P-ISSN: 2618-0723
E-ISSN: 2618-0731

Extension Journal

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 7; Issue 7; July 2024; Page No. 258-262

Received: 15-04-2024
Accepted: 17-05-2024

Indexed Journal
Peer Reviewed Journal

Analysis of social network of DSR growers farmers and its contribution on diffusion of DSR in Bihar

[1]Kevin Christopher, [2]Anil Pawsan, [2]Chandan Kumar Panda, [3]Shivnath Das, [4]Priyanka and [4]Chaitali Singh

[1]Department of Extension Education, Dr. Kalam Agricultural College, BAU, Sabour, Bihar, India

[2]Department of Extension Education, Bihar Agricultural University, Sabour, Bihar, India

[3]Betelvine Research Centre, Nalanda, Bihar, India

[4]Department of Extension Education, Veer Kuvar Singh Agricultural College, BAU, Sabour, Bihar, India

DOI: https://doi.org/10.33545/26180723.2024.v7.i7d.802

Corresponding Author: Anil Pawsan

Abstract

The study was aimed at analyzing the rate of diffusion of agricultural technology (direct seeded rice) in India through social network analysis technique. The present study is based on 240 purposely selected farmers' responses gathered using different data collection methods such as snowball method, focus group discussion etc. during the year 2021-2022. Using SPSS and UNI-NET 6 software, the collected data were analysed using the sociometric matrix, percentage and frequency, mean, and standard deviation. The study's findings demonstrated that government institutions had a major role in the network's diffusion process.. All the stockholders of governments hold central position in the network flow. The network's information flow was unidirectional. The qualities of various networks differ from one another. It is concluded that governments agencies plays an important role in diffusion of innovation in India hence the government agencies should be strengthens for the diffusion of innovation.

Keywords: Attributes, diffusion, direct seeded rice, innovation, social network analysis

Introduction

Long-term increases in labour productivity, income, food security, and general economic growth are being driven by technological advancements, particularly in agriculture (Maertens *et al*., 2012) [9]. The adoption of technology in rural regions has always been a difficult task due to various variables such as the unique cultural values, traditions, and beliefs of rural inhabitants, the heterogeneous rural social structure, socio-economic considerations, and the inherent uncertainty associated with innovations. (Jyothi *et al*., 2019) [7]. When it comes to adopting technology, farmers have different information needs, thus they look for information from a number of sources through exogenous variables. (Stefano *et al.*, 2005) [17]. A farmer's decision to accept new technology is influenced by these exogenous networks, or external influences, including their neighbouring farmers, peer farmers, family, friends, various private organisations, rural cooperatives, extension agents, agriculture departments, etc. And the term "social network" refers to the connectivity, interdependence, and interconnection of a single farmer inside his network. A group of people who communicate and are connected to each other is called a social network. (Marin *et al*., 2011) [11]. The study of the relationships between people, groups, and other organisations that serve as channels for information sharing is known as social network analysis (SNA). Due to social networks' influence on the diffusion and productivity of agricultural inventions, farmers can learn more about them from one another through social learning or by merely imitating their colleagues. (Young, 2009) [21]. These networks offer knowledge on how to use new technology and its expected benefits, which helps to reduce the risk and uncertainty that come with its adoption.

For about half of the world's population, rice (*Oryza sativa* L.) is the primary food source; it is referred to as the "GLOBAL GRAIN." The world's second-largest producer of rice is India, which occupies almost one-third of the planet's landmass and produces rice at a rate second only to China. After puddling, rice is physically transplanted in standing water in Bihar. This process is time-consuming, inconvenient, and water-intensive. It also destroys the soil's structure. The preparation of rice fields uses between 20 and 40 percent of the water required for crop cultivation. In India, 90% of all fresh water that is diverted is used for irrigated agriculture, of which more than half is used for irrigated rice (Tabbal *et al*., 2002) [19]. For a number of years, the water table in Bihar has been alarmingly declining. It is projected that the state's major rice-growing regions will have a yearly fall in the ground water table of 0.43 metres. (Raghvendra, 2017) [14]. Rather than transplanting rice seedlings from a nursery, direct seeded rice (DSR) is the technique of cultivating a rice crop directly from seeds sowed in the field with a specified row pattern, or spreading them. In a situation like this, direct seeded rice without puddling may be a good substitute for its establishment because it uses less manpower, is more mechanized, and uses less water. In light of this, the current study maps the DSR farmers' social network and the spread of direct-seed rice throughout the farming network. The study was conducted in the Bihar districts of Bhagalpur and West Champaran in the years 2020–2022.

