STRENGTHENING AGRICULTURAL EXTENSION WITH REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM INFORMATION

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ABSTRACT

Last two decades belongs to ICT and it is assisting all most all sectors including agriculture. ICT revolution impact was felt with invasion of Mobile phones. In order to strengthen sustainable agriculture, agricultural extension is nourished since decades. For imparting cutting edge information and knowledge to the farmers' assorted modes are availed by NGO's, Agriculture Universities, government and even private sector in India. Best options today is bombarding information on farmers' mobile via short message service (SMS) or using WhatsUP mobile app. To disseminate timely related and required cognitive updated knowledge in an inferable form to each individual farmers' is still a big issue. To increase knowledge and ultimately sustainability of farmers, this paper proposes an innovative method of dissemination of timely precise information via SMS by integrating information from Remote Sensing (RS) & Geographical Information System (GIS).

Keywords: *sustainable agriculture, rs, gis, food shortage, sms, agricultural extension*

Introduction

Indian economy is classified in three sectors — Agriculture and allied, Industry and Services. Agriculture sector includes Agriculture (Agriculture proper & Livestock), Forestry & Logging, Fishing and related activities (Arjun, 2013) and it contributes 17.9% of GDP in year 2014. Share of Agriculture & allied sector has declined at 18.20% in 2013-14. Total production of agriculture sector is $366.92 billion. India is 2nd larger producer of agriculture product. India accounts for 7.68 percent of total global agricultural output. (StatisticsTimes.com, 2016).

In India, ratio of people under the grip of poverty is more and even percentage of illiterate is more compared to literate. Land ratio per person is decreasing continuously. The total land area of India is 143 million hectares of which 108 million hectares is dependent on annual rainfall. Growth in the production of agricultural crops depends upon acreage and yield. Given the limitations in the expansion of acreage, the main source of long-term output growth is improvement in yields (Chauhan, 2000). Thus there is need for renewed research to boost production and productivity. For this all-round development of people esp. farmers is required. This task might be easily accomplished through the medium of Extension Education.

Agricultural Extension

Moto of Agricultural Extension Education is almost an all-round development of rural people. It is fact that techniques and technology prevalent today will not give same result in future. Farmers' problem is changing day by day, therefore, in order to mitigate problems, it is necessary that there should be an institution, which act as a bridge between scientists and farmers. It should introduce new techniques to the farmers and address the problems of farmers to the scientists. Extension Education educates people through "learning by doing" and "seeing is believing". Extension Education is a two-way system of education. It brings scientific knowledge to the rural people and conveys the problems of rural people to the scientific institution for solution.

Remote Sensing (RS)

Remote sensing means acquiring information about a phenomenon object or surface while at a distance from it. This name is attributed to recent technology in which satellites and spacecraft are used for collecting information about the earth's surface. Based on type of radiation remote sensing is bifurcated as passive and active remote sensing which can be further classified as microwave remote sensing, Thermal, Infrared, Radio. Each of this classified remote sensing has specific area of application.

Geographical Information System (GIS)

GIS is an information system dealing with geographic information. It narrates factual about already occurred geographic phenomena or going to occur in nearby feature. Geographic phenomena can be defined as a manifestation of an entity or process of interest that can be named or described, that can be georeferenced, that can be assigned a time (interval) at which it is/was present (de, 2009**).** GIS software provides the functions and tools needed to store, analyse and display geographic information. Key software components are tools for the input and manipulation of geographic information, database management system (DBMS), tools that support geographic query, analysis and visualisation and at last a graphical user interface (GUI) for easy access to tools. GIS technology is of limited value without trained technical experts who manage the system and develop plans for applying it to real-world problems. GIS users range from technical specialists who design and maintain the system to those who use it to help them perform their everyday work.

The most commonly practiced application of duo RS and GIS for agriculture is mapping land cover to identify crop types. It can be also be applied for many other application viz. monitoring agricultural operations like process of sowing and total crop area; various operation of crop inventory like production forecast, changes in cropping pattern, cropping system analysis etc. Crop health monitoring is a prime operation which can assist framers in increasing yield by providing regular updates regarding crop condition and requirement, assessment of drought or any other tragic calamity and many more.

Dissemination of Agricultural information.

Farmers require various kind of information at different stages of crop cultivation like best seed for sowing and its available sources for procurement, water management, fertilizer application, pest management, harvesting, post-harvest handling, transport of products, packaging, preservation, processing/value addition, quality management, storage, marketing and insurance. This information must be availed to the farmers in user-friendly form, easy to access, cost-effective and must be accurate. Agricultural extension, in a rapidly changing world, has been recognized as an essential mechanism for delivering knowledge (information) and advice as an input for modern farming (Jones, Swanson, Bentz, & Sofranko, 1997). With ICTs in picture, these information will be in digital format i.e. photographs, audio, video, process descriptions and many more.

