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Understanding the Knowledge and Social Networks in India- Case study of Bihar

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ABSTRACT

Knowledge networks and social networks are the drivers of information sharing and they play an important role in diffusion of technology and related knowledge. In this study the key informants in a village setup are studies to understand the farmer's network with an objective to understand the existing social, knowledge systems and their structure, characteristics and relationships between different actors. The purpose is to use these channels as means to disseminate technologies and related information. We use the network map analysis as a tool to demonstrate the linkages between the key actors. Attributes captured in the study are information flows between different actors, the type of information, timeliness and frequency of information and mode of communication. The study is undertaken in 6 districts covering 20 villages of Bihar where 111 key informants were interviewed and this is supplemented with survey of 1000 households. The paper uses a mixed approach of quantitative and qualitative analysis.

Keywords: Farmers networks, Social networks, Information and communication, Bihar, Technology dissemination

JEL codes: L15, Q16

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1. Introduction

Knowledge networks and social networks are the drivers for information sharing and they play an important role in diffusion of technology and related information & knowledge. These networks connect different stakeholders and agents having different roles in the network. They are either information creator or intermediar in the flow of information and sometimes alaso utilize these information themselves. Mapping these social and knowledge networks (SKN) and understanding their role in the system is an important strategy to promote wider dissemination of technology and related knowledge. Understanding of these networks will provide a platform for introducing the technologies and getting connected to wider groups of farming communities. This will help to channelize the energy of different agencies that exist in the agrarian system of particular geographical locations and provide opportunities to work along with them to attain the objective of faster diffusion of technology adoption and impact. With this background, this paper maps the knowledge networks and social networks existing in selected districts of Bihar. This is done with the objective to- Identify the linkages between these networks and farming households- How the farmers are associated with these networks? What information is delivered by the networks to the farmers? What constraints the functioning of these networks and what potential exists to use these knowledge networks for promoting wider knowledge use and alos identify the underutilized opportunities? The existing knowledge networks can be the potential entry points to disseminate information about technology, increase the chances of adoption of technology and eventually creating impact.

2. Data

The study focuses on Bihar where around 150 key informants were targeted but we could gather information from only 111. These interviewers form the part of social and knowledge networks done in 6 districts (Begusarai, Samastipur, Vaishali, Lakhisarai, Arah and Buxar) covering 20 randomly selected villages and the respondents were interviewed through a structured questionnaire during October- December 2013. The details from the key informant interviews are being supplemented by information from a household level data set of around 1000 farmers where they have responded about their social and political capital and information networks. This household survey of 1000 farmers was done as part of the Zero tillage adoption survey in Bihar under CSISA project in 2013. The key informants that the

study interviewed are the district agricultural officers, Block agricultural officers, agricultural coordinators, *kisan salahakars* that are part of Department of Agriculture, Govt. of Bihar. Others are the *Krishi Vigyan Kendra's* project coordinators, service providers, Progressive farmers, input dealers, NGOs and research institutions, representatives from *panchayat*, women groups, and farmers' cooperative. The study intended to interview all possible actors (major or minor) who interact with farmers for farming-based information. Based on the selected respondent pool, interviews were conducted at different geographical unit right from the village level to the state capital level wherever applicable.

The objective of this part of the research is to familiarize ourselves with the existing social, knowledge systems and their structure, characteristics and relationships between different actors. It is important to understand these social and knowledge networks to understand what are prominent channels of communication and exchange of information in particular geographies. Through these channels are very similar in different location and are governed by the similar state/ central government structures, but their functioning also depend on network nad linkaes with private firms, cooperatives and individuals. The major attributes captured through the key informant interviews are information flow between different actors, type of information, timeliness and frequency of information, mode of communication.

The study uses descriptive analysis to highlight importance of various attributes. In the study we use Network Analysis tool - **Netdraw©.** Netdraw© is a software developed by analytical technologies which is used to visualize the social network data in pictorial form. It incorporates attribute data into the diagrams to develop a network map using its inbuilt algorithm to connect the actors by the nodes. The networks is further characterized by the colors and shapes to define the actors or attributes. E.g. the actors are the respondents and nodes are source of information of knowledge in case of our analysis for Bihar. The attributes take for analysis were role and type of institution to which the individual is associated. The role was defined as shape and type as color as given in the social network analysis of Bihar (refer legend in Table 6 and details later in the paper).

3. What we know about knowledge networks from earlier studies and data

The boundaries of a social network can be interactional, spatial or temporal. Network Analysis is often used to elicit information regarding the farmers' agricultural information network. Goswami and Basu (2011) study has demonstrated the influence of individuals' position within agricultural information networks on their acceptance of new crops. It has provided some basic propositions in the given area and identified the factors that affect the adoption decision of farmers regarding the adoption of new crops. While the early generation adopters mostly had higher prestige scores within the network, the late generations were not necessarily the excluded ones of the network. Extension professionals may have ideas on how agricultural information flows in a network, they may understand the critical roles of important network nodes/ actors, may get sensitized regarding the important role of small and resource-poor farmers in diffusion process. Lamb et al. (2010)- by constructing maps of the connections between clusters of actors, demonstrated the extent to which network position coincides with qualitative characteristics of network actors.

An earlier CIMYYT, 2011 survey on sources of information and information needs analyses 240 households across 24 villages and it showed that the farmers gathered most of their information from traditional and modern media sources (Mittal, 2012). The most important information sources in Bihar, as also highlighted in that study were mainly other farmers and radio.

4. Results from the study based on Key Informant Interviews (KII)

4.1 Roles in the network

The key informants were identified and interviewed based on a pre-structured questionnaire that tries to understand the various knowledge networks- people, institutions, organizations with which these key actors interact. The key actors themselves play an important role in either creating a new information that is important for farmers in their agricultural activity or/ and also play an important role in transmitting the important information and knowledge about different aspects of agriculture and farming to farmers. These key actors are identified at state level, district level, block level and village level so as to have a right mix of creators and intermediaries of information in our pool. Total of 111 such interviews were conducted to get a variety of information that will help us to understand the knowledge networks that exist in

these districts. These actors are classified into six major groups by type of institutions (reclassification details in annexure Table 14) in the knowledge networks as presented in Table 2. Of the total key actors interviewed 37 % were from the Dept. of Agriculture Government of Bihar at state, district, block and panchayat level. This particular class comprises of the largest network of employees (roughly 300 per district) deployed for extension services to the farmers. At the village level progressive farmers who sometimes are also service providers (farmers who own farm machinery and offer custom hire services to adjoining farmers) form informal network with farmers for sharing information. Service providers and Progressive farmers form the second largest group interviewed (28.8%) because of their higher involvement in the whole network. They, in most cases, play role of the most crucial intermediary between government and farmers. Farmers in the village are more reliant on these progressive farmers, as they are from their own community and their is a matter of trust amongst them. Government also acknowledges these progressive farmers as an important part of the network and accordingly strategizes its information dissemination channel.

Table 3 further classify all these actors into three groups based on their roles in the information network. 'Creator of Information' means the actor who has brought this information on board to be disseminated for use. 'Intermediary to pass information' refers to actors who are involved in passing on of information from one actor to another within the network, not necessarily to the end users (farmers) only. 'Utilizer of Information' primarily refers to end users as well as users within the network. Users within the network utilize information to validate/refine/customize/demonstrate the information for themselves during the process of information transmission. Accordingly, one actor generally plays more than one role in the whole network as reflected in the
Table **3**.

We better understand this grouping by taking the example of how information about Zero tillage technology is created and who are the main players as intermediaries and also utilizers of the information is also presented in Figure 1.

The major role of the interviewed actors is that of intermediaries who pass the information received from government agencies to the farmers (82.9%), majority of them are also utilizers of the information (86.5%) (

Table **3**). People who are instrumental in creating information (6.3%) are also intermediary in passing the information to farmers. They are usually creators of different information and intermediary for some other information. These are people basically at state government level and block level. Only one service provider (amongst interviewed) in Vaishali district has been instrumental in creating information as well. This service provider is also a progressive farmers and thus whatever he observes from his knowledge and experiments in the field, he passed that information to the fellow villages either through personnel communication or through calling up on mobile phones. The category of intermediaries of information transmission mainly consists of actors at block level, KVK's (Krishi Vigyan Kendra's) and NGO's. In the total sample there are 19 respondents who only have the role of utilizing information and don't form a part of creating or passing information. These are mainly progressive farmers who don't see their role as passing information to other farmers, although farmers might be coming to them for their queries. 13 respondents mainly input dealers only see their role as information intermediaries. This is mainly because input dealers sell products that the private sector ask them to sell and they don't usually advise the farmers on their own because of lack of any new infor]mation, but only pass the information relevant to the products that they sell. Input dealers domain of information category mainly goes to improved seed varieties and herbicides. Farmers visiting these stores often do seek advice for better performing varieties and herbicides, as claimed by these input dealers. The District agricultural officer (DAO) interviewed in Vaishali also see his role as only the intermediary to pass information that he gets from other allied information agencies. There are 72 respondents (65%) who have the dual role of both intermediary and utilizer of information. Their distribution is given in Table 4.

