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# Use of mobile multimedia agricultural advisory systems by Indian farmers: Results of a survey

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**There are several organizations extensively using modern information technology in India to facilitate better communication between researchers, extension workers and their farmer clients to transfer technologies and information more cost effectively. But, many of these initiatives are focused on delivering generic information rather than providing the farm plot or crop specific advisories pertaining to the requirements of individual farmers. This paper through a well structured pre-tested questionnaire administered to participating farmers tried to find answers to the use of mobile multimedia agricultural advisory system (MAAS). The answers to the research questions had potential implications for refining the approach of making efficient agricultural extension services available through a call centre platform, equipped with mobile multimedia agricultural advisory system, to the rural farming communities. This study has shown that a majority of the farmers perceived information on pest and disease control as most important and they also felt that accessing information through mobile phone is easy and convenient. Although there were perceived benefits by farmers, the quality of information, timeliness of information and reliability of information were the three important aspects that have to be considered seriously to meet their requirements and prospects in the coming years. Correlation analysis proved that irrespective of the socio-economic characteristics, farmers were utilizing the mobile multimedia agricultural advisory system.**

**Key words:** Information and communication technology (ICT), information needs, ICT benefits, ICT constraint, mobile phone.

## INTRODUCTION

In India, more than half of the population is directly or indirectly relying on agriculture as a source of livelihood though its contribution to the Gross Domestic Product (GDP) has decreased between 1990 to 1991 and 2010 to 2011 from 30.00 to 14.50% (State of Indian Agriculture, 2012). While involving in farming operations, farmers need different types of information during each stage of the development process, ranging from weather forecasts, pest attacks, inputs, cultivation practices, pest and disease management and prices (Jenny, 2011; Nilusha et al., 2011; Claire et al., 2010; Mittal, 2012; Nitin, 2012). This information will differ based on the landholding size of farmers or agro climatic region (Rivera, 1996). According to the 2003 survey

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(NSSO, 2005) access to information from any source increases with larger farm size and only 5.7% of surveyed respondents used public sector extension as source of information. However, Marcel and Bart (2012) reported that the main source of information for agricultural prices, weather forecast and advice on agricultural practice is the farmer's own observation and experimentation followed by a conversation with other farmers. Radio and television are also common sources of information particularly for weather aspects. But, majority of farmers in India do not have access to any source of information (Claire et al., 2010).

The public agricultural extension system which is responsible for disseminating agricultural information to farmers has become less effective, more time consuming and unsuccessful in meeting the requirements of those involved in agricultural production and there is a gap between the extension agent and the farmers (Mruthunjaya and Adhiguru, 2005). In order to revitalize the existing agricultural extension system in the country, the Department of Agriculture and Cooperation has been initiating a number of schemes through which the extension services are being provided to farmers. For instance, Doordarshan aims to make farmers aware of modern technologies and research outcomes related to agriculture and its allied areas, by means of programmes telecast 5 to 6 days a week through National and Regional Kendras within predefined time windows. Similarly, All India radio is broadcasting programmes of 30 min durations for farmers 6 days a week. Kisan Call Centres have been set up in every state of the country and all the centres are accessible through a toll free number from 6.00 am to 10.00 pm for 7 days in a week. Call centre agents answer farmer's queries in their local language. The department has also set up Agri clinics and Agri-Business Centres to provide self employment opportunities for professionally qualified agricultural graduates facilitating delivery of value added extension services (State of Indian Agriculture, 2012).

Applications of information technology support economic development of agricultural producers as outlined by Richardson (1996). Information and communication technologies (ICTs) these days play a crucial role in agricultural extension services meeting the information requirement for farmers. There are several organizations extensively using modern information technology in India to promote communication between researchers, extension workers, and their farmer clients to transfer technologies and information more effectively (Saravanan, 2010; Kameswari, 2011; Nikulsinh, 2010). But, most of the initiatives have been using computer based web portals for the delivery of information or through local village internet kiosks. Since they are computer and Internet based, these initiatives have not been very successful, as farmers were either illiterate or not culturally attuned to access information through the Internet.

