various literature related to the objective of the study. The secondary sources for review of literature were online thesis, journal articles and reports available in research websites. The analysis of reviewed quantitative research studies reflected positive impact of SHGs on members both in India and Gujarat boosting up their self-confidence and self-reliance. However, qualitative research findings highlighted that there were barriers in boosting up the confidence levels in patriarchal system in Gujarat, where women still require permissions of their husbands or household members for several reasons. More qualitative research such as focus group discussions and case studies need to be encouraged in future for in-depth understanding of the barriers of SHG members in enhancing their self-confidence and probable means of overcoming these barriers.
Keywords: Self Help Group, self-confidence, self-reliance, quantitative research, qualitative research

GPA 7

Assessment of grain storage practices followed by the farm women of South Saurashtra agro climatic zone

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ABSTRACT

The present study was conducted in the South Saurashtra Agro-climatic Zone of Gujarat

State. Total 100 farm women from 10 villages of 10 talukas were selected random sampling method. The results of the research reveals that pulse beetle, rust red flour beetle and khapra beetle were major pest occurred during storage. Metal bins/kothi, small tin/ container glass bottle and polyethylene bags were used by the most of farm women for storage of wheat, pearlmillet and pulses. The reasons for use of these grain storage structures were easily availability and easy in use. Boric powder and sulphos chemical were used during grain storage practices by most of the farm women. Dry neem leaves and castor oil common indigenous practices were adopted during storage. The major reason behind used of these storage practices were cheaply, easily availability, safe in use and rapid control.
Keywords: Assessment, grain storage practices

GPA 8

Perceptions of farm women on training needs for soil and water conservation practices

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ABSTRACT

Considering women's involvement in a wide range of conservation practices, it is evident that production potential can be realized only if women get the necessary training, technical know-how and support. Training is an important education tool, which can be effectively used to improve, refresh or to update the knowledge of learner. A systematically arranged training programme brings about desirable changes inbehaviour on the part of the people. Therefore need based training necessitate to equipping the women with specialized knowledge and skills. This paper explores the perceptions of farm women regarding their training needs for soil and water conservation practices. The study was conducted in eight villages within the Girwa (tribal) and Badgaon (non-tribal) administrative units in the Udaipur district of Rajasthan. Data were collected from 200 randomly selected respondents (100 tribal and 100 non-tribal women) using a detailed questionnaire and personal interviews. The findings revealed that over half of the respondents (54%) fell into the medium training needs group. The top priority training needs expressed by the respondents included developing various land management practices (MPS 90.3) and raising awareness of water harvesting structures and their judicious use (MPS 90.3). Conversely, the least priority training needs were the implementation of the furrow method of sowing (MPS 52) and making fencing around the catchment area (MPS 67.3). There was no significant difference in the training needs between tribal and non-tribal women regarding natural resource conservation. Based on these findings, it is recommended that training modules and skill-oriented programs related to soil and water conservation practices be organized for farm women to ensure the effective utilization of natural resources.
Keywords: Farm women, Natural resources, Soil & Water, Conservation practices, Land management, Water harvesting

GPA 9

Women friendly agricultural tools: A review

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ABSTRACT

Most of rural women get their earning from agriculture sector. Right from seed sowing - harvesting of crop – post harvest operations, in all steps, women participate in every work related to agriculture. Due to intensive physical work, they get drudgery. Ergonomically designed, especially for women reduces drudgery and make them work more efficiently. This paper aims to review women friendly agricultural tools developed by ICAR institutes and state agricultural universities. Various institutes had developed tools and equipment which are easy to work with and more efficient.

Keywords: Ergonomics, women, hand tool, agriculture

GPA 10

Group cohesiveness among members of Farm Women Interest Groups in Kheda district

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ABSTRACT

Groups are structures formed for mutual help and the accomplishment of special goals. Today in the context of the changing scenario of agriculture farmers and farm women groups can play significant roles in acquiring skills, accessing inputs, forming enterprises, processing and marketing the produce to gain profit. In this context, the present study was conducted in Kheda district. The study revealed that the majority of the FWIGs members were found in the middle age group, secondaryto higher secondary level of education, had 5 to 10 years of experience in FWIG, had a small size of land holding and had annual income up to ₹ 50,000/.The majority of their membership in one to two organizations had received 6 to 10 training, had medium extension contact and mass media exposure. The FWIG members showed more than half (57.34 per cent) of the FWIGmembers had medium to high Group cohesiveness, followed by low (17.33 per cent) and very high (13.33 per cent) Group cohesiveness.

Keywords: Farm women interest groups, skill, farm women, organization, education, size of land holding

GPA 11

Attitude of the women members towards Self Help Group (SHGs) & its activities

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ABSTRACT

According to NABARD- Self Help Group (SHG) is a small, economically homogenous and affinity group of rural poor, voluntarily formed to save and mutually agree to contribute in a common fund to be lent to its members as per group decision for their socio-economic development. In India, many SHGs are ‘linked’ to banks for the delivery of micro-credit. Micro-credit in common parlance refers to small loans that help the poor women to meet their immediate credit needs. The most important functions of a Self-Help Groups are to encourage and motivate its members for saving, to persuade them to make a collective

plan for generation of additional income and to act as a conduit for formal banking services to reach them. In order to realize the objective of the study, 180 SHG women members were selected from 18 villages of the 6 talukas of Junagadh and Rajkot districts of Saurashtra region by employing multistage, purposive and random sampling technique. In order to measure the attitude of the SHG members, the attitude scale was developed and it was measured by using scale product method. Final scale consists of 28 statements from total 44 statements. The scale was administrated to the SHG members to measure attitude toward SHG & its activities.The result showed that 27.78 per cent of the respondents had medium level of the attitude towards Self Help Groups and its activities, followed by 26.67 per cent of the respondents had high level and 16.67 per cent of the respondents had very high level of the attitude toward SHG & its activities, respectively. Whereas, 21.66 per cent of the respondents had low level of the attitude toward SHG & its activities.
Keywords: SHGs, attitude, women members etc.

GPA 12

Working models of SHG bank linkage programme

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ABSTRACT

SHGs are either registered or unregistered, affinity group of about ten to twenty people from a homogenous class, who come together for addressing their socio economic problems. They start with saving and not with credit and make voluntary thrift on a regular basis and use this pooled resources to make small interest bearing loans to their members. The vision of the formation of SHG is to empower rural poor women for overall development of the country. The main object of the SHG approach is providing access to credit in the context of poverty reduction and women empowerment. There was a net addition of 6.73 lakh SHGs during the year.The SHGs having savings linkage to 85.77 lakh as on 31 March, 2017. The savings outstanding of SHGs with banks as on 31 March, 2017 had reached an all-time high of ₹ 16114.22 crore. The growth of SHG was found positive in the year 2016-17.
Keywords: SHG, credit, saving & bank etc.

GPA 13

Problems faced by women Self-Help Groups in agriculture in South Gujarat

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ABSTRACT

The Self-Help Group (SHG) movement in India has evolved into a powerful platform for empowering rural women, particularly in agriculture. With 67 million women across 6 million groups, SHGs facilitate savings, credit, and collective entrepreneurship, playing a vital role in agricultural development. This study focuses on the four districts of South Gujarat-Navsari, Valsad, Surat, and Tapi—to identify the problems faced by Women SHG members engaged in agricultural activities. Using the Garrett ranking method, the study revealed that the

most significant obstacles include lack of marketing information and communication, limited market access and inadequate promotional strategies. Other critical issues identified were high transportation costs, insufficient infrastructure for processing and value addition, distance from market and high competition. These obstacles significantly hinder the economic potential of SHGs in agriculture, limiting their members' ability to capitalize on market opportunities. The findings highlight the urgent need for targeted interventions to enhance marketing capabilities of women members of SHG's through training in marketing and promotion, group marketing of their produce and systematic efforts for branding and proper packaging of their produce.
Keywords: Women, SHGs, marketing, problems

GPA 14

Assessment of food and nutritional security status of farm women of Junagadh and Porbandar district

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ABSTRACT

The food and nutritional security of farm women in India is a concerning issue. Despite the fact that agriculture is essential to the nation's economy, prejudice against women farmers and their restricted access to resources frequently lead to food and nutritional poverty. Because women are crucial in the selection, preparation, and presentation of food for their families, they can be a valuable collaborator and contributor to the nutritional security of rural residents. Considering the above facts, it seems worthwhile to know the food and nutritional security status of farm women. The study was conducted in Junagadh and Porbandar district to assess food and nutritional security status of farm women and to study the relationship between food and nutritional security status and profile of farm women with 180 respondents. The result of study revealed that slightly less than two third (65.56 per cent) of farm women had medium food and nutritional security status. The characteristics like annual income and cropping pattern had positive and highly significant relationship with the food and nutritional security status. Education, training received, size of land holding, social participation, livestock holding, source of information, mass media contact were positively and significantly related with the food and nutritional security status.

