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Do Information Networks Enhance Adoption of Sustainable Agricultural Practices? Evidence from Northern Dry Zone of Karnataka, India

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ABSTRACT

The study aimed to analyze the perception of farmers towards sustainable agricultural practices (SAPs) and identify social networks using primary data collected randomly from 300 farmers of the northern dry zone of Karnataka. Five-point Likert scale was used to analyze the perception of farmers towards SAPs and open-source software named "Gephi" was used to map farmers' social networks. Farmers' perceptions towards SAPs were poor and only one in eight respondents reported high perception towards SAPs. Comparatively, large farmers had better perception towards SAPs and had better access to capacity building (extension contact and farm events) than the small and marginal farmers. Social capital (neighbor, progressive and relative farmers) had also played an important role in spreading SAPs related information among the farmers. However, local input dealers failed to be key informants and hardly disseminated information regarding SAPs. Government extension officials were the dominant informants on SAPs. Given the low level of adoption of SAPs in the study area, exploiting the potential of ICTs, training local input dealers, capacity building of the farmers and effective utilization of social capital are the suggested policy options to enhance the adoption of SAPs.

INTRODUCTION

Agricultural extension system in India primarily disseminates information about latest agricultural technologies and management practices, assisting in agricultural production and rural development (Nedumaran et al., 2019). However, lack of knowledge about latest technologies, low-cost eco-friendly agricultural practices, and marketing strategies would reduce the profitability of farming. So, agricultural extension services should bridge the gap between research labs and millions of small and marginal farmers, timely and efficiently. In developing countries, agricultural systems are becoming knowledge-intensive, and information is becoming a vital input (Babu et al., 2011; Mittal & Mehar, 2015). Indian agricultural extension system has significantly reduced the knowledge gap and it has been restructured multiple times (Mittal & Mehar, 2012). However, the number of operational holdings for each agricultural extension agent was around 1156 and on an average an extension agent covers 1187 ha of cropped area (Sajesh & Suresh, 2016). This ratio seems to be massive for every extension agent and it reduces the connectivity with farmers. Various studies reported that still the local cosmopolite sources dominate the information network of the majority farmers (Bhagat et al., 2004; Raina et al., 2011; Nain et al., 2015; Ravikumar et el., 2015; Panda et al., 2019). However, in recent years, extension system has changed its perspective from 'linear technology transfer' to pluralistic

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'innovation system' involving multiple agencies in information dissemination (Graforth, 2011).

Integrating multiple agencies like government officials, local input dealers, and private agri-input manufacturers, would increase the effectiveness of extension advisory services. Particularly, local agricultural input dealers are in frequent contact with the farmers and have gained farmers' trust (Nain & Chandel, 2013). Further, the input dealers have better understanding about the localized problems, and easy access to farmers' field (Singh et al., 2016). Further, they lend credit to farmers and buy their final produces, making them indispensable in the information chain. Though they have doorstep access, they mostly recommend conventional cultural practices, sub-standard seeds, agro-chemical inputs, and not Sustainable Agricultural Practices (SAPs). So, to utilize their effectiveness in disseminating information among farmers, National Institute of Agricultural Extension and Management (MANAGE) has initiated a formal training program for the input dealers to provide formal education about the extension services and regulate their activities (MANAGE, 2012). Recentlylaunched *Pradhan Mantri Kisan Samriddhi Kendras*, are aimed to create awareness among the farmers about prudential use of chemical inputs apart from retailing fertilisers (PIB, 2022).

SAPs such as micro irrigation, soil and water conservation practices, agro-forestry, integrated farming systems, integrated pest management, crop rotation etc. have a vital role to maintain sustainability of agriculture in the long run. These practices are formulated in such a way to reduce over exploitation of natural resources without reducing the profitability of farming and are subsidized by the Indian Government. Though such schemes were launched by the government, to witness reduction in chemical usage and regulate over exploitation of resources, perception of farmers about SAPs should be changed. For which agricultural extension would play a crucial role. Hence, this study is formulated to analyze the level of perception of farmers towards SAPs and map the network of farmers with their information sources and figure out the most effective way of information dissemination that would help in adopting SAPs.

