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Smallholder Farmers' Satisfaction with Agricultural Information for Enhancing Climate Change Adaptation in Mbogwe District, Tanzania

Jackson Raymond Sawe
Department of Geography, University of Dar es Salaam
Email: sawe.jackson@udsm.ac.tz

Abstract

This article examines the satisfaction of smallholder farmers with the agricultural information used for climate change adaptation in Mbogwe District, Tanzania. It examines the types and availability of information, farmers' satisfaction levels, and the reasons for dissatisfaction. Using a mixed-methods approach that combines both quantitative and qualitative data, the study involved 300 smallholder farmers. Findings indicate that 59 per cent of farmers were satisfied with the information, citing benefits such as guidance on planting dates, improved conservation practices, enhanced knowledge, and increased awareness of crop production. In contrast, 41 per cent were dissatisfied due to a lack of, delays in, or non-specific information. The research highlights that access to relevant agricultural information boosts farmers' ability to adapt to climate change. Enhancing dissemination methods can improve climate resilience and support sustainable farming practices. Stakeholders should focus on providing timely, context-specific, and accessible information that is relevant to their audience. However, since the study is limited to Mbogwe District, its findings may not be fully applicable elsewhere. Additionally, it did not thoroughly examine external factors, such as market conditions and government policies. Future research should investigate these broader influences to develop more comprehensive adaptation strategies.

Keywords: Smallholder farmers, Satisfaction, Agricultural information, Climate change, Adaptation

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Introduction

Climate change is a primary global concern in the twenty-first century (Antwi-Agyei et al., 2025). Changes in temperature and rainfall patterns are expected to significantly affect crop productivity, as highlighted in the IPCC Fifth Assessment Report (IPCC, 2020). By 2100, global mean sea levels could rise by 15–95 cm, whereas the mean annual global surface temperature may increase by 1–3.5°C (Zambrano et al., 2024). These changes could have a severe impact on agriculture, particularly in regions with vulnerable farming systems. Rising temperatures will alter precipitation patterns, creating temporal and geographical variability in rainfall (Zambrano et al., 2024). Consequently, climate change adaptation measures are essential, especially in the Global South (dos Santos et al., 2022).

Agriculture is the backbone of many African economies, making it highly susceptible to climate change (Malekela & Nyomora, 2020). In Tanzania, agriculture plays a pivotal role in driving economic development, reducing poverty, and promoting environmental sustainability (Zwane, 2019). The sector consists of both smallholder and large-scale

commercial farmers. This study focuses on smallholder farmers, who, according to the FAO (2022), are defined as those cultivating small plots of land with family labour and limited access to capital, inputs, and technology. Smallholder farmers make a significant contribution to food security in developing nations (Nevermann, 2022). However, one of their considerable challenges is accessing timely and relevant agricultural information. The diversity of smallholder farmers further complicates the dissemination of accurate information (Mitter et al., 2024). As a result, delivering the correct information at the right time remains a key challenge for climate change adaptation (Kaske et al., 2018). Agricultural information is a critical component in addressing this challenge (Sawe, 2022). Access to agricultural information enhances productivity and supports climate change adaptation strategies. Reliable information enables farmers to seize opportunities to enhance yields and incomes (Atta-aido et al., 2022; Ndimbwa et al., 2021). Studies highlight that informed farmers adopt better agricultural practices, leading to increased productivity in a changing climate (Alidu et al., 2022). Therefore, strengthening agricultural information systems is crucial for empowering farmers with knowledge that enhances decision-making and resilience to climate change.

Scholars emphasise how access to agricultural information promotes progress in the agricultural sector by enabling farmers to make informed decisions (Ahmad et al., 2023; Sawe, 2022; Silayo, 2016). Kaske et al. (2018) argue that sustainable agricultural development in the era of climate change depends on farmers receiving timely and relevant information. The ability of smallholder farmers to access, acquire, and utilise agricultural information significantly influences the sector's prosperity (Ndimbwa et al., 2021). Therefore, improving access to agricultural information is crucial for enhancing agricultural productivity and adapting to climate change.

