

CONCLUSIONS AND SUGGESTIONS

Since agriculture has transformed its nature from subsistence to high value agriculture involving all the stakeholders in value chain or supply chain. Nowadays agriculture is no more a traditional type of farming rather it has evolved a new pattern, as a great deal of information and knowledge is generated and applied. Particularly the developments like green revolution and technological advancements in the areas of seeds, fertilizers, pest and markets etc. have added a new flavor in the agriculture sector. This vast level of information and knowledge is needed to be delivered in an efficient way to make farmers more informed and progressive in all the farming decisions. Typically this information on improved agricultural technologies and practices is primarily delivered by publicly funded agriculture extension services.

In most developing countries including India it has been felt that the lack of reach to cover large number of farmers in the geographically dispersed areas, low motivation and lack of accountability of field level staff etc. are the factors identified as flaws in making effective and efficient information delivery to farmers thereby causing information asymmetries. Several mass media provisions initiated by public sector are employed to address these critical issues but the major breakthrough has occurred during 1990s with the development of information and communication technologies (ICTs) like mobiles/ phones, computer/ internet, television etc. Strengthening information dissemination to farmers with the help of ICTs can turn agriculture into more diversified, knowledge intensive sector of the economy and thus become more effective in meeting farmer's aspirations. With the recent developments in the field of information dissemination a number of public, private and mixed partnerships ICT enabled models came into existence to help the farmers making decisions in advanced and real time manner.

Total sample surveyed of both group of users (92%) and non users (91%) were male dominated. The user and non user groups involved in the study were from the mature group having average age of 37 years. User group farmers were more educated than non

users: While 59% non user farmers were educated up to secondary level. It indicates that use of ICTs may not be constrained due to lack of formal education especially if there is a provision of adequate and appropriate content in the local language. In the user group 65% farmers belonged to general category and 30% farmers to OBC category whereas 21% user and 12% non user belonged to high income group. 83% of total surveyed farmers took decisions about leasing of land less than 5 ha whereas the large landholders (>5 ha) dominate within the group. Large land holders are the opinion leaders for the small and marginal farmers in adopting the latest agricultural technologies.

Farmers showed multiple responses in using various sources of information for effective decision making. Small land holders generally adopt good quality of information from progressive farmers. Several mass media such as mobile, radio, TV etc. having high presence among the rural people showed a high level of familiarity and adoptability but were unable to disseminate updated information. Internet because of cost and infrastructural factors was accessed by only 29% farmers. Farmer's adoption of computer/internet and other mass media may provide a space for information intermediaries in selection of different media under an effective institutional provision. The extension workers, government agencies, NGOs and cooperatives were reported by lesser number of farmers because of less deterministic and unaccountable approach of field workers.

The sources of information in various sub sectors of agribusiness have been identified in the study. The penetration of information based services by extension workers was found to be very low. Only 45.1% farmers adopted parental agricultural information. 9.9% farmers received information from 'other progressive farmers', 6.6% from 'input dealers' and 3.8% from 'e-choupal'. Farmers generally adopt their own/ parental experiences in making effective planning of agricultural decisions followed by other progressive farmers, input dealers and information delivery models. For input decisions, input dealers (16.3%) were identified as the major source in delivery of information followed by own (16%), other farmers (12.9%), progressive farmers (14.5%), primary cooperative society (5.4%), KVKs (5.2%) and information delivery models (6.6%). Cultivation and harvesting decisions were mainly adopted from 'parental/ own' and 'TKS' sources. This shows the dependency of farmers on interpersonal sources of information for the above four stages. In the case of marketing and distribution decisions, farmers adopt more diverse sources of information.

The usage level and quality of information in planning stage such as how to grow (70%), land allocation (48%), seed selection (48%) farmers/ respondents gave a neutral response as compared to other stages in which they responded as 'very poor' and 'poor' in quality rating. 10% of farmers received good quality of information at planning level offering a quality space for information providers including both public and private organizations. Interpersonal sources were identified as the major source of information for most of the activities except for seed selection, soil testing and cropping pattern because farmers do not always prefer to seek information from them (especially when faced with a new problem).

