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INFORMATION SEEKING BY AGRICULTURAL HOUSEHOLDS IN INDIA: DETERMINANTS OF ACCESS AND CHOICE OF SOURCES

ARITRI CHAKRAVARTY

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CENTRE FOR DEVELOPMENT STUDIES
(Under the aegis of Govt. of Kerala & Indian Council of Social Science Research)
Thiruvananthapuram, Kerala, India

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ABSTRACT

This paper attempts to understand the factors that explain an agricultural household's decision to access information as well as its choice of information source(s) in India. Cross sectional data from the 70th Round of NSSO on Situation Assessment Survey of Agricultural Households in India (2012-13) is utilised for this study. Simple and multinomial logistic regression models are employed to find the drivers of household decisions about information seeking. Results show that households with cultivation as the main source of income with larger consumption expenditure, land holdings, cropping area, irrigated land, a greater number of farmers, better educated (head of household) belonging to upper social group and aware of market policies have a higher probability of accessing information. Multinomial analyses to determine the choice and number of sources of information accessed show that households prefer private and media sources to public sources.Households with higher educated heads and households belonging to well-endowed social groups prefer media sources or a combination of media and public/private sources while poorer households prefer private sources of information. Also, richer households with better education, more formal loans, land, larger proportion of irrigated land and belonging to the uppermost social group have a higher probability of accessing multiple sources.

Keywords: Agriculture, Information, Decision-making, Multinomial logit analysis, Socio-economic characteristics

JEL classification codes: Q12, D81

1. Introduction

A key concern for Indian policy makers has been to develop technology and channelize information to farmers to achieve better farm outcomes. The formal agricultural extension program has been one ofthe major initiatives of the government to disseminate necessary information and knowledge to the farmers. In India, the public extension system has been in place since independence to bring farmers closer to modern agricultural practices. India's 10th and 11th five-year plans emphasized strengthening agricultural extension as a means to increase agricultural growth by reducing the yield gap in agricultural fields (Planning Commission, 2005 and 2006). However, a major problem in information dissemination is its limited and uneven coverage (Glendenning et al. 2010). Thishuge information asymmetryprevails in almost every stage of the agricultural supply chain in developing countries inducing inefficiencies across the chain (Eggleston, Jensen and Zeckhauser, 2001; Ravallion, 1986; Aker 2011).Further, heterogeneity in farmers' characteristics in terms of land, social and economic status complicates the need and use of information (Adhiguru 2009, Adhiguru and Mruthyunjaya, 2004; Rao, 2006 and Birthal etal., 2015) on the demand side. India like other developing countries, also faces similar issues (Gollakota, 2008).

In India, public extension system has been facing several hurdles in achieving its targets and to overcome these problems policy makers introduced pluralistic extension involving private agents and consequently developed demand-driven, farmers' need-based extension

to address the heterogeneity in information requirement. One of the ways for better outreach of extension is Agricultural Technology Management Agency (ATMA), a pluralistic, demand-driven (bottom-up) initiative by the government introduced in 2005. It aims at decentralised information dissemination to help increase farmers' inputs into programme planning and resource allocation and to increase programme coordination and integration for sustainable and profitable farming. Despite all efforts, the reach of technology and related information remains limited. The 70th Round of NSSO (2012-13) on Situation of Agricultural Households reports that over the last ten years, share of agricultural households accessing information for the purpose of cultivation has stagnated at 41 per cent. This paper empirically explores the reasons for the low and stagnating share of rural households in accessing information for cultivation in India. It tries to identify the factors that determine access to information and the preference for various sources of information.

There are several studies on understanding information-seeking behaviour of agricultural households in India but they are mostly limited geographically to a group of villages or districts or to specific information sources. Recently, Birthal etal. (2015) has estimated the impact of information use on farm returns using data from the 59th Round of NSSO (Situation Assessment Survey of Farmers, 2002-03) and found that users of information realise 12 percent higher net returns than non-users. However, access to information remains low at 41 percent and has not changed in a decade from 2002-03 to 2012-13 (NSSO 2005, 2014). From a policy perspective, it is important to identify the major bottlenecks ailing the agricultural sector in terms of accessing and using information. This is the first step towards better outreach of agricultural extension. Once the major hurdles are identified, policies can then be calibrated at the local level to suit the needs specific to different types of regions or crops. The point of concern here is to find why households are not accessing information even though it is found to be useful and

beneficial. In other words, what are the factors impeding farmers from accessing information when it is available. This paper tries to address this issue by exploring the information seeking behaviour of Indian farmers in accessing information. The objective is to identify systematic differences in household's access to information as well as preferences of sources for the country as a whole.

Thus, this paper explores the demand side factors that determine access to information subject to its availability by analysing the information seeking pattern of agricultural households across the country using the 70th Round of NSSO data. It also tries to analyse the differences in their choices of information sources as well as their decision to simultaneous access from different sources.

The study finds that access to information is skewed in favour of households with advantageous socio-economic characteristics as well as households with educated heads. These households also access from multiple sources. Access varies across sources; progressive farmers and media (ICTs) rank in the top while public sources (especially *Krishi Vigyan Kendra* and agricultural universities) and NGOs are accessed by few. Having given a brief background about the study in this section, section 2 discusses the analytical framework. Section 3 broadly covers the data and lays out the scheme of the method of analysis. Sections 4 and 5 discuss the empirical models used here. Each section discusses the method of analysis, descriptive statistics and results in detail as separate sub-sections. Section 6 summarises the result and makes some concluding remarks.

2. A Brief Review of Existing Studies

Schultz (1968) points out that modern inputs and high skills are complementary in agricultural production and over time tend to substitute for traditional agricultural inputs. He further says that the differences in the supply of high skills and complementary modern

physical inputs are a major cause of differences between developed and developing countries in agricultural production. Thus, adoption of information requires both the availability of relevant information and the capability of the decision-maker to understand it properly. Hence, it is important to understand the information-seeking behaviour of farmers.

Here we discuss how scholars have approached the issue of information seeking by farmers/ farming households, mainly by focussing on studies examining the factors determining farmers' decision to acquire information (technical advice) for cultivation. Diekmann et al.(2009) find that there are mainly threereasons that motivate information search. One is to look for information that helps in some transaction like buying land; another is to develop or improve one's expertise and knowledge for potential benefit in the future and the last is the psychological satisfaction associated with the process of searching itself. Farmers' search and use of information have been extensively studied for many years. Studies that have tried to identify the factors that determine a farmer's or agricultural household's decision to seek information have either formulated theoretical models or empirical analysis to identify these factors. Assuming that information is available, search of information hinges on two main factors. First isattitude towards risk (since new technology entails risk) captured by unobservable psychological factors and observable farm and farmer (socio-economic and demographic) characteristics. The second is human capital that leads to higher returns through better comprehension and utilisation of technology/information.The relevant studies are discussed below.

Attitude towards Risk

The decision to acquire information is largely governed by individual's attitude towards risk. Byerlee and Anderson (1982) find that the degree of risk aversion may have important effects on the value attached to the information but may not be positively correlated since the decision to acquire new information also entails risks. Newer

information might not reduce variance/risk and thus prevent a farmer to acquire newer information even when it seems that the monetary returns are apparently higher than the cost. They tested this on Australian farmers' decision to reserve fodder for livestock production under drought situation in the presence of information on rainfall forecasts. This is also supported by Blair and Romano (1988). They built a model comparing the relative value attributed to forecasting by risk-neutral people and risk-averse individuals. They find that even though perfect forecasting will lead to higher mean profit, it might also lead to higher randomness which a risk-averse farmer will not be willing to undertake. In the presence of imperfect forecasting, they show using an example that imperfect information induces adjustments in choice variables in response to the new information which can, in turn, make the variability of profits higher than without the forecast information and hence risk averse individuals, again, might attribute less value to forecast than risk-neutral individuals.

