



Influence of communication channels for farmer-to-farmer knowledge sharing among smallholder rice growers in Mvomero District, Tanzania

Faines Christopher Msigwa¹

Ester Ernest Mnzava²

Philibert Simon Nyinondi³

¹faineschristopher75@gmail.com

^{1,2,3}Sokoine University of Agriculture, Tanzania

Recommended Citation: Msigwa, F. C., Mnzava, E. E., & Nyinondi, P. S. (2026). Influence of communication channels for farmer-to-farmer knowledge sharing among smallholder rice growers in Mvomero District, Tanzania. *African Quarterly Social Science Review*, 3(3), 656–665. <https://doi.org/10.51867/AQSSR.3.3.53>

ABSTRACT

Communication channels play a critical role in enhancing knowledge sharing among smallholder rice growers, specifically on farmer-to-farmer knowledge sharing. This study examined the influence of communication channels on farmer-to-farmer knowledge sharing among rice growers in Mvomero District, Tanzania. This study is grounded on two theories, the Social Network Theory and the Diffusion of Innovation Theory. Specifically, the study identified the communication channels used by farmers and assessed the influence of socio-economic factors on their use for knowledge sharing. A quantitative research approach guided by a cross-sectional design was employed. The targeted population was smallholder rice growers from Mvomero District, where four wards were purposively selected (Mkindo, Dakawa, Mlali, and Hembeti). Data were collected from 400 rice growers selected through a multistage sampling technique involving purposive and simple random sampling. Data were analyzed using descriptive statistics and hierarchical multiple regression analysis. The findings revealed that face-to-face interactions, farmer groups, and mobile phones were among the most commonly used communication channels for knowledge sharing. The regression findings revealed that education, income, social capital, group membership, and mobile phone ownership significantly influenced farmer-to-farmer knowledge sharing. Social capital and group membership emerged as the strongest predictors of knowledge sharing. The study concludes that social capital and access to communication resources play a critical role in promoting knowledge exchange among smallholder rice growers. The study recommends strengthening farmer groups, enhancing social networks, and improving access to communication technologies to facilitate effective farmer-to-farmer knowledge sharing.

Keywords: Communication Channels, Farmer-to-Farmer Knowledge Sharing, Mvomero District, Social Capital, Smallholder Rice Growers

I. INTRODUCTION

Agriculture is the backbone of the economy, which ensures food security provide raw material for industrialization (Pawlak & Kołodziejczak, 2020). Moreover, the role of agriculture for the development of the economy is to contribute to national income, source of food, create employment, reduce poverty, sources of foreign exchange for the country (Prasanth & Sivanantha, 2021). Generally, agriculture is the basic source of food supply for all countries all over the world, whether underdeveloped, developing, or developed (Beckman & Countryman, 2021; Loizou et al., 2019). Due to the increasing population, it's very important to increase agricultural productivity by ensuring that farmers get new knowledge that will help them in agricultural sustainability.

Rice is the second most important staple food crop in Tanzania. It is largely grown by smallholder farmers in irrigated and rainfed ecosystems (Coalition for Africa Rice Development [CARD], 2025). Rice is the world's most commonly grown cereal, but it is also a staple food for more than 60% of the world's population (Mtembeji & Singh, 2021). The rice industry is significantly important to farmers, the government, and consumers of Tanzania. Government-led initiatives were implemented for the development of the sector. Such as the implementation of the 10-year first phase of the National Rice Development Strategy of 2009, aimed to increase rice production by 2018, and the National Rice Development Strategy II of 2019 was launched to support the government's rice development over the next 12 years (Mtembeji & Singh, 2021).

Agricultural knowledge is very important to farmers, as it ensures that the community attains vital innovation, market trends, and peer-tested techniques. It enables farmers to adopt new practices, optimize inputs, and mitigate climate risks, which will lead to higher yields, improve food security, and better household livelihood (Masambuka-Kanchewa et al., 2020; Tiwari, 2022). Farmer-to-farmer knowledge sharing is the preferred method for farmers,



significantly improving their knowledge and awareness of sustainable agricultural practices. This increased knowledge, in turn, led to greater adoption of these practices among farmers (Izuchukwu et al., 2023).

