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Article

Agricultural Information Needs and Access Channels of Small-Scale Coffee Farmers in Mbinga District, Tanzania

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Highlights

- Fertiliser and soil management are the leading farmers' information needs.
- Marketing and price information are the second most reported needs.
- AMCOS is the most frequently reported agricultural information channel.
- Family networks are a major information channel for coffee farmers.
- Digital tools and research institutions remain less frequently used channels.

Abstract

Background: Coffee is among the top ten most exported crops, with production spanning over 50 countries. Globally, coffee is cultivated in approximately 10 million hectares and supports the livelihoods of about 12.5 million farmers. Small-scale coffee farmers produce 80% of coffee on farms of less than 5 hectares. Despite its economic significance, smallholder productivity remains low compared to national expectations. Among other factors, limited access to timely, relevant agricultural information is a key challenge that constrains farmers' ability to make informed decisions in the coffee value chain. This study explored the agricultural information needs and access channels of small-scale coffee farmers in Mbinga district, Tanzania. **Methods:** The study employed a qualitative case study design in Kilimani, Sepukila and Utiri villages and collected data through 34 semi-structured interviews, 6 key informant interviews, and 3 focus group discussions. Thematic data analysis was used to analyse the data, and the study also adopted the Diffusion of Innovation Theory (DOI) to interpret the results. **Findings:** The findings revealed six categories of agricultural information needs among small-scale coffee farmers: fertilisers and soil management, marketing, disease control, good agricultural practices, seeds, and farm mechanisation. Coffee farmers access the information through the Agricultural Marketing Co-operative Society (AMCOS), family members, extension services, agro-dealers, traditional media, research institutions, and digital tools. **Conclusion:** This study concludes that understanding small-scale farmers' agricultural information needs and access channels is crucial to rural development and the agriculture sector. This study recommends strengthening extension service coverage, expanding AMCOS-based training, and investing in digital infrastructure and rural connectivity.

Keywords: agricultural information needs; information access channels; small-scale coffee farmers; agricultural information; agricultural extension services; Tanzania

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1. Introduction

Coffee is among the top ten most exported and consumed beverages, supporting the livelihoods of millions of people (Ngambila et al., 2024). It is estimated that there are about 25 million coffee family farmers worldwide, with coffee being the primary source of income for 12.5 million

of these farmers (International Coffee Organization [ICO] & United Nations Industrial Development Organization [UNIDO], 2024). Coffee is produced in more than 50 countries worldwide; at the same time, Arabica and Robusta are the main varieties of coffee being produced (TechnoServe, 2018). Brazil, Indonesia, Vietnam, Colombia, and Costa Rica are the global leading coffee-producing countries, while Ethiopia, Uganda, the Ivory Coast, and Tanzania are the largest coffee producers in Africa (Ngambila et al., 2024). In the Tanzanian context, coffee is the second-largest export crop and is essential to the country's economy (Mbunduki, 2024b). It is considered that this crop contributes to the foreign exchange and accounts for 4 per cent of the country's GDP, while over 24 million people are employed in the sector, with 450,000 households directly participating in coffee production (Mbuba & Shechambo, 2023; Tanzania Coffee Board, 2021). Tanzania is largely a producer of Arabica and Robusta coffee, with 70% of production dominated by Arabica coffee produced in the Northern part of the country, including the Arusha region, and the Southern Highlands of Tanzania, such as Mbeya, Songwe, and Ruvuma regions (Tanzania Coffee Board, 2021). In comparison, Robusta accounts for 30% and is produced in the Kagera region. 90% of the coffee produced in Tanzania is for export, while 10% is for domestic consumption (John, 2025; Mhando & Mdoe, 2018). In recent decades, coffee exports have been contributing about 100 million dollars per year in Tanzania, whereas Japan, Italy, Germany, Belgium, the USA, and Morocco are the leading destinations for Tanzanian Coffee (Tanzania Coffee Board, 2021).

Small-scale farmers produce 80 percent of coffee worldwide, within a farm size of less than 5 hectares (ICO & UNIDO, 2024). For example, studies indicate that 90 percent of the coffee is produced by small-scale farmers in Tanzania, and 10 percent is grown on estates or plantations (Mhando & Mdoe, 2018; Tanzania Coffee Board, 2021). However, in Kenya, 90,000 hectares of 115, 600 hectares of coffee farms belong to small-scale farmers, while only 25,000 hectares are plantations (Karuri, 2021). Similarly, in Guatemala (Latin America), 90% of coffee farmers are small-scale (TechnoServe, 2018). Coffee is a highly demanded crop in the global market, but its supply chain remains limited (ICO & UNIDO, 2024; Mhando & Mdoe, 2018). In Tanzania, coffee production has stagnated at around 50,000 metric tons per year over the past 30 years (Tanzania Coffee Board, 2021). As a result, coffee exports in Tanzania declined from 7.2 percent to 2.3 percent between 2001 and 2017 (Mhando & Mdoe, 2018). The decline in productivity has been exacerbated by extreme weather conditions, aging of the coffee tree, reduced use of inputs, a high cost of production, and price fluctuations (John, 2025; Tanzania Coffee Board, 2021). Through the New National Development Strategy (NNDS), the Government of Tanzania aimed to triple coffee production from 50,000 to 300,000 metric tons between 2021 and 2025 (Tanzania Coffee Board, 2021). Yet, this objective is not being met today, and Tanzania's coffee productivity remains low compared with Ivory Coast, Uganda, and Ethiopia, which produce 106.5 million tons, 337.2 million tons, and 442.2 million tons, respectively (Mbunduki, 2024a).

Lack of access to timely and relevant agricultural information is a significant concern among small-scale farmers in developing countries (Ndimbo et al., 2026). Information is an essential factor in sustaining the development of a society by reducing uncertainty, improving the quality of decision-making, and addressing agricultural challenges (Haule et al., 2025). Ensuring access to information is a crucial tool for the development of the agricultural sector. Studies in Ethiopia found that farmers with access to timely agricultural information are likely to increase their productivity and income, which are essential to improve their living conditions (Gebeyehu & Jira, 2024). Similarly, small-scale farmers who effectively utilise agricultural information achieve better production results by increasing yields (Shitaye et al., 2025).

Studies identify that small-scale farmers use various channels to access agricultural information, such as extension service workers, farmers-to-farmers interactions, radio, and Television (Acheampong et al., 2017; Shitaye et al., 2024a). ICT tools play a crucial role in transforming the agricultural sector and improving the livelihoods of small-scale farmers by providing timely access to relevant agricultural knowledge, market, and weather forecasting information (Ndimbo et al., 2025; Nyamayevu et al., 2024). Similarly, smartphones facilitate easier access to agricultural information through various means, such as text, audio, pictures, and videos, and make agricultural activities more commercial (Haule et al., 2025). Depending on the nature of the crop, small-scale farmers differ in their information needs and access channels, and they are not satisfied with a single source of information (Gebeyehu & Jira, 2024). The existing literature has focused on cashew, rice, and other crops (Acheampong et al., 2017; Chandrakumar et al., 2025), while paying little attention to coffee, particularly in the localised context of Tanzania, where coffee production has stagnated for more than three decades. Against this background, this study explores the types of agricultural information needs and access channels of small-scale coffee farmers in Mbinga District, Tanzania.

2. Theoretical Frameworks

The Diffusion of Innovation theory (DOI) guided the analysis of this study on agricultural information needs and access channels of small-scale coffee farmers. The DOI was developed by Everett M. Rogers (1962) and further elaborated by Rogers and Shoemaker in 1971 (Haule et al., 2025; Ndimbo et al., 2026). Based on the DOI theory, innovation or ideas spread through communication over time within a social system, and the expected results of the diffusion are the adoption of new ideas or technology (Ndimbo et al., 2026). This theory also explains how information flows through communities and highlights the roles of social networks and communication channels in the diffusion of the innovation (Shitaye et al., 2024b).