To overcome these challenges, mobile phone based ICTs are being implemented across the country. For instance, farmers can raise queries related to agriculture and allied sectors using their mobile phone to a farmer call centre which has been operating in every state of India. In another initiative called farm science centre, weekly sms alerts are issued to farmers on various agricultural developments like weather forecast, disease forecast, and market information (Saravanan, 2010; Ashutosh et al., 2012). IFFCO Kissan Sanchar Limited (IKSL) and Reuters Market Light (RML) are providing services through sms and voice messages about agriculture related information (ICTFSECBP, 2009; Marcel and Bart, 2012). Similarly, there are many private and public organizations that are disseminating agricultural related information on farmers' mobile phone. These are Bharat Sanchar Nigam Limited (BSNL) - price on agricultural commodities, Nokia Life Tools - information on seeds, fertilizer, pesticides, market prices and weather, Fisher Friend Project - Fishing opportunities, risk and market information, Rubber Board, India-Market Price by Short Message Service (SMS) - price on natural rubber (Saravanan, 2010). Farmers are seeking agricultural related queries using their mobile phone (Lall and Sahi, 2009). But, many of the initiatives are focusing on delivering generic information rather than providing the farm plot or crop specific advisories pertaining to the requirements of individual farmers. Further Claire et al. (2010) reviewed some of the agricultural extension approaches currently in India and reported that farmers face a lot of difficulties in getting timely, reliable, and relevant information. This is mainly because the technologies developed for farmers were not suited to the farmers' capacity to take risk. This severely affects their ability to increase their productivity, profitability and income.

Keeping this view, the Indian Institute of Technology Madras's Rural Technology and Business Incubator (IITM's RTBI), Chennai, has developed Multimedia Agricultural Advisory System (MAAS) with the aim of building inexpensive tools and user friendly technologies to bridge some of the information gaps in farmer's field. MAAS has a call centre like interface where personalized information pops up at the expert's end when farmer calls through their mobile phone. The expert views the farmer's dashboard and analyses the situation to give query based advice to the farmer. This technology also has provision for uploading the images of pest and disease attacked plants in dashboard using their mobile phone. A farmer who has registered to the system using mobile technology can raise a query to the agricultural expert. IITM's RTBI in joint partnership with Tamil Nadu Agricultural University (TNAU), Coimbatore, and three more grassroot level organizations viz. National Agro Foundation, Erode Precision Farm Producers' Company Ltd and Dharmapuri Precision Farmers Agro Services Ltd. launched this initiative in Tamil Nadu (Kancheepuram,

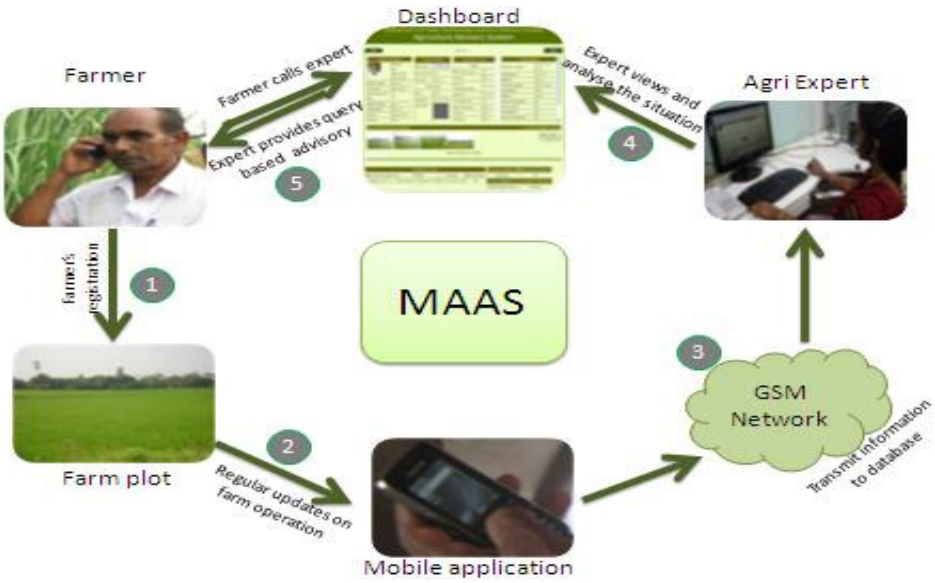


**Figure 1.** Farmers' registration method and information flow.

Erode and Dharmapuri districts), India, to deliver farm/crop specific advisories to farmers through a call centre approach.

## Field testing of mobile multimedia agricultural advisory system (MAAS)

A baseline survey was conducted to identify the farmers in these three districts and based on the outcome of the survey results 9 crops were selected as focus for this field testing: paddy, groundnut and brinjal for Kancheepuram district, turmeric, sugarcane and coconut for Erode district, mango, tapioca and tomato for Dharmapuri district. These crops were chosen since they are grown as prominent crops in all the three districts. A representative sample of 1200 farmers were selected for the field testing, 400 in each of three districts covering 182 villages with an average of nearly 7 farmers per village. The farmers' selection criteria include having mobile phone, cultivating the crops chosen and willingness to take part in this project.