Farm Characteristics

Farm size is an important factor in influencing the attitude towards search and use of information and also in selecting the sources [Ford and Babb (1989), Ortmann et al. (1993), Schnitkey (1993), and Foltz et al. (1996)]. It is a reflection of the economic status of the farmer and influences the decision to access information (Solano et al. 2003; Alvarez and Nuthall 2006; Llewellyn 2007), Feder and Slade (1984) postulate that larger farmers are likely to allocate more resources to information acquisition and will, therefore, possess higher levels of cumulative information at any given period, ceteris paribus. Using 59th round of NSSO data Adhiguru et al. (2009) found that small and marginal farmers accessed less information and from fewer sources as compared to large and medium farmers. This finding is also supported by Birthal et al. (2015) using the same data. Small and large farmers also have differential preference and access to information sources (Singh,1983; Karippai

et al., 1995; Adhiguru et al., 2009). Carter and Batte 1993, Schnitkey et al. (1992) and Ortmann et al. (1993) found that the farm's use of information and attitudes toward different information sources varied by enterprise type, that is, the business orientation of the farmer. Ownership of farm was also found to be an important factor (Ngathou et al., 2006).

Information needs can vary across the type of crops grown. The hypothesis is that farmers growing high-return non-food crops that involve higher risks would access information more than farmers growing food-crops only. Again, poorer farmers growing subsistence crops may also seek information to avoid crop failure and/or starvation. In other words, risk-averse farmers would seek more information provided they have the capability and resources to access it.

Socio-economic and Demographic Characteristics

Ethnicity, gender, socio-economic status, and power relations determine access to information and resources (Hoang et al., 2006) Lowcaste, education, or income constitute a substantial impediment in access, use, and affordability of media and communication (Blattman, 2003). Some of the prominent observable socio-economic variables are discussed in this section. **Age** and **experience** are important factors determining access to and use of information (Carter and Batte 1993). Schnitkey et al. (1992) argue that age is related to farming experience, and that farmers with more experience should have less demand for external information. This finding is also supported by Ford and Babb (1989) and Schintkey et al. (1992). Usually, older farmers are less likely to explore new sources of information and thus more likely to substitute search with their experience (Babu etal., 2011). Ngathouet al.(2006) argue that older farmers may find the cost of information gathering less desirable than younger farmers but also acknowledge that its influence varies across sources. However, the direction of influence is often ambiguous. For example, the NSSO data on both 59th and 70th Round show that older farmers access more information. However, Meera et al.,

(2004) find that access and use of information is skewed in favour of younger people. Some studies by Pompelli et al. (1997), Foltz et al. (1996), and Ortmann et al. (1993) in the context of U.S. farmers find age as statistically non-significant.

Caste, captured by **social groups**, plays a pivotal role in shaping social capital and determining several outcomes in the India. (Deshpande, 2001). It is an important indicator of social hierarchy in India (Anderson, 2011, Deshpande, 2001). Access to and use of information is also differentiated by social identity (Birthal et al., 2015). The social categories used here are scheduled castes (SCs) and scheduled tribes (STs) at the bottom, followed by other backward castes and upper castes. Batte and Arnholt (2003) and Ali (2012) show that early adopters of innovations (and hence, early access) usually belong to the higher socio-economic strata. Primary occupation of the farmer also influences the decision to access information.

Gender, like other social variables can also influence several outcomes. For example, in rural India especially, data shows that females have lower levels of education than males (Census, 2011). They also have less or no autonomy in household decisions. Some argue women are more risk averse than men and hence their decisions and searching patterns are different from those of men (Doss and Morris, 2003). In the studies discussed here, even though gender may not turn out to be statistically significant in some, males have a higher share in accessing and using information, especially in the developing countries in Asia and Africa (Aker, 2011; Mittal et al., 2010, Meera et al., 2004, Doss and Morris, 2003). The 59th and 70th Rounds of NSSO on Situation of Agricultural Households (Schedule 33) also show that female headed households access and useless information than males.

Household decisions with respect to labour requirement can be influenced by the number of family members. If a new information/ technology embodies labour intensive technique or labour involvement

of some sort, then the decision to access and/or use labour might be influenced by the labour availability in a household (Doss and Morris, 2001). Thus, **household size**, a reflection of the amount of family labour available, can be a determinant of access to and use of information.

Also, **geographical factors** like proximity to market centres (Solano et al. 2003) and nearest technological adopter (Llewellyn 2007, Birthal, et al., 2015) can also influence access to information. Weather, climate and topography guide the crops grown in any region and thus influence the cropping pattern. Different crops might require different types and levels of information and hence, may lead to different access to information. Farmers might access lesser information to grow relatively less risky food crops as compared to high risk-high return cash crops. It is found from the NSSO data on Situation Assessment Survey of Farmers, 59th and 70th Rounds (2005, 2014) that food crop growers have a lower rate of access than non-food crop growers.

Human Capital

The reduction in uncertainty is contingent upon information acquisition (Stiglitz, 1985) and the ability to process and use information varies across individuals resulting in different outcomes (Simon, 1959). Variability in human capital can lead to variability in performance under uncertainty where human capital is determined by an individual's educationand experience (Schultz, 1975, Simon, 1957, Schnitkey et al. 1992 Huffman, 1977; Rahm and Huffman, 1984, Ali, 2012 and Birthal 2015). It follows from here that information acquirers/users are heterogeneous in nature and this trait is captured in the study by Just et al.(2002) where they develop a model to show that demand for information from different sources is shaped by an individual's functional role in the production chain and human capital constraints. They propose that individuals with higher human capital tend to access and use information that is more human capital intensive like data, formal and public information in this case.

Feder and Slade (1984) highlight the role of active information accumulation by developing a model of diffusion of a new technology involving a variable input. They specify a Constant Return to Scale (CRS) production function for a farmer at a given point of time where output is a function of land, a new variable input (associated with the new technology) and knowledge which has two parts – general and specific to the new input. They distinguish information gathering as passive which takes place by listening to discussions among other farmers and/or looking at neighbours and active gathering of information, which entails costs in terms of time, cash or both. Rice cultivators in two districts were asked about their awareness or knowledge of two improved practices – seed treatment and use of zinc sulphate. Their probability of knowing them was estimated as a function of human capital (captured by years of schooling and their score in a simple numeracy test), farm size and access to information (captured by visits by extension agents) using a logit model. A district dummy was used since climatic conditions in the two were different. All these parameters came out to be significant for both the treatments supporting the hypotheses that farm size, education and extension agents are positively and significantly related to knowledge. Farmers with easier access to information or better endowments of human capital will also acquire higher levels of knowledge.

Source(s) of Information

Households' choice of the source(s) to be accessed is governed by similar factors on the demand side. Farmers are not a homogenous group and their information needs might vary substantially. Majority of the farmers are marginal and small but they are mostly outside the ambit of public extension which is often criticised for being biased against them (Adhiguru et al., 2009). Lack of proper funds often lead to inefficiencies (Sulaiman and Van de Ban, 2003). Anderson (2008) notes that public extension is generally understaffed and is often maligned with lack of

motivation, competence, performance, and accountability. Even when information on cultivation is available, it does not reach all the farmers.

On the other hand, role of social capital in sharing and using information has especially gained its importance in this context following the seminal work of Putnam in 1993 (Glaeser et al., 2002). Progressive farmer stend to accumulate higher social capital because of their greater proclivity towards gaining memberships in farmers' associations and clubs, which are, in turn, likely to increase their access to latest information. This might be a reason for their popularity as a channel of disseminating information. Farmers' interactions with input dealers, extension agents, other farmers as well as their connection with government officers can be captured by their level of social capital and could help in understanding farmers' information-seeking behaviour.