The central idea of DOI is centered on four key elements: innovation, communication channel, time, and social system. Diffusion is a process by which an innovation or idea is communicated through a channel among members of a social system (Mugwisi, 2013). The theory advocates four attributes that determine the rate of adoption of the idea or technology, which include relative advantage (perceived usefulness over the existing idea), compatibility, complexity (easy to understand and use), trialability, and observability (Mambile & Mwogosi, 2025). A communication channel refers to the means by which a message gets from one individual to another. It is considered that mass media channels such as radio and newspapers are more effective in creating awareness of innovation, while interpersonal channels are essential for shaping attitudes and driving adoption decision-making of the knowledge (Mugwisi, 2013). Time is also a key element of innovation, whereby the innovation decision goes through five stages: knowledge, persuasion, decision, implementation, and confirmation. An individual seeks information at various stages of the innovation decision to reduce the risk of unexpected results from the innovation. Furthermore, a social system is a set of interrelated units that are involved in joint problem-solving to accomplish a main goal. Within the social system, opinion leaders and change agents play a major role in guiding innovation decisions, and these decisions are categorised as optional, collective, or individual. This decision influences the choice to adopt or reject the innovation.

The study adopted Rogers and Shoemaker's model for the diffusion of innovation, which breaks down the communication process into five components such as Source (S), Message (M), Channel (C), Receiver (R), and Effect (E), to explain how the innovation can bring about societal changes, as illustrated in Figure 1. Based on this context, S is the Ministry of Agriculture, Food Security and Co-operative (MAFSC) and extensions, which are the originator of the innovation or information that serves as the origin of the M. The message refers to content communicated, including advice on the application of fertilisers, pesticides, improved seeds, product quality, and marketing conveyed by the source or channels. C are the means through which information is communicated, including smartphones, mobile phones, radio, Television, farmer-to-farmer information sharing, and research institutions, all of which communicate the M. The R is the targeted audience of the information or innovation. Based on this study, the R is smallholder coffee farmers, who are the primary recipients of the information being supplied, and the E refers to the outcomes of the provided information, including the adoption of new farming systems, increased productivity, and improved livelihoods for smallholder farmers. Through effect, feedback is conveyed to the source, enabling it to evaluate the effectiveness of the information being supplied.

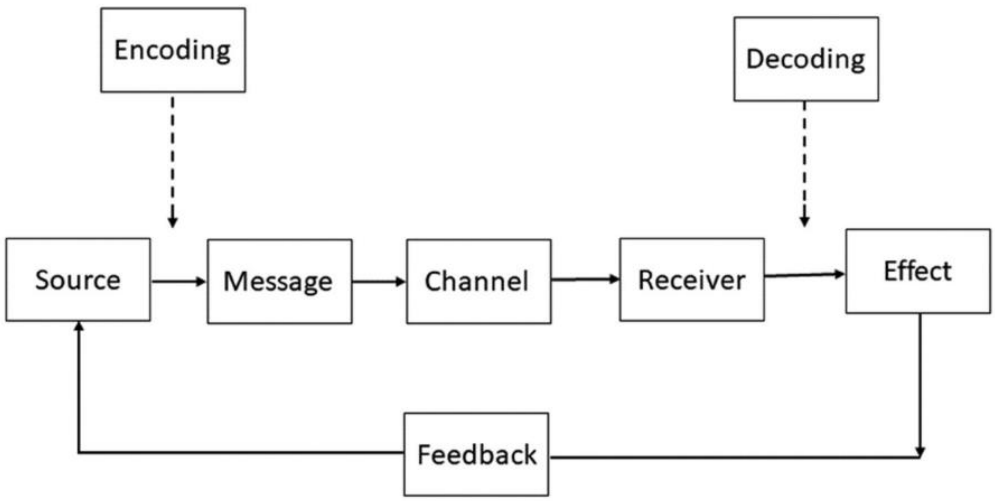


Figure 1. Source–Message–Channel–Receiver–Effect model.
Source: Rogers & Shoemaker (1971) as cited by Haule et al. (2025), Isaya et al. (2018), and Ndimbo et al. (2026).

The focus of this study is on messages, or agricultural information, and Channels as they interact with the receiver, or small-scale coffee farmers. The effectiveness of the agricultural information is determined by the relevance, specificity, and perceived usefulness to the small-scale farmers based on the specific context. Additionally, it depends on the accessibility and interactivity of the channel based on the socio-economic and communication capabilities of the farmers. In this context, the receiver, or farmer, is not a passive recipient of the information but an active actor whose information needs shape the entire process of seeking the information. This study aimed to clarify what agricultural information smallholder coffee farmers need, which access channels they use, and how agricultural information diffuses in Tanzania.

3. Methodology

3.1. Study Area

This study was conducted in three villages: Kilimani, Sepukila, and Utiri of Mbinga District, Ruvuma Region, Tanzania, as shown in Figure 2, from July to late September 2025. The district was purposively selected because it is one of Tanzania's major coffee-producing regions. The dominant coffee producers are small-scale farmers with farms of less than 5 hectares. Mbinga District is well known for Arabica coffee production (Kapinga & Gores, 2021). These villages were also selected purposively because they are among the coffee-producing areas comprised of small-scale coffee farmers.

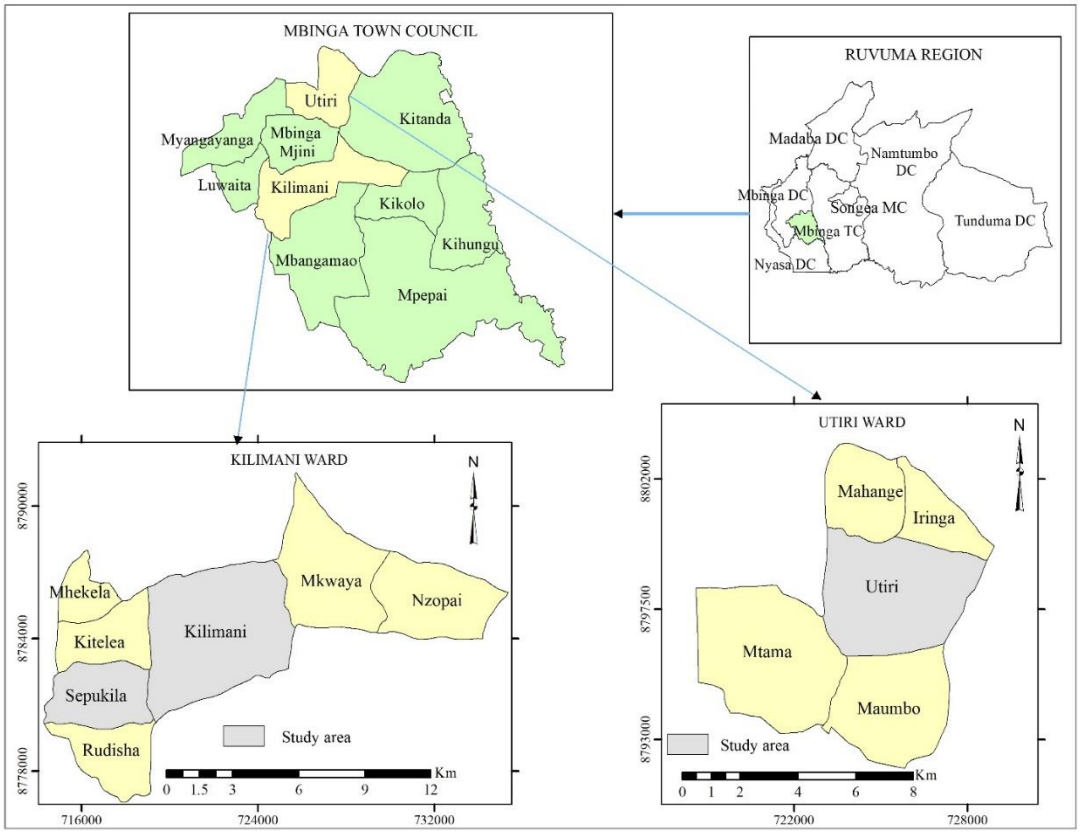


Figure 2. Map showing the study area.