Agricultural policies play a crucial role in transforming the sector by promoting access to agricultural information (Ahmad et al., 2023). Smallholder farmers need timely, accurate, and relevant information to make informed decisions that enhance productivity. The fourth industrial revolution has made information more accessible, but verifying its quality remains a challenge. Providing up-to-date and useful agricultural information can ultimately improve farmers' livelihoods (Antwi-Agyei et al., 2025). Thus, effective policies should prioritise the dissemination of reliable agricultural information to strengthen farmers' adaptive capacity. In this regard, agricultural information on improved farming practices can help reduce costs and encourage poor farmers to engage in entrepreneurial activities (Tumpe et al., 2022). Farmers need information on efficient farming techniques, pest and disease management, and market prices to enhance their adaptive capacity (Sharafi et al., 2021). Timely climate-related information also supports the development of effective drought management strategies (Sharafi et al., 2021). Access to such information enables farmers to adopt more effective strategies, thereby increasing their resilience to the impacts of climate change.

Despite progress in agricultural information dissemination, many rural communities in Tanzania still lack access to relevant and adequate information. Studies by dos Santos (2022), Sawe (2022), and Nevermann (2022) indicate that although agricultural information is widely recognised as essential, most smallholder farmers in developing countries, including Tanzania, struggle to access it. Limited access to relevant information hinders effective adaptation to climate change, particularly in remote areas. While existing studies have extensively explored sources, access to, and use of agricultural information, they have mainly overlooked smallholder farmers' satisfaction with the information they receive. Studies by

Antwi-Agyei et al. (2025), Zambrano et al. (2024), Ahmad et al. (2023), Sawe (2022), Mwantimwa (2020), Ndimbwa et al. (2021), and Mkenda et al. (2017) have examined how farmers access and utilise agricultural information. However, they have not thoroughly examined whether this information is accurate, relevant, timely, and easy to use for adapting to climate change. It is essential to fill this gap because a robust platform for sharing agricultural information helps boost farming productivity, improve farmers' decision-making, and enhance small farmers' ability to adapt to climate change. Information dissemination goes beyond merely providing access; it ensures that farmers receive timely, relevant, and context-specific knowledge that enables them to make informed choices about adaptive farming practices.

This study fills that critical gap by evaluating smallholder farmers' satisfaction with agricultural information for climate change adaptation using a structured dissemination model. This research looks at more than just access to information. It also focuses on the reliability of the information, whether it meets local farming needs, and how much farmers trust different sources. The study employs a model to disseminate agricultural information, focusing on key factors that influence satisfaction. These factors include the ease of understanding the language, the frequency of updates, and the use of digital versus traditional communication methods.

This research presents a model designed to enhance agricultural information systems. It ensures that these systems are not only accessible but also effective in helping small farmers adapt more effectively. Understanding how satisfied farmers are with an agricultural information system will help create more effective policies, support services, and digital tools that aid farming in addressing climate change.

Literature Review

This review examines the types of agricultural information accessed and utilised by smallholder farmers, highlighting the crucial role of information in climate change adaptation. It identifies key information sources and barriers to access, and discusses the implications for effective climate change adaptation strategies. Moreover, it examines farmers' satisfaction with agricultural information related to climate change adaptation and identifies factors influencing smallholder farmers' satisfaction with such information.

Types of agricultural information that smallholder farmers access and utilise

Kandji and Verchot (2020) emphasise that agricultural information significantly impacts farmers' socio-economic decisions, including crop selection, resource allocation, and market participation. Muema et al. (2021) further argue that access to agricultural information guides smallholder farmers in selecting seeds, preparing land, and determining optimal planting schedules. Similarly, Siyao (2022) asserts that well-informed farmers adopt improved farming techniques, high-yield crop varieties, and modern pest management strategies, ultimately increasing resilience to climate change. Ensuring that smallholder farmers receive accurate, relevant, and timely information is therefore essential for promoting sustainable agricultural practices.

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Smallholder farmers require a diverse range of agricultural information at different stages of production. A systematic review of the literature reveals that agricultural information crucial for climate change adaptation falls into three main categories: pre-production, production, and post-production information (Ahmed & Ouma, 2023). In the pre-production stage, farmers rely on climate forecasts, seasonal weather patterns, and soil fertility data to make informed decisions about what, when, and where to plant (Hisali et al., 2023). Access to knowledge on drought-resistant and pest-resistant crop varieties further enhances their preparedness for climate risks (Zambrano et al., 2024). Sawe (2022) notes that information on land preparation techniques, irrigation methods, and seed selection helps farmers optimise resource use and improve productivity before the planting season begins.