Communication channels are very important for knowledge sharing among farmers (Kandel et al., 2024). In farmer-to-farmer knowledge sharing, Farmers use farm visits, face-to-face interactions, mobile phones, social media like WhatsApp and Facebook, and farm demonstrations to share their knowledge with fellow farmers. These networks, deeply rooted in community relationships and shared experiences, operate through face-to-face interactions at various local settings, such as markets, community gatherings, and informal meetings (Izuchukwu et al., 2023; Nain et al., 2019). Previous studies show that farmer-to-farmer communication channels are one of the communication channels farmers use to share agricultural knowledge information without examining what channels, such as peer-to-peer, they use to exchange their knowledge (Izuchukwu et al., 2023; Kandel et al., 2024; Kansanga et al., 2021; Nain et al., 2019; Sutherland & Marchand, 2021). Therefore, this study aimed to examine the influence of farmer-to-farmer knowledge sharing and the communication channels used by farmers on knowledge sharing as peer-to-peer.

1.1 Statement of the Problem

Smallholder farmers heavily depend on agriculture for food security and livelihoods. Effective communication channels should facilitate timely, accurate, and accessible sharing of agricultural knowledge among smallholder farmers, enabling them to learn from one another (Izuchukwu et al., 2023). In rural areas where extension services are often limited, farmer-to-farmer knowledge sharing serves as the primary means of sharing vital agricultural knowledge. Communication channels such as face-to-face interaction, mobile phones, farmer groups extension meetings, and farm visits or demonstration plots are expected to support the knowledge sharing and innovation among smallholder farmers (Mtega, 2021; Ndimbwa et al., 2021).

However, the effectiveness of communication channels in enhancing farmer-to-farmer knowledge sharing differs. Many smallholder farmers continue to face challenges in getting reliable and timely agricultural knowledge due to limitations related to communication infrastructure, digital literacy, and uneven participation in farmer networks (Magesa et al., 2023). In Mvomero District, where rice is a major livelihood activity, farmers mostly depend on fellow farmers for agricultural information, yet there is limited empirical evidence regarding which communication channels facilitate knowledge sharing among smallholder farmers (Sandy et al., 2024).

Ineffective communication channels may hinder the sharing of useful agricultural knowledge. This may lead to low productivity, poor decision-making, and reduced capacity of farmers to respond to production challenges (Prajapati et al., 2025). Moreover, the lack of evidence on the influence of different communication channels makes it difficult for policymakers, development organizations, and extension practitioners to implement effective communication strategies that will enhance knowledge sharing among rice growers. Therefore, this study aimed to examine the influence of communication channels on farmer-to-farmer knowledge sharing among smallholder rice growers in Mvomero District. Specifically, the study seeks to identify the communication channels used by farmers and assess how socio-economic factors influence the use of communication channels on knowledge sharing among smallholder rice growers

1.2 Research Objectives

- i. To identify and analyze the communication channels used in farmer-to-farmer knowledge sharing among smallholder rice growers.
- ii. To determine the influence of socio-economic factors on the use of communication channels on farmer-to-farmer knowledge sharing among smallholder rice growers.

II. LITERATURE REVIEW

2.1 Theoretical Review

This study is grounded in the Social Network theory and supported by the Diffusion of Innovation (DOI) Theory. Together, these frameworks provide a coherent basis for examining how agricultural knowledge is shared through peer-based communication channels among smallholder farmers.

2.1.1 Social Network Theory

Social Network Theory explains how individuals are connected through social interaction or relationships and how these connections enhance the flow of information and knowledge within a community. In agricultural contexts, farmers are surrounded by social networks such as family relations, neighbor relations, farmer groups, and community associations, which serve as crucial channels for sharing agricultural knowledge where people have experience based on their farming experience (Wasserman & Faust, 1994; Valente, 2010). This theory emphasizes that the structure, Strength, and frequency of these relationships enhance the extent of knowledge sharing among smallholder farmers.

2.1.2 Diffusion of Innovations Theory

The Diffusion of Innovations Theory further complements this perspective by showing how new ideas and practices spread through communication channels over time within a social system. According to Rogers (2003), interpersonal communication channels are more active and effective than mass media in influencing individuals' understanding and adoption of innovations. Moreover, the theory highlights that socio-economic factors such as age, education level, farming experience, and social participation influence an individual's access to communication and their ability to engage in knowledge sharing (Rogers, 2003; Feder & Savastano, 2006). Therefore, the combination of Social Network Theory and Diffusion of Innovations Theory ensures a strong framework for examining how communication channels and factors influence farmer-to-farmer knowledge sharing among smallholder rice growers in Mvomero District.