Geographically, Mbinga District is located between longitudes 34°24' E and 35°28' E and latitudes 10°15' S and 11°34' S (Mbinga District Council, 2024). The district covers an area of 4,858.69 km² and is characterised by highland plateaus at altitudes of 534 m to 2,100 m above sea level. Mbinga District has a total population of 285,582, with 141,271 males and 144,311 females (National Bureau of Statistics, 2022). Kilimani village is located in the southern part of Mbinga Town and is bordered by Mbangamao ward to the south, Sepukila village to the West, and Lifakala village to the West. Sepukila is one of the villages in Kilimani Ward and is bordered by Kilimani village to the East, Rudisha village to the South, Kihulila Ward to the West, and Kitelea village to the North. Utiri village is one of the villages in Utiri Ward, located in the Northeastern part of Mbinga Town, and is bordered by Kitanda Ward to the East and Mtama village to the West.

3.2. Research Design

The study used a qualitative research approach to address the research question. Qualitative research is one of the most preferred methods for studying the social sciences because it provides an opportunity to understand the opinions, experiences, and views of local communities, allowing the researcher to obtain deeper information about the situation under study (Coombs, 2022). Qualitative research responds to inquiries concerning significance, insights, and experiential aspects of human existence and societal worlds (Hammarberg et al., 2016). Using a qualitative research approach enabled the researcher to gain a deep understanding of the types of information needed and the access channels of small-scale coffee farmers in the Mbinga District. To achieve this objective, the researcher used three villages, Sepukila, Utiri, and Kilimani, as case studies to collect data to answer the research questions. A case study is preferred in social science research because it enables a researcher to gain more insights into a specific situation or phenomenon within a particular geographical area (Coombs, 2022).

3.3. Sampling Techniques and Characteristics of the Participants

The study employed purposive and snowball sampling to select respondents. Purposive sampling intends to obtain in-depth insights into respondents rather than generalising the findings (Ahmad & Wilkins, 2025). Purposively, the study selected 34 small-scale coffee farmers, 2 extension officers, 3 AMCOS leaders, and 1 District Agricultural Officer as participants. The study selected these respondents because of their knowledge and experience in coffee farming in Mbinga District, particularly in the selected villages. However, snowball sampling was adopted to identify small-scale coffee farmers through referrals from previously selected coffee farmers. With assistance from village agricultural extension officers, the researcher selected the first respondent based on the study criteria, and subsequent respondents were selected through referrals from previous respondents. The study's target population was small-scale coffee farmers in Mbinga District who cultivate coffee on 5 hectares or less and have been involved in coffee farming for at least 5 years. These inclusion criteria reflect that, in Mbinga District, small-scale farmers mainly produce coffee, with no large-scale farming. Also, 5 years is enough to capture variability in the information needed and farmers' access channels. We determined the number of participants through data saturation. Saturation was reached after 30 semi-structured interviews with small-scale coffee farmers, and 4 additional interviews were conducted to confirm it. Saturation was judged by code recurrence and the absence of newly emerging themes in the preceding interviews.

3.4. Data Collection

The primary data sources were used in order to answer the research questions. The researcher went to the field and used different qualitative approaches to gather data and explore the information needs and access channels of small-scale coffee farmers. The researcher engaged in semi-structured interviews, key informant interviews, and focus group discussions. The variety of data collection tools also helped the researcher gather more comprehensive information essential to answering the research questions.

3.4.1. Semi-Structured Interviews

The researcher conducted 34 semi-structured interviews (SSI) with small-scale coffee farmers to gather data to address the central research question. The researcher adopted SSI purposively to obtain detailed individual experiences and opinions on coffee production, focusing on Kilimani, Utiri, and Sepukila as case studies; interviews lasted 30 to 45 minutes. The use of SSI is highly preferred in qualitative research due to its ability to combine open-ended questions, which allow the researcher to probe respondents and provide a better understanding of the subject matter under study (Busetto et al., 2020). To ensure the validity and reliability of the data collection, the SSI guide was developed and tested through a pilot study. The study used five steps to develop the SSI guide: identifying the requirements for using SSI, gathering and leveraging existing knowledge, drafting the initial SSI guide, conducting a pilot study to test the guide, and presenting the final SSI guide.

3.4.2. Key Informant Interviews

The key informant interviews (KII) were conducted with selected leaders to obtain in-depth information on their experiences and knowledge of coffee production in the selected villages. We conducted KIIs with 2 Village Agricultural Extension Officers and developed tailored questions to explore their technical and institutional understanding of coffee farmers' agricultural information needs. We also interviewed 3 AMCOS leaders, one from each village, to obtain relevant data. Lastly, the 1 District Agricultural Officer was interviewed to understand the initiatives developed to facilitate timely access to agricultural information in Mbinga District, Tanzania. The interview lasted 30 to 35 minutes for this category of respondents. Recruiting KIIs was crucial because they are

believed to have rich, detailed information from technical and administrative perspectives crucial to addressing the research question.

3.4.3. Focus Group Discussion

The study conducted three FGDs: one with non-AMCOS members and two with AMCOS members, to understand the types of information small-scale coffee farmers receive from AMCOS. FGDs helped the researcher understand participants' collective views, opinions, and perceptions regarding their information needs and access channels. Each FGD included six participants: three men and three women. FGDs are vital in qualitative research because it purposefully uses social interaction to generate data (Boateng, 2012).

3.5. Data Processing and Analysis

Since the study used a qualitative research approach, thematic data analysis techniques were employed to analyse the data. This technique involves identifying, analysing, and reporting themes within the data to get the key meaning and information; this method is also regarded as helpful and flexible in qualitative research (Braun & Clarke, 2006). The study followed the six steps of data analysis developed by Braun and Clarke (2006): (i) Familiarising with the data, (ii) Generating initial codes, (iii) Searching for the themes, (iv) Reviewing the data; the researcher checked the data set to ensure the accuracy of the represented data, (v) Defining and naming the themes, and (vi) Producing the report. Moreover, the qualitative results were presented as themes, and interview excerpts were quoted to support the findings of the study. During the analysis process, the researcher did not disclose the names of the respondents involved in the study. All respondents were given a code; for SSI, it ranged from SSI 1 to SSI 34, based on the total number of respondents. For KII, the district agricultural officer was KII 1, the village agricultural extension officers were KII 2, and the FGD was FDG 1–3. The entire data analysis process was done manually, without software, to help researchers better understand qualitative data analysis.