4.2 Information Networks

The key actors in the network are connected to each other and thus play multiple roles - of creating, transmitting and utilizing information. It is interesting to see the linkages between these different actors and institutions and how they facilitate each other in this network. These results are presented in Table 5 for all the six districts together and further expressed in form of network map for individual districts to understand the differences across districts. This information was collected from the respondents by asking them to list the names of teams, people and organizations they interact with-in their job role. They were also asked to list if they get information from these sources or they give information to these sources or both.

Frequency of interaction with these other actors in network was also asked although it is not analyzed at present in Table 5.

For Bihar as a whole, the government institutions are well networked with similar government set-ups and have limited interactions with the non-government sources. Within the government institutions- *Krishi Salahakars* (who are the people in direct touch with farmers) do not interact directly with the other government actors, although they are very well networked with private input dealers. DAO's, Block development officers (BAO's), Agricultural coordinators (AC) and *Krishi Mela* are the most important information sources that widely form a part of the information network of most of the respondents. It is interesting to note that in these six districts CSISA[2] is also featuring as an important information source that key formal and informal networks interact with to get information. This perhaps happened because the village sample was drawn randomly from the list of CSISA-intervened villages of Bihar. It may or may not be the case in non-CSISA villages (villages where CSISA has not yet started its intervention). Also interesting to note that there is limited interaction of farmers with different types and institutions this also implies that limited feedback goes back to the system directly from farmers. This we will be exploring further in other sections of this paper.

4.3. Network mapping

Individual district network maps are also drawn and presented in figures (

Figure **2**, Figure 3,

Figure 4, Figure 5, Figure 6, Figure 7) to give a closer look to the dynamics of type of institutions and information sources and also the inter-linkages between them. The detailed legends used in these network maps is given below in Table 6.

Interpretation of visual data display- As the network maps are visual representation of the relationship between different actors, interpretations can be drawn from understanding the major source of information from the large number of actors attached to the nodes. The relationship is represented by lines or arrows. The frequency of contacts can be understood by

[2] CSISA is a "Cereal Systems initiative for South Asia" www.csisa.org

the thickness of the line (although in the analysis presented in this paper we have not used this) and direction of the relationship could be drawn from the arrows. The position of the nodes represents the importance of the source of information. They are positioned in center if most important and as their level of importance declines they move towrads the periphery or get isolated. The attributes helps us to distinguish the actors based on their characteristics to draw inference regarding the trait which are associated with the selection of a particular source. Coloring or giving shape to nodes/actors based on their attributes help us to group them. The density of each of the district map varies depending on number of respondents in that district and number of most prominent information networks prevailing in the location. Any source which is listed by only one actor is not incorporated in the map.

There are three dimensions based on which these networks are drawn. The first dimension is role of each respondent. Each actor is represented by a point which is differentiated by a shape. Different shapes differentiate between the actors based on their role in the information network. E.g. square represent the actor that have the role of intermediary in information network. The second dimension is that of color which distinguishes each actor based on the type of institution they belong to. e.g. red color denotes the actors belonging to government institution and black represent *panchayat* representatives. The third dimension is the key people or organization these actors interact with. These are represented by the abbreviations given in Table 6. Not all district network maps will have all the shapes, colors or abbreviations. They will differ based on the actors who responded to the interviews and their own individual interaction networks. E.g. in Buxar district all the actors responded as playing the role of intermediary (represented by a square) in the information network although they belonged to different type of institutions represented by different colors of the squares. Each individual actor in the network map is represented by the initial of its district e.g. ARA for Arah district, BEG for Begusarai district and the digits after it represent its unique id in the data base. E.g. SAM-10 means the respondent id 10 in Samastipur district. In a quick look at these maps we get the first impression about the important information sources and how different sources are networked or connected. If a source of information is towards the center and surrounded by lot many arrows, it signifies that it is prominently an important source of information and large number of actors in the network interacts with this source. Thus the important information sources are usually in center of these network maps and distance between the different sources also show how similar kind of actors interact closely with the different sources. E.g. in

Figure 4 in Buxar district CSISA and *Krishi Mela* (KM) are two prominent information sources to various key actor in network, while in the same map KVK and DAO fall on extreme outer side because they are connected to only three actors represented by BUX- 04, 05, 06.

Based on these maps the major inferences are cited below. Arah: In this district most of the knowledge actors are closely connected between CSISA, krishi Mela, input dealers, kisan salahakars and agricultural coordinators. In Arah, mostly the information intermediaries and utilizers are well knotted with these information sources. Begusarai: This district show a scattered network and thus not major interaction between different actors is visible in this map. Only BAO and Krishi salahakars are connected with closer to the centre in this map. Buxar: the map shows three major layers of actors and their interaction. In the centre is the Krishi Meal which is most prominent sources of networking area to most of the actors and other actors also closely interact with CSISA, Krishi Salahakar, Agricultural coordinators. The government department actors like DAO, BDO, ATMA, *Kisan Pathshala* and KVK fall on extreme left side of the map, although they show close proximity to each other. Lakhisarai: The map is uniform in its dimension with close proximity between DAO, BAO, State Agriculture Department, Krishi Mela and Agricultural coordinators. In this district, other farmers also form part of the knowledge network which is not prominent in other district maps. Samastipur: Not much proximity is evident between different knowledge actors in this district map. Although DAO and BAO are seen in the centre. In Vaishali district DAO, Krishi Mela and KVK are in the centre of the network with good proximity with CSISA as well.

4.4 Information feedback channels and mechanisms

Each of the key information actors were asked to list the channels through which they get feedback from the farmers. Some of them are directly in link with the farmers and some indirectly. The results are presented in the Figure 8 below. The three most important channels through which the information networks get feedback from farmer is during their personnel visits to farmers field, connecting to farmers through telephonic calls on their mobile phones and *krishi mela*. The key informants often said that they would interact with the farmers during personal visits which are often supplemented or followed up by interaction through mobile phones. Farmers give feedback to the information networks also through the agricultural extension officers. 31.7% feedback received through ‘personal visits’ is not a good sign of an

efficient model looking at the ratio of 'number of farmers to be served' and 'available extension personnel'. Based on census 2011 data, one agriculture extension person has to serve roughly 1500-2000 farming households. It indicates that many farmers would have not got a chance to put their feedback if waiting for a personal visit to mention their issues before the concerned person. It would have been a better condition if feedback collection process gets somehow centralized locally (at farmer cooperative, input dealers, service providers, etc.). Often when, farmers participate in trainings that also serve as a venue to receive feedbacks from farmers. Even when we look at the feedback channels by type of institutions (Table 7) the pattern is similar. Interesting aspect to note is that private input dealers and private company representatives do get feedback about farmer's requirements via interacting through the KVK's.

Unless the feedback received from the farmers is incorporated back into the system, through these information network actors the process is incomplete. This is usually the week linkage in the information network system. Most of the respondents have shown dissatisfaction towards the feedback incorporation process. They feel that either there is no formal system or the system has either not been appropriately established to incorporate feedback. Figure 9 present the responses that we got from the actors interviewed. It is interesting to note that no formal process exists in the system to incorporate the feedback received from the farmers.

Although the feedback received from the farmers are incorporated informally by individuals in the system of information network. Mostly, the feedbacks from the farmers are incorporated during awareness campaigns, trainings and workshops. All these processes try to handle farmer's common concerns about new technologies and pests etc. The actors in information network usually try to solve problems of farmers based on their own experience and capability and tend to interact personally with farmer to get a customized solution. The whole system of getting feedback (from farmers) and its subsequent incorporation (providing solutions to farmers) is largely based on 'personal visits' making it unexpectedly time consuming. For example, if a farmer reports pest infestation in his/her crop, it is reported to the kisan salahkar (deputed at panchayat level by Dept. of Agriculture, GoB). Actors interviewed within the Govt. & outside stated that kisan salahkars as of now are not equipped enough to give on-spot solution to most of the crop related problems reported by farmers. The message is then moved up to concerned agriculture institute/organization via AC, BAO and DAO to get a full proof solution. Then the solution again moves downward via the same channel to the farmers. In

such cases, lack of timeliness dilutes the relevance of that solution. But, the increased mobile penetration has somewhat resolved this challenge through accelerating the information flow/bypassing irrelevant layers in between. A pictorial depiction of both the prevalent processes is presented in Figure 10.