The participating farmers had to begin by registering for the project, using a newly developed mobile application by providing the personal profile and farm plot information such as soil physicochemical properties, history of the crops grown, inputs used, crop yields, pest and disease history and subsequent farm operations were being regularly updated. All this data was transmitted using general pocket radio service (GPRS), which is a wireless data service deployed as a standard feature in many mobile phones. The GPRS transmits data over the mobile operator's network to an internet gateway, further to which it goes to a dashboard for expert's view and analysis. Collection of data is done on the mobile phone using an installed java-based application. Figure 1 depicts the farmer's registration and information flow. The farmers participating in this initiative used project mobile phone for initial registration and data collection, but farmers used their own mobile phone for seeking agricultural advisory from the expert. Apart from mobile based data collection, GPS devices had been used for geospatial data like geographical location, farm size, contours of the land. This information was further edited using customized software (Photo tagger for Data logger tracks and Map source for Garmin tracks) and the developed farm plots assigned to individual farmers. Each farm plot is saved in a Shape file format and made available on the dashboard. The farmers' initial feedback and suggestions contributed to a customization of the MAAS. Need based awareness kind of training workshops were organized for these farmers at each of the project locations, in order to demonstrate the details and the working of the MAAS during which they were also taught how to raise queries to agricultural expert for seeking advice on their mobile phone.

The call centre equipped with MAAS was set up in IITM's RTBI premise in Chennai, the state capital of Tamil Nadu in India. The registered farmers from the respective district raised the query by calling the agricultural expert. When farmer's phone call lands at the call centre, the concerned farmer's profile and farm plot specific information are displayed on dashboard. By presenting all this information in the context of farmer's query, the expert viewed and analyzed the situation and promptly provided the query based advisories in Tamil (the local language). The details of query by farmer, the responses provided to those queries by expert are

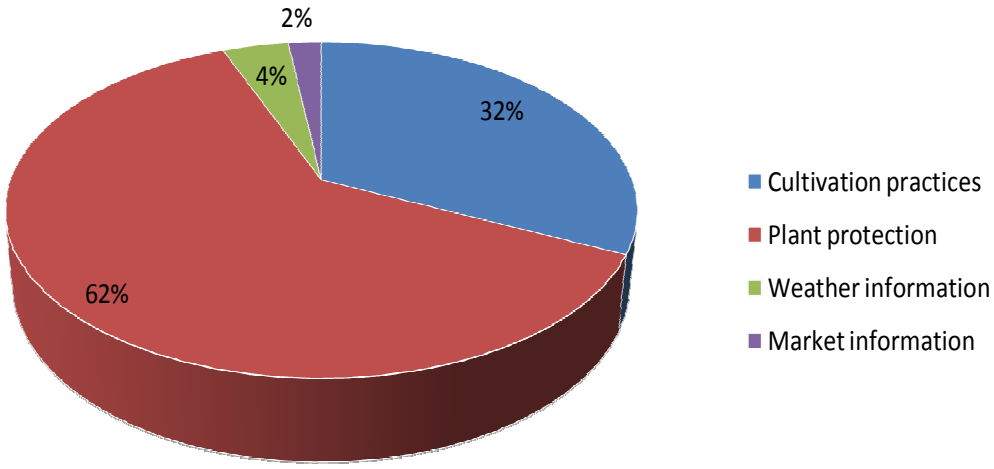


**Figure 2.** Types of queries raised by the farmers.

recorded as call history. Further, this has helped the expert to revisit the past queries and responses, when there were similar queries from the farmers. A total of nearly 1190 queries have been raised by the farmers from all the three districts as on June 30, 2012. An analysis of the queries reveals that majority (62%) of the farmers have raised queries about plant protection aspects as they have largely faced the problem of pest and disease prevalence. Figure 2 presents the types of queries raised by farmers to the agricultural expert.

It is much needed to know the relevance of information. It is also important to know whether the farmers benefitted and what are the constraints the farmers faced. Keeping this in mind, the present study aims at describing the farmers' reaction towards agricultural extension adopted through a call centre approach equipped with MAAS. This study was conducted with the following research questions:

1. What types of information are more appropriate in terms of relevance under farmer's circumstances?
2. What are the benefits of MAAS as perceived, and constraints experienced by the farmers during the advisories?
3. Do socio-economic variables (district, age, education, landholding, innovativeness, mass media exposure) of farmers have any association with the frequency of use of MAAS?