3.6. Qualitative Trustworthiness

This study followed the four criteria for qualitative trustworthiness proposed by Lincoln and Guba (1985): credibility, dependability, transferability, and confirmability, as cited by (Anney, 2015; Enworo, 2023). Credibility was ensured by triangulating data from semi-structured interviews, key informant interviews, and focus group discussions. Triangulation involved respondents (farmers, extension officers, AMCOS leaders, and the DAO) and field engagement from July to September 2025. The researcher conducted member checking by summarising emerging themes from selected participants during subsequent visits and at the end of each FGD. However, the researcher addressed dependability by using an appropriate research design and sampling techniques. The researcher systematically followed the six phases of thematic analysis developed by Braun and Clarke (2006). The researcher maintained reflexivity through a field diary in which they recorded assumptions, which enhanced data interpretation. The study supported transferability through descriptions of the study area, the targeted population, and the three selected villages for the case study. This enabled readers to judge the applicability of findings to comparable settings. The study strengthened confirmability by grounding all themes in verbatim interview excerpts and discussing preliminary interpretations with the supervisor and peers. Furthermore, the researcher coded manually without qualitative data analysis software. The study documented the developed codes in a codebook, and a supervisor and peers independently reviewed a subset of transcripts.

3.7. Ethical Consideration

To ensure ethical conduct, the study obtained ethical approval at the institutional level (China Agricultural University) and the local government level (Mbinga district). First, at the Institutional level, a researcher obtained a research permit from China Agricultural University (CAU). This approval confirmed that the study met CAU's academic and ethical standards and was intended solely for conducting field research in Tanzania. Second, at the local government level in Tanzania, the researcher obtained the official research permits required to conduct the field research. The researchers followed the stages to obtain the research permit. (i) application and approval from the Ruvuma Regional Administrative Secretary (RAS) and the Mbinga District Administrative Secretary (DAS) for regional and district-level clearance; (ii) presentation of the clearance to the Ward Executive Officer (WEO) and the Village Executive Officer (VEO) of each of the three study villages (Kilimani, Sepukila, and Utiri); and (iii) verbal informed consent obtained from all participants before each interview, with the purpose of the study, voluntary participation, confidentiality, and the right to withdraw explained in Kiswahili. However, the researcher ensured confidentiality by informing respondents that the information would be used solely for research purposes and that no names would be reported.

4. Results

4.1. Demographic Characteristics of the Respondents

Examining respondents' demographic characteristics was essential to understanding the information needs and access channels of small-scale coffee farmers in Mbinga District, Tanzania (Table 1). The study included 34 small-scale coffee farmers, distributed as follows: Kilimani (12), Sepukila (12), and Utiri (10). Of the 34 respondents, 22 (65%) were male and 12 (35%) were female.

Table 1. Demographic characteristics of the respondents.

Demographic Characteristics		Villages							
		Kilimani		Sepukila		Utiri		Overall	
		N	%	N	%	N	%	N	%
Gender	Total	12	35	12	35	10	30	34	100
	Male	9	26	8	24	5	15	22	65
	Female	3	9	4	11	5	15	12	35
Age	18–35	4	11.7	5	14.7	4	11.7	13	38.25
	36–59	6	17.6	6	17.6	5	14.7	17	50
	60+	2	5.9	1	3	1	3	4	11.75
Marital Status	Single	0	0	2	5.9	0	0	2	5.9
	Married	10	29	9	27	8	24	27	79.35
	Widow	2	6	0	0	2	6	4	11.75
	Divorced	0	0	1	3	0	0	1	3
Education Level	No formal education	1	3	1	3	0	0	2	5.9
	Primary education	7	19.4	8	24	7	19.4	22	64.7
	Secondary education	2	5.9	1	3	1	3	4	11.75
	Diploma	1	3	1	3	2	5.9	4	11.75
	Degree	1	3	1	3	0	0	2	5.9
Farm Size	0–1	4	11.75	3	8.8	5	14.7	12	35.3
	2–3	8	24	8	24	5	14.7	21	61.7
	4–5	0	0	1	3	0	0	1	3
Farmers Experience	5–10	2	6	4	11.75	4	11.75	10	29
	10–25	5	14.7	6	17.6	5	14.7	16	47
	25+	5	14.7	2	5.9	1	3	8	24

Source: Field data 2025.

Based on age, 13 (38.2%) respondents were aged 18−35, 17 (50%) were aged 36−59, and 4 (12%) were aged 60 years and above. This means that, currently, coffee production is dominated by the working population in the study area. Age determines the channels for accessing information; youth have great potential to use ICT tools, while older people primarily rely on interpersonal communication channels. This study also reveals that 2 (5.9%) of the respondents were single, 27 (79.4%) were married, 4 (11.8%) were widows, and 1 (2.9%) was divorced. Marital status shapes the division of labour and social interaction within the community. For married individuals, social interaction is high through many spouses, unlike unmarried individuals, whose access to information is low due to limited social interaction.

Regarding respondents' education levels, 2 (5.9%) had no formal education, 22 (64.7%) had primary education, 4 (11.8%) had secondary education, 4 (11.8%) had a diploma, and 2 (5.9%) were degree holders. This implies that the majority of small-scale coffee farmers have attained a basic level of education, which is essential for seeking and analysing information across different channels. Additionally, the study finds that 12 (35.3%) respondents had farm sizes of 0–1 hectares, 21 (61.7%) had farms of 2–3 hectares, and 1 (3%) had farms of 4–5 hectares. This indicates that most small-scale coffee farmers have farms of 2–3 hectares. Regarding farming experience, 10 (29%) had 5–10 years, 16 (47%) had 10–25 years, and 8 (24%) had more than 25 years. This implies that most farmers have sufficient experience with coffee and understand their needs, and that access to information depends on the effectiveness of the existing channels.

4.2. Types of Agricultural Information Needed by Small-Scale Coffee Farmers

The analysis of the interviews from the farmers revealed a defined need for different types of agricultural information that are essential for coffee farming and market outcomes, as presented in Table 2 below. The information needs (innovations) have been grouped into six categories, such as fertilisers and soil management, marketing and price, and pest and disease control information as the most in need, followed by seed and crop variety, good agricultural practices, and farm mechanisation information. This need represents a Message within the DOI theory that must be effectively communicated to the farmers; these needs are not uniformly prioritised but differ across the villages under study.

Table 2. Agricultural information needs of small-scale coffee farmers.

Types of Information Needs	Villages							
	Kilimani		Sepukila		Utiri		Overall	
	N	%	N	%	N	%	N	(%)
Fertilisers and soil management	10	29.4	9	26.5	9	26.5	28	82.4
Marketing and price	8	23.5	9	26.5	6	17.6	23	67.6
Pesticides and disease control	7	20.6	6	17.6	8	23.5	21	61.7
Seeds and crop varieties	4	11.8	3	8.8	6	17.6	13	38.2
Good agricultural practices	6	17.6	6	17.6	5	14.7	17	50
Farm mechanisation	1	2.9	3	8.8	2	5.9	6	17.6

Fertilisers and soil management, accounting for 82.4%, was the most needed information. The need was highly reported in Kilimani village 29.4%, while it was consistent in Sepukila and Utiri, accounting for 26.5% each. Respondents explained the specific need for information on the practical application of industrial fertilisers such as Diammonium Phosphate (DAP), Calcium Ammonium Nitrate (CAN), Urea, and Nitrogen, Phosphorus and Potassium (NPK), as well as integrated soil management practices that use both organic and inorganic fertilisers to sustain soil health. This was articulated during the interview when respondents explained their information needs: "The type of information that I need is about the types of fertilisers which are suitable for the production of coffee, which will help me to improve my production and increase productivity." (SSI 18)

Another respondent added that:

> The use of fertiliser depends on the soil type. We have been advised not to use some of the fertilisers, like Sulphate of Ammonium (SA), but we can use fertilisers such as DAP, NPK, and Yara, which are friendly to our soil. We need to know which fertilisers are suitable for coffee and which are for different crops. Therefore, we need more education on the correct use of fertilisers. (SSI 29)