Many scholars have tried to empirically test the relation between farm/farmer characteristics and their choice of sources in accessing information using multinomial or multivariate empirical tools. They found that preferences of information sources were determined by farm size, computer use (Shnitkey et al., 1992), operator's age, (Shnitkey etal., 1992, Jenkins et al. 2011 and Velandie et al., 2011) and farm sales, years in farming, internet access (Diekman, 2009), farm type (Shnitkey et al., 1992, Diekman and Batte, 2009), education (Just et al, 2002 and Jenkins et al. 2011), income (Jenkins et al. 2011 and Velandie etal., 2011), land tenure, location and percentage of income from farming (Velandie et al., 2011). Birthal et al. (2015) also find that farmers with larger farms and those from forward social groups use information from multiple sources, but more from mass media. Below we highlight some important studies relevant to the choice of information sources by farmers.

The literature alludes to several socio-economic, demographic and psychological factors in explaining farmers difference in their information Further, the existing studies show, irrespective of national differences, that educated and wealthier farmers with large land holdings

tend to access information and from multiple sources which are more human-capital intensive. In general, poor farmers tend to rely more on interpersonal communication as the main source of information.

Thus, existing studies on information seeking behaviour of agricultural households in India are mostly limited geographically or to specific information sources. Recently, Birthal et al. (2015) have estimated the impact of information use on farm returns using the 59th Round of NSSO but did not look specifically into the determinants of information access. Hence, the point of concern here is to find why households are not accessing information even though they report it to be useful and beneficial. This paper tries to bridge the existing gaps by exploring the information seeking pattern of agricultural households across the country using the 70th Round of NSSO data and analyse differences in their choices of information sources as well as their decision to simultaneous access from different sources.

3. Data

The objective is to understand access to information, its simultaneity in access and variability across sources. To do so, two empirical models are used. Each model is discussed separately in sections 4 and 5 respectively. However, before moving to the models I will briefly discuss about the data. The main data source is from Situation Assessment Survey of Agricultural Households, 70th Round of NSSO conducted from January 2013 to December 2013 to survey the agricultural year 2012-13 in two halves, July to December, 2012 and January to June,2013. The survey extensively covers information on socio-economic characteristics of households, demographic characteristics, market awareness of cultivators, crops grown by them and the corresponding expenses and returns from cultivation. It also asks the households if they have accessed/used information for the sole purpose of cultivation in that period.

The survey asked each household about accessing and/or using *technical advice* for the purpose of cultivation. Information here is used synonymously with *technical advice*.[1] It defines information as *technical advice* and identifies eight sources of its dissemination – Extension Agent, *Krishi Vigyan Kendra* (KVK), Agricultural University/ College, Private Commercial Agents, Progressive Farmer, Radio/TV/ Newspaper/Internet (ICT), Veterinary Department and NGO[2]. It also records the reasons for not accessing and adopting information and whether the advice was *useful* and *beneficial*. However, the survey does not detail out what type of *technical advice* has been sought or given. This is a major limitation in identifying the nature of information sought by farmers for policy purposes.

The survey was conducted only for rural households covering 35,200 households across all the states and Union Territories. Out of those 30, 521 households responded to the question on information accessed/used for cultivation purposes. Of the 30,521 households, 13,344 (44 percent) of the households reported accessing information from at least one of the sources. The remaining 17, 177 (56 percent) households were asked to cite one of four reasons for not accessing information – *not available, not aware*, *not required* and *others*. 3938 (23 percent) households reported *unavailable*, 4758 (28 percent) reported *not aware*, 3237 (19 percent) households and 329 households (2 percent) answered *not required* and *others* respectively. The remaining 28 percent reported a combination of above four reasons for not accessing information.

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1 Block 14 of Schedule 33, NSSO 70th Round records data on information accessed and adopted/used for any of the crops grown by each household.

2 According to this classification by NSSO, the first three sources along with Veterinary Department come under public source; Radio/TV/Newspaper/ Internet can be clubbed under media sources and the rest as private sources.

4. Determinants of Access to Information

As already mentioned, 44 percent of the households accessed information. 23 percent of those households not accessing information equivalent to 13 percent of the total sample households, report it is due to unavailability. Since some of the households cannot access information due to its unavailability, treating them same as the households that have not accessed information (when it was available) might lead to a sample selection bias[3]. Hence, there is an entry condition, availability, which is given by equation 2 below. After that only we can estimate the factors determining access to information (equation 1). Thus, the error terms in equations 1 and 2 may be correlated owing to unobservable factors that influence both availability and access, which may lead to sample selection bias. Hence, using a simple logit/probit model lead to inconsistent parameter estimates. Again, dropping these households from our analysis might lead to loss of important information. Thus, we use a two-step Heckman selection model to correct for potential endogeneity from sample selection bias and estimate the determinants of access. The model is described below.

4.1 The Model

The outcome equation is specified as a probit model as follows.

$$P_i = \text{Prob}\,(\text{access}_i = 1|X_i) = F(X_i'\beta) \qquad (1)$$

F is the cumulative distribution function (cdf) of a standard normal which follows from the distribution of the error term ***u*** in the latent equation.[4]

X_i is the vector of explanatory variables (discussed below) and β is the corresponding vector of parameters including the constant. *i* denotes the unit of observation, household.

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3 For details see Heckman, 1976; 1979

4 Prob(access=1)=Prob ($y^*=X'\beta + u > 0$) = Prob ($-u < X'\beta$) = $F(X'\beta)$ where y^* is the latent variable

The outcome, access, can be observed only if information is available. This is the selection condition and the selection equation is given by equation 2. Access to information for the i^{th} individual is observed only if it is available. Thus, in the first step we are separating the households that did not access information because of unavailability to account for the unobservable factors that may predict both availability and access.

$$\text{Availability}_i = Z_i'\gamma + \varepsilon_i > 0 \quad (2)$$

Z_i is again the vector of explanatory variables and γ is the corresponding the vector of parameters including the constant. The random error terms in both equation 1 and 2 are assumed to be normally distributed and are expressed below.

$$u_i \sim N(0, 1)$$

$$\varepsilon_i \sim N(0,1)$$

$$\text{Corr}(u_i, \varepsilon_i) = \rho$$

The presence of sample selection bias is indicated by the correlation between the error terms of equations 1 and 2. If the correlation coefficient of the error terms, ρ, is zero it means that the log likelihood for the probit model with sample selection is equal to the sum of the probit model for the outcome (access) and the selection (availability) model. This means that the selection equation and the outcome equation are independent and hence, can be run separately. However, in our model, the Wald test of independent equations show that the value ρ is significantly different from 0 as shown at the end of Table 6. Hence, instead of a simple probit model I have used probit model with sample selection.

The potential explanatory variables have been identified from existing studies as discussed in the literature. These are either continuous or categorical in nature. It is to be noted that the selection model should

have at least one explanatory variable that does not affect the outcome equation. This is the exclusion restriction. Here I use two exclusion restrictions. The first is proportion of households reporting availability of information in a village. A variable capturing the proportion of households in a village reporting availability of information is constructed. It is expected that this variable will have a positive influence on the total number of households availing information at the village level and simultaneously not affect access directly but through the selection variable. The second is an interaction between the agricultural zone and state dummy. Since availability of information is also a supply-side factor and agriculture comes under the purview of the state, we use a state dummy to capture political and state-related factors that potentially influence availability and interact it with agricultural zone to control for agro climatic variability that might affect availability. Table 1 notes the explanatory and exclusion variables. The total observation after removing the outliers is 30,338.

