"e-Velanmai' – An ICT Enabled Agricultural Extension Model

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ABSTRACT

Farmers in India lack timely access to scientific information on agricultural technologies to solve their farm specific problems. Action research was initiated during 2007 to pilot test an ICT based extension approach called 'e-velanmai' (means, electronic-agriculture) in India. ICT tools such as computer, internet, digital camera and mobile phone were handled by farmers/Field Coordinators (FC) to send images of crop status to researchers and get advice. Majority (85.37 %) of small holders participated in 'e-agriculture' and accessed 2279 items of technical advices to practice farming effectively. It was proved that farmers were willing to pay for availing ICT based agricultural extension services from experts based on the size of their farms. The turnaround time of dissemination was 1-3 hours in a day. The rate of adoption of scientific practices by the farmers was found to be high (77.00 %). The advices helped farmers to improve their farm profit by INR 2102/acre (for seasonal crops eg: vegetable) and INR 3101/acre (for plantation crops eg:Coconut) by achieving higher efficiency in the use of inputs. 'e-agriculture' facilitated participatory, cost effective, quality and timely extension service to promote sustainable farming and develop the livelihood status of farmers in the region. Based on the success achieved in the pilot experimentation, the project was upscaled in 19 command areas of Tamil Nadu state during 2011-12. e-agriculture extension model has been proven to perform well both in pilot as well as in the upscaled stages in Tamil Nadu and hence it is recommended to adopt it as one of the effective means to reach the unreached in India.

Key Words : *e-Velanmai ; e-agriculture ; Field Coordinators ; Water Users Association (WUA)*

Extension is typically seen as a service – public or private – that responds to the needs of farmers for agro technologies they can adopt to improve their productivity, income and welfare, and to manage the natural resources on which they depend in a sustainable way. Extension brings information and new technologies to farming communities, allowing them to improve their production, income and standard of living. (Rivera and Qamar, 2003). The concept of Training and Visit (T&V) extension was developed in the early 70s, and implemented in India during 1974 and adopted in many Asian countries in 1980s. Many development scholars and extension practitioners commented on the weakness of the T&V design and implementation and the model disappeared within 25 years of its inception in many countries including India (Anderson,et al., 2006). Some of the extension performance issues highlighted by Feder et. al., 2001 include: the cost of reaching large, geographically dispersed and remote smallholder farmers, high transport costs, weak accountability to clients and financial unsustainability. With a large and diversified clientele, only a small fraction of farmers can be served directly (face-to-face) by extension, and agents tend to focus on the larger, better resourced and more innovative farmers. Limited outreach to smallholder clientele reduces the benefits and impact of extension.

The public extension system like T&V was also criticised due to its top-down approach, which have been supply-driven, technically weak, patronizing, catering only to large farmers and providing insufficient coverage of and contacts with farmers (Qamar, 2002). He also stated that public extension services have been ineffective in reaching farmers and farm communities with agricultural information and technologies needed to ensure food security and sustainable development. Despite the limitations, farmers have managed to obtain information from other sources. It is obvious from past studies, that there is need for agricultural information to suit the needs of farm communities – thus necessitating improvement in ways and means to provide the extension support that meets the demands of farm communities.

Action research on the development of a sustainable, workable and replicable ICT based agricultural extension model accomplishing the information needs of small farmers in time was felt essential in a developing country like India. With this researchable issue in focus, an innovative ICT based agricultural extension model of technology support for sustainable farming named as "e-Velanmai" ('Velanmai' means 'agriculture' in Tamil language; "electronic-agriculture") was conceived to achieve the goals of agricultural development and improve the standard of living of the farmers in India. This paper describes the action research process and effects of the innovative and sustainable ICT based extension approach implemented in Tamil Nadu and outline its applicability of adoption in developing countries. The overall objective of the action research project, 'e-agriculture' is to provide quality, timely, farm-specific scientific advice with the support of three components namely ICT tools, agricultural scientists and FC to the needed farmers at their farm gate.