These statements indicate that small-scale coffee farmers perceive the benefits of effective application of fertiliser for crop productivity. Also, it suggests that the application of fertilisers depends on the nature of the soil of a place and, therefore, is not homogeneous across all coffee-producing zones. Also, 67.6% of respondents expressed a need for marketing and pricing information. Sepukila village accounts for 26.5%, followed by Kilimani 23.5% and Utiri 17.5%. Respondents expressed a need for timely, accurate information on fair pricing, market trends, timing, and buyer requirements, which is essential to improving coffee productivity and quality and strengthening bargaining power within the coffee value chain. This information is also necessary in navigating the market dynamics and the risks of exploitation from buyers who may offer a price that is not beneficial to farmers and below the government-indicated price rate, as affirmed in the following statement:

> As one of the key agricultural issues for a coffee farmer is price, we need to be aware of the state market as we produce our crop. We don't fully grasp the price a farmer should receive, as we have encountered many dishonest individuals. Sometimes, you may find yourself in a situation where the government's indicative price is high, but private traders are buying at a lower price. (SSI 8)

This statement highlighted market empowerment, which is essential to strengthening farmers' bargaining power and reducing exploitation by coffee buyers. Additionally, the study found that information regarding pesticides and disease control was also a crucial need, accounting for 61.7%. The demand for this information was high in Utiri village 23.5%, followed by Kilimani 20.6% and Sepukila 17.6%. Respondents explained the motive for demanding this information, which is associated with the impacts of Coffee Berry Disease (CBD) and Leaf Rust (LR) diseases negatively

impacting coffee productivity. Farmers need an actionable message on identifying types of disease, effective management, and effective pesticides to be used in the specific season. This can be substantiated in the following statement:

> I need to get various information about the types of diseases that attack coffee crops, including Sylvisca, LR, and CBD, as well as plant wilting, and how to deal with those diseases. Here, I mean knowing the types of pesticides that should be used, how to use them, as well as knowing which pesticides should be used in the relevant agricultural season to get a good result and ultimately increase production. (SSI 17)

This quote shows the importance of providing accurate and timely information on diseases and pest control among small-scale coffee farmers, where the demand is high in Utiri, indicating localised information access. Additionally, the study revealed that information on Good Agricultural Practices (GAPs) is essential in coffee farming. The study revealed consistent demand in Sepukila and Kilimani, at 17.6% compared to Utiri (14.7%). Respondents demonstrated a demand for knowledge on pruning coffee trees, proper spacing, shade management, harvesting, processing, and maintaining the quality of coffee beans.

The study found that 38.2% of respondents indicated a need for information on improved seeds and crop varieties. During fieldwork, this need was most pronounced in Utiri village 17.6%, followed by Kilimani 11.8% and Sepukila 8%. The highest need for this information in Utiri is due to the perceived benefits of the improved seed, while the lower demand in Kilimani and Sepukila is associated with limited adoption and perceived usefulness of the new seeds, which makes farmers not focus much on this message. During the fieldwork, we observed that small-scale coffee farmers are transitioning from local coffee farming to modern farming. While farmers use both traditional and improved seeds, demand for modern, improved coffee varieties is growing. The respondents stated that modern coffee seeds are high-yielding, resistant to climate change, and to diseases and pests. Respondents elaborated that:

> For us, small-scale coffee farmers, we need information about the best coffee seeds that are resistant to the climate of our area, as well as various diseases. Modern seeds take a very short time to start bearing fruit, unlike local seedlings, which can take many years. The best seeds will help us revive our farms and increase the farmers' income. (SSI 25)

Also, the district agricultural officer explained that:

> Our farmers need information on the availability of coffee seeds. Nowadays, the government encourages coffee production using modern seeds, so farmers need to know where they can obtain high-quality modern seeds, since old seedlings no longer produce viable coffee. Modern seedlings are tolerant to diseases such as CBD and LR. (KII 1)

Additionally, the study revealed the significance of information regarding farm mechanisation. The analysis showed that Sepukila represents the highest need at 8.8%, followed by Utiri at 5.9% and Kilimani at 2.9%. Respondents explained the need for tools and machinery such as sprayers and pruning shears to facilitate on-farm activities. Modern processing equipment reduces labour time and improves coffee quality. Respondents elaborated that, "Other information we need to get is about farm machinery. In coffee farming, we need sprayers, pruning shears, and modern machinery to improve coffee quality and reduce the time spent on coffee drying and pulping." (FDG 1)

Additionally, AMCOS leaders explained:

> In our coffee AMCOS, our farmers need to be informed about the availability of modern machines that can quickly peel, remove sugar, grade, and dry coffee. These machines are essential because they enable us to prepare coffee and deliver it to the market, even as coffee prices fluctuate. (KII 2)

This finding highlights a collective information need, other than individual needs, at the AMCOS level, essential for pulping and grading the coffee to improve markets.

4.3. Agricultural Information Access Channels of Small-Scale Coffee Farmers

The study revealed that small-scale coffee farmers access agricultural information from various channels as described in Table 3. The reliance on a given channel is shaped by its accessibility, trust, and integration into the coffee value chain rather than its technical capabilities.

Table 3. Access channels of small-scale coffee farmers.

Channels of Information	Villages							
	Kilimani		Sepukila		Utiri		Overall	
	N	%	N	%	N	%	N	(%)
AMCOS	8	23.5	9	26.5	8	23.5	25	73.5
Family members/relatives	9	26.5	8	23.5	6	17.7	23	67.6
Extension services	3	8.8	6	17.7	6	17.7	15	44
Agro dealers & private companies	4	11.7	5	14.7	3	8.8	12	35.3
Traditional media (Radio & TV)	3	8.8	6	17.7	2	5.9	11	32.4
Research institutions & NGOs	2	5.9	1	2.9	2	5.9	5	14.7
Digital tools (smartphones & Mobile phones)	2	5.9	1	2.9	2	5.9	5	14.7

The findings revealed that AMCOS emerged as the main agricultural access channel for small-scale coffee farmers in Mbinga District, Tanzania, used by 73.3% of the respondents. However, it showed a slight variation in Sepukila village 26.8%, while in Kilimani and Utiri it was 23.5%. The field data show that 75.5% of respondents were AMCOS members, while 26.5% were non-AMCOS members (Figure 3). Each of the selected villages had one farmer's co-operative: Kimuli, Kilimani, and Sepukila AMCOS in Utiri, Kilimani, and Sepukila villages.

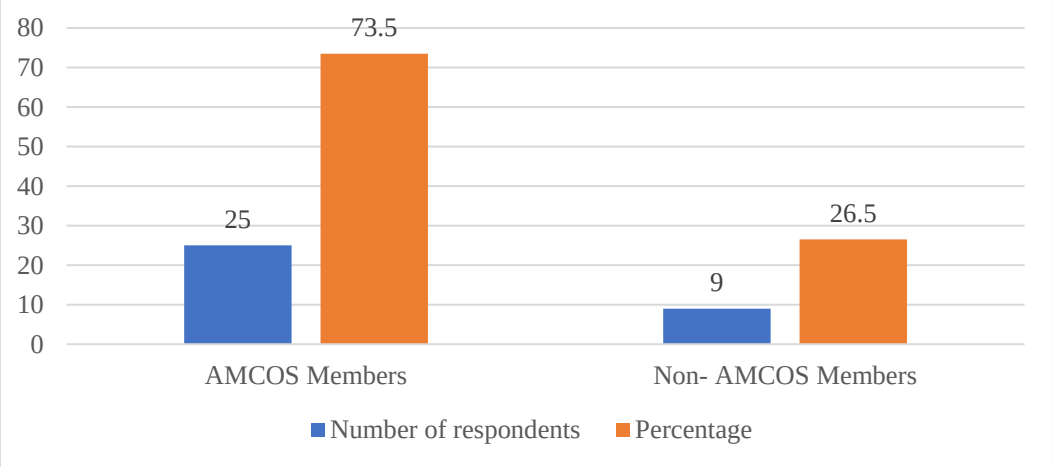


Figure 3. Number of AMCOS and non-AMCOS members.