Traditional ICTs such as radio, TV, mobiles etc. were also reported as significant by few farmers whereas information delivery models (e-choupal, TKS, lifeline, IFFCO procurement) play an important role in the selection of crops. 67% farmers approached private and public organizations in the selection of seeds in which information delivery models provide good quality of information. Most of the sources provided low quality of information thus indicating the existence of huge potential to improve the quality of information delivery by adopting modern technology models at planning level.

Some of the input related factors such as input price and availability (63%), irrigation sources (63%), use of farm machinery (53%), use of fertilizers (46%) and seed sources (46%) were graded with a neutral response by assigning 'satisfactory' rating. The input decisions such as technical support (38%), government subsidies (49%), insecticides and weed management (34%) were reported as highly important by farmers. Small number of farmers reported good quality of information for the activities like use of fertilizers (32%) and sources of seeds (32%).

Input dealers were identified as the most reliable source of information for input price and availability, use of fertilizers and pesticides, seed sources, insecticides and weed management. Besides this, farmers also collected information by traditional means of low quality. It implied that farmers were not aware or less inclined to update themselves for the above input activities and these void spaces could be filled up by facilitating updated and relevant information to the farmers by modern ICT tools.

The study gives an assessment of the role of the private and public organizations in imparting good quality of information though they are accessed by lesser number of farmers. Farmers adopted traditional sources of information for technical, irrigational and

credit facilities due to lack of infrastructural, technological and cost barriers. Though the farmers lack financial instruments, it leads to giving policy recommendation for governments to make the availability of effective financial services.

Quantity of seeds and frequency of fertilizers were identified as the most preferred activities based on good quality of information by the farmers and this information was collected from diverse sources. For cultivation decision, input dealers provided better quality of information than paternal source. The farmers who were connected with any private or public sector organizations got more trusted information regarding quantity of seed and frequency of fertilizers/ pesticides. Irrigation practices mostly followed traditional pattern. This can be improved by making appropriate infrastructure, training facilities and education to farmers to reduce the wastage of water and financial burdens incurred by farmers.

Post harvest practices were reported as poor in quality except for 'time of harvesting the produce'. This indicates the lack of farmer's persuasiveness to these activities and the lack of innovation in business modeling approach. It leads to a strong recommendation that entrepreneurial nature of farming may be achieved by facilitating post harvest information and services especially on sorting, grading, inventory etc. to the farmers at grass root level and making them active stakeholders in agricultural supply chain.

Marketing price information to sell the produce was accessed by most of the farmers followed by the activities like marketing channels, nature of transaction and types of transportation. 45% farmers received poor quality of information for marketing prices and changes in government policies. The major source of information to access market prices was through personal medium followed by output buyer and mass media channels. However the farmers were getting low quality of information by the personal means but mass media showed mixed results of good and satisfactory level of quality of information.

The integrated use of ICTs would change the outlook of majority of the farmers by improving marketing value. Marketing arrangements to sell the produce may create hope if they sell their produce to buying agencies or sell in bulk quantity to IFFCO procurement, cooperatives, e-choupal buyer etc. Transportation and financial transaction services were accessed and facilitated by the sources such as 'own' and 'progressive farmers' respectively and output buyers identified as a reliable source of information.

Finally the above results concluded that most of the sources lacked in quality of information dissemination, as reliability, relevancy and timeliness were the major constraints. It was observed that though the farmers had access to a wide range of media/ sources they mostly relied on middlemen, traditional knowledge and local/ input dealers in accessing agriculture information. Modern ICTs such as information delivery models, mobile phones and internet are increasing rapidly in Indian context and their potential can be exploited in all stages of agricultural supply chain rather than limiting them to price negotiations, market prices etc. In the absence of formal and effective modes of information delivery the middlemen were also the suppliers of seeds, fertilizers, pesticides and credit to the farmers and this skewed relationship limited the benefits that could be derived from the use of ICTs.

The importance of ICTs was established in the previous results, the study was extended to the various information delivery models working in different modes of information provision to facilitate advanced and real time information in more efficient ways. These results were based on the quality of decision making by doing a comparative analysis of four models that were categorized as informational, transactional and e-governance models (ICT models = Lifeline, E-choupal, CSC and non ICT model = TKS).

