

Do the information networks of farmers differ across gender? Evidence from the hills of Uttarakhand using Social Network Analysis

Abstract

Vegetable growers need information on improved cultivars and production practices and usually tend to receive this information from informal sources due to certain constraints. This study attempts to study and describe the information networks of hill farmers across gender for accessing information about vegetable cultivation. Through simple random sampling two hill districts of state Uttarakhand were chosen and 320 vegetable growers were selected. The results showed that in comparison to female farmers, male farmers' social networks frequently include cosmopolite formal information sources. The main factors determining the pattern of information network usage by women farmers were education, farming experience, hours dedicated to farming, group membership and contact with extension agencies, whereas income, landholding, access to mobile, contact with extension agency and frequency of contact affected the agriculture network usage among male vegetable growers. Suggestions for policymakers and programme planners for bridging gender divide by devising effective information dissemination in hill regions have been provided.

Keywords: Social network analysis, gender, information usage pattern, vegetable growers

Introduction

Information has gained widespread reverence as a vital resource for the twenty-first century. All human societies rely heavily on knowledge for their survival because information is necessary for life. For objective decision-making, information sources must be identified and used correctly. In the end, understanding and application of relevant information ensures both individual and

organizational functioning. Information's main purpose is to expand user understanding while lowering their level of doubt and confusion. Information needs to be accurate, timely, and relevant in order to be effective. Information is a crucial tool for personal growth, survival, and development¹. Any object that a person views or comes into contact with can be thought of as a source of information². Information sources are the instruments that may be able to satisfy the information needs of various user strata. Different sources of information exist, but the important aspect is "what" sources are accessible, pertinent to the various user types, and useful for their information-seeking and sharing behaviours. Although extension agents, state horticulture and agriculture departments, radio and television shows, agricultural booklets, etc. are all expected to provide rural farmers with agricultural knowledge, farmers mostly rely on interpersonal sources of information.

Agriculture, along with its allied sectors, is certainly the largest livelihood provider in India. In the years after the green revolution, the focus shifted from food grains to horticultural crops, which include fruits and vegetables. However, growing vegetables in hills remains an unorganized sector as farmers are still following traditional ways. Besides, they are not as well dealt with the current extension system as the farmers cultivating food grains. Vegetable growing is highlighted as a financially lucrative technique that could replace subsistence farming in the hills. Vegetable cultivation is more profitable particularly over food crops, as food crops are labor-intensive but less remunerative and largely cultivated by rural and marginal farmers. Moreover, most of the vegetable growers in Himalayan states like Uttarakhand are small and marginal farmers, and they have their peculiar worries and issues, which need to be studied quickly and sincerely. Uttarakhand's distinct agro-climatic and soil conditions are favourable for the production of vegetables. Vegetable growers need timely information, advice, inputs and resources to grow more

produce and get maximum profit. Across gender, access to information becomes more difficult due to lack of identity of women as farmers and restricted mobility of women farmers to information providers. Women also lack access to resources like mobile, radios, and other information media in comparison to men and thus remain dependent upon their male counterparts for information and advice on farming. There are few financial services available in rural areas, and the few financial services that are already available are rarely beneficial to rural women³. Barriers in the societal, economic, legal, and in some cases educational spheres limit women's access to these services⁴.

According to accumulating empirical research, the structural organization of the smallholders' social network must be understood in order to improve their access to information. Farmers' communication networks comprise of both formal and informal sources. However, the way in which actors are socially integrated and the structural design of the social network itself affect how information moves through networks. A network is made up of a number of actors, sometimes known as nodes, and the relationships that connect them. Limited studies have analyzed the network structures across gender- for male and female farmers and no study exists for hill regions. The study's major goal was to discover the dominant information networks by gender as well as the centrality measures of the information sources to evaluate their dominance and influence inside the network. In addition, an effort was made to identify the variables that might affect information network usage among male and female vegetable growers. Understanding the existing information networks among the vegetable growers is necessary for technology developers, policymakers, research scientists and extension personnel so that effective and appropriate extension approaches and delivery systems could be developed for enhancing the productivity and ensuring the well-being of the vegetable growers in the state.