4.5 Information disseminated and its relevance

Usually the surveys ask the farmers what kind of information they get and how relevant they find that information. Through the KII's we have asked the key actors in the knowledge networks, about what information they give to the farmers and what is their perspective about relevance of that information to the farmer. We also asked them, if they think farmer is able to utilize the information. Similar analysis on farmer's perception about relevance and timeliness of information from important sources of information is also presented in section 5 using data from household survey.

The analysis show that the most prominent information that is delivered to the farmers is about seed varieties and other inputs like fertilisers, technologies like zero tillage, SRI and DSR, about weed and pest management, machinery and government programs related to agriculture. On the relevance of the information, largely all actors think that the information are of relevance to farmers, but largely they feel, that it is the information about seed, inputs, few new methods of technologies like ZT, DSR and government programs that are most relevant to farmers (Table 8). But on famers ability to utilise this information only 55-60 % respondents said that seed, input and zero tillage information is the only information that farmer is able to utilise and bring in action.

Further probing for the reason of not utilising other information revealed two important facts- First reason emerged being, the lack of next level support system (infrastructure) to bring this information into practice (Seed certification, Soil testing, Irrigation, PHT, LLL, Weather information). Secondly, some of the information is beyond the control of individual farmers to practice (output price and input price).

4.6 Major constraints and ways to make the system efficient

There are several constraints listed by the information network actors about why inspite of information and knowledge being transmitted to farmers, the farmers are not able to utilize the information completely. These are divided into five major type of constraint- Institutional,

Infrastructure, policy, poor access to inputs and knowledge (Source: *Authors calculations from Key informant survey*

Table 9). The actors in information network feel that the existing system lack appropriate manpower to handle the demand of the farmers, the available man power is not technically skilled to serve efficiently to the other actors in knowledge network. Skill set of staffs dealing with on-field issues is paramount (which is not the case as reported) because farmers in most cases expect on-spot solution rather than reporting their problem and then waiting to get the response/solution. There is lack of incentives for the farm level extension workers to work and often level of bureaucracy also hinder the work of the extension agents. Poor infrastructure like inappropriate roads acts as a constraint restricting the mobility of farmers and extension staffs/input dealers that result in non-convergence of the two. The formulation of certain government policies are not in coordination with the reality on the ground. Like certain technologies are promoted by the government which might not be suitable for certain locations, but still the government subsidy programme or other incentives make the adoption of that technology distorting. Respondents also cited that factors like recurring droughts and floods, fragmented lands (small landholding) often make it difficult for farmers to utilise the information appropriately.

We also asked the actors in the knowledge network to suggest ways through which these constraints can be reduced and feedback mechanisms can be strengthened so that information transmitted can be better utilized and adoption rate of technology can be improved. Open ended responses were provided by the key informants. The results are presented in
Table **10** for all the interviews. The table show that a large number of respondents have questioned the actual skill set and work motivation of the staff working in the extension and agricultural departments. They responded that the key state and district level departments don't have adequate manpower both actual availability and also proper qualified manpower to take care of the needs of the farmers on the field. Thus they have raised the issue of hiring manpower which is appropriately qualified to undertake the job responsibility and also to create an office environment where the staff works punctually and with dedication. It is suggested that the present staff should be provided training to upgrade their skills about new agricultural technologies and also skill sets on computers so that they can find the right information and also communicate it to the farmers and other beneficiaries of this information. Respondents have also highlighted that a lot of staff is hired on contractual basis and thus lack motivation

to devote time for the job whereas on the other hand permanent staff don't work with punctuality and lacks work ethics. This is a tricky situation that needs carefully handing human resource issues in terms of right monetization of benefits in balance with incentives to improve efficiency along with disincentive for not doing the job to satisfaction.

The other important step to improve the information dissemination process is use of modern communication tool. 15.9 % of the responses highlighted that timely delivery of information is very crucial and thus subsequently 8.7% of the respondents also proposed improving the ways in which this interaction with the farmers can be made efficient. They suggested that use of modern communication tools like video based clips and delivering messages through mobile phones can help to improve the efficiency of information delivery. Respondents also suggested that more frequent visits to the field by the information network actors is required so as to be able to understand what the information needs are and directly provide customized solutions. Farmers need more information about technology know-how and weather forecast, thus an appropriate feedback mechanism needs to be incorporated into the system to understand such needs. 9.1 percent of respondents suggested that along with delivering information it is equally important to make farmers aware about the new technologies and also train them in using them. This also needs improvement in infrastructure facilities like availability to proper electricity, irrigation facilities, soil testing facilities and efficient marketing channels and inputs availability in terms of quality and on time. The respondents said that technological innovations and knowledge in itself is not the sufficient condition to bring about benefits to farmers if these infrastructure constraints persist. In addition to this 7.1 per cent of the responses also directed towards improving the policy implementation processes. As an example that was often cited was non-availability of fertilizer and new variety of seeds on right time, even though subsidies are announced on these crucial inputs. It is suggested that most of the policy formulations take top to bottom approach which should be changes to inclusive feedback from the farmers and also the district level agricultural workers and krishi salahakars.

5. Results from farmer's household surveys

The results in this section are based on the data collected in 2013 under CSISA project (ref: Survey led by Alwin Keil and Joel Michalski) of 1000 randomly selected farmers from 40 villages across six districts of Bihar- Ara, Buxar, Begusarai, Lakhisarai, Samastipur, and Vaishali. Although the sample was stratified by Zero tillage adoption status to ensure that it

contains 400 ZT users and 600 non-users, but overall we feel that this sample will also be representative of the overall sample population to understand the sources of information used by farming HH's in these districts where the key informant surveys were also done. From the detailed household survey we have only used the details on farmer's sources of information to add in the dimension and perspective of farmers on the key information providers. The analysis is presented for the all the households together and is not sub-divided as ZT adopters or non-adopters.

Of the total 1000 households surveyed only 288 households responded to the quesation on sources of information. Of these 196 reportedly use of only one source of information, 62 households reported for 2 sources of information and 23 households reported for 3 sources of information and only 7 houses reported using more than 3 sources to gather information. These sources of information don't include farmer to farmer interactions. Because of reporting on multiple sources of information used by households, the total frequency of number of responses is 418 as shown in Table 11. The results show that krishi Mela and input dealers are the sources used by majority of the respondents. 46.2 percent of the households use krishi mela as the source of information. Agriculture extension officers are an important source of information for only 20 per cent of farmers, KVKs for 12.5 percent among the information provider's farmers are largely dependent on input dealers (46.2%). These results are similar to what had been seen earlier in other studies (NSSO 2005; Mittal and Mehar 2012, 2013). Sources of media and ICT are not prominently used by the farmers. Thus in further tables to simplify the comparison of inferences from key stakeholders we have dropped these sources as part of presentation.

Households interact with these sources of information for specific agriculture related information. The most prominent information need is that of seed varieties and seed prices. Input dealers and krishi mela is the main source of information for seed information to farmers (Table 12). The second most important information is about other inputs and their prices and for this farmers largely depend on input dealers. If we compare this with Figure 11 then it is clear that even the key actors of the knowledge network list seed variety and other inputs information as the most desirable information by farmer's earlier studies have concluded the same (NSSO, 2005; Mittal et.al, 2010, Mittal, 2012). Weed and pest control is the thirst most required information by farmers and this is followed by information on ZT, LLL, DSR and

land preparation and government programs. Although relatively fewer farmers have reported using this information, but the farmers usually get this information from krishi mela.

It is also important to understand how farmers rate the various sources of information as relevant source of information and how do they rate them in timeliness of proving information. The respondents were asked to respond in continuous scale of 1 to 5 where 1= very low relevance and very poor timing and 5 = very high relevance and very good timings. The mean scores of farming households that rated for these two indicators are presented in Table 13. The mean reliability score is highest for input dealers of 4.1 and SAU's of 4.0 followed by KVK of 3.9. But the farmers rely the least on commission agents with mean reliability's core of eths ample HH's as 3.0. Farmers also value for timely information delivery and most of them had averagely ranked all the sources as high on timeliness as well. Input dealers are rated as most timely source and commission agents as the least. The mean average scoring for relevance and timeliness as very similar for all the sources and may be farmers see relevance and timeliness as related variables.