METHODOLOGY

An action research project was initiated to test-verify and validate the ICT based agricultural extension model called 'e-velanmai' (e-agriculture). It was aimed at addressing the problems of farmers in agriculture through ICT tool based dissemination of agricultural technologies from scientists of Tamil Nadu Agricultural University (TNAU) either directly to the needed farmers or through Field Coordinators (FC) sourced from the project at sub basin level. The project was pilot tested in three irrigation project command areas namely Palar and Aliyar sub basins of Coimbatore district and Varahanadhi sub basin of Villupuram district during July 2007-08 in Tamil Nadu state with the support of the World Bank and the Tamil Nadu-Irrigated Agricultural Modernization Water and Restoration Management (TN-IAMWARM) project of the Government of Tamil Nadu, India. The performance of the extension model in these two different scenarios was field tested for its feasibility and results. The description of the extension model is presented as follows:

Components of e-agriculture

There were six vital components in the project as given below:

- Farmers – the enrolled members in the 'e-agriculture' project
- Multidisciplinary expert team of scientists formed at TNAU (at district level/sub basin level)
- Field Coordinators (FC) to develop the capacity of farmers in handling ICT tools and to facilitate the technology transfer.
- ICT tools like compter, internet, mobile phone and camera to link farmers, FC and experts
- Information about the agricultural problems (images/data) collected from farmers for advice
- The technical message delivered by the experts to solve problems faced by the farmers and follow-up actions on the advices adopted by the farmers.

This technology transfer model typically follows the development communication model proposed by Berlo (1960) which included the elements of communication namely Source (Data from farmers for consultation with experts), Message (Technical advice), Channel (ICT tools), Receivers (Farmers), and Effect (Adoption and follow-ups).

Pilot testing at field level

The ICT enabled farming, 'e-agriculture' was evolved from a public model initiated during July 2007 to a paid model during October, 2008. To enhance the participation of farmers in scientific farming and to achieve sustainability of the project, paid model of 'e-velanmai' was introduced in three river sub basins namely, Palar and Aliyar sub basins of Coimbatore district and Varahanadhi of Villupuram district through 12 selected Water Users Associations (WUA). These three sub basins were distinctly characterized by canal and well irrigation dominated by plantation crops and poultry in Palar, Canal irrigation dominated by plantation and cash crops in Aliyar and tank irrigation dominated by seasonal crops such as Vegetables and Paddy in Varahanadhi. Hence the model was pilot tested in these three sub basins which represented three different agricultural scenarios. A multidisciplinary team of scientists were set up at sub basin/district level who offered technical advices to the farmer's problem by diagnosing the digital images of the crop status using computer, internet and telephone. The team of scientists was identified at the Agricultural Research Station (ARS) or Krishi Vigyan Kendra (KVK) of the TNAU that functioned at District level to serve the farmers at first hand in these three sub basins. In case if there were any unsolved problems at district level, it was solved immediately by the scientist team formed at university level. A website www.evelanmai.com was created to document the technical information on agriculture, weather, market intelligence and other activities of the project. In each sub basin, one Field Coordinator (FC) was appointed under the project to facilitate the ICT enabled farming among the farmers of selected WUA. He attended the farmers call to solve their field problems by capturing and sending the digital images of their crop status with descriptions seeking the advice from the scientists of TNAU. The two main roles of the FC was to facilitate the technology transfer from the experts and to train the farmers/family members in handling ICT tools such as digital camera and internet to upload photos to the scientists for seeking technical advice.

Farmers of the selected WUA in each sub basin, who were interested to avail the services of 'e-agriculture' were asked to pay membership fee of INR 50 to INR 300 per year depending on the size of their farms. The fee structure was decided by the farmers themselves through two brainstorming meetings held at both village and WUA level of the Palar sub basin during 2008. The fee structure and number of members enrolled during 2008-10 is presented in the Table 1.