The high use of this channel is due to its integration into the coffee market and providing different services. Respondents explained that AMCOS serves as an information hub for small-scale coffee farmers and provides its members with market and price information, fertiliser, and new seed information. Farmers depend on AMCOS for informed decision-making and receive the support they need for coffee farming. Respondents stated that:

> I am a member of the co-operative society, and I also sell my coffee there. AMCOS helps me obtain various information, such as agricultural inputs, especially fertilisers and pesticides, as well as information about modern coffee seeds provided by our co-operative (AMCOS). I also have the opportunity to obtain low-interest loans when I have no money, especially during the rainy season, and repay them when harvest time comes. (SSI 24)

The AMCOS leader also explained that:

> We offer various information, including best practices for coffee farming, information on climate change (members are required to learn how to adapt to it), and market insights. We begin with auction information, export market data, market performance during the relevant season, and details on the quality of coffee in demand in the market. This helps farmers identify ways to improve the quality of their coffee, which increases the value of the coffee crop in our markets. (KII 2)

The findings also revealed that family members or relatives have a crucial role in access to agricultural information among small-scale coffee farmers, as 67.6% of the respondents use this

channel. This channel was highly relied upon in Kilimani village 26%, followed by Sepukila 23.5% and Utiri 17.7%. Small-scale coffee farmers learn by observing friends and family members who have long cultivated coffee and achieved great success. Respondents reported:

> I gather information from individuals with extensive experience in coffee farming who maintain model farms. If you visit them, you can obtain valuable insights. My father has extensive experience in farming coffee, so he advised me. Also, a friend shared information about seedlings with me. (SSI 15)

Another respondent added that:

> From my close friends, I get information about coffee farming. When I see that my friend's farm is doing well, I ask him about how he takes care of his farm, especially the type of seeds he planted and the inputs he uses. I decided to buy those inputs and use them on my farm. (SSI 8)

The quote above implies that, through social interaction with friends and family, small-scale coffee farmers learn and seek information, including the types and practical applications of fertilisers and pesticides. This channel is also valued for its immediacy and contextual relevance, which help farmers get one-time support information.

Additionally, the study revealed that formal agricultural extension services are one of the access channels used by small-scale coffee farmers to access agricultural information. The use of this channel was high in Utiri and Sepukila villages, 17.7% each, compared to Kilimani, 8.7%. The differences were realised due to the presence of dedicated village agricultural extension officers in Utiri and Sepukila villages, who provide knowledge and technical support to coffee farmers in these areas. In Kilimani village, the farmers explained that they rely on the ward-level agricultural officer, who, due to a lack of work, is less frequent and less accessible to individual farmers. Agricultural extension officers provide on-farm technical support, including effective application of fertilisers and pest and disease control. Also, they organise village meetings and facilitate farmers' groups to effectively disseminate required information to farmers. During the interviews, the respondent elaborated on the value of extension services:

> Here in our village, we have an extension officer who visits to assess the condition of our coffee plantations and provides advice when needed. This year, he has visited twice. When I encounter a disease or problem that I do not understand, I report it to the extension officer, who advises me on how to handle the situation. (SSI 18)

An agricultural extension officer elaborated that:

> We help farmers access various information regarding pesticides. As agricultural officers, we deliver this information to farmers in multiple ways. First, we have the opportunity to speak at public meetings. Also, at AMCOS meetings, we form farmers' groups. We also try to visit each farmer individually, holding public meetings four times a year and in small groups. (KII 2)

This statement suggests that the presence of a dedicated extension officer at the village level is more effective for ensuring regular contact with farmers. The study further finds that Agro dealers and private companies are a crucial channel for agricultural information among coffee farmers, with 35.3% of respondents reporting their experiences with this channel. Agro dealers and private companies show variability across the villages, with Sepukila reporting the highest at 14.7%, followed by Kilimani at 11.7%, and the least reported in Utiri at 3.8%. Small-scale coffee farmers expressed that they have come to trust Agro dealers and private companies that supply fertilisers after using their services and seeing the empirical results on their own farms. Respondents elaborated that:

> To control diseases, I usually visit Agro dealers, explain my problem and the type of challenge, and they then provide me with a pesticide. I later tried using it on my farm. If I get good results, I usually continue using that pesticide again. (SSI 10)

Another respondent added that the interaction between the agro-dealer and farmers is facilitated by visual aids (Pictures) and technical advice provided by the agro-dealers:

> Through Agro-dealers, I obtain information on new types of fertilisers suitable for coffee plantations. They also provide information on available pesticides that are suitable for use on coffee crops. When I visit their shop, I see pictures of coffee diseases and pesticides that are ideal for treating them. I explained this to the staff, and later, I received good service. (SSI 22)

This statement suggests that Agro dealers provide a compensatory role, especially where public extension services are limited, thereby providing immediate support to farmers. However, the findings revealed that traditional media such as radios and TVs serve as essential channels of information, reported by 34.4% of the respondents. This channel serves as a general knowledge or awareness tool where other channels are weak. Farmers explained they use both national broadcasts, such as Tanzania Broadcasting Corporation (TBC), and regional stations like Ruvuma FM, Hekima FM, and Salvation FM radios to acquire general farming knowledge of the coffee crop. One of the respondents reported:

> I usually listen to the radio during the farmers' session; that's where I get various educational information on the types and correct use of farming inputs, especially for coffee and other crops, without needing to rely on an extension officer. I usually listen to TBC and Salvation FM radio to get that coffee production information. (SSI 11)

An institutional effort also showed the importance of TV. A District agricultural officer noted that the strategic use of this channel is essential for learning by observing:

> Nowadays, technological development is advancing as well; for example, the Coffee Board has initiated a TV program on farming, allowing farmers to learn through observation. (KII 1)

These statements highlight the role of traditional media as a channel for accessing information among coffee farmers; its effectiveness is also influenced by other channels that facilitate interaction with farmers in transforming knowledge into on-farm action.

The study finds that research institutions and NGOs are high-quality sources of information, although they are underutilised by most small-scale coffee farmers in Mbinga District. Only 14.7% of the respondents explained how they accessed the information from this source. Access to this channel in Utiri and Kilimani was 5.9% for each, and in Sepukila, 2.9%. The leading actor is the Tanzania Coffee Research Institute (TaCRI), the main research branch located in Mbinga District at Ugano. In this region, TaCRI serves as a significant source of scientific innovation in coffee, developing and disseminating highly improved seeds and providing coffee-farming programs. The NGOs, including Hanns R. Neumann Stiftung (HRNS), work with AMCOS to build farmers' capacity, specifically by mobilising farmers to form groups, strengthening co-operatives, and providing localised extension support to facilitate access to and sharing of agricultural information. A respondent explained the transformation of the advantage of this channel:

> TACRI has helped me a lot because I was not a coffee farmer. Still, after attending TACRI, I received education on coffee seedling production, and later I decided to start farming coffee. TACRI has provided me with a valuable job opportunity, as I now know how to establish farms and provide proper coffee care. (SSI 29)

Another respondent explained that, "The government now produces and distributes modern seedlings to farmers at no cost. For example, last season we distributed over 4 million seedlings to our coffee farmers, and regarding seeds, TACRI provides them." (SSI 1)

The role of NGOs was also emphasised as crucial for accessing agricultural information. The respondent elaborated that:

> The HRNS organisation greatly helps us farmers. Before this organisation was established, farmers worked independently; however, the organisation has encouraged the formation of coffee farmers' groups. It aims to help small coffee farmers access a range of resources and information on coffee production. Without them, we wouldn't be able to meet together. (SSI 16)

These statements imply that TaCRI and NGOs represent a high-quality agricultural innovation source, and their underutilisation indicates a gap in the diffusion of scientific knowledge from the source to the receiver and therefore hinders access to the needed message.

