Interaction of small growers with formal and informal institutional arrangements: case of dissemination of knowledge in tea and natural rubber

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Using agricultural innovation system perspective, the paper has analysed the types of information sources involved in the dissemination of knowledge as well as the factors influencing the decision to interact with these sources taking the case of two plantation crops – tea and natural rubber. Interaction with various sources and getting information from them is particularly important for small growers who are resource poor and faces uncertainty over the cultivation of these perennial crops due to long gestation lag in production. Moreover, these crops have historically received considerable attention of the State. This had led to the establishment of formal institutional arrangements for the generation and dissemination of knowledge to these growers. The analysis showed that in the dissemination process of knowledge despite the presence of formal institutional mechanisms, the small tea growers seemed to have greater reliance on informal sources on account of unavailability of services from formal sources as well as due to certain farm and farmer characteristics. On the contrary, institutional intervention which seemed to adjust as per the need of the NR growers, seems to have resulted in greater interaction of the growers with formal source. Though their interaction with informal source was also high, but it was not due to lack of supply of such services from the formal source rather on account of farm, farmer and crop specific characteristics.

Key words: dissemination of knowledge, interaction, small growers, plantation crops, formal and informal institutional arrangements.

1. Introduction

It is well known that invention unless applied cannot be termed as innovation, the solutions attained by the researcher in their research stations has to reach out to the farmers in the field. One issue of particular interest in this regard is dissemination of knowledge to the farmers, particularly small farmers and the extent of their access to it. To look into this issue, we take the case of two plantation crops- tea and natural rubber (henceforth NR). Historically, given their importance as a foreign exchange earner (Tea) and an import substitute (NR) for the Indian economy, both crops have an elaborate formal institutional mechanism (respective commodity boards, research institutes and advisory network) for the generation and dissemination of knowledge. Their support is of utmost importance for the small farmers/growers[1] who are resource poor mainly in terms of lack of

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[1] Here farmers and growers are used interchangeably. Small growers are defined as those with land less than 10 hectares. In case of NR, 98% of small growers have land less than 2 hectares and contributes to around 94 per cent of production (Indian Rubber Statistics, Vol 36, 2013) while for tea, the average land holding of small growers was around 1 hectare in 2007. Small tea growers' contribution to production is 34 per cent (Tea Board data, 2015).

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knowledge about market, modern technology, proper use of modern inputs and also others such as land holding size and credit availability (Van Der Meer, 2006; Dev 2012).

Moving beyond the role played by traditional/formal extension services, various non-traditional actors have also evolved to deliver these services to the tea and NR growers. These non-traditional/informal actors are indeed important part of the agricultural value chain but are not traditionally involved in research. Studies have pointed out that they could include agribusiness owners, input and output dealers and policy makers (Van Rooyen and Tui, 2010 as cited in Mapila et al. 2014). Since growers' needs and information requirements vary in different stages of production and a single source cannot always provide everything that they need (Mittal and Mehar, 2013), so interaction with various sources gains importance. Hence, at the outset, the paper attempts to understand what type of information sources (formal/informal) are they interacting[2] with and what kind of information growers are getting from them?

Further, on getting an understanding of the information sources, it would be pertinent to understand the factors that determine the decision of the growers to interact with (choose) these arrangements and how it differs across tea and NR growers? Except for few studies such as Mittal and Mehar (2013) whose focus was on annual crops, this issue has not been addressed in the context of developing countries. Particularly, our knowledge on this issue regarding plantation crops is limited. There are certain specificities of plantation crops that sets them apart from general agriculture. Plantations are said to have traditionally stood on a different footing from general agriculture because of their mono-crop orientation (Sivaram, 2002). They are perennial crops with a gestation lag between planting and harvesting. Unlike annual crops, the gestation period is long[3]. The production could continue for decades, once the gestation period is over. Hence, in case of annual crops like wheat, paddy and cotton, where farmers have the option to shift to other crops in line with the market situation, cultivators of plantation crops will have to necessarily continue with the same crop over a long period (Joseph and Joseph 2005). Given the perennial nature of these crops, and the uncertainty and risk involved in terms of long gestation period in production, the decision of a grower to choose the varied information sources assumes importance. Farmer is

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[2] It needs to be noted that interaction is viewed in terms of the various information sources accessed by the growers. Further, if a grower has accessed a particular information source, this decision would implicitly indicate choice of that source among the available sources. As such we have used the terms 'information sources accessed', 'interaction with information sources' and 'choice of information sources' interchangeably.

[3] Gestation period is the time taken between initial planting and first output. It is as long as 7 to 8 years in case of NR and around 3 to 4 years in case of tea.

considered as a decision making unit who have the capacity of making use of their own experience and knowledge as well as take advantage of externally sourced knowledge (Just et al. 2002).

The paper is organised as follows. The analytical framework and data sources are discussed in the second and third section respectively. The fourth section maps out the various traditional/formal and non-traditional/informal actors involved in the dissemination of knowledge for tea and natural rubber; and the kind of information growers are getting from them. In the fifth section, drawing from the existing literature on extension services and choice of information sources by farmers, we examine the factors affecting the decision of tea and NR growers to interact with these formal and informal sources; and generate plausible hypothesis from it. The sixth section provides brief analysis based on descriptive statistics. In the seventh section, we model the choice of information sources by (tea and NR) grower households using a logistic regression analysis. The last section provides summary and concluding observations.

2. Analytical Framework

Over the years, the theoretical perspectives related to agricultural extension approaches have moved away from various approaches such as transfer of technology approach, participatory extension and technology development, to innovation systems approach in recent years (Friederichsen et al. 2013). The innovation systems framework is said to provide "more inclusive ways of thinking about the actors and the institutional context in which the generation, diffusion and use of new knowledge takes place" (Sulaiman and Hall 2000: 226).

Agricultural innovation system (AIS) approach draws on the concept of "National System of Innovation". In this approach though the importance of scientific and technological changes in fostering productivity growth and poverty reduction is accepted, there is a growing concern towards a process based systems-oriented understanding of innovation (Spielman and Kelemework, 2009). In contrast to the neo-classical framework of linear knowledge flows from public sector knowledge generators to adopting farmers, AIS approach considers innovation to be the result of a process of networking and interactive learning among a heterogeneous set of actors (Leeuwis, 2004; Hall et al. 2006; Roling, 2009 cited in Klerkx et al. 2010). These actors include, among others, farmers, input industries, processors, traders, researchers, extensionists, government official and civil society organisations (ibid). In this approach, farmers are included as an important part of this complex network of heterogeneous actors along with the institutions and policy

environments that influences these interactions (Spielman and Birner, 2008). The usefulness of this approach lies in the recognition it gives to the innovation process involving not only formal scientific research organisations but also a range of other organisations and non-research tasks (Hall et al. 2004).