6. Recommendation and conclusion

Based on the above analysis, it is largely seen that the key information and knowledge actors are connected to each other and thus play multiple roles of creating, transmitting and utilizing information. For Bihar as a whole, the government institutions are well networked with similar government set ups and have limited interactions with the non-government sources. Within their own group interaction with *Krishi Salahakars* who are the people in direct touch with farmers do not fall closely in the direct interaction zone of government institutions. While the same *Krishi Salahakars* are very well networked with private input dealers. It is recommended that *Krishi Salahakars*, service providers and if possible, progressive farmers should be used strategically to make the whole information & knowledge networks efficient. The action plan should be around 'development of skill-set of this group' in terms of local farming issues, new farmer friendly locally feasible technologies with technological know-how, and ongoing programs of government useful for farmers, etc. Local agriculture knowledge should be made available in local language for farmers reference (a local agri-knowledge bank) and should be further supplemented by 'consultation over phone with other concerned authorities' sitting outside the village. This can substantially increase the efficiency of the existing channel by reducing time lag in information flow and increasing accessibility of solutions around farmers.

This can further prove to be an important step in up scaling the adoption of improved agricultural technologies.

Service providers and progressive farmers should be used as an entry point for gathering localized knowledge and should be made nodal points for knowledge creation. They are at present playing an important role in knowledge transmission but this role can be further strengthened and brought into a systematic framework to strengthen the knowledge delivery of information about new technologies and know how. This can prove to be an important step in up-scaling the adoption of technologies.

The input dealers usually act as information transmission agents of the knowledge about inputs particularly seed varieties, herbicides and pesticides. But they are considered as an important source of information by the farmers because of mainly dealing with crucial farm inputs. If these input dealers are made the nodal points then it can be an effective information delivery channel making farmers aware about improved crop varieties & chemical molecules.

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Tables and Figures

Table 1. Basic Profile of the districts covered in the study

Name Of The Districts	Area (sq. km)	Population (Census 2011)	No. of Blocks	No. of Villages	Literacy Rate (%)	Sex Ratio	Major Cereal Crops
Buxar	1624	17,06,352	11	819	70.14	922	Paddy & Wheat
Arah	2474	27,28,407	14	1244	70.47	907	Paddy & Wheat
Vaishali	2036	34,95,021	17	1414	66.60	895	Wheat, Maize & Paddy
Samastipur	2904	42,54,782	21	1237	61.86	911	Maize, Paddy & Wheat
Begusarai	1880	29,70,541	18	1229	63.87	895	Paddy, Wheat & Maize
Lakhisarai	1294	10,00,912	7	472	62.42	902	Wheat & Maize

Source: http://gov.bih.nic.in/Profile/Districts.htm;

http://www.census2011.co.in/census/state/bihar.html

Table 2. Types of Institutions re-classified into different groups

Type of Institute	Key actors interviewed	
	In numbers	In per cent
Government	41	36.9

Cooperatives and NGO	10	9.0
KVK	4	3.6
Private input dealers	12	10.8
Service Providers and Progressive farmers	32	28.8
Member of *Panchayat*	12	10.8
Total	111	100.0

Source: Authors calculations from Key informant survey

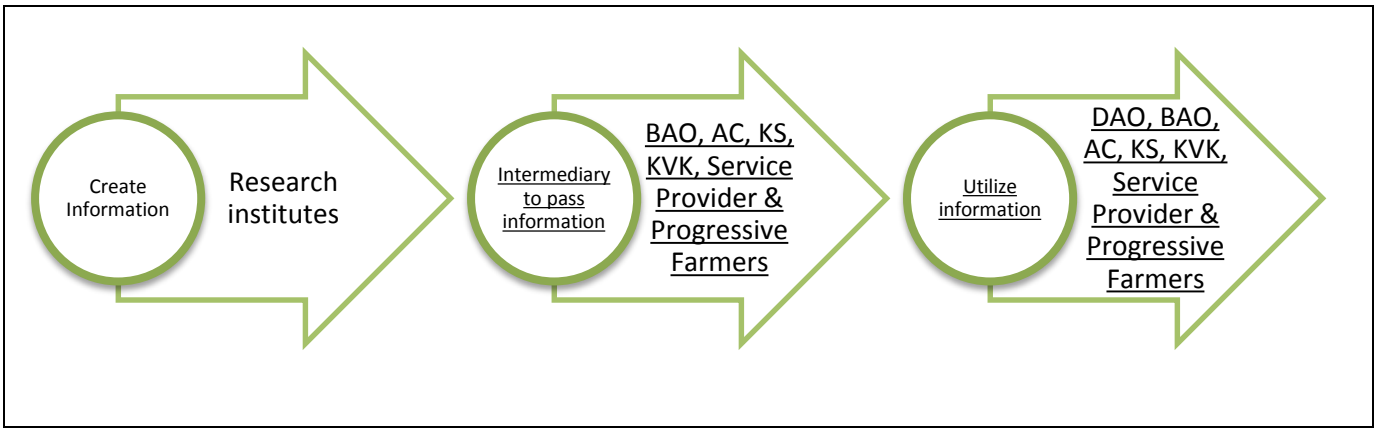
Table 3. Role of Interviewed respondents in information network

Role of key actors	**Key actors interviewed**		
	In numbers	**total N**	**In per cent**
Create Information	7	111	6.3
Intermediary to pass information	92	111	82.9
Utilize information	96	111	86.5

Note: same respondent may have multiple roles and thus the total is higher than the sample size

Source: Authors calculations from Key informant survey

Figure 1. Example of role of actors of knowledge network in flow of information of Zero Tillage technology



Source: Drawn by author based on observed trends

Table 4. Roles and designation of interviewed key actors in knowledge networks.

Designation	**Total Respondents**	**Role of both Intermediary and Utilizer**

	In numbers	In numbers	In per cent
Block Agricultural Officers	10	8	80.0
Subject Matter Specialist / Agricultural Coordinator	13	12	92.3
Krishi Salahakars	16	16	100.0
Progressive Farmers	9	1	11.1
Representative of Panchayat	12	11	91.7
Service Providers	7	6	85.7
Input dealers/ Distributors/ marketing team	12	3	25.0
Co-operatives	9	8	88.9
Both Progressive farmers and service providers	16	7	43.8
Total	111	72	64.9

Source: Authors calculations from Key informant survey

Table 5. Key information network by institutions and sources of information.

Type of institutions	**Govt.**	**KVKs**	**Cooperatives and NGO**	**Panchayat**	**Private input dealers**	**Service Providers and Progressive farmers**	**total**
Key people/ teams/ organization to interact with	***Number of key actors who responded***						
Formal Institutions							
DAO	39	3	4	7	5		58
BAO	23	6	1	1	21	12	64
Subject Matter Specialist /	18	5	2	1	18	10	54

Agricultural Coordinator							
Krishi Mela	23	3	7	21	10		64
Krishi Salahakar	4	5			27	9	45
KVK	20			1	4	1	26
SAU	26	2	4	0	4		36
ATMA	19			2	1	1	23
Informal Institutions/ Sources							
CSISA	10	3	5	3	23	4	48
Input Dealer	6			2	21	6	35
Other Farmers	15	1	3	9	5	1	34
News Paper	5	4		8	2	2	21
Private company representatives	1	1		13	3		18
Agriculture Cooperative	2	6			4	3	15
IFFCO	6	6	3				15
TV	5	2		2	4	2	15
total	222	47	29	70	152	51	571

Source: Authors calculations from Key informant survey

Table 6. Legends for reading network maps

Role of the respondent in information network	**Shape**
intermediary to pass information	Square
utilize information	Up triangle
create & intermediary to pass information	Box
intermediate & utilize information	Diamond
create, intermediary to pass & utilize information	Down triangle
Type of the institution	**Colour**
Government	Red

NGO + Co-operative	Yellow
KVK	Violet
Private company	Green
Farmers	Navy blue
Panchayat	Black
Key people/teams/organization	**Abbreviations**
Agricultural Coordinator (AC)	AC
Agriculture Cooperative	AgCo
ATMA	ATMA
Bank	Bank
Block Agricultural Officer	BAO
Block Development officer	BDO
BRBN (Bihar Rajya Beez Nigam)	BRBN
CSISA, CGIAR, CIMMYT, IRRI	CSISA
District Agricultural Officer	DAO
ICAR	ICAR
IFFCO	IFFCO
Input Dealer	I/PD
JDA	JDA
Kissan call center	KCC
Krishi Mela	KM
Krishi pathshala	KP
Krishi Salahakar	KS
KVK	KVK
Market	MKT
Ministry of agriculture	MoA
National Seed Cooperation	NSC
Nehru Yuva Kendra	NYK
NGO	NGO
Other Farmers	OthFr
private company representatives	PVT

