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Agricultural information networks, information needs and risk management strategies: a survey of farmers in Indo-Gangetic Plains of India

Surabhi Mittal and Mamta Mehar

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Agricultural information networks, information needs, and risk management strategies: a survey of farmers in Indo-Gangetic Plains of India

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Acronyms

CIMMYT:	International Maize and Wheat Improvement Center
CSO:	Central Statistical Organization
GoI:	Government of India
GSDP:	Gross state domestic product
ICAR:	Indian Council of Agricultural Research
ICRIER:	Indian Council for Research on International Economic Relations
ICT:	Information and communication technology
IGP:	Indo-Gangetic Plain
KVKs:	Krishi Vigyan Kendras
NGOs:	Non-governmental organizations
NSSO:	National Sample Survey Organisation
SAUs:	State agricultural universities
SIM:	Subscriber identity module
SMS:	Small message service
TRAI:	Telecom Regulatory Authority of India
VAS:	Value added service

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Executive summary

Introduction

Access to reliable, timely and relevant information can help significantly and in many ways to reduce farmers' risk and uncertainty, empowering them to make good decisions. However, whether or not this access leads to impact often depends on issues related to markets, institutions, policies and resource availability. Several studies have shown that the wide availability and multiple sources of information have not significantly changed farmers' behavior towards new technologies and information - a fact that is often attributed to a lack of knowledge or understanding of farmers' perspectives and needs on the part of information providers.

Objectives

The main objective of the study was to identify the information needs of farmers that would enable them manage risk in the wheat, maize and rice cropping systems in Indo-Gangetic Plains (IGP). And also analyze the factors that impact the selection of information sources by farming households.

Methods

This study surveyed 1,200 farmers in the 5 major states (Bihar, Haryana, Punjab, Uttar Pradesh and West Bengal) of the Indo-Gangetic Plains (IGP) of India. It assessed farmers' information needs and information networks. The main objective was to identify the information that farmers needed to be able to manage risk in IGP wheat, maize and rice cropping systems. The study analyzes factors that influence the choice of information source by farming households, the extent and potential benefit to farmers of mobile phone use to access agricultural information and farmers' perceptions regarding the expanded use of mobile phones to manage production and marketing risks.

Results

The farmers surveyed accessed information on agriculture from 17 different sources, which were grouped into four categories: (1) face-to-face interaction, (2) other farmers, (3) traditional media and (4) modern information and communication technology (ICT). For each source, farmers were asked their opinion regarding accessibility, relevance, reliability, frequency of use and timeliness, with reference to different crops. More than 90% of the farmers cited other farmers in their own or neighboring villages as the most reliable, easily accessible source of information. Most farmers have access to multiple sources of information; almost one-third use a combination of three sources. Despite this, they are not able to distinctively categorize any of the sources as the most useful or timely. A multivariate probit specification was used to examine whether there was any significant difference between farmers' socioeconomic background and their choice of a source category. The results suggest that large farm size, better education level and large number of crops grown increase the likelihood of farmers accessing information from more advanced or modern sources.

Conclusion

The rising spread of mobile telephony in almost all states of the IGP shows the potential of delivering information through mobile phones. On the other hand, there is wide variance in farmers' perceptions regarding the usefulness of mobile phones or mobile-based information services. Whereas 99% of the farmers surveyed had access to mobile phones, only 41% used them for purposes relating to agriculture. The impact of mobile phones as a source of information for farming depends on how mobile networks are able to link the farmers to required information in a timely and accurate manner. This study also shows that, although mobile phones play an important role in bridging the information gap, they cannot substitute for face-to-face interaction and their use to deliver information has to be complemented with other information sources.

1. Introduction

1.1 Background

Farmers face new challenges due to lack of information on how to deal with the issues of climatic variability, market uncertainty, new technology etc. For example, a farmer producing wheat on his field for generations, now faces new changes of weather, temperature, soil moisture, soil quality, and biological factors. This has resulted in emergence of new types of weeds, pests, and diseases (such as stem rusts) that can significantly affect the health, and thus yield and profitability, of the wheat crop. It is difficult for a farmer to find information on these new challenges from their conventional sources of information, to maintain or improve their yield. Farmers need to adapt to these challenges with information about the advanced techniques and methods that are relevant to their local environment.

Information has an extensive and multifaceted role in agriculture. It empowers farmers to respond to different types of risk, market incentives and competition more efficiently. Agricultural extension plays a key role in information and technology transfer (Kumar and Rosegrant 1994; Evenson, Pray, & Rosegrant, 1999; Fan & Hazell, 1999; Mittal & Kumar, 2000). However, agricultural extension systems - especially those that are state-managed in South Asia - have limited outreach. This is because of shortages of trained personnel, rising delivery cost, and the need for rapid response to changing climate and markets (Economic Survey, 2011; MOAC 2010). The dynamics of the agriculture sector demands that conventional wisdom and extension systems need to be restructured and modernized.

Along with the public extension services, farmers access information from a variety of other sources. These sources can be divided into formal and informal information networks. The informal networks constitute face-to-face interactions with friends, relatives, other farmers, and extension agents among others. On the other hand, formal sources refers to information that is created specifically for farmers through media such as radio and television based agricultural programs, tele-centers and mobile based information services. Farmers use a combination of these formal and informal modes of accessing information simultaneously, for different information. A CIMMYT scoping study (Mittal, 2012) highlighted limitations to these formal and informal networks and criticized their lack of knowledge or understanding of the farmer's perspective and need for information. It is important to understand the demand for information relating to the agricultural activity of the farmers. This need or demand will vary across regions, crops and farmers landholding size.

Studies have shown that most farmers have access to a variety of traditional information sources (television, radio, newspapers, other farmers, government agricultural extension services, traders, input dealers, seed companies and relatives), which they regularly access for agricultural information (Mittal & Kumar, 2000; NSSO, 2005; Sarvanan, 2011). These traditional sources have been an important tool for several decades now. They disseminate scientific and technical agricultural knowledge to the farmers and also help improve adoption of technologies. They played an important role during the green revolution in the 1970s and 1980s (Sulaiman et al., 2011). In early 2000 with the fast growth of internet and mobile phone services, modern ICT-

based extension services (mainly through mobile phones and internet) provided an opportunity to strengthen these extension services and dissemination of information. These new ICTs play an important role in enabling farmers to get connected to experts, extension agents, and information sources. More appropriate is availing an opportunity to provide farmers with information related to changing climatic conditions and an ability to cope with the risk of climatic uncertainties.

The National Sample Survey Organisation (NSSO) Situation Assessment Survey of farmers in India (NSSO, 2005b) showed that only 40 % of farmers have access to one or more sources of information. This raises concern for the remaining 60%, who are ignorant of the basic knowledge and changing dynamics of the agricultural sector. The survey also revealed the type of information that farmers request for. This includes information on seed, fertilizers and plant protection that are most prominent. For this information, the farmers usually inquire from other farmers and input dealers. The present survey conducted by CIMMYT, investigates the available information networks along with various information based risk management measures that farmers adopt.

1.2 Objectives

The main objective of the study was to identify the information needs of farmers that enable them to manage risk in the wheat, maize and rice cropping systems in the Indo-Gangetic Plain (IGP) of India. The specific objectives were to:

1. Identify existing information networks, information needs and constraints to access of information.
2. Analyze factors that impact the selection of information sources by farming households.
3. Identify the extent of use of mobile phones, their potential benefit to farmers for agricultural information and farmers' perception on further use of mobile phones to manage production and marketing risks.