Furthermore, the study revealed the potential of digital tools in accessing timely, visual, and interactive information. This channel has an overall usage of 14.7%, with Utiri and Kilimani village accounting for 5.9% each, while Sepukila village accounts for 2.9%. Small-scale coffee farmers explained that digital tools are used for multiple functions; for example, search engines like Google and YouTube videos allow farmers to ask questions and visualise the best farming practices. Respondent reported:

> Currently, the internet has greatly facilitated access to information, particularly through mobile devices. I go to Google and ask a question about coffee, and then I get answers based on that question. Sometimes I use YouTube to watch some people instructing about coffee farming. (SSI 15)

Mobile phones enable small-scale coffee farmers to access government digital agriculture services (M-Kilimo) that offer options to submit questions and receive immediate agricultural information. Respondent responded:

> I use a mobile phone to get various farming information. For example, there are government-run websites (M-Kilimo) where you can access any farming information you need and ask a question to receive an answer promptly. This helps us understand the current situation and track market information, especially the world coffee price. (SSI 16)

This statement suggests that digital tools are an essential channel for delivering visual, real-time information to address farmers' information needs.

5. Discussion

The study explored the agricultural information needs and access channels of small-scale coffee farmers in Mbinga District, Tanzania. The results show that small- scale coffee farmers have different agricultural information needs and access channels. The findings are discussed in the context of the Diffusion of Innovations (DOI) theory, namely the Source-Message-Channel-Receiver-Effects model, with the main focus on Message and Channel to understand how the chain of delivery of essential agricultural information works in Tanzania. The information needs have been grouped into six categories, with fertilisers and soil management information, marketing and price information, and pest and disease control information as the most in need, followed by seed and crop variety, good agricultural practices, and farm mechanisation information.

The overwhelming demand for information on fertiliser and soil management supports the DOI quality of relative advantage. Farmers feel that accurate information in this sector would be the best path through which to maximise yield, the major economic stimulant. They express their requirement for specificity: which fertilisers are good for coffee, which demonstrates a mismatch in compatibility; however, the generic fertiliser advice is seen to be incompatible with their particular crop and soil situation. The result is consistent with studies in India and Bangladesh which have shown site-specific, soil-test-based recommendations to be very effective at enhancing productivity (Bhawariya, 2023; Hossain & Siddique, 2020). Such an absence of personalised advice in Mbinga indicates a structural issue of adapting the message to the local context. Additionally, a study on soil management practices in coffee in the Asia Pacific region indicates that a lack of soil knowledge may lead to the adoption of unintended soil management practices in coffee farming (Kiup et al., 2025).

The study also found that access to accurate and timely marketing information is a primary need for small-scale coffee farmers. This information reinforces the importance of the message that is linked to the market in the context of a commercial crop system. In relation to the DOI theory, the need for marketing and price information highlights its relative advantage, especially in improving farmers' bargaining power and avoiding exploitation by buyers. Access to real-time price data is a source of power in the bargaining power of farmers (Rugerinyange & Buyinza, 2023; Wambua et al., 2025). This finding is consistent with other studies showing that real-time market prices give small-scale farmers greater bargaining power by providing the knowledge necessary for price negotiation, rather than simply taking prices from buyers (Ndimbo et al., 2025; Rugerinyange & Buyinza, 2023; Rwela, 2023). However, a study of coffee in Kenya indicates that marketing and price information influence the volume of coffee production among small-scale farmers (Wambua et al., 2025). This study contributes by revealing that marketing and price information are crucial and depend on the production cycle and marketing timing, and that farmers need this information for each cycle to effectively plan resource allocation, anticipate returns, and time the sale of coffee.

Additionally, this study found the need for information on pesticides and disease control, specifically on CBD and Leaf Rust management. The acute need for information on pest and disease control is a reaction to a critical threat to production or the observability of the problem. Farmers are interested in messages that provide experimental advice on a particular pesticide and practical application guidelines. This finding aligns with the studies showing that unmet information needs have direct negative economic impacts on coffee production. For example, in Ethiopia, the post-harvest loss of coffee due to CBD is between 24 and 30% annually (Alemu, 2025), while in Tanzania, it is 80%, in Colombia, 60%, and in Malaysia and Uganda, 80% (Mbuba & Shechambo, 2023). Also, it is reported that African coffee-producing countries lose approximately $300–$500 million annually due to CBD (Humphries et al., 2025).

Based on the access channels of small-scale coffee farmers, the results revealed that AMCOS is the most widely used channel for agricultural information in Mbinga District, Tanzania. The preference for use is attributed to structural integration in the coffee sector, where farmers are required to join co-operatives to access formal markets, sell coffee legally, and access premium markets. This finding aligns with the DOI theory concept of change agent (AMCOS) leaders who actively shape farmers' understanding of information quality, leading to better prices and greater

observability through premium pricing. Farmers have confidence in AMCOS due to the fact that they would pack the information with real services such as inputs, credit and market access. This is in line with a study in Tanzania which recognised co-operatives as an important channel of information regarding access to inputs and reduction of transaction costs (Anania et al., 2020; Kapinga & Gores, 2021). Farmers are motivated to join AMCOS due to easy access to crop price information, farm inputs, and credit (Rwela, 2023). A study in Tanzania revealed that AMCOS serves as a marketing information source for 46.7% of coffee and 53.1% of cashew nut farmers (Kimaro & Nnko, 2024). Additionally, studies indicate that co-operatives empower small-scale farmers to access distant markets beyond the reach of a single individual and improve their bargaining power (Israel et al., 2022; Kapinga & Gores, 2021).

The study revealed the potential of digital tools in accessing agricultural information by small-scale coffee farmers. This study reveals that smartphones and mobile phones are a crucial channel for accessing timely agricultural information among small-scale coffee farmers. This finding is consistent with studies demonstrating that smartphones facilitate access to real-time market, financial, and weather information (Haule et al., 2025; Ndimbo et al., 2025). Additionally, mobile-based advisory services such as TigoKilimo and UshauriKilimo in Tanzania and Wefarm in Kenya deliver advice on pest and disease control and weather (Emeana et al., 2020). Mobile phones also facilitate online transaction services such as M-Pesa and Tigo Pesa, thereby improving access to credit among small-scale farmers (Haule et al., 2025; Ndimbo et al., 2025; Sanga et al., 2016). These channels are not yet in a position to reach a critical mass due to issues of digital literacy, cost, and connectivity. This observation is similar to issues in ICT-for-agriculture research in Africa (Emeana et al., 2020), and it is confirmed that even in the presence of the tool, the lack of infrastructure and skills can suffocate the diffusion of innovation.