Our study found that overall users and non users of models showed distinct behavior in quality of agricultural decision making. The user group farmers got improved quality of information on all the aspects of supply chain decisions related to planning, input, cultivation, post harvest, marketing and distribution decisions except the agricultural activities such as how to grow, seed sources, credit support, irrigation sources, government subsidies, land preparation, number and type of irrigation, time of harvesting, transportation/ logistics, inventory decisions and nature of transactions activities.

The results indicated that farmers using any model were more planned to their farming practices in comparison to non user group. User group farmers organized their farming practices from the initial level, they were less cautious about cultivation decisions, more inclined to save their post harvest losses, well informed about market prices, more concerned about marketing and channelizing their produce in local or distant markets. Information and services delivered by models for decision making at different levels of agricultural supply chains were far better than those used by farmers who applied traditional sources of information. This strongly recommends the need of information to

be delivered in appropriate manner and to be prioritized according to agricultural supply chain stages which ultimately will lead to increase production and income of the farmers.

A clear distinction has been found between user and non user groups, and then we advanced the study by comparing these models in making quality decisions by user group. The study found that the farmers using ICT models made better quality of decisions in comparison to those using non-ICT models. E-choupal users made better quality of decisions than lifeline. Lifeline (an informational model) provided better information (on 18 activities) than TKS (on 5 activities). Lifeline users made better quality of decisions across the whole supply chain except for planning decisions.

Users of CSC model (kiosk based-internet) were making better decisions for planning, input, post harvest, marketing and distribution as compared to TKS model except for some of the activities like sources of seeds, soil testing and crop selection as these are the front end activities provided by TKS model via franchise ownership. While on comparing users of e-choupal with TKS we found the huge difference in quality of information as TKS model lagged at all the stages of agricultural supply chain. The above results conclude that ICT models are far better in delivering services and information than a non-ICT model.

As the clear difference between ICT and non-ICT models has been established, we compared among three ICT based models. E-choupal users adopted more planned decisions than lifeline users as 14 out of 41 decisions were found to be significant. Both the set of users were on same status for cultivation decisions whereas rest of the results with significant difference favoured e-choupal users. The above results interpret that the transactional model has an edge on informational model by not only delivering information but also by providing the relevant solutions regarding seeds, weeds, markets etc. i.e. providing information as well as facilitating transactions related to these activities.

Users of e-choupal performed better than the users of CSC model on 28 activities though both are of transactional type and using internet technology but the first one covers the whole agricultural supply chain and the second one only facilitates e-governance transactions like electoral identity cards, driving licenses, passport, certificates etc.

These findings suggest that by embedding agricultural information services with the CSC model, farmers could be facilitated with more enhanced and useful information/

knowledge on most of their agricultural decisions. CSC being a government initiated model of wide coverage area and population it would fill the void space with latest agricultural technologies and services.

Comparison between informational model (Lifeline) and e-governance model (CSC) illustrated mix results. 'CSC model' was efficient in input and marketing level information and deprived in cultivation decisions whereas 'Lifeline model' provided better quality of information regarding planning and post harvest decisions. All the above findings concluded that there was a need to review and revisit the model's approaches toward service provision and to make necessary changes so as to provide services in holistic manner by controlling weak aspects regarding the whole agricultural supply chain activities. In the light of above findings we can say that farmers would get enhanced production, increased income and bargain price for their surplus produce that will align them with mainstream development of the nation and will recognize them to be an important player in the agriculture value chain.

The above findings brought to light important results by comparing all the models on the basis of their functioning. Transactional model (E-choupal) has emerged as the most successful model on comparing with other three types of models. This clearly indicated that e-choupal user group farmers were making better decisions right from planning to marketing and distribution stage than those of all the three models.

Informational model (Lifeline) of service provision appeared to be the second most effective model for cultivation, post harvest and marketing stages but partially abortive for planning and input decisions (very few of the activities were significant) in comparison to non ICT model (TKS). Crop selection, cropping pattern, balanced fertilizer application, weed management, technical support and training were better availed by users of informational model (Lifeline) that would reduce farmer's extra expenses incurred on inputs and facilitate better training to proper utilization of inputs that will enhance farmers financial status and establish them more firmly in the competitive market. The data gives interesting results on comparing informational and e-governance models. Users of e-governance model made better decisions for planning, input and marketing while users of informational model performed better in cultivation and post harvest decisions.

