

Do the information networks of farmers differ across gender? Evidence from the hills of Uttarakhand, India using social network analysis

Kushagra Joshi* and Jyoti Rawal

Indian Council of Agricultural Research-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora 263 601, India

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 describes the information networks of hill farmers across genders for accessing data about vegetable cultivation. Through simple random sampling, two hill districts in Uttarakhand, India, were chosen and 320 vegetable growers were selected. The results showed that in comparison to female farmers, the social networks of male farmers frequently included formal information sources. The main factors determining the pattern of information network usage among women farmers were education, farming experience, hours dedicated to farming, group membership and contact with extension agencies, whereas income, land-holding, access to mobile phones, contact with extension agencies and frequency of contact affected the information network usage among male farmers. The study gives suggestions for policymakers and programme planners to bridge the gender divide by devising effective information dissemination in the hill regions.

Keywords: Gender, hill regions, information usage pattern, social network analysis, vegetable growers.

INFORMATION has gained widespread attention as a vital resource for the 21st century. All human societies rely heavily on knowledge for 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 ensure both individual and organizational functioning. The main purpose of information is to expand user understanding while reducing their level of doubt and confusion. Information needs to be accurate, timely and relevant in order to be effective. It is a crucial tool for personal growth, survival and development¹. Any object that a person views or comes into contact with can be considered as a source of information². Also, information sources are the instruments that help satisfy the 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 programmes, agricultural booklets, etc. are all expected to provide rural farmers with agricultural knowledge, they 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 the hills remains an unorganized sector as farmers are still following traditional methods. Besides, they are not as familiar with the current extension system as the farmers cultivating food grains. Growing vegetables is projected as a financially lucrative technique that could replace subsistence farming in the hills. Vegetable cultivation is more profitable, particularly over food crops, as the latter are labour-intensive but less remunerative, and largely cultivated by rural and marginal farmers. Moreover, most of the vegetable growers in the Himalayan states like Uttarakhand are small and marginal farmers, and they have their peculiar issues which need to be properly dealt with. The distinct agro-climatic and soil conditions of Uttarakhand are favourable for the production of vegetables. The vegetable growers need timely information, advice, inputs and resources to grow more produce and gain maximum profit. Across genders, access to information becomes more difficult due to the lack of identity of women as farmers and the restricted mobility of women farmers to information providers. Women also lack access to resources like mobile phones, 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 only a few financial services available in rural areas, and these are rarely beneficial to rural women³. Barriers in the societal, economic, legal and, in some cases, educational spheres limit the access of women to these services⁴.

According to accumulating empirical research, the structural organization of the social network of smallholder

*For correspondence. (e-mail: Kushagra.Joshi@icar.gov.in)