As per this approach, knowledge is considered to be the most fundamental resource and its acquisition as an interactive learning process (Lundvall, 1992). AIS is said to view innovation as being "dependent on the multi-directional flow of knowledge and emphasizes the demand side in innovation processes, as opposed to previous concern for the supply and one-way diffusion of scientific knowledge" (Klerkx and Leeuwis 2008 as cited in Friederichsen et al. 2013).

Among the heterogeneous network of actors, farmers are the ones from whom demand for extension services emanates to conduct their agricultural activity. Further, the need to focus on farmers/growers comes from the recognition that while technological solutions are often given due importance, an equal importance is not accorded to organizational and institutional issues. As such it is important to focus not just on "farming" but also on "farmers", thereby emphasizing both the technological and organizational aspects (Kannan, 2011). Keeping farmers at the centre of the innovation system, understanding their decision making process for obtaining information from various sources to conduct their agricultural activity is important.

In this interactive process, on the supply side, there exists set of actors that provide extension services to the growers. These actors are not homogeneous, in a sense that we could see it in terms of intervention of the State. Particularly so in case of plantation crops which have historically received considerable attention of the State. Despite agriculture being a state subject, owing to their role in export earnings, commodity boards[4] for each of the crops were established and they were kept under the Ministry of Commerce, Government of India. Further, legislations that empowered these boards to undertake various activities needed for plantation development were drawn. Along with it, either these commodity boards have their own research institute as in the case of natural rubber or contributes to the funding of research activities undertaken by other

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[4] Coffee Board was established by an Act of Parliament in 1942; Rubber Board by Rubber Act of 1947;Tea Board in 1954 under the Tea Act, 1953; Cardamom Board in 1964 and later it became the Spices Board by covering all the 52 major and minor crops under it in 1986.
Given the significance of the plantation crops in terms of export earnings and providing direct and indirect employment to large number of people in the country, the GOI has identified some prominent crops as high-value crops of great economic importance and set up commodity boards to provide better opportunities for the entire value chain participants of the plantation sector Shivakumar (2013).

actors[5]. Besides these actors, there are bridging institutions in the form of producers' organisations and associations which acts as a link between these boards and growers. On the one hand, these actors could be termed as formal sources of information. On the other hand, there are other set of actors which does not directly operate under the intervention of the State (through commodity boards). These actors could be mostly private consultants, input dealers, output dealers, friends/neighbours and so on.

Viewed in this perspective, the enquiry would enable us to understand the role of farm, farmer and crop characteristics, indicating the demand side aspect, in influencing the interaction of growers with these actors Further, it would help to understand the relative importance of different actors (formal/informal) in the decision making process of the growers.

3. Data sources

This paper is based on fieldwork conducted in the tea growing regions of Assam[6] and Natural Rubber growing regions of Kerala. The unit of analysis are the small growers in tea and natural rubber. The survey was undertaken in the Golaghat district of Assam for small tea growers and Kottayam district of Kerala for small NR growers. It was conducted during February to May, 2015. A sample of 122 tea growers and 200 NR growers were selected for the study based on multi-stage random sampling method[7].

4. Dissemination of knowledge: formal and informal actors involved

In what follows, we describe the actors that the tea and NR growers are reliant on for getting information at various stages of production. As mentioned earlier, historically, both tea and NR has had an elaborate formal institutional mechanism for the generation and dissemination of knowledge. These formal institutional arrangements includes the producers of knowledge such as research institutes for these crops, respective commodity boards and bridging institutions such as producers' organisations and associations. The major formal institutional arrangement concerned with the overall development of the small tea growers is the Tea Board. Along with the Tea Board,

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[5] such as in case of tea, where Tocklai tea research institute receives 50 per cent of its funding from the Tea Board

[6] Assam is the main tea growing region in India with a contribution to over 50 per cent of total production. Likewise, Kerala is a major natural rubber growing region in India contributing around 90 per cent of total rubber production.

[7] For want of space, the discussion on selection of households is not provided here in detail.

the other formal arrangements[8] are in the form of Assam Agricultural University and Tocklai Tea Research Institute which are funded by the Tea Board for undertaking research on aspects of tea cultivation and disseminating it to the small growers. In case of NR, it is mainly the Rubber Board, Rubber Research Institute of India (RRII) and the Rubber Producers' Societies[9] who are actively engaged in the dissemination of knowledge to the growers. As far as informal actors in tea are concerned, they included input dealers, labourers from nearby tea estates, bought leaf factories[10] and friends/neighbours. In case of NR, they were private agents, traders and friends/neighbours. It needs to be noted that since our focus is on two way interaction between the growers and the information sources, we have not considered media as a source of information for our analysis as it is concerned with one way interaction[11].

(See Table 1) The small tea growers were mainly seeking information related to only production from various formal and informal sources. This was because the growers were engaged only in the production part of the value chain while the processing and marketing of tea was undertaken by bought leaf factories. Unlike tea growers, along with production, the NR growers were engaged in the processing and marketing of NR. The NR growers were getting information on production, processing and marketing from a set of both formal as well as informal actors. Further, it could be observed that while producers' organisations such as RPSs was engaged in providing information to the NR growers, small tea growers associations was not involved in providing any information to the small tea growers.

However, for post-harvest information related to the price of green leaves, it needs to be noted that none of the formal sources of information was observed to be involved in case of tea. The information sources on prices of green leaves were friends/neighbours, leaf agents and bought leaf

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[8] Note that there is Tea Research Foundation (TRF) managed by United Planters Association of South India (UPASI) in South India. However our analysis here is restricted to only North Indian tea plantations which contributes to around 80 per cent of total tea production in India.

[9] The Rubber Board undertakes interaction with individual growers by adopting a strategy of group approach. This group approach relates to the formation of voluntary organisations of small rubber growers at village level namely the Rubber Producers Societies from 1986 onwards. RPSs helps the growers realize economies of scale through group procurement of plantation inputs, group processing, sale of rubber avoiding middle men and technology transfer. It has also promoted the formation of SHGs which are involved in additional income generating activities such as rubber wood furniture making, apiculture among others.

[10] Bought Leaf Factory is a tea factory which buys from small growers either its entire requirements of green leaves or a part of its requirement. Many of the BLFs do not own even an acre of tea land. Some of them own estates but they are too small to feed the factories fully.

[11] We are following the distinction of information sources made in National Sample Survey Organisation's situation assessment survey of farmers in terms of one way and two way interaction. Television, radio and newspaper are considered as one-way communication sources.

factories[12]. The case was different in case of NR, wherein several information sources on prices was found to be operating. This ranged from radio, newspaper, trader, government agency, cooperatives, friends/neighbours as well as mobile SMS service which was the initiative of the Rubber Board. This implies that unlike in case of small tea growers, it could be expected to provide greater transparency in price information obtained by the NR growers.