Materials and Methods

Study area

In the middle of the Indian Himalayas, in the mountainous state of Uttarakhand, the study was carried out. Almost 86 percent of Uttarakhand's land is mountainous, making it fully dependent on rain; the remaining 14 percent is located in valleys and plains, where irrigation is moderate. More than three-fourths of the state's total population is employed in agriculture. The region's agriculture is entwined with farming, animal husbandry, and natural resource management. Farming in hilly areas of Uttarakhand is characterized by small and scattered farm holdings. More than seventy-one percent of the farmers of the state fall in the marginal farmer category and these small and marginalized farmers produce vegetables in their small land



Fig. 1. Study area (Map of Uttarakhand State depicting the sampled districts)

holdings. Men from the hilly area typically move to the plains in pursuit of work, leaving the women behind. The major reason for migration is the non-availability of livelihood options. For agricultural and socio-economic development of the state, it is necessary to provide vegetable growers with information, advice, expertise and skill.

Sampling framework

For selecting respondents, a multi-stage sampling approach was used. Villages from Hawalbagh and Tarikhet blocks of district Almora and villages from Betalghat and Bhimtal blocks of district Nainital were chosen by simple random sampling. A total of 320 vegetable growers were selected as respondents equally divided over gender.

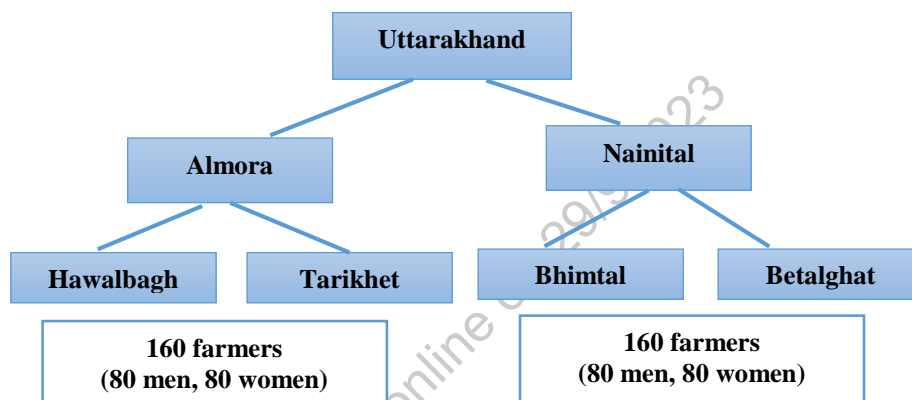


Fig. 2. Sampling plan of the study

Data processing and analysis

The data collected was analysed using Social network analysis which is the process of investigating social structures through the use of networks and graph theory. It characterizes networked structures in terms of nodes (individual actors, people, or things within the network) and the ties, edges, or links (relationships or interactions) that connect them. GEPHI, a visualization application developed in Java language, was used mainly for visualizing, manipulating, and exploring networks and graphs from raw edge and node graph data.

Results

The results of the present study are discussed under the sub-heads of socio-personal profile of farmers, information network usage pattern across gender, and factors determining information usage by male and female vegetable growers.

Socio-personal profile of farmers

Table 1 presents the socioeconomic findings for vegetable growers.