GPA 15

Scale to measure attitude of women towards Self Help Groups

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ABSTRACT

Self Help Groups (SHGs) are widely recognized as a crucial means for the development of women globally. The primary objective of forming and nurturing SHGs is to motivate and assist women in engaging in productive activities that enhance their quality of life. However, a significant issue is the tendency for these groups to become defunct after years of successful operation. This failure in sustainability is a major concern. To address this, it is essential to study the attitudes of women towards SHGs. In this context, the researcher felt need to developed a scale to measure attitude of women towards self help group. Among the techniques

available, researchers were used 'Scale product method' which combines the Thurnstone's Technique (1928) of equal appearing interval scale for selection of items and Likert's Technique (1932) of summated rating for ascertaining the response on the scale as proposed by Eysenck and Crown (1949). The scale contains 37 statements. From 37 statements, 22 statements were selected as they were found to be unambiguous and non-factual. Out of 22 statements, seven statements are negative and remaining is positive. The responses can be collected on five point continuum viz. strongly agree, agree, undecided, disagree and strongly disagree with weight of 5, 4, 3, 2 and 1, respectively for favorable or positive statements and with weight of 1, 2, 3, 4 and 5, respectively for unfavorable or negative statements. Co-efficient of reliability between these two sets of score was calculated by Rulon's Formula (Guilford 1954), which was 0.745

Keywords: Attitude, crown, Likert's technique, Rulon's Formula, scale, Self Help Groups, Thurnstone's technique, women.

GPA 16

Empowering women beyond Self-Help Groups: Effective strategies

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ABSTRACT

A woman is said to empower when she has the power to increase her own self-reliance, self confidence, self esteem and self-strength. The means of achieving empowerment are economic freedom, freedom of action, ability and involvement in decision-making, self-esteem, gender equality, improvement in health and knowledge etc. The present investigation was carried out to know the empowerment strategies of Non SHGs women members in Amreli district of Gujarat State. Five talukas of Amreli district selected purposively where self help groups were formed under the Integrated Watershed Management Programme (IWMP) for comparative study. Ten villages were randomly selected from five selected talukas. From each villages nine Non SHG members were selected. The results revealed that for empowerment of Non SHG member, strategies which ranked highest was freedom in taking decision regarding children's education and health (90.00 per cent) followed by presence of bank account (88.89 per cent) while freedom from family bound for participation of different programme organized by different departments, for interaction with others and to visit SHGs (87.78 per cent) were ranked as third most prioritized strategies among women.

Keywords: Integrated watershed management programme, non SHG members, women, Self Help Groups

GPA 17

A path analytic study of profile characteristics on attitude of woman faculties towards professionalism

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ABSTRACT

Attitude is conceptualized as a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour. In the current study, attitude of woman faculties is regarded as their positive or negative feelings towards professionalism. A woman with a favourable attitude towards professionalism enables them to well manifest their professional role in conducting teaching, research and extension activities. Such a professional woman could only able to equip with a prompt attitude towards their profession to become a professional and her inherent traits may help to organize the activity for professionalism. There are several factors which profoundly affects the attitude of woman faculties towards professionalism. In the present study, attitude of woman faculties towards professionalism was measured using a developed scale and those factors which decisively affects its nature were identified using path analysis. A path analytic study was conducted for analyzing the direct and indirect effects of profile characteristics of woman faculties on their attitude towards professionalism. The study was carried out among hundred-woman faculties working in four state agricultural universities of Gujarat state *viz:* NAU, Navsari, JAU, Junagadh, AAU, Anand and SDAU, Dantewada. The analysis results indicated that majority (87.00%) of the woman faculties had highly favorable attitude towards professionalism. The path analysis results indicated that professional experience (0.603) had exerted maximum direct positive effect and age (0.586) had exerted highest positive total indirect effect on attitude of woman faculties towards professionalism. In maximum substantial indirect effect on attitude, professional experience routed maximum times.

Keywords: Path analytic study, profile, attitude, woman faculties, professionalism

GPA 18

Potential role of farm women to bridge the gap of food and nutritional security in community

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ABSTRACT

Adequate and quality food intake is first and important step toward healthy life. Under nutrition and over nutrition both have severe impact on health as well as economical state. In India is a second large country in the world in terms of population. People of slum and villages both are living in deprive areas. Various factors leads to food and nutritional insecurity but the major are poor purchasing power, low education level and unawareness regarding food and their nutritional contents. Empowerment and education of women play leading role in bridging the gap. Food purchasing, preparation of food and serving food to the family members are performed by women in most of the house hold. Nutritional education and financial incipiency both can uplift the condition of food and nutritional security. Women's health must be protected to ensure productive and reproductive roles. Three pillars have been identified by IFPRI Food Policy Report viz Women end food production, Women and economic access to food and Women and nutrition security. Current situation demand more efforts to educate and empower

women.

Key words: Food security, Woman, Nutritional security, Health, Empowerment

GPA 19

The role of women in kitchen gardening and kitchen waste management: contributions to food security, family health and environmental conservation

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ABSTRACT

This paper explores the critical role of women in kitchen gardening and kitchen waste management and their contributions to food security, family health, and environmental conservation. Women play a vital role in kitchen gardening and kitchen waste management, activities that contribute significantly to food security, family health and environmental conservation. Kitchen gardens provide households with a steady supply of fresh, nutritious vegetables, herbs and fruits, reducing dependency on market-purchased produce and promoting dietary diversity. Women, as primary caregivers, utilize traditional agricultural knowledge and practices, which enhances household nutrition while preserving local biodiversity. Their expertise in waste management complements gardening efforts; by composting organic kitchen waste, women reduce household waste, improve soil fertility and contribute to sustainable farming practices. This review examines the social, economic, and environmental impacts of women's involvement in these practices, along with the challenges they face, including restricted access to resources, limited land ownership and societal constraints on mobility and decision-making. Despite these challenges, women demonstrate resilience, managing household resources efficiently and creatively, often turning surplus produce into small-scale income opportunities. Policies and initiatives that support women's access to gardening resources, training in waste management and cooperative models can amplify their contributions. Recognizing and supporting women's roles in kitchen gardening and waste management is crucial for promoting sustainable communities, enhancing food security and advancing environmental stewardship. Empowering women in these areas could also play a significant role in achieving broader sustainable development goals, particularly those related to gender equality, sustainable agriculture and waste reduction. This paper calls for targeted policies and programs to enable women's full potential in these essential yet underappreciated domains.

Keywords: Kitchen gardening, kitchen waste management, food security, family health and environmental conservation

GPA 20

Relationship between extent of participation of farmwomen in family welfare and agricultural development with their profile

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ABSTRACT

Women in India are the backbone of the society and important resource in agriculture and rural economy. They make essential contributions to the agricultural development and household activities and pursue multiple livelihood strategies but, their contribution is undervalued and getting less chance in taking decisions. The present study was carried out in Vadodara district of Gujarat. From these four Talukas were selected on the basis of area under higher cotton production viz, Karjan, Dabhoi, Sinor and Padara. The study was conducted to know the relationship between extent of participation of farmwomen in family welfare and agricultural development with profile of the respondents. Out of seventeen independent variables viz. social participation, land holding, occupation, information seeking behavior, management orientation, self-confidence, attitude of farmwomen towards agricultural activities and attitude of farmwomen towards family welfare had established positive and significant relationship and variables like, Education, Land holdings, annual income and mobile exposure had established negative and significant relationship with their extent of participation in family welfare and agricultural development. Whereas, age, experience in farming, types of family, material possession, extension contact and mass media exposure had failed to show significant correlation with their extend of participation in family welfare and agricultural development.

Keywords: Participation, relationship, farmwomen, agricultural development and family welfare

GPA 21

Role of women in decision making regarding dairy farming practices

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ABSTRACT

The dairy farming plays a pivotal role in the economy of our country. It helps in augmenting food supply, generating employment and raising nutritional level. The major advantage of dairy farming is its minimum land dependency and resource flexibility. It is a major source of income to major segment for rural betterment in small, marginal farmers and rural women. Women dairy farmers' knowledge, skill, their participation and decision making affect their efficiency in dairy farming and ultimately to their socio-techno-economic status. The present study was carried out in Gandhinagar district to know the role of women in decision making regarding dairy farming. In context of the study, it was found that Majority of the women dairy farmers had medium level of decision making in dairy farming. Education, social participation, annual income, occupation, herd size, size of land holding, mass media exposure, extension participation, scientific orientation, risk orientation, credit orientation, innovativeness and knowledge were found positive and highly significant relationship with extent of decision making of women dairy farmers regarding dairy farming, whereas age and experience in animal husbandry were found negative and highly significantly related extent of

decision making of women dairy farmers regarding dairy farming while size of family was found positive non-significantly related with extent of decision making of women dairy farmers regarding dairy farming.