Table 1: The demand for and supply of information

Information needs	Information sources	
	Tea	**Natural Rubber**
Production related		
Planting materials	**Formal source** - Tocklai tea research institute (TTRI) **Informal source** - Private nursery (run by persons who were tea growers as well), own nursery, estates	**Formal source** - Rubber Board, Rubber Research Institute of India (RRII) **Informal source** - Private nursery (run by persons who were NR growers as well), own nursery
Plant protection	**Formal source** - Tea Board, TTRI, Assam Agricultural University (AAU) **Informal source** - Input dealers (who were also tea growers), friends/neighbours	**Formal source** - Rubber Board, RRII, Rubber Producers' Societies (RPSs), **Informal source** - private dealers, friends/neighbours,
Agronomic practices	**Formal source** - Tea Board, TTRI, AAU, **Informal source** - friends/neighbours, tea estate labourers	**Formal source** - Rubber Board, RRII RPSs **Informal source** - friends/neighbours
Post-harvest: Price of green leaves/NR	**Informal source** - Friends/neighbours, leaf agents and Bought leaf factories (BLFs)	**Formal source** - government agency, cooperatives, **Informal source** - trader, friends/neighbours **Media** -Radio, Newspaper, , mobile SMS started by Rubber Board
Processing related	-	**Formal source** - Rubber Board, RPSs **Informal source** - friends/neighbours,
Marketing related	-	**Formal source** - Rubber Board, RPSs **Informal source** - Private agents (local dealers/wholesalers), friends/neighbours

Source: Field survey, 2015

When we consider the access to these information sources by the growers, it shows different combinations of sources – only formal, only informal, both formal and informal. In the case of tea, it could be observed that none of them were accessing only formal source. Majority (93.44 %) of

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[12] The BLFs would cite the green leaf prices to the leaf agents based on the prices fetched for made tea. On our visit to Kamarbandha BLF, it was observed that outside the main building of the factory, a writing board was fixed, where the price of green leaves was written for that particular day. While having conversation with the manager of the BLF, he stated that the rates are cited in the board accordingly as and when there are changes in the rates.

them were accessing information from informal sources while only around 7 per cent were doing so from both formal and informal source.

Table 2: Access to information sources by the small tea growers and NR growers

Information sources accessed by the small tea growers	Small tea growers		NR growers	
	Frequency	Percentage	Frequency	Percentage
Only formal source	0	0	11	5.50
Only informal source	114	93.44	125	62.50
Both formal & informal	8	6.56	64	32.0
Total	122	100	200	100

In the case of NR too, access to informal sources was as high as around 60 per cent. Given that the informal sources have a deeply embedded position in communities as well as high levels of interpersonal relationship and interaction (Just et al. 2002), these sources seemed to have importance for NR growers similar to that for small growers. Thus, highlighting the role of social capital[13] in the process of learning and information exchange (Katungi et al.2006). However, the reliance of NR growers on formal sources was found to be relatively higher than those of tea growers. Dependence of the NR growers on only formal source was around 6 per cent. It was observed that 32 per cent of the NR growers were accessing information from both the formal and informal sources. This was indicative of multiple information sources available to the NR growers unlike for tea growers.

On getting an understanding of formal and informal sources in these two crops and their varied combinations, we would now proceed to examine the factors that determine the decision of the growers to interact with these arrangements and how it differs across tea and NR growers?

5. Factors affecting the decision of the grower to interact with the information sources

The aim of this section is to generate plausible hypotheses regarding the factors influencing the decision of the grower to interact with varied information sources.

To this end, we would draw insights from existing literature on extension services in general agriculture[14] and choice of information sources by farmers. First, we would examine the issues

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[13] 'Social capital depicts the features of social organisations, such as social institutions, networks or associations, less institutionalized networks of friends, relatives and acquaintances (or private social networks) and civic engagement, that enable knowledge gathering and information exchange' (Katungi et.al. 2006: 2).

[14] Since, there are not many studies which have considered issues related to extension services in plantation crops exception being (Joseph, 2011) on small cardamom and (Mani and Santhakumar, 2011; NRPPD, 2013) on natural rubber.

covered by the existing studies on agricultural extension and then see what these studies have to say about the choice of information sources by the farmers. The first enquiry would help to place our problem in a perspective and thereby situate the case of tea and NR. The second one would enable to draw factors that would influence the decision to interact with the information sources and make plausible hypothesis about it.

Several challenges are faced by Indian agriculture (which includes but is not restricted to) - relatively low average rates of total factor productivity growth, food security, sustainability, farm incomes and poverty reduction. Extension is considered as one among the inputs and enablers required to address these challenges (Ferroni and Zhou 2011). There is a growing body of literature examining and reviewing agricultural extension in India (Raabe 2008; Birner and Anderson 2007; Sulaiman and Holt 2002; Glendenning et al. 2010; Ferroni and Zhou 2011). These studies provide an account of the role of public provisioning of extension services, weakening of research-extension-farmer linkages post-green revolution, reasons for such a trend, governmental intervention to tackle this situation and its effectiveness. Along with public provision of extension, other providers of extension such as private comprising input dealers, suppliers and buyers of produce, third sector including NGOs and foundations are increasingly offering services to the farmers. Such a trend indicates growing importance of agricultural markets and value chains (Ferroni and Zhou 2011). Given the issue of inability of public extension to reach all the farmers, studies have highlighted the importance of contributions from new extension providers in ensuring coverage of all. The need for public and private extension systems to complement each other is underlined by these studies.

Another major issue of importance specifically underlined by other set of literature is changes in approach undergone by the public agricultural extension[15] since the green revolution (Moore 1984; Hall et al. 2000; Birner et al. 2009; Birner and Anderson 2007; Davis 2008). Earlier it was the Training and Visit (T&V) approach, which gradually gave way to a new approach focusing on increased accountability towards the farmers. In line with this new approach, the focus has shifted away from increasing production via technology transfer towards a decentralized, demand-driven, and participatory approach to reach the farmers (Glendenning et al. 2010). The latter approach has brought about an expansion in the role of agricultural extension. This ranges from enhancing skills

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[15] See Glendening et.al. 2010 for a detailed account of evolution of approaches to agricultural extension in India and worldwide over the years.

and knowledge for production and processing to facilitating access to markets and trade. It also includes organising farmers and producers groups as well as working with farmers towards sustainable natural resource management practices (Swanson 2008 as cited in Glendenning et al. 2010). The expansion in its role has led to a widening of the extent of information it could support. Moreover, given that farmers are operating in an increasingly complex agricultural scenario[16], access to reliable and relevant sources of information assumes importance. Further, this change in approach is expected to have a significant impact on reflecting the local information needs of the farmers in a better way (Glendenning et al. 2010).

When we consider the information needs of the farmers, they require a diverse range of information to support their farm enterprises (Glendening et al. 2010). This information relates to best practices and technologies for crop production and regarding post-harvest aspects such as processing, marketing, storage and handling (*ibid*). With regard to farmers' information needs, studies have examined whether the information needs of the farmers are met by agricultural extension. They have questioned the coverage and relevance of information provided by the agricultural extension system. It is pointed out that there exists a gap between the content of information provided and the information actually required by the farmers. This mainly highlights the issue of inadequate consultation of farmers about their information needs and a poor understanding of their information search strategies (Babu et al. 2012). Schnitkey et al. (1992) has stated that there is a limited understanding of the extent to which information needs of the farmers are being met.