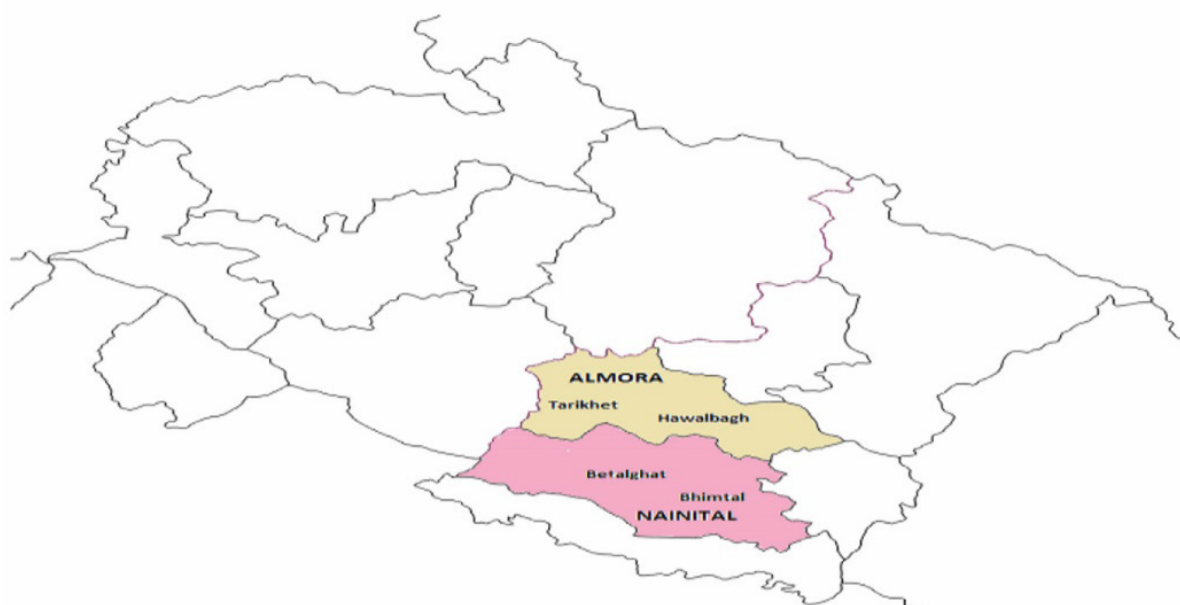


Figure 1. Map of the study area depicting the sampled districts of Uttarakhand, India.

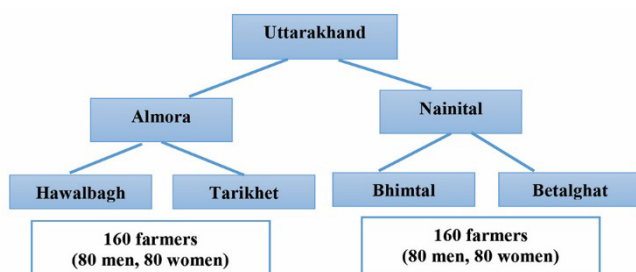


Figure 2. Sampling plan of the study.

must be understood in order to improve their access to information. The communication networks of farmers comprise both formal and informal sources. However, how 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 analysed the network structures across gender – for male and female farmers, and no study exists for the hill regions. The major goal of the present study was to identify the dominant information networks by gender as well as the centrality measures of information sources to evaluate their dominance and influence within a 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 can be developed for enhancing productivity and ensuring the well-being of vegetable growers in the state.

Materials and methods

Study area

The present study was carried out in the mountainous state of Uttarakhand in the Indian Himalaya (Figure 1). Almost 86% of Uttarakhand’s land is mountainous, making it fully dependent on rainfall; the remaining 14% 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 71% of farmers in the state fall in the marginal category. These small and marginalized farmers produce vegetables in their small landholdings. Men from the hilly areas typically move to the plains in pursuit of work, leaving the women behind. The major reason for such migration is the non-availability of livelihood options. For the 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 Almora district and from Betalghat and Bhimtal blocks

Table 1. Allocation of vegetable growers according to their socio-economic status

Variables	Male (N = 160; %)	Females (N = 160; %)
Age (years)		
Young (18–35)	13.75	28.75
Middle (36–52)	56.25	55
Old (>52)	30	16.25
Caste		
General	96.25	97.5
Other	3.75	2.5
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
Family type		
Nuclear	57.5	63.75
Joint	42.5	36.25
Family size (members)		
Small (up to 4)	31.25	41.25
Middle (5–8)	50	48.75
Large (>8)	18.75	10
Land holding (acre)		
Less than 1	61.25	71.25
1–5	38.75	28.75
More than 5	0	0
Farming experience (years)		
0–10	6.25	20.00
10–20	41.25	65
More than 20	52.5	15
Time dedicated to vegetable farming (h)		
2–4	11.25	27.5
5–7	60	45
8–10	28.75	27.5
Farming mode		
Full-time	100	100
Part-time	0	0
Group membership		
Yes	12.5	37.5
No	87.5	62.5
Accessibility to extension services		
Yes	52.5	38.75
No	47.5	61.25
Media ownership		
Access to mobile phones	100	100
Ownership of mobile phones	93.75	83.75
Ownership of smartphones	46.25	28.75

of Nainital district were chosen by simple random sampling. A total of 320 vegetable growers were selected as respondents, equally divided over gender (Figure 2).