During the production stage, smallholder farmers depend on information related to pest and disease control, fertiliser application, and water management. According to Dang et al. (2021), timely updates on integrated pest management and organic farming practices enable farmers to mitigate crop losses caused by emerging pests and diseases. A study conducted by Diemer et al. (2020) in Ethiopia found that farmers actively seek knowledge on organic and conventional pest management techniques when confronted with unfamiliar pest infestations. Likewise, Mbwangu (2022) emphasises the critical role of extension services in guiding sustainable farming techniques, such as crop rotation and agroforestry, which contribute to building climate resilience.

After harvesting, farmers require information on post-harvest handling, storage techniques, and market access. Ahmed and Ouma (2023) emphasise that knowledge about food preservation methods reduces post-harvest losses, while access to market price information strengthens farmers' bargaining power. Dang et al. (2021) found that real-time access to market trends allows farmers to make strategic decisions about when and where to sell their produce. Additionally, information on credit access and financial management plays a crucial role in enabling farmers to invest in climate-smart agricultural technologies and expand their farming enterprises (Phiri et al., 2022).

Despite the availability of these essential types of information, many smallholder farmers continue to struggle with accessing practical and actionable knowledge tailored to their specific needs. Research shows that farmers typically seek information when they encounter urgent problems with their crops or livestock, rather than planning to prevent issues. To enhance climate adaptation efforts, agricultural information systems must prioritise localised, context-specific, and farmer-friendly dissemination strategies. Hisali et al. (2023) stress that integrating mobile-based platforms, community radio programs, and farmer field schools can significantly enhance information accessibility and usability, particularly in remote rural areas.

Based on the reviewed literature, it is evident that smallholder farmers require comprehensive agricultural information throughout all stages of farming to adapt to climate change effectively. Strengthening dissemination strategies and ensuring that information is timely, relevant, and easily accessible can empower farmers to make informed decisions, enhance productivity, and build resilience against climate variability.

Farmers' Satisfaction with Information for Climate Change Adaptation

Masekela and Nyomora (2020) reported that smallholder farmers' adaptation to climate change largely relies on the nature and quality of the agricultural information they access. Studies show that to boost agricultural productivity, farmers need access to agricultural information that is useful, accurate, and relevant (Siyao, 2022; Ndimbwa, 2021; Diemer et al., 2020). A recent survey conducted by the Food and Agriculture Organisation (FAO) in 2022 across 15 African countries found that only 42% of smallholder farmers were satisfied with the agricultural information they received, while 58% reported dissatisfaction due to outdated, incomplete, or inaccessible content (FAO, 2022).

Chetri et al. (2021) warn that dissatisfaction with agricultural information can have serious consequences for smallholder farmers' adaptation to climate change, as poor information quality or accessibility may hinder timely decision-making. A study conducted in Uganda by the World Bank (2021) found that 61% of smallholder farmers were dissatisfied with the weather forecasts they received, citing inaccuracy and limited local specificity as significant challenges. Unhappy farmers were less likely to employ climate adaptation strategies, such as drought-resistant crops and irrigation methods, than those who were satisfied with their farming conditions. Only 28% of the dissatisfied farmers adopted these methods, while 54% of satisfied farmers did.

Nicholas-Ere (2017) argues that when smallholder farmers are dissatisfied with the available information on climate adaptation strategies, they are left with limited choices and may resort to migration, often relocating to urban areas in search of formal and informal employment opportunities. This shift weakens rural agricultural production and disrupts local food systems, ultimately threatening national food security (Phiri et al., 2022; Jack & Hewitson, 2020). For instance, a study by Sharma et al. (2012) found that 65 per cent of farmers in India expressed dissatisfaction with information regarding seed varieties, weather forecasts, and market prices, leading to lower productivity and increased rural-urban migration. Similarly, in Nigeria, only 34.7 per cent of vegetable farmers reported satisfaction with the agricultural information they received, highlighting a significant gap in the effectiveness of information dissemination strategies (Mkenda et al., 2017).