Most of the studies have looked at factors affecting the adoption of a particular technology (Griliches 1957; Feder, Just and Zilberman 1985[17]). However, prior to understanding this issue, as an initial enquiry, it is imperative to understand the factors that influences the choice of information sources by the farmers. This issue, to the best of our knowledge, has not been addressed by the existing studies in the context of developing countries. Exception being the study by Mittal and Mehar (2013) who have analysed the factors influencing the selection of information sources by farming households engaged in rice, wheat and maize cropping systems in the Indo-Gangetic Plains. Further, our knowledge on this issue with respect to plantation crops is limited. Given the perennial nature of the plantation crops and the risk involved in terms of long gestation period to

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[16] Market conditions becoming increasingly affected by global factors and technologies also becoming more complex (Schnitkey 1992).
[17] Refer to Feder, Just and Zilberman (1985) for a detailed survey of the studies on adoption of agricultural innovations.

obtain production, choice of information sources assumes importance. Majority of the studies on selection of information sources are mainly confined to developed country context with regard to a particular technology (such as Jenkins et al. 2011 on precision farming; Velandia et al. 2009 on agricultural risk management tools as well as precision farming; except for Schnitkey et al. 1992 whose study deals with farmers' information preferences for marketing, production and financial decisions). However, we could draw insights from these existing studies regarding the factors influencing the choice of information sources and the hypothesis related to it.

Broadly, the existing studies have considered farm characteristics and farmer characteristics as the major factors affecting the choice of information sources along with controlling for location and regional variables outside the farmers' management decision context. Farm characteristics includes farm size, land tenure, type of farm enterprise. Farmer characteristics includes age of the farmer, education, whether engaged in part-time or full-time farming, household income. Given the distinct character of plantation crops, along with farm and farmer characteristics, we have considered characteristics related to the respective crops as well.

5.1. Determinants – hypotheses and variable construction

The following variables have been hypothesised to influence the choice of information sources by the growers.

Experience of the grower – Majority of the studies have considered age of the farmer as a proxy for farming experience. Age of the farmer is an important modifier of information demand (Schnitkey et.al. 1992). In the existing literature, older and younger farmers' preferences for information sources is observed to be ambiguous (Velandia et.al. 2009). Schnitkey et.al. 1992 found that older farmers prefer to use extension as a source of information over private sources. Velandia et.al. 2009 points out that older farmers might have lower ability to process the information obtained from public sources. Hence they might prefer private sources which provides customized services over public sources. However, age is considered to have a high correlation with farming experience (Schnitkey et.al. 1992). It is this experience, which provides increased knowledge about the environment in which decisions must be made. Hence, experience may serve as a substitute for information. At least it could modify the decision set for which information is sought or may modify the preferences for information attributes (*ibid*). Here, instead of age of the

farmer, to capture farming experience, we have considered the year in which the cultivation of respective crops was started in the grower household. This would help us capture the experience of the grower both in terms of the growers' own engagement in cultivation as well as the tacit knowledge obtained from the earlier generations who were engaged in the cultivation of the respective crops. Based on the aforementioned discussion, the experience of the grower could be expected to have either positive or negative effect on the choice of multiple information sources.

Education of the grower – Education is said to enhance the ability of an individual to recognize, acquire and process information (Schultz 1975). Studies have considered education as a measure of the ability to process information and have looked into its effect on the use of information sources in agriculture (Just et al. 2002; Schnitkey et al. 1992 as cited in Velandia et al. 2009). According to Just et al. 2002, private information sources such as crops consultants and farm input dealers are said to provide customized and simplified information to support the specific needs of the farmers whereas public sources of information such as media and extension are said to provide general information that needs to be further processed to target a particular problem. Following this postulate they hypothesized that farmers with less education tended to prefer private sources of information while those with more education prefer public sources of information. Further, education is said to increase participation in associations (Haddad and Maluccio 2003 as cited in Katungi et al 2006). Thus, Katungi et al (2006) notes that education increases the likelihood of acquiring information from formal sources rather than informal mechanisms. Based on these studies, we hypothesize that growers with more years of education would prefer formal source of information than informal sources. Education of the grower is considered as a dummy variable which takes the value of 1, if the grower has higher secondary and above level of education and 0, if the education level is secondary and below.

Besides the education of an individual, studies such as by Basu, Foster and Subramanian (2000), shows the importance of proximate literacy i.e. the presence of educated member within the households and their involvement in the decision making process of the households (Asfaw 2004). In various contexts, it is stated that an illiterate person will be poorly placed in terms of availing useful information and the problem would be more acute if the illiterate person belongs to a household with no literate members (Basu, Foster and Subramanian 2000). As such even if the farmer is illiterate, if there are educated members in the family the choice of information sources could be expected to be different. Thus literacy status of the household could have an effect on the

choice of information sources accessed. It is hypothesised that as the proximate education of the household increases, the growers would be more likely to choose both sources and formal information source. Proximate education of the household was obtained by adding the years of education of family members of the farmers who were above the age of 14.[18]

Engaged in part-time or full-time farming – Velandia et al. 2009 in their study have used percentage of income from farming as a measure of the level of part-time farming. Higher off-farm income is taken as an indication of less time for engaging in farming activities. Hence farmers with higher off-farm income are more likely to prefer private sources that provide customized and simplified information over public sources that provides information which needs further processing. Schnitkey et al. 1992 have pointed out that an important difference exist between the part-time farmers and full-time farmers with regard to information accessed. Unlike full-time farmers, part-time farmers have less time to devote to farm decisions. Hence, time constraint would have an influence on the amount of information collected. Drawing from these studies, we hypothesize that growers engaged in full time farming would more likely prefer formal over informal sources. Proportion of monthly income earned from the cultivation of respective crops to the total monthly income of the grower is taken as a proxy for the level of part-time farming. Another proxy considered is the occupational status dummy, where engagement of the grower in both farm and non-farm activities is taken as one while only being engaged in tea/NR cultivation is considered as zero.

Household income – Jenkins et al. 2011 considers household income to be positively related with selection of an information source for precision farming. They state that the selection process may involve opportunity costs in the form of time required to search and process information. Hence, farmers with higher incomes may have more resources to invest in the selection process. Moreover, higher income levels would probably facilitate access to consulting services that complements new technologies (Rogers 1983 as cited in Jenkins et al. 2011). Crop consultant and farm dealers may specialize in services that would complement precision farming technologies whereas extension may emphasize on the needs of a particular region. The information provided by the former source may be more detailed and customized but may come at higher costs than that provided by the latter. Thus, farmers with higher income level could be expected to select crop consultants and/or farmer

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[18] Considering those of the age 14 and below as children.

input dealers while lower income farmers may be more likely to select extension as an information source. Further, higher household income could be related to higher risk taking capacity and the ability to meet the cost associated with information gathering, hence they are likely to choose multiple information sources. Based on this discussion, we expect that farmers with higher household income would be more likely to select informal over formal source of information (for NR)/both sources (for tea) compared to those with lower income.

