PERFORMANCE OF SYSTEM OF RICE INTENSIFICATION (SRI) TECHNIQUE IN RICE (*ORYZA SATIVA* L.) ON FARMER'S FIELD

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ABSTRACT

Rice being a hydrophilic crop consumes high quantity of water for production. System of Rice Intensification (SRI) is a technique which can improve productivity with augmenting factor productivity, particularly water. Fifty eight (58) demonstrations had been organized on the farmer's field in middle Gujarat comprising the districts of Ahmedabad, Anand, Kheda, Vadodara and Dahod during kharif season of 2008 and 2009. Results showed comprehensive gain in grain yield (15.6 percent) under SRI over farmer's practice (FP). Moreover, under SRI technology, saving of inputs like seed (80 percent), nursery area (90 percent) and water (33 percent) exhibited input use efficiency over FP, which was reflected in higher WUE (4.12 kg/ha-mm) under SRI as compared to FP (2.67 kg/ha-mm). Higher monetary return (₹ 85561 ha^{-1}) and BCR (6.63) had been obtained under SRI. Farmers' adaptation ratio was also increased from 50 % to 88%.

Keywords: *rice, system of rice intensification, farmer's Practice*

INTRODUCTION

Rice (Oryza sativa L.) is the staple food for over half of the world's population. Ninety per cent of the world's rice is produced and consumed in Asian region only. In Gujarat, it occupies 7.28 lakh hectare with production of 15.63 lakh ton and productivity of 2149 kg/ha. (Anon, 2016). Rice being a hydrophilic crop consumes about 3600 lit of water to produce 1 kg of rice grain. Considering this production, in Gujarat alone 562.68 x 10^{10} liter of water is required. The common practice to keep the rice field flooded with water during its life period leads to wastage of the most precious natural resource, water and also results in to occurrence of the problems like deterioration of soil physical, chemical and biological properties, leaching loss of nutrients like nitrogen, and emission of the most harmful gas, methane, responsible for global warming.

The introduction of new aerobic rice technology in rice cultivation has proved to get reasonably good yields with 2-3 irrigations, thus saving 30-40 percent of water. System of rice intensification technology, popularly known as SRI, is another emerging water saving technology for rice (Laulanie,1993). Due to creation of aerobic condition soil physico-chemical as well as biological property has been improved, which resulted in to sustainable crop production. In India, SRI is experimented in all the 22 districts during 2003 *kharif* with encouraging results in Andhra Pradesh. Over 1,00,000 farmers are experimenting with this system worldwide at present. In Gujarat, though its significance has been established at Main Rice Research Centre, AAU, Nawagam; its practical implementation and popularization amongst the farming community was still awaiting.

OBJECTIVE

To know the performnce of system of rice internsification (SRI) technique in rice (*Oryza Satiiva* L.) on farmer's field.

METHODOLIGY

Under Farmer's Participatory Action Research Programme (FPARP) fifty eight field demonstrations on SRI Technique in rice during *kharif* -2008 and *kharif*-2009 were demonstrated in Ahmedabad, Anand, Kheda, Vadodara and Dahod districts of middle Gujarat. SRI technology had been executed on farmers' field and compared with farmers' practices (FP) of rice cultivation. GR-12 and Gurjari varieties had been evaluated under SRI technology versus farmer's practice (FP) in different agro-ecological situations.

Under all the demonstrations same methodology

has been applied, which could be classified under nursery management and field preparation. Under nursery management pre-sprouted seeds @ 5 kg ha^{-1} were sown on raised nursery bed having area of 1.0 guntha ha^{-1}. Nursery bed was prepared like garden crops, wherein, a layer was prepared with fine manure, on which spouted seeds of rice were spread and then it was covered with another layer of fine manure. The bed was then mulched with paddy straw and watered carefully till transplanting.