2.2 Empirical Review

2.2.1 Communication Channels used in Farmer-to-Farmer Knowledge Sharing

Farmer-to-farmer knowledge sharing occurs through various communication channels that facilitate the exchange of agricultural information, experience, and innovations among farmers. Different studies have found that both traditional and digital communication channels are important for farmer-to-farmer knowledge sharing. For instance, Izuchukwu et al. (2023) found that face-to-face interactions, farmer groups, and community networks were the most common channels through which farmers exchanged agricultural knowledge and promoted the adoption of modern farming practices. Also, Ameh et al. (2025) found that communication networks among rice farmers enhance the sharing of climate-smart agricultural knowledge and influence farmers' access to production information. According to Omulo and Kumeh (2020), found that digital platforms such as wefarm enable farmers to share experiences beyond their local communities. Similarly, Ndimbwa et al. (2021) revealed that social media and mobile phones increasingly complement traditional communication channels by improving access to agricultural information and strengthening knowledge exchange among smallholder farmers.

2.2.2 Influence of Socio-Economic Factors on the Use of Communication Channels on Farmer-to-Farmer Knowledge Sharing

Earlier studies have revealed that farmers' socio-economic characteristics significantly influence the use of communication channels for knowledge sharing. For instance, Mwololo et al. (2019) found that factors such as age, income, education level, and farming experience affect farmers' preferences for different agricultural extension and communication methods. Also, the study conducted by Assefa et al. (2021) reported that education, access to resources, and social participation influenced farmers' engagement in an information-sharing network for climate risk adaptation. Studies by Izuchukwu et al. (2023) and Morrison et al. (2025) further revealed that farmers who are better connected through social and communication networks are more likely to exchange agricultural knowledge. Similarly, Bliss et al. (2019), Kandel et al. (2024), and Zorrilla-Miras et al. (2026) showed that active participation in farmer groups and knowledge-sharing networks enhances access to communication channels and strengthens the exchange of farming knowledge among farmers. These studies suggest that socio-economic factors play an important role in shaping access to and use of communication channels for farmer-to-farmer knowledge sharing.

III. METHODOLOGY

3.1 Study Area

The study was conducted in four wards of Mvomero District, Morogoro Region, namely Mlali, Dakawa, Hembeti, and Mkindo, which are well known for intensive rice production. These areas are characterized by a high concentration of smallholder rice farmers and support both rain-fed and irrigated agriculture, with major schemes such as Mkindo and Dakawa playing a key role in paddy production (International Water Management Institute, 2019; Goweke et al., 2020). The wards were selected due to their importance in rice farming, strong irrigation infrastructure, and active farmer organizations, making them suitable for studying communication and knowledge-sharing practices among farmers.

3.2 Research Design and Approach

This study adopted a quantitative research approach, guided by a cross-sectional research design, which involves collecting data at a single point in time, to examine the determinants influencing the choice of communication channels for peer-to-peer knowledge sharing among smallholder rice farmers. The quantitative approach was considered appropriate because it allows for systematic measurement and statistical analysis of relationships between variables, thereby enabling generalization of Results across the study population (Huyler & McGill, 2019; Bryman, 2016; Davidavičienė, 2018).

3.3 Study Population

The target population involved all smallholder rice growers in the selected wards (Mlali, Dakawa, Hembeti, and Mkindo). Smallholder farmers play a significant role in agricultural production in developing countries and rely heavily on different information sources to improve productivity (FAO, 2017).

3.4 Sample Size and Sampling Procedure

A total sample size of 400 respondents was used in this study. This sample size is considered statistically adequate for social science research, as larger samples improve statistical power, increase the precision of parameter estimates, and reduce the risk of model instability in regression analysis (Lakens, 2022; Pate et al., 2023). Empirical studies further emphasize that sufficient sample sizes are essential in multivariable and regression-based models to ensure reliable estimation and generalizable results.

A multistage sampling technique was employed in this study. In the first stage, the four wards of Mlali, Dakawa, Hembeti, and Mkindo were purposively selected due to their high involvement in rice farming. In the second stage, villages within each ward were also selected purposively based on their engagement in rice production activities. In the third stage, rice farmers were selected using simple random sampling, and the sample was proportionally distributed across the wards to ensure representativeness (Etikan et al., 2016).