2. Methodology

2.1 Overview

The Indo-Gangetic Plain (IGP) comprising of the five major states (Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal) is the food bowl of India and contributes about 51% (2009-10) of the total food grain production (Ministry of Agriculture, 2011). Punjab and Haryana are among the most prosperous states of this region. They were among the first few states that witnessed the green revolution era of 1960s. During the 1970s and 1980s the Indo-Gangetic plains of South Asia, especially regions in India, registered high yield production of rice and wheat (Sinha, 1997). By the 1980s, farmers started facing problems of high pesticide and fertilizer use and declining ground water level in their local domain (Shiva 1993, Swaminathan 1993). IGP is also identified as an area with high social vulnerability[1] (Chhetri & Chaudhary, 2011). According to Swaminathan (2010), due to the changing climate scenario, India's food basket (Punjab-Haryana region) may become food-insecure by the early 2030s.

The surveyed states represent the major wheat-maize-rice cropping system of India. There are also variations amongst the states on parameters such as population size, per capita income, infrastructure, and ICT penetration (Table 1). The surveyed states of IGP broadly share common characteristics of rice-wheat cropping pattern, fertile soil and good availability of water resources. However, there are substantial differences too. Punjab and Haryana being the first states to experience the green revolution always tower over the others in access to high yield varieties of seed and advanced machinery. Unfortunately, due to excessive pumping of ground water for irrigation purposes, these states are faced with lowering down of the water table.

Table 1. Socioeconomic and ICT indicators of the surveyed states.

States	Population (in million)[1]	Rural literacy rate[1]	Per capita income (Rs.)[2]	Share of agriculture in GSDP[3] (%)	Teledensity[4]		
					Rural mobile	Rural fixed lines	Total internet
Bihar	103.8	44.0	14,654	18	21.5	0.4	0.3
Haryana	25.4	63.2	77,878	18	50.0	1.3	1.6
Punjab	27.7	64.7	61,035	29	53.9	3.0	3.2
Uttar Pradesh	199.6	52.5	22,558	23	26.3	0.3	0.1
West Bengal	91.4	63.4	36,322	17	37.7	0.6	1.2

[1]Data source: Census of India, 2011. [2]At current prices; data source is Census of India, 2011. 1 US$= 44.78 Rs. at time of survey
[3]GSDP = Gross State Domestic Product; data source is Central Statistical Organization, GoI, 2010.
[4]TRAI = Telecom Regulatory authority of India, GoI, 2011. Teledensity is defined as telephone ownership per 100 people.

Whereas eastern IGP states- Bihar, West Bengal and Eastern UP still have vast ground water facility, they are also faced with limited access to water due to poor electrification of villages. The relevance of diversity in the present study is necessary, because Indian states with high mobile penetration can be expected to have a high growth of Gross State Domestic Product (GSDP) and is expected to increase by 1% per year on average for every 10% increase in the penetration rate faster than those states with lower mobile penetration rates (Kathuria, Uppal and Mamta,2009).

[1]Some of the indicators used to measure social vulnerability were percentage of workers employed in agriculture, the percentage of landless labourers in the agricultural workforce, human capital (as represented by literacy levels), and gender discrimination.

2.2 Survey design and data collection

We used data collected from a primary survey of 1,200 farming households in five Indo-Gangetic states of India. The survey was conducted by CIMMYT between January - March 2011 in Bihar, Haryana, Punjab, Uttar Pradesh and West Bengal. A multi-stage sampling technique was used for selecting states, districts, villages and households for the study. Four districts were chosen in each state. In each district, six villages were chosen, while in each village, 10 households were randomly selected. The villages covered are presented in Appendix 1.

During the field survey, about 17 different sources of information were collected. For the purpose of analysis, these different sources were grouped together in four categories (face-to-face interaction, other farmers, traditional media and modern ICTs). This was based on the common characteristic of the source of information (ref to Appendix 2). The 'other farmers' were not included in the 'face-to-face' group because these two groups are major sources of information to most of the farmers. More than 90% of the farmers reported that they access information from other farmers located in their own or neighboring villages.

2.3 Empirical Model - Multivariate Probit Model

Information on socioeconomic characteristics of the households and household assets was also collected. A multivariate probit specification is being used to examine how different socioeconomic factors influence the likelihood of farmers in choosing different sources of information. Multivariate probit model is appropriate for jointly predicting two or more choices of an individual. In this analysis, farmers have a choice to select from several sources of information. Their decision to choose a specific source is a function of socio-economic characters of the household and regional dummies.

The proposed methodology shed some insight into the role of a farmer's background in using different means to access information on how to improve their farming techniques. The empirical specification of choice decision over the four groups of sources of information can be framed in two possible models i.e. multinomial logit/probit model or multivariate logit/probit model. One of the underlying assumptions of multinomial models is independence of irrelevant alternatives i.e. error terms of the choice equations that are mutually exclusive (Greene 2003).

However, the choices among the information sources are not mutually exclusive. Farmers' access information from more than one source at the same time and therefore the random error components of the information-sources may be correlated. Therefore, consideration was made for using a multivariate model which allows for the possible contemporaneous correlation in the choice, to access the four different sources simultaneously. Multivariate probit estimation has been used in a number of studies. This evaluates factors that affect adoption of agricultural technologies (Jenkins et al., 2011; Gillespie et al., 2004). Jenkins uses this approach to evaluate factors that affect cotton producers' adoption pattern of different information sources i.e. private, extension and media. Gillespie et.al, 2004 used this approach to estimate factors that affect adoption of four breeding technologies in hog production. They argue that modeling

adoption decisions using a multivariate probit framework, allows for increased efficiency in estimation in the case of simultaneity of adoption. Empirically the model can be specified as follows:

$$\left.\begin{aligned} Y_{i1} &= X'_{i1}\,\beta 1 + \varepsilon_{i1} \\ Y_{i2} &= X'_{i2}\,\beta 2 + \varepsilon_{i2} \\ Y_{i3} &= X'_{i3}\,\beta 3 + \varepsilon_{i3} \\ Y_{i4} &= X'_{i4}\,\beta 4 + \varepsilon_{i4} \end{aligned}\right\} \qquad (1)$$

Where, *i*= farmer id, $Y_{i1} = 1$, if farmer access information from 'face-to-face' sources (0 otherwise), $Y_{i2} = 1$, if farmer access information from 'Other Farmers' (0 otherwise), $Y_{i3} = 1$, if farmer access information from 'Traditional Media' sources (0 otherwise), $Y_{i4} = 1$, if farmer access information from 'Modern ICT' sources (0 otherwise), X'_i= Vector of factors affecting access to the information source, β_j= Vector of unknown parameters (j= 1, 2, 3,4), and ε= is the error term. The hypothesis can be tested by running four different independent binary probit or logit models. The assumption is that error terms are mutually exclusive. However, the decision to adopt different sources may be correlated, thus the elements of error terms might experience stochastic dependence. In this situation, a multivariate probit model of the following form is used to test the hypothesis

$$Y_{ij} = X'_{ij}\,\beta_j + \varepsilon_{ij} \qquad (2)$$

Where *Yij* (*j* =1,...,*4*) represent the four different information sources faced by the *ith* farmer (*i* =1,..., 1200) , X'_{ij} is a 1×*k* vector of observed variables that affect the choice decision of farmer, β_j is a *k* ×1 vector of unknown parameters (to be estimated), and ε_{ij} is the unobserved error term. Assuming the error terms (across *j* =1,..., *m* alternatives) are multivariate and are normally distributed with mean vector equal to zero, the unknown parameters in equation (2) are estimated using simulated maximum likelihood[2]. The method uses Geweke-Hajivassiliour-Keane (GHK) smooth recursive conditioning simulator procedure to evaluate the multivariate normal distribution. We estimate the model using STATA (version 11) software. Prior to the estimation of the model parameters, it is crucial to look into the problem of multicollinearity among the explanatory variables. A condition index was used to detect correlation (Belsley, Kuh, & Welsch, 1980). The value of condition index is found to be less than 30. Therefore the data has no serious problem of multicollinearity.