Table 1. Number of farmers availing the e-agricultural extension services in Tamil Nadu

Sub basin	Farm size, Number of farmers enrolled & Fees paid by the farmers					
	<5 ac (INR 50)		5-10 ac (INR 200)		>10 ac (INR 300)	
	Farmers enrolled (No.)	Fees (INR)	Farmers enrolled (No.)	Fees (INR)	Farmers enrolled (No.)	Fees (INR)
Aliyar	405	20250	51	10200	36	10800
Palar	603	30150	65	13000	40	12000
Varahanadhi	218	10900	16	3200	02	600
Total	**1226 (85.37%)**	**61300**	**132 (9.20%)**	**26400**	**78 (5.43%)**	**23400**

Deliverables of 'e-agriculture' to the farmers

The project delivered timely and quality technical advices making use of ICT tools within a turnaround time of 1 - 3 hours to the farmers' problem-based queries on the areas such as crop production, protection, management and post harvest technologies including decision based queries on market intelligence, market price forecast, and weather forecast based management decisions related to agriculture, horticulture, forestry, sericulture, agricultural engineering, and veterinary enterprises. The problem based queries (for eg: Management of insect pest/disease/nutrient deficiency in a crop) were addressed by analyzing the digital images on the crop status sent by the FC to the scientist team set up at the university. The decision based queries (for eg: Market price forecast of agricultural commodities over a season/spacing/varieties to be adopted etc.) were answered instantly without a photo document. Other extension services delivered to the farmers under the 'e-agriculture' project are detailed as follows :

- Training all the farmers or their wifves or adult children (at least one in each farmers' family) on handling ICT tools such as framing digital photographs of the pest symptoms and uploading the same to the scientists for getting technical advice.
- Field diagnostic visits to farmers' field by a multidisciplinary team of scientists to solve complex, serious and endemic problems in agriculture and allied enterprises.
- Organizing technical seminars on vital topics related to agricultural enterprises to farmers in their villages by the scientists team of the project.
- Millions of INR were spent to develop various crop management, production and protection technologies related to agriculture and allied enterprises as suited to the seven agro climatic zones of Tamil Nadu by the TNAU scientists for the benefit of its farmers. This information is disseminated to all the farmers of the entire state by providing the contents on this aspect in Tamil and English versions as links in the project web site for the benefit of the farmers to adopt scientific farming practices.
- Dynamic market price forecast, season-wise price trends and market intelligence of major commodities were also analyzed seasonally and disseminated to the farmers from TNAU-Domestic and Export Market Intelligence Cell. This information is also uploaded in the web site of the project which provided effective guidance for the farmers to take decisions to market their commodities in the state or elsewhere in the country.
- The website also feeds the block wise and district wise day to day weather status of the state on certain vital parameters such as temperature, RH, wind and rainfall forecast for next four days generated by the Agro Climate Research Centre of TNAU to the farmers.
- A video film explaining the process of technology transfer, implementation and success stories running to seven minutes in English and Tamil is loaded in the website which also briefs about the scheme activities.

RESULTS AND DISCUSSION

The process of technology transfer and effects

The technology transfer process in the 'e-agriculture' project typically followed four steps. The process performance of the 'e-agriculture' project and its effects among farmers were analyzed based on the record of observations maintained for the project activities in the form of a field register and membership card entries done for each of the farmers periodically since the beginning of the project. The results achieved in the project are presented as follows :

Step 1. Depending on the interest to learn the operation of ICT tools, the farmers or their wifves / children were trained to frame the photograph of symptoms/crop status in digital camera and to upload to the scientist of

TNAU set up for the project seeking technical advice using internet and/or mobile.

Achievement : A total of 1436 farmers joined the scheme, most of them (85.37%) were small and marginal farmers with <5 acre holding (Table 1). A membership fee of INR 1,11,100 was deposited in bank in the name of the WUA account. One individual from each farmer's family was included for the training offered to handle ICT tools needed for technology access.