Farm characteristics

Farm Size – Farm size would reflect the differences in the preference of information sources arising from scale (Schnitkey 1992). Mittal and Mehar (2013) have taken farm size as a proxy for farmer's economic status and hypothesizes that farm size is positively associated with the probability of using modern techniques and multiple sources of information. Within small growers (though the definition given by commodity boards are those having less than 10 hectares of land), there exists heterogeneity within this group in terms of land holding size. We consider area under tea/NR cultivation as a proxy for farm size. It is expected that as the farm size increases, a grower would be more likely to select both over only formal/informal sources.

Family labour employed - In the context of labour shortage, presence of family labour plays an important role in carrying out the NR cultivation[19]. Family labour at the disposal of the grower could be expected to enable the grower to have access to formal sources for instance they could take out time for attending training programmes, if there are other family members to help them with the cultivation. We have considered the number of family labour employed in NR cultivation.

Crop characteristics

Crop characteristics, which captures crop specificities could be expected to have an influence on the decision of the growers to interact with the information sources. NR cultivation are particularly subjected to certain protocols from the Rubber Board related to the cropping system which is required to be followed by the growers to get access to the schemes of the Board. Crop characteristics considered for NR are age of the NR trees, tapping system, number of days tapped, plant variety used and intercropping. It is to be noted that for tea only two crop characteristics are applicable namely age of the tea bushes and plant variety used. However, since the small tea

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[19] This is not applicable for tea, because in the survey area, small tea growers (78%) were found to be mostly reliant on hired workers.

growers mostly had tea bushes with an average bearing age of 20 years. This variable could not be considered. Rather only plant variety used by the tea growers was taken as a variable for crop characteristics.

Age of the NR trees – Age of the NR trees could be expected to have an influence on the decision to interact with information sources. Though the NR trees have a life span of over hundred years, its economic life period is around 32 years – immature phase of 7 years and productive phase of 25 years.[20] To offset the large capital investments and long gestation period of 7 years, the Rubber Board provides both capital and input subsidies during the immature phase. As such in the initial years, growers could be expected to interact with the formal sources to avail the subsidies. However, in the later years after the peak bearing age, the trees are subjected to slaughter tapping.[21] Slaughter tapping is undertaken to extract as much latex as possible without giving any consideration to the technique, intensity or standard of tapping. At this last phase, the grower would be less likely to access any information sources. Hence it could be expected that as the age of the trees increases, the growers will be less likely to interact with multiple information sources and formal source as well.

Tapping system - There are different systems of tapping NR trees- High frequency and low frequency tapping. High frequency would mean tapping the trees every day (d1) or in alternate days (referred to as d2). Low frequency tapping includes tapping the trees once in three days (d3), once in four days (d4) and once a week (d7). On the basis of various trials undertaken by the RRII, low frequency tapping is recommended to the growers since it provides various benefits to the growers in the context of the prevalent low NR prices, rising cost of production and acute shortage of skilled tappers (Thomas 2017). Alternate day tapping or high frequency tapping requires more than double the number of tappers available. A study conducted by RRII shows that there are only around 78 thousand tappers to tap trees available to tap trees. Further, it is observed that high frequency tapping leads to higher incidence of tapping panel dryness which results in reducing the harvesting life of the trees from 42-43 years to 17-20 years. Thereby forcing the grower to introduce slaughter tapping early.

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[20] http://rubberboard.org.in/ManageCultivation.asp?Id=3 (accessed on 13th September, 2016)
[21] Slaughter tapping refers to the last stage in the tapping cycle wherein highly intensive tapping is undertaken prior to replanting. Slaughter tapping is undertaken to extract as much latex as possible without giving any consideration to the technique, intensity or standard of tapping. http://rubberboard.org.in/ManageCultivation.asp?Id=123 (accessed on 14th August 2016).

It could be expected that if high frequency tapping (d2) is followed, then growers would be less likely to interact with the formal institutional arrangements since they are not strictly following the recommendation of the Rubber Board. Tapping system is considered as a dummy variable, 1 if following high frequency tapping, 0= low frequency tapping.

Number of days tapped – The number of days the NR trees are tapped is conditional on the tapping system followed. Number of days tapped would be higher if high frequency tapping system is followed and vice versa in case of low frequency tapping. It can be hypothesized that as the number of days the rubber trees are tapped increases, the growers would be less likely to interact with formal institutional arrangements on account of non-compliance of the Rubber Board recommendation related to tapping.

Plant variety used – Plant variety in the form of high yielding clones are approved by the Rubber Board to be used by the growers. As mentioned earlier, the foremost clone released was RRII 105. Thereafter several other newer variety of clones such as RRII 414 and RRII 430 have been released. Earlier, the Rubber Board used to supply quality planting materials to the growers at marginal rates. With Rubber Board discontinuing the distribution of planting materials, growers are now reliant on private nursery. It could be expected that those who are using the newer clones have knowledge about the recent management practices and are more likely to follow the recommendations of the Rubber Board and hence would be more likely interact with formal source. We have used plant variety dummy, 1= RRII 105, 0 = newer varieties.

In case of tea, there exists difference[22] between tea bushes raised from seeds and from clones in terms of their susceptibility to pests and diseases attack. Being genetically different, the tea bushes raised from seeds are heterogeneous, hence they can adjust to a wide range of environmental conditions without much change in their overall performance. However, unlike seeds, tea bushes raised from clones though high yielding are alike and are equally susceptible to pests and disease attack. It tends to suggest that being reliant on combinations of seeds and clones enables the small growers to undertake cultivation on their own without being reliant on recommended practices for the clonal variety, hence they are less likely to choose multiple information sources. We have used plant variety dummy, 1= using combinations of seeds and clones, 0 = only clones.

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[22] See Wickramaratne (1981) for a detailed discussion on tea clones and seeds.

Intercropping –With a view to enhance productivity, mono-cropping culture was promoted by the Rubber Board in the early years. The cultural practice was linked to the subsidy scheme for the small growers as such they had to adopt the mono-cropping pattern to avail the subsidy. However, mono-cropping has been argued to be inimical to the small holder's concern for reducing market risk associated with price fluctuations (Joseph, Thapa and Wicken 2014). Keeping in view to enable the growers to have a diversified income, intercropping has been allowed by the Rubber Board in recent times. Crops such as pineapple, banana, vegetables and yam are allowed to be cultivated during the immature phase of NR cultivation whereas crops such as coffee, cocoa and medicinal plants are recommended for the mature phase (Siju, George and Lakshmanan 2012). Though there are changes in the recommendations of the Rubber Board with regard to intercropping, the earlier protocol could be expected to have acted as an impediment for the growers to get access to the formal source. Hence, it is hypothesized that if growers are undertaking intercropping then they could be less likely to interact with formal source. We consider intercropping as a dummy variable where 1 equals engaged in intercropping, otherwise 0.