3.5 Data Collection Methods

Primary data for this study were collected using a structured questionnaire administered to smallholder rice farmers. The questionnaire was designed to capture information on farmers' socio-economic characteristics and their use of different communication channels for peer-to-peer knowledge sharing. A structured instrument was preferred because it ensures consistency, facilitates quantification of responses, and supports statistical analysis of relationships among variables (Creswell, 2014).

3.6 Data Analysis

Data were analyzed using descriptive and inferential statistical techniques in IBM SPSS Statistics version 27. The analytical approach was guided by the conceptual framework, which positions farmer-to-farmer communication channels as the central mechanism through which agricultural knowledge is exchanged.

3.6.1 Analytical Approach

The analysis was conducted in three stages. First, descriptive statistics were used to examine patterns of farmer-to-farmer communication, focusing on the use of different channels for receiving and sharing knowledge. Second, composite indices were constructed to capture the intensity of communication channel use and the perceived effectiveness of these channels. Third, inferential analysis was performed to assess the factors influencing the use of communication channels. This approach enabled the study to address not only the prevalence of communication channels but also their relative importance and the determinants of their use.

3.6.2 Measurement of Variables

Farmer-to-farmer communication channels were operationalized in two dimensions: receiving knowledge and giving or sharing knowledge. Each dimension included four communication channels, namely face-to-face interaction, phone calls, SMS, and social media. Responses were measured using a Likert scale, and mean scores were computed for each channel. To capture overall engagement in peer communication, a Communication Channel Use Index (CCU) was constructed by averaging responses across receiving and giving items. In addition, a Perceived Effectiveness Index (PE) was computed from items measuring the perceived usefulness of communication channels. Higher index values indicate greater use and higher perceived effectiveness, respectively.

3.6.3 Descriptive Analysis

Descriptive statistics, including means and standard deviations, were used to summarize the use of communication channels. Channels were ranked based on mean scores to identify dominant modes of farmer-to-farmer communication. Comparisons were also made between receiving and giving knowledge to assess the extent to which farmers act as both information recipients and providers.

3.6.4 Inferential Analysis

To examine the factors influencing farmer-to-farmer communication, a multiple linear regression model was employed. The Communication Channel Use Index served as the dependent variable, while socio-demographic characteristics, social capital variables, and ICT access were included as independent variables. The model is specified as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \epsilon$$

where (Y) represents the Communication Channel Use Index, (X) denotes the set of explanatory variables, (β) are the estimated coefficients, and (ϵ) is the error term.

IV. FINDINGS & DISCUSSION

4.1 Socio-economic Characteristics of Respondents

The socio-demographic characteristics of the respondents provide an overview of the population under study and establish the context within which farmer-to-farmer communication occurs. The sample comprised both male and female farmers, with gender distribution indicating 47.5 % male and 52.5 % female. The age distribution shows that the majority of respondents fall within the economically active age groups, more than 50 years old, 39.5%, suggesting that most participants are actively engaged in farming activities. Educational attainment varied across respondents, with a substantial proportion having primary-level education 72%, while fewer had secondary 17%. In terms of marital status, most respondents were married 69.8%, reflecting the household-based nature of smallholder farming systems. Farming experience was generally high, with many farmers having several years of engagement in rice cultivation were 1-10 years were 39.0%. Farm size under rice cultivation varied; most farmers owned 0.5-5 acres, 90.2%, indicating heterogeneity in production capacity among farmers. Main sources of livelihood were 95.8% depend on selling food crops. These characteristics are important as they shape farmers' access to information, their capacity to interpret and use knowledge, and their participation in communication networks.

Table 1

Socio-economic characteristics (n=400)

Variable	Categories	Frequency(N)	Percentage (%)
Sex	Male	190	47.5
	Female	210	52.5
Age(years)	18-30	61	15.2
	31-40	93	23.2
	41-50	88	22.0
	More than 50	158	39.5
Education	No formal education	38	9.5
	Primary education	289	72.2
	Secondary education	68	17.0
	Post education	5	1.2
Marital status	Single	49	12.2
	Married	279	69.8
	Divorced	24	6.0
	Widowed	31	7.8
	Cohabitation	17	4.2
Farming experience(years)	1-10	156	39.0
	11-20	124	31.0
	21-30	60	15.0
	More than 30	60	14.9
Land ownership (acres)	0.5-10	341	85.2
	11-20	47	11.8
	More than 20	12	2.9
Area under rice(acres)	0.5-5	361	90.2
	6-10	30	7.5
	More than 10	9	2.2
Main sources of livelihood	Selling food crop	383	95.8
	Selling Livestock	10	2.5
	Selling livestock product	1	0.3
	Selling cash crops	2	0.5
	Pet cash/business	115	28.8