GPA 22

Kitchen gardening a way to improve nutrition and income of rural women: Success story of women farmer of Amreli district

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ABSTRACT

Kitchen gardens can play a crucial role in addressing food security and nutritional diversity, especially in developing countries where access to fresh produce may be limited. By utilizing small spaces like balconies, rooftops, or even windowsills, people can grow their own vegetables, herbs, and fruits, ensuring a steady supply of nutritious food. The primary objective of this study was to improve nutrition and income of rural women by providing kitchen gardening kit by KVK, Amreli. The success story was collected by Krishi Vigyan Kendra, amreli of her progressive farm women Chandrikaben M. Nakrani. Chandrikaben M. Nakrani is a successful farmer of Amreli district Village: Mangawapal, Ta: Lathi. She got education up to 08th Std. she had 25year farming experience. Personal Interview technique was used to know the success story of farm women. Chandrikaben M. Nakrani. Chandrikaben M. Nakrani is a successful farmer of Amreli district. Due to Covid-19 situation she was badly suffer from lower economic condition. She came in contact with KVK, Amreli during one of the training programme on kitchen gardening. In this programme knowledge regarding kitchen gardening was given by scientist Dr. Neha Tiwari to farm women and kitchen gardening kit (sprinkle season) was distributed to all the participants and Chandrikaben M. Nakrani is one of them. Chandrikaben M. Nakrani used this kitchen gardening kit at her farm and found very good production of vegetable like bottle guard (5 gm.), cowpea (25gm.), palak (25gm.), coriander (25gm.), menthi (25gm.), Radish (10gm.), Cucumber (05gm.), Drum stick (05gm.), Okra (25gm.), Chilli (02gm.), Onion (10 gm.) and Cauliflower (05gm.) She used this vegetables for her household chores and also distributed to her relatives. By that way she was retaining her economic condition by cutting down the expenses of vegetable. Again a new kit of kitchen gardening of winter season was given by kvk amreli to farm women. Chandrikaben M. Nakrani saving rupess 10,000 per season by cutting expenses from vegetables. She used the same kit and good production without any harm was noticed by her. Instead of that all the vegetables are rich in several vitamins like Vitamin A, B, C, E and K also rich in iron, magnesium and phosphorous which very good for overall health development.

GPA 23

Awareness of the farm women regarding selected drudgery reduction technologies in agriculture and animal husbandry

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ABSTRACT

Agricultural technology refers to technology for the production of machines used on a farm to help with farming. Agricultural machineries have been designed for practically every stage of the agricultural process. They include machines for tilling the soil, planting seeds, irrigating the land, cultivating crops, protecting them from pests and weeds, harvesting, threshing grain, livestock feeding and sorting and packaging the products. Technology has played a big role in developing the agricultural industry. And women play major role in farming activities, which constitute nearly 43% of the world's agricultural labor force, which rises up to 70% in some countries. But they do not have adequate awareness and access to improved technologies to reduce their drudgery and improve productivity, unlike men. Hence the present study has been conducted to make a positive impact by empowering them and bring awareness. The present study is an action research which aims to technologically empower the farm women in selected drudgery reducing technologies. The awareness of the respondents about any technology may initiate the sequence of later stages that leads to adoption or rejection of the technology. Hence an effort was made to study the awareness of farm women regarding selected drudgery reducing technologies. The farm women were asked whether they have heard, seen, knew the name, cost and power required to operate the technologies. There were 14 technologies related to agriculture i.e. wheel hoe, manual rice transplanter, manual seed drill, knapsack sprayer, serrated sickle, manual bund former, maize sheller, ground nut decorticator, pedal operated thresher, hanging type cleaner cum grader, ground nut striper, battery operated sprayer, fertilizer broadcaster and bhindi plucker and 5 technologies related to animal husbandry were rake, shovel, moving stool, wheel barrow and chaff cutter. Result of the study reveal that none of the respondents had heard and seen other technologies like maize sheller, manual seed drill, ground nut decorticator and hanging type cleaner cum grader. Other technologies namely rake, shovel, wheel hoe and moving stool were heard and seen by very few of the respondents (0.83 to 12.5 %). It can be said that majority of the respondents were not aware of the selected drudgery reduction technologies in animal husbandry.

GPA 24

Empowering women farmers: Transforming agricultural extension for gender equality

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ABSTRACT

Women play a crucial role in agriculture, particularly in developing countries, where they are often the backbone of food production and rural economies. However, despite their significant contributions, women frequently face numerous challenges that hinder their full participation in agricultural activities. These challenges include limited access to resources, lack of training and education, cultural barriers, and minimal involvement in decision-making processes. Agricultural extension services can be pivotal in addressing these issues and promoting women's empowerment in the sector. Agricultural extension services aim to provide farmers with the knowledge and skills they need to enhance productivity and sustainability. By

integrating a gender-sensitive approach, these services can specifically target the needs of women farmers. This involves not only delivering agricultural training but also addressing broader socio-economic barriers that limit women's participation in farming. Women often encounter systemic barriers that restrict their access to vital resources, such as land, credit, and agricultural inputs. Traditional gender roles can further entrench these limitations, as women may not be recognized as primary decision-makers within their households or communities. As a result, their contributions to agriculture are frequently undervalued, which undermines their potential impact. Empowering women in agriculture leads to numerous positive outcomes, not just for women themselves but for their families and communities as a whole. Research shows that when women have greater control over agricultural production, they tend to invest in their children's education and health, ultimately contributing to improved household well-being. Additionally, women's involvement in agriculture enhances food security, as they often prioritize growing diverse crops and engaging in sustainable practices.

GPA 25

Utilization of Pradhan Mantri Ujjwala Yojana (PMUJ) by rural women

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ABSTRACT

Pradhan Mantri Ujjwala Yojana (PMUY) was launched in May, 2016 to end the drudgery of the Indian rural women who cook on firewood. This initiative aims to provide clean cooking fuel to households. PMUY is one of the largest social transformation programmes in the country to provide clean cooking fuel to Indian kitchens. The effectiveness of the schemes depends upon how well the services of the scheme are being utilized by rural women. Thus, the present research was undertaken to study the utilization of services of Pradhan Mantri Ujjwala Yojana (PMUY or Ujjwala scheme) by rural women. Study was carried out in two districts namely Banaskantha and Patan of North Gujarat. The 320 beneficiary rural women of 16 villages of 4 Talukas of 2 districts were selected randomly. Multistage Random Sampling was used for the study. Interview technique was used for collecting data. Data was analysed by using frequency, percentage, mean and Correlation. The findings reveal that 62.81 per cent respondents had low utilization whereas 30.00 per cent respondents had medium level of utilization of services of PMUJ. Very few respondents (7.19%) were in high utilization category. Although the respondents were using Ujjwala gas connection but its use was very limited due to the high refilling cost, less income, making food on normal chulla is cheaper and regular maintenance of equipment (gas stove, regulator) due to its poor quality. Despite lots of efforts by the government, the rural women were still compelled to use unclean cooking energy resources. Thus, there is a need to rethink about the price and the subsidy provided by the government over the refilling of the cylinders.

Keywords: Cooking fuel, gas connection, constraints

GPA 26

Assessing the impact of training on mushroom production technology: knowledge and adoption among women in hilly regions of Uttarakhand

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ABSTRACT

This study evaluates the impact of training programs on the knowledge and adoption levels of mushroom cultivators in the mid-hill regions of Uttarakhand. The ICAR-funded Farmer FIRST program, implemented by GBPUA&T, Pantnagar, focuses on promoting sustainable agricultural enterprises to enhance farmers' livelihoods and double their incomes. As part of this initiative, Dogra and Suryatala villages in Nainital district were selected to be developed as "Mushroom Villages," with a particular emphasis on involving hill women in mushroom cultivation and processing. The study was conducted among women farmers from Dogra and Suryatala villages. Two groups were formed: beneficiaries who received training under the Farmer FIRST program and non-beneficiaries who did not participate in the training. Data were collected through structured interviews and questionnaires focusing on knowledge levels and the adoption of mushroom cultivation practices. The training sessions covered various aspects of mushroom production technology, including substrate preparation, spawn inoculation, harvesting, and post-harvest management. The findings revealed that the training significantly improved the knowledge levels of beneficiaries, with most participants demonstrating a higher understanding of mushroom cultivation practices compared to non-beneficiaries. Additionally, the rate of adoption of key mushroom production technologies was markedly higher among the trained group. This suggests that the training program played a crucial role in enhancing both knowledge and practice, leading to better livelihood opportunities for hill women.

Keywords: Knowledge, adoption, mushroom cultivation

GPA 27

Role of co-operative societies in promoting women's empowerment in rural communal

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ABSTRACT

The empowerment of women represents a progressive ideology aimed at integrating democratic values within both the family unit and society at large. It signifies the attainment of equal status for women, ensuring that they, along with children, have equal access to productive resources. This empowerment fosters greater participation in economic and commercial sectors while promoting awareness of their rights and responsibilities. Rural women often face the dual challenge of being socially and economically 'invisible.' Civil society organizations strive to enhance their visibility in these domains. Among these entities, a cooperative organization characterized by open membership and democratic governance is likely to be more impactful than others focused on social and economic advancement. A dairy cooperative exemplifies such a civil society organization dedicated to uplifting rural communities. Dairying serves as an

allied agricultural sector and a significant economic activity for women in rural settings, providing widespread employment opportunities and contributing to the economic development of these communities. Rural landless individuals, along with small and marginal farmers and women, play a significant role in milk production. Dairy cooperatives function as socio-economic organizations at the grassroots level, dedicated to empowering rural communities. This study seeks to explore the social transformation and economic advancement of rural women facilitated by dairy cooperatives. It specifically aims to highlight how the socio-economic context, awareness of dairy cooperatives, and the active involvement of rural women in these cooperatives have contributed to their social and economic progress.
Keywords: Cooperative, women empowerment, economic, rural areas, dairy cooperatives, mass employment