Data processing and analysis

The data collected were analysed using social network analysis, which is the process of examining social structures through the use of networks and graph theory. It characterizes networked structures in terms of nodes (individual actors, people, or things within a network) and the ties, edges or links (relationships or interactions) that

connect them. GEPHI, a visualization application developed in Java, was used mainly for visualizing, manipulating and exploring networks and graphs from raw edge and node graph data.

Results

Socio-personal profile of farmers

Table 1 presents the socio-economic status of vegetable growers. The majority of male participants (56.25%) were middle-aged, and most of them belonged to the general

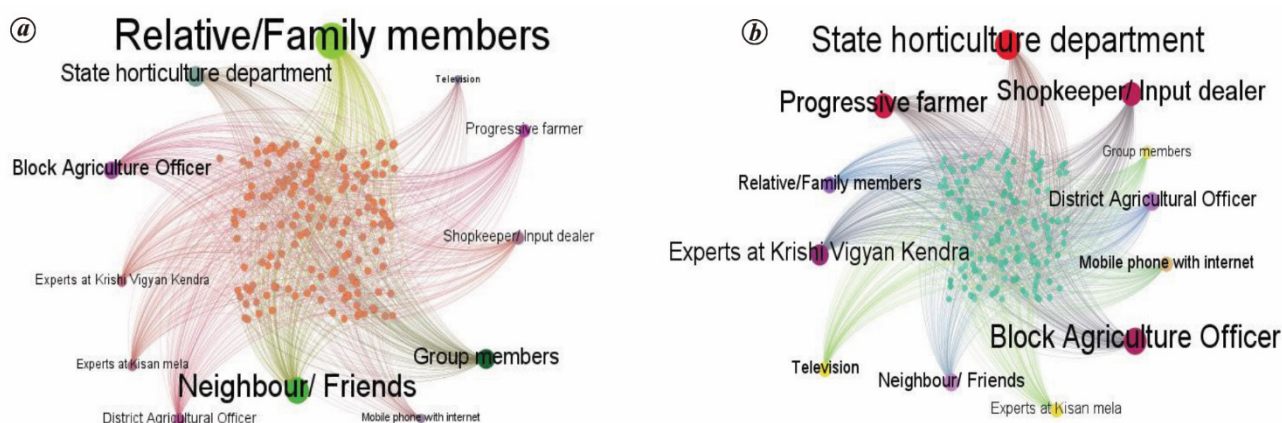


Figure 3. Network structure of (a) female and (b) male vegetable growers.

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

Information networks of vegetable growers across gender

There is a lot of evidence showing that men and women get their knowledge from different sources. Compared to female farmers, male farmers have more social networks, which frequently include members who live outside their locality. Male farmers are also more likely to serve as organizers and gatekeepers compared to female farmers⁵.

Local, interpersonal sources of information were popular among women farmers as they chose relatives/family members, neighbours/friends and group members as their most preferred information sources (Figure 3 a). For male vegetable growers, it was observed that more formal interpersonal information sources were preferred, as they chose the State Horticulture Department as their preferred information source, followed by progressive farmers and shopkeepers/input dealers (Figure 3 b). With respect to electronic media, both male and female farmers chose mobile phones with the internet over television as the most preferred mass media.

Network structures of farmers across gender

A person or source with the most network connections would influence information dissemination and technology adoption in his/her network. Table 2 is a reference vocabulary of the social network analysis terms discussed in this study. Since nodes and the links that connect them are the two fundamental elements of a network, size and density are the two fundamental network properties. The number of nodes in a network determines its size, whereas density measures the proportion of linkages that are actually formed to all possible ties.