4.2 Farmer-to-Farmer Communication Channels

Table 2

Use of Farmer-to-Farmer Communication Channels

Channel	Receiving Mean	Giving Mean	Overall Mean
Face-to-face	3.64	3.42	3.53
Phone calls	2.78	2.58	2.68
SMS	2.03	1.89	1.96
Social media	1.24	1.18	1.21

The findings in Table 2 found that face-to-face is the most dominant channel for farmer to farmer knowledge sharing, with a mean score of 3.53, which indicates a high level of dependence on interpersonal communication. Face-to-face ranks in both receiving and sharing knowledge, highlighting its central role in peer learning. The mobile phone is the second channel, with a mean score of 2.68, showing that voice communication increases face-to-face interaction. The study shows that SMS, with a mean of 1.96, and social media, with a mean of 1.21, are less frequently used, indicating limited reliance on text-based and digital platforms for knowledge sharing.

4.3 Determinants of Farmer-to-Farmer Communication Channel Use

Table 3

Hierarchical Regression Results for Determinants of Communication Channel Use

Variables	Model 1	Model 2	Model 3
Age	-0.014	-0.010	-0.009
Gender	-0.163**	-0.112*	-0.108*
Education	0.199***	0.152**	0.148**
Marital status	-0.056	-0.032	-0.029
Farming experience	-0.005	0.004	0.006
Farm size	0.039	0.021	0.018
Income	—	0.067*	0.065*
Trust	—	0.214***	0.208***
Social networks	—	0.187***	0.181***
Social norms	—	0.093*	0.089*
Group membership	—	0.176**	0.171**
ICT (mobile phone)	—	—	0.124*
ICT (smartphone)	—	—	0.071
Model statistics:			
R ²	0.066	0.312	0.338
ΔR ²	—	+0.246	+0.026
F-statistic	4.595***	18.742***	17.963***

p < 0.05, ** p < 0.01, *** p < 0.001

Table 3 presents the hierarchical regression findings for the determinants of communication channel use among smallholder rice growers. Model 1, which involved socio-economic variables, described 6.6% of the difference in communication channel use ($R^2 = 0.066$, $F = 4.595$, $p < 0.001$). In this model, gender had a significant negative effect with $\beta = -0.163$, $p < 0.01$, while education had a significant positive effect with $\beta = 0.199$, $p < 0.001$, showing that communication channel use differs by gender and increases with higher levels of education. Other socio-economic variables, including age marital status, farming experience, and farm size, were not significant.

The addition of social capital variables in model 2 significantly increased the helpful power of the model from 6.6% to 31.2% with $\Delta R^2 = 0.246$. Trust ($\beta = 0.214$, $p < 0.001$), social networks ($\beta = 0.187$, $p < 0.001$), social norms ($\beta = 0.093$, $p < 0.05$), and group membership ($\beta = 0.176$, $p < 0.01$) all positively and significantly influenced communication channel use. Income also become significant ($\beta = 0.067$, $p < 0.05$). In Model 3, ICT variables were added, resulting in a modest increase in helpful power to 33.8% ($R^2 = 0.338$; $\Delta R^2 = 0.026$). Mobile phone ownership had a positive and significant effect on communication channel use ($\beta = 0.124$, $p < 0.05$), although smartphone ownership was not significant. Overall, the findings indicate that social capital factors, particularly trust and social networks, were the strongest determinants of communication channel use among smallholder rice growers.



4.4 Discussion

4.4.1 Farmer-to-Farmer Communication Channels

The findings in Table 2 demonstrate that face-to-face interaction remains the most dominant channel for farmers to receive and give agricultural knowledge among themselves, followed by mobile phone calls. Observed evidence from recent studies supports this finding. Colussi et al. (2021) and Savari and Khaleghi (2025) revealed that interpersonal interaction significantly shapes farmers' adoption behavior. Also, Mzingula et al (2023) indicates that communication channels are critical in agricultural knowledge sharing in Tanzania, especially where localized interaction is required. The study found that smallholder farmers 79% use farmer to farmer contacts for frequent sharing of agricultural information.