Method

Study population and data collection

The research was carried out in Bihar between 2020 and 2022. A total of 240 farmers were selected from Bihar as respondents. The farmers were specifically chosen for the study since it required only those farmers who have successfully embraced technology in the recent past. The farmers who were cultivating direct seeded rice who responded were chosen at random. The information was gathered utilising a semi-structured interview schedule and a variety of data gathering techniques, including key informant interviews, snowball techniques, and household surveys. Data was gathered taking into account the following variables: cosmopolitateness, age, education, family type, size, agricultural experience, land holding, annual income, extension contact, mass media contact, and social network features. To compile data for social media, all participants—individual farmers—were questioned regarding the information sources they preferred to use (across five different information domains): irrigation, harvesting, government programmes, plant protection, fertilizer/pesticide, seed/planting material, and irrigation). The range of these information domains is shown in Table 1. In interactive exercises with the villagers before the field survey, these five information fields were determined and prioritised. Questions like "Who do you consult or approach for excellent seed or planting material?" were posed to the respondents, who were invited to provide their opinions. A binary variable (Yes = 1; No = 0) was used to measure the responses. Following the completion of data gathering, the answers go through a screening and cleaning process. After being coded and tabulated, the data was statistically analysed. Numerous statistical techniques, such as frequency, percentage, mean, standard deviation, and statistical software, such as SPSS and UCINET-6, were used in the data analysis process. A thorough social network analysis application called Ucinet 6 for Windows was used to analyse the network data. Ucinet is a stand-alone software suite designed for uncertainty analysis with a primary focus on large-scale distribution dependent modelling. The network drawing tool Netdraw employs a number of methods to organise nodes in two-dimensional space and carry out fundamental network analysis. The characteristics of nodes were characterised by their degree, closeness, and betweenness centrality scores, while the properties of networks were characterised by their degree/closeness/betweenness centrality, size, density, and centralization, in accordance with statistical criteria. Table 2 provides a brief overview of the various node and network features.

Result

Table 1: Five information domains and their nature of information covered by them

Variables	Measurements
Seed/ Planting material for DSR	Understanding DSR practice packages, where to find seed, how much it costs, and DSR cultivation techniques.
Fertilizer and plant protection	Important phases of applying fertiliser or nutrients, Application Sources of Nutrients, classification of fertilisers and nutrients Plant protection techniques, as well as nutrient and fertiliser dosages
Irrigation Management for DSR	Critical stages of irrigation application 1. In dry direct seeded rice 2. In wet direct seeded rice
Harvesting of DSR	Time of harvesting, Method of harvesting
Government Schemes/Programs	Giving up taxes, New businesses: bank loans, insurance, how and where to obtain them; new government initiatives; cooperative societies for agriculture; technical education and training, etc.

Table 2: Description of nodes and network properties used in study

Elements	Definitions
Network size	Total number of nodes in a network
Network density	Number of ties, expressed as percentage of the number of ordered/unordered pairs. When density is close to 1.0, the network is said to be dense, otherwise it is sparse
Centrality	Measure of a node's tie count in relation to the total number of ties in the network; degree, proximity, and betweenness are examples of centrality metrics.
Degree centrality	A node's total number of connections to other nodes. When a node has more ties next to it than any other, it is considered central.
Closeness centrality	Metric representing the reciprocal of a node's geodesic distance—the shortest path between two nodes—to every other node in the network. If a node is situated near several other nodes, it is considered "close" (as in physically adjacent)
Betweenness centrality	The quantity of times a node appears on the shortest path connecting two other nodes.

Table 3: Network properties for all domains

Domains	No. of ties	Network density	Mean in degree centrality	No. of ties	Network density	Mean in degree centrality
	Bhagalpur			West Champaran		
SP	234	16	2.8	214	15	2.3
FPP	270	19	2.1	128	10	2.3
I	371	26	2.9	201	14	1.4
H	322	23	2.3	198	11	2.3
GS	297	21	2.0	188	7	2.1

Through the household survey, data was acquired about the information flows and patterns in the community regarding five distinct information domains: government schemes (GS) of agricultural produce; harvesting (H); irrigation (I); fertiliser and plant protection (FPP); and seed and planting materials (SPM). Using centrality data for the entire network and ego network, the network analysis produced the network diagrams, which gave insight into the information flow patterns for each of these five information domains inside the community. The particular role that various individuals performed inside these networks was also determined through analysis. We also compared the variations among the centre nodes of the five networks.