Table 1. Allocation of vegetable growers according to their socioeconomic status

S.I.	Variables	Male (N=160)	Females (N=160)
1	Age		

	Young (18-35 years)	13.75%	28.75%
	Middle (36-52 years)	56.25%	55%
	Old (>52years)	30%	16.25%
2	Caste		
	General	96.25%	97.5%
	Other	3.75%	2.5%
3	Education		
	Illiterate	5%	18.75%
	Literate	2.5%	12.5%
	Primary school	16.25%	35%
	High school	41.25%	21.25%
	Intermediate	26.25%	10%
	Graduation and above	8.75%	2.5%
4	Family type		
	Nuclear	57.5%	63.75%
	Joint	42.5%	36.25%
5	Family size		
	Small (upto4 members)	31.25%	41.25%
	Middle(5-8 members)	50%	48.75%
	Large (>8 members)	18.75%	10 %
6	Land holding		
	Less than 1 acre	61.25 %	71.25%
	1-5 acre	38.75%	28.75%
	More than 5 acre	0	0
7	Farming experience		
	0-10years	6.25%	20.00%
	10-20 years	41.25%	65%
	More than 20	52.5%	15%
8	Hours dedicated to vegetable farming		
	2-4 hours	11.25%	27.5%
	5-7 hours	60%	45%
	8-10 hours	28.75%	27.5%
9	Farming mode		
	Full time	100%	100%
	Part time	0%	0%
10	Group membership		
	Yes	12.5%	37.5%
	No	87.5%	62.5%
11	Accessibility to Extension services		
	Yes	52.5%	38.75%
	No	47.5%	61.25%
12	Media ownership		
	Access to mobile	100%	100%

Ownership of mobile phone	93.75%	83.75%
Smart phone ownership	46.25%	28.75%

The majority of male participants (56.25%) were middle-aged, and most of them belonged to the general caste (96.25%). About 41.25 percent of the male participants had completed high school. The great majority (57.5%) made up of nuclear family whereas about 50 percent of the male respondents had medium family size and a majority (61.25 %) of the respondent had small land holdings. Every male respondent had access to mobile and 93.75 percent of them had their own mobile but only 46.25 percent male vegetable growers had smart phones. Majority of female participants (55%) were middle-aged, and most of them belonged to the general caste (97.5%). About 35 percent of the female participants were educated up to primary level. The great majority (63.75%) made up of nuclear family whereas about 48.75 percent of the female respondents had medium family size and a majority (71.25%) of the respondent had small land holdings. Every female respondent had access to mobile and 83.75 percent of them had their own mobile but only 28.75 percent female vegetable growers owned smart phones.

Information networks of vegetable growers across gender

There are a lot of evidences showing that men and women get their knowledge from different sources. Compared to female farmers, men have greater social networks. In comparison to female farmers, male farmers' social networks frequently include more members who live outside their locality. Male farmers are also more likely than female farmers to serve as organizers and gatekeepers⁵.

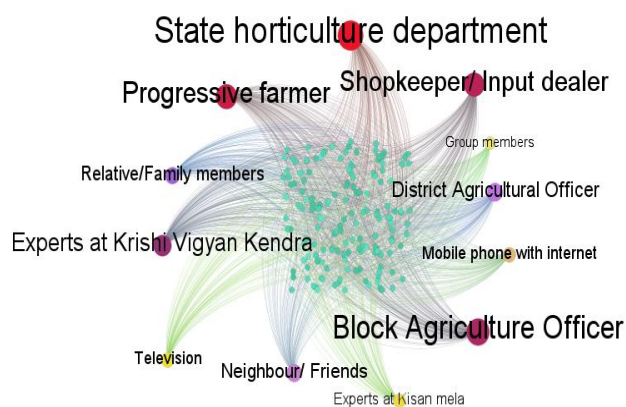
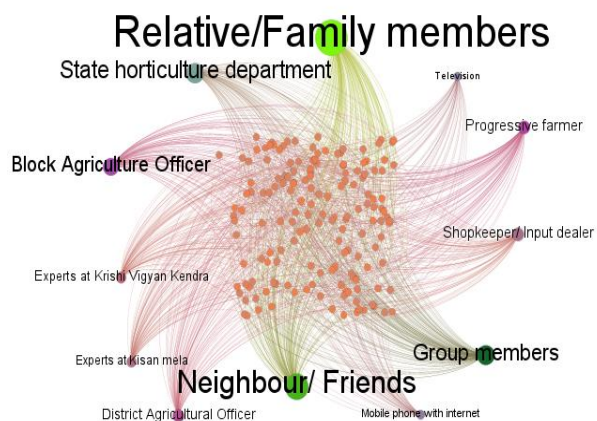