The answers to these research questions have potential implications for refining the move towards making efficient agricultural extension information services available through a call centre approach to the rural farming communities. The remainder of the article is organized as follows: Section 2 describes the methodology in which is outlined, the study location and survey with MAAS users, section 3 presents the results and discussion, Section 4 concludes and section 5 presents the limitations and future research.

## MATERIALS AND METHODS

We started by briefly describing the location of study and a survey with MAAS users.

### Description of location of study

This study was conducted during December 2010 to June 2012 in Tamil Nadu (Kancheepuram, Erode and Dharmapuri districts) with the financial support of National Agricultural Innovation Project (NAIP), New Delhi. NAIP is a World Bank and Government of India funded project being implemented by Indian Council of Agricultural Research. The overall objective of NAIP is to contribute to the sustainable transformation of Indian agricultural sector from an orientation towards primary food self-sufficiency to one in which a market orientation is equally important for poverty alleviation and income generation. A number of novel technological innovations are being developed under the project. MAAS is one such technology developed by Indian Institute of Technology Madras's Rural Technology and Business Incubator and field tested among the farmers in the above mentioned three districts of Tamil Nadu in India. The description about the study undertaken is presented in the subsequent section.

Figure 3 shows the location of study area. Kancheepuram district lies between 11° 00' to 12° 00' North latitudes and 77° 28' to 78° 50' East longitudes. The district has a total geographical area of 4393.37 $km^2$ and coastline of 57 km. Erode district lies between $10^o$ 36' to $11^o$ North latitudes and $76^o$ 49' to $77^o$ 58' East longitudes. The district has a total geographical area of 5714 sq.kms. Dharmapuri district is located between latitudes N 11 47' and 12 33' and longitudes E 77 02' and 78 40'. The total geographical area of Dharmapuri district is 4497.77 $km^2$.

### Survey with MAAS users

The present study carried out descriptive research to investigate the farmers' reactions towards agricultural extension adopted through a call centre approach which is equipped with MAAS. The research methods used in this study was the survey, whereby researchers conducted personal interviews with the respondents. Survey is a data collection method for social science research (Glock, 1967). A list of farmers who had registered to MAAS from the same districts was prepared. From this, a list of farmers was

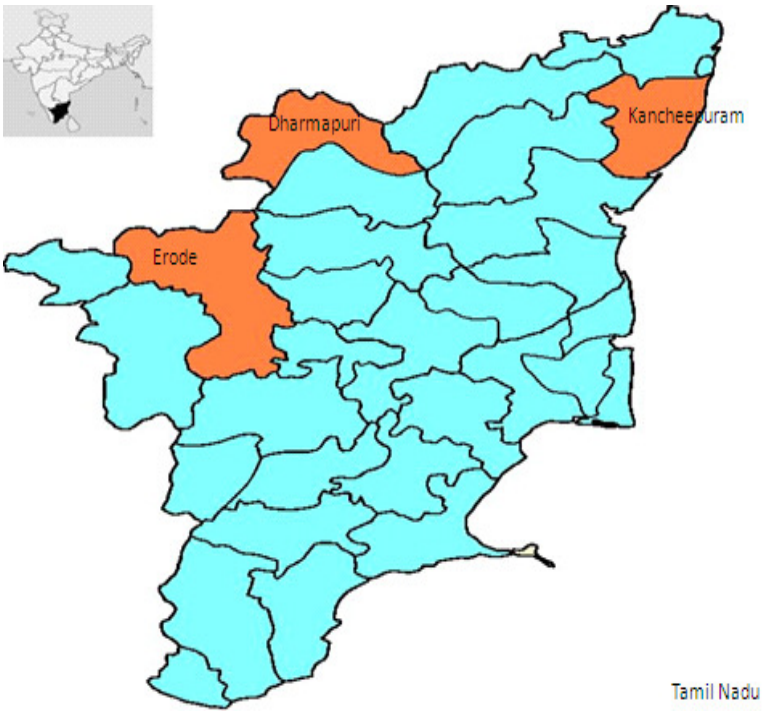


**Figure 3.** Location of study area.

then prepared based on the usage of MAAS services. It was observed that out of 1200 farmers, only 243 farmers had been involved in using the MAAS services provided through call centre approach giving a successful participation rate of 20.25%. Others did not take part in this initiative following registration process. The reasons might be lack of awareness, lack of motivation to the farmer and communication gap between the expert, field level staff and farmers. Lack of interest to adopt modern technologies among the farmers can also be one of the reasons for not actively participating beyond the farmers' registration. Because of the small number of MAAS users, it was decided to interview all of them. Out of 243 farmers, who were involved in using the MAAS services, 229 participated in the survey research. The remaining 14 farmers did not participate in this survey as they were not available at field of site during survey. The survey is done using an interview schedule consisting of three sections:

a) Farmer's socio-economic characteristics: The socio-economic characteristics of farmers such as gender, age, education, size of landholding, mass media exposure, innovativeness and use of MAAS were collected

b) Information needs of the farmers: an exhaustive list of possible needs was prepared based on queries which had been raised at our call centre and also through meticulous review of literature, consultation with experts and extension workers. The respondent farmers were asked to rate the listed needs according to relevance under their circumstances.