The social network's features include: With a combined web of 234, 270, 371, 322, 297, and 214, 128, 201, 198, and 188 on five different information domains—seeds and planting materials, fertiliser and plant protection, irrigation, harvesting, and government schemes—the 120 participants were drawn from the districts of Bhagalpur and West Champaran. In the Bhagalpur district, the network density (Table 3), which measures a network's degree of connectivity, was 16, 19, 26, 23, 21 in comparison to five domains. This indicates that only 5–6% of all possible direct linkages are present in these networks. For each of the five domains, the network density in the West Champaran area was 15, 10, 14, 11, 7, and so on. This demonstrates that these networks only contain 4–5% of all potential direct linkages. It has not occurred in all five networks that alters (nodes related to the ego) of a central node can communicate with one another more quickly in a relatively dense network. Still, a little bit lower density helps keep the network from being overly connected or brittle. It could also offer low-risk information flow lock-in. A visual comparison of the networks shows that, with three to four core members and close connections, the SPM and FPP networks are extremely similar. The GS network appears scattered and has few key nodes.

In terms of seed and planting material, the mean degree centrality of the entire network was 2.8. In Bhagalpur district, the corresponding statistics for fertiliser and plant protection, irrigation, harvesting, and government schemes were 2.1, 2.9, 2.3, and 2.0. According to this data, there is a chance that the actors in the government programmes network will become more connected to one another, which would help the government's direct-seed rice programme spread. Additionally, the average degree of network centrality for the West Champaran district is 2.3, 1.4, 2.3, and 2.1 for each of the five domains. According to this data, there is a chance that the actors in the government programmes network will become more connected to one another, which would help the government's direct-seed rice programme spread.

The network's central actors: It was found that each network relied heavily on a small number of central actors. We looked at the degree centrality (the relationship between farmers), out-degree centrality (influence), in-degree centrality (prestige/prominence), closeness centrality (proximity), and betweenness centrality (liaison/strategic position) in order to determine which of the players is more important. We selected the nodes with greater than mean+2 SD centrality scores (in-degree scores whenever applicable). We've covered the first three of these maintenance nodes in detail.

The role of many actors in the district of Bhagalpur's invention dissemination process is revealed in Table 4. The table might be interpreted as follows: the central actors in the area of seeds and planting materials are ego 71, 62, 49 (in degree centrality), ego 93, 76, 62 (closeness centrality), and ego 72, 52, 41 (betweenness centrality). Domains 88, 75, 64 (in degree centrality) and egos 82, 64, 53 (closeness centrality) and 52, 40, 34 (betweenness centrality) are the key players in the fertiliser and plant protection domains. The central actors for the irrigation domain are ego 98, 92, 41 (closeness centrality), ego 46, 40, 26 (betweenness centrality), and domain 82, 73, 59 (in degree centrality). Central actors for the harvesting domain are ego 51, 47, 41 (closeness centrality), ego 40, 37, 31 (betweenness centrality), and domain 91, 85, 79 (in degree centrality). The key players for the credit domain are ego 49, 36, 31 (closeness centrality), ego 52, 49, 43 (betweenness centrality), and credit domain 84, 73, 65 (in degree centrality). The domains 96, 95, and 91 (in degree centrality), as well as the egos 42, 40, and 41 (closeness centrality) and 48, 41, and 40 (betweenness centrality), are the key players in government plans. Thus, the personnel of Krishi Vigyan Kendra, in order of degree centrality, closeness centrality, and betweenness centrality, were the primary actors for the diffusion of direct seeded rice in the Bhagalpur district. They were followed by the Agricultural Technological Manager, farmers' friends, opinion leaders, progressive farmers, and block technological managers.

Furthermore, ego 93, 87, 80 (in degree centrality), ego 93, 88, 76 (closeness centrality), and ego 54, 50, 43 (betweenness centrality) are the leading actors in the West Champaran District for the domain of seeds and planting materials. The important players for fertiliser and plant protection are domains 94, 82, 81 (in degree centrality) and egos 51, 49, 42 (closeness centrality) and 50, 49, 39 (betweenness centrality). Ego 46, 45, 39 (closeness centrality), ego 57, 51, 50 (betweenness centrality), and domain 96, 92, 89 (in degree centrality) are the central actors for the irrigation domain. The major participants in the harvesting process are domains 89, 86, and 81 (in degree centrality), together with egos 51, 50, and 46 (closeness centrality) and 46, 41, and 38 (betweenness centrality). The primary players in government systems are the domains of ego 89, 82, and 80 (in degree centrality), ego 59, 46, and 41 (closeness centrality), and ego 48, 41, and 40 (betweenness centrality). In terms of degree, closeness, and betweenness centrality, progressive farmers, opinion leaders, agricultural technology managers, block technical managers, progressive farmers, and farmers' friends appeared to be essential actors for dissemination.