Due to wide variations in farmer's selection pattern across various combinations of sources of information, there is a possibility that a farmer's choice of any particular source was correlated with their choice of other source of information. To test this hypothesis, pair-wise correlation coefficients across the residuals of multivariate probit model in the four sources of information models are calculated.

[2]It is estimated using *mvprobit* command in Stata software, version 9.2

These coefficients measure the correlation between the different information sources, after controlling the influence of the observed factors that has been accounted (Greene 2003). The positive signs of the correlation coefficients suggest that the decision to use or adopt one particular source of information may make it more likely that other sources of information will also be selected.

Explanatory variables and their statistical distribution

We hypothesize that the choice of source of information is influenced by farm and respondent characteristics, in particular, age of farmers, education level, farm size, number of crops cultivated by farmers and access to household ICT assets (radio, TV, and mobile phones) and state dummies. Each variable is briefly described below. It includes the theoretical justification for its inclusion in the model. Descriptive statistics of these variables are presented in Table 2.

Age of the farmer is measured as respondent's age in years, at the time of data collection. Usually older farmers are less likely to explore new sources of information and thus less likely to depend on multiple sources for information. The hypothesis is that the increase in age would have negative influence on choice of multiple sources of information.

Education level is collected as 0=illiterate, 1=primary schooling, 2= secondary and high school, and 3= higher education. Education is one of the important factors that influence a farmer's decision to bear the risks associated with new technologies and modern information sources. Farmers with better education are earlier adopters of modern technologies. They also apply modern inputs more efficiently throughout the adoption process (Feder et al 1985). Thus famers who are more highly educated are likely to diversify their information base and more likely to use multiple sources of information.

Farm size is a proxy for farmer's economic status and is measured in acres, and is positively associated with the probability of using modern techniques and multiple sources of new information.

The **number of crops** the farmer cultivated indicates diversified cropping patterns and is expected to depend more on new sources of information and not just indigenous knowledge.

Access to household information assets is captured as a farmer's ownership of mobile phone, landlines, radio and television. The data is of categorical nature (i.e. yes=1 if access, otherwise 0) for radio, television and mobile phones. Farmers with access to modern assets are more likely to acquire information from a modern ICT source.

Five state dummies representing the different states are included in the model to account for heterogeneity in the sample, due to geographical disparity.

3. Results

3.1 Descriptive statistics

Among farmers surveyed, a majority were within two age groups: 26 to 40 and 41 to 55 years respectively. The mean age was 42. Interestingly, the same pattern is seen across all states. For education, 71% of the farmers had formal schooling (primary and secondary school). For land holdings, 66% of those surveyed were small and marginal landholders, while only 3% had large farm holdings (Table 2). This distribution of farming households on the basis of land size is very similar to the statistics produced by the agricultural census of India. The distribution of mobile phones across states was uniform with 99% of the farmers having access to mobile phones. This is mainly due to the increasing mobile penetration, even in rural and remote areas, as well as reduction in prices of handset and call charges. The penetration of mobile phones has also increased because of poor access to landline phone facility in these states. Of farmers' households surveyed, 79% had televisions while 32% had radios in their house, with the highest percentage of ownership (radio), being in Bihar. Access to computers or internet is very low among the farming households.

Table 2. Distribution of demographic and economic characteristics of the surveyed farmers in IGP.

Variable	Survey States	Bihar	Haryana	Punjab	Uttar Pradesh	West Bengal
Age category (Years)						
Less than 25	135	11	20	46	36	22
26-40	443	100	93	100	64	86
41-55	404	80	87	54	80	103
More than 55	217	48	40	40	60	29
Mean Age	42	45	43	40	44	42
Education level						
Illiterate	146	11	34	38	44	19
Primary schooling	235	32	41	61	30	71
Secondary & high school	673	141	146	122	138	126
Higher Education	146	56	19	19	28	24
Land-holdings[1]						
Marginal (less than 1 ha)	436	80	32	24	132	168
Small (1-2 ha)	361	81	55	109	59	57
Semi medium (2-4 ha)	237	58	76	55	33	15
Medium (4-10 ha)	135	20	62	39	14	0
Large(more than 10 ha[2])	31	1	15	13	2	0
Mean size of land holdings (ha)	2.16	1.77	3.90	2.88	1.36	0.93
Average no of plots[3]	3.1	4.0	2.4	1.3	2.8	4.8
Average plot size (ha)	0.69	0.44	1.62	2.14	0.48	0.20
Access to ICT assets[4]						
Radio	381	196	85	12	53	35
Television	948	168	237	237	150	156
Landline Phone	79	4	19	26	16	14
Mobile Phone	1188	239	239	238	234	238
Computer/Internet	56	13	11	24	7	1

Notes:

[1]*This is the standardized distribution of land holding used by Agricultural Census of India and other Ministry of agriculture, Government of India publications.* [2]*Conversion: 1hectare = 2.47 acres*

[3]*Average plot size is calculated by dividing average farm size by no. of plots.*

[4]*Farmers have access to multiple assets*

Only 6 females (4 from Uttar Pradesh and 2 from West Bengal) were reported in survey of 1200 interviewed farmers. Sample covers 240 farmers from each state: Unit: no. of farmers N = 1200.

In the surveyed area, farmers mainly follow the rice - wheat cropping system. Only 13% of farmers in the survey reported growing maize. Many farmers (40%) practiced intercropping. The main crops were sugarcane (19%), cotton (10%), jute (26%), mustard (21%), potato (10%) and tomato (5%). Farmers largely depend on private seed agro-dealers and traders in the village for access to seed. Only a few of the farmers source their seeds from government agencies or the cooperatives.

3.2 Information sources

All surveyed farmers reported that they access information from multiple sources. They said they usually do not find any single source providing all that they need. They added that they also don't exclusively over rely on any one source. They said they have various sources for different types of information. It was surprising to find that less than 10% of the surveyed farmers used government initiated efforts like research stations, Krishi Vigyan Kendra, and state agriculture universities to access information. Interestingly, most of the traditional sources are used by farmers to access agricultural information. Among the modern ICTs, use of mobile phone is predominant (Table 3).

Table 3: Access to sources of information sources by farmers.

Sources of information	Source used by farmers		Most important source[1]	
	Number of farmers	Percentage of farmers	Number of farmers	Percentage of farmers
Face-to-Face				
KVKs/Research Stations	109	9	24	2
State agriculture universities (SAU's)[2]	3	0	0	0
Krishi Mela	240	20	87	7
Input Dealers/shops/private companies	812	68	250	21
Commission agent/Mandi	62	5	2	0.2
State dept. of agriculture	297	25	100	8
NGO[2]	2	0.2	1	0.1
Cooperatives	277	23	17	1
Other farmers				
Other farmers	1097	91	497	41
Traditional Media				
Television	657	54	53	4
Radio	244	20	28	2
News paper	397	33	7	1
Modern ICT				
Landline Phone[2]	8	1	2	0.2
Mobile Phone	429	36	123	10
Kiosk/ internet[2]	5	0.4	2	0.2

Note:
[1]Farmers are reporting use of multiple sources of information, thus farmers were asked to report one of the most important sources of information in their perception.
[2]Few users access information from these sources, so these are dropped in further tables.