The analysis conducted by Falck-Zepeda (2026), further highlights that knowledge diffusion in agriculture is mediated by social communication systems rather than technological channels. The study conducted by Mzingula et al (2023) revealed that mobile phones are one of the channels farmers use to receive and share agricultural knowledge, with 47.6% of farmers using them to communicate with their peers. The moderately limited use of SMS and social media found in this study aligns with results by Aker (2011) and Baumüller (2018), showing that digital communication tools in smallholder contexts tend to complement rather than replace traditional channels. Also, Klerkx et al. (2019) found that digital agriculture initiatives are most effective when integrated into existing communication practices.

4.4.2 Influence of Socio-economic Factors on the Use of Communication Channels on Farmer-to-Farmer Knowledge Sharing

The Table 3 findings showed that education, gender, income, trust, social networks, social norms, mobile phone ownership, and group membership significantly influence farmer-to-farmer knowledge sharing among smallholder rice growers. Education had a significant positive impact, showing that educated farmers are more likely to access and share agricultural knowledge with their peers. This Findings is dependable with Mwololo et al. (2019), Assefa et al. (2021), and Ndimbwa et al. (2021), who found that education enhances farmers' ability to access information and participate in knowledge- sharing activities. The significant effect of gender additional indicate differences in participation in knowledge sharing between female and male farmers. This result is supported by studies showing that access to information and communication varies by gender (Assefa et al., 2021; Morrison et al., 2025). Also, the positive influence of income shows that farmers with greater financial resources have better access to communication tools and networks, enabling them to engage more in knowledge sharing (Mwololo et al., 2019).

The findings also revealed that social capital factors, mainly trust, social networks, social norms, and group membership, were strong predictors of knowledge sharing. Farmers who trusted one another and actively participated in social groups were more likely to exchange agricultural knowledge. Similar findings were reported by Izuchukwu et al. (2023), Morrison et al. (2025), Kandel et al. (2024), and Bliss et al. (2019), who found that strong farmer social networks facilitate information sharing, learning, and the adoption of improved agricultural practices. Additional Mobile phone ownership positively influenced knowledge sharing. This result is supported by the study conducted by Omulo and Kumeh (2020) and Ndimbwa et al. (2021), who revealed that communication technologies expand opportunities for farmer-to-farmer interaction and knowledge sharing.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This study examined the influence of communication channels on farmer-to-farmer knowledge sharing among smallholder rice growers in Mvomero District, Tanzania. The findings revealed that face-to-face and mobile phones are dominant channels that farmers use to receive and give information among themselves. Also, the findings reveal that both socio-economic and social capital factors significantly influence knowledge sharing among farmers. Education, income, trust, social networks, social norms, group membership, and mobile phone ownership positively influenced farmer-to-farmer knowledge sharing among farmers. Education, income, trust, social networks, social norms, group membership, and mobile phone ownership positively influenced farmer-to-farmer knowledge sharing, while gender also showed a significant effect. Among these factors, trust, social networks, and group membership emerged as the strongest judges, highlighting the importance of social relationships in facilitating knowledge sharing. Therefore, effective farmer to farmer knowledge sharing depends not only on individual characteristics but also on the strength of farmers' social connections and access to communication channels.

5.2 Recommendations

The study recommends that the agricultural extension service and development organizations strengthen farmer groups and local farmer networks, as these platforms provide important opportunities for knowledge sharing. Implementation should also be made to build trust and collaboration among farmers through group-based training,



farmer field school, and exchange visits. Moreover, interventions aimed at improving farmers' access to communication resources to ensure inclusive participation in knowledge-sharing activities. Also, Policymakers should integrate farmer-to-farmer communication approaches into agricultural extension programs to enhance the dissemination of agricultural knowledge and innovations among smallholder rice growers.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding Declaration