Regional disparities in smallholder farmers' satisfaction with agricultural information further shape climate adaptation strategies. In Sub-Saharan Africa, studies indicate that satisfaction levels vary depending on access to digital platforms, extension services, and local climate information systems. In Ethiopia, for example, Kaske et al. (2017) found that only 39% of smallholder farmers were satisfied with the agricultural information provided. Kenyan farmers are generally more satisfied, with 57 per cent expressing happiness because they have access to reliable mobile services that provide them with agricultural information. This includes SMS and mobile apps that give real-time weather updates and farming advice (Ambani & Percy, 2019). The higher satisfaction rate in Kenya is associated with a 40 per cent greater likelihood of adopting climate-smart agriculture techniques compared to Ethiopian farmers (FAO, 2022).

In South Asia, regional differences in farmers' satisfaction with agricultural information also influence climate adaptation. In Bangladesh, where frequent floods and cyclones disrupt agricultural activities, smallholder farmers rely on early warning systems and digital weather platforms. Studies show that 54 per cent of farmers in Bangladesh are unhappy because they struggle to get local climate information that is easy for them to understand (Ahmed et al.,

2023). This dissatisfaction correlates with a 30 per cent lower adoption rate of flood-resistant rice varieties and other adaptive measures. On the other hand, Indian farmers involved in community information-sharing groups, such as cooperatives and online support platforms, tend to be more satisfied with their experiences. About 62 per cent of them say that the agricultural information they received was valuable and practical (Zambrano et al., 2024).

Latin American countries also illustrate stark contrasts in farmers' satisfaction with agricultural information. In Brazil, government-supported extension services and digital platforms have enhanced information accessibility, leading to increased confidence among farmers in climate adaptation strategies. A 2022 study by Diemer and others showed that 68 per cent of farmers in Brazil were satisfied with the agricultural information they received. This satisfaction made them 50 per cent more likely to adopt conservation farming methods, such as no-till farming and agroforestry. Meanwhile, in rural Guatemala, a lack of localised, indigenous-language information dissemination has resulted in lower satisfaction levels, with only 31 per cent of farmers reporting that they found the agricultural information helpful. Consequently, farmers are adopting adaptation measures, such as crop diversification and improved irrigation systems, at significantly lower rates (Phiri et al., 2022).

In addition to infrastructure and technological disparities, socio-economic factors further shape farmers' satisfaction with agricultural information. Malekela and Nyomora (2020) argue that differences in education levels, literacy rates, and financial capacity influence how farmers perceive and utilise agricultural knowledge. Moreover, language barriers, information complexity, and the timing of agricultural programs on media channels are also critical factors determining satisfaction (Muema et al., 2021). Therefore, regional variations in farmers' satisfaction have continued to influence adaptation outcomes. The literature indicates that some areas possess effective digital information systems and well-organised support services. In contrast, others face challenges such as inadequate infrastructure, low literacy rates, and limited access to local information.

Theoretical Facts Underpinning the Study

This study employed the dissemination of agricultural information model as its theoretical framework. Msoffe (2015) proposes the model. The model comprises six interdependent components, which include information systems, farmers, information providers, farmers' satisfaction, information usage, and benefits. Msoffe's theoretical framework, which emphasises these components, is central to understanding how agricultural information can support smallholder farmers, especially in the context of climate change adaptation. The information system component underscores the importance of system quality, service quality, and information quality. These factors directly influence farmers' satisfaction and subsequent use of the system. When the information system meets the needs of farmers, it encourages consistent engagement and leads to better results.

Next, the study highlights the role of farmers in the process. Farmers must be able to identify their information needs and seek appropriate sources of information. This assumption considers that farmers' competencies are crucial for effective adaptation. When farmers can effectively utilise information, they can make informed decisions that enhance their climate resilience. Furthermore, information providers play a crucial role in this process. This component emphasises that information providers must create an enabling environment for

farmers, delivering information in a manner that is both relevant and easily accessible. This ensures that the information reaches farmers in a manner that is practical and useful.

Furthermore, farmers' satisfaction is a central factor in the theoretical model. Farmers' satisfaction with agricultural information refers to their contentment with the relevance, quality, and accessibility of the information that helps them make informed decisions about their farming practices (Diemer, 2020). In the context of climate change adaptation, satisfaction is paramount, as farmers rely on this information to improve their farming methods and respond effectively to environmental changes. When farmers find helpful information that effectively enhances their agricultural practices, they are more likely to use it consistently, which in turn fosters better adaptation strategies to changing climatic conditions (Siyao, 2022). Msoffe's theoretical framework further underscores that when farmers are satisfied with the information they receive, they are more likely to use it consistently. This, in turn, leads to improved agricultural practices and tangible benefits. Satisfaction has a direct influence on the likelihood of continued engagement with the information system, reinforcing the model's emphasis on satisfaction as a key driver of information usage.