METHODOLOGY

The study was carried out in Northern Dry Zone (NDZ) of Karnataka. Three stage sampling was adopted and four districts from NDZ namely, Vijayapur, Bagalkot, Belagavi, and Gadag were randomly selected. From these selected districts 300 farmers were surveyed from 15 villages selected in random from 15 taluks. Regarding source of information, if a farmer has access to internet at least one hour a day, a score of "1" was given and "0" otherwise. Similar scores were given for accessing "Radio/TV." Likewise, a score of "1" was given to farmers who had extension contact at least once a month, and for those who have attended a farm event in the previous year, and if not, a score of "0" was given. With respect to print media usage, a score of "1" was given to those who have access at least once a week, and "0" otherwise. If a respondent had access to any one of the information sources, he was given a score of "1," and if he/she had access to all the sources, a score of "5" was given.

With respect to perception towards SAPs, 15 questions were asked to the farmers and their responses were recorded in a 5-point Likert Scale (strongly disagree, disagree, neutral, agree, and strongly agree). The constructed scale was reliable with an alpha value of 0.86. Since all the statements are positive, respondents who had "strongly disagreed" the statement was given a score of "1", whereas a score of "5" was given to those who had "Strongly Agreed". So, the total perception score is the sum of the scores of 15 statements for each farmer, which ranged between 15 (15x1) and 75 (15x5). Based on mean and standard deviation of the total perception score, the respondents were classified as having "Low," "Medium," and "High" level of perception towards SAPs. Weighted Average Score (WAS) was calculated by multiplying the frequency of response with the corresponding scores as mentioned above and dividing it by total number of respondents (N=300). Further, to exhibit the information dissemination networks on SAPs, the inquiry, *"Who are your most important source of information on SAPs?"* was recorded. Degree centrality denotes the number of ties a node has. More the number of linkages (ties) higher the level of centrality and vice versa. It outlines the importance of a particular actor in the network (Landherr et al., 2010). It could be formalized as

$$\sigma D\ (x) = \sum a_{xi}$$

Where, σD is the degree centrality score for node x using an adjacent matrix A= (a_{ij}). A software called 'Gephi' was used for pictorial representation. However, betweenness, closeness and eigenvector were not given importance as it is out of the scope of the study.

RESULTS AND DISCUSSION

Farmers' access to different sources of information

Regarding the respondents' access to different sources of information, about half the proportion had access to internet at least one hour per day and watched television / listened to radio at least one hour per day (Table 1); around 47 per cent participated in farm events such as mela, conferences, demonstration, meetings and agri-expo. However, only one-third had reported to contact the government agricultural extension officials at least once a month. Whereas, nearly 46 per cent opined that they contact local input dealers at least once a month. Nearly, 70 per cent of the farmers have received information either from relative, neighbor or progressive farmers.

Among different information sources, nearly a half of the total respondents had access to internet at least one hour a day, but only one-third had reported to contact with extension agents. Besides, majority of the farmers had visited farm events and had frequent access to print media. Though there existed a difference in access to different information sources among the farmer groups, the difference was significant for extension contact (p=0.001), farmers (p=0.001), farm events (p=0.049), and other farmers (p=0.001). More than a half of the large farmers (53%) had regular contact with extension agents, whereas only 13 per cent of the marginal farmers had such contacts. Scope of doing progressive farming, ability to implement new inventions, adopting recommended cultural practices, sufficient capital, and risk bearing ability were some of the reasons why medium and large farmers

Table 1. Access to different sources of information by farm class (%)