c) Benefits perceived and constraints experienced by the farmers during MAAS service: In order to analyze the benefits perceived and constraints experienced by farmers during advisories provided through MAAS, the data was quantified by first ranking the benefits perceived and constraints experienced based on the responses obtained from the farmers and then Rank Based Quotient (RBQ) was calculated as given by Sabarathnam (1988), which is as follows:

$$R.B.Q = \frac{\sum fi(n+1-i)}{N \times n} \times 100$$

Wherein, fi = Number of respondent reporting a particular benefit/constraint under $i^{th}$ rank; N = number of respondents; n = number of benefits/constraints identified.

The interview schedule was pretested with five participating farmers from each district. During pre-testing, it was found that some of the questions on information needs of the farmers, perceived benefits and constraints experienced by farmers during MAAS services needed some changes and thus were modified accordingly. This was done to ensure the questions were correctly framed in order to ensure reliability and validity as well as for ease of understanding by respondents. Information was collected through the pre-tested interview schedule by three trained investigators who were working as Senior Research Fellow in the MAAS initiative. Overall, 229 farmers were interviewed from all the three districts. The distribution of the respondent farmers according to their district is presented in Table 1.

The data collected was entered and analysed using SPSS 7.5.1 ® software (Statistical Package for Social Sciences). The analysis was done using descriptive statistics and correlation. The correlation was used to study relationship between socio-economic characteristics of the farmers and frequency with which the farmers used the information services of MAAS.

## RESULTS AND DISCUSSION

### Respondents' socio-economic characteristics

To provide better insights into the participants, respondents' socio-economic characteristics including district, gender, age, education, landholding size,

**Table 1.** Distribution of respondents based on their socio-economic characteristics (N = 229).

| Characteristic | Category | Frequency | Percent |
|---|---|---|---|
| District | Kancheepuram | 63 | 27.50 |
| | Erode | 76 | 33.20 |
| | Dharmapuri | 90 | 39.30 |
| Gender | Male | 221 | 96.50 |
| | Female | 8 | 3.50 |
| Age (in years) | < 35 Years (Young) | 47 | 20.52 |
| | 36 - 45 years (Middle) | 107 | 46.72 |
| | > 46 years (Old) | 75 | 32.75 |
| Education | Primary school | 19 | 8.30 |
| | Middle school | 33 | 14.41 |
| | High school | 72 | 31.44 |
| | Higher secondary school | 48 | 20.96 |
| | Graduate | 35 | 15.28 |
| | Post graduate | 10 | 4.37 |
| | No education | 12 | 5.24 |
| Size of landholding | Marginal (< 1 ha) | 13 | 5.68 |
| | Small (1-2 ha) | 91 | 39.74 |
| | Medium (3-5 ha) | 95 | 41.48 |
| | Large (> 5 ha) | 30 | 13.10 |

innovativeness and mass media exposure were analyzed. Table 1 showed that number of respondents (90) was proportionately higher in Dharmapuri district as compared to other two districts. Gender composition consists of nearly 97% male participants. About 46.72% of the respondents were middle aged (36 to 45 years), 32.72% old (46 years and above) and 20.52% young (< 35 years). The frequency distribution showed that there was higher number of older respondents as compared to the younger age group. However, our results are in contradiction to Meera et al. (2004) who reported that young people are getting more involved in ICT projects for agriculture and rural development. The analysis of educational background of the farmers showed that 31.44% had high school education (up to 10 standards), nearly 21% had studied higher secondary school (up to 12 standards) and 15.28% were under graduates. Only 5.24% of the farmers did not have any formal education. The analysis of landholding of the farmers showed that majority of them was small (39.74%) to medium (41.74%) farmers.