6. Descriptive analysis

Before we test the hypotheses through an econometric modelling of growers' choice of information sources (interaction with the information sources), it is important to provide a brief descriptive analysis of the variables that was outlined in our earlier discussion. Table 3 shows that there exist statistically significant difference between tea and NR with respect to the factors that would affect the choice of information sources.

Table 3: Sample characteristics of small tea growers and NR growers

Variables	units	Mean		Std. deviation		t-value
		Tea	NR	Tea	NR	
Experience of the grower	years	19.87	45.32	3.18	15.84	-17.58*
Education of the grower	years	12.97	11.49	2.88	2.81	4.53*
Proximate education	years	16.86	35.97	9.13	16.30	-11.83
Area under cultivation of respective crops	hectare	1.18	0.89	1.17	0.60	2.50*
Monthly income of the grower from the cultivation of respective crops as a proportion of total monthly income of the grower	proportion	0.68	0.53	0.28	0.42	-3.93*
Monthly Household income	Rs	25049.18	18494.00	23093		-2.66*
		Tea		NR		
Engaged in multiple occupations	% of growers	68.85		34.50		
Family labour employed	% of hhs	21.31		63.5		

Mean Age of the trees	Years	19.87	15.58
Mean tapping days	Days	na	125
Tapping system(high frequency tapping-d2)	% of growers	na	73.50

Note: * and ** indicates significant at 1 % and 5% level respectively; na=not applicable for tea

7. Modeling choice of information source by (tea and NR) grower households: A logistic regression analysis

Since the dependent variable is the choice of information sources which is a categorical variable with multiple categories, existing studies have used discrete choice models. Most frequently used discrete choice models are logit and probit models and they often yield results similar to one another (Schnitkey et al. 1992). Schnitkey et al. (1992) have employed multinomial logit model to examine the factors that influences farmers' use and perceived usefulness of information regarding production, marketing and financial decisions. They argue that use of multinomial probit model requires evaluation of multiple integrals over multivariate normal density functions. Since these evaluations are difficult and impractical to compute, they use multinomial logit analysis which is based on estimates obtained from maximum likelihood procedures.

However, there are studies such as by Just et al. (2006) which has used single equation probit regressions to analyse the choice of information sources by the farmers. Studies such as by Velandia et al. (2009) have argued that choice among the information sources are not mutually exclusive. However, multinomial logit regression implicitly assumes independence between alternative information sources. In such a case, multivariate probit regression[23] is considered to be appropriate for jointly predicting two or more choices of an individual. The multivariate probit model is said to recognize the possibility of simultaneous choice of various information sources and the potential correlation of choice decisions (Velandia et al.2009). Mittal and Mehar (2013) have also used multivariate probit model to examine the factors influencing the likelihood of the farmers in choosing difference information sources.

Multivariate probit model is based on estimation using simulated maximum likelihood (SML) method. Cappellari and Jenkins (2003) state that under standard conditions, the SML estimator is consistent as the number of draws and number of observations tend to infinity. Further, the sample size needed for reducing the finite sample bias will increase with the number of equations. They

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[23] Multivariate probit model is a natural extension of the probit model that allows more than one equation, with correlated disturbances, in the same spirit as the seemingly unrelated regressions model (Greene 2002).

point out that the simulation bias could be reduced to negligible levels when the number of draws is raised with the sample size. To ensure this, the number of draws should be equal to an integer approximately equal to the square root of the sample size.

Other things being equal, the more the number of draws, more accurate results could be expected. Their illustrations shows that the "multivariate probit's SML estimates are similar to ML estimator – conditional on the number of random draws used in the former being sufficiently large" (Cappellari and Jenkins 2003: 288).

Existing studies which have used multinomial probit model have considered sample size of over 1000 farming households. Since our total sample size is 200 for NR grower households and 122 for small tea growers households, which is relatively lesser than that used by the existing studies, we use logistic regression instead of multivariate probit model.

Drawing from the existing discussion, variables related to farm, farmer and crop characteristics are used in specifying the model for growers' choice of information sources. The dependent variable is choice of information sources. For tea, the choice of information sources has two categories namely only informal and both while NR, has three categories namely only formal, only informal and both. Hence, the appropriate specification in this context for tea growers is binomial logit model while for NR growers, it is multinomial logit model.

The estimated equation is as follows:

$$
\begin{aligned}
ML_{ij} \ = \ \alpha + \ & \beta_1 \ EXP_{ij} \ + \ \beta_2 \ EDU_{ij} \ + \beta_3 \ PROXEDU_{ij} \ + \ \beta_4 \ FPTF_{ij} + \beta_5 \ OCCU_{ij} + \beta_6 \ HHI_{ij} \\
& + \ \beta_7 \ AREA_{ij} \ + \ \beta_8 FAMLAB_{ij} \ + \beta_9 AGETREE_{ij} \ + \beta_{10} TAPPDAY_{ij} \\
& + \ \beta_{11} TAPPSYS_{ij} \ + \ \beta_{12} PLANTVAR_{ij} \ + \beta_{13} INTERCROP_{ij} \ + u_{ij}
\end{aligned}
$$

In case of tea, for all i = 1,2,……122 (growers); j = 0,1(choices)

In case of NR, for all i = 1,2,……200 (growers); j = 0,1,2 (choices)

Wherein ML_{ij} is the choice of information sources. In case of tea, it takes a value of 0, if the grower has chosen only informal source and a value of 1, if the grower has chosen both formal and informal source. In case of NR, it takes a value of 0, if the grower has chosen both formal and informal sources; a value of 1, if the grower has chosen only informal source; and a value of 3, if the grower has chosen only formal source.

EXP = experience of the grower in the cultivation of respective crops; EDU = education dummy; $PROXEDU$ = education of household members; $FPTF$ = whether the grower is engaged in full/part time farming; $OCCU$ = occupational status dummy; HHI = monthly household income; $AREA$ = area under the cultivation of respective crops; $FAMLAB$ = family labour employed; $AGETREE$ = age of the trees; $TAPPDAY$ = number of tapping days; $TAPPSYS$ = tapping system dummy; $PLANTVAR$ = plant variety dummy; $INTERCROP$ = intercropping dummy; u_{ij} = error term.

Results and discussion

Small Tea Growers: Table 4 gives the results of the estimated model for small tea growers. Only informal source is the reference category. The results are interpreted as odds ratios.

Considering the odds of growers to choose both sources over informal sources, farmer characteristics such as proximate education and household income and farm characteristics namely area under tea cultivation was found to be statistically significant. The odds ratio for proximate education is less than 1 and statistically significant at 10% level. For a per unit increase in the years of education of the household members, the odds of choosing both sources was lower compared to only informal source. This result is contrary to expectations. One plausible explanation for this could be that with the members of the grower households having higher education, they would be engaged in non-farm activities as such growers may not feel the need to invest their time and resources in accessing information from both sources, hence their reliance on easily accessible informal source compared to hardly available formal sources.