GPA 28

Gender Development: Significance in Agriculture

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ABSTRACT

Gender refers to the socially constructed roles and responsibilities of men and women, in a given culture or location. These roles are influenced by perceptions and expectations arising from cultural, political, environmental, economic, social and religious factors, as well as custom, law, class, ethnicity and individual or institutional bias. Gender development is the process of enhancing status, roles, responsibilities of men and women by mainstreaming the most disadvantaged sex in the society. Components of gender development are sensitization, mainstreaming, equality, equity and empowerment. In the context of India, where agriculture is not only an economic activity but also a way of life, the importance of gender development in this sector cannot be overstated. Addressing gender disparities and ensuring that women have equal access to resources, education, and opportunities will not only improve agricultural productivity but also contribute to the broader goals of poverty reduction, economic development and social equity. By mainstreaming gender considerations in agricultural policies and practices, we can create a more inclusive and prosperous rural economy. According to the 2011 Census, the Indian population is 1210.57 million (51.9% men and 48.1% women) and about 60.4% of them depend on the agricultural sector for their livelihood and out of them 54.87% are engaged in agricultural labour.
Keywords: Roles and responsibilities, gender development, mainstreaming, sensitization, equality, equity, empowerment, rural economy

GPA 29

Role and Participation of Women in Dairy Farming: A Study in Panchmahal, Gujarat

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ABSTRACT

This study examines the participation of women in dairy farming across 16 villages in four talukas of Panchmahal, Gujarat, with a sample size of 160 respondents selected randomly. The findings reveal that women play a predominant role in most dairy farming activities. Their active involvement is noted in feeding calves, collecting fodder, watering, storing feed, and feeding animals, as well as milking, cleaning utensils, managing dung disposal, and caring for newborn calves. In breeding-related tasks, women are engaged in assisting with parturition, bathing animals after calving, monitoring animal pregnancies, and detecting heat. Additionally, women take charge of healthcare activities, including caring for pregnant and sick animals and arranging for vaccinations and treatments. However, their participation is comparatively lower in financial aspects such as insurance, loan acquisition, and purchasing feed, fodder, and other necessities. While women show an interest in making curd and buttermilk, they are less inclined to produce other milk products like mava and ghee, preferring instead to sell milk. Overall, women's participation is highest in nutritional activities, followed by management, breeding, healthcare, and value addition, with relatively lower involvement in finance and value-added dairy product processing.

GPA 30

Knowledge of farm women about kitchen gardening in Jamnagar and Devbhumi Dwarka district of Gujarat

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ABSTRACT

In India, about two billion people suffer from vitamin and micronutrient deficiency, among them, the child malnutrition rate is very high. Kitchen gardening directly provides food and nutritional security by giving access to food that can be harvested instantly. The present study was about the knowledge of kitchen gardening Practices in rural women in Jamnagar and Devbhumi Dwarka district of Gujarat. Knowledge about kitchen gardening practices of 300 respondents was measured by some selected questions through structured interview schedule and analyzed by using the suitable statistical method. In this study result found, the majority of respondents belong to middle age group (62.67%), educated up to graduation (28%), have the occupation of farming with animal husbandry practices (42.33%), they live in joint families (51%), they have 1 to 2 lakhs annual income (44%). Social media and television are important sources of mass media for knowledge gain. In the present finding, the majority (68.00 per cent) of the farm women had a medium level of knowledge regarding kitchen gardening, while 17.33 per cent and 14.67 per cent of the farm women had low and high levels of knowledge regarding kitchen gardening, respectively. Variables like use of mass media, education, no. of animals, annual income and occupation had positive significant relationship; while, age have negative significant relationship with the knowledge regarding kitchen gardening.

Keywords:- knowledge, kitchen gardening, nutrition, rural women

Navigating from Farm Future with Advanced technology and Empowering for Resilient Tomorrow

FFA 1

Gen.AI and the future of farming: Empowering digital agricultural communities

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ABSTRACT

The global AI in agriculture market is projected to grow significantly, from USD 1.7 billion in 2023 to USD 4.7 billion by 2028, with a Compound Annual Growth Rate (CAGR) of 23.1% whereas, AI-driven agriculture market in India is expected to grow significantly, with a compound annual growth rate (CAGR) of approximately 24.9% through 2030. (www.marketsandmarkets.com).This rapid expansion is driven by the increasing need for real-time, data-driven insights in agriculture. AI empowers farmers by enabling precision monitoring of soil quality, plant health, and temperature, and by automating irrigation and pesticide processes, which collectively improve crop quality and accuracy. Applications such as precision farming, livestock monitoring, drone analytics, agricultural robots, and labor management systems are transforming farming efficiency, with deep learning technology significantly enhancing crop productivity. In India, generative AI is revolutionizing agriculture through data-centric solutions that align with national policies like PM-KISAN, Digital India, and AgriStack, which collectively aim to boost farmer income and promote digitalization in rural areas. The government's AgriStack initiative creates a digital ecosystem providing advisory services, weather updates, and marketplaces for inputs and produce. Similarly, the National Agriculture Market (eNAM) facilitates online trading for farmers, while mobile apps like Kisan Suvidha and BharatAgri provide farmers with precision farming data, crop prices, and weather forecasts, helping them make informed decisions. Despite limited internet infrastructure in some rural areas, improvements in mobile connectivity and digital literacy are expanding access to these digital tools. Generative AI also enhances precision farming software by delivering customized recommendations on crop health, water management, and nutrient application. Platforms such as IFFCO Kisan further support farmers by providing real-time expert guidance, which enhances productivity and operational efficiency. Next-generation farming techniques—including vertical and indoor farming, rooftop agriculture, regenerative agriculture, and permaculture—are further enabled by AI, which helps optimize climate control and nutrient requirements, reducing resource use and environmental impact. The integration of AI and automation in agriculture is also changing the labor landscape, automating repetitive tasks like sowing and harvesting, while creating demand for skills in data analytics, robotics, and AI. This shift requires collaboration among government, industry and educational institutions to equip the workforce for evolving roles in agricultural technology. AI-driven initiatives are modernizing Indian agriculture, fostering sustainable farming practices, and creating resilient, tech-driven rural communities.

Keywords: Generative AI, government implication, AI

FFA 2

Knowledge to action: AI in agricultural extension for informed farming practices

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ABSTRACT

The integration of Artificial Intelligence (AI) into agricultural extension services is transforming the way farmers access knowledge, make decisions, and implement farming practices. As the agricultural sector faces increasing challenges due to climate change, resource scarcity, and the need for sustainable practices, AI offers data-driven solutions that enable more informed and precise farming. By analyzing vast amounts of data from soil, weather patterns, and crop health, AI supports extension services in providing timely, actionable insights to farmers, promoting efficient resource use and optimizing yields. This paper explores the role of AI in enhancing agricultural extension by facilitating decision support, real-time crop monitoring, and tailored advice through tools like predictive analytics, chatbots, and remote sensing. Case studies from AI-driven extension initiatives demonstrate how these technologies improve farm management, increase resilience, and empower farmers with actionable insights, even in remote areas. While the potential for AI to revolutionize agricultural extension is substantial, challenges such as cost, infrastructure, and digital literacy must be addressed to ensure equitable access. Ultimately, AI in agricultural extension represents a pivotal shift from knowledge dissemination to knowledge-based action, paving the way for a more resilient and informed farming future.

Keywords: Artificial Intelligence, knowledge-based action, information, extension system

FFA 3

Mobile-enabled real-time classification of Maize seeds for poultry feed using deep learning for agricultural quality assessment

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ABSTRACT

The agricultural sector faces significant challenges in ensuring the quality of seeds used for farming, particularly in markets where seed quality is inconsistent and difficult for farmers to assess. This study presents a novel approach to classifying maize (corn) seeds into multiple quality categories—such as "Good," "Average," and "Bad"—using computer vision and deep learning techniques. The primary goal of this research is to develop an automated, mobile-based system that enables farmers to quickly assess seed quality at the point of purchase. To achieve this, the researchers investigate the use of real-time object detection models, particularly those optimized for high-speed inference on low-powered mobile devices, to classify maize seeds based on their visual characteristics. Several popular deep learning models, including YOLOv5 (Tiny), MobileNetV2-SSD, and EfficientDet, were explored and evaluated for their performance in terms of speed, accuracy, and suitability for deployment in resource-constrained environments. These models were trained on a custom dataset of maize seed images, captured under varied lighting conditions and backgrounds, to ensure robustness. The proposed system will be designed to operate in real-time using a mobile camera, allowing farmers to simply scan a handful of seeds. The model will then classify the seeds into predefined quality categories and provide a percentage breakdown of the classes. The results of this study will show that the system can offer reliable and fast seed quality assessment, with

significant potential for adoption in rural markets, helping farmers make informed purchasing decisions and ultimately improving agricultural productivity. This research will demonstrate the effectiveness of using lightweight object detection models in agriculture, opening the door for further advancements in precision farming and digital agriculture technologies.
Keywords: poultry feed, maize seed classification, object detection, deep learning, mobile agriculture, real-time evaluation, agricultural quality assessment

FFA 4

Applications of Artificial Intelligence (AI) tools in sustainable insect pest management programme

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ABSTRACT

According to the Food and Agriculture Organization, annually 20 to 40% worldwide loss occurred due to agricultural insect pests. Serious issues arises when pesticides are used excessively and in injudicious way to control the insect pests. As per current needs, farmers need to tackle these notorious insect pests by employing smart agriculture, which includes artificial intelligence (AI) methods with contemporary information and communication technologies. This is non-chemical and eco-friendly technology for the pest management. Artificial intelligence (AI) includes Machine learning (ML), deep learning, latest computer technologies, and other related fields. Among them, Machine Learning (ML) is the integral part of AI. AI applications in agricultural entomology are very crucial for study on population ecology of insect pests and further research on pest management. AI is also helpful in taxonomic studies. AI plays great role in deciding timely pest management strategies with primarily focuses on the use of AI in pest detection, monitoring, prediction, and identification of insect pests. The main usage of AI in plant protection is diagnose and identify insect pests for management. AI based tools in smart agriculture shows 90% accuracy in insect identification. AI based mobile tools for the detection of insect's pests exhibited the way for the pest management based on image analysis. AI based automatic moth detection method utilizing AI tool with photos gathered from pheromone traps for timely pest control, since monitoring insect pests is an essential part of pheromone-based pest management systems. AI based autonomous robotic vehicle showed 94.3% recognition accuracy of pyralidae insects (Lepidopteran insects). Therefore, combining entomological approaches with artificial intelligence tools will aid in the prompt and efficient pest identification and thereby timely intervention could be possible to reduce the yield loss to the end user.
Keywords: Artificial Intelligence (AI), insect detection, Machine Learning, pheromone traps.