Of the whole sample of 229 farmers (Figure 4), 57.21% had a medium exposure to the mass media and about 21% high exposure, leaving nearly 22% in the low exposure category. As can be seen in Figure 4, almost 80% of the farmers in all the three districts under study had a medium to high level exposure to mass media. The education level of farmers was low but majority of them had medium to high exposure to mass media. Another interesting observation was that majority (48.91%) of the farmers were medium innovative in adopting the new agricultural technologies in their field (Figure 5). The results also showed that nearly 32% of farmers used mobile multimedia agricultural advisory system frequently as and when they needed information (Figure 6). This result is in conformity with those of Meera et al. (2004) wherein they do a comparative analysis of three ICT projects in agricultural development from India.

## Information needs of farmers

The main focus of MAAS is to meet the information needs of the farmers. The study was designed to reveal these needs of the farmers for the crops under focus, which were chosen in the respective districts. Thus an attempt was made to find out the agricultural information which the farmers consider relevant to their needs, according to their current socio-economic conditions (Table 2).

In all the three districts, information on weather factors like rainfall, temperature and humidity was perceived

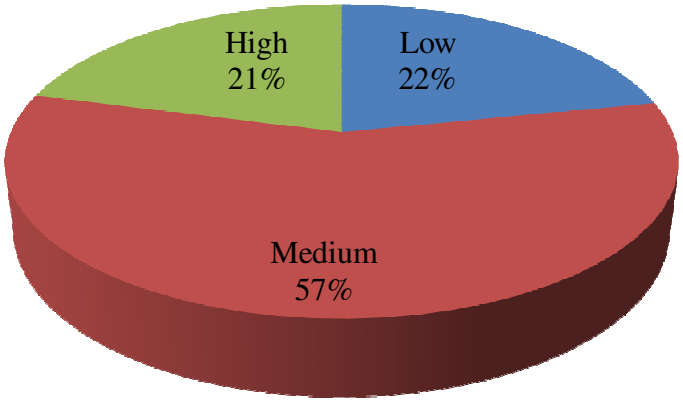


**Figure 4.** Distribution of respondents based on their mass media exposure.

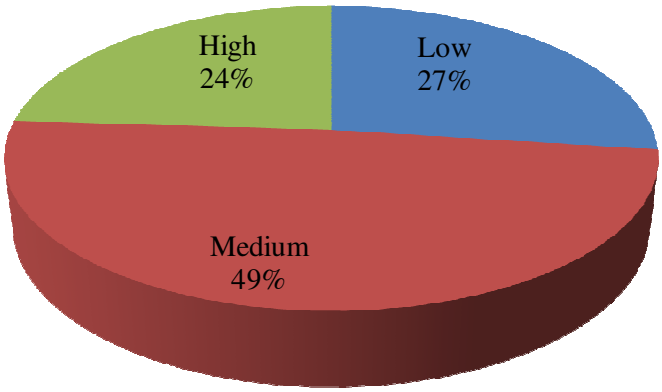


**Figure 5.** Distribution of respondents based on their innovativeness.

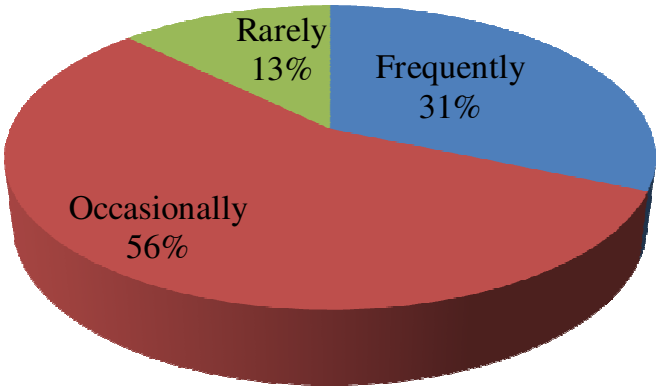


**Figure 6.** Distribution of respondents based on their use of MAAS.

most appropriate by about 47.16% of farmers while about 36.24% respondent farmers rated it as appropriate. This is because weather information is crucial for farmers to plan farm operations. For instance, information on rainfall