Step 2. Any farmer, who had a problem based query, called the FC over his phone. Other decision based queries like choice of variety, market information were delivered over phone directly without referring to a photo document. Complex problem based queries which were not able to be addressed through digital images were addressed by the experts through personal visits. Important issues in farming at village level were tackled through seminars and discussions.

Achievement : About 2300 scientific advices were offered to the farmers to solve both problem and decision based queries (Table 2). Fourteen diagnostic visits were made in person by the scientists team to the farmers' field to solve complex problems. About 18 seminars were organized on important topics in Agriculture to the farmers in their respective villages.

the risk of incurring production losses.

Step 3. The FC inspected the farmer's field and framed digital images using a camera and transferred the photo through www.fileflyer.com using the lap top and internet data card (available with the FC of each sub basin sourced under the scheme) to the scientists team set up at TNAU. Some farmers had sent the photos directly to the scientists for advice. Normally photos seeking advice were uploaded before 12 noon every day to access the scientists' recommendations between 1 and 3 pm on the same day.

Achievement : About 203 farmers had sent the photos directly to the scientists either by themselves or through their children and the rest through FC. About 2093 advices (91.84%) were delivered on the same day in which the query was raised.

Step 4. The scientist team analyzed the symptoms (through digital photos) and offered technical advices to the FC (or) directly to the farmers as the case may be on the same day using telephone or through email (evelanmai@gmail.com). The farming advices were recorded in the membership card by the FC and guided the farmers for adoption of the recommended advices. Recording the advices builds accountability as well as follow up for the services rendered. The process of ICT based technology transfer happens on day to day basis.

Table 2. Technical advices recommended to farmers under e-agriculture

Sub basin	**Number of advices given to farmers**			**Total no. of advices**
	Crop production	**Crop protection**	**Management, marketing & others**	
Palar	221	640	234	1095
Aliyar	151	499	154	804
Varahanadhi	53	277	50	380
Total advices (%)	**425 (18.66%)**	**1416 (62. 13%)**	**438 (19.21%)**	**2279 (100%)**

The results revealed that about 2279 items of technical advice were offered to the farmers to solve their farming problems in various areas of agriculture under the e-agriculture mode of technology transfer. Farmers raised majority of the queries on solving crop protection problems (62.00 %) such as tackling the problems created by pests, diseases, nutrition deficiency, weeds followed by crop management, marketing and others (19.21 %) such as, irrigation management, fertilizer management, post harvest management, , weather forecast based farming decisions, market price/forecast and the crop production advices (18.66 %) such as choice of variety, agronomic practices, intercropping, soil and water conservation etc. It could be inferred that farmers depended on scientific technologies mostly to solve their crop protection related issues in order to save their crop from damage due to insect/disease pests and avoid

Achievement : It is proven that by exploiting the ICT tools, it is possible for an agricultural scientist to provide expert advice to farmers without visiting his farm for the purpose of solving agricultural problems. The digital flow of information helped a farmer take critical decision faster drawing from the expertise**.** The country has invested enormously in agricultural university. This result draws support from the Ratnam et. al., 2006 who stated that the agricultural experts generated the advice based on the information about the crop situation received in the form of both text and digital photographs.

The project achieved to facilitate users' interactivity among all the three players namely, the farmers, FC and scientists through website, mobile phones, e-mail and personal contacts to facilitate scientific farm decisions.

Concerns on digital divide and equity

The contents/links developed in the project website addressed the agricultural information needs of farmers of the entire state. However the e-agriculture model addressed the location specific, farm specific problems confronted by farmers on one to one basis in a personalized manner. The digital gap has been narrowed down by training at least one member of a farmers' family (mostly adult children) so that all the farmers are empowered to handle ICT tools effectively to access technical advice to solve their farm problems on any agricultural or allied enterprises.