Fig. 3a. Network structure of female vegetable growers

Fig. 3b. Network structure of male vegetable growers

Local interpersonal sources of information were quite popular among women farmers as they chose relative/family members, neighbour/ friends and group members as their most preferred information sources (Figure 3a). For male vegetable growers it was observed that more formal and cosmopolite interpersonal information sources were preferred as they chose state horticulture department as their preferred information source followed by progressive farmer and shopkeeper/ input dealer (Figure 3b). Among electronic media both male and female farmers chose mobile phone with internet over television as the most potent mass media.

Network structures of farmers across gender

The person or source with the most network connections would influence the information dissemination and technology adoption in their network. Table 2 is a reference vocabulary of the Social Network Analysis terms that have been discussed. Since nodes and the links that connect them are the two fundamental elements of networks, size and density are the two fundamental network properties. The number of nodes in a network determine its size, whereas density measures the proportion of linkages that are actually formed to all possible ties.

Table 2. Glossary of SNA concepts

Term	Definition
Density	Indicates how closely actors within the networks are connected to each other
Modularity	Network structure is measured by segmenting the network into functional modules, each of which represents logical connectedness.
Average degree	In the graph, an average number of edges per node.
Average path length	An average amount of travel time along the shortest routes between each pair of network nodes. It evaluates how well data is transferred inside a network.
Network diameter	The diameter is the maximum graph distance possible between any two network nodes.
Nodes	The entities that make up a network; sometimes called actors
Ties	The relationships between nodes

Table 3 depicts the attributes of the network for male and female vegetable farmers. Networks of two-mode affiliation between farmers and information sources are shown in the social network analysis results. A network with a density of 0 is said to be entirely disconnected, whereas a network with a density of 1 is said to be fully connected. Density values are particularly helpful when comparing networks with similar sizes. Low-density ratings are typical for networks that are quite vast. The network of female farmers was less dense than the male farmers' networks, which indicates that the communication between the women growers was operating through sparse network. About 9 percent of nodes in women's networks were connected while in men's networks, about 14% of nodes were connected. While more open or sparse networks may provide better access to more varied information, denser networks may increase the possibility of sharing resources that are extremely similar.

Table 3. Network attributes of male and female vegetable growers

Network attributes	Male	Female
Density	0.14	0.09
Average degree	13.49	11.32
Modularity	0.097	0.162
Network diameter	3.00	4.00
Average path length	1.89	2.01

Similarly, the higher average degree of network shows more connectedness among the actors. In case of male vegetable growers, the key actor i.e. information source was connected with about 14 vegetable growers whereas in the case of females, an information source was connected with about 11 vegetable growers. Higher network diameter of female's network shows that the two nodes or actors are much far apart than in the men's network. Average path length was higher among female networks which means less connectivity among the nodes and communication network among males is relatively more efficient compared to females. The higher modularity of

female's network reveals that there are more small factions in their network than that of male's network.

Centrality measures of information networks

To evaluate their dominance and influence inside the network, centrality measures of the information sources of different networks were determined. Degree centrality measures a person's network of connections and, thus, their capacity to operate as a hub of information. The degree to which an actor is placed on a path between other actors is indicated by their betweenness centrality. This indicates that it is the authority an actor has over how the actors share information. The degree to which a person is related to other actors in the network is indicated by their closeness centrality. In the case of male farmers, the centrality measures were highest for Horticulture department, followed by progressive farmers and input dealers/shopkeepers (Table 4). These were the most sought sources (In-degree centrality), were in a position to spread information quickly (Closeness centrality), and had a high influence over the flow of information in the network (Betweenness centrality).