Among the different sources that each farmer uses for collecting information, they were asked to list the most important source of information on the basis of timely availability, accuracy and

reliability of information. Based on these three criterions, 41% of the farmers ranked other farmers as the most important source of information, followed by input dealers (21%) and mobile phones (10%)

The use of different sources varies across different states is indicated in Figures 1 and 2. The pattern of accessing information from other farmers and input dealers does not vary much across states. In Bihar, radio is the most important source of agri-information, mainly through community radios. The pattern of use of other sources like television, KVKs, newspapers and state departments varies across states. Krishi Mela[3] is most dominant in Punjab, while mobile phones dominate in Haryana and Bihar. There might be variation in the degree of use or importance of different sources of information across states due to variations in government schemes or supporting infrastructure.

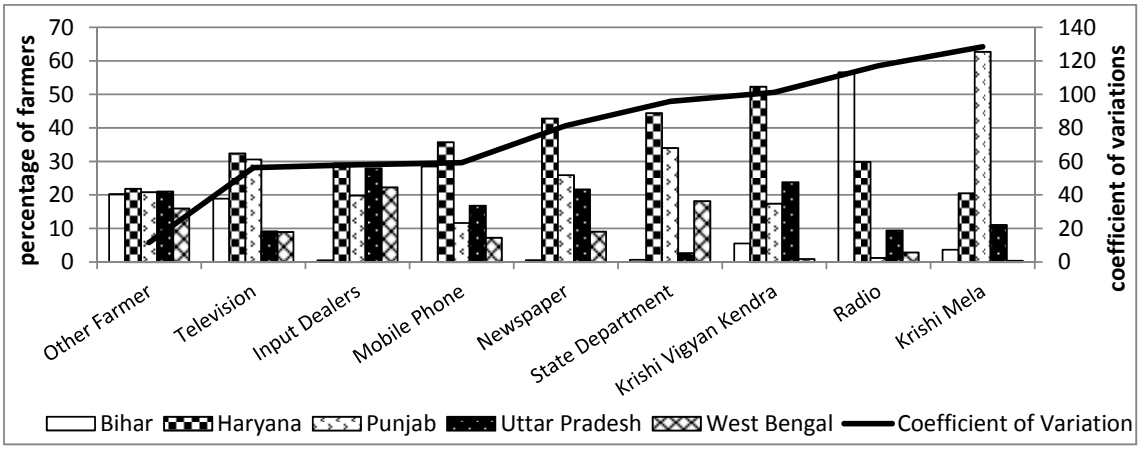

Figure 1: State-wise information accessed by farmers from different sources.

Note: Major sources of information are presented here. Percentage refers to respective source used in respective states by all surveyed farmers

[3]Krishi Mela or Village fair: Village fair includes the fairs sponsored by government or private agencies as well as the normal religious and cultural fairs in an area. Exhibitions on a variety of agricultural items are included in this category. This source also includes Kisan Mela or a Stall set up by government/private agency in a religious/cultural fair visited by farmers regularly.

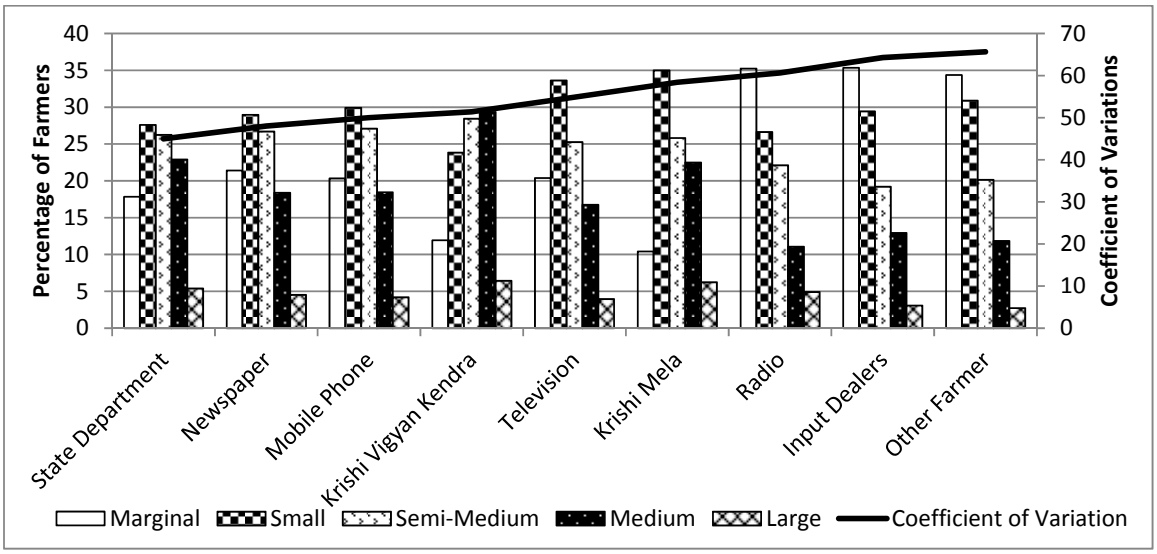

Figure 2: Information accessed by farmers from different sources according to farm-size.

Note: Major sources of information are presented here
Percentage refers to respective source used in respective states by all surveyed farmers

The most frequently accessed source of information by surveyed farmers is 'other farmers', followed by the 'traditional media' of information - television, radio, and newspapers. Farmers use multiple sources of information because no one source gives them complete information. Although farmers responded that different sources of information were useful, these sources did not provide them with information on time (Appendix 3). It was established that although farmers gather information from various possible sources, they are also not able to distinctively categorize any of the sources as the most useful or timely. We also tried to explore why they preferred a particular source of information over the other (Appendix 4).

Timely availability, accuracy and reliability of information are the most important pillars for the successful deployment on any information mode. Adequacy of information is vital for effective performance of farmers. This can be possible if the information contents are qualitative/useful, timely available and unbiased towards any technique or institution. Radio and television broadcasting times are sometime not appropriate for most people.

3.3 Information needs and gaps

Farmers' needs and information requirements vary by the stages of production in agriculture. In general, all farmers seek to acquire complete, high quality and timely information to make decisions related to risk, throughout the year. Farmers can reduce the probability and magnitude of losses due to risk and uncertainty, if they are able to access relevant and timely information. Evidence suggests that ICT has potential to minimize agriculture production risk due to climate variation, pest and disease (Ospina & Heeks, 2010; Singh & Singh, 2009, Mittal, 2012). Farmers need both technical and awareness information corresponding to different farm activities. During the survey, farmers were asked to list the five most important information needs relevant

for different crops. These needs were grouped according to different stages of cultivation (Table 4 and Appendix 5)

Table 4. Topmost information need/demand identified for crops in IGP.

Information need	Percentage of respondents/farmers		
	Wheat (N= 1070)	**Rice** (N= 1125)	**Maize** (N= 149)
Pre-sowing	23.4	20.1	21.0
Input availability	38.0	33.7	21.5
Input prices	12.5	11.9	17.5
Post-sowing	12.5	14.7	12.5
Agronomic information	5.1	9.2	11.0
Harvesting	1.7	1.8	1.6
Packaging and storing	6.2	7.8	11.9
Marketing	0.6	0.8	3.1

Note: Multiple Responses of the farmers were recorded.

