IMPACT ANALYSIS AND EXPERIENCE OF ESAGU IMPLEMENTATION FOR COTTON CROP

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ABSTRACT

The developments in information and communications technologies should be exploited for providing better extension services. During last decade, research efforts are being made to build information technology based systems to disseminate agricultural information and related services. At IIIT, Hyderabad, a research effort is being made to build eSagu system, which is an IT based personalized agro-advisory system in 2004. The eSagu system aims to give agricultural expert advice to each farm at regular intervals from sowing to harvesting. In this system, the agricultural expert, rather than visiting the crop, delivers the expert advice based on the digital crop photos and text. This study reports the assessment of eSagu experiment implemented for cotton crop in Andhra Pradesh, India during 2004–05. The results show that eSagu has demonstrated the possibility of bringing crop situation (crop images, text) and comprehensive information of soil, weather, etc. to the place of agricultural experts for right diagnosis of crop problems and effective control. Further, multi disciplinary services of agricultural experts, quick and periodic dissemination of advisories, more coverage of farms, feedback and content documentation, offer relative technical efficiency over the earlier extension system. Added to these, farmers have realized quantitative benefit flows in the form of savings in fertilizers, pesticides and enhanced yield. The results show that the advisories delivered through eSagu are acceptable to farmers.

Keywords: *IT for Agriculture Extension, IT for Development, Personalization, Information System.*

1. INTRODUCTION

Agriculture holds an important place in India in terms of GDP, exports, food security, livelihoods and the overall economic progress. However, the challenges to agriculture are multiple and complex, resulting in a serious crisis overtime. Studies on agrarian crisis have brought out that depletion of land, water resources, indiscriminate use of chemical inputs, climatic changes have led to higher costs and lower yields. Added to these, the emerging crop composition, input structure, complex technologies have opened wide information gap among the farmers. It is well recognized long before that future productivity gains are likely to result from improved information and management skills (Taxler and Byerlee, 1992). The ongoing crisis has a close bearing with the deficiencies in extension services in agriculture. As against this, present agricultural extension system is unable to deliver crop advisories in efficient and timely manner (Rita Sharma, 2001; Robert Chapman and Tripp, 2003) and has not been able to reach majority of the farmers (NSSO, 2005). As a result, farmers are guided by input vendors leading to negative externalities, crop failures, health and environmental problems (Joshi, 2001; Shetty, 2004; World Bank, 2008). The research challenge is to bridge this gap in extension exploring new ways of dissemination by integrating latest technologies.

It is argued that imaginative use of Information and Communication Technologies (ICTs) would be a useful strategy for improved dissemination of information (Chapman *et al.*, 2002; Damona Doye, 2004). On the Policy front (MOA 2000; and MOA 2007) have laid the emphasis on the need to harness information technology for agricultural extension. Despite huge potential, initiatives using ICTs in agriculture are only a small component. Though, some grassroots projects are using ICTs, they are rarely been studied, no comparisons have been made and properly evaluated (Keniston, 2002). Opportunities to learn from Indian experience so far remain unutilized.

The programmes using ICTs in rural areas as provided in (Sarvanan, 2010) and others reveal that few programmes have a broad focus on administrative services (for ex. Gyandoot, Drishtee, N-logue, Tarahaat, etc.) Some concentrate on market information to the farmers (*i.e.* AGMARKNET, e-Krishi Vipnan, ITC-e choupal, etc.). NGOs and other organizations have established Village Knowledge Centres (VKCs), Village Resource Centres (VRCs), Community Information Centres (CICs), IFFCO—Agri portal, I Shakti, etc. to provide multiple services including agriculture to rural people. Under the programme of central government, several states have established information rich agricultural websites such as e-Krishi, ASHA, KISSAN and others. Projects like DACNET, e-Extension, VASAT facilitate online guidance, question-answer sessions on agriculture. Projects with a major focus on agriculture include aAQUA, Digital Green, e-Arik provide digital documentation of crop condition, participatory content creation, content screening for better adoption and promotion of innovative practices among farmers. In an effort to examine the feasibility and acceptability of Information Technology (in agricultural extension, IIIT, Hyderabad has developed eSagu an IT based personal agro advisory system. Since 2004, research efforts (Krishna Reddy and Ankaiah, 2005; Krishna Reddy *et al*., 2006; Ratnam *et al*., 2006, Uday Kiran *et al*., 2010; Krishna Reddy *et al*., 2012) are going on to develop an efficient and scalable eSagu system.