FFA 5

Enhancing agricultural knowledge and educational engagement through gamification and interactive learning

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ABSTRACT

This study examines the significance of gamification and interactive learning tools as innovative methods to enhance engagement and knowledge dissemination in both agricultural extension and higher education. In agricultural research, games provide an efficient and cost-effective approach to simulate real-world scenarios, facilitating community involvement and knowledge exchange. Findings indicate that board games serve as effective tools to educate farmers, evidenced by improved awareness and adoption of best practices in cotton cultivation after exposure to an interactive game. Such tools could aid extension workers in optimizing input use for farmers across diverse regions, such as Punjab and Madhya Pradesh. Similarly, gamification is emerging as a vital educational strategy for Generation Z in higher education. Given that new-age learners display unique engagement patterns, conventional pedagogies may fall short. Gamified educational environments foster motivation and enhance cognitive, social, and emotional learning experiences. The paper underscores platforms like Duolingo, which leverage gamified principles to enrich language learning and engagement through collaborative and competitive elements. With a focus on the Indian Higher Education (IHE) system, this study critiques over-reliance on quantitative assessment metrics, advocating for holistic evaluation methods that address the sector's diversity and complexity. The findings provide valuable insights for policymakers, educators, and academic institutions to integrate gamified learning frameworks, which align with both evolving educational needs and meaningful learning objectives across sectors.

Keywords: Gamification, education

FFA 6

Use of Artificial Intelligence on agriculture fields

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ABSTRACT

Agriculture is a sector which depends on various aspects like humans, animals, machineries, weather, soil etc. To get output from agriculture all aspects are important. Artificial intelligence is being used in other sectors. But, its use in agriculture is very limited in India. In this era of climate change, to get better outputs from agriculture is real time need. Therefore, this paper aims with reviewing works related to use of artificial intelligence for agricultural. Results of the study shows in various fields artificial intelligence is being used in agriculture like for irrigation, weeding, post-harvest, etc.

Keywords: Artificial intelligence, agriculture, sectors, climate change

FFA 7

Precision agriculture: Revolutionizing farming with AI and Machine Learning in all-terrain vehicle automation

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ABSTRACT

This paper presents an in-depth review of the integration of machine learning (ML) and artificial intelligence (AI) in all-terrain vehicle (ATV) automation, revolutionizing precision farming practices. By employing AI-driven tools, ATVs now enhance tasks such as planting, harvesting, crop monitoring, and pest management. The study reveals significant impacts, including increased crop yield (up to 20%) and reduced resource use, such as a 30% decrease in pesticide application. Through bibliometric analysis, the paper maps emerging research trends, highlighting the transformative role of AI vision and ML algorithms in precise, data-driven farming decisions. Challenges such as data privacy, system scalability, and technology accessibility for small-scale farmers are also discussed, offering insights into future research directions.

Keywords: Precision agriculture, AI, machine learning, ATV automation, crop monitoring, sustainable farming

FFA 8

Smart farming technologies in sustainable agriculture development

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ABSTRACT

The pressure on agricultural food production to produce high-quality and sustainable food has increased dramatically as a result of population growth, urbanization and climate change. Food shortage and population growth are two of the world's major challenges to long-term sustainable development. So, in recent years technological development such as smart farming has resulted substantial changes in the agricultural production and progression in farming methods. Smart farming is a method of agricultural production that integrates information and communication technologies to maximise resource efficiency. Smart farming technologies such as automated tractors, artificial agricultural intelligence, automated irrigation and weather forecasting, Internet of Things, drones and remote sensing (GIS and GPS) can provide realistic solutions to the world's challenges. The accurate application of this technology in conjunction with the Internet of Things (IoT) is expected to be a advantageous for the farmers to improve their living standards through increased production and profit which is a good indicator for sustainable agriculture development. However, due to lack of internet access, high costs and lack of application knowledge there are still barriers to the adaptation and conversion of smart farming.

Keywords: Smart farming, sustainable development

FFA 9

Empowering rural women through the drone DIDI project

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ABSTRACT

The "Drone Didi" project is an innovative initiative aimed at empowering rural women by training them in the operation of agricultural drones, thereby transforming traditional farming practices. This project not only addresses the gender gap in technology and agriculture but also introduces precision farming techniques, enabling sustainable and efficient agricultural practices. By equipping women with drone operation skills, the initiative enhances their economic independence while contributing to smart agriculture. Drones are used for activities like crop monitoring, pesticide spraying, and yield estimation, reducing labor-intensive tasks, minimizing input costs, and optimizing resource usage. These advanced practices result in improved productivity, reduced environmental impact, and better crop health management. The "Drone Didi" project also fosters community involvement and encourages female participation in agricultural innovation, promoting inclusiveness in rural development. As rural women gain technical skills, they become agents of change, inspiring others to adopt technology-driven practices in farming. In conclusion, the "Drone Didi" project has dual significance: it empowers women by building their capacity in cutting-edge technology and simultaneously revolutionizes agriculture with precision farming methods, paving the way for sustainable rural development.

Keywords: Agricultural drone, farm mechanization, sustainable practice

FFA 10

Assessing the implementation of kisan drones: insights from a nationwide survey of KVK experiences

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ABSTRACT

As the agricultural landscape evolves toward precision farming, the use of drones, particularly Kisan drones, is gaining momentum in India. Krishi Vigyan Kendras (KVKs), which serve as the frontline agricultural extension systems under ICAR, have been crucial in adopting these advanced technologies. To better understand the deployment, usage, and impact of Kisan drones, a comprehensive survey was conducted across all Agricultural Technology Application Research Institute (ATARI) zones during 2022-23, receiving 92 responses from KVKs nationwide. The survey reveals that while 75 KVKs have procured drones, others opt for rental models, showcasing flexible adoption strategies. Leading brands such as Agribot and GARUDA Aerospace are frequently used for both ownership and rental, reflecting a preference for reliable, versatile models. Drone demonstrations have engaged over 36,000 farmers in crucial agricultural activities, such as insecticide, weedicide, and micronutrient spraying. Drones have proven especially effective for spraying insecticides on crops like paddy and cotton and applying weedicides and micronutrients on wheat and mustard. When compared with manual and tractor-based methods, drones demonstrate superior efficiencies, including significant reductions in time, water, and chemical use, with substantial cost savings for various crops. However, challenges to broader adoption remain, such as high maintenance and training costs, limited technical support, and regulatory barriers. Economic viability, although promising, is hindered by high initial costs, although long-term resource efficiency and profitability potential are strong. Most KVKs consider drones more effective and easier to operate than traditional methods, with positive implications for employment opportunities. To foster wider adoption, KVKs recommend crop-specific standard operating procedures, expanded training programs, custom hiring centers, and financial support to improve accessibility. Kisan drones represent a transformative innovation in Indian agriculture, with significant potential to enhance productivity and sustainability.

Keywords: Kisan drone, KVK, precision agriculture, ATARI

FFA 11

Impact of regenerative agricultural practices on sustainability and productivity in Indian farming

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ABSTRACT

Regenerative agriculture is becoming more and more acknowledged as a sustainable substitute for traditional farming, providing strategies to improve biodiversity, slow down climate change, and fight soil erosion. This study explores the fundamentals, difficulties, and success aspects of regenerative agriculture in India. Crop rotation, agroforestry, and cover crops are among the important methods that are studied, with an emphasis on implementation issues such resource constraints and knowledge gaps. Data from extension services and government initiatives highlight the necessity of policy assistance to advance regenerative practices throughout India's heterogeneous agricultural environment. The results show that education and resource accessibility play a dual role in promoting regenerative farming and provide guidance on how to incorporate sustainable practices into conventional agriculture.

Keywords: Regenerative agriculture, sustainable farming, soil health, biodiversity, agroforestry, climate resilience, India

FFA 12

Artificial Intelligence powered decision support system for sustainable agriculture

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ABSTRACT

Introduces an innovative method for sustainable agriculture whereby an AI-powered decision support system (DSS) is developed that makes use of an AI chatbot solution. Using

machine learning algorithms and data analytics, such as the ones that support the AI-DSS allows for real-time insights and advice or suggestions to be given out on best farming methods, and crop management among other things. Farmers can talk about the system's comfortability and take advice that is personalized with the AI chatbot interface. The project seeks to boost agricultural productivity, cut down environmental negative influences, and advocate sustainable methods of farming. This study intends to link AI technology with farming, to make our future world more sustainable and food secure.