The most commonly cited information need of the farmers who were sampled was information about input availability (what input to use, how much to use, when and from where to purchase inputs). These were mainly inputs like seeds, fertilizer, machinery, pesticides, herbicides and labor. Information on availability of inputs is an important parameter that helps farmers access better inputs and increase adoption of modern varieties of seeds and other technologies. It also increases the yield (Ghimire et.al 2012). The other most important information need is pre-sowing - soil quality testing, land preparation and good farm practices, choice of crop and most suitable varieties. For wheat and rice growers, information on input availability and pre-sowing are top priority. Beside these, maize farmers have specific needs for information related to input prices, sowing, agronomic practices, and packaging and storing.

Marketing information is not always needed most. This is because of two reasons: first for wheat, maize and rice, there are government announced prices for procurement and thus the variability in prices across markets is limited. Secondly, most of the traditional media and modern ICT modes of information primarily deliver information on markets and prices. This leads to the information gap diminishing over time.

The state-wise comparison (Appendix 6) gives interesting insights about a farmer's information requirements. In Punjab, Haryana and Uttar Pradesh farmers, information about pre-sowing planning and management and input supply was top priority. However, this contrasted with farmers in Bihar and Uttar Pradesh who want to have more information on input prices. Besides crop specific information, farmers require other kinds of agricultural information like government schemes, machinery repair and animal husbandry. During the survey, most of the farmers desired to get regular information on government schemes related to loans, subsidies, prices and new techniques or agriculture related programs.

There are various factors that act as constraints in utilizing the full benefit of information that farmers secure through various sources. This also disables them from managing risk effectively, even if they are well informed. The most commonly cited constraints in IGP and across all states

is a poor extension facility (Table 5 and Appendix 7). Almost 47% of the farmers said that the biggest constraint they faced in improving their productivity is lack of access to any extension service or credible information source. This is the situation for all states except for Haryana, where farmers reported availability of quality inputs as the biggest constraint in utilizing the benefits from the information. Even when farmers are aware about the quality of seed, fertilizer and other input to use, non availability of input does not allow them to utilize the opportunity. Haryana farmers has also cited a shortage of labor to carry out agricultural operations as a big constraint. For farmers in Bihar, poor access to irrigation facilities and lack of electricity to operate their water pumps is a big constraint. About 8% of the farmers reported no constraint, 41% of them being small and marginal farmers. This may be because these farmers have very small farms and most of their produce is for their own consumption. They are less likely to be motivated to go around looking for market or new technology linked information.

Most of these issues are institutional and infrastructural which cannot be sorted by the delivery of information. Nevertheless, as long as these constraints exist, the farmers cannot fully utilize the benefits of information.

Table 5. Constraints faced by farmers in utilizing the benefits of information.

Constraint in accessing information	Weighted average number of farmers[1]	Percentage of farmers
Poor extension facility	563	50
Inappropriate availability of quality inputs (seed, pesticides and fertilizers)	226	19
Poor access to electricity and irrigation facility	122	10
Shortage of labor	67	6
Poor or no access to soil and water testing facility	66	6
Poor access to markets	17	1
Other issues[2]	16	1
Inadequate crop storage	4	0
No problem	96	8
No need of information or no response	23	
Total	**1200**	**100**

Note:
[1]Number of farmers is weighted by the number of constraints highlighted by them, with three being maximum number of constraints. For instance, if a farmer has listed three constraints then each constraint is given a weight of 0.33 and if one farmer has listed only one constraint as the most important then that is given a weight as 1.
[2]Other issues include sabotage by herds of animals, floods, fire etc.

3.4 Factors that impact the selection of information sources

Selection pattern of sources of information by farmers

The pattern of use of information sources by farmers is computed on the basis of frequency of farmers with all possible logical relations of farmers accessing different sources of information (Table 6). Only 10% of the farmers use a single category of information. This is either other farmers or face-to-face interactions. Most of these farmers own less than 1.62 ha and therefore belong to the category of small or marginal farmers.

Table 6. Farmers using different combinations of information sources.

Possible sources of information combination	Frequencies of farmers	Percentage of farmers
Only 'Face-to-Face'	49	4
Only 'Other Farmers'	66	6
Only 'Traditional Media'	0	0
Only 'Modern ICT'	0	0
'Face-to-Face' and 'Other Farmer'	213	18
'Face-to-Face' and 'Traditional Media'	24	2
'Face-to-Face' and 'Modern ICT'	7	1
'Other Farmer' and 'Modern ICT'	25	2
'Other Farmer' and 'Traditional Media'	80	8
'Modern ICT' and 'Traditional Media'	9	1
'Face-to-Face', 'Other Farmer' and 'Traditional Media'	336	28
'Face-to-Face', 'Other Farmer' and 'Modern ICT'	36	3
'Face-to-Face', 'Traditional Media' and 'Modern ICT'	13	1
'Other Farmer', 'Traditional Media' and 'Modern ICT'	81	7
All four	260	22
None of the four	1	0
Total	**1200**	**100**

Note: Four sources of information as categorized for the analysis are- face-to-face interaction, traditional media, modern ICT and other farmers.

No farmer solely depends on either traditional media or modern ICT for information. Farmers usually prefer a mix of face-to-face or other farmers as sources of information with traditional media, but some also like to gather information through modern ICTs. This also suggests that farmers using traditional media and modern ICTs are more prone to use multiple sources of information that makes them better informed. Almost one third of the farmers use any combinations of three sources to obtain information and 22% of the farmers use all four categories of information. Multiple information sources are therefore used by farmers to have access to a complete set of required information. This relates to agriculture and more specifically climate change and risk management.

Table 7. Correlation coefficients between information-source-selection decisions.

Information source choices	Correlation Coefficient[1]	Standard Error
'Face-to-Face' and 'Other Farmer'	-0.441*	0.079
'Face-to-Face' and 'Traditional Media'	0.113	0.074
'Face-to-Face' and 'Modern ICT'	0.068*	0.073
'Other Farmer' and 'Modern ICT'	-0.055**	0.066
'Other Farmer' and 'Traditional Media'	-0.026*	0.066
'Modern ICT' and 'Traditional Media'	0.245*	0.053

Note: [1]*Correlation coefficients between the residuals from the multivariate probit equation*
, **, * indicate statistical significance at the 1%, 5% and 10 % level respectively.*

The sign of face-to-face interaction mode with modern ICT and between modern ICT and traditional media is positive and significant (Table 7). This implies that the decision to use one particular source of information correlated the decision to use another source. This can be explained as farmers use this as complementary sources of information. Whereas negative and significant coefficients of combinations with other farmers may imply that if farmers are

accessing information from 'other farmers' then it is most likely that they will not be accessing information from other sources of information.

Results of Multivariate Probit Model

Under face-to-face equation (Table 8), the coefficient on farm size is positive and significant so farmers with large land ownership are more likely to obtain information from face-to-face sources, besides a variety of other sources of information. Among the state dummies, farmers in Bihar and Haryana are more likely to use traditional media and in West Bengal it is the opposite.

Table 8. Estimated parameters of farmer's attributes on adoption of different sources of agriculture information: Multivariate Probit Model.