It can be observed that the initiatives integrating ICTs for dissemination of extension services have a major focus on question-answer session, online interaction, transfer of crop information messages to farmers. Such facilities no doubt give information whenever farmer requires but does not take cognizance of the crop situation and other details specific to farms periodically that are important in advice making. In this backdrop, there is a need to improve the extension services more particularly crop advisories without losing sight of the essential elements of earlier extension system. The eSagu model delivers personalized agro-advisories by considering the farm-level situation by exploiting developments in IT. The eSagu model was put for experimentation covering 1050 cotton farms in three villages in Warangal District of Andhra Pradesh (India) during 2004–05. In this paper, we report the assessment of eSagu implementation during 2004–05.

2. OBJECTIVE AND METHOD

The main objective is to assess the eSagu performance assessed at the system level and its impact at the field level for the experiment conducted during 2004–05. The present study is an outcome of the project evaluation report 2004–05 and the deliberations of workshop on eSagu held during May 2005 at IIIT, Hyderabad (Krishna Reddy *et al*., 2005).

At the system level, functional efficiency is analyzed as to the feasibility to deliver advice based on crop photographs, personalization and its relative merits over the earlier extension system. Data for system level analysis such as personnel, infrastructure and the work procedure were taken from eSagu database. In addition, interviews and opinion surveys were conducted among scientists, coordinators and farmers about system functioning.

At the field level, a census study covering 749 farmers was conducted to measure the impact in the ‘before’ and ‘after’ frame of analysis. Further, a cross section study with 180 farmers comprising 25 per cent sample from Project Area (PA) and an equal number from the non-project area (NPA) was taken up. Periodic interactions with farmers about eSagu, mid term appraisals also helped to elicit qualitative information.

3. IMPLEMENTATION OF ESAGU DURING 2004–05

3.1 About eSagu System

The main objective of eSagu (word ‘sagu’ means cultivation in Telugu language) is to deliver a personalized expert advice in a timely manner to each individual farm at regular intervals (once in a week/two weeks) from the sowing to harvesting stage. The eSagu system contains five components viz., farm/farmers, coordinators, agricultural experts, Agricultural Information System and Communication system (Krishna Reddy and Ankaiah 2005). Farms belong to farmers who are the end-users of the system. A coordinator, appointed by the eSagu, is an educated (minimum up to 10th standard) and also an experienced farmer from the village. Agricultural Experts (AEs) possess a university degree in agriculture and trained to provide expert-advice. Agricultural Information System (AIS) is a computer based information system that contains all the related information such as farmer details, farm photographs and weather data etc. Communication System is a mechanism to transmit information from farms to agricultural experts and vice versa.

The system works as follows. In the conventional extension system agricultural expert should physically visit each farm for delivering the expert advice. As against this, under eSagu a coordinator who is associated with a group of farmers visits the farms at regular intervals and collects farm details in crop images as well as text and sends to agriculture information system. By accessing the information of soil, weather, crop details the agricultural experts prepare the advice. The coordinator gets the advice at the local centre through internet and delivers them to the respective farmers.

3.2 Implementation of eSagu Prototype During 2004–05

The eSagu prototype was implemented for 1051 cotton farms. eSagu main lab and the required infrastructure (one server, and eleven desktop computers, one printer, and other related equipment) was setup at IIIT, Hyderabad. Software system was developed and a five member team was formed with agricultural scientists from different disciplines. The farmers of three villages (Oorugonda, Gudeppad, Oglapur) in Warangal district, Andhra Pradesh were identified and a eSagu local centre was established at Oorugonda village. It is furnished with computers (3) printer, generator, weather equipment. A computer operator was hired to look after data entry and transmission activities at the local centre. Fourteen Coordinators were appointed and necessary training was imparted regarding field scouting, photography and farm related data collection. For weather data, equipment was installed.