Table 3 shows the network attributes of 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 density = 0 is considered to be entirely disconnected, whereas a network with density = 1 is fully connected. Density values are beneficial when comparing networks of similar size. Low-density ratings are typical for vast networks. The network of female farmers was less dense than that of male farmers, which indicates that the communication between women farmers operates through a sparse network. About 9% of nodes in women farmers' networks were connected, while for men, about 14% of nodes were connected. While more open or sparse networks may provide better access to varied information, denser networks may increase the possibility of sharing similar resources.

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

Table 2. Glossary of social network analysis concepts

Term	Definition
Density	Indicates how closely actors within the networks are connected to each other.
Modularity	Network structure is measured by segmenting it 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 are transferred inside a network.
Network diameter	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. Network attributes of male and female vegetable growers

Network attribute	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

networks reveals that there are more small factions in the network than males.

Centrality measures of information networks

To evaluate their dominance and influence inside a 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. The actors who influence the flow of information in the system. The degree to which a person is related to other actors in a network is indicated by the closeness centrality. In the case of male farmers, the centrality measures were highest for the State Horticulture Department, followed by progressive farmers and input dealers/shopkeepers (Table 4). These were the most sought-after sources (in-degree centrality), were in a position to spread information quickly (closeness centrality) and had significant influence over the flow of information in the network (betweenness centrality).

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

Factors affecting information networks usage by female vegetable growers

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

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

Income, landholding, access to mobile phones, 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 the hills. If correctly planned, 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 maximum number of farmers and understanding the farmers' information networks and their characteristics are prerequisites for effective information dissemination.

Building the capacity of players with high centrality ratings may strengthen how 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 this study that the information networks of farmers may vary across genders and applied social network analysis techniques to delineate the networks.

It was found that the information networks of farmers varied across genders. Female vegetable growers had more informal and local sources in their information networks

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

Information source	Centrality measures		
	In-degree	Betweenness	Closeness
Neighbours/friends	111	951.352	0.610
Relatives/family members	116	875.695	0.633
Progressive farmers	142	1549.481	0.784
Group members	90	539.194	0.531
Shopkeepers/input dealers	139	1476.875	0.763
State Horticulture Department	150	1970.160	0.846
Block Agriculture Officer	137	1722.196	0.750
District Agricultural Officer	113	990.728	0.619
Experts at Krishi Vigyan Kendra	133	1247.087	0.724
Experts at kisan mela	98	653.996	0.558
Television	97	733.111	0.555
Mobile phone with internet	103	731.118	0.577

Table 5. Centrality measures of existing information sources among female vegetable growers

Information source	Centrality measures		
	In-degree	Betweenness	Closeness
Neighbours/friends	135	2394.693	0.737
Relatives/family members	149	3684.597	0.838
Progressive farmers	89	712.082	0.527
Group members	119	1583.812	0.647
Shopkeepers/input dealers	70	730.150	0.464
State Horticulture Department	101	1637.205	0.566
Block Agriculture Officer	93	1320.156	0.534
District Agricultural Officer	85	693.512	0.511
Experts at Krishi Vigyan Kendra	78	504.565	0.494
Experts at kisan mela	73	455.601	0.480
Television	54	206.095	0.429
Mobile phone with internet	58	279.525	0.413

pertaining to vegetable cultivation, which were easy to access and were in frequent contact with them. Researchers have reported similar findings that the major source of information for the women respondents was family/relations/friends, and women were less likely to consult formal sources, unlike males^{8,9}. The study also found that the significant factors determining the pattern of information network usage by women farmers were education, farming experience, time dedicated to farming, group membership and contact with extension agency. Women in the hill regions, being de facto farmers due to male migration, shoulder various responsibilities like working in the fields, feeding the cattle, rearing children, taking care of elderly members of the family, preparing food, collecting firewood, etc. The women farmers have fewer opportunities to interact with formal information sources such as the State Horticulture Department, Block Agriculture Officer, shopkeepers/input dealers, Krishi Vigyan Kendras (farm science centre), etc. Thus, they prefer local interpersonal sources, which are easier to contact. due to the easy availability of such sources¹⁰.