Independent variable	Face-to-face	Other farmers	Traditional media	Modern ICT
Age	-0.008 (-0.005)	-0.001(-0.005)	-0.009*(-0.003)	0.001(-0.003)
Educational Level	-0.016 (-0.063)	-0.151*(-0.051)	0.057(-0.036)	0.257*(-0.035)
Farm size	0.080* (-0.026)	0.001*(-0.013)	0.023**(-0.011)	0.024*(-0.007)
Number of Crops	0.033 (-0.096)	-0.053(-0.072)	0.003(-0.055)	0.109*(-0.055)
Access to Radio/television	0.031(-0.188)	-0.226(-0.167)	#-	0.168(-0.139)
Access to Mobile Phone	-0.601(-0.823)	0.381(-0.548)	0.299(-0.394)	#-
State Dummies				
Bihar	-3.848*(-0.264)	-0.253(-0.202)	0.674*(-0.122)	0.454*(-0.128)
Haryana	1.84 (-154.486)	1.988(-82.468)	0.953*(-0.096	0.432*(-0.07)
Punjab	-0.081 (-0.103)	-0.055(-0.075)	0.359*(-0.047)	-0.097**(-0.048)
West Bengal	-0.200*(-0.048)	-0.246*(-0.036)	-0.060**(-0.025)	-0.118*(-0.028)
Constant	2.806*(-0.959)	2.187*(-0.662)	-0.238-0.461)	-1.763*(-0.283)
Log-likelihood		-1661.7454		
Wald test χ^2 (DF=18)		967.34*		
Likelihood ratio test of ρ_{ki}		49.212 *		
Number of observation		1199		

Note: Uttar Pradesh is used as a benchmark dummy, # Variable dropped in respective regression equation to avoid multi-colinearity; Figures in parenthesis are robust standard errors. *, **, and *** represent statistical significance at 1%, 5%, and 10% levels, respectively.
Likelihood Ratio Test *H*0: $\rho_{21} = \rho_{31} = \rho_{41} = \rho_{32} = \rho_{42} = \rho_{43} = 0$, $\chi^2_{(6)} = 49.212$, p-value = 0.0000
The explanatory variable access to Radio or Television and Access to mobile phone has been removed from the last two columns, due to their perfect collinearity with their respective dependent variable.

Results of the equation 'Other Farmers' has education level and farm size as significant variables. Like the earlier equation here also farm size has positive, significant estimation for likelihood to information from other farmers. The coefficient of education level with other farmers is negative and significant, this implies that as farmers get more education, they are less dependent on other farmers for information on agriculture. West Bengal has a lower likelihood of accessing information from other farmers than farmers in the omitted Uttar Pradesh state.

The main results of third equation of traditional media are that with increase in age, farmers are less likely to use traditional media for information. But farmers with larger farm size, who that are also resource rich are likely to use traditional media for information. Farmers in Bihar and Haryana are more likely to use traditional media but not in West Bengal.

In the forth equation on modern ICT, the estimated parameters of education level, farm size and number of crops are positive and significant. This means that resource rich and educated farmers are more likely to access information from modern ICT. Farmers producing more crops require more information due to diversification and thus they are more likely to depend on modern ICT for information. There are clear regional differences: farmers in Bihar and Haryana are more likely to use modern ICT than those in Punjab and West Bengal.
- Uttar Pradesh

3.5 Farmers' perception on use and utility of mobile phones for agriculture

The third objective of this study was to identify the use of mobile phones by farmers. It focused on perceived benefits that farmers accrued with use of mobile phones for their agricultural activities and how they perceived it as an important source of information to manage production and market risk. Almost all the respondents had access to a mobile phone. However, only 41% of those farmers use mobile phones for accessing information relating to agricultural activities. Mostly service providers deliver information to the farmers on their mobile phones in the form of short service message (SMS) with 76% of the farmers who own mobile phones receiving SMS in their local language. It is important to deliver information in localized languages because of low literacy levels that limit farmers' ability to read and type messages on mobile phones in English. Only 51% of farmers in IGP can read the SMS and only 28% of the total farmer's can reply back in text form. Many of these farmers are unable to read or access the information/messages themselves. However, someone in their family or neighborhood is able to read it to them. In India, many Mobile Based Information Service (MBIS) providers have been operational since 2007. However, they had poor penetration and low awareness among the surveyed farmers as described below. This section has two parts: farmers who were using the MBIS and those who were not using the MBIS but were aware about any such service in their neighborhood. Only 44 farmers who were aware about the services and only 13 farmers have used the service out of the 1,200 who were surveyed with five discontinuing the use due to poor information quality.

The most popular service provider was IFFCO Kissan Sanchar Limited (IKSL), which was used by 26 farmers. During the survey, the farmers were asked if they were aware about the services, and if they were, what factors stopped them from using these services. This was intended to understand the constraints that these services had that prevented farmers from using these services. The most important reason the farmers gave was that although they had heard about these services from others, they don't understand their proper benefit and use. No one has approached them to guide them on usability of these information sources. Also, some of them felt that the messages delivered on mobile through MBIS were not too relevant or useful and

many felt the charge was too high. MBIS have not yet penetrated or become popular with majority of farmers, because of the cost for service or dissatisfaction with the relevance of content.

Farmers were briefed about these services and asked if they would like to use them. In response, 90% said they were interested in receiving the information on their mobile phones. These numbers contradict the actual usage as well as highlight the potential market that exists for the service provider. For the extension agents, this also points towards the potential mode of getting connected to the farmers in a cheaper, quicker way. But the most preferred mode was voice message. Although in India various MBIS providers exist and deliver information, the models are largely based on SMS. Nearly 55.5% of the farmers opted for Hindi as their most preferred language for receiving messages, followed by other regional languages like Punjabi. These results indicate a direction for farmer's preference and need.

The purpose of this section of the survey was to have a perception about farmer's willingness to pay for these services. General opinion was that farmers are small and poor and would not be willing to pay for such services. During the survey it was established that 47% of the farmers were not willing to pay for the services. They believed the service is supposed to be provided for by government and do not consider this kind of information to be of economic value. Most farmers are willing to pay, only if they find that the services is useful, trustworthy and has some positive impact on their income, farm yields and cost of production. Although a more in-depth analysis is required to understand the willingness to pay, separate studies have to be designed to understand better the economic value of the information, as perceived by the group of farmers who will be using these services for their agricultural activities.

Most of the farmers reported that they use mobile phones mainly for social communication. However, they now increasingly use it to get connected with people like traders and other farmers, who have agricultural related information. Most of the small farmers reported some increase in convenience and cost savings from using their mobile phones as basic communication device seeking information such as input availability or market prices. Some other benefits that farmers listed are improved access to information such as seed variety selection, best cultivation practices, protection from weather-related damage and handling plant disease. The survey had 35% of farmers who experienced an increase in yields due to the availability of this information. The highest yield gains of this group were observed by farmers in Punjab (49%) and Haryana (43%) (Table 9).

Table 9. Benefits of mobile based information[1]

	Percentage of Farmers			
States	**Using mobile phone for agricultural information**	**Get better connected to markets**	**Getting better prices**	**Increasing yield**
Bihar	51	99	66	21
Haryana	65	99	80	43
Punjab	26	78	83	49
Uttar Pradesh	45	70	70	29
West Bengal	17	66	49	34
Total (n= 1200)	**41**	**87**	**72**	**35**

Note: [1]This percentage of farmers is from the 41% of farmers, who are using mobile phone to access agricultural information, Farmers have multiple responses.
These numbers are being rigorously evaluated under the ongoing research to measure the actual effect of mobile phones on income and welfare of households.