Table 4. Centrality measures of existing information sources among male vegetable growers

Sl. No	Information sources	Centrality measures		
		In-Degree	Betweenness	Closeness
1	Neighbour/ Friends	111	951.352	0.610
2	Relative/Family members	116	875.695	0.633
3	Progressive farmer	142	1549.481	0.784
4	Group members	90	539.194	0.531
5	Shopkeeper/ Input dealer	139	1476.875	0.763
6	State horticulture department	150	1970.160	0.846
7	Block Agriculture Officer	137	1722.196	0.750
8	District Agricultural Officer	113	990.728	0.619
9	Experts at Krishi Vigyan Kendra	133	1247.087	0.724
10	Experts at Kisan mela	98	653.996	0.558
11	Television	97	733.111	0.555

12	Mobile Phone with internet	103	731.118	0.577
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Table 5. Centrality measures of existing information sources among female vegetable growers

Sl. No	Information sources	Centrality measures		
		In-Degree	Betweenness	Closeness
1	Neighbour/ Friends	135	2394.693	0.737
2	Relative/Family members	149	3684.597	0.838
3	Progressive farmer	89	712.082	0.527
4	Group members	119	1583.812	0.647
5	Shopkeeper/ Input dealer	70	730.150	0.464
6	State horticulture department	101	1637.205	0.566
7	Block Agriculture Officer	93	1320.156	0.534
8	District Agricultural Officer	85	693.512	0.511
9	Experts at Krishi Vigyan Kendra	78	504.565	0.494
10	Experts at Kisan mela	73	455.601	0.480
11	Television	54	206.095	0.429
12	Mobile Phone with internet	58	279.525	0.413

In present study, informal sources of information, such as family members, had the highest centrality measures for females, followed by neighbors and friends, and group members (Table 5). Mostly the dominant sources were interpersonal sources, which were localite for female vegetable growers.

Factors affecting information networks usage by female vegetable growers

A simple linear regression analysis was done to understand the factors determining information source usage by vegetable growers of both genders.

Table 6. Factors affecting information network usage by female vegetable growers

Factors	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
(Constant)	3.980	.954		4.170	.000
Age	-.009	.014	-.052	-.657	.512
Education*	.202	.093	.165	2.177	.031
Family size	-.054	.051	-.075	-1.047	.297
Income	2.643	.000	.038	.519	.604

Landholding	.012	.010	.082	1.138	.256
Farming experience*	.502	.165	.270	3.045	.003
Hours dedicated to farming*	-.191	.073	-.208	-2.604	.010
Group membership*	.700	.274	.179	2.555	.011
Access to mobile	.777	.420	.133	1.848	.066
Contact with extension agency*	.723	.313	.173	2.312	.022
Frequency of contact	.235	.143	.118	1.640	.103

*significant at 95% confidence level

Table 6 describes the factors that are expected to influence the information network usage by female vegetable growers. It is evident that the determining variables of agriculture information network usage were education, farming experience, hours dedicated to farming, group membership and contact with extension agency. Being a member of a group like self-help group, commodity interest group, etc. has a positive and significant relation, whereas hours dedicated to farming was negatively significant with agriculture information network usage.

Table 7. Factors affecting information network usage by male vegetable growers

Factors	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
(Constant)	5.361	1.387		3.865	.000
Age	.006	.013	0.53	-.020	.984
Education	-.209	.140	-.150	-1.479	.143
Family size	.073	.050	.140	1.453	.150
Income*	1.439	.000	.239	2.568	.012
Landholding*	.028	.011	.260	2.528	.014
Farming experience	-.040	.159	.026	-.252	.802
Hours dedicated to farming	-.003	.093	-.003	-.032	.974
Group membership	-.233	.471	-.050	-.495	.622
Access to mobile*	1.728	.710	.233	2.433	.017
Contact with extension agency*	2.033	.412	.567	4.930	.000
Frequency of contact*	-.449	.125	-.386	-3.585	.001

*significant at 95% confidence level

Income, landholding, access to mobile, contact with extension agency and frequency of contact were the main factors that affected the agriculture network usage among male vegetable growers (Table 7).