Table 1: Descriptive statistics (mean/proportion) of the Explanatory Variables

Explanatory Variables	Sample Mean/ Proportion
Land Owned: hectares	1.5*
Cultivation as primary source of income: percent	65
Male headed households: percent	92
Age of farmers in a household: years	50.6*
Square of age of farmers in a household: years^2	2751*
Farmers in a household: persons	2*
Education Level Attained by Head of Household	
Illiterate: percent (Base)	34
Primary and Below: percent	26.5
Middle: percent	16

Cont'd.....

Secondary: percent	11.5
Above secondary: percent	11
Social Category	
Scheduled caste: percent	19
Scheduled tribes: percent (Base)	13
Other backward classes: percent	40
Others: percent	28
Food Crop: percent (Base)	50
Non-Food Crop or Mixed: percent	50
Households involved in MGNREGA: percent	45
Proportion of households reporting availability of information in a village	0.8
Agroclimatic Zone Dummies	15^
State Dummies	36^
No. of observations	30,338

Unless otherwise mentioned, the figures in the second column are proportions which are expressed as percentages. For variables with multiple categories the percentages represent the share of the particular characteristic in the respective category that accessed information.

* denotes sample mean, ^ denotes total number of agro climatic zones and states in India.

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).

Possessing MGNREGA card is an indication of alternate source of income for the household. Since information or its application can be costly, households with alternate sources of income might be better at supporting that cost of accessing and using information. Moreover, interpersonal interaction of the MGNREGA workers at job site might lead to higher awareness and increase the chances of accessing information. Thus, it is expected that households with NREGA card will potentially have higher access than households without.

4.2 Results

4.2.1 Profile of households

A preliminary comparison of some important characteristics of households accessing and not accessing information reveals interesting insights. Table 2 shows the difference in means and proportions of selected characteristics of households that have accessed and not accessed in the sample. Households accessing information have better socio-economic conditions, higher education levels and belong to upper social groups. They are mainly male headed households with fewer proportion of female farmers and with older head of household. These households also have larger gross cropped area, with more land under irrigation, higher returns from agriculture and growing non-food crops or a combination of food and non-food crops. They are also more informed about market policies and have higher loans as well as greater proportion of formal loans.

Table 2: Comparison of some salient characteristics between households accessing and not accessing information

Characteristics	(1) Accessed	(2) Did not Access	Difference in Means (1-2)
Socio Economic characteristics			
Land Owned: hectares	1.8	1.4	0.4***
Cultivation as primary source of income: percent	78.4	76.2	2.2**
Male headed households: percent	94.2	92.0	2.2***
Age of farmers in a household: years	50.2	47.6	2.6***
Farmers in a household: percent	47.1	42.7	4.4***
Female farmers in a household: percent	3.9	6.2	-2.3***
Educational attainment of the head of household: percent			
Illiterate	28.1	36.2	-8.1***
Primary and Below	26.4	27.5	-1.1**

Cont'd.....

Middle	17.5	15.9	1.6***
Secondary	13.6	10.4	3.2***
Above secondary	14.4	10.0	4.4***
Social Group: percent			
Scheduled caste	10.3	12.4	-2.1***
Scheduled tribe's	15.1	24.7	-9.6***
Other backward classes	42.5	36.9	5.6***
Others	32.1	26.0	6.1***
Farm Characteristics			
Gross cropped area: hectares	1.6	1.1	0.5***
Area irrigated: percent	53	48	5***
Net return from farming (Rs.)	53419	29938	23481***
Food Crop: percent	43	54	-11***
Market and policy awareness[5]			
Minimum support price: percent	31.4	16.5	14.9***
Insurance: percent	8	4.2	3.8***
Total loan (Rs.)	93673	48813	44860***
Formal Credit: percent	57.1	48.1	9.0***
No. of observations	13344 (44%)	17,177 (56 %)	

*, **, *** represents significance at 10, 5 and 1 percent respectively

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).

4.2.2 Regression Results

The above descriptive statistics show that households' decision to access information and socio-economic characteristics like social group, education and land holding are not independent. To establish

5 Awareness of MSP and crop insurance are related access to information. Also, loans (both total and formal) can be incurred to access information. Hence these variables can have a reverse relationship with access and to avoid the endogeneity from reverse causality, these are dropped in the regression.

the causation, we need to run a regression which would also control for all the potential factors influencing access to information and help us infer the influence of these socio-economic variables on access to information. To do so, I run a probit regression using a Heckman type selection model as discussed above. The regression results are presented in Table 3. The correlation between the error terms of the selection and outcome equation, rho, is -0.44 and the Wald test of independence rejects the null hypothesis (rho=0) at 1percent level of significance. This implies an existence of unobservable factors influencing both the equations and the coefficients obtained otherwise would have been biased owing to sample selection. This justifies the use of the Heckman selection model.

The coefficients in Table 3 are robust estimates where the standard errors are clustered over 4634 villages. All the socio-economic factors significantly explain the probability of access in the expected direction. The probability of access increases with rise in education level and social category as compared to the respective base categories. Households possessing more land with cultivation as the primary source of income, more farmers and belonging to higher social categories have a higher probability of accessing information. Again, households where the head is male, older and more educated access more information. However, after the age of 62, the probability of access reduces as shown by the negative coefficient of square of age in Table 3. The inflexion point is at 62 years. Information is also accessed more by households that have a larger cropping area and also grow a mix of food and non-food crops as compared to growing only food crops.

It is found that access to information is skewed in favour of the well-endowed and socially better households. The share of illiterate or less educated farmers as well as marginal and small farmers is highest in the sample and they are the ones with least access to information. Thus, socio-economic and demographic conditions have a significant role in shaping farmers' access to information in India.

Table 3: Regression results of Probit Model with Selection

	Outcome Equation Coefficient	Selection Equation Coefficient
Dependent Variable	Access Base=no access	Availability Base=unavailable
Socio-economic Characteristics		
Total Household Land	0.065*** (0.007)	0.043***(0.009)
Gender of head of household (Base=Male)	-0.114***(0.033)	0.005 (0.041)
Age of head of household	0.012***(0.004)	0.009*(0.005)
Square of age of head of household	-0.00009*** (0.00004)	0.00007 (0.00005)
Number of farmers per household	0.023***(0.008)	-0.006(0.010)
Main source of income (Base=Cultivation)	-0.106*** (0.026)	0.076**(0.034)
MGNREGA Job Card (Base=Yes)	0.04 (0.026)	0.106*** (0.034)
Social Group (Base=ST)		
SC	0.131** (0.052)	0.167**(0.065)
OBC	0.254***(0.045)	0.177***(0.055)
General	0.216***(0.049)	0.1534**(0.056)
Educational Attainment of Head of Household (Base=Illiterate)		
Primary and below	0.108***(0.025)	0.029(0.030)
Middle	0.180***(0.030)	0.108***(0.036)
Secondary	0.236***(0.034)	0.099**(0.044)
Higher Secondary and above	0.292***(0.036)	0.127***(0.037)
Type of crops grown (Base=Non-food crop)		
Food crop (or both)	-0.156*** (0.028)	-0.157*** (0.037)
Constant	-0.461 (0.136)	-0.67***(0.196)
Exclusion Restriction		1.956*** (0.090)
Agricultural zones Fixed Effects	Yes	Yes
State Fixed Effects	No	Yes
State x Agricultural Zone	No	Yes
Rho	-0.44*** (0.086)	
Correlation between exclusion variable and outcome variable		0.13
Total Observations	30,338	
Selected = 26,420; Non-selected = 3,918		
Wald chi 2(29) = 520.17, Prob> chi2 = 0.00, Log pseudo likelihood = -26852.38		

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).
Village wise clustered standard errors in parentheses (adjusted for 4,364 clusters in village)

*** p<0.01, ** p<0.05, * p<0.1

5. Determinants of the Type of Information Source(s) Accessed

After exploring the factors that influence access to information, this section moves on to find the variability of access across different sources of information. Out of the eight sources identified by NSSO, media (radio/TV/newspaper/internet) and progressive farmers have the highest rate of access at 32 and 26 percent respectively (Table 4). Veterinary department ranks third in access at 11 percent. NGOs and agricultural universities/colleges have the lowest access rate at 1.5 and 2 percent respectively followed by *Krishi Vigyan Kendras* (KVKs) and private commercial agents, both accessed by less than 10 percent. Table 4 reports the percentage of households accessing information from each source and the share of each source in access (column percentage) is given in the parentheses. For example, 8 percent of total households surveyed have accessed information from extension agents which forms 10.5 percent of the total households accessing information.