Sources of information	Marginal	Small	Medium	Large	Total	Chi^2
Internet of Things	48.35	43.00	52.05	61.11	49.00	3.842^{NS}
Extension contacts	13.19	31.00	50.68	52.78	33.00	33.03*
Farm-events	36.26	48.00	52.05	61.11	47.00	7.877**
Other farmers	83.52	67.00	22.12	10.89	70.33	18.47*
Local input dealers	42.86	46.00	49.32	44.44	45.67	0.707^{NS}
Total sample farmers (No.)	91	100	73	36	300	

Note: NS- Non-significant, ** significant at 5% probablity level, * significant at 1% probability level

are approached by the extension officials (Adhiguru et al., 2009). On the contrary, marginal, and small farmers fail to have any of the mentioned characteristics.

Similarly, a major share of large (61%) and medium farmers (52%) had attended farm events during the previous year when compared to marginal (36%) and small farmers (48%). Seeking information about latest technologies for farm improvement has encouraged the medium and large farmers to attend farm events, but marginal and small farmers had no scope for improving their farm with less capital and smaller size of operational holding. This has discouraged them from attending farm events. However, a greater share of marginal (84%) and small farmers (67%) received information from other (progressive, relative and neighbour) farmers. This was comparatively lesser in case of medium (22%) and large farmers (11%). Most of the times, marginal and small farmers receive information from the neighbour farmers and progressive farmers. They were found to be risk-averse and tend to adopt advanced techniques and technologies only after their larger counterpart adopts the same. However, there was no significant difference witnessed with respect to accessing mobile phones or internet as it is available to everyone and had very little to do with size of land holding

Level of information among different farm classes

Farmers were given a score of "1" for every information source they had access to (Table 1). So, they would get a maximum score of 5 if they had access to all the five information sources and "0" if they did not have access to any of the sources. Further, based on the mean and standard deviation of the overall scores, farmers were classified in to four categories viz., "Highly informed," "Moderately informed," "poorly informed," and "No information" (Table 2). Overall, only 15 per cent of the farmers were highly informed, which was lesser than the proportion of farmers who had no access to any information sources (22%). Whereas more than one third (36%) were less informed and 26 per cent were moderately informed. There was a significant difference (Chi^{2-} = 75.52, P=0.000) between the farm classes in accessing different information sources. Comparatively, a greater share of large farmers (44%) was highly informed than farmers who belonged to marginal (4%), small (12%), and medium (19%) categories. Similarly, more than 90 per cent of the large farmers were either moderately informed or highly informed, which was 55, 34 and 20 per cent in case of medium, small and marginal farmers, respectively. In contrast, a greater proportion of marginal (46%) and small farmers (43%) were found to be in no information category. Farmers with small land holding often have poor access to information (Baker, 2011). Hence, size of land holding positively affects the access to sources of information.

Farmers' perception on sustainable agricultural practices

Since perception could not be directly observed, a set of 15 statements pertaining to sustainable agriculture were presented to the respondents and their perception were recorded and the results are ranked according to their weighted average score (Table 3). Farmers strongly believed that regulation in the usage of chemical inputs and substituting it with organic manures would make agriculture sustainable in the long run (Rank I). Weighted average score (WAS)of farmers' perceptions on proper use of pesticides was 4.48 followed by proper use of chemical pesticides (WAS=4.36), using organic manure (WAS=4.37), and long-term crop rotation using legumes (WAS=4.32). Farmers were aware about the fact that overusing of chemical inputs harms the ecosystem. Similarly, majority opined that personal involvement in marketing of output (WAS=4.02) would make agriculture sustainable in the long run. However, a considerable proportion of respondents disagreed to the the fact that, burning crop residues after harvest (WAS=2.52), and improper energy usage (WAS=2.52) negatively affects sustainability, which were at the bottom of the rank list.