As aged farmers were mostly illiterate and lack interest to learn computers and upgrade their skills, the strategy to train their children was opted and it was observed that the youth learnt quickly to handle the ICT tools and participated in the e-agriculture project to send the digital photos seeking advice from the scientists. This finding draws support from the studies of Subramanian (2006) who stated that increasingly, it is the young boys and girls than the aged adults of the rural community, who quite often accessed the tele centres and learnt to use the modern ICTs.

In the case of complex, serious and endemic problem which required personal contacts for in depth diagnosis and interactions with the farmer, the project facilitated field diagnostic visits and technical seminars followed by farmers' discussion forums for the benefit of farmers on vital topics organised in the village itself. These approaches solved the gap between content and services. Two way communication and complete interactivity all time (24x7) was facilitated between the farmers and scientists to bridge the gap between the content provided and actions required to be done in the field level. The project facilitated both resource poor marginal/small farmers as well as the rich farmers to become agripreneurs and raised their farm income and standard of living through the delivery of appropriate farm specific scientific knowledge and marketing strategies at the right time. ICT is utilized as an effective tool to ensure timeliness, cost effectiveness and acts as an enabler to provide appropriate scientific advice to all farmers uniformly in a society to achieve equity and efficiency in achieving development in the region.

Uniqueness of 'e-agriculture' technology transfer model

The unique features of the 'e-agriculture' project describing its significant effects are discussed as follows:

- This project is the first of its kind and unique in the country, wherein a Government funded Agricultural University Scientists (Research system) were directly involved in giving timely agricultural extension advice to the farmers by harnessing the potentials of user-friendly ICT tools for a nominal membership fee collected from farmers' based on their farm size.
- Farmers were made to participate in the scientific farming and empowered in the ICT based technical support process by paying a nominal membership fee based on their farm size. This fee payment creates the farmers' a sense of belongingness, ensures greater participation and feels comfortable to demand their queries from the project team. Hence this approach of extension is described as participatory and demand driven.
- The advices rendered were recorded and accountable. Appropriate mechanisms for fostering accountability to clients who can best observe the quality and quantity of extension input were created in the project. Two way communication was achieved between scientist and farmer directly or through FC. The advices were appropriate, authentic, credible and farm-specific based on diagnosis of the crop status and feed back. This enabled the farmers to practice scientific farming and achieve maximum yield in their farm.
- Cost-effective quality extension advices in agricultural and allied enterprises were rendered to the farmers immediately within the same day. The model drastically reduced the time lag in dissemination from research system to client system as the turn around time was estimated to be 2-4 hours.
- As the agricultural scientists were having very high reputation among the farmers in the state, the credibility attached by the clients over the scientific advices/information was rated to be high and hence the rate of adoption of scientific practices were also found to be high (77%) among farmers through this project.
- This project catered to the technological needs of poor, small and marginal farmers as evidenced by highest number of membership enrolment (85.37%) from the category of farmers who owned less that 5 acre farm.
- The project could also pave way for creation of self employment opportunity for enthusiastic youth who have interest to learn both scientific farming and skill in handling ICT tools by serving as volunteers in their respective villages.
- The model improved the capacity building and empowered the farmers/farm women/their children in rural areas to handle ICT tools to access scientific information from agricultural scientists.
- Gave farmers the confidence to continue farming as a risk-free venture i.e., without fear of loss due to pest damage/other factors as they were well supported with the scientific advice.
- The project can function sustainably and the WUA

would continue the ICT enabled farming in the rural society. The most important feature is that the model is workable, replicable, sustainable and scalable at both state and national levels. This scenario required the deployment of scientists from agricultural universities and research centers at either state or national level.