Discussion

The present study examined the nature of communication networks related to vegetable farming in hills. If correctly planned, the information networks at the grassroots level can help extension agents reach their target systems more effectively. The flow of agricultural information in a network and the crucial functions of key network nodes and actors must be understood by extension specialists and information providers. They need to be made aware of the crucial role that small, resource-poor farmers play in the dissemination process⁶. Providing effective services to reach the greatest number of farmers and understanding the farmers' information networks and their characteristics is a pre-requisite for effective information dissemination.

Building the capacity of players with high centrality ratings may strengthen the way that information spreads through social networks. It is strongly advised that agriculture and extension organizations identify and communicate with actors who hold high levels of centrality while establishing the programme for disseminating knowledge and resources⁷. In the study locale, significant information actors with high centrality measures were identified and mapped. We assumed in the study that the information networks of farmers may vary across gender and applied social network analysis techniques to delineate the networks.

It was found that the information networks of farmers varied across gender. Female vegetable growers had more informal and localite information sources in their information networks pertaining to vegetable cultivation, which were easy to access in their near locality and are in frequent contact with them. Researchers have reported similar findings that major source of

information for the women respondents was family/relations/friends and women are less likely to consult formal sources and typically have more informal sources of information in their networks, whereas males tend to contact formal sources^{8,9}. The study also found that the significant factors determining the pattern of information network usage by women farmers were education, farming experience, hours dedicated to farming, group membership and contact with extension agencies. Women in hill regions being de-facto farmers due to male migration shoulder various responsibilities as productive and reproductive roles; to perform from working in fields to fetching the fodder for cattle, rearing the children to taking care of the elderly members of the family, preparing food and collecting the firewood, etc. The women farmers suffer time poverty and get fewer opportunities to interact with cosmopolite information sources such as state horticulture department, block agriculture officer, shopkeeper/ input dealer, Krishi Vigyan Kendras (farm science centre), etc. Thus, they prefer local interpersonal sources over cosmopolite ones, which are easier to contact. due to the easy availability of these sources¹⁰.

Education is an important factor that positively affects the information network usage of women growers, i.e. more educated woman is more likely to acquire information on any subject and she would seek various sources to get valid information. Women's independence in their information-seeking behaviour is impacted by the level of education¹¹. If female vegetable growers dedicate more hours to farming, then they are left with less time to interact with the information sources in the agriculture network. The reasons for engaging more time in farming activities is that the activities which are predominantly carried out by women are time taking, monotonous and are done manually without any mechanical aid. Group membership also affects the information usage pattern as if a woman is a member of a collective, she is more likely to attain information related to agriculture or any other aspect than a woman who is not associated with a group. The women's

collectives are approached more and often by the extension agencies and also are a platform to discuss livelihood-related problems and their possible solutions. The farmers who participate in structured groups are more likely to communicate with their peers by disseminating the knowledge acquired from various sources¹².

The male vegetable growers had more cosmopolite and formal sources of information in their networks. The male farmers had more access to mobile phones than the female farmers. Men generally have access to mobile phones and have a higher frequency of contact with distant cosmopolite information sources through mobile phones. They have more access to formal cosmopolite sources like horticulture officers, extension agencies, block offices, etc., even if they are located at a distance.

Male farmers preferred formal and cosmopolite sources of information and mobility is not a big issue for male farmers so they should be encouraged to visit the relevant offices and should be exposed to social forums, trainings, exposure visits to other places, etc¹³. Extension personnel should persuade the vegetable growers to avail information and buy inputs from blocks and horticulture departments as these departments provide quality inputs at subsidized rates and women farmers must be targeted for input distribution in the villages as main beneficiaries. Men generally have access to mobile phones and they sometimes use mobile phones to access information regarding any topic. Income, landholding, access to mobile, contact with extension agencies and frequency of contact were the main factors that affected the agriculture network usage among male vegetable growers. People with more income and relatively large landholdings tend to seek more information to increase production and earn more profit, and hence access information from various sources regarding agriculture. Researchers also stated that a unit

increase in land holding size and income of the respondents would drive farmers towards more use of information communication tools¹⁴.