As hypothesised, with the increase in household income, the growers would be more likely to choose both sources over only informal source. This could be because as the household income of the grower increases, it would imply more resources at their disposal which could be used for accessing information from multiple sources.

With a per unit increase in the area under tea cultivation, the odds of accessing both sources was higher compared to only informal source. This result shows that as farm size increases, the growers would have the incentive to invest in multiple information sources to undertake cultivation. To account for non-linear relationship[24] between area under tea and information sources accessed,

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[24] Two way scatter with Lowess shows a non-linear relationship between area under tea cultivation and information sources accessed. Hence we have included the squared term of area in the model.

area squared was included as a variable in the model along with area under tea. It is observed that there is positive effect of area and a negative effect of area squared on the choice of both sources over informal source. This indicates that as the area under tea cultivation increases, the growers are more likely to choose both sources, however, with further increase in area, the growers are more likely to be reliant on only informal source.

Table 4: Estimates of Logistic Regression Model for the Choice of Information Source by the Small Tea Growers

Explanatory Variables	Both formal & informal	
	Coefficient	Odds Ratio
Farmer Characteristics		
Experience	0.140 (0.715)	1.150
Education dummy (1= higher secondary & above; 0 = secondary & below)	4.474 (14.97)	87.70
Proximate education	-0.067* (0.036)	0.935*
Full/part time farming	1.207 (1.571)	3.344
Occupational status (1= multiple occupations, 0 = only tea)	0.894 (1.208)	2.445
Log monthly hh income	2.852** (1.330)	17.32**
Farm Characteristics		
Area under tea cultivation	2.526** (1.240)	12.50**
Area square	-0.354* (0.196)	0.702*
Crop characteristics		
Plant variety (1= seed & clones; 0= only clones)	-2.363 (2.136)	0.094
Constant	-34.94* (19.25)	0.000*
Only informal source is the reference category		
Number of observations = 122; LR chi2(10) = 15.14; Prob>chi2 = 0.1270; Pseudo R2 = 0.2564		

Note: Figures in the parentheses are standard errors
'*', '**' and '***' indicates significance at 10%, 5% and 1% respectively

Natural Rubber Growers: We had estimated a multinomial logit model taking three categories namely only formal, only informal and both (see Table 5). The reference category considered is both sources. The results are as follows:

Considering the odds among the growers to choose only formal over both sources, farmer characteristics such as engagement in full/part time farming and crop characteristics such as number of days trees were tapped, tapping system and intercropping was observed to be statistically significant.

It was observed that with an increase in the proportion of income earned from NR indicating the engagement of the grower in full time farming lowers the odds of choosing only formal source over both. This implies that a grower engaged in full time NR farming is more likely to choose both sources over only formal source. As the number of days tapped increases, the odds of choosing only formal source over both sources decreased by 4 per cent. Thus the growers are more likely to choose both sources with an increase of number of days the trees are tapped.

The odds of choosing only formal over both sources are 30 times higher for growers following high frequency tapping than those following low frequency tapping. This result is contrary to our expectation. It could be indicative of the ease of access to the formal sources by the growers, despite the recommended practice of low frequency tapping not being followed by them. The inability of the growers to follow the recommended low frequency tapping could be on account of their need to retain the employed tappers in the context of labour shortage. Even if the growers are not following the recommendations of the Rubber Board in terms of adopting low frequency tapping, the growers do access the formal source suggesting the flexibility offered in terms of interacting with the Rubber Board. Further, as expected, those growers who undertook intercropping with NR had lower odds of accessing only formal source than both sources.

Regarding the odds among the growers to choose only informal over both sources, farmer characteristics (experience, education, engagement in full/part time farming), farm characteristics (area under NR cultivation), crop characteristics (such as plant variety used, intercropping) and interaction term between education and experience was found to be statistically significant.

With an increase in the experience of the grower, the probability of a grower to choose both sources over only informal source increases by 6.5 per cent. One possible explanation for this could be that with the gaining of more experience, their awareness about the increasingly complex environment in which they are operating in terms of pests and diseases, fluctuating prices and new technologies would increase. To solve such issues, along with their experience, they would seek information

from multiple sources. Thus, despite an increase in their experience, they had their reliance on both formal and informal source.

The odds of choosing only informal over both sources is lower for those with educational level of higher secondary and above than those having education of secondary and below. As per expectations, this indicates that as the educational level of the grower increases, they are more likely to choose multiple information sources over only informal source.

A one percent increase in the proportion of income earned from NR, indicating the engagement of the grower in full time farming, lowers the odds of choosing only informal source over both sources by 233 per cent. This implies that a grower engaged in full time NR farming is more likely to choose both over only formal source. It tends to suggest that a grower's engagement in full time farming would mean they could devote more time to farm decisions than part-time growers, hence their reliance on both sources over only informal source.

As the area under NR cultivation increases, the growers were less likely to choose only informal over both sources. This result is in line with the results of existing studies (Jenkins et al. 2011; Mittal and Mehar 2013) which shows that farm size is positively correlated with the selection of information sources. Further, in the field, growers reported that they had less incentive to contact any information sources since they owned very less amount of land. Thus indicating the importance of scale with regard to land for accessing the information source.

The odds of choosing only informal over both sources was five times higher for those using older variety of planting material than those using newer variety. This result in on expected lines since use of newer variety of planting material would imply that the growers are aware about the newer planting materials brought out by the Rubber Board. Hence they could be expected to interact with the formal source to get information on the agro-management practices related to it. Thus the choice of both sources is more likely than the choice of only informal source.

The odds of choosing only informal over both source was lower for those growers who undertook intercropping with NR than those resorting to monocropping. Even though the growers were following intercropping to diversify their earning, it does not seem to act as a disincentive for them to not access the formal source. It needs to be noted that earlier though monocropping was promoted by the Rubber Board as a criteria for accessing subsidy during the immature phase of NR. However, keeping in view the adverse effect of monocropping on the earning of the grower,

Rubber Board has accordingly undertaken steps to change their protocol. Thus, given this attempt on the part of the Rubber Board, the growers who are following intercropping are more likely to choose both sources over only informal source.

With regard to interaction term of education and experience of the grower, growers with higher education and longer experience were found to be more likely to choose only informal over both sources. This tends to suggest that the experience of the grower in terms of their own education and tacit knowledge gained from earlier generations could act as a substitute for the information obtained from both sources.