Table 4: Access to Information from various Sources

Information Sources	Frequency	Percent
Extension Agent	2412	8 (10.5)
KrishiVigyan Kendra	1311	4 (6)
Agricultural University/College	564	2 (2)
Veterinary Department	3224	11 (14)
Private Commercial Agents	1867	6 (8)
Progressive Farmers	5963	20 (26)
Radio/TV/Newspaper/Internet (Media)	7244	24 (32)
NGO	355	1 (1.5)
Any Source	13344	44 (100)

The figures in the last column represent the percentage of households accessing information from each category and figures in parentheses denote percentage share of each category in total number of sample households.

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).

Here, the reasons for this variability in access is studied. To do so, these 8 sources are further categorised into three groups– government, private and media. It is to be noted that this categorisation should not be confused with the main source of information, the public extension system. In India, information is generated or outsourced primarily by government. However, the same is disseminated through several channels which may or may not be government. Based on NSSO, three main channels of dissemination are identified – government/public, private and media. Thus, the term 'sources' used here refer to 'channels of dissemination' of information and any future reference to sources should not be confused with any other definition.

As per NSSO, extension agents, KVKs, agricultural universities and veterinary departments constitute government sources. Private sources comprise of progressive farmers, private commercial agents (including drilling contractors) and NGOs. Table 5 shows the distribution of households accessing from these 3 source categories. A household accessing from all 3 categories will be included in all the three categories. The distribution of access across these 3 categories singly, simultaneously from 2 and 3 categories respectively is shown in Table 6. Table 5 shows that access from media and private is highest while that from public is lowest. Among the total households, 19 percent have accessed from public sources. 13,344 households have accessed information of which public sources have a share of 29 percent.

Having shown the pattern of access across different sources of information, this section tries to explore the factors that determine it. This is done by exploring the factors that determine the choice of the source of information accessed by agricultural households using multinomial logistic regressions as explained in the following sub-section.

Table 5: Access to Information from different categories of sources

Categories	Frequency	Percentage	Total Households
Public	5,885	19 (29)	30,521
Private	7,184	24 (35)	30,521
Media	7,244	24 (36)	30,521
Any Source	13,344	44 (100)	30,521

In the third column, numbers represent the percentage of households accessing information from each category and figures in parentheses denote percentage share of each category in total number of sample households.

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).

5.1 The Model

To analyse this choice, we use a multinomial logit model with the choice of the information source as the dependent variables. Now, a restrictive assumption of the multinomial logit model is the independence of irrelevant alternatives (IIA). This means that the choice between two options should not be related to the other options. However, in reality, households choose simultaneously from the source categories as shown in Table 6. Thus, choices are correlated and this problem is described and addressed below.

The frequencies in Table 4 show the total number of households that have accessed information from each of the 8 sources either singly or simultaneously. For example, 24 percent households accessing media includes households only accessing media as well as households accessing other source(s) along with media. Similarly, when we categorise these 8 sources into public, private and media as in Table 5, households can either access from one of these categories or more from joint categories. This means that choices of sources are not independent of available options. Under such situation the assumption of Independence of Irrelevant Alternatives (IIA) does not hold. IIA implies that the alternatives are independent, that is, the log of odds ratio between

two alternatives does not change with the introduction of new alternatives. The log of odds ratio is given as

$$log\left(\frac{\text{Prob}\,(Y_i = source_j)}{\text{Prob}\,(Y_i = source_1)}\right) = \beta_1 + \beta'_j X_i \qquad \forall j = 1 \ldots . J \qquad (3)$$

j denotes the number of alternatives and i denotes the number of households. In other words, IIA implies that the log of odds ratio between two alternatives is a function of only the parameters of those two alternatives and not of any other alternative.

Using nested logit models and multivariate probit models can help in overcoming this problem because these models do not need IIA as an underlying assumption. However, in this context both these models face certain limitations which inhibits us from using them in this analysis[6]. To overcome this problem, we categorise the choices in such a way that they are not correlated as shown in Table 6.

Table 6: Categorisation of Sources Accessed by Agricultural Households

Categories	Frequency	Percent	Cumulative Frequency
Only Public	1,885	14.13	14.13
Only private	3,360	25.18	39.31
Only Media	2,634	19.74	59.05
Both public and private	855	6.41	65.45
Both public and media	1,641	12.30	77.75
Both private and media	1,465	10.98	88.73
All three	1,504	11.27	100.00
Total	13,344	100.00	

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).

6 Nested logit model is a generalised version of alternative-specific conditional logit models. However here we do not have any alternative (choice)-specific variables and hence cannot use this model. For more details see McFadden (1977, 1981) and Hensher, Rose, and Greene (2005). In the case of large datasets and categorical explanatory variables like here, running multivariate probit models becomes problematic. For more details see Green (1997)

The main focus in this section is to see if access from public, private and media sources differ significantly and identify the factors causing this difference. A multinomial logit regression model using access from public, private and media (as in Table 5) as the dependent variable will not suffice because there can be simultaneity in access from these sources and this would violate the assumption of IIA. Hence, we further categorise the data in to 7 unordered categories. When households access from only one of the categories - public, private or media; we get the first three categories. When households access from any two from public, private and media sources, we get the next three categories and when they access from all the three sources, we get the seventh category. Thus, uncorrelated and unordered source categories are constructed to carry out the multinomial logit analysis. These are displayed in Table 6 and used as the dependent variables for our analysis.

Considering *only public* as the base category, the multinomial logit model for *j* unordered categories can be written as follows.

$$\ln(Y_{ij}) = \beta_{0j} + \sum_{k=1}^{K} \beta_{jk} X_{ik} \qquad \forall j = 2 \ldots, 7, k = 1 \ldots K \qquad (4)$$

Where,

Y_{ij} = odds of accessing from category j

$$= \frac{\text{Probability of choosing category } j}{\text{Probability of choosing only public}} \quad \forall\ j = 2,3,\ldots,7$$

and i denotes the number of households.

β_0 is the constant and β_{jk} is the coefficient corresponding to the k^{th} explanatory variables, X_k for the jth category where K represents the total number of explanatory variables. The explanatory variables have been constructed from the literature discussed above and listed in Table 7.

Table 6 shows that around 60 percent of the households are accessing information from one of the first three categories– *only public*,

only private and *only media*. Thus, in the model discussed above, I use 4 unordered categories to avoid unnecessary confusion from using all the 7 categories.[7] Here, the first three categories remain the same and the last four categories are grouped under the fourth category, *others*. The revised multinomial model with 4 unordered categories is given below.

$$\ln(Y_{ij}) = \beta_{0j} + \sum_{k=1}^{K} \beta_{jk} X_{ik} \quad \forall j = 2,3,4, k = 1 \dots K \qquad (5)$$

Where,

Y_{ij} = odds of accessing from category j =

$$= \frac{\text{Probability of choosing category } j}{\text{Probability of choosing only public}} \quad \forall\ j = 2,3,4$$

j = 2 refers to *Only Private,* j = 3 refers to *Only Media* and j=4 refers *to Others.* All the other notations have the same meaning as in equation 4.