Education is an important factor that positively affects the information network usage of women growers, i.e. a

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 time to farming, then they are left with less time to interact with the information sources in the agriculture networks. The farming activities predominantly carried out by women are time-consuming, monotonous and done manually without any mechanical aid. Group membership also affects the information usage pattern, since woman member of a collective, is more likely to obtain information related to agriculture or any other aspect than one who is not associated with any group. The women's collectives are approached more often by the extension agencies and are also 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 formal sources of information in their networks. They also had more access

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

Factors	Unstandardized coefficients				
	<i>B</i>	Standard error	Standardized coefficients β	<i>t</i>	<i>P</i> -value
Constant	3.980	0.954		4.170	0.000
Age	-0.009	0.014	-0.052	-0.657	0.512
Education*	0.202	0.093	0.165	2.177	0.031
Family size	-0.054	0.051	-0.075	-1.047	0.297
Income	2.643	0.000	0.038	0.519	0.604
Landholding	0.012	0.010	0.082	1.138	0.256
Farming experience*	0.502	0.165	0.270	3.045	0.003
Time dedicated to farming*	-0.191	0.073	-0.208	-2.604	0.010
Group membership*	0.700	0.274	0.179	2.555	0.011
Access to mobile phones	0.777	0.420	0.133	1.848	0.066
Contact with extension agencies*	0.723	0.313	0.173	2.312	0.022
Frequency of contact	0.235	0.143	0.118	1.640	0.103

*Significant at 95% confidence level.

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

Factors	Unstandardized coefficients				
	<i>B</i>	Standard error	Standardized coefficients β	<i>t</i>	<i>P</i> -value
Constant	5.361	1.387		3.865	0.000
Age	0.006	0.013	0.53	-0.020	0.984
Education	-0.209	0.140	-0.150	-1.479	0.143
Family size	0.073	0.050	0.140	1.453	0.150
Income*	1.439	0.000	0.239	2.568	0.012
Landholding*	0.028	0.011	0.260	2.528	0.014
Farming experience	-0.040	0.159	0.026	-0.252	0.802
Time dedicated to farming	-0.003	0.093	-0.003	-0.032	0.974
Group membership	-0.233	0.471	-0.050	-0.495	0.622
Access to mobile phones*	1.728	0.710	0.233	2.433	0.017
Contact with extension agencies*	2.033	0.412	0.567	4.930	0.000
Frequency of contact*	-0.449	0.125	-0.386	-3.585	0.001

*Significant at 95% confidence level.

to mobile phones than the female farmers. Men generally have access to mobile phones and have more contact with distant, formal information sources through them. They have more access to formal sources like horticulture officers, extension agencies, block offices, etc. even if they are located at a distance.

Male farmers preferred formal sources of information, and mobility was not an issue for them. So they should be encouraged to visit the relevant offices and be exposed to social forums, training, exposure visits to other places, etc.¹³. Extension personnel should persuade the vegetable growers to avail information and buy inputs from blocks and horticulture departments, as these provide quality inputs at subsidized rates, while women farmers must be targeted for input distribution in the villages as the main beneficiaries. Income, landholdings, access to mobile phones, contact with extension agency and frequency of contact were the main factors that affected the agricultural network usage among male vegetable growers. People with more income and relatively large landholdings tend to seek more infor-

mation to increase production and earn more profit, and hence access information from various sources. Researchers have reported that a unit increase in landholding size and income of the respondents would drive farmers towards greater use of information communication tools¹⁴.