The operation of the eSagu during 2004–05 consists of seven steps of which (ii) to (vii) were performed every week for every farm. They are:

1. *Farmer and Farm registration:* The coordinator collect the farmer's details, land preparation, sowing, soil details in separate forms. All these details are entered into AIS.
2. *Collection of crop status:* The coordinator collects the crop status for each farm once in a week, he is expected to cover 20 farms a day. For crop status coordinator visits the farm, takes one or two photographs for each crop problem, altogether takes about five photographs. He also fills in crop observation form in which he mentions crop problem, whether the farmer has followed preceding week's advice or not etc.
3. *Data set preparation:* At the local centre, each crop photograph is renamed by associating the corresponding farm identifier. The data set along with weather information is written on to compact disks (CDs).
4. *Transmission of data set to agricultural information system:* The CDs are transmitted to the main system through courier service (the available band width is not adequate to transmit huge data). The data set in the CDs is uploaded to AIS at the main lab.
5. *Expert advice preparation:* For each farm, agricultural experts prepare the advice by analyzing crop situation through observation of crop images. They also consider previous advices, soil, weather, agronomic practices etc.
6. *Down loading expert advice at the local centre:* The computer operator at the local centre down load and print the advices through dial-up telephone connection from AIS.
7. *Delivering advice to the farmer:* Coordinator deliver the advice and explain it to the farmer for compliance.

4. IMPACT ANALYSIS RESULTS

We report the results by assessing at the system level and field level.

4.1 System Level

Given the deficiencies in the extension services, eSagu as a system need to be evaluated in terms of the performance of the operations envisaged in the model and its ability to make improvements over the existing system. The experience has shown that it is feasible to provide crop advisories to the farmers under eSagu:

1. *Brings crop situation to the expert:* Under eSagu crop situation in the form of crop images and text has provided better advantage to the agricultural expert in pest and disease identification. This will ease the burden of time consuming and expensive farm visits (Ariel Dinar 1996) by scientists. It saves the time of scientists and farmers traveling to each other for crop problems.
2. *Technical improvements:* Facility of zooming crop images helped experts to count the pests per leaf and estimate ETLs (economic threshold levels) and also natural enemies feeding on pest colonies. Tracking pest cycle helps in early detection and effective control.
3. *Diversified experts, comprehensive information:* Growing pest and disease problems require expertise and sophisticated knowledge. Group of experts in different disciplines at one place under eSagu resolve this problem. Comprehensive information in the form of soil, weather, history of farm operations, earlier advices, etc. helped in the right diagnosis of the problems.
4. *Coverage of more farms and accountability:* Crop situation at the doorstep of expert enables him to cover more farms, about hundred a day. He spends less time on good crop and more on problematic crop. There is an in-built accountability as the agro-advisory developed by each expert is archived, hence expert takes utmost care.
5. *Acceptable periodic and round trip response time:* It is observed that weekly crop advices provided under eSagu are acceptable to the farmers. The round-trip response time is 24–36 hours *i.e.* from coordinator taking crop photograph to the advice delivery to the farmer.
6. *Documentation and content development:* Documentation of more than one lakh crop visuals and 20,000 advices in one year will help in future agricultural extension as well as research.
7. *Cost of advice:* The cost per advice per farm worked out to be around ₹ 150/- and at per acre level it is ₹ 75/-.
8. *Aids in crop insurance and other government schemes:* eSagu operation covers the entire crop cycle. The data set can be exploited useful in the implementation of crop insurance, drought relief and other programmes.

4.2 Field Level: Access, Knowledge, Adoption

At the field level, comparison of census data in the pre and post implementation stages and cross section sample data collected from Project Area (PA) and Non-Project Area (NPA) shows positive results. The study clearly shows that farmers have greater access to information in the project area. Access score is two and half times higher in the PA as compared to NPA. The knowledge score developed for the included aspects show that the farmers in the project area acquired better knowledge (45.2 per cent) as against only 16 per cent NPA.

Table 1: Adoption of eSagu Advices

S. No.	*Items*	*The Relative Knowledge and Adoption Rates*		
		P.A (n = 180)	*N.P.A (n = 180)*	*Difference*
1.	Use of Micro-Nutrients	14(7.7)	2(1.1)	12
2.	Crop Rotation	81(45.0)	17(9.4)	64
3.	Stem Application of Pesticides	43(23.8)	1(0.5)	42
4.	Non use of Synthetic Pyrethroids (<90 days)	166(92.2)	22(12.2)	144
5.	Trap Crops	151(83.8)	55(30.5)	96
6.	Topping	174(96.6)	84(46.6)	90
7.	Use of Pheromone/Light Traps	80(44.4)	3(1.6)	77
8.	Identification of Pests and Their Threshold levels	172(95.5)	30(16.6)	142

Source: Sample Survey 2005.

Note: Figures in the parenthesis indicate percentage to sample size.