Impact of e-agriculture

The impact of the project among farmers was analyzed through documentation of five cases drawn from the each of the three sub basins (total =15 cases) where the project was implemented. The case studies (refer www.evelanmai.com for details) focusing on the impact of the project among farmers revealed that the ICT based expert advices helped majority of small and marginal farmers to improve their farm profit to an extent of INR 2102 /ac (Vegetable) and INR 3803/ac. (Coconut) by achieving higher input use efficiency and by adoption of appropriate dose and type of inputs like seeds, fertilizers, water and pesticides. The farmers were able to reduce their cost of cultivation by reduced usage of pesticides and fertilizers due to the electronic agriculture project. 'e-agriculture' indirectly covered technical support to the farmers in three districts spread over 55 villages covering plantation, vegetables, cereals, pulses, flowers, cash crops and livestock enterprises. The farmers attached credibility over the advices and adopted scientific farming and market forecast based crop planning and decision making in their farms and reaped enhanced farm income than it was earlier. Success stories expressed several positive impacts attributed to 'e-agriculture'. The farm women were happy to receive the advices at their farm gate immediately within the same day. Farmers/family members gained confidence to handle ICT tools and derived satisfaction over their timely access to agro-advisory information from the scientists team of the project from TNAU.

Upscaling of 'e-agriculture' in Tamil Nadu

Based on the successful results achieved through pilot testing of e-agriculture model in three command areas of the state, this model has been upscaled in 19 sub basins of Tamil Nadu state, India from during 2011-12 with support of the world bank aided TN-IAMWARM Project of the Government of Tamil Nadu.

The results were quite encouraging at state level. About 4556 farmers comprising 76.47 per cent small farmers followed by 22.7 per cent medium and 0.83 per cent big farmers had joined the project voluntarily. The member ship fee of INR Rs. 283300/- was paid by the farmers to avail the e-agriculture services. About 6816 members were trained in handling the ICT tools to capture damaged specimens of the crops cultivated by the farmers. Among this, 5521 farmers were trained to handle digital camera and 1295 farmers were trained to access internet facility for technology transfer. About 10797 technical advices were offered to the farmers to tackle their farm problems. Among the advices, 70.33 percent were offered to tackle problem based queries and 29.67 per cent were offered to aid decision based queries. The plant protection based queries dominated the proportion of the advices (67.07 %) in general.

This model offers scope for upscaling at National level. It is workable and hence upscaled at state level as every district of Tamil Nadu has one Krishi Vigyan Kendra or an agricultural research station of the State Agricultural University. The 'e-Velanmai' mode of technology transfer could be achieved at each district level by setting up an expert team of scientists for this purpose at either KVK or ARS located in Tamil Nadu. Similarly, all states in India have one or more Agricultural Universities and ICAR research institutes which include one KVK in each district. Hence this project is replicable throughout India with the existing technical manpower and IT infrastructure. e-agriculture could be upscaled in other states where similar such public IT infrastructure and Agricultural Universities are available in India.

CONCLUSION

ICT is one of the pillars of 'e-agriculture' and acted as a fulcrum for extension activity. This model provided evidence that ICT tools can be used by farmers to practice scientific farming and achieve success in contributing towards increasing the food production and earn enhanced agricultural income. Rather than visiting the crop in person, the agricultural scientist delivered the expert advice to each farm by getting the crop status in the form of digital photographs and other information either sent by the farmers or volunteers. Hence efficiency in providing extension advice to large number of farmers within a day was achieved with the support of ICT tools like internet, mobile and digital camera.

The action research 'e-agriculture' had established a methodology for ICT based extension and proved it to be an effective means technology transfer in agriculture to enhance the agricultural productivity and income of farmers. The project has prepared the capacity of farmers and their family members to handle ICT tools for accessing technical advice from agricultural scientists either directly or through FC on a sustainable basis. It has been proved that farmers were willing to pay for availing the agricultural extension services from agricultural experts.

Public extension services in developing countries and under developed countries can be made to function effectively in reaching farming communities with scientific agricultural information and technologies needed to ensure food security and sustainable development by adopting ICT enabled agricultural technology transfer model to render cost effective, quality and timely extension services for promotion of profitable farming and develop the livelihood status of small and marginal farmers.

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