Main field was prepared similar to that of regular rice cultivation with proper leveling. A trench to facilitate drainage was prepared at every 3 m distance. Lines were drawn both ways at 25 cm x 25 cm spacing with the help of marker for transplanting.

A 12 days old seedling, having only two small leaves, before development of fourth phyllochron, was uprooted carefully from the nursery with minimizing trauma during transplanting and placed it in the field without plunging too deep into soil at intersection at 25 cm x 25 cm in a square pattern with only one seedling per hill. Two weeding, first weeding initiated 10 days after transplanting, along with two interculturing with "Paddy hoe" were done before panicle initiation to keep the rice crop weed free as well as to aerate the root zone. The crop was watered regularly just to keep the field moist, not flooded as in case of farmer's practice, with intermittent drying, alternating aerobic and anaerobic soil condition up to panicle initiation. Then after up to physiological maturity of the crop 5 cm water level was maintained in the field. From physiological maturity to harvesting of the crop, water was drained out. FYM or compost @ 10 t ha^{-1} was applied in addition to 100-25-00 NPK kg ha^{-1}, out of which 25 percent nitrogen was applied through organic source (FYM) as against 100-25-00 NPK kg ha^{-1}, totally through chemical fertilizers under farmer's practice. Methodology has been summarized in Table-1.

Table 1 : Input comparison in SRI with FP

Sr. No.	Agronomic Practice	System of rice intensification (SRI)	Farmer's Practice (FP)
1	Seed rate (kg ha^{-1})	5 kg ha^{-1}	25 kg ha^{-1}
2	Seed bed	Raised bed	Flat bed
3	Nursery Area	1.0 Guntha for 1 ha. Transplanting	10.0 Guntha for 1 ha. Transplanting
4	Transplanting days	12-14 DAS	25-30 DAS
5	T.P. Spacing	25 x 25 cm	Arbitrary @ 15-22 seedlings/ m^2
6	Seedling/ hill	One	Two
7	Water management:	Only keep moist field from transplanting to panicle initiation (PI) stage. Keep flooding 5 cm of water from PI to physiological maturity	Field is filled with water throughout the cropping season.
8	Nutrient Management	100 – 25 N-P kg/ha, out of which 25 % N and 100 % P_2O_5 is applied as basal, while remaining N is applied in two to three equal splits. 25 % N from organic source.	100 – 25 N-P kg/ha, out of which 25 % N and 100 % P_2O_5 is applied as basal, while remaining N is applied in two to three equal splits.

RESULTS AND DISCUSSION

Fifty eight farmers from Ahmedabad, Anand, Kheda, Vadodara and Dahod districts were selected for demonstrations on "SRI Technique" under FPARP. The results are presented in the given tables.

Grain Yield

Results presented in Table-2 revealed that for variety GR-12 gave 14.7 % and variety Gurjari gave 16.9 % higher grain yield under SRI over farmer's practice (FP). Overall, 15.6 % increase was observed for mean grain yield under SRI technique as compared to FP. This might be due to good root growth because of good aeration of soil under restricted moisture condition which also provided more oxygen in the rhizosphere and increased nitrogen availability due to improved microbial activities in the soil. Good root system also gave 40 to 50 tillers per plant under SRI as compared to 25 to 35 tillers per plant under FP. More over, each additional weeding helped not only reduced weed competition, but also resulted in increased productivity because of better aeration in the rhizosphere. Rice variety Gurjari responded well over variety GR-12 with 16.2 % and 13.9 % higher grain yield under SRI and FP, respectively.