FFA 13

AI-driven innovations in agriculture: Transforming farming practices for a resilient tomorrow

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ABSTRACT

The agricultural sector is experiencing significant changes through the integration of advanced technologies that drive productivity and sustainability. This paper deals with the role of digital farming and Artificial Intelligence (AI) in shaping the future of agriculture, examining technologies that help farmers to optimize their practices and build resilience. Key tools explored include farm management software, digital extension services, and online marketplaces, each offering unique benefits to improve farm productivity and expand market reach. There is the need to evaluate adopted potential AI-driven innovations, such as crop prediction models, automated farming systems, and AI-based decision support, which assist in resource optimization, crop forecasting, and overall farm efficiency. While these technologies promise substantial gains, the paper also highlights challenges in adopting digital farming and AI, particularly around connectivity, digital literacy, and high implementation costs, which pose barriers for many farmers, especially in rural and tribal areas. Findings emphasize that by addressing these obstacles and enhancing access to technology, agriculture can move towards a more sustainable, efficient, and profitable future. Ultimately, the integration of AI and digital tools is presented as a vital pathway for creating a resilient agricultural ecosystem, benefitting not only individual farmers but also the broader agribusiness landscape.

Keywords: Digital farming, Artificial Intelligence, precision agriculture, AI applications

FFA 14

Effectiveness and importance of drone technology in Precision agriculture

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ABSTRACT

Drone technology has become an integral part of precision agriculture, offering farmers advanced tools for optimizing crop management and improving sustainability. By capturing

high-resolution aerial imagery and multispectral data, drones provide critical insights into crop health, soil conditions, and moisture levels. This enables farmers to detect diseases early, assess plant health, and monitor large areas quickly and efficiently, enhancing decision-making processes and minimizing resource waste. Drones are particularly effective in enabling targeted interventions for irrigation, fertilization, and pest control, reducing excessive input use and supporting eco-friendly practices. As labor costs rise and manual scouting becomes increasingly impractical, drones help alleviate labor challenges by automating field assessments, allowing workers to focus on more strategic tasks. The importance of drones in agriculture extends to promoting sustainable resource use, conserving water, and reducing the environmental impact of chemical runoff. This review paper examines the effectiveness of drone technology through case studies and technological advancements, exploring how drones not only improve productivity and reduce operational costs but also play a crucial role in addressing food security and supporting environmentally conscious farming. Drones represent a pivotal advancement in the transition toward more sustainable and data-driven agricultural practices, making them essential tools for modern farming.

Keywords: Drone technology, precision agriculture, crop management, sustainability, resource optimization

FFA 15

Benefits and challenges in the adoption of agricultural drones in India

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ABSTRACT

The use of drone technology in agriculture presents a transformative approach to enhancing productivity, efficiency, and sustainability. In India, drones, or "Kisan Drones," have garnered government support to streamline agricultural practices, offering significant advantages such as precision spraying, real-time crop health monitoring, yield estimation, and improved resource management. These applications not only increase crop yields and reduce input costs but also minimize environmental impact by targeting specific areas for pesticide and fertilizer application. Drones further enable farmers to assess soil and crop conditions, analyze terrain, and monitor livestock with greater accuracy and speed. However, several challenges hinder the widespread adoption of drones in Indian agriculture. High initial costs, limited technical expertise among farmers, regulatory constraints, weather dependencies, and data management complexities are major barriers. Additionally, there are concerns over job displacement and privacy, with many farmers lacking the required knowledge and confidence to operate these advanced systems. The Indian government has initiated measures, such as financial subsidies and training programs, to facilitate drone adoption. The Production-Linked Incentive (PLI) scheme, along with dedicated policies like the Drone Rules 2021, aims to make drone technology accessible and affordable for small and marginal farmers. This study highlights the dual nature of agricultural drone technology—its potential to revolutionize farming in India and the challenges that must be addressed to achieve this goal. Collaborative efforts among government agencies, agricultural institutions, and technology providers are essential to overcoming these barriers and promoting sustainable drone integration. This approach is expected to enhance agricultural productivity, improve environmental stewardship, and support the socio-economic well-being of farmers.

Keywords: Agricultural drones, kisan drones, precision agriculture, drone technology, crop monitoring, sustainable agriculture, Indian agriculture, drone adoption challenges

FFA 16

Role and effectiveness of artificial intelligence in digital agriculture: Transforming extension services for enhanced farmer support and productivity

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ABSTRACT

The integration of Artificial Intelligence (AI) in digital agriculture is revolutionizing extension services by enhancing farmer support and improving productivity. AI technologies, such as machine learning and predictive analytics, provide farmers with data-driven insights into crop management, pest control, and resource allocation. This review examines the role of AI in digital agriculture, highlighting its effectiveness in delivering tailored recommendations and real-time information directly to farmers. By facilitating better decision-making, AI empowers farmers to optimize inputs, increase yields, and adopt sustainable practices. Additionally, AI-driven digital platforms enhance farmer engagement through personalized advisory services, enabling timely responses to challenges and reducing the need for on-site visits from extension agents. This shift not only increases the efficiency of extension services but also addresses labor shortages in rural areas. Furthermore, the paper discusses the barriers to AI adoption, such as digital literacy and infrastructure constraints, and explores potential solutions to facilitate integration within extension frameworks. Overall, the effectiveness of AI in digital agriculture is significant, fostering resilience and productivity in farming while promoting sustainable agricultural practices. As the agricultural sector continues to evolve, leveraging AI technologies within extension services will be crucial for supporting farmers and enhancing food security.
Keywords: Artificial Intelligence, digital agriculture, extension services, farmer support, productivity

FFA 17

Internet of Things (IoT) in Agriculture 4.0

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ABSTRACT

Until the advent of Agriculture 3.0, farming relied heavily on the knowledge and decisions of individual farmers, making it susceptible to human error and inefficiencies. Factors such as climate change, diminishing agricultural land and increasing global demand highlight the need for precision in agriculture. IoT-based Agriculture 4.0 emerges as a transformative solution, utilizing agricultural robots and smart tractors to automate essential tasks like ploughing, seeding and watering, thereby improving seed distribution and minimizing waste. Equipped with IoT sensors, these systems collect real-time data on environmental conditions, allowing for optimized irrigation and enhanced water use efficiency. Furthermore, IoT networks facilitate pest detection and weed identification, with the

integration of AI enabling timely interventions to mitigate outbreaks. IoT technology also helps monitor soil nutrient levels, providing farmers with actionable fertilizer recommendations. Weather monitoring systems enhance predictive capabilities, sending alerts for adverse conditions to enable proactive measures. Additionally, IoT applications extend to animal husbandry, where sensors monitor livestock health and behaviour. By also analyzing global market trends, IoT-based systems empower farmers with insights for optimal harvesting times, ultimately aiming to increase agricultural productivity and profitability.

FFA 18

Artificial Intelligence innovations in climate research: Modelling and sustainable solutions

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ABSTRACT

Artificial Intelligence (AI) plays a pivotal role in advancing climate research through the application of data analytics, machine learning, and modelling capabilities. Its contributions extend to enhancing our comprehension of climate systems, predicting changes, and supporting mitigation and adaptation strategies. In the realm of agrochemical management, AI is instrumental in minimizing environmental impact via precision agriculture. This involves the collection and analysis of environmental data related to crop growth, enabling well-informed decisions that reduce chemical usage. Within the industrial sector, AI optimizes processes through data analysis, fostering energy conservation. Furthermore, AI contributes to an improved understanding of nature, enabling accurate predictions of deforestation and tree loss to support environmental protection initiatives. In climate modelling, AI enhances the accuracy and efficiency of models by analysing extensive climate datasets. This analysis identifies intricate patterns, trends, and correlations that may pose challenges for traditional methods. Additionally, AI assists in predicting extreme weather events, assesses climate impacts on various sectors, and contributes to emission reduction by optimizing energy production and consumption. Several case studies underscore the practical applications of AI in climate modelling and analysis. For instance, IBM's GRAF model employs deep learning to enhance short-term weather forecasts. Google's machine learning capabilities predict rainfall patterns, aiding in flood prediction. Microsoft's AI for Earth program supports projects like "LandCoverNet," which maps land cover changes. Carbon Monitoring for Action (CARMA) utilizes data analytics for monitoring global carbon emissions. The European Centre for Medium-Range Weather Forecasts (ECMWF) utilizes machine learning to refine weather forecasts, including predicting hurricane tracks. The Climate Trace initiative leverages satellites, remote sensing, and AI for detailed global emission tracking.
Keywords: Artificial Intelligence, challenges, climate, sustainable, modelling

FFA 19

Ensemble learning in machine learning: Algorithms, techniques and applications

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ABSTRACT

Ensemble learning in agriculture combines models like decision trees, random forests, and boosting techniques to enhance predictive accuracy in areas such as crop yields, pest detection, soil health and weather forecasting. This aids farmers in making informed decisions on planting, irrigation and crop protection, leading to improved productivity, reduced losses, and cost savings. By adapting to diverse environments and crop types, ensemble models provide localized precision, enabling better resource management, sustainable farming practices and reduced chemical inputs. The idea behind ensemble learning is to leverage the diversity of different models to produce more robust and accurate predictions than any individual model could achieve alone. Popular ensemble methods include Bagging, Boosting and Stacking. The key advantages of ensemble learning increased robustness to noise and outliers and reduced overfitting. Additionally, they offer market insights, helping farmers secure better prices and build resilience against climate and market fluctuations.