This study revealed that public agricultural extension services remain an officially recognised, formal channel for agricultural information. This is attributed to the presence of dedicated VAEOs providing on-farm technical support and practical knowledge exchanges on the application of fertilisers and pest and disease control. A dedicated extension officer at the village level is essential for maintaining regular contact with farmers and facilitating the dissemination of technical information critical to coffee farming. In relation to the DOI theory, the extension officers function as change agents by translating the technical knowledge into actual practices. This finding aligns with the study on extension services in Tanzania, which reported similar results: farmers who received extension services were more likely to adopt the application of organic and inorganic fertilisers, new seeds, and irrigation practices (Mugizi, 2025). Additionally, a study examining the roles of extension services in SSA highlights that extension services are a more effective channel in the dissemination of new agricultural technologies, which are provided through the Training and Visit and participatory extension model (Abhijeet et al., 2023). However, the low coverage of public extension services indicates a fundamental failure in the formal diffusion of agricultural information. The DOI theory assumes that the change agents are the extension agents. Their small coverage and disproportionate village-level coverage, which is one of the effects of the long-term understaffing of agriculture, severely limit the delivery of scientifically proven messages. This finding is consistent with studies that highlight that the ratio of extension officers to farmers in Tanzania is about 1:1172 for crops, which is also below the World Bank's recommended ratio of 1:200, as well as the standard of the Tanzania Ministry of Agriculture of at least two extension officers per village (Mangole et al., 2025). These difficulties lead to limited accessibility and poor interaction quality for small-scale coffee farmers with extension services. The root cause is inadequate funding, limited resources, and staff training, which hinders the quality and consistency of the message from the official source.

5.1. Policy and Practical Implications

This study highlights the need for policy interventions, both locally and nationally, that address the needs of small-scale farmers. The results indicate that small-scale coffee farmers need access to timely, accurate, and relevant agricultural information to increase their productivity and support the sustainable development of the agricultural sector. The policy and practical interventions should aim at empowering the public agricultural extension services through the deployment of village agricultural extension officers in the regions where there are no extension services. The frequent visits would help close the gap in the spread of information and give the farmers the required agricultural information. Additionally, improving infrastructure such as roads, internet connectivity, and electricity would facilitate the flow of the information needed by small-scale coffee farmers. Reliable road infrastructure is essential for facilitating access to markets and extension services. At the same time, electricity and internet connectivity are essential for enabling farmers to use digital tools and access mobile-based information. Public-Private Partnerships (PPPs) should be promoted to invest in digital infrastructure by developing low-cost mobile services that provide the agricultural information small-scale coffee farmers need. Moreover, regular capacity-building

and monitoring for AMCOS board leaders should be done to ensure transparency and accountability of the co-operatives.

Theoretically, the study supports DOI theory by adding to the literature on small-scale coffee farmers' agricultural information needs and access channels, and by describing how needed agricultural information is communicated to them. Applying this theory reveals that the social system of global coffee production demands market-responsive information, while the sources, channels, and messages within the local extension systems are inadequate and result in innovation gaps. This study identified AMCOS as the main access channel of agricultural information for small-scale coffee farmers. This preference reflects coping strategies due to limited trusted channels. AMCOS is a market-oriented source integrated into the coffee value chain and essential for accessing marketing information. This highlights a critical shift for this kind of commercial crop: the trusted source is not official agricultural extension services but market intermediaries. This aligns with the theory's focus on the social system in the global coffee system, and market actors become essential sources of innovation.

5.2. Limitations and Areas of Future Research

Although this study offers the necessary information about the agricultural information needs and access channels of small-scale coffee farmers, it is important to acknowledge the following limitations: First, sampling constraints: this research was conducted in three villages that were purposely selected as the case studies, and the respondents were recruited through purposive and snowball sampling techniques. Snowball referral tends to cluster respondents within familiar social networks; this limits the generalisation of the results across all coffee-producing regions in Tanzania. Second, the inclusion criterion of at least five years of coffee farming experience excluded newly entered farmers. This group may have different information needs and access channels. Future research should deliberately sample new entrants, youth, and female-headed households. Third, while the study used a qualitative approach that provided valuable insights into the experiences, perceptions, and views of small-scale coffee farmers, it lacked quantitative measures to establish statistical relationships among variables. Fourth, the manuscript does not include field photographs, and all empirical evidence derives from textual interview records, focus group transcripts, key informant interviews, and researcher field notes. Furthermore, the percentages in this study describe response distributions within a qualitative sample; they are not prevalence estimates and should not be treated as representative of the wider farmer population. Based on the limitations of this study, future studies should therefore expand the study area by integrating other coffee-producing regions in Tanzania to identify convergences and divergences in information needs and access channels across these regions, utilising large-scale quantitative data to explore the statistical correlation between information needs and information access channels and levels of coffee farmers' productivity, and conducting a longitudinal study on how digital extension channels evolve.

6. Conclusion and Recommendations

Understanding agricultural information needs and access channels is crucial to developing effective extension services that meet small-scale farmers' needs. The study found that small-scale coffee farmers mainly needed information on fertilisers and soil management, disease and pest control, market prices, GAPs, and new improved seeds to make informed decisions about coffee production. Additionally, farmers primarily access this information through AMCOS and farmer-to-farmer networks, with limited access to agricultural extension services, research institutions, and digital tools. This underscores the need to strengthen institutional and digital channels to improve small-scale coffee farmers' access to and dissemination of required agricultural information.

Based on the findings of this study, the following recommendations are provided: first, to strengthen the coverage of public extension services, the Government of Tanzania, through the MAFSC, in collaboration with the President's Office, Regional Administration, and Local Government (PO-RALG), should prioritise deploying new VAEOs in underserved areas. Second, provide soil testing services to smallholder coffee farmers. Given the high demand for fertilisers and soil management information, the Ministry of Agriculture, through district and extension services, should equip village and ward-level extension officers with soil-testing kits. These will support soil health analysis, which is also essential for providing specific fertiliser recommendations for coffee crops. Third, strengthen AMCOS-based training and information delivery. Given that AMCOS is one of the main channels for agricultural information used by most smallholder coffee farmers, the government, in collaboration with NGOs, should strengthen its role in structuring agricultural training. AMCOS should develop an integrated, regular GAP training program for each production season, rather than waiting for the AMCOS meeting, which is held only twice a year. Fourth, invest in digital infrastructure and rural connectivity. Fourth, invest in digital infrastructure and rural connectivity: the government, through the Tanzania Communications Regulatory Authority (TCRA) and private telecommunications providers, should expand rural connectivity and promote low-cost

digital advisory services. Mobile phone network and Internet coverage should be expanded in all coffee-producing villages, and SMS and voice-based advisory services should also be promoted, which allow for low data usage. Fifth, to strengthen research, extension, and farmers' linkages, the Ministry of Agriculture, in collaboration with TaCRI, agricultural universities, and NGOs, should develop a formal coordinated platform that links research, extension, and farmers' groups; the emphasis should be placed on the existing institution rather than on introducing a new structure to ensure the timely realisation of the results.

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Abbreviations

The following abbreviations are used in this manuscript:

AMCOS	Agricultural Marketing Co-operative Society
CAU	China Agricultural University
CBD	Coffee Berry Disease
DAO	District Agricultural Officer
DAS	District Administrative Secretary
DOI	Diffusion of Innovation
FDG	Focus Group Discussion
GAPs	Good Agricultural Practices
KII	Key Informant Interview
LR	Leaf Rust
MAFSC	Ministry of Agriculture, Food Security and Co-operative
RAS	Regional Administrative Secretary
SSI	Semi-Structured Interview
TaCRI	Tanzania Coffee Research Institute
VAEO	Village Agricultural Extension Officer
VEO	Village Executive Officer
WEO	Ward Executive Officer

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