Farmers also highlighted other benefits of using mobile phones like being connected better to Kisan call centers[4] and other agricultural experts for advice and recommendations. A few farmers felt they are able to save time and money by getting connected. Farmers cite these benefits, drawing a comparison to previous periods, when they didn't have access to mobile phones. Mittal et. al (2010), notes that the potential benefits of information flow are obtained mainly by large farmers in the various states of India. This is attributable to the fact that small farmers, despite their access to information, have not succeeded in overcoming constraints of poor access to capital, poor infrastructure and lack of access to markets. The CIMMYT (2011) survey also highlights similar results (Table 10). In the report, almost 91% of the large farmers who used mobile phones got better price for their commodities, while only 63% of marginal farmers and 71% of small farmers could benefit from thje price information.

Table 10. Benefits of mobile phones based on land size.

Land Size	**Percent of farmers using mobile phone**	**Getting connected to market**	**Getting better price**
Marginal (less than 1 ha)	27	72	63
Small (1-2 ha)	40	91	71
Semi-medium (2-4 ha)	53	91	72
Medium (4-10 ha)	64	93	79
Large (more than 10 ha)	68	95	91
Total	41	87	72

Note: This percentage of farmers is from the total farmers who are using mobile phone to access agricultural information. Farmers have multiple responses.

[4]The Department of Agriculture & Cooperation (DAC), Ministry of Agriculture, Govt. of India launched Kisan Call Centers on January 21, 2004 across the country to deliver extension services to the farming community via telephone call in services.

4. Conclusion

Agricultural information plays a crucial role in agricultural development as well as in improving the livelihoods of farmers. Agriculture information is dynamic, due to increased awareness of farmers of their needs. Farmers use a combination of formal and informal sources of information to secure information. More than 90% of farmers reported that they are accessing information from other farmers located in their own or neighboring villages. The farmers use multiple sources of information because no one source gives them complete information. They also do not completely trust any one source. Among all the surveyed farmers, 99% said they had access to mobile phones. However, only 1% indicated that they have access to agricultural information through the internet. In such a case, it is mainly for information on output prices. Overall lack of extension facilities and access to agricultural inputs are the major constraints that farmers face in fully utilizing the benefits of information.

Socioeconomic characteristics of farmers such as age, the level of education and farm size are significantly related to a farmer's decision to use different sources of agricultural information. Conventionally, farmers prefer to get information through other farmers or through face to face interaction rather than any other source. Estimates of age have had a negative effect. This is most likely because as age increases, a farmer's planning horizon shortens. This makes the farmer less likely to spend time and/or money searching for information about new technologies (Jenkins et al., 2011). Educated and resourceful farmers are more likely to adopt new methods of accessing information. They usually use traditional media and modern ICTs like mobile phones and internet for information. These results are supported from earlier studies that showed that rich and large farmers are able to benefit more from the information delivered through mobile phones (Abraham, 2008; Jensen, 2007; Mittal et al., 2010).

Use of ICT resources of information helps farmers be better informed. As a result, they benefit from better yields, reduced cost of production and better price realization (Abraham, 2008; Aker, 2008; Jensen, 2007; Mittal, Gandhi, & Tripathi, 2010). ICT plays a key complementary role in establishing a link to conventional information sources. This helps bridge the information gap.

This study is a representative sample of five states of India. It only surveyed farmers who were engaged in rice, wheat and maize cropping system. Consequently, results varied for states with more crop diversification, indicating that the need for information may be different. This study only accounted for the information sources, needs, and some estimates on impact of the use of mobile phones by farmers. These estimates are based on farmers' perspectives. A more detailed survey and analysis is required to systematically document the impact of modern ICT interventions.

The impact of modern ICTs as a mode of providing information for farming will depend on how mobile networks are able to link the farmers to all the required information in a timely and accurate manner. Overall, the successful use of information as a resource for development of agriculture depends to a large extent, on accessibility and adequacy of information mode as well as the attitude of farmers towards information and information sources. The real challenge is not only delivering information that is required, but also getting farmers to use that information

which is often constrained by issues related to markets, institutions, policies and resource availability. It is also reconfirmed from this study that mobile phones cannot substitute the existing face to face interaction modes and thus this mode of information delivery has to be complemented with existing information sources but it does play an important role in bridging the information gap.

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Appendices

Appendix 1: Survey area

State	District (villages)			
Bihar	Samstipur	East Champaran	Nawada	Bengusarai
	- Chakiaiwani	- Aniraulia	- Bajiour	- Bandwar
	- Digambra	- Bakri Mahesh	- Baliyari	- Hawaspur
	- Manda	- Kanchhedwa	- Dosut	- Jamaldipur
	- Rajhopur	- Kanthchapra	- Kajhiya	- Narepur
	- Sarai Ranjan	- Rajapur	- Kulna	- Pachamba
	- Udaipur	- Sonbarsa	- Rasanpur	- Rajapur
Haryana	Sonepat	Kurkshetra	Karnal	Yamuna Nagar
	- Barwasani	- Atwan	- Gudha	- Alhar
	- Gasauli	- Barwa	- Gumyana	- Barsan
	- Khanda	- Bilochpura	- Jaduli	- Jaidhara
	- Moi	- Mathana	- PremKhara	- Mahalawali
	- Rattangarh	- Megh Majara	- Rambha	- Sabapur
	- Silana	- Ratangarh	- Shahjanpur	- Sabilpurjatan
Punjab	Amritsar	Bhatinda	Ludhiyana	Sangrur
	- Ramdas	- Balhar Mehma	- Gurusar Kaunke	- Kanoi
	- Harar Kalan	- Kattar Singh Wala	- Rajgarh	- Ugrahan
	- Khayala Kalan	- Gehri Buttar	- Bhatha Dhua	- Nandgarh
	- Makhan Pura	- Mehma Sarja	- Gill	- Punhwa
	- Gaunsabad	- Ancorgarh Urf	- Allamgir	- Hareri
	- Mudhal	Machana	- Mehdoodan	- Daram Garah
		- Jodh Pur		
Uttar Pradesh	Barabanki	Deoria	Maharaj ganj	Meerut
	- Daultapur	- Bhatwatiwari	- Agya	- Behoampur
	- Jesusalmchak	- Kurmauli	- Bargadwa	- Bijoli
	- Kurauli	- Laxman chak	- Ekma	- Dhantalla
	- Mahmudabad	- Malhani	- Jamihani	- Latifpur
	- Safipur	- Piprachandra bhan	- Paraspandey	- Malipur
	- Sipahiya	- Sonda	- Pokharbind	- Tarapur
West Bengal	Murshidabad	Nadia	North Dinajpur	South Dinajpur
	- Amanigang	- Bhat Janla	- Chanditala	- Alipur
	- Belun	- Bhimpur	- Chapduar	- Bhatapara
	- Chandipur	- Fulkomli	- Chatrapur	- Bhawanipur
	- Dahapara	- Gobarpaota	- Galaisara	- Chakharina
	- Dangapara	- Kulgachi	- Khalsi	- Chingishpur
	- Goribagh	- Tetia	- Mirual	- Shivrampur

Appendix 2: Differences in different mode of information for agriculture services.