All the explanatory variables are "alternative-invariant" and hence we choose multinomial logit[8] which assumes IIA. The estimates derived from the multinomial models are tested to see if the assumption of Independence of Irrelevant Alternatives (IIA) holds or not. This test is done on the basis of Hausman and McFadden Test (1984) that compares the full model with the restricted models. The null hypothesis is that the full model follows IIA. In other words, the coefficients in both the models are not significantly different from each other. We use the post estimation technique called *Seemingly Unrelated Estimation* in Stata 15 to check

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7 The results of the main model (equation 4) is given in the Appendix (A1) and the findings are qualitatively same as in Table 8 and hence not discussed in the main section separately.

8 In case of alternative-specific explanatory variables, conditional logit models are used. Multinomial logit models are a special case of the former model when there are no alternative-specific variables (see Mc Fadden, 1973 for further details)

for IIA. The test results are given the Appendix A2. The test results fail to reject the null hypothesis and hence we have no evidence against the models violating IIA. Thus, we continue using multinomial logit regression for the analysis.

All the explanatory variables are given in Table 7 below. These are a subset of the variables used in the previous analysis. Four additional variables have been used for this estimation and these are briefly described below.

Monthly per Capita Consumption Expenditure (MPCE) of a household is used as a proxy for household's income since we do not have data on income of the households. Consumer expenditure in the last 30 days is reported by the households in the survey and then it is divided by the family size of each household to arrive at this measure. The natural log of this value is used here. We want to see how choice of information sources is influenced by income. It is expected that wealthier households will access from multiple sources (see for example, Birthal et al., 2015, Feder and Slade, 1984).

Gross Cropped Area (GCA) is used to see if total area under cultivation affects the choice of category selected. Irrigation is an important parameter in cultivation and determines several agricultural decisions and outcomes. Hence, a variable is constructed to capture the extent of irrigated land in a household. The **proportion of area under irrigation** is calculated by dividing the total area under irrigation and gross cropped area for each household to see if it has any significant role in choosing source categories by agricultural households. In the data, few households have **crop insurance**. It is expected that households with insurance will have a greater interaction with formal sources of information. Thus, they may access more from multiple as well as formal sources.

Table 7: List of Explanatory Variables Used

Variable	Observation	Mean
Land owned (hectares)	13,344	1.9
Ln (MPCE)* in Rs.	13,344	7.2
Proportion of farmers in a household	13,344	2.5
Age of head of household (years)	13,344	52
Square of age of head of household (years^2)	13,344	2863
Gross Cropped Area (hectares)*	13,203	1.6
Proportion of land under irrigation*	13,812	0.5
Social Group	13,344	**Percent**
ST (Base)	2,024	15
SC	1,366	10
OBC	5,673	43
General	4,281	32
Educational Attainment	13,344	**Percent**
Illiterate (Base)	3,753	28
Primary and Below	3,527	26
Middle	2,333	18
Secondary	1,824	14
Above Secondary	1,907	14
Sex of Head of Household	13,344	**Percent**
Male	12,442	93
Female	902	7
Type of Crop	13,339	**Percent**
Non-Food Crop (Base)	2,862	22
Food Crop	5,794	43
Both	4683	35
Crop Insurance *	13,303	**Percent**
Yes	12,247	92
No (Base)	1,056	8

* Additional variables

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).

5.2 Results

Table 8 displays the multinomial logistic regression coefficients as well as the relative odds ratio for the three categories of information sources when *only public* is the reference category. For private sources, education is the most important factor indicating that relative probability of accessing from *only private* category as compared to *only public* is lower for households with education levels middle, secondary and above secondary as compared to illiterates. In other words, for relatively higher educated heads of households, the probability of accessing *only private* is lower than their probability of accessing from *only public* category. However, caste does not turn out to be a significant factor in influencing access from *only private* category as compared to the reference category.

For *only* media and *joint* categories both caste and education are significant determinants. The relative probability of accessing from *only media* and also *joint* categories vis-a-vis *only media* category is higher for all education levels as compared to illiterates (except it is statistically non-significant for middle level for *only media)*. Similarly, this is true for all caste categories as compared to STs, except it is statistically non-significant for SCs in *joint* categories. It indicates the higher educated households belonging to the upper echelon of the social category have a higher probability of accessing from media and joint source as compared to *only public sources.* Just et al. (2002) find that better educated farmers comprehend general information which are human-capital intensive like from media more easily as compared to "context-specific and decision-focused" (Boehlje,1998) information supplied by private agencies or interpersonal exchanges. Since households in the *Others* category have a greater number of educated households, it can be argued that they are the ones accessing more of human-capital intensive information from media unlike other households that access more from private sources.

People from advantageous social groups have a higher chance of attaining better education and hence influence the choice of sources accessed. In other words, apart from the main (direct) effects of both social group and education separately on the choice of sources accessed, there can be an interaction effect between the two influencing the same. To test that, an interaction term is introduced in the regression (equation 5) but the coefficients turn out to be statistically non-significant and hence are not reported in the result in Table 8.

As observed by many researchers, large landed farmers access information more from public sources. Here also it is found that households with more land have a lower probability of accessing other source categories as compared to *only public*. Further the coefficient of MPCE is only significant for *joint* category indicating that richer households prefer combination source categories as compared to accessing from *only public* sources.

As compared to the reference category, the probability of access from the other three categories increases with increase in gross cropped area. Also, the relative probability of accessing information is lower for households growing only food crops than non-food crops for all source categories as compared to the base category and it is also lower for households growing mixed crops for *only private* and *only media* categories.

Younger farmers tend to favour *only private* and *media* sources as compared to *public* sources but the odds of accessing these sources relative to the base does not change with increase in age as shown by the relative odds ratio of 1 for square of age of the head of the household. The negative coefficient of the insurance dummy implies that households having crop insurance have a lower probability to access from informal (private) or media sources as compared to *only public* (formal) sources. This is in agreement with the hypothesis that formal arrangements like crop insurance lead to larger interaction with formal channels of information.

Table 8: Coefficients and Relative Odds Ratio (ROR) of Multinomial Logit Estimation of Choice of Source Categories

Dependent Variables (Bases=Only Public)	Only Private		Only Media		Joint Categories	
Explanatory Variables	Coefficients	ROR	Coefficients	ROR	Coefficients	ROR
Total household land	-0.12***	0.89***	0.15***	0.86***	-0.08**	0.92**
	(0.04)	(0.04)	-(0.04)	(0.04)	(0.04)	(0.04)
Gross Cropped Area	0.11**	1.12**	0.11*	1.12*	0.11*	1.11*
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
Type of Crop (Base=Non-food Crop)						
Food crop	-0.35**	0.70**	-0.34**	0.71**	-0.33***	0.72***
	(0.14)	(0.10)	(0.14)	(0.10)	(0.12)	(0.09)
Mixed	-0.26**	0.77**	0.24*	0.79*	0.05	1.05
	(0.13)	(0.77)	-(0.13)	(0.11)	(0.12)	(0.12)
Social Group ((base= Scheduled Tribe)						
Scheduled Caste	0.13	1.14	0.34*	1.40*	0.13	1.14
	(0.18)	(0.21)	(0.20)	(0.28)	(0.17)	(0.19)
Other Backward Classes	0.07	1.08	0.50***	1.65***	0.24*	1.28*
	(0.15)	(0.17)	(0.16)	(0.26)	(0.14)	(0.18)
General	0.12	1.13	0.64***	1.90***	0.34**	1.40**
	(0.17)	(0.19)	(0.17)	(0.33)	(0.15)	(0.21)
Education Level (base = Illiterate)						
Primary and Below	-0.11	0.89	0.19*	1.21*	0.22**	1.24**
	(0.09)	(0.21)	(0.10)	(0.12)	(0.09)	(0.11)
Middle	-0.33***	0.72***	0.12	1.12	0.26**	1.29**
	(0.11)	(0.08)	(0.12)	(0.13)	(0.10)	(0.13)
Secondary	-0.34***	0.71***	0.39***	1.48***	0.49***	1.62***
	(0.13)	(0.09)	(0.13)	(0.19)	(0.12)	(0.19)
Above Secondary	-0.39***	0.68***	0.54***	1.71***	0.46***	1.59***
	(0.13)	(0.09)	(0.13)	(0.22)	(0.12)	(0.18)