E-governance model (CSC) has been recognized as the third most effective model in delivery of information to farmers. Generally CSC users were getting better information than TKS users for planning, input, post harvest, marketing and distribution but for cultivation both the users were similar in decision making.

Thus the provision of information and knowledge through ICT models is likely to improve the decision making process among the farming community. Further the study performed the user and non-user groups' analysis of these four models. These results will be helpful in designing of models and to add the relevant content according to the needs of the user groups. Lifeline model did not significantly improve the performance of users as a very less number of activities were better informed for decision making. Due to lack of education and unfamiliarity to the technologies, farmers prefer interpersonal information sources as more reliable. Inefficiency of field workers and farmers' unwillingness to pay for the particular information may be the reason for poor performance of lifeline model.

The findings showed that the farmers with low level of education were not able to make proper use of information and knowledge being provided to them. On the other hand the farmers with higher education were able to acquire information with or without ICT enabled facilities available to them, and thereby, made relatively better decisions on nine activities. Farmers having moderate education level made significant impact on the quality of decision making on most of the activities across the agriculture supply chain.

Users of e-choupal farmers made planned decisions at all stages of agricultural supply chain. The results indicated that the user group farmers of higher education level (graduate and above) showed much better quality of decision for planning level activities (seven out of nine activities were significantly better). User farmers educated up to secondary and senior secondary level showed significantly different results for input decisions (six out of eleven activities were significant). While the user group having education up to moderate level significantly impacted on the quality of decision at cultivation processes. The results also indicated the importance of post harvest decisions, when the education level was moderate and higher. It implied that users were seriously concerned about the activities like cleaning, sorting, grading and weighing in particular.

The same justification is for moderately educated user group at marketing level. According to land holding size, medium landholding farmers were more concerned about

planning activities than large farmers (seven out of nine activities were significant). However as we move up the hierarchy of social category from OBC to General the impact on quality of decision making between user and non user group improved significantly.

Common Service Center (CSC) model providing e-governance services to the rural masses impacted better decisions on only nine activities out of forty one. Categorical analysis related to socio demographic variables indicated that highly educated users' preferences shifted towards input, post harvest, marketing and distribution activities. It strongly pronounced the reason that less educated farmers were not familiar with the technologies like internet and computer, as they lack in trust of information being delivered to them. Land holding pattern also showed similar results as in the case of e-choupal model. OBC users made better quality of decisions and were frequent users of CSC kiosks to transact e-governance related activities like caste certificate, ration card, BPL cards etc.

TKS (a non-ICT model) provides informational as well as transactional services to farmers via franchises and on-the-field demonstration medium. Farmers up to junior level of education showed significant decisions giving the perception that information content is more relevant to this group (7 out of 41 decisions were significant). According to land holding size, medium farmers made more significant decision at different levels of agricultural supply chain (8 out of 41 significant decisions were made). Socially higher class farmers often made more informational and transactional exchanges in comparison to other social groups, the justification is same as in the case of e-choupal model.

The findings conclude that the socio demographic factors such as education, landholding size and social groups are important factors affecting the usage of ICT in making decisions for the whole agricultural supply chain. The above analysis postulates some recommendations for designing the information delivery models. The services and information content should be in fragmented form according to the social characteristics, education status and land holding size. Integrating ICT components would impact better in service provision to farmers as the farmer groups consist of different levels of understanding of the information content through the medium by which they accessed. Information and knowledge delivery should be tuned with different modes of ICTs by presenting in easy, understandable and reliable format.

Locally interpreted and easily understandable information must be offered which is a prime task of ICT enabled models. The socially higher class generally made transactional and informational processing but the resource poor farmers often lack in reaping these benefits. Resource constraint may be the major barrier to these groups. ICT interventions need to take holistic and integrated approach for the socially lower class to use the available information with a particular attention of financial services provision.

The public-private partnership could enhance the usage level of the models by covering different levels of agricultural supply chain. To make it a success, educating the farmers (especially the small and the marginal ones) is the need of the hour. Proper training is to be imparted to make them understand how to use the techniques of ICTs. This is the onus of the government to make optimal use of ICT by formulating a policy on the same. The study strongly recommends that ICT models embedded with transactional, informational and e-governance services greatly cater to the needs of all sects of agrarian community.