Table 4: Role of different actors in diffusion process

Domain	Degree centrality				Closeness Centrality				Betweenness Centrality		Ego Characteristics
	In		Out		In		Out				
	Ego	Score	Ego	Score	Ego	Score	Ego	Score	Ego	Score	
Bhagalpur											
SPM	71	16.00	2	6.00	76	47.00	36	11.7	52	331.9	KVK
	62	10.00	41	4.00	93	35.9	21	13.6	41	191.3	ATM
	49	19.00	40	4.00	62	36.4	61	11.43	72	180.5	Progressive farmers
FPP	88	14.00	69	6.00	82	38.23	35	20.89	52	279.61	KVK
	75	10.00	53	5.00	64	34.36	30	17.36	40	241.27	Opinion leaders
	64	9.00	41	5.00	53	33.29	23	31.00	34	276.54	Farmer friends
I	82	12.00	17	6.00	41	28.50	26	20.38	46	212.36	KVK
	73	10.00	11	6.00	92	28.99	47	18.27	40	211.49	ATM
	59	9.00	49	5.00	98	20.21	39	18.25	26	206.38	BTM
H	91	10.00	50	6.00	51	30.25	37	11.11	40	232.33	ATM
	85	9.00	42	5.00	47	26.32	30	10.00	31	211.00	BTM
	79	9.00	39	5.00	41	22.32	25	10.00	37	199.28	Farmer friends
GS	96	15.00	69	4.00	42	48.00	48	16.00	48	182.00	KVK
	95	15.00	64	3.00	41	47.00	41	15.00	41	180.69	BTM
	91	12.00	59	3.00	40	45.00	40	15.00	40	166.35	Farmers friends
West Champaran											
SPM	93	16.00	13	5.00	93	43.73	42	17.09	54	276.92	ATM
	87	15.00	11	5.00	88	38.95	41	15.06	50	265.36	Farmer friend
	80	15.00	10	4.00	76	30.76	36	13.32	43	251.95	KVK
FPP	94	31.00	21	6.00	51	56.81	49	20.14	39	256.24	ATM
	81	29.00	17	6.00	49	54.74	43	19.87	50	245.78	BTM
	82	26.14	11	5.00	42	50.14	30	19.00	49	219.79	Farmer friend
I	96	24.00	18	4.00	46	49.85	45	25.79	57	198.35	ATM
	92	21.00	15	4.00	45	44.36	41	21.79	51	192.92	Opinion leaders
	89	20.00	13	3.00	39	41.83	40	20.36	50	186.94	KVK
H	89	36.00	19	5.00	50	47.36	49	17.81	45	201.54	Progressive farmer
	86	33.81	18	4.00	49	45.89	71	15.25	41	199.37	ATM
	81	29.00	12	4.00	47	41.55	30	14.99	39	190.00	Opinion leader
GS	89	42.00	56	6.00	59	59.48	54	21.85	44	150.23	ATM
	82	40.00	52	4.00	46	57.65	51	20.26	41	141.25	KVK
	80	35.00	48	3.00	41	51.32	50	19.95	38	140.99	Farmer friend

Conclusion

One of the most crucial resources for sustaining a way of life is information, and social networks play a critical role in disseminating this knowledge in rural areas. The community can adopt technology and engage in social learning through the smooth transfer of agricultural knowledge. In order to gain a better understanding of the nature of social networks of farmers associated with agriculture and related industries, this study examines five information domains: seed and planting materials, fertiliser and plant protection, irrigation, harvesting, and government schemes in Bhagalpur and the west Champaran district of Bihar. Just 5–6% of all potential direct linkages in the networks were represented by the district of Bhagalpur's network density. Only 4-5 percent of the potential direct links networks are present in the West Champaran district's network density. According to the mean degree centrality data, there is a chance that the actors in the government programmes network will become more connected to one another, which would help the government's direct seeded rice programme spread throughout both districts. The agricultural technological manager and the staff of Krishi Vigyan Kendra are important figures in the spread of innovation in the Bhagalpur district. In the West Champaran district, the key players in the diffusion of innovation are the progressive farmers and their friends, as well as the agricultural technical manager. The study's findings support the notion that farmers at all levels should be encouraged to adopt new innovations. A relatively new and inventive technique, direct seeded rice is slowly making its way through the network of famers. Direct seeded rice, or any other new innovation, needs to be promoted among farmers' social networks in order to spread more quickly. Since significant and pivotal individuals play a critical role in the dissemination process, it is imperative that their capacities be developed. Government programmes for the dissemination and promotion of particular new innovations are also crucial. Focusing on direct seeded rice promotion and dissemination initiatives across farmers' social networks is therefore advocated.