**Table 2.** Appropriate Information perceived by farmers (N = 229).

| Information need | Most appropriate | | Appropriate | | Less appropriate | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Weather Information | 108 | 47.16 | 83 | 36.24 | 38 | 16.59 |
| Best package of practices | 158 | 69.00 | 65 | 28.38 | 6 | 2.62 |
| Input price | 143 | 62.45 | 64 | 27.95 | 22 | 9.61 |
| Plant protection (Pest and disease control) | 208 | 90.83 | 16 | 6.99 | 5 | 2.18 |
| Market information | 116 | 50.66 | 78 | 34.06 | 35 | 15.28 |
| Value addition to farm products | 63 | 27.51 | 75 | 32.75 | 91 | 39.74 |
| Animal husbandry and dairy | 124 | 54.15 | 64 | 27.95 | 41 | 17.90 |
| Risk cover | 115 | 50.22 | 58 | 25.33 | 56 | 24.45 |

will enable them to take a decision on whether pesticide application can be delayed or not. Similarly, this information will help to speed up the harvesting practice of crops. Information on air humidity is a good predictor of pest infestation (Marcel and Bart, 2012). With regard to the importance of improved crop production and management practices, approximately 69.00% of farmers felt that information regarding the best packages of practices for various crops cultivated in the area, particularly the crops being chosen in the project were most appropriate. This information will assist farmers to opt for more appropriate technology including choice of variety, pesticide and fertilizer etc. (Marcel and Bart, 2012). The information on the availability of agricultural inputs and input prices was perceived as most appropriate by majority (62.45%) of farmers. Giving due consideration to importance of early warning and management of pest and disease, a large portion (90.83%) of the sample of farmers, perceived information on early warning systems about outbreaks of disease and pest infestation and information on how to manage such outbreaks as most appropriate. The reason for higher number of farmers requiring this information might be due to pest and diseases posing a major threat to them.

The farmers perceived market information, including daily updates on the prices of agricultural commodities in the local markets of the surrounding district, as one of the most relevant mobile based agricultural information services. This was considered as most appropriate by 50.66% of farmers. Timely access to market price information at the time of harvest helps farmers decide where to sell (Jensen, 2007), which enables them to fetch good prices for their products. About 39.74, of the farmers considered information on value addition to farm products less appropriate. It may be that the farmers do not seek out this information because they are unaware of the importance of value addition to food processing. The information on animal husbandry and dairy was highly required by majority (54.15%) of farmers and observed as most relevant to their need.

Detailed information on risk cover including crop insurance, animal insurance and insurance against property were felt to be most appropriate information by about 50.22, of farmers. Dhaka and Chayal (2010) have also reported almost similar information needs of the farmers in their attempt to analyse the reaction of the farmers towards ICT as a source of reliable and timely information about best production practices, processing, marketing, and input and output prices, financial and risk covering institutions.

However, it is important to note that identifying the value of information is difficult as indicated by Marcel and Bart (2012). They further mentioned that value of information keeps changing with every circumstance. In particular, information is useful when the farmer who received the advisories can act upon it. For example, daily updates on the prices of agricultural commodities in the local markets of the surrounding district are most useful during harvesting time. In contrast, availability of agricultural inputs and input prices information are most useful at planting time. Similarly, information about improved crop production and management practices are mainly helpful to farmers during crop cultivation. This means that, for information to be useful it must be provided in a timely manner.

## Perceived benefits

There was an increasing realization about the potential benefits of MAAS among the farmers. The results presented in the Table 3 revealed that easy and convenient access through mobile phone emerged as an important benefit and based on RBQ value (77.62) given highest priority. The next most frequently mentioned priority was time and cost saving by using the mobile as a basic phone as it was perceived to provide quick access to information from the agricultural experts. It was reported by the farmers that the information received using mobile based ICT was reliable and timely as it provided easy access to more subject matter. The results are in accordance with Surabhi and Gaurav (2009) who have reported some increase in convenience and cost savings by using small farmers' mobile phone as basic

**Table 3.** Perceived Benefits of ICT by farmers (N = 229).

| Benefit | RBQ | Overall rank |
|---|---|---|
| Easy and convenient access through mobile phone | 77.62 | I |
| Time and Cost saving by using the mobile as a basic phone | 67.69 | II |
| Reliable and Timely information accessible | 58.62 | III |
| Easy access to more subject matter coverage | 46.07 | IV |

**Table 4.** Constraints experienced by the farmers (N = 229).

| Constraint | RBQ | Overall rank |
|---|---|---|
| Inadequate call centre agricultural expert's knowledge | 74.16 | I |
| Difficult to get accurate weather information | 69.00 | II |
| Lack of quality, timely, irrelevant, and unreliable information | 64.77 | III |
| Limited technological skills in operating mobile phone | 39.08 | IV |
| Inadequate mobile phone connectivity | 35.01 | V |
| Lack of mobile phone facility | 30.20 | VI |

**Table 5.** Factors associated with use of MAAS services by farmers.

| Factor | Correlation coefficient ('r' value) |
|---|---|
| District | 0.241** |
| Age | 0.045 |
| Education | -0.251** |
| Landholding | 0.018 |
| Innovativeness | -0.479** |
| Mass media exposure | -0.483** |

** Significant at 1% probability level.

communication devices to seek information like input availability or market prices.