Table 2: Grain yield, straw yield (kg/ha) and water requirement (mm) of rice as influenced by SRI and FP (Av. of 2 years)

Sr. No.	District	Variety	Water Requirement (mm)		Grain Yield (kg ha^{-1})		Straw Yield (kg ha^{-1})		Water Saving over FP (mm)	Water Saving over FP (%)	Yield Increased over FP	
			SRI	FP	SRI	FP	SRI	FP			kg ha^{-1}	Percent
1	Ahmedabad	GR-12	1200	1600	4217	3872	8218	7439	400	33.33	345	8.9
2	Kheda		1200	1650	4158	3490	9156	7028	450	37.50	668	19.1
3	Vadodara		1000	1500	5147	4582	10324	8261	500	50.00	565	12.3
4	Anand		1200	1700	4284	3628	8624	6981	500	41.66	656	18.1
5	Dahod		1200	1600	5758	4973	10254	8321	400	33.33	785	15.8
	Varietal Mean		**1160**	**1610**	**4713**	**4109**	**9315**	**7606**	**450**	**38.79**	**604**	**14.7**
6	Ahmedabad	Gurjari	1300	1600	6123	5428	11236	8964	300	23.08	695	11.3
7	Anand		1400	1800	5034	4138	9824	7628	400	28.57	896	21.6
8	Kheda		1200	1500	5274	4486	10637	7959	300	25.00	788	17.5
Varietal Mean			**1300**	**1633**	**5477**	**4684**	**10566**	**8184**	**333**	**25.62**	**793**	**16.9**
Mean			**1213**	**1619**	**5000**	**4325**	**9784**	**7823**	**406**	**33.47**	**675**	**15.6**

Input savings

Results given in Table-3 indicated savings in inputs and increase in their efficiencies.

Seed requirement under SRI is reduced to 80 % and only 5 kg seeds ha^{-1} as against 25 kg seeds ha^{-1} needed for FP. The area requirement for raising nursery is also cut down to1/10th in SRI technique compared to FP. Application of 25 % nitrogen through organic source under SRI against FP would be beneficial for mitigating ill effect of chemical fertilizers along with cutting down the cultivation costs. The most important feature of SRI Technique was its potentiality to save water. The saving of water was higher for variety GR-12 (38.79 percent) compared to variety Gurjari (25.62%) under SRI over FP. On an average, 406 mm water was saved under SRI, which tuned to 33.47 % saving over FP. So, for production of 1 kg grains of rice, 2426 lit. of water was sufficient under SRI, as against 3743 lit. water required for producing the same quantity under FP, indicating about 35 % higher efficiency of water under SRI over FP. Likewise, WUE was also higher (4.12 kg/ha-mm) under SRI as compared to FP (2.67 kg/ha-mm).

Table 3 : Savings or benefits (%) in various inputs under SRI as compared to FP

Sr. No.	Item	SRI Technology	Farmer's Practice (FP)	Benefit/ Saving (%)
1	Water required to produce 1 kg grain of rice (lit)	2426	3743	33.5
2	water use efficiency (kg/ha-mm)	4.12	2.67	35.0
3	**Yield (kg ha^{-1})**			
a	Grain yield	5000	4325	15.6
b	Straw yield	9784	7823	25.0
4	**Inputs used**			
a	Land required for nursery (guntha)	1 guntha	10 guntha	90.0
b	Seed	5	25	80.0
5	Gross Income (₹. ha^{-1})	85561	73091	12470
6	Gross Expenditure (₹ ha^{-1})	12906	11819	1087
7	Net Realization (₹ ha^{-1})	72655	61272	11383
8	BCR	6.63	6.18	-

Economics

Economics shown in Table 4 revealed that there was a clear-cut increase in gross (`.85561 ha$^{-1}$) as well as net (`.72655 ha^{-1}) realization under SRI over FP, in spite of higher net expenditure (`.1150/ha) under SRI. This was also

reflected in BCR and higher BCR (6.63) was obtained under SRI as compared to FP (6.18).