Policy implications and way forward

The findings of this study highlight the advantages and disadvantages of the information system from the standpoint of policy measures and suggest various reforms in the existing information dissemination systems in the hills. They strongly indicate that the existing extension and delivery system needs to be strengthened. There are fewer training institutions in villages, which indicates that infrastructure development 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 they face due to the cultural and infrastructural constraints in the hills. Some provisions to promote basic and functional media literacy should be made. Every farmer cannot afford or operate smartphones. So, provision should be made to establish centres or interactive kiosks where male and female farmers can visit and get information. Recruiting helping staff (information providers) at the community level who would assist the farmers in operating such kiosks, mobilize farmers, arrange meetings with extension personnel and subject experts so that the farmers get acquainted with the ICT and other dominant information sources may be done. Traditional media such as folk media, fairs, puppet shows, plays and exhibitions should be complemented with ICT usage, as both male and female farmers are still less familiar with ICT. The information material generally comprises complex and high-tech language, and farmers find it difficult to decipher. So 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 the community level should be promoted, and women farmers should be encouraged to join these groups. If a woman joins a group, she can learn from her fellow group members and interact with the experts to attain knowledge. Women farmers spend most of their time in the fields performing their day-to-day activities. So they are left with little time to visit the resource centres. Extension personnel should visit the farmers' fields more often so that women farmers who find mobility a constraint can meet them. Women prefer informal information sources; thus, there is a need to enhance the capability of actors with high centrality scores in the women farmers' networks. These skilled and well-informed sources will provide valid and accurate information to the women farmers. The success stories of progressive and successful farmers in the community should be recognized and popularized to motivate fellow women farmers to get inspired to gain information and knowledge about new technologies. Information disseminators, preferably women workers, may be appointed at the village level so that the women farmers feel more comfortable contacting them. Programmes 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 the hills, the information providers need to meet the farmers (especially 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 effectively and in a cost-effective manner, 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 the social networks leads to more knowledge dissemination to the 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 the social networks (i.e. formal and informal) in vegetable production. The results of this study highlight the need 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. Due to 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 knowledge among the rural community. Despite the potential of mobile phone-based services, it is crucial that intervention designers use caution when relying excessively on mobile devices to reach women farmers. By considering women's access to mobile phones, their literacy levels, preferred languages, preferences for voice-over text messaging, and the ideal times to reach them directly, intervention designers can validate their method. Among the strategies to reduce the gender gap in information dissemination, use of women's self-help groups 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 conclusions derived from this study may serve as guidelines for establishing a reliable and effective system for delivering information to male and female farmers.

Conflict of interest: The authors declare that they have no conflict of interest.

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. *J. Am. Soc. Inf. Sci. Technol.*, 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, Food and Agriculture Organization of the United Nations, Rome, Italy, 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 Res. J. Extens. Educ.*, 2016, **16**(1), 25–34.
 7. Rohit, J. *et al.*, Structural analysis of social network among farmers for information acquisition in rainfed areas: a study on farmers' information acquisition dynamics. *Indian J. Extens. Educ.*, 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. *Cont. J. Agric. Econ.*, 2011, **5**(1), 1–6.
 9. Vishnu, S., Gupta, J. and Subhash, S. P., Social network structures among the livestock farmer's vis-à-vis calcium supplement technology. *Inf. Process. Agric.*, 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 J. Agric. Sci.*, 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 J. Inf. Manage.*, 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. *Environ. Eng. Manage. J.*, 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 Res. J. Extens. Educ.*, 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. *J. Agric. Extens.*, 2019, **23**(2), 101–112.
 15. Noack, E. M., Are rural women mobility deprived? – a case study from Scotland. *Sociol. Rural.*, 2011, **51**, 79–97.
 16. Ann, B., Cornell, J. and Chrysa, L., Social networks and farming resilience. *Outlook Agric.*, 2021, **50**(2), 196–205.
- ACKNOWLEDGEMENTS. We thank the respondents for their participation and cooperation during data collection. We also thank the Indian Council of Social Science Research, New Delhi for funding this study.
- Received 13 April 2023; revised accepted 25 August 2023
- doi: 10.18520/cs/v125/i11/1235-1243