Keywords: Machine learning, ensemble learning methods, application in agriculture

FFA 20

Weed identification and spraying herbicide through drone technology in modern farms: A comprehensive review

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ABSTRACT

Drones have become a cutting-edge aerial spraying procedure in the realm of advanced agriculture. Compared to conventional procedures, this novel strategy provides increased flexibility and a more deliberate approach, yielding an impressive 60-fold gain in efficiency. Drone can be used to collect images, which can then be processed and sprayed to identify weed spots. The "downwash" effect that the rotors provide, which improves deposition on the target, is an extra advantage of spraying. To improve drone weed management efficiency, it is crucial to evaluate specific application techniques. An overview of the most recent scientific studies on the spraying of herbicides after weed detection using drones fitted with cameras is given in this article. Studies comparing sprayers and the effectiveness they provide in spraying have shown that this technology can take the place of applications that are mostly carried out using knapsack sprayers in order to lower occupational dangers. There are a number of variables that could impact how effective this specific aerial spraying technology is. These include the spraying's altitude and speed, the weather, the pace at which the solution is delivered, the droplet producer's features, and the spray solution's attributes. For this new technology to be implemented successfully, a number of obstacles must be overcome. Guidelines and specifics related to formulation and labeling must be handled by skilled experts. Furthermore, comprehending the aerodynamic impact of droplets is crucial for its effectiveness.

Keywords: Drone, weed, herbicide, spraying, technology

FFA 21

Artificial Intelligence: Innovations in pest identification and management

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ABSTRACT

The advent of Artificial Intelligence (AI) has revolutionized plant protection by providing innovative solutions for pest identification and management. Traditional methods often require extensive field expertise and time, limiting the ability to respond promptly to pest outbreaks. AI-powered tools, such as image recognition systems, machine learning models, and predictive analytics, have streamlined pest identification, offering real-time, accurate, and scalable solutions. These technologies leverage vast datasets, including pest images, environmental factors, and crop health indicators, to identify pest species and predict their potential spread. Furthermore, AI-driven decision support systems enable farmers to implement targeted interventions, reducing dependency on broad-spectrum pesticides and promoting sustainable agricultural practices. Integration with IoT devices and drone technologies enhances the precision and efficiency of pest management strategies. This paper explores the transformative role of AI in plant protection, highlighting case studies, technological advancements, and future prospects for achieving resilient and sustainable agricultural ecosystems.

Keywords: Plant protection, Artificial Intelligence, decision support systems

FFA 22

AI and machine learning in precision agriculture: Enhancing crop management and efficiency

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ABSTRACT

The adoption of AI and machine learning (ML) in precision agriculture has optimized resource allocation and improved crop management efficiency. This study examines AI-driven methods, including AI vision and ML algorithms, for precision farming tasks such as seeding, pest control, and crop monitoring through ATV automation. Key findings indicate that these technologies can increase crop yields by 15-20% and reduce overall farming costs by up to 30%. By utilizing real-time data and predictive analytics, AI-enhanced ATVs enable targeted interventions, minimizing waste and environmental impact. Despite challenges like data security and high implementation costs, precision agriculture remains a promising solution to meet global food demands sustainably.

Keywords: Precision farming, AI vision, machine learning, crop management, resource optimization, environmental sustainability

FFA 23

A comprehensive review of AI-driven precision agriculture: Opportunities and challenges in automated farming

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ABSTRACT

This review evaluates recent advancements in AI and machine learning (ML) applications within precision agriculture, particularly focusing on ATV-based automation. AI and ML technologies are revolutionizing crop management by enabling ATVs to perform specific tasks like seeding, spraying, and harvesting with high precision. Case studies illustrate the effectiveness of AI in reducing labor costs, increasing productivity, and improving environmental sustainability. However, challenges such as data interoperability, high costs, and limited access for small-scale farmers are highlighted as barriers to widespread adoption. Future prospects include enhancing scalability through adaptive algorithms and developing accessible solutions for diverse agricultural landscapes.

Keywords: Precision agriculture, AI-driven farming, ATV automation, scalability, environmental impact, small-scale farming

FFA 24

Transforming agriculture with all-terrain vehicle automation using AI and machine learning

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ABSTRACT

This review explores advancements in all-terrain vehicle (ATV) automation through machine learning (ML) and artificial intelligence (AI) vision, focusing on enhancing precision agriculture. ATV-based automation enables accurate and efficient planting, harvesting, spraying, and crop monitoring by integrating ML algorithms and AI-driven sensors. The study highlights applications, including AI-powered crop health monitoring, optimized pesticide use, and data-driven decision-making. Benefits include a 15–20% yield increase, 25–30% cost reduction, and minimized environmental impact. The paper also examines challenges, such as data privacy and scalability, and presents future directions for agricultural automation using ATV systems. These insights provide valuable guidance for stakeholders to adopt sustainable and high-efficiency agricultural practices.

Keywords: Precision agriculture, ATV automation, AI vision, machine learning, crop health monitoring, environmental sustainability

FFA 25

Precision farming and the role of AI-driven ATV automation

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ABSTRACT

This paper presents a comprehensive review of AI and machine learning (ML) in automating all-terrain vehicles (ATVs) for modern precision farming. The adoption of ATV-based automation equipped with ML and AI vision systems has transformed agricultural practices by optimizing crop management tasks such as planting, spraying, and harvesting. With advancements in real-time data analysis, these technologies enhance yield and reduce labor and chemical input costs. The review analyzes case studies illustrating the integration of sensor-based monitoring for crop health, efficient spraying practices, and soil-specific seed placement. The findings demonstrate that precision agriculture, supported by AI-driven ATVs, holds significant potential to increase productivity by up to 20% while supporting environmental sustainability. Future developments in adaptive AI algorithms and data security are critical to scaling this technology across diverse agricultural settings.

Keywords*:* AI in agriculture, precision farming, automated ATVs, crop management, environmental sustainability

FFA 26

A bibliometric review of AI and machine learning applications in agricultural ATV automation

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ABSTRACT

This bibliometric analysis evaluates recent trends in machine learning (ML) and artificial intelligence (AI) applications in all-terrain vehicle (ATV) automation for precision agriculture. The study employs a keyword network diagram to identify research clusters within the domain, revealing significant interest in precision agriculture and moderate connectivity of AI-ML technologies with ATV platforms. Through examples of AI vision for disease detection, ML algorithms for planting and harvesting, and sensor fusion for crop monitoring, the review underscores the potential of ATV automation to enhance yield, reduce input costs, and support sustainable farming practices. The paper also addresses challenges in data security, interoperability, and access for small-scale farmers, suggesting that addressing these barriers is essential for broader adoption of AI and ML technologies in agriculture.

Keywords*:* AI vision, machine learning, ATV automation, bibliometric analysis, data privacy,

small-scale farming

FFA 27

Adoption of kitchen gardening in the Surat city of Gujarat

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ABSTRACT

Consumption of vegetables and fruits has numerous benefits to health. It helps to boost immunity, prevent degenerative disease and constipation. These benefits can be availed only if the vegetables are fresh and organic. Vegetables which are full of pesticides may lead to many non-communicable diseases. In urban areas, people are now very much aware about their health and therefore, there is a demand of organic and fresh vegetables. Even if people pay more, they are not getting organic and fresh vegetables. Kitchen garden is a best solution for this issue. People who want 100 per cent organic and fresh vegetables can develop their own kitchen garden in the open space if available, balcony and on terrace. To evaluate the adoption of kitchen garden among city people, this study was carried out in Surat city. Three hundred owners of kitchen garden were selected randomly from the trained group by KVK, Surat. The data was collected by personal interview through structured schedule. The decided aspects for getting their adoption critically enumerating while developing structure schedule. The simple statistical tools were used to analyze data.Results revealed that majority of the respondents (70%) had medium level of adoption of kitchen gardening, while it was low level among 16 percent respondents. Only 14 percent respondents had higher level adaptation rate about kitchen gardening. Based on the results, it can be concluded that still people should be encouraged to adopt kitchen garden.
Keywords: Adoption, degenerative disease, boost immunity, pesticides

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Awareness regarding kitchen gardening among urban people in Surat district of Gujarat state

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ABSTRACT

Kitchen garden is very popular now days in rural as well as urban areas. Kitchen garden serve many benefits such as it helps in improving physical and mental health together with supplying fresh and organic vegetables and fruits. Urban areas where land is unavailable, people grow vegetables in balcony and terrace. Fresh and organic vegetables help to boost immune system as they are full of vitamins, minerals and phytochemicals. This study was conducted in the Surat city, Gujarat. From the city, 300 urban kitchen gardening owners were selected randomly from the trained group by KVK, Surat. The data was collected by personal interview through structured schedule. The decided aspects for getting their awareness critically enumerating while developing structure schedule. The simple statistical tools were used to analyze data. Results revealed that majority of the respondents (71.67%) had medium level of awareness of kitchen gardening, while it was low level among 18 percent respondents. Only 10.33 percent respondents had higher level awareness about kitchen gardening. Still there is a need to make people aware about kitchen gardening and its benefits.