Additionally, the study highlights the importance of effectively utilising information. Farmers are more likely to use information if they are satisfied, according to Msoffe. This results in better adaptation to climate change and improved farming outcomes. Ultimately, the model highlights the benefits that farmers derive from utilising the information. Farmers are satisfied with the information when they see tangible benefits in their farming practices and measurable improvements, particularly in crop production.

The model proposed in this study addresses the key factors influencing the satisfaction of smallholder farmers with agricultural information. It focuses on ensuring that information is accessible, relevant, and of high quality, all of which are essential for effective climate change adaptation (Zambano, 2024). The model highlights the roles of information providers and the importance of a supportive environment in delivering information in a manner that farmers can utilise effectively. By focusing on farmers' capabilities and the importance of meeting their information needs, the model provides a strong theoretical basis for understanding how agricultural information can help farmers adapt to the challenges posed by climate change (Sawe, 2022).

Research Methodology

This study was conducted in four villages in Mbogwe District. These villages are Bunyihuna and Iponya from Iponya Ward, and Lubeho and Nyakafuru from Nyakafuru Ward (Figure 1). Mbogwe District, which is located in the Geita Region of Tanzania, was selected for this study because of the presence of many smallholder farmers (85%) of the total residents (National Bureau of Statistics, 2022). Moreover, it was selected due to its significant reliance on smallholder agriculture, which is highly vulnerable to climate change impacts such as erratic rainfall and temperature fluctuations (United Nations Development Programme (UNDP), 2020). Additionally, Mbogwe District is an area where agriculture plays a significant role in the livelihoods of local communities. The villages of Bunyihuna, Iponya, Lubeho, and Nyakafuru were purposefully chosen because they represent the diverse agricultural practices and environmental challenges faced by farmers in Mbogwe District. Moreover, these villages have been identified in previous studies as areas highly affected by droughts and unpredictable

University of Dar es Salaam Library Journal
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weather patterns, which significantly impact agricultural productivity (Luhunga & Songoro, 2020).