Policy implications and way forward

These findings highlight the information system's advantages and disadvantages from the standpoint of policy and suggest various reforms in the existing information dissemination systems in the hills. It strongly indicates that the existing extension and delivery system needs to be strengthened. There are fewer numbers of training institutions in villages, which indicates that some infrastructural developments and changes are required at the village level. Many women find it difficult to engage in social and economic activities because they lack mobility and it affects their standard of living¹⁵. More women will be able to access such training institutions by breaking the mobility barrier which they face due to the cultural and infrastructural constraints in the hills. Some provisions to promote basic and functional media literacy should be done. Every farmer can't afford as well as operate smartphones so provision should be made to form such centers that are equipped with some software or interactive kiosk where men and women farmers can visit and get information. Recruiting helping staff (Information Providers) at community level who would assist the farmers in operating such kiosks, mobilize farmers, arranging meetings with extension personnel and subject experts so that the farmers get friendly with the ICT and other dominant information sources may be done. Usage of traditional media such as folk media, fairs, puppet shows, plays, and exhibitions should be complemented with ICT usage as still the farmers, both male and female, have less familiarization with modern ICTs. The information material generally comprises complex and high-tech language and people find it difficult to decipher the meaning so this kind of information. The information must be provided in vernacular languages for easy comprehensibility.

As women farmers are less educated in comparison to their male counterparts, in order to impart knowledge and information among illiterate or less educated women farmers, audio-visual and voice-based information services should be started. Formation of groups at community level should be promoted and the women farmers should be encouraged to join the groups. If a woman joins a group, she can learn from her fellow group members and can interact with the experts, and attain knowledge. Women farmers spend most of their time in fields and performing their day-to-day work, so they are left with less time to go to the resource centers. Extension personnel should increase regular trainings and visits to the farmers' fields to guide farmers so that women farmers who find mobility a constraint can meet the experts. Women prefer informal information sources, thus there is a need to enhance the capability of actors with high centrality scores in women's networks. These skilled and well-informed sources will act as carriers of valid and accurate information to the women farmers. The success stories of progressive and successful farmers in the community should be recognized and popularised to motivate fellow women farmers so that they get inspired to attain information and knowledge about new technologies. Information disseminators, preferably women workers, may be appointed at village level so that the women farmers feel more comfortable in contacting the same gender. Programme for providing smartphones to women farmers at subsidized rates can also promote the usage of ICTs and social media platforms to access updated information pertaining to improved agriculture. To disseminate information in ways that impact improved production and marketing of vegetables in hills, the information providers need to meet the farmers (and women farmers) where they are so that the mobility issue can be addressed.

Although policymakers and programme planners might be able to use social networks to disseminate information inexpensively and effectively, the decision of whom to target within a

network has implications for who would benefit from the information. Targeting training and information to the most influential nodes within social networks leads to more knowledge dissemination to other nodes, in this case-males, who are fairly well-connected. To determine the most helpful strategy, service providers need to be mindful of the structure of social networks (i.e., formal and informal) in vegetable production. The results highlight the necessity for policymakers, researchers, and organizations involved in improved vegetable production to comprehend the social networks that enable the dissemination of information.

Conclusion

Agriculture in highland areas is characterized by its distance from markets and supplies, ability to thrive in harsh environmental conditions, sparse population, and inadequate infrastructure. Because of this, agriculture in these areas is more likely to depend on interpersonal social networks to remain sustainable¹⁶. One of the most crucial inputs for sustaining a livelihood is information, and communication networks are crucial for disseminating this knowledge in rural community. Despite the potential of mobile-based advising services, it is crucial that intervention designers use caution when relying excessively on mobile devices to reach to women farmers. By looking into women's access to phones, literacy levels, preferred languages, preferences for voice over text messaging, and the ideal times to reach them directly, intervention designers can validate the viability of their method. Among the strategies to reduce the gender gap in information dissemination, use of women's SHGs for collective engagement; strengthening women's information networks, less reliance on mobile phones to reach women farmers directly due to ownership and phone-literacy constraints, and establishing information centres in the community are the recommended ones. The study's conclusions may serve as guidelines for creating a reliable and effective gendered information system for delivering information to male and female farmers.