Rabi Mahotsava	RM
SAU- Pusa, Sabour, Dhumrao Krishi Vishwavidhalya	SAU
Service provider	SP
State Agriculture department	SAgD
TV, Newspaper, magazine, Radio,	Media
Tri development Cooperation	TDC

Figure 2. Arah district (N= 33)

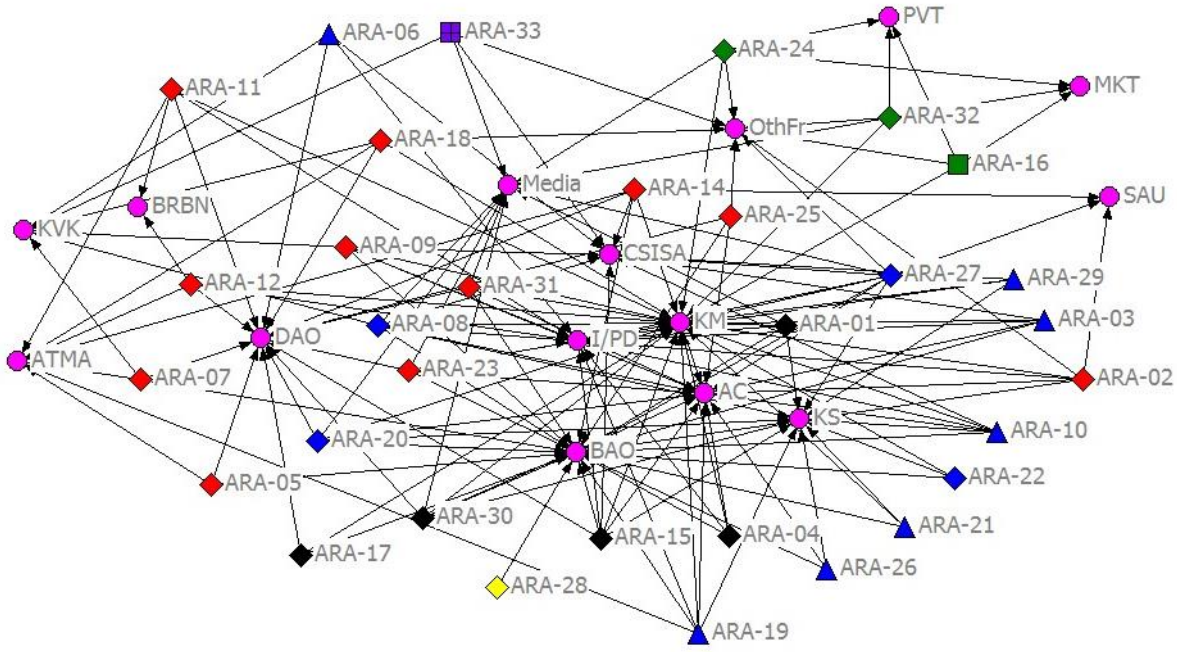


Figure 3. Begusarai district (N=17)

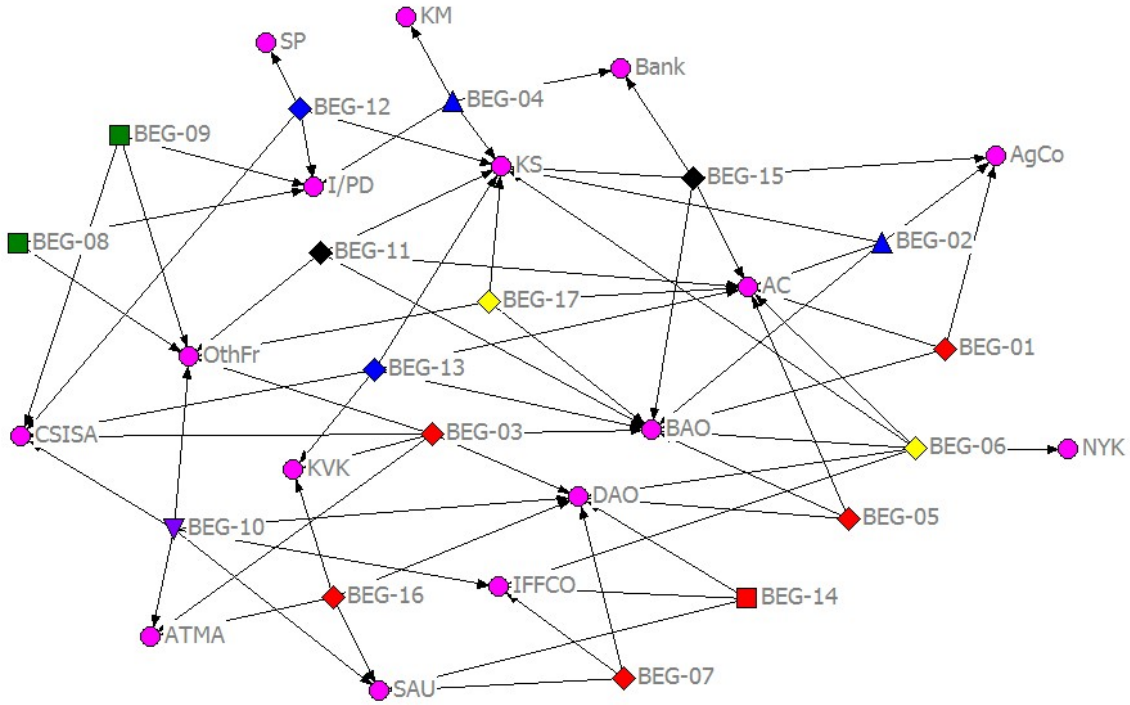


Figure 4. Buxar district (N= 16)

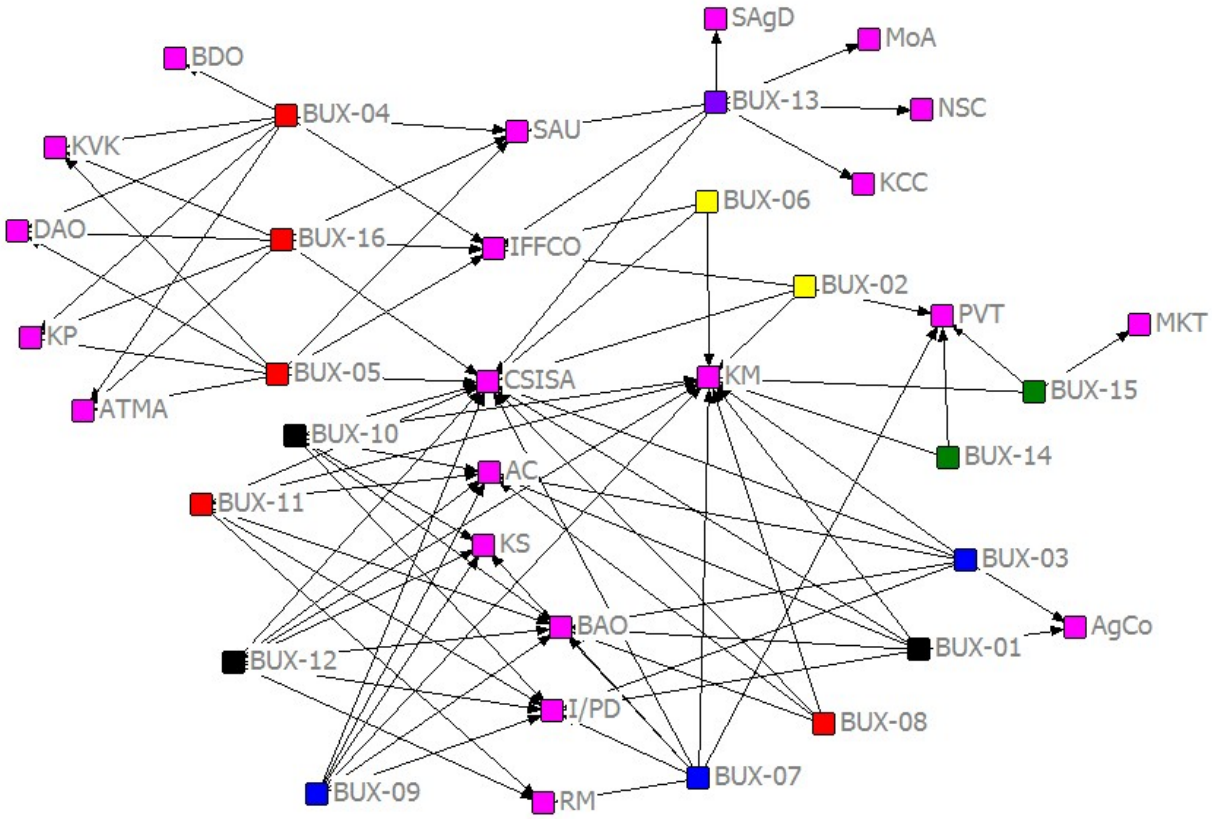


Figure 5. Lakhisarai district (N=14)