References

1. Albizua A, Bennet EM, Larocque G, Krause RW, Pascual U. Social networks influence farming practices

and agragian sustainability. PLoS ONE. 2021;16(1):69-89.
2. Conley TG, Christopher U. Social Learning through Networks: The Adoption of New Agricultural Technologies in Ghana. Am J Agric Econ. 2021;83:668-673.
3. Dandedjrohoun L, Diagne A, Biaou G, N'Cho S, Midinogyi S. Determinants of diffusion and adoption of improved technology for rice in Benin. Rev Agric Environ Stud. 2017;93(2):171-191.
4. Gawande RP, Ahire MC, Patil SD. Mass media utilization pattern and constrain faced by cotton growers. J Commun Stud. 2009;27(2):69-78.
5. Hinnou LC, Sartas M, Mongbo RL, Biaou G. Influence of social network on the diffusion of local rice innovation in Benin. Res J Social Sci. 2018:13-32.
6. Jha CK, Gupta V. Farmer's perception and factors determining the adoption decision to cope with climate change: An evidence from rural India. Environ Sustain Indic. 2021;10:328-236.
7. Jyothi SPP, Devrani L. Farmers Network Analysis on Diffusion and Adoption of CAU-r1 variety in Imphal East District of Manipur. Curr J Appl Sci Technol. 2019;36:1-17.
8. Lu H, Hu L, Zheng W, Yao S, Qian L. Impact of household land endowment and environmental cognition on the willingness to implement straw incorporation in China. J Chem Prod. 2020;262:1214-1247.
9. Maertens A, Barreti CB. Measuring Social Network Effects on Agricultural Technology Adoption. Am J Agric Econ. 2012;95:353-359.
10. Mannan S, Nordin SM, Rafik-Galea S, Rizal ARA. The ironies of new innovation and the sunset industry: Diffusion and adoption. J Rural Stud. 2017;55:316-322.
11. Marin A, Wellman B. Social Network Analysis: An Introduction. Sage Publication; 2011:11-25.
12. Matuschke I. Evaluating the Impact of Social Networks in Rural Innovation System: An Overview. IFPRI Discuss Pap. 2012.
13. Phondani PC, Maikhuri RK, Rawat LS, Negi VS. Assessing farmers' perception on criteria and indicators for sustainable management of indigenous agroforestry systems in Uttarakhand, India. Environ Sustain Indic. 2020;5:356-364.
14. Raghvendra S. Effect of Methylotrophs on Growth and Yield of Direct Seeded Rice in Karnataka. J Agric Sci. 2017;22:118-121.
15. Rao KV, Singh SP, Surekha K, Muthuraman P. Site Specific Integrated Nutrient Management in rice and Rice Based Cropping System. Indian Agric Res. 2010:1-3.
16. Singh AK, Burman RR. Agricultural extension reforms and institutional innovations for inclusive outreach in India. In: Agricultural extension Reforms in South Asia. Academic Press; 2019:289-315.
17. Stefano LA, Sitwell C, Morris C, Hendricks SL, Miya D, Mehize T, *et al*. An Action Research Study of The Agricultural Knowledge and Information System of Small Scale Commertial Organic farmers in umbumbulu, Kwazulunatal. In: Food Security Programs Project. University of Kwazulunatal; 2005.
18. Sukhdeep KM, Varinder R, Kaur K. Reactions of self-help groups members toward functioning of self-help group. Rajasthan J Extens Educ. 2011;19:79-83.
19. Tabbal DF, Bouman BA, Bhuiyan SI, Sibayan EB, Sattar MA. On Farm Strategies for reducing water Input Irrigated Rice; Case Studies in Philippines. Agric Water Manag. 2002;56:93-112.
20. Wang GL, Lu Q, Capareda SC. Social network and extension services in farmer's agricultural technology adoption efficiency. PLoS ONE. 2020;15:101-116.
21. Younge HP. Innovation Diffusion in Heterogeneous Population: Contagion, Social Influence and Social Learning. Am Econ J. 2009;99:1899