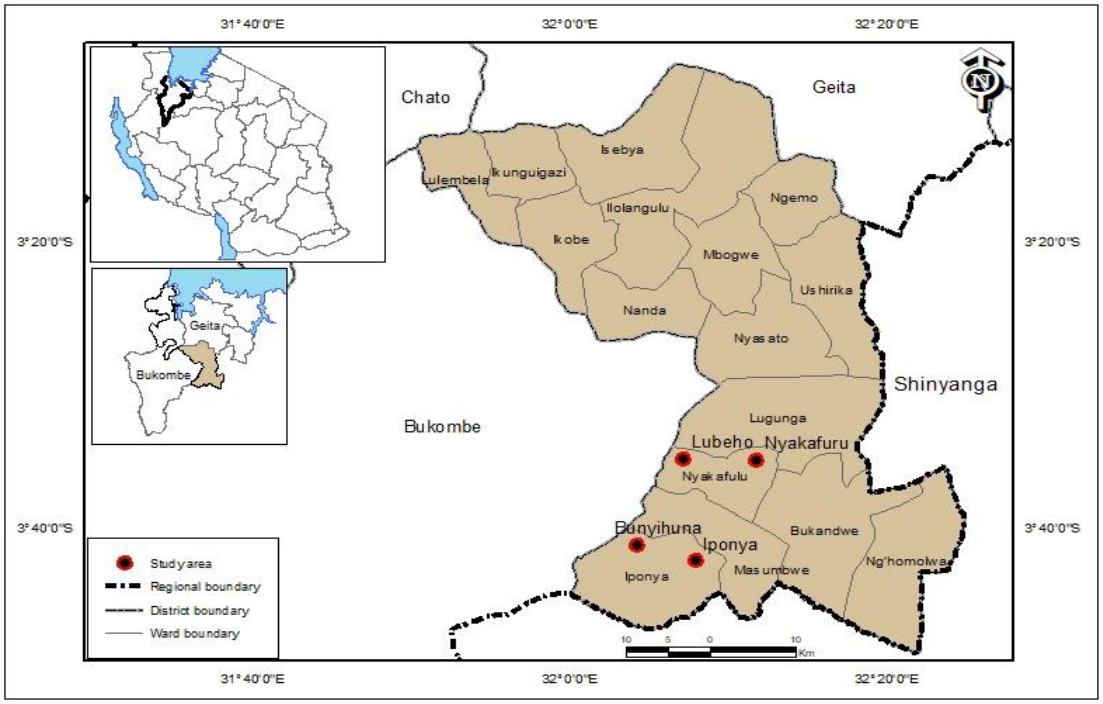

Figure 1: Location of the Study Area
Source: Cartographic Unit, UDSM

Research Design and Approach

This study employed a mixed-methods research design. This design is suitable for this study because it combines both quantitative and qualitative approaches, providing a comprehensive understanding of the issue. The quantitative aspect enables the measurement of satisfaction levels and the identification of patterns across a larger sample. At the same time, the qualitative approach provides deeper insights into farmers' personal experiences and perceptions. This combination enables a more complete assessment of the factors that influence satisfaction and the effectiveness of agricultural information systems. By integrating both methods, the research can address both the breadth and depth of the topic, leading to more informed conclusions and recommendations for improving adaptation strategies. Therefore, a quantitative approach was employed to collect and analyse quantitative data, while a qualitative approach was used to collect and analyse qualitative data.

Study Population, Sample and Sampling Procedures

Smallholder farmers aged 20 years or above were used in this study. The age of 20 years or older is significant in climate change adaptation studies because individuals in this age group have accumulated practical farming experience and are more involved in decision-making regarding agricultural practices (Deressa et al., 2021). Additionally, older farmers are more likely to recognise climate variability and adopt adaptive strategies based on past environmental changes (Maddison, 2024). This age group also has better access to information and resources necessary for implementing adaptation measures. Village executive officers provided a list of farmers involved in crop production, which helped

determine the sample size. The data obtained from these officers indicated that Iponya Village had 300 farmers, Bunyihuna had 280, Nyakafulu had 330, and Lubeho Village had 290, totalling 1,200 smallholder farmers who constitute the sampling frame. Therefore, the total number of smallholder farmers from both villages was 1,200. Yamane's formula (1967) was used to determine the sample size for this study. A 95% confidence level was used to calculate the sample size, as indicated below.

Thus; $n = \frac{N}{1+N(e)^2}$

Where n = sample size, N total number of households (1200), and e Allowable error.

$$n=\frac{1200}{1+1200\ (0.05)2}$$

n=300

Since the total number of households for the four study villages was not uniform, a proportional sample size was determined. The formula used to get this proportional sample size is indicated below;

$$nh = \frac{Nh}{N}$$

Whereby;

Nh = Number of households in each village
nh = Proportional sample size of each village
N = Total number of households in the villages
n = Total sample size of the study population

Therefore, the following is the proportional sample size for each village;

i. nh= $\frac{300}{1200}$× 300= 75, the sample size of Iponya village is 75 households.
ii. nh= $\frac{280}{1200}$× 300= 70, the sample size of Bunyihuna village is 70 households.
iii. nh= $\frac{330}{1200}$× 300= 82.5, the sample size of Nyakafulu village is 82.5 households.
iv. nh= $\frac{290}{1200}$× 300 = 72.5; the sample size of Lubeho village is 72.5 households.

Table 1: Distribution of Sample Size in the Study Area

Villages	No. of households	Sample size	Percent
Iponya	300	75	25
Bunyihuna	280	70	23.3
Nyakafulu	330	82.5	27.5
Lubeho	290	72.5	24.2
Total	1200	300	100

Source: Field Data (2023)

Simple random sampling was used to select farmers for quantitative data collection. The village executive officers provided a list of farmers' names, which the researcher used to select

study respondents. The names were written on pieces of paper that were folded and placed in a box, from which the researcher selected one at a time to determine the study respondents, until the required sample size of 300 was reached. The names from each village were treated separately to ensure proportional samples (Table 1). Purposeful sampling was used to select key informants for in-depth interviews to generate qualitative data.