It is observed that farmers in PA have greater knowledge and technology adoption rate in respect of eight components of new technology as compared to farmers in NPA (Table 1). However, the adoption rates varied across different components. Adoption rate varied between 7.7 and 96.6 per cent. The stagewise adoption rates varied significantly within a single crop period. The adoption rate in the initial advisories was low as compared to the adoption of later advisories. In the absence of regular extension services, the higher rate of new technology in PA than in NPA may be attributed to eSagu experience. The analysis of census data obtained from all the farmers covered under eSagu in the post operation stage indicates that all farmers have adopted the technology but at different levels. Of the 18 advices provided to each farmer, 18 per cent have adopted in the average of 51–75 per cent, 57 per cent have adopted 25 to 50 per cent of advices. About one-fourth concentrates in the lower level of adoption. The overall adoption can be summarized as moderate. As far as the utility of the project is concerned 78 per cent farmers have responded it as ‘more useful’, the remaining as ‘useful’. Farmers have expressed their willingness to pay a part of the expenditure of the project.

4.3 Field Level: Quantitative Benefits

The analysis of Census data shows that whatever the level of adoption, about 83.3 per cent farmers responded positively to the increased yield on account of the improved practices. The farmers are found to hold right attitudes and perceptions regarding the recommended technology. In quantitative terms, the benefit flow includes an increase of yield by 1.5 quintals per acre amounting to ₹ 2485.3. Farmers have also responded favorably to saving in fertilizers. On the average, they saved fertilizer @ 0.76 bags per acre worth of ₹ 229.7. Soil tests revealed excess of available Phosphorus and therefore farmers were advised not to go for DAP fertilizer. Rightly, farmers reduced the consumption of DAP. Similarly, farmers have also saved the cost by reducing the pesticide consumption @ 2.3 sprays per acre worth of ₹ 1105.0. Thus, the overall benefit is ₹ 3820.0 per acre (Table 2).

Table 2: Flow of Benefits on Account of eSagu

S. No.	*Particulars*	*Gain/Saving*	*Monetary Benefit (₹)*
1.	Increase in yield	150 kg/acre	2485.3
2.	Fertilizers	38 kg/acre	229.7
3.	Pesticides	2.3 sprays/acre	1105.0
Total monetary benefit			3820.00

4.4 Issues

Farmers have mentioned few problems in the implementation of eSagu the advice to be provided in local language (which was fulfilled later), extension of eSagu to all crops, delay in advice in few cases, etc. The adoption of technology by the farmers was slow at the beginning. The level of confidence picked up with education and motivation.

5. CONCLUSIONS

The eSagu system is an IT based Agro-advisory system developed by IIIT, Hyderabad worked smoothly along the proposed lines with the designed infrastructure. Different wings in the system functioned in a coordinated manner to move information from one end to the other. It has demonstrated the possibility of bringing crop situation (in the form of crop images, text) to the place of agricultural scientists with better pest/disease identification. Minute details of pests and diseases through magnification of crop images, comprehensive information of soil, weather, etc. helped the experts in the right diagnosis of crop problems, early detection and effective control. eSagu offers multi disciplinary services of agricultural experts, quick and periodic dissemination of advisories, more coverage of farms, farmers' feedback, content documentation, etc. These contributions of eSagu offer relative technical efficiency over the earlier extension system.

At the field level, cross section comparison of project area with that of non-project area shows better access to information, knowledge score, higher rate of adoption of modern practices in the project area. Farmers have realized quantitative benefit flows in the form of savings in fertilizers, pesticides and enhanced yield. The gain due to eSagu is about ₹ 3820 per acre and the cost benefit ratio for the project as a whole is 1:3. eSagu is acceptable to the farmers as 78 per cent responded it as 'more useful', remaining as 'moderately useful' and have expressed their willingness to pay a part of the expenditure of the project. Extension of eSagu to all the crops in different areas in the later period has shown that it is scalable, sustainable and cost effective for dissemination of information.

The analysis results show that the eSagu system which delivers the advisory services by focusing at the farm level considerably benefits the farming community, including poor and marginal farmers. In (Sarvanan, 2010), several IT-based agriculture extension efforts have been reported. By considering the profile of Indian farming community in which majority of them are illiterate and hold small farm holdings, it is necessary to investigate the building of cost-effective and scalable personalized agro-advisory systems to cover all farms in a focused and regular manner throughout crop period by exploiting the good features of ongoing ICT-based agro-advisory systems and the latest progress in information and communication technologies and agriculture.

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