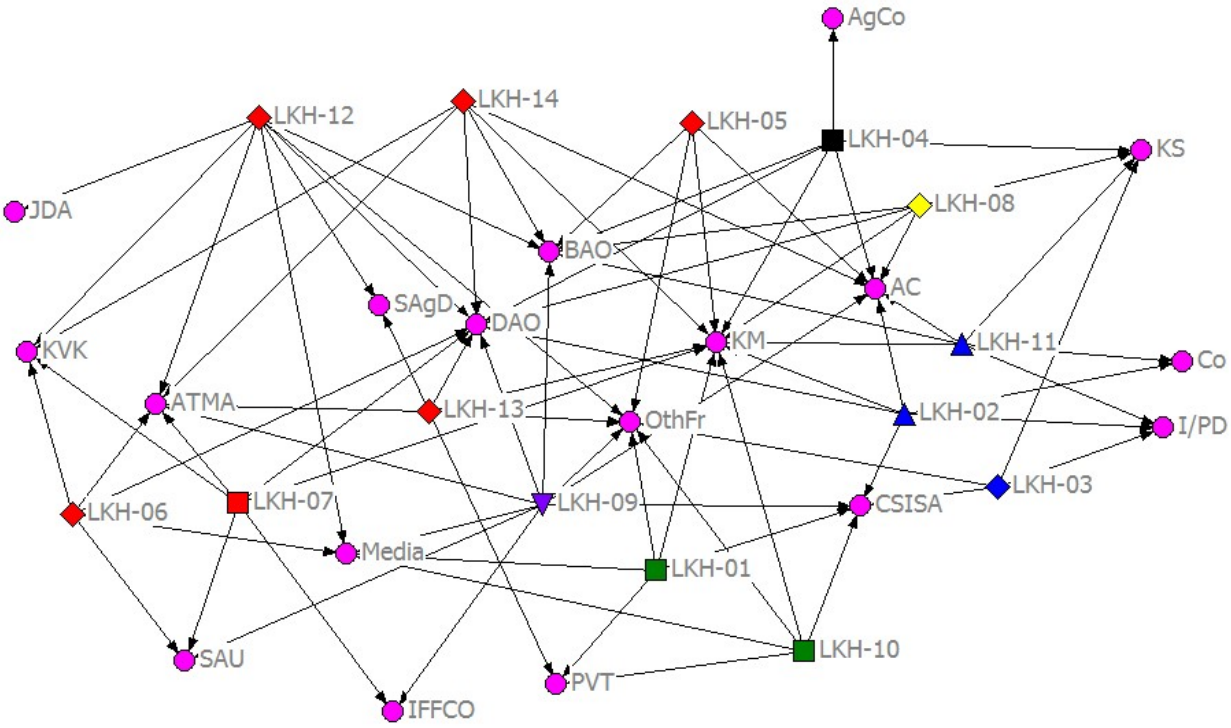


Figure 6. Samastipur district (N= 17)

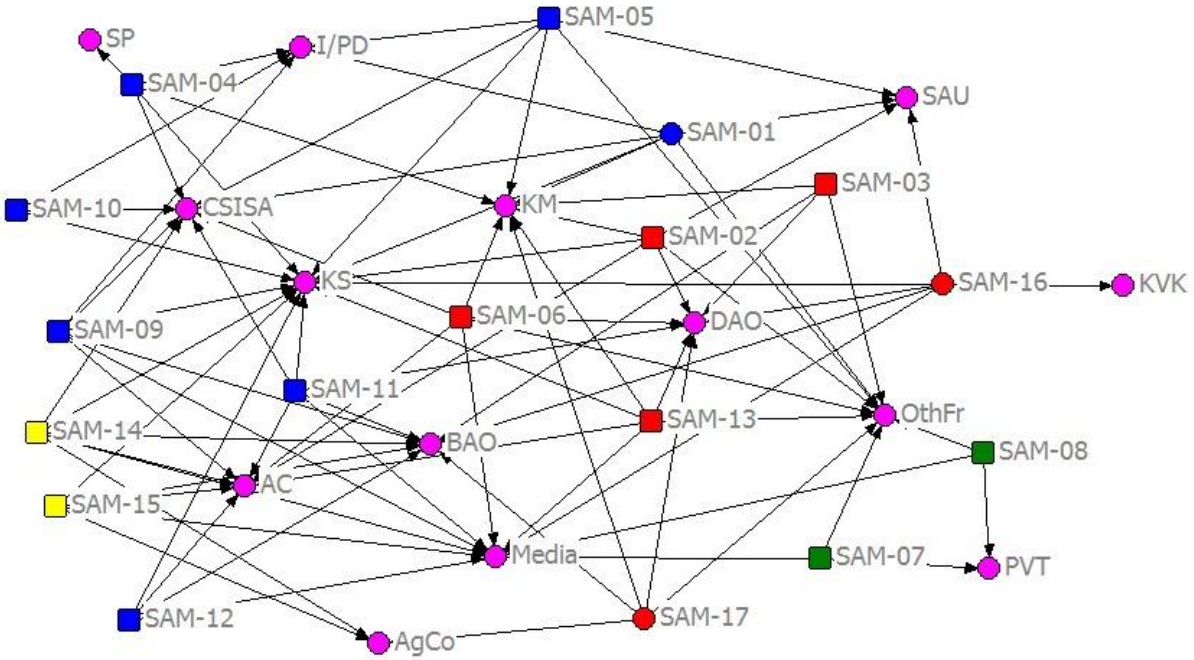


Figure 7. Vaishali District (N= 13)

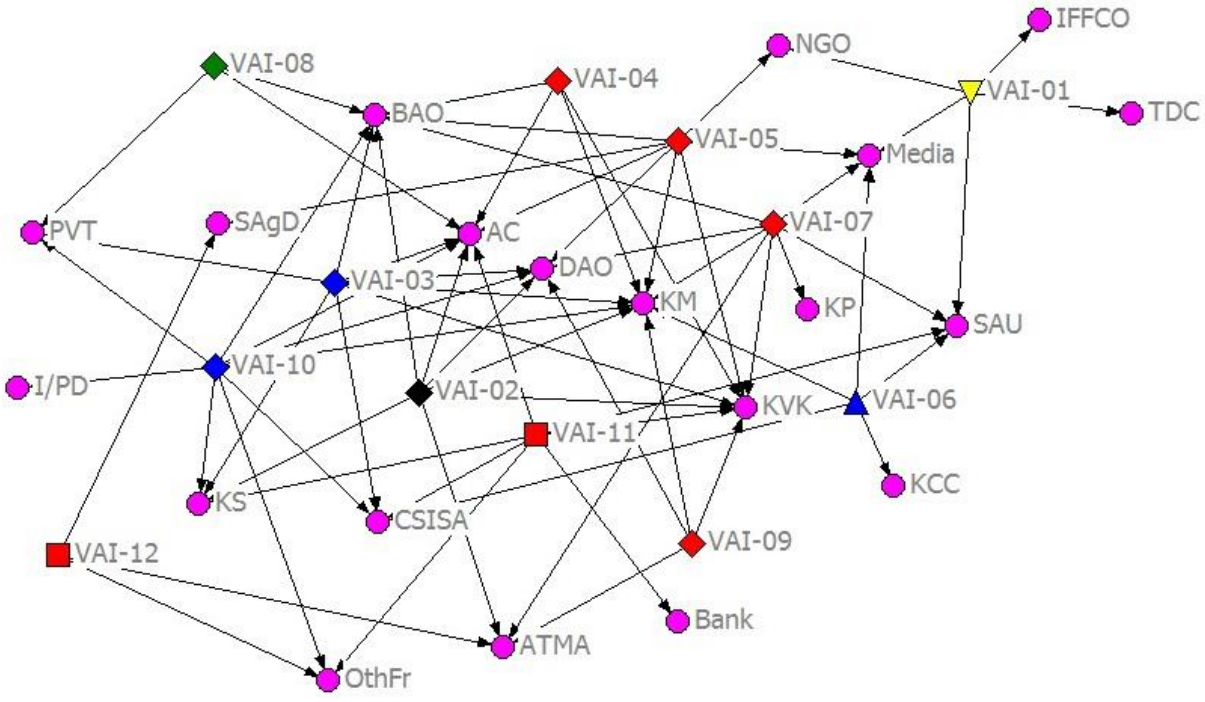
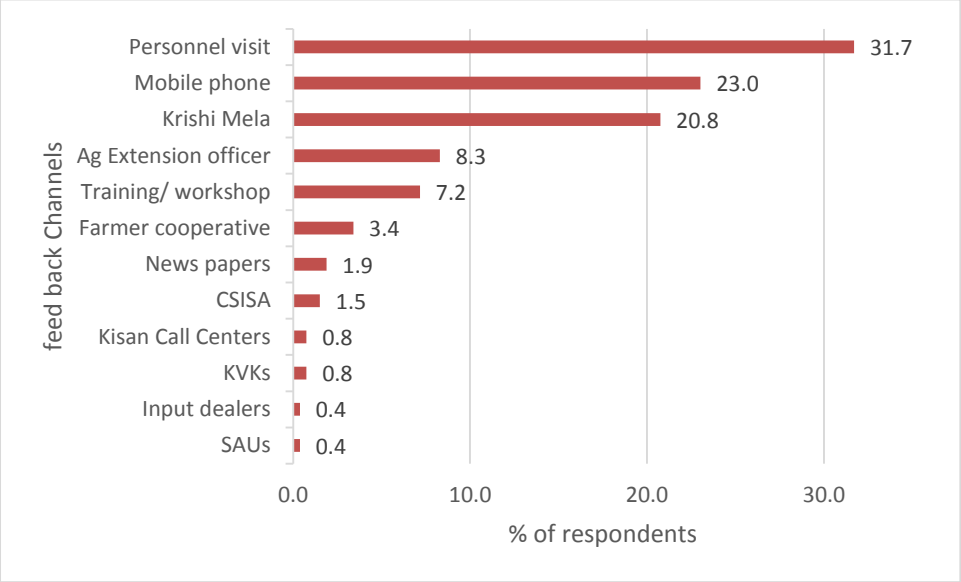