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Conflict of interest

The authors declare that they have no conflict of interest.

References

1. Ayanyemi, O.O., The role of information in enhancing the status of women in developing countries. *Nigerbiblos*, 2006, **1**, 151- 170.
2. Bates, M.J., Fundamental of forms of information. *Journal of American Society for Information Science and Technology*, 2012, **57(8)**, 1033-1045.
3. Taylor, S. and Boubakri, N., Women and finance: Unlocking Africa's hidden growth reserve. In: Financial Inclusion in Africa (eds Triki, T. and Faye, I.), African Development Bank Group, Tunis, Tunisia, 2013, pp. 75–83.
4. FAO. Women's access to rural finance: Challenges and opportunities. Rome, 2019, License: CC BY-NC-SA 3.0 IGO.
5. Cadger, K., Quaicoo, A.K., Dawoe, E. and Isaac, M.E., Development interventions and agriculture adaptation: A social network analysis of farmer knowledge transfers in Ghana. *Agriculture*, 2016, **6 (3)**, 32.
6. Haldar, S., Misra, S., Pal, S., Basu, D. and Goswami, R., Understanding agricultural information networks in West Bengal India. *Indian Research Journal of Extension Education*, 2016, **16 (1)**, 25-34.

7. Rohit, J., Nirmala, G., Beevi, A., Shankar, K. R., Nagasree, K., Pankaj, P.K., Sindhu, K. and Singh, V.K., Structural analysis of social network among farmers for information acquisition in rain fed areas: A study on farmers' information acquisition dynamics. *Indian Journal of Extension Education*, 2021, **57(1)**, 1-6.
8. Ayanwuyi, E. and Zaka, K. O., Analysis of extension service needs of women cassava farmers in Akinyele local government area of Oyo state, Nigeria. *Continental Journal of Agricultural Economics*, 2011, **5(1)**, 1–6.
9. Vishnu, S., Gupta, J. and Subhash, S. P., Social network structures among the livestock farmer's vis a vis calcium supplement technology. *Information Processing in Agriculture*, 2019, **6(1)**, 170-182.
10. Kumar, K. R., Nain, M. S., Singh, R., Chahal, V. P. and Bana, R. S. Analysis of farmers' communication network and factors of knowledge regarding agro meteorological parameters. *Indian Journal of Agricultural Sciences*, 2015, **85(12)**, 1592–1596.
11. Guite, F. and Hangsing, P. Impact of education on health information seeking and decision-making among rural women. *SRELS Journal of Information Management*, 2020, **57(6)**, 327-335.
12. Tey, Y. S., Li, E., Bruwer, J., Abdullah, A. M., Brindal, M., Radam, A. and Darham, S., Factors influencing the adoption of sustainable agricultural practices in developing countries: A review. *Environmental Engineering and Management Journal*, 2017, **16**, 337–349.

13. Muthulakshmi, B. and Singh, R. J., Social networks of farmers on climate change mitigation and adaptation in western agro climatic zone of Tamil Nadu. *Indian Research Journal of Extension Education*, 2019, **19 (1)**, 43-48.
14. Luqman, M., Yaseen, M., Ashraf, S., Mehmood, M. U. and Karim, M., Factors influencing use of information and communication technologies among farmers in rural Punjab, Pakistan. *Journal of Agricultural Extension*, 2019, **23(2)**, 101-112.
15. Noack, E. M., Are Rural Women Mobility Deprived? – A case study from Scotland. *Sociologia Ruralis*, 2011, **51**, 79-97.
16. Ann, B., Cornell, J., and Chrysa, L., Social networks and farming resilience. *Outlook on Agriculture*, 2021, **50(2)**, 196-205.