Keywords: Kitchen garden, nutrients, phytochemicals, awareness

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Use of Drones and Sensors in Agriculture: A review

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ABSTRACT

The agriculture sector in India, particularly in Maharashtra, faces challenges in productivity despite a significant rural population dependent on it. To address this, there's a growing need for precision agriculture. Drone technology emerges as a solution for precision input application and resource mapping. This paper explores various drone types and sensor technologies used in agricultural applications. Fixed-wing drones offer stability and extended flight times, suitable for large-area mapping. Rotary drones, with their vertical takeoff and landing capability, excel in smaller areas and surveillance tasks. Hybrid drones combine advantages of fixed-wing and rotary drones, offering versatility for various agricultural operations. Drones are categorized by weight, ranging from nano to large drones, each with distinct applications. Different sensors like visual cameras, multispectral cameras, thermal cameras, and LiDAR are employed for data collection, enabling informed decision-making in agriculture. This paper provides insights into the diverse landscape of agricultural drones and sensor technologies, highlighting their potential in transforming Indian agriculture towards improved productivity and food security.

Keywords: UAV, drone, agriculture

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Speed Breeding: An AI Tool to Fasten Rice Improvement Programme

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ABSTRACT

Rice (*Oryza sativa* L.) is one of the most important staple food crops that feed over more than half of the global population. As the global population projected to reach 10 billion by 2050, the demand for rice is expected to grow significantly that's why rice plays a pivotal role in global food security. Genetic gain is the way to measure the genetic improvement in any breeding programme, however in traditional method rice breeding is constrained by long generation times and seasonality as we can complete one or two generations per year. To overcome this challenge, it is necessary to increase the number of generations per year and shortening the breeding cycle of rice improvement programme. Generation time of rice can be

reduce by speed breeding (early flowering in rice by managing photoperiod (light), humidity, temperature, $Co_{2)}$, which significantly accelerates rice growth and generation advancement and ultimately genetic gain. In Speed breeding we can grow up to 4-5 generations of rice in a year. Actual concept of Speed breeding was initially developed by NASA in the 1980s as part of their Controlled Ecological Life Support Systems, but now a days it is used in many crops improvement programme for rapid generation advancement as well as in Marker Assisted Selection progemme. IRRI South Asia Regional Centre took the experimentation for rapid generation advancement in the speed breeding setup by combination of light, humidity, temperature *etc*. through which we can advance up to 4-5 generation per year. They found that high red-to-blue light spectrum ratio, followed by green, yellow and far-red light with high light intensity (800 µmol m^{-2} s^{-1}) for 24-h long day (LD) photoperiod for the initial 15 days of the vegetative phase, results early flowering. Then after 10-h short day (SD) photoperiod in the later stage should be manage. Day and night temperatures of may be 30-32°C, along with 65% humidity facilitated early flowering around 60 days. Additionally, we can also speed up our programmme by embryo rescue by reducing time for maturity of seed. Through this method we can increase genetic gain by rapid generation advancement.

Keywords: Light spectrum and light intensity; photoperiod; rice; speed breeding

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Use of Drone in Pest Management

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ABSTRACT

Crop health monitoring is one of the major components of precision agriculture. Which includes irrigation, fertilization, pesticide sprays, and timely harvest of the crop. Further, the progressive change in growth and development is critical in crop monitoring and taking suitable decisions to maintain health status. To accomplish the task, drones are highly useful for on-site detection of problems to undertake corrective measures instantly. Although it is expensive to build algorithms and establish relationships between ground truth and spectral signatures, it is a user-friendly technique once the basic studies are done. As labour availability and technical manpower are extremely limited, particularly in India, drones are gaining popularity in the context of smart farming. Insect pests are known to cause catastrophes and drastic reductions in food grain production across the globe. In the pest management programme, plant protection measures are to be taken on a community basis to ensure effective management of pests. In India, more than 80% of farmlands are in the category of small and marginal (<1 ha), so it is very difficult to manage the notorious pests. If one field is sprayed, the pests simply shift their feeding to the neighbouring fields. The piloted aircraft that carry a regular sprayer can cover well over hundreds of hectares of crop fields. However, piloted aircraft are not prevalent in all areas. To address this, drones become essential. Drones are Unmanned Aerial Vehicles exploited in a wide array of disciplines such as defense, monitoring systems, and disaster management but are only beginning to be utilized in agricultural sciences. UAVs are operated remotely either by telemetry, where the operator maintains visual contact with the aircraft or autonomously along preprogrammed paths using GPS and inertial guidance. Despite their potential, adopting drone technology in agriculture faces regulatory challenges, such as the need for certifications, flight restrictions, and operational guidelines. Addressing these regulatory hurdles is crucial for broader implementation. Moreover, collaboration among stakeholders including researchers, policymakers, agricultural extension workers, and industry

players is vital for advancing drone-assisted pest management and ensuring its practical adoption in diverse farming environments. Research, development and stakeholder engagement are necessary to fully realize the potential of drones in integrated pest management (IPM) systems.
Keywords: Crop health, drone, pest management, plant protection, Unmanned Aerial Vehicles.

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Artificial Intelligence Based Pest Detection in Rice Eco system

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ABSTRACT

Rice is the world's main food crop, feeding half of the world's population. According to the International Rice Research Institute, farmers lose an average of 37% of their rice production each year due to insect pests and diseases. Millions of dollars are spent every year to protect rice crops from insects and pests that cause damage during harvest and storage. Early pest detection, which allows the crop to be protected from pest attack, is one form of crop protection. The best way to learn about the health of a crop is to examine it regularly. If pests are discovered, adequate steps may be taken to prevent the crop from suffering a major loss of yield. Early detection will help to reduce the use of pesticides and direct the pesticide selection process. It has grown into a large field of science, with a lot of work being done around the world to detect pests automatically. The typical way of inspecting the fields is with the naked eye. A farmer must manually search and assess over a vast landscape of fields, risking overlooking different affected areas and conducting thorough research across large lots. To analyse the entire area, several human experts are needed, which is both costly and time-consuming. This proposed system is mainly intended to develop an Intelligent IT-driven system using various Artificial Intelligence and Computer Vision Algorithms for precision farming, enabling the delivery of information directly to the farmer's phone, providing the details of damage localization, crop health, and needs for fertilizer and pesticide application. The algorithm is used to classify the photograph dataset and apply coaching information. The visual representation contrasts with the informed data for identification and prediction. For increased precision, unsupervised learning is used.
Keywords: Agriculture, Object detection, Artificial Intelligence, supervised Learning, Rice

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Role of Artificial Intelligence (AI) technology in Pest Monitoring and Management

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ABSTRACT

According to United Nations report, up to 40% of yearly global crop production is lost due to pests. The artificial intelligence proves to be a powerful tool for effective pest control applications in agriculture. The applications of artificial intelligence (AI) in focusing on pest monitoring and management through harnessing AI-powered technologies such as machine learning algorithms and computer vision systems. Based on AI tools, the entomologists can

automate and streamline different aspects of pest detection, identification, and management. The transformative potential of AI in addressing the challenges of pest management in agriculture and urban settings, ultimately enhancing crop health, productivity, and sustainability. The insect pests hold immense significance in agricultural ecosystems where pests can create havoc on crop yields. Moreover, the traditional methods of pest monitoring and management are often labour-intensive method with inadequate pest control measures. However, the artificial intelligence (AI) offering innovative solutions to enhance pest monitoring and management practices. Automated pest detection systems leverage image recognition algorithms to analyze images captured by drones, cameras, smartphones, quickly identifying pests and alerting farmers to potential infestations. Decision support systems, powered by AI, integrate data from diverse sources including weather forecasts, crop health monitoring, and pest population dynamics to provide actionable visions for pest management. By analyzing complex datasets and predicting future pest outbreaks, these systems empower farmers and pest control professionals to make informed decisions about when and where to deploy control measures, thereby optimizing pesticide applications, reducing environmental impact, and maximizing crop yields. Moreover, AI-based species identification tools utilize huge datasets of insect images and taxonomic information to accurately identify pests, facilitating specific targeted pest management strategies.

Keywords: Artificial intelligence (AI), Insect-pests, Monitoring, Management, etc.,

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Impact of farmers benefits linking A digital platform: Empowering Farmers in Viksit Bharat

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ABSTRACT

A digital platform for agricultural extension is an online tool or service that connects agricultural experts, extension officers, and farmers to improve agricultural productivity, provide knowledge dissemination, and offer practical solutions for farming challenges. These platforms are designed to address the information gap in rural and agricultural communities by utilizing digital technologies such as mobile apps, websites, and social media channels to provide services. Fist is how to use digital platform in agricultural after is farmers benefits linking a digital platform. Digital platforms enable farmers to get advice from agricultural experts and Home Scientist on various aspects of farming, including crop production, pest control, irrigation, soil health, and sustainable practices, Weather.

Key words: Smart farming app, Website and Social media knowledge of new technology of farming with weather.

National Seminar- 2024

Agricultural Extension for *Viksit Bharat*: Innovations and Strategies for Sustainable Development

(December 27-28, 2024)

Jointly Organized by
Society of Extension Education, Gujarat
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