Though the socio demographic factors greatly influence the ICT adoption behaviour among farming community, farm related functions and its attributes are also debatable issues. Regression analyses of these variables in the adoption of ICTs pictured important results in designing ICT based information delivery models. The major part of farmer's income coming from the farming sector is more likely to influence the adoption of ICTs related decisions. The disadvantaged farmers and poorer communities (socially deprived people) gained 57% more from the ICT-assisted interventions than those who belonged to socially higher class.

Age factor analysis showed that the older farmers were less likely to adopt modern agricultural planning decisions as the age coefficient was significantly negative. The farmers having income less than Rs. 5000 were more likely to adopt technological information as 77 % for planning, 71 % for input and 63 % for cultivation decisions. Farmers who possessed leased land of greater than 5 ha were more likely to adopt technological information as well as the large landholding size also significantly influenced the adoption. The business characteristics of farmers such as awareness of government subsidies influenced input decisions 2.5 times more as compared to those who were unaware.

The farmers who availed demonstration facilities regarding agricultural decisions were 164% more likely to adopt ICT based information for overall agriculture decisions

whereas planning, input and cultivation decisions were also better adopted. Personalized technical assistance such as expertise provided by crop consultants and input suppliers appears to have the greatest impact on adoption. The study found that the farmers having mobiles as an asset are 96 % more likely to use this for information dissemination for agricultural decisions and 211% & 147% for planning and cultivation decisions respectively.

Hypothesis Tested: The study developed three hypotheses to test whether these are affecting the adoption of ICT based information's use in agricultural decision making or not. Hypothesis 1 (H1) was divided into five sub hypotheses under the head of socio demographic characteristics of farmers. The study found H1 only partially true as "Age (H1₀₁), Education (H1₀₂) and Income (H1₀₃)" were not found significant leading to their rejection. However the "Secondary Occupation (H1₀₄) and Social Category (H1₀₅)" were found to be significant and accepted. Hypothesis 2 (H2) denoted the "Farm characteristics" of the farmers and it was categorized into three sub hypotheses. Hypothesis 2 partially failed as two out of three indicators were found not significant. Leasing of land greater than 5 ha (H2₀₂) factor was found to be significant and hence accepted. However the other two factors of farm characteristics namely "Landholding Size (H2₀₁) and Number of Crops Grown (H2₀₃)" were not significant that lead to their rejection. Business orientation of the farmers was represented in hypothesis 3 comprising four factors, of which three factors {Awareness of Government Subsidies (H3₀₂), Availed Demonstration Facilities (H3₀₃) and Mobile Phones Owned (H3₀₄)} were significant and thus accepted. However the factor "Cooperative Membership of the Farmers (H3₀₁)" was found not significant leading to the rejection of this sub hypothesis. Hence the hypothesis 3 (H3) was only partially accepted.

The study demonstrated that a single information delivery system could not optimally benefit the farmers. The study strongly advocated that the mixed delivery approach of services comprising both ICT and demonstration facility (informal interaction and formal training) would enhance farmer's capacity to use agriculture information more efficiently. This type of support would be much more expensive to afford than the generic information programs but could be administered through cost-sharing or other incentives which would encourage farmers to utilize ICT technologies in information processing.

As evident from the recent IT development mobile accessibility has increased enormously; the potential of it could be exploited using different features of mobile

delivery mechanism like SMS, Voice call etc. This has sketched a blueprint for the ongoing ICT projects run through public, private and NGOs initiatives in delivery of information content.

These findings have implications not only for India but for all developing countries having similar structure of agrarian community. Because of cost, resource and time constraints the scope of the study was kept limited to only one state of India by covering only four districts. It should be expanded to more geographical locations and environmental conditions to get more results which could be generalized for the whole country.

Further the study could be extended to cover up more models according to the way of dissemination of services like SMS based, video based and telecenter based to view an integrated ICT model. Additional explanatory variables such as psychological traits could be added to further research in order to enhance the predictability of models and to offer an improved understanding of farmer's adoption behavior in using ICT based interventions.