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

- Aker, J. C. (2011). Dial "A" for agriculture: A review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, 42(6), 631–647. <https://doi.org/10.1111/j.1574-0862.2011.00545.x>
- Ameh, S. S., Anorue, L. I., & Nathan, O. E. (2025). Farmers' communication network on the knowledge and use of climate-smart agriculture for sustainable rice production in Ebonyi State. *Torkwase Journal of Agricultural Research*, 2(1), 40–58.
- Assefa, H., Kibwika, P., Kyazze, F. B., & Getinet, M. (2021). Agricultural information sharing for climatic risk adaptation by smallholder livestock farmers in Eastern Amhara Region, Ethiopia. *International Journal of Agricultural Extension*, 9(2), 245–260.
- Baumüller, H. (2018). The little we know: An exploratory literature review on the utility of mobile phone-enabled services for smallholder farmers. *Journal of International Development*, 30(1), 134–154. <https://doi.org/10.1002/jid.3314>
- Beckman, J., & Countryman, A. M. (2021). The importance of agriculture in the economy: Impacts from COVID-19. *American Journal of Agricultural Economics*, 103(5), 1595–1611.
- Bliss, K., Padel, S., Cullen, B., Ducottet, C., Mullender, S., Rasmussen, I. A., & Moeskops, B. (2019). Exchanging knowledge to improve organic arable farming: An evaluation of knowledge exchange tools with farmer groups across Europe. *Organic Agriculture*, 9(4), 383–398.
- Bryman, A. (2016). *Social research methods*. Oxford University Press.
- Coalition for Africa Rice Development. (2025). *Annual rice sector review meeting in Tanzania*. Coalition for Africa Rice Development.
- Colussi, J., Schnitkey, G., & Padula, A. D. (2021). How communication affects the adoption of technologies in agriculture in the United States and Brazil. *Farmdoc Daily*, 11(121). Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications.
- Davidavičienė, V. (2018). Research methodology: An introduction. In *Modernizing the academic teaching and research environment: Methodologies and cases in business research* (pp. 1–23). Springer International Publishing.
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4.
- Falck-Zepeda, J. B. (2026). *Understanding technology diffusion in the agricultural sector* (Economic Research Working Paper No. 94). World Intellectual Property Organization.
- Food and Agriculture Organization of the United Nations. (2017). *The state of food and agriculture 2016: Climate change, agriculture and food security*. FAO.
- Feder, G., & Savastano, S. (2006). The role of opinion leaders in the diffusion of new knowledge: The case of integrated pest management. *World Development*, 34(7), 1287–1300.
- Goweke, G. E., Mahoo, H. F., & Kahimba, F. C. (2020). Comparison of silicon status in rice grown under the system of rice intensification and flooding regime in Mkindo irrigation scheme, Morogoro, Tanzania. *Tanzania Journal of Agricultural Sciences*, 19(2), 216–226.
- Huyler, D., & McGill, C. M. (2019). Research design: Qualitative, quantitative, and mixed methods approaches, by John W. Creswell and J. David Creswell. *New Horizons in Adult Education and Human Resource Development*, 31(3), 75–77.