Figure 8. Feedback channels that connect key informants with farmers



Note: Multiple channels are used by each actor and 21 actors didn't respond about any channel.

Table 7. Feedback channels by type of institutions

Type of institute	**Government**	**Cooperatives and NGO e**	**KVK**	**Private input dealers**	**Service Providers and Progressive farmers**	**Panchayat**
Feedback channel	***Percent of respondents***					
KVK	0.7	-	6.7	36.7	-	-
Personal visits	26.4	38.9	13.3		38.5	50
News paper	2.9	-	-	3.3	-	-
Kissan Call center	-	-	13.3	-	-	-
Mobile phones	21.4	33.3	20	30.0	25.6	12.5
Trainings	11.4	-	13.3	-	2.6	-
CSISA	0.7	-	13.3	-	2.6	-

SAU	0.7	-		-	-	-
Krishi Mela	17.9	27.8	20	23.3	17.9	33.3
Ag Extension	13.6	-	-	3.3	5.1	-
Farmer Cooperatives	3.6	-	-	3.3	7.7	-

Note: - represent not cited as a feedback channel

Source: Authors calculations from Key informant survey

Figure 9. Mechanisms to incorporate feedback

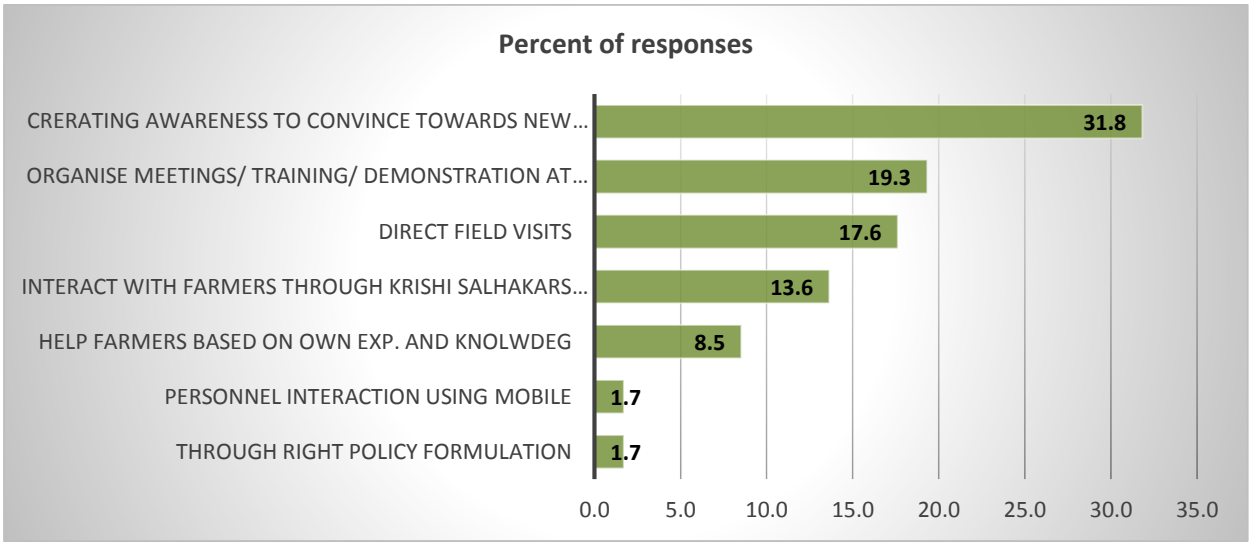
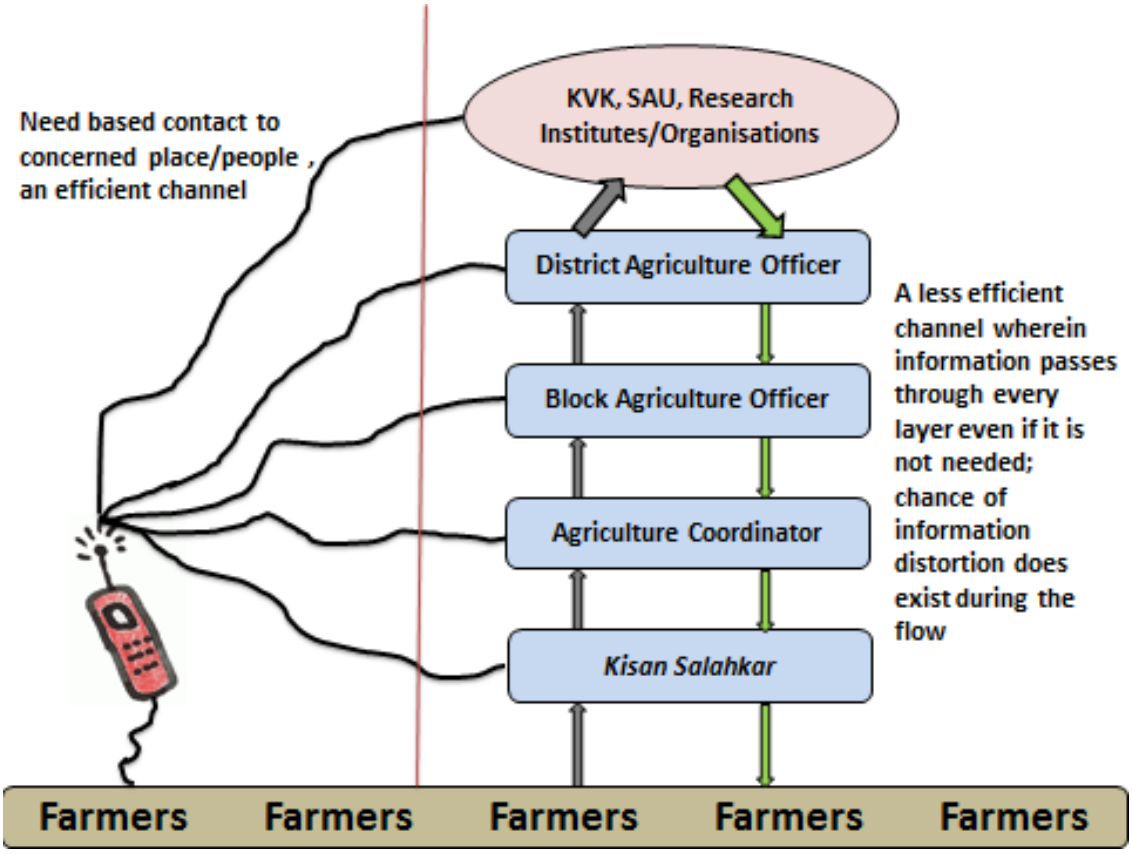


Figure 10. Common feedback mechanism prevalent among knowledge network in Bihar



Source: Drawn by author based on observed trends

Figure 11. Type of information disseminated through the knowledge networks

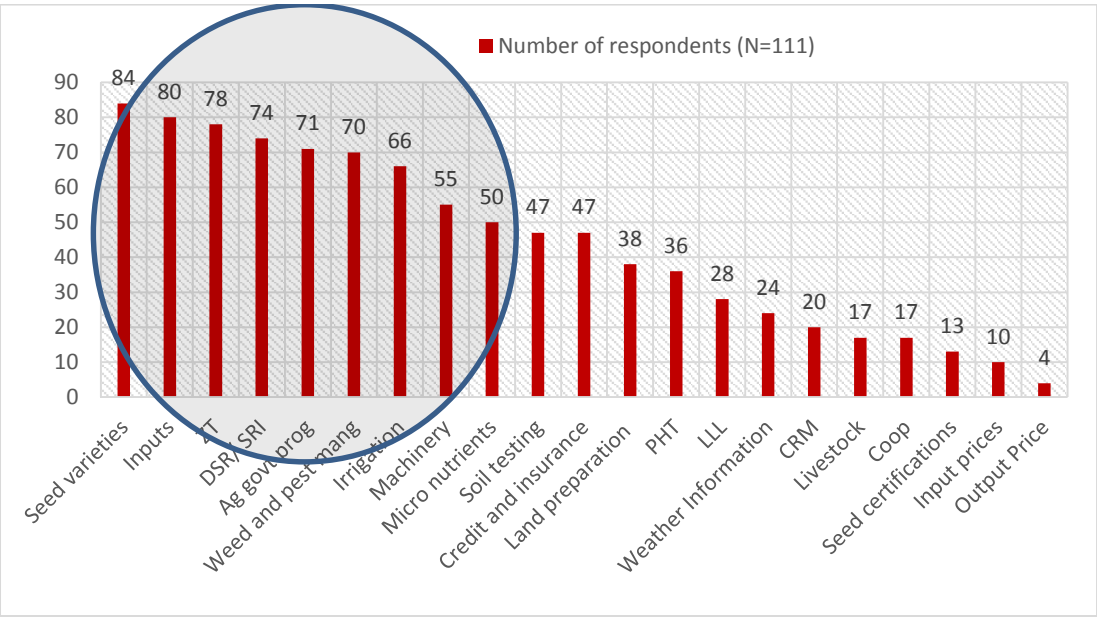


Table 8: Knowledge network actors' perspective on relevance and usability of information

Type of information	In your opinion how relevant do farmers find this information		Are farmers able to use this information appropriately?
	% of respondents saying 'Somewhat relevant'	% of respondents saying 'very high relevance)	% of respondents saying yes
Seed varieties	26.1	**63.1**	**56.8**
Other inputs (fertilizer, pesticides, herbicides)	11.7	**70.3**	**63.3**
Zero Tillage	19.8	**64.0**	**57.6**
DSR/ MTR/ SRI	20.7	**56.8**	**51.1**
Agriculture related govt. schemes and programs	20.7	**55.0**	49.5
Weed and inspect pest management	20.7	**54.1**	48.7
Irrigation	25.2	42.3	38.1
Machinery / implements	14.4	41.4	37.3
Micro nutrients/ nutrient management	11.7	35.1	31.7
Soil testing	21.6	21.6	19.5
Credit and insurance	24.3	23.4	21.1
Land preparation	13.5	20.7	18.7
Post-harvest technologies	18.0	18.0	16.2
Land laser levelers	13.5	13.5	12.2
Weather Information	15.3	8.1	7.3
Crop residue management	12.6	3.6	3.2

Animal husbandry / livestock management	6.3	9.0	8.1
Cooperatives/ organizations	8.1	7.2	6.5
Seed certifications	3.6	8.1	7.3
Input prices	8.1	1.8	1.6
Producers price/ MSP	2.7	0.9	0.8

Source: Authors calculations from Key informant survey

Table 9. Constraints in utilisation of information

Constraint	Number of responses	In Per cent
Institutional systems	14	9.7
Infrastructure- Road and electricity	14	9.7
Policy issue	7	4.8
High cost of inputs and lack of credit	28	19.3
Non availability or timely availability of inputs	48	33.1
Lack of awareness	34	23.4
Total	145	100

Note: Multiple constraints cited

Source: Authors calculations from Key informant survey

Table 10. Suggestions by respondents to improve the knowledge networks

Suggestion	Number of responses	In Per cent
Improve skill sets	50	19.8
improve work efficiency and ethics	47	18.7
Improve infrastructure (computers, electricity, irrigation facility, soil testing, marketing facility etc.)	23	9.1
Improve information dissemination	40	15.9
Improve quality check parameters	7	2.8
Improve farmers information and knowledge base about new technologies	23	9.1

Improve inputs supply like fertilizer, seed especially new varieties	18	7.1
Improve ways to interact with farmers	22	8.7
Improve the process of policy implementation	18	7.1
Improve function of farmer cooperatives	4	1.6
Total	252	100

Source: Authors calculations from Key informant survey

Table 11. Major sources of information to farmers

Information Sources	**Number of responses**	**Percentage of responses (N= 418)**	**Percent of Households (N= 288)**
KVK's	36	8.6	12.5
SAU's	6	1.4	2.1
Krishi Mela	133	31.8	46.2
Ag Extn officers	58	13.9	20.1
input dealers	109	26.1	37.8
commission agents	6	1.4	2.1
farmer cooperatives	12	2.9	4.2
television prog	16	3.8	5.6
Radio	21	5	7.3
news paper	17	4.1	5.9
Kissan call centers	2	0.5	0.7
mobile phone based services	2	0.5	0.7
Total	418	100	145.1

Note: Here in this analysis N is the ones who have responded and not the complete number of households surveyed.

Source: Authors calculations from household survey

Table 12. Number of households using different types of information from different sources.

	Sources of information							
Type of information	**KVK's**	**SAU's**	**Krishi Mela**	**Ag Extn officers**	**input dealers**	**Comm-ission agents**	**farmer coop.**	**Total**
Land preparation and soil testing	11	1	**27**	16	4	1	2	62
Seed varieties and seed prices	23	6	**80**	44	**98**	6	4	**261**
Other inputs (fertilizer, pesticides, herbicides) and their prices	5	4	**36**	24	**68**	3	6	**146**
Zero Tillage/ Land Laser Leveling/ Direct Seeded Rice	11	2	**42**	14	2	0	3	74
Weed and pest control	12	1	**33**	11	28	1	1	87
Rainfall and temp. forecasts	1	0	2	7	1	0	1	12
New pests/ diseases	1	0	4	0	6	0	0	11
New harvesting techy	2	1	6	1	1	0	0	11
Market prices of produce	0	0	3	1	20	0	3	27
Credit and insurance	1	0	0	1	1	0	2	5
Agri. related govt. schemes and programs	8	1	**29**	12	7	0	4	61
Machinery / implements	1	0	**29**	1	0	0	0	31

Animal husbandry / livestock management	1	0	5	1	1	0	0	8
Crop residue management	0	0	0	0	0	0	0	0

Source: Authors calculations from household survey

Table 13. Farmers rating to sources of information on relevance and timeliness of the source.

Sources of information	**(1= very low relevance) and 5= (very high relevance)**	**No. of respondents (1= very poor timing) and 5= (very good timing)**
	Relevance mean score	Timeliness mean score
KVK's	3.9	3.6
SAU's	4.0	3.8
Krishi Mela	3.6	3.4
Ag Extn officers	3.7	3.7
input dealers	4.1	4.1
commission agents	3.0	3.0
farmer cooperatives	3.3	3.3

Source: Authors calculations from household survey

Annexure

Table 14. Types of Institutions classifications

S.No	**Type of institution**	**It includes**
1	Government	District Agricultural officers, block agricultural officers, agricultural coordinators, Krishi Salahakars and State government officials
2	Cooperatives and NGO	Cooperatives and NGO
3	KVK	Programme coordinators of KVK
4	Private input dealers	Input dealers, distributors and input marketing teams

5	Service Providers and Progressive farmers	Service Providers and Progressive farmers
6	Member of *Panchayat*	Representative of Panchayat

Source: Authors classification