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).Village wise clustered standard errors in parentheses (adjusted for 3,094 clusters in village) *** p<0.01, ** p<0.05, * p<0.1

Dependent Variables (Bases=Only Public)	Only Private		Only Media		Joint Categories	
Explanatory Variables	Coefficients	ROR	Coefficients	ROR	Coefficients	ROR
Crop Insurance (Base=Not Insured)	-0.27*	0.76*	-0.52***	0.59***	0.16	1.17
	(0.17)	(0.13)	(0.19)	(0.11)	(0.15)	(0.18)
Proportion of land under irrigation	-0.11	0.90	0.32**	0.73**	0.05	1.05
	(0.13)	(0.11)	-(0.13)	(0.09)	(0.11)	(0.12)
ln (MPCE)	-0.08	0.92	-0.023	0.97	0.26***	1.30***
	(0.09)	(0.38)	(0.09)	(0.77)	(0.0809)	(0.10)
Sex of Head of Household (Base = Male)	0.12	1.12	0.24*	1.27*	0.08	1.08
	(0.13)	(0.15)	(0.14)	(0.18)	(0.12)	(0.13)
Age of head of household	-0.06***	0.94***	-0.05***	0.95***	-0.01	0.99
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
Square of age of head of household	0.0001***	1.00***	0.0004***	1.00***	7.32e-05	1.00
	(0.0001)	(0.001)	(0.0002)	(0.001)	(0.0001)	(0.001)
Proportion of farmers per household	0.003	1.00	0.02	0.99	0.05	1.05
	(0.03)	(0.03)	-(0.03)	(0.03)	(0.03)	(0.03)
Constant	1.55**	3.58	1.97**	5.42**	-1.01	0.38
	(0.85)	(3.00)	(0.80)	(4.27)	(0.72)	(0.27)
Zone FE	Yes		Yes		Yes	
Observations	13,116		13,116		13,116	

Wald chi2(96) = 1025.30, Prob> chi2 = 0.0000, Log pseudo likelihood = -15807.17

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey of Agricultural Households (2012-13).Robust standard errors adjusted for 3,094 clusters in village in parentheses*** p<0.01, ** p<0.05, * p<0.1

Overall, a strong correlation is seen between education and type of source accessed. Less educated households prefer informal sources. Caste or social group is also significant in determining the preference except for *only private* category. Other factors that are important in determining source preference are total land owned by the household, their gross cropped area and the type of crops they grow. Age and crop insurance are significant for *only private* and *only media* categories while MPCE is only significant for joint categories.

6. Conclusion

A key concern for Indian policy makers has been to increase the productivity of agriculture, a sector that supports the livelihood of almost half of the population. India's 10th and 11th Five-Year Plans emphasised on strengthening agricultural extension to achieve higher agricultural growth by reducing the yield gap in farmer fields. The government has, since 2005, implemented the Agricultural Technology Management Agency (ATMA) at each district across the country to decentralise information dissemination, help increase farmer input into programme planning and resource allocation and to increase programme coordination and integration to achieve sustainable and profitable farming. Despite these measures, the reach of technology and related information remains limited. This is reflected in the stagnation of access to information by agricultural households for a decade as shown by the NSSO reports on Situation Assessment survey of Agricultural Households (both 59th and 70th Rounds).

This paper has tried to identify the socio-economic and other factors that influence an agricultural household's decision to access information and also probe deeper by exploring the preferences of information sources accessed. It is found that households with better socio-economic conditions and market awareness access more information than their counterparts. Also, these households access more

of multiple sources and media sources. Education comes out to be an important factor in accessing information as well as in the choice of sources. Access is highest for media and progressive farmers but more educated households belonging to OBC and General castes prefer media while the poorer less educated belonging to lower caste groups prefer interpersonal exchanges from progressive farmers. Access to public sources is lowest among all sources despite considerable effort from the government in disseminating information through extension agents, *Krishi Vigyan Kendras*, agricultural universities and veterinary departments. Among public sources, highest access is from veterinary departments. Moreover, access to public sources is skewed in favour of economically better off households, which is a typical criticism of public extension systems like extension agents.

Amidst the endeavours to improve farmers' access to information, measures to alleviate the socio-economic conditions is equally important because variations in these factors lead to variability in access, preferences of sources and number of sources accessed. Therefore, mere availability of information does not ensure its access. Access is driven mainly by education, better infrastructure and awareness, all of which require stronger efforts from the government to penetrate deeper into the rural sector.

Aritri Chakravarty *has recently submitted her PhD thesis titled 'Farm Households in India: Acquisition and Use of Information' at Centre for Development Studies, Trivandrum. Her research interests are in the area of applied microeconomics, rural and agricultural development and, efficiency and productivity analysis. Her current research pertains to policies related to agricultural reforms and impact and use of information in Indian agriculture.*

Email: aritri15phd@cds.ac.in
aritri.chakravarty@gmail.com

Appendix

A1: Determinants of Sources Accessed: Generalised Hausman Specification Test

I. Restricted Model: Model 2 without 'private' [Base Category: Public]		
Category	Chi Square Value	Probability > chi2
Media	15.98	0.53
Public cum Private	10.26	0.90
Public cum Media	11.80	0.81
Private cum Media	11.79	0.81
All Three	17.57	0.42
II. Restricted Model: Model 2 without 'media'[Base Category: Public]		
Private	19.66	0.30
Public cum Private	12.14	0.79
Public cum Media	10.65	0.87
Private cum Media	11.92	0.81
All Three	13.81	0.68
III. Restricted Model: Model 2 without 'public cum private' [Base Category: Public]		
Private	18.60	0.35
Media	1206	0.80
Public cum Private	8.66	0.95
Public cum Media	10.12	0.90
All Three	12.10	0.79
IV. Restricted Model: Model 2 without 'public cum media' [Base Category: Public]		
Private	8.45	0.96
Media	20.51	0.25
Public cum Private	9.24	0.93
Private cum Media	6.75	0.99
All Three	10.42	0.89

Cont'd.....

V. Restricted Model: Model 2 without 'private cum media' [Base Category: Public]		
Private	20.14	0.27
Media	17.56	0.42
Public cum Private	12.23	0.79
Public cum Media	13.33	0.71
All Three	16.57	0.48
VI.Restricted Model: Model 2 (without 'all three') [Base Category: Public]		
Private	14.91	0.60
Media	10.98	0.86
Public cum Private	12.41	0.77
Private cum Media	7.46	0.98
Public cum Media	12.23	0.79

H_0: Independence of Irrelevant Alternatives

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey ofAgricultural Households (2012-13).