Agriculture extension worker's main job is to transfer information and knowledge over large distances relatively timely, rapidly and precisely. They need to achieve greater interactivity in communicating, evaluating, producing and sharing useful information and knowledge. In some situations they need to collect feedback and even analysis it. ICT has many potential applications in agricultural extension (Zijp, 1994 and Chauhan *et al.*, 2016)

Time required for knowledge transfer and problem solving has declined by integrating ICT and agriculture. Various ICT are tools used for dissemination of agriculture advisory (RAJ, KATHIRIYA, & VEGAD, 2016).

According to the latest report from IAMAI, in India mobile internet users will rise up to have 371 million by adding approx. 65 million new mobile internet users during the period of six months, ending June 2016 (Mobile Internet Users In India 2016: 371 Mn by June, 76% Growth In 2015, 2016). Thus most prominent and farmer friendly mode of knowledge transfer is sending advisory on his/her mobile by using short message service. These messages can be in regional language and even target regional issues, so it is considered as most favorable mode. These type of advisory is disseminated by KVK's, government organization related to agriculture, meteorological department and even by many private companies.

With 220 mn smart phone users Indian is second in the world in this category. WhatsUP is smartphone application and it has boom market with its popularity. By using this application, farmers belonging to same area of interest can create a group and can share ideas and knowledge.

Problem with existing scenario

Dissemination of information via SMS is most convincing, though it has some functional drawbacks. In order to receive advisory one need to register his/her mobile number with the organization by filling online or offline form. Then after, s/he will receive all SMS push by organization. These SMS may contain information pertaining to various fields or corps or sectors. Thus these information may or may not be requirement of the receiver or farmer. A person how has registered his mobile for more than one advisory may receive multiple SMS containing diametric information from different organizations. Today also small scale farmers do not have smart mobile phone. Thus, for simple mobile

phone, memory to store SMS is limited. As a result it might happen that memory becomes full and important SMS may get missed by the farmer. Farmer can also become member of a WhatsUP group of his/her field crop. But he may not continue to cultivate same crop forever.

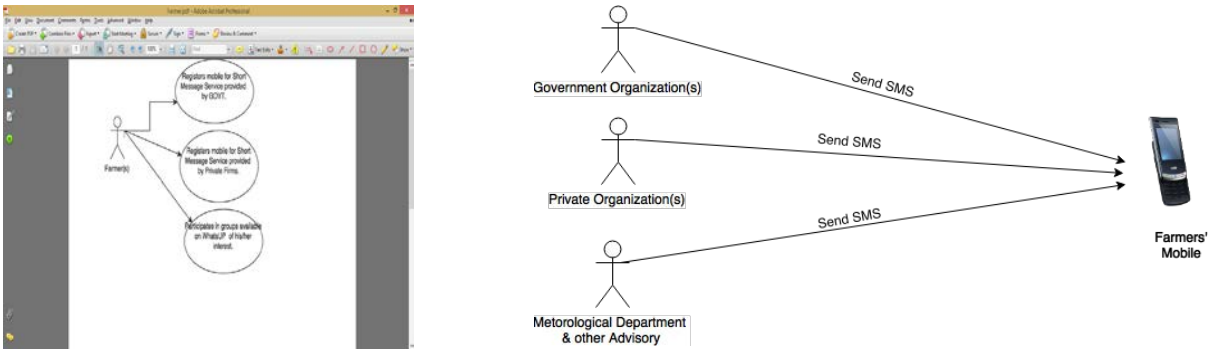


Figure 1: Existing problem of multiple duplicate SMS delivered on Farmers' mobile

Proposed Solution

Many organizations governed by Government in developing countries, NGOs' and private organizations are trying to assist farmers by providing them valuable information using different modes (Zhang, Wang, & Duan, 2016). Intention of all these organization is to support farmers and to make them sustainable. Increase in sustainability will affirmatively affect GDP of an agriculture based country as well as food shortage issue. To deal these issues better extension service supported by ICT tools is required. One of the speediest ICT tool which can send timely valuable information is Short Message Service (SMS) provide by telecom sector.

In order to restrict unwanted SMS, collaboration is required between Advisory Providing Organizations (APO). While pushing SMS APO should consider regional language and terminology. To convert information into knowledge a proper synchronization is also required for pushing cognitive SMS to the respective farmer. A log of pushed SMS should be maintained and shared between advisories, so that synchronization is feasible and duplication can be avoided. After reviewing and evaluating log of pushed SMS, APO can decided next SMS. Farmers requires support related to their current crop. Perspective support can be provided by integrating mobile database, climate and current crop information cultivated by a particular farmer. This integration is feasible using Global Positioning System, Remote Sensing and Geographical Information System. In GIS, along with land & crop information and mobile number of a land owner data should be stored. Farms can be monitored periodically using satellite images by experts eliminating physical on spot examination and verification. Expert's views can be stored in shared or global database. These should be publicly accessible or shared between advisory providers. These information can be stored at a cloud level and organization willing to access this information should pay in terms of either monetarily or services.