## Constraints experienced

Although there were perceived benefits in MAAS, the farmers had been experiencing many problems. Preferential ranking technique was used to identify the constraints. Based on the ranks given by the farmers for the six constraints, the rank based quotients were calculated and presented in Table 4. Among the various constraints experienced by the farmers, inadequacy of the call centre agricultural expert's knowledge with RBQ value of 74.16 emerged as the most prominent constraint and given highest priority. The second most prominent constraint was difficulty in getting accurate weather information with RBQ value of 69.00. More than half of the farmers expressed their view that information provided lacked quality, was not provided in time. That the information was irrelevant and unreliable was rated as the third most prominent constraint with RBQ value of 64.77. This is in accordance with Claire et al. (2010) who have reviewed some of the agricultural extension approaches currently in India and reported that unavailability of timely, reliable and relevant information were the main constraints. The limited technological skills in operating mobile phone and inadequate mobile phone connectivity in rural areas were perceived to be constraints by less than half of the farmers in making the best use of mobile based multimedia agricultural advisory system. Lack of mobile phone facility was also the problem for some of the farmers, as per RBQ value 30.20 but it was not considered as the main constraint because it was ranked last.

## Correlation of frequency of use of MAAS services

The frequency with which the farmers used the MAAS correlated with a few socio-economic variables such as district, age, education, land holding, innovativeness, and mass media exposure (Table 5). It was observed that the district was found to be positively and significantly

correlated with the frequency of using MAAS services. Age and landholding size were found to have no impact at all indicating that all the farmers, irrespective of their age and landholding size, were using them. It means that farmers' age and landholding size have no comportment on their frequency of use of MAAS services. It was observed that exposure of farmers to mass media and their level of innovativeness correlated negatively and significantly with the frequent use of the MAAS services in all the three districts. This means that farmers, who were either relatively new or old to mass media, were more enamored by the system. Another interesting observation was that education was not associated at all with the frequency of using information services. These results were encouraging as farmers' socio-economic characteristics have no bearing on their frequency of use of MAAS services.

## Conclusions

This study has presented the potential of MAAS which has been field tested among the farmers. This is emerging as an effective modern ICT tool in the agricultural development services. An effective utilization of this ICT tool can improve farming communities and enable the speedy recommendation of requisite information in mobile based user friendly mode. The ability to access the information at the right time through any basic mobile phone saves time and cost of the farmer. However, this study has found that quality of information, timeliness of information and reliability of information are some of the constraints experienced by the farmers during the advisories.

Some recommendations can be made based on this study regarding the strengthening of a call centre approach equipped with MAAS. Efforts should be directed towards the improvement of knowledge and skill of the call centre agricultural expert in order to provide plot/crop specific advisories that meet the information needs of the farmers. Secondly, effective steps need to be taken with regard to providing weather forecasting information to farmers. So, it is suggested that personalized weather related information could be collected from the universities and institutes and then it could be delivered directly to farmers. Thirdly, reliable information must be provided in a timely manner according to the local conditions. Correlation analysis proved that farmers' socio-economic characteristics except the district variable were not related to making use of MAAS. It is hence concluded that the MAAS is being utilized by the farmers irrespective of their socio-economic conditions.

## LIMITATION AND FUTURE RESEARCH

There are some limitations in this study which should be noted. First, out of 1200 farmers who had registered to MAAS only 243 had been utilizing the information services provided through MAAS. Among them only 229 took part in this survey research during the data collection. While the study helps us greatly in understanding the information needs of the farmers and perceived benefits and constraints experienced by farmers towards MAAS, it is difficult to generalize the results to the entire three districts wherein this initiative was field tested. Perhaps, different farmers have different socio-economic characteristics such as district, gender, age, education, landholding, innovativeness and mass media exposure. Therefore, further research should be conducted with larger number of registered farmers after they have been using the system to obtain a more conclusive and generalisable result. Second, this study uses a primary survey research approach, so a randomized controlled trial (CRT) is needed to test the effect of MAAS on the performance of agricultural crop yield and perception of MAAS by the farmers. For example, two treatments can be implemented. Treatment 1, all the participating farmers are offered MAAS services; Treatment 2, a proportionate number of farmers are not offered any of MAAS service and it should be treated as control. Bruhn and McKenzie (2009) have shown that, in randomized controlled trials, stratification improves efficiency. Thus, randomization of treatments across villages in each district can be implemented in future.

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