A2: Agroclimatic Zones of India

Zone	Name	Broad Composition	Percentage of House holds
1	Western Himalayan	Jammu and Kashmir, Himachal Pradesh, Uttaranchal	5
2	Eastern Himalayan	North Eastern States and 3 northern districts of West Bengal	15
3	Lower Gangetic Plains	Rest of West Bengal	6
4	Middle Gangetic Plains	Bihar and Eastern Uttar Pradesh	11
5	Upper Gangetic Plains	32 districts of Uttar Pradesh	8

Cont'd.....

6	Trans-Gangetic Plains	Punjab, Haryana & Ganganagar district of Rajasthan	4
7	Eastern Plateaus	Chhota Nagpur region and Hills	8
8	Central Plateaus and Hills	Most of Rajasthan and Madhya Pradesh	7
9	Western Plateaus and Hills	Most of Maharashtra and western Madhya Pradesh	8
10	Southern Plateau and Hills	Telangana, parts of Andhra Pradesh, Karnataka and Tamil Nadu	6
11	East Coast Plains and Hills	Coastal Orissa, Andhra Pradesh, Tamil Nadu and Pondicherry	10
12	West Coast Plains and Hills	Kerala, Goa, coastal Maharashtra and Karnataka	5
13	Gujarat Plains and Hills	Gujarat, Daman and Diu and Dadra and Nagar Haveli	4
14	Western Dry Region	9 districts of Rajasthan	2
15	The Island Region	Andaman and Nicobar Islands and Lakshadweep	1
	Total Households		100 (35,200)

*Source:*Author's calculation based on Planning Commission 1989 and NSSO 70th Round, Situation Assessment Survey of Agricultural Households in India (2012-13)

Figure in parenthesis is the total number of households surveyed

A3: Coefficients from Multinomial Logit Regression [Base Category=Only Public]

Explanatory Variables	Only Private	Only Media	Public and Private	Public and Media	Private and Media	All
Total household land	-0.0358*	-0.0733***	-0.0279	-0.0131	-0.0141	-0.00396
	(0.0196)	(0.0220)	(0.0266)	(0.0175)	(0.0159)	(0.0148)
Ln(MPCE)	-0.00882	0.0321	0.0190	0.111***	0.212***	0.203***
	(0.0351)	(0.0353)	(0.0484)	(0.0390)	(0.1051)	(0.0416)
Age of head of household	-0.0567***	-0.0482***	0.0121	-0.0417**	-0.0182	-9.01e-05
	(0.0162)	(0.0165)	(0.0245)	(0.022)	(0.0194)	(0.0198)
Square of age of household	0.000363**	0.000428***	-0.000276	0.0004**	9.30e-05	-7.21e-05
	(0.000151)	(0.000152)	(0.000233)	(0.0002)	(0.000180)	(0.000183)
Number of farmers per household	0.0145	-0.0208	0.0630	0.0384	-0.0271	-0.0366
	(0.0316)	(0.0333)	(0.0435)	(0.0356)	(0.0376)	(0.0375)
Social Group (base = Scheduled Tribe)						
Scheduled Caste	0.141	0.2724	0.0421	-0.0344	0.352	0.206
	(0.184)	(0.200)	(0.229)	(0.226)	(0.224)	(0.233)
Other Backward Classes	0.0692	0.497***	0.0582	0.174	0.431**	0.426**
	(0.154)	(0.163)	(0.189)	(0.191)	(0.187)	(0.193)
General	0.125	0.625***	0.143	0.20	0.587***	0.654***
	(0.171)	(0.172)	(0.205)	9(0.194)	(0.219)	(0.210)

Cont'd.....

Education Level (base = Illiterate)						
Primary and Below	-0.116	0.175	-0.229*	0.339***	0.161	0.381***
	(0.0889)	(0.1112)	(0.141)	(0.113)	(0.129)	(0.113)
Middle	-0.308***	0.0826	-0.437***	0.467***	0.276**	0.282**
	(0.111)	(0.116)	(0.161)	(0.130)	(0.142)	(0.132)
Secondary	-0.348***	0.354***	-0.324**	0.778***	0.389***	0.539***
	(0.125)	(0.125)	(0.177)	(0.145)	(0.153)	(0.142)
Above Secondary	-0.403***	0.472***	-0.532***	0.857***	0.209	0.563***
	(0.133)	(0.126)	(0.178)	(0.142)	(0.159)	(0.146)
Proportion of land under irrigation	-0.0911	-0.308**	0.271*	-0.0802	-0.156	0.308**
	(0.127)	(0.131)	(0.167)	(0.133)	(0.149)	(0.140)
Type of Crop (Base = Non-food Crop)						
Food crop	-0.335**	-0.347**	-0.0103	-0.374**	-0.303*	-0.580***
	(0.141)	(0.140)	(0.174)	(0.151)	(0.162)	(0.168)
Constant	1.857**	2.725***	-0.067	1.012	-0.93	0.532
	(0.726)	(0.667)	(0.903)	(0.156)	(0.806)	(0.766)
Zone FE	YES	YES	YES	YES	YES	YES
Observations	13,108	13,108	13,108	13,108	13,108	13,108

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey ofAgricultural Households (2012-13).
Village wise clustered standard errors in parentheses (adjusted for 3,095 clusters in village)
*** p<0.01, ** p<0.05, * p<0.1
Wald chi2(186) = 1641
Prob> chi2 = 0.0000
Log pseudo likelihood = -22381.182
Pseudo R2 = 0.0855

Table A 4: Choice between Progressive Farmers and Media

	Model A [Base=Other sources]		Model B [Base=Prog. armers]
Explanatory Variables	Prog. Farmers	Media	Media
Total household land	-0.0245	-0.0627***	0.0038
	(0.0152)	(0.0188)	(0.0139)
Ln (MPCE)	0.00413	0.0286	0.1248*
	(0.0344)	(0.0330)	(0.0736)
Age of head of household	-0.0157	-0.0142	0.00914
	(0.0164)	(0.0154)	(0.0131)
Square of age of head of household	5.02e-05	0.000172	6.11e-05
	(0.000154)	(0.000142)	(0.000123)
Number of farmers per household	-0.0199	-0.0384	-0.00597
	(0.0308)	(0.0307)	(0.0247)
Social Group (base= Scheduled Tribe)			
Scheduled Caste	0.213	0.293	0.0618
	(0.190)	(0.193)	(0.159)
Other Backward Classes	0.110	0.471***	0.294**
	(0.158)	(0.157)	(0.134)
General	0.0494	0.589***	0.468***
	(0.173)	(0.167)	(0.147)
Education Level (base = Illiterate)			
Primary and Below	-0.0446	0.204**	0.327***
	(0.0869)	(0.0915)	(0.0739)
Middle	-0.247**	0.139	0.515***
	(0.110)	(0.110)	(0.0899)
Secondary	-0.240*	0.454***	0.744***
	(0.127)	(0.119)	(0.0981)
Above Secondary	-0.471***	0.520***	1.034***
	(0.141)	(0.119)	(0.110)
Proportion of land under irrigation	-0.138	-0.205*	-0.0945
	(0.123)	(0.117)	(0.106)
Type of Crop (Base = Non-food Crop)			
Food crop	-0.148	-0.252**	-0.160
	(0.142)	(0.127)	(0.125)
Constant	1.218	1.717**	-0.225
	(0.866)	(0.765)	(0.712)
Zone FE	Yes	Yes	
Observations	7,150	8,019	
	Wald chi2(62) = 539.05*** Log pseudo likelihood = -7126.18 () contains robust standard Errors adjusted for 2,636 clusters in village		Wald chi2(31) = 509.85*** Log pseudo likelihood =-4549.21() contains robust standard errors in adjusted for 2,574 clusters in village

Source: Author's calculation based on NSSO 70th Round Situation Assessment Survey ofAgricultural Households (2012-13).

*** p<0.01, ** p<0.05, * p<0.1

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