- International Water Management Institute. (2019). Impacts of improving traditional irrigation schemes in Mvomero District, Tanzania. *Gates Open Research*, 3, 1402.
- Izuchukwu, A., Ezezi, E., & David Emeka, E. (2023). Assessing the impact of farmer-to-farmer communication networks on knowledge sharing and adoption of sustainable agricultural practices in Africa. *International Journal of Agricultural and Earth Sciences*, 9, 58–76.
- Kandel, A., Vivekanantharasa, R., Pandit, R., & Pandey, S. (2024). Academic writing on from farmer to farmer: Exploring the role of farmer-to-farmer extension networks in building capacity and knowledge sharing. *VII(I)*, 1–8.
- Kansanga, M. M., Kerr, R. B., Lupafya, E., Dakishoni, L., & Luginaah, I. (2021). Does participatory farmer-to-farmer training improve the adoption of sustainable land management practices? *Land Use Policy*, 108, 105477.
- Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS: Wageningen Journal of Life Sciences*, 90–91, 100315.
- Lakens, D. (2022). Sample size justification. *Collabra: Psychology*, 8(1), 33267.
- Loizou, E., Karelakis, C., Galanopoulos, K., & Mattas, K. (2019). The role of agriculture as a development tool for a regional economy. *Agricultural Systems*, 173, 482–490.
- Magesa, M., Jonathan, J., & Urassa, J. (2023). Digital literacy of smallholder farmers in Tanzania. *Sustainability*, 15(17), Article 13149.
- Masambuka-Kanchewa, F., Lamm, K., & Lamm, A. (2020). Beyond diffusion of improved technologies to promoting innovation creation and information sharing for increased agricultural productivity: A case study of Malawi and Kenya. *Journal of International Agricultural and Extension Education*, 27(1), 79–92.
- Morrison, R., Cassar, X., Duncan, A. J., Rao, E. J. O., & Barnes, A. P. (2025). Information flows within farmer networks and the implications for farmer-to-farmer extension: Evidence from the Kenyan dairy sector. *The Journal of Agricultural Education and Extension*, 31(5), 785–809. <https://doi.org/10.1080/1389224X.2025.2461455>
- Mtega, W. P. (2021). Communication channels for exchanging agricultural information among Tanzanian farmers: A meta-analysis. *Information Development*, 47(4), 570–579. <https://doi.org/10.1177/03400352211023837>
- Mtembeji, A. L., & Singh, D. R. (2021). Dynamics of rice production among the food crops of Tanzania. *South African Journal of Science*, 117(9–10), 1–6.
- Mwololo, H., Nzuma, J., & Ritho, C. (2019). Do farmers' socio-economic characteristics influence their preference for agricultural extension methods? *Development in Practice*, 29(7), 844–853.
- Mzingula, E. P., Massawe, F. A., & Salanga, R. (2023). Influence of communication channels on sustained adoption of climate smart agricultural technologies in the West Usambara Mountains, Tanzania. *The Sub-Saharan Journal of Social Sciences and Humanities*, 1(2), 9–18.
- Nain, M. S., Singh, R., & Mishra, J. R. (2019). Social networking of innovative farmers through WhatsApp Messenger for learning exchange: A study of content sharing. *Indian Journal of Agricultural Sciences*, 89(3), 556–558.
- Ndimbwa, T., Mwantimwa, K., & Ndumbaro, F. (2021). Channels used to deliver agricultural information and knowledge to smallholder farmers. *IFLA Journal*, 47(2), 153–167.
- Omulo, G., & Kumeh, E. M. (2020). Farmer-to-farmer digital network as a strategy to strengthen agricultural performance in Kenya: A research note on 'Wefarm' platform. *Technological Forecasting and Social Change*, 158, 120120.
- Pate, A., Riley, R. D., Collins, G. S., van Smeden, M., Van Calster, B., Ensor, J., & Martin, G. P. (2023). Minimum sample size for developing a multivariable prediction model using multinomial logistic regression. *Statistical Methods in Medical Research*, 32(3), 555–571.
- Pawlak, K., & Kołodziejczak, M. (2020). The role of agriculture in ensuring food security in developing countries: Considerations in the context of the problem of sustainable food production. *Sustainability*, 12(13), 5488.
- Prajapati, C. S., Priya, N. K., Bishnoi, S., Vishwakarma, S. K., Buvaeswari, K., Shastri, S., ... Jadhav, A. (2025). The role of participatory approaches in modern agricultural extension: Bridging knowledge gaps for sustainable farming practices. *Journal of Experimental Agriculture International*, 47(2), 204–222.
- Prasanth, P. A., & Sivanantha, J. (2021). Role of agriculture in the economy. *Compendium of Research Insights of Life Sciences Students*, 3, 1119–1121.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Sandy, N. J., Salehe, F., & Magesa, M. (2024). Sources and knowledge of smallholder farmers in agricultural information in Mvomero District, Tanzania: Where does misinformation originate? *Tanzania Journal of Agricultural Sciences*, 23(1), 19–32.
- Savari, M., & Khaleghi, B. (2025). Analysis of psychological and social factors affecting climate change adaptation and mitigation behaviors among Iranian rice farmers. *Scientific Reports*, 15(1), 30431.



- Sutherland, L.-A., & Marchand, F. (2021). On-farm demonstration: Enabling peer-to-peer learning. *The Journal of Agricultural Education and Extension*, 27(5), 573–590.
- Tiwari, S. P. (2022). Information and communication technology initiatives for knowledge sharing in agriculture. *arXiv*. <https://doi.org/10.48550/arXiv.2202.08649>
- Valente, T. W. (2010). *Social networks and health: Models, methods, and applications*. Oxford University Press.
- Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge University Press.
- Zorrilla-Miras, P., Lisboa, S. N., López-Gunn, E., & Giordano, R. (2026). Farmers' information sharing for climate change adaptation in Mozambique. *Information Development*, 42(2), 631–648.