Process Flow of sending Advisory SMS

- Based on soil report send SMS suggesting crops that can be cultivated.
- Send list of authorized vendors of seeds for suggested crops.
- Send required fertilizer dose.
- Send list of authorized vendors of fertilizer.
- Based on irrigation method opted by farmer send estimated irrigation schedule dates.
- Based on cumulative evapotranspiration rate and rainfall data send exact date of next irrigation before at least 2 days.
- Send precautionary informative SMS based on prediction done from analysis of satellite images and weather data esp. related to crop monitoring.
- At harvesting time send details of nearby storage house for their crop and current market price of nigh Agriculture Market or list of sites where farmers can sell their yield online.

Daily updates

- Daily weather report.

Log of above SMS can be stored in shared database. An organization willing to send SMS should review this log

and then needed SMS to the farmers of that region.

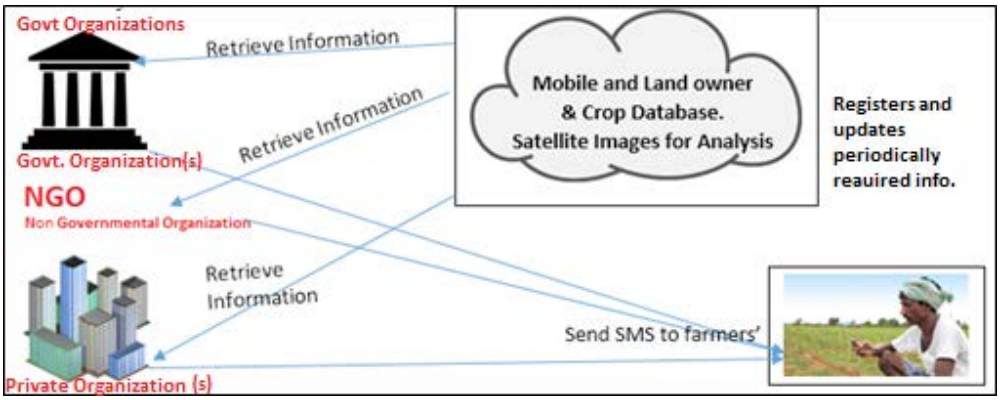
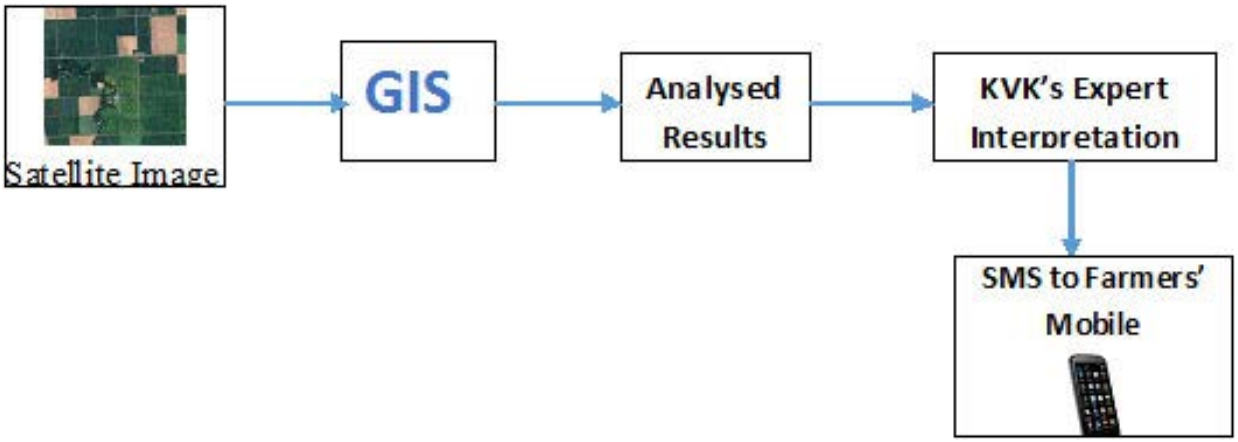


Figure 2: Proposed solution to leverage sustainability of farmers and increase yield and thereby reduce food shortage



In India KVKs can play an important role in dissemination of precise and region specific knowledge. KVKs are quite aware about local requirement and even economic conditions of farmers. They can even explain or send SMS using local terminology and language. KVKs should be empowered with an additional GIS expert with access privilege to conceptual database (containing land owner, crop grown and mobile number details) and satellite image of KVK periphery. Using these satellite images GIS expert can analysis crop condition and effect of climate on it. Based on these analysis KVKs can send advisory to the farmers.

CONCLUSION

Knowledge of farmers' should be updated sporadically to increase their sustainability by increasing returns on their crops. They should also be updated about current mortal or immortal crisis and its remedy to mitigate its effect and increase overall yield and thereby resolve food shortage. They should also be updated about future phenomenon to take precautionary measures. Agriculture Extension does a wonderful chore of imparting knowledge to the farmers and enhance their livelihood. Extension person cannot physically visit each and every place timely and provide information. ICT assist them to accomplish this task on time, but in this case accuracy and authenticity of the information may be less as they have not personally visited site. Remote sensing and Geographical Information System comes to their rescue. By accessing satellite image of their

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