Methods of Data Collection

Data collection employed multiple data-gathering methods to facilitate triangulation and enhance the validity of the results. These methods include household surveys, in-depth interviews, focus group discussions, observation, and document review methods. A household survey was conducted among smallholder farmers, who were selected to participate in the data collection process through the use of questionnaires. These questionnaires had both closed-ended and open-ended questions. The process lasted between 30 and 45 minutes per questionnaire. The questionnaires used both nominal and ordinal (Likert scale) scales. To measure the level of satisfaction, a Likert scale was used: 1 = very satisfied, 2 = satisfied, 3 = neither satisfied nor dissatisfied, 4 = very dissatisfied, and 5 = dissatisfied. Part of the demographic details included information on the types of agricultural information that smallholder farmers access, their degree of satisfaction, and the factors affecting their satisfaction with agricultural information related to climate change adaptation.

Moreover, in-depth interviews with key informants were conducted to collect qualitative data. Key informants comprised district and ward agricultural and extension officers, village executive officers, and two village elders from each village. These informants were purposely selected. The key informant was important due to their position, knowledge, and experience, which enabled them to provide detailed information regarding climate change trends and adaptation strategies employed. The saturation point determined the number of key informants. The interview used a semi-structured guide in face-to-face interview sessions that lasted 30–45 minutes. The researchers used a notebook and a tape recorder to record the responses. This was done to gain a better understanding and clarify several study topics, including the types of agricultural information, the level of satisfaction farmers have with the information they receive, and the factors that affect small farmers' satisfaction with agricultural information for adapting to climate change.

Additionally, the researcher collected qualitative data through focus group discussions with both male and female participants. To validate the data gathered through the households' questionnaires, the researcher acquired additional in-depth information about respondents' attitudes, ideas, and opinions on the research issue through focus group discussions (FGDs). Each village hosted two focus group discussions, with eight participants each. Before conducting FGDs, participants were informed about the study theme and were asked for their consent to participate. All participants gave their consent, which allowed the researcher to proceed with data collection. During the focus group discussions, every participant was able to share their opinions, views, and perceptions. The discussions were held in Kiswahili, and the material was later translated into English. Lastly, field observation was used to capture what smallholder farmers were doing in their area. The observations primarily focused on how access to agricultural information affected adaptation practices. This information helped to confirm and support findings gathered through other methods. Furthermore, document review was also used to collect secondary data.

Data analysis and presentation

After completing data collection, the following stage was data analysis. During this stage, qualitative and quantitative data were analysed separately. Quantitative data analysis was performed after the data was verified and validated. Generally, the study utilised the Statistical Package for the Social Sciences (SPSS) software, version 22, to generate percentages and frequencies from the quantitative data. The analysis outputs are presented in tables. On the other hand, content analysis was employed to analyse the qualitative data. This began by collecting data through in-depth interviews and focus group discussions, ensuring a comprehensive understanding of farmers' perspectives. The data was then transcribed and systematically reviewed to identify recurring patterns and concepts. The researcher developed a coding framework, categorising the data into meaningful segments. The codes were carefully analysed and organised into main themes that highlight farmers' satisfaction and difficulties with the agricultural information they received. This methodical approach facilitated a nuanced understanding of the factors influencing farmers' adaptation strategies and their satisfaction with agricultural information platforms for climate change adaptation. Finally, direct quotes and narrative summaries present the qualitative data.

Results

Demographic characteristics of respondents

To gather information on demographic characteristics, respondents were asked to report their sociodemographic details. Specifically, they were asked to indicate their gender, age, marital status and education level (Table 2). The results indicate that a significant percentage (70%) of the respondents involved in the study were male, while the minority (30%) were female. The findings of African culture reveal that households are typically led by men, who are the primary speakers of the family. Furthermore, the findings indicate that above three-quarters (82%) of the respondents were aged between 21 and 50, while those aged 50 and above accounted for 18%. The findings indicated that many smallholder farmers were young adults and middle-aged people who mostly participated in agricultural production. This is a positive development because the livelihoods of the surveyed communities are heavily reliant on agricultural production. Education-wise, the results show that over two-thirds (71.7%) of the respondents involved in the study had primary education. Those with no formal education accounted for 21.7%, while those with secondary education or higher accounted for 6.6%. Additionally, the results indicate that the marital status of the respondents in the study area varied. Most (78.3%) were married, and the rest were single, divorced, separated or widowed. This suggests that the smallholder farmers were part of a family union.

Table 2: Respondents' Demographic Characteristics

Variable		Number of respondents (n=300)	Percentage of respondents
Gender	Male	210	70.0
	Female	90	30.0
Education	Not attended	65	21.7
	Primary	215	71.7
	Secondary and above	20	6.6

University of Dar es