The perception scores had a mean value of 55 with a standard deviation of 12. The respondents who have scored less than 47 are considered to have low level of perception, while those who have scores greater than or equal to 67 are considered to have high level of perception, and the respondents in between 48 and 66 are

Table 2. Level of information among different farm classes (%)

Level of information	Marginal	Small	Medium	Large	Total
Highly Informed	4.40	12.00	19.18	44.44	15.33
Moderately Informed	15.38	22.00	35.62	50.00	26.67
PoorlyInformed	47.25	38.00	35.62	5.56	36.33
No Information	32.97	28.00	9.59	-	21.67

Overall Pearson Chi^{2-} = 75.5163, P=0.000.

Table 3. Farmers' perception on sustainable agricultural practices

Perception statements	Weighted average score	Rank
Use of recommended level of pesticides	4.5	I
Use of FYM	4.4	II
Use of recommended level of chemical fertilizers	4.4	III
Long-term crop rotation incorporating legume crops	4.3	IV
Required level of irrigation	4.3	V
Personal involvement in marketing farm produce	4.0	VI
Enlarging farm size by buying land	4.0	VII
Leaving the farm to one heir only	4.0	VIII
Soil testing	4.0	IX
Taking adequate measures to recharge aquifers	3.9	X
Proper care of animal health	3.8	XI
Reforestation/ Afforestation of less advantaged farm land	2.6	XII
Incorporating residues after harvest	2.5	XIII
Optimal use of energy sources in agriculture	2.5	XIV
Use of adequate size of farm machinery	2.5	XV

Note: WAS denotes Weighted Average Score

considered to have medium perception. Pearson's chi-squared test indicated the existence of significant difference (Chi^2 = 90.08, p=0.000) between the level of perception among the farmers of different farm categories (Table 4). Overall, more than a half (54%) of the total respondents had medium perception towards SAPs and only 16 per cent had high perception. Whereas a little less than one third (30%) had low perception towards SAPs. Looking into class-wise distribution, majority of the large farmers had high perception (56%), followed by medium farmers (25%) and small farmers (10%). Only a small share (6%) of large farmers had low perception levels. Further, Two-thirds of the medium farmers had medium perception, and only one-fourth (25%) had high level of perception. However, non-marginal farmers were reported to have high perception level on SAPs. Further, 46 percent of marginal farmers had low perception. Lack of proper knowledge, access to information and extension contacts have negatively affected the

Table 4. Farm size-wise level of perception on sustainable agricultural practices

Level of Perception	Marginal	Small	Medium	Large	All
High	-	10.00	24.66	55.56	16.00
Medium	53.85	49.00	52.05	38.89	53.67
Low	46.15	41.00	23.29	5.56	30.33

Overall Pearson Chi^{2-} = 90.0836, P=0.000.

marginal and small farmers. In contrast, medium and large farmers were comparatively better informed and were in regular contact with extension agents making them have a better perception towards SAPs.

Degree centrality of key informantsonsustainable agricultural practices

The degree centrality (DC) indicates the count of direct information links for a respondent in the network. Figure 1 represents the network of farmers with their information sources regarding SAPs. Capacity building through training, exposure visits by extension department followed by social capital (neighbor farmers) seemed to be the prime sources of information about the SAPs. Further, relative farmers, and progressive farmers were good source of information. Whereas local input dealers failed to pass information regarding any SAPs. The DC measures of the information sources were also estimated for SAPs (Table 5). Agriculture officer or the extension workers (37%), were the major source of information on SAPs followed by the neighbor farmers (28%). More than a half of the medium and large farmers have received information regarding SAPs from agricultural extension officers, while the proportion was comparatively lesser among marginal (37%) and small farmers (43%).