Table 5: Estimates of Multinomial Logit Model for the Choice of Information Source by the NR Growers

Explanatory Variables	Only formal		Only informal	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Farmer Characteristics				
Experience	0.097 (0.070)	1.101	-0.065*** (0.020)	0.937***
Education dummy (1= higher secondary & above; 0 = secondary & below)	3.752 (4.472)	42.63	-2.191* (1.259)	0.112*
Proximate education	-0.0008 (0.026)	0.999	-0.003 (0.011)	0.997
Full/part time farming	-5.171* (2.726)	0.006*	-2.336** (1.060)	0.097**
Occupational status	-1.311 (1.026)	0.269	-0.135 (0.478)	0.874
Log monthly hh income	0.116 (0.453)	1.123	-0.263 (0.222)	0.769
Farm Characteristics				
Area under cultivation	-0.338 (1.000)	0.713	-1.200* (0.621)	0.301*
Number of family labour employed	-0.967 (0.948)	0.380	-0.434 (0.270)	0.648
Family labour dummy(1= yes, 0 =no)	0.086 (1.413)	1.090	0.137 (0.576)	1.146
Crop characteristics				
Age of the trees	-0.001 (0.061)	0.999	0.029 (0.027)	1.029
Tapping days	-0.040** (0.019)	0.961**	-0.003 (0.007)	0.997
Tapping system	3.405* (2.003)	30.11*	-0.970 (0.705)	0.379
Plant variety used	0.593 (1.404)	1.809	1.670** (0.681)	5.311**

Intercropping	-2.220** (0.961)	0.109**	-0.773* (0.419)	0.462*
Area*full time/part time farming	2.039 (1.525)	7.683	1.175 (0.779)	3.238
Education* experience	-0.051 (0.075)	0.950	0.048* (0.025)	1.049*
Constant	-6.321 (6.198)	0.002	7.665*** (2.433)	2.132***
Both sources is the reference category				
Number of observations = 192; LR chi2(32) = 66.41; Prob>chi2 = 0.0003; Pseudo R2 = 0.2095				

Note: Figures in the parentheses are standard errors
'*', '**' and '***' indicates significance at 10%, 5% and 1% respectively

8. Summary and Conclusion

Using agricultural innovation system perspective, the paper has analysed the types of information sources involved in the dissemination of knowledge as well as the factors influencing the interaction with these sources by taking the case of two plantation crops – tea and natural rubber. Here the focus is on the small growers in these crops for whom interaction with various actors and getting information from them assumes significance. This is because they are resource poor and are faced with uncertainty over the cultivation of these perennial crops due to the long gestation lag in production. Moreover, these crops have historically received considerable attention of the State. This had led to the establishment of formal institutional arrangements for the generation and dissemination of knowledge to these growers.

It was observed that the small tea growers were mainly seeking information related to production from various formal and informal sources. This was because the growers were engaged only in the production part of the value chain. However, regarding the price of green leaves, none of the formal sources of information was observed to be involved in case of tea. This pointed towards the lack of proper price setting mechanism in tea unlike natural rubber wherein several formal and informal actors were involved in providing price related information to the small growers. Further, unlike tea growers, along with production, the NR growers were engaged in the processing and marketing of NR. The NR growers were getting information on production, processing and marketing from a set of both formal as well as informal actors.

Regarding the access of these growers to formal and informal information sources, it was understood that the tea growers were mostly interacting with only informal source or both (formal and informal source). None of the tea growers were accessing only formal source. While the NR growers interaction varied from only formal, only informal and both sources. This was indicative of multiple information sources available to the NR growers unlike for tea growers. Similar to the tea growers, though the reliance of the NR growers on informal source was over 50 per cent, the latter's access to formal sources was higher than the former. On account of informal sources having a deeply embedded position in communities as well as high levels of interpersonal relationship and interaction, informal mechanisms of information diffusion seemed to be important for both NR growers and small tea growers. However, the natural rubber growers' dependence on both formal and informal sources was relatively higher (32 per cent) than those for small tea growers (7 per cent).

Considering these various combinations of information sources accessed by the tea growers and NR growers, we attempted to understand the factors that influenced the choice of these sources by the growers.

Using discrete choice analysis, in case of tea it was observed that the growers choosing multiple information sources over only informal source were the ones with higher household income and larger area under tea cultivation. However, the variable area squared considered to account for non-linear relationship of area under tea cultivation with choice of information sources was found to be negative. This suggests that as that the area under tea cultivation increased, initially the growers were more likely to choose multiple information sources but as the area increased further, the growers were more likely to be reliant on only informal source. As opposed to the usually held notion of importance of education for accessing multiple information sources, education of the grower was found to be insignificant. However, growers with higher proximate education of the household were more likely to access only informal sources than both formal and informal sources. One plausible explanation for this could be that with the members of the grower households having higher education, they would be engaged in non-farm activities as such growers may not feel the need to invest their time and resources in accessing information from both sources, hence their reliance on easily accessible informal source compared to hardly available formal sources.

In case of NR, regarding the choice of only formal source over both sources, farmer and crop characteristics was observed to be statistically significant. As expected, it was found that the growers who were accessing information from both sources rather than only formal source were more likely to be engaged in full time farming and their cropping system was characterised by longer number of tapping days, and intercropping. Contrary to expectations, those who were following high frequency tapping (as against the recommendation of the Rubber Board), were found to be more likely to interact with only formal over both sources. This is suggestive of the flexibility offered in terms of interacting with the Rubber Board, in spite of the growers not following the recommended practice of low frequency tapping. The inability of follow the practice could be due to the necessity to retain the employed tappers in the context of labour shortage.

Pertaining to the choice of only informal source over both sources, farmer, farm and crop characteristics was found to be important factors influencing the choice of NR growers. The growers more likely to choose both sources were having longer experience in tea cultivation, with higher educational level, engaged in full time farming, having larger area under NR cultivation, using newer variety of planting material and engaged in intercropping. The interaction term of education and experience of the grower was found to be positively significant indicating that growers with higher educational level and longer years of experience were more likely to choose only informal source over both sources. Thus pointing out that knowledge of the grower in terms of their education and experience could act as a substitute for the information obtained from both sources. With regard to the intercropping system followed, it needs to be noted that even though the growers were following intercropping to diversify their earning, it does not seem to act as a disincentive for them to not access the formal source. It needs to be noted that earlier though monocropping was promoted by the Rubber Board as a criteria for accessing subsidy during the immature phase of NR. However, keeping in view the adverse effect of monocropping on the earning of the grower, Rubber Board has accordingly undertaken steps to change their protocol. Thus, given this attempt on the part of the Rubber Board, the growers who are following intercropping are more likely to choose both sources over only informal source.

From the discussion on the results of the discrete choice model, it can be said that in the dissemination process of knowledge though formal institutional mechanisms are there in place for tea, there seemed to be greater reliance on informal sources on account of unavailability of services from formal sources as well as due to certain farm and farmer characteristics. On the contrary,

institutional intervention which seemed to adjust as per the need of the NR growers, seems to have resulted in greater interaction of the growers with formal source. Though their interaction with informal source was also high, but it was not due to the lack of supply of such services from the formal source rather on account of farm, farmer and crop characteristics.

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