Table 4: Economics of SRI and FP in rice

Sr. No.	Grain Yield (kg ha^{-1})		Straw Yield (kg ha^{-1})		Gross Expenditure (₹. ha^{-1})		Gross Income (₹. ha^{-1})		Net realization (₹. ha^{-1})		Realization over FP (₹. ha^{-1})		BCR	
	SRI	FP	SRI	FP	SRI	FP	SRI	FP	SRI	FP	Gross	Net	SRI	FP
1	4217	3872	8218	7439	13250	12500	75582	69239	62332	56739	6344	5594	5.70	5.54
2	4158	3490	9156	7028	12750	11500	76104	62892	63354	51392	13212	11962	5.97	5.47
3	5147	4582	10324	8261	11500	10500	92691	81122	81191	70622	11570	10570	8.06	7.73
4	4284	3628	8624	6981	13650	12000	77196	64892	63546	52892	12305	10655	5.66	5.41
5	5758	4973	10254	8321	13000	11500	101751	87077	88751	75577	14675	13175	7.83	7.57
Var. Mean	**4713**	**4109**	**9315**	**7606**	**12830**	**11600**	**84668**	**73044**	**71838**	**61444**	**11624**	**10394**	**6.60**	**6.30**
6	6123	5428	11236	8964	12850	12000	96453	84010	83603	72010	12443	11593	7.51	7.00
7	5034	4138	9824	7628	13500	12750	80178	65236	66678	52486	14942	14192	5.94	5.12
8	5274	4486	10637	7959	12750	11800	84518	70257	71768	58457	14261	13311	6.63	5.95
Var. Mean	**5477**	**4684**	**10566**	**8184**	**13033**	**12183**	**87050**	**73168**	**74017**	**60985**	**13882**	**13032**	**6.68**	**6.01**
Mean	**5000**	**4325**	**9784**	**7823**	**12906**	**11819**	**85561**	**73091**	**72655**	**61272**	**12470**	**11383**	**6.63**	**6.18**

Selling price :

Variety	Grain (`₹ ha^{-1})	Straw (`₹ ha^{-1})
GR 12	15.00	1.50
Gurjari	13.00	1.50

Total benefits accrue (tangible & intangible):

(A) Tangible benefits

a. More yield per drop of water
b. Saving of land for nursery preparation
c. Better water use efficiency
d. Better fertilizer use efficiency
e. Saving in seed quantity
f. Better yield with lesser resources

(B) Intangible benefits

a. Soil health can be sustained for a longer period
b. With the same amount of water more area can be covered under cultivation.
c. Taking less time in nursery for seedling preparation, reduce the possibilities of insect/pest and disease infestations.
d. Frequent weeding made the soil porous and allows more growth of roots, enhancing more number of tillers per seedling.
e. Improves soil physical condition for a longer period.
f. Lower the methane emission.

Adaptability of the technology by the farmers

During *kharif*- 2008, only 16 farmers were ready to allow the demonstrations on SRI on their field. Out of them, only 8 farmers (50%) were carried out the demonstrations successfully. But in the second year (kharif-2009) 58 farmers were ready to demonstrate the technology on their field and 51 farmers (88 %) were successfully conducted the demonstrations. This reflected the response of farmers in adopting this technique.

Effectiveness of the technology

During kharif-2009, monsoon was very weak. Rainfall was erratic and scanty (Av. 400 mm against state av. of 927 mm) . In spite of this adverse condition for rice cultivation, SRI Technique gave higher yield (5 to 6 t/ha) against av. productivity of 2.4 t /ha of conventional method of transplanted rice cultivation. During *kharif*-2009, 52 demonstrations on SRI have been conducted on farmers' field. And under the vagaries of monsoon, 46 farmers have successfully conducted the demonstrations.

CONCLUSION

For efficient use of water, SRI is an effective and farmer's friendly technology which not only helped to sustain productivity of rice, but also assisted for higher factor productivity of the crop.

FUTURE THRUST

The technology is practically feasible as well as economically viable. Therefore, it can be replicated on large plots in wider range of soils and climate. Particularly, area having limited and scanty rainfall or where irrigation facility is limited and under control, this technique is proved far better than conventional technique of rice transplanting. Not only that, but under vagaries of monsoon the crop can be sustained with considerably good yield.

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