	Various Categories of Information Delivery		
Source of Information	**Face-to-face**	**Traditional media**	**Modern ICT**
	- Krishi Vigyan Kendra's - Research stations - State Agricultural Universities - Krishi Mela (Farmers fair) - State Department of Agriculture - NGO - Cooperatives - Commission agent/middle men/Mandi input dealers - Private companies, shops	- Television - Radio - Newspaper	- Landline (Tele-centers) - Mobile Phone - Internet Kiosk/Internet
Type of service provider	Government	Mostly Government	Mostly private
Information quantity	Restriction in volumes	Restriction in volumes	No restriction in volumes of information
Scale of Information Dissemination	One person at one time	Many person	Unlimited number of person can be covered in some cases, e.g. sending information via SMS
Content of information	Generic information	Generic information	Customized information and individual solutions
Information Flow Process	Two-way	One-way	Two-way
Adequacy of Information	Information not updated, not available on time	Not timely though reliable	Timely and reliable
Distance	Distance Restriction	In case of television distance restriction	No distance restriction
Literacy	No issue	Literacy for newspaper is an issue	Basic literacy for reading SMS, proper education for internet
Problems	Availability of Extension officer	Electricity Problem in case of television	Local content of SMS, farmers lack awareness and technical know-how to use. Infrastructure of kiosks a limitation

Source: Author's own compilation from CIMMYT survey, 2011

Appendix 3: Usefulness & timeliness of information to farmers from Different sources of information.

Source of information	Total farmers accessing information using this source	Useful			Timely		
		Yes	Some-what	No	Yes	Some-what	No
Face-to-Face							
KVKs/ Research Stations	109	103(94.5)	5	1	48(44.0)	9	52(47.7)
Krishi Mela	240	233(97.1)	2	5	68(28.3)	8	164(68.3)
State dept. of agriculture	297	279(93.9)	10	5	110(37.0)	41	143(48.1)
Input dealers/shops/private companies	812	735(90.5)	72	4	643(79.2)	136(16.7)	31
Commission agent/Mandi	62	61(98.4)	1	0	27(43.5)	3	31(50.0)
Cooperatives	277	262(94.6)	10	4	112(40.4)	26	138(49.8)
Other farmers							
Other farmers	1097	925(84.3)	169	3	975(88.9)	89	17
Traditional Media							
Television	657	614(93.5)	38	1	278(42.3)	145	230(35.0)
Radio	244	216(88.5)	23	1	158(64.8)	30	52(21.3)
News paper	397	368(92.7)	25	2	234(58.9)	42	119(30.0)
Modern ICT							
Mobile Phone	429	388(91.4)	33	2	378(88.1)	29	15

Note: Figures in parenthesis show the percentage of farmer's response.

Appendix 4: Reasons for choosing a particular source of information.

Source of information	Total farmers accessing information using this source	Reason for accessing information			
		Source nearby	Good quality	Timely available	Only source available
Face-to-Face					
KVKs/ Research Stations	109	29	60	16	16
Krishi Mela	240	82	184	11	15
State dept. of agriculture	297	100	174	30	58
Input dealers/shops/ private companies	812	410	256	321	80
Commission agent/Mandi	62	16	13	10	31
Cooperatives	277	134	149	14	49
Other farmers					
Other farmers	1097	884	281	272	48
Traditional Media					
Television	657	380	245	81	71
Radio	244	120	93	19	20
News paper	397	229	75	113	46
Modern ICT					
Mobile Phone	429	108	94	273	12

Appendix 5: Grouping according to different activities and different phases in production cycle.

Different phases in production cycle	Information need
Pre-sowing	Soil quality, land preparation/farm practices, seed variety, crop choice
Input availability	Seed, fertilizer, machinery, labor, pesticides, weedicides/herbicides
Input prices	Seed prices, fertilizer price, pesticide price, weedicides/herbicides price, implements price
Sowing	Application of inputs, irrigation, rainfall forecasting, temperature, electricity
Agronomic Information	Best farm management practices
Harvesting	Machinery and best practice method
Packaging and storing	Cold storage facility, packing and storing
Marketing	Prices for output, best market

Appendix 6: Information needs across states and major crops.

State	Information need	% of the farmers who responded		
		Wheat	Rice	Maize^
Bihar	Pre-sowing	7.7	19.4	21.2
	Input supply	28.6	17.8	17.8
	Input prices	27.3	21.2	18.9
	Sowing	17.3	19.2	11.5
	Agronomy and farm practices	5.4	6.8	11.3
	Harvesting	0.7	0.7	1.0
	Packaging and storing	10.1	11.8	14.4
	Marketing	2.8	3.1	4.0
Haryana	Pre-sowing	24.4	28.5	
	Input supply	44.3	35.4	
	Input prices	5.6	5.2	
	Sowing	10.0	10.7	
	Agronomy and farm practices	1.7	4.2	
	Harvesting	0.7	0.8	
	Packaging and storing	13.1	14.9	
	Marketing	0.2	0.4	
Punjab	Pre sowing	42.6	19.0	
	Input supply	27.9	30.9	
	Input prices	1.6	5.3	
	Sowing	6.9	14.3	
	Agronomy and farm practices	13.0	16.8	
	Harvesting	6.8	12.1	
	Packaging and storing	1.2	1.7	
	Marketing	0.0	0.0	
Uttar Pradesh	Pre-sowing	10.7	7.2	10.0
	Input supply	53.5	51.1	45.0
	Input prices	17.7	18.8	22.5
	Sowing	10.7	10.7	10.0
	Agronomy and farm practices	4.3	9.6	8.8
	Harvesting	0.5	1.9	0.0
	Packaging and storing	2.5	0.6	3.8
	Marketing	0.1	0.1	0.0
West Bengal	Pre-sowing	23.1	25.1	27.9
	Input supply	36.0	33.1	25.2
	Input prices	9.2	7.2	6.3
	Sowing	24.7	17.7	19.8
	Agronomy and farm practices	4.4	12.2	10.8
	Harvesting	1.6	0.4	6.3
	Packaging and storing	1.1	4.2	3.6
	Marketing	0.0	0.1	0.0

Note: ^ the surveyed farmers belonging to Punjab and Haryana are not producing maize, so they have not mentioned their needs requirement for rice and wheat only.

Appendix 7: Constraints face by farmers in states of IGP in utilizing the benefits of information.

Constraint in utilizing information	Bihar	Haryana	Punjab	Uttar Pradesh	West Bengal
	Weighted average number of farmers*				
Poor extension facility	169.5(70.6)	19.0(7.9)	137.2(57.1)	119.5(49.9)	154.3(64.3)
Inappropriate availability of quality inputs (seed, pesticides and fertilizers	3.5(1.5)	120.0(50.0)	13.5(5.6)	72.6(30.3)	16.6(6.9)
Poor access to electricity and irrigation facility	57.6(24.0)	27.9(11.6)	8.0(3.3)	15.9(6.7)	12.7(5.3)
Shortage of labor	-	53.0(22.1)	2.33(1.0)	7.0(2.9)	4.3(1.8)
Poor or no access to soil water testing facilities	2.0(0.8)	8.6(3.6)	-	1.2(0.5)	12.9(5.4)
Poor access to markets	2.0(0.8)	0.5(0.2)		7.8(3.3)	9.4(3.9)
Others issues**	0.33(0.1)	4.7(1.9)	-	12.9(5.4)	0.5(0.2)
Inadequate crop storage	-	2.5(1.0)	-	-	0.3(0.1)
No problem	-	3(1.2)	78.0(32.5)	2.0(1.0)	13.0(5.4)
No need of Information or no response	5.0(2.1)	1.0(1.4)	1.0 (0.4)	-	16.0(16.7)

Note: *: Number of respondents is weighted by the number of constraints highlighted by respondents with three being maximum constraints. E.g. If a farmer has listed three most important constant then each constraint is given a weight of 0.33 and if one farmer has listed only one constraint as the most important then that is given a weight as 1.

**Other issues include sabotage by herds of animals, floods, fire etc

Figures in parenthesis are percentage of farmers.