However, social capital (neighbor and progressive farmers) was found to be the major source of information regarding SAPs for the marginal and small farmers. Even though information and communication technologies (ICT) act as vital source of information, the farmers were not found to receive information through ICT

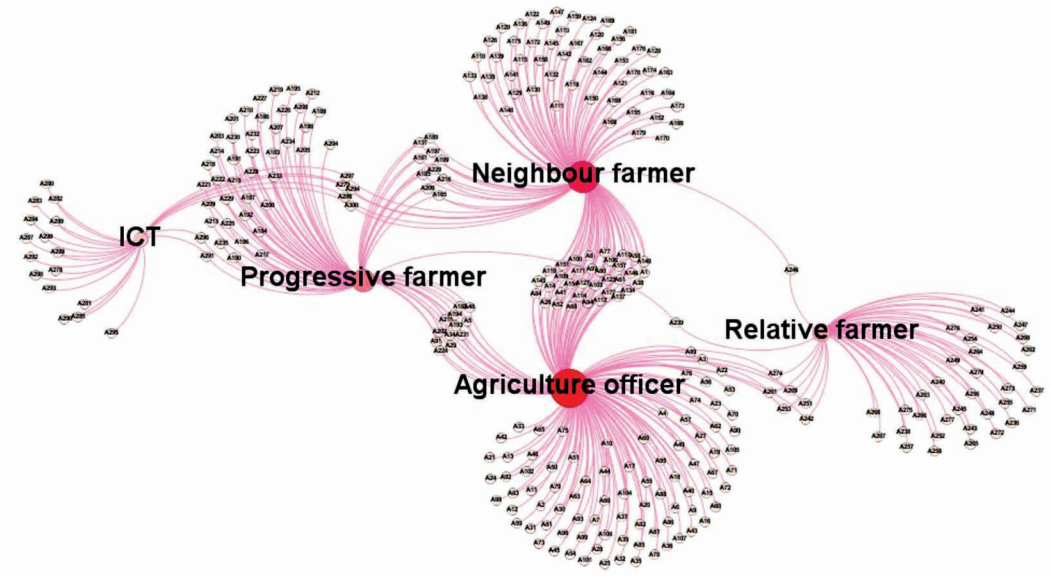

Figure 1. Social network map of sustainable agricultural practices

Table 5. Degree centrality of key informantson sustainable agricultural practices (%)

Key informants	Marginal	Small	Medium	Large	Total
Extension agents	37.36	43.00	56.16	58.33	46
Neighbour farmers	43.96	33	28.77	27.78	33.67
Progressive farmers	27.47	20	20.55	22.22	22.67
Relative farmers	12.09	14	15.07	13.89	14
ICT	6.59	7	6.85	5.56	7.67
Local input dealers	-	-	-	-	-
Total responses	127.47	117	127.4	127.78	124.0

Note: Total responses percentages are more than 100 on account of access to multiple sources of information.

regarding SAPs. In contrast, farmers use ICTs to know about latest technologies such as HYVs, upgraded machinery, farm implements, and other conventional inputs. Similarly, local input dealers were found to be important source of information regarding general agricultural practices (Table 5), but they were not found to involve in disseminating information related to SAPs. Primarily, SAPs are meant to be followed with a view of not exploiting the existing natural resources at the same time generating a sustainable profit. Hence, government policies are diverted towards promoting such SAPs with some incentives to the farmers adopting such practices. So, farmers mostly receive information about SAPs via the government officials. Besides, farmers who have already benefited from such polices tend to be key informants for their neighbor farmers.

CONCLUSION

Dissemination of general information on agricultural activities were found to be different among various information sources. Further, small and marginal farmers had poorer access than medium and large farmers, particularly in case of extension officials. Social capital, a source of motivation to adopt new inventions, effectively disseminates information on SAPs especially to marginal and small farmers. Further, level of information is found to be highly associated with the perception towards SAPs. Despite the existence of a pluralistic extension system, local input dealers are close to the farmers but they have failed to transfer information regarding SAPs. Therefore, exploiting the potential of ICTs, providing training to local input dealers and promotion of SAPs along with input supply and crop advisory services through recently launched PMKSK, capacity building through community events and harnessing potential of social capital are some of the suggested policy options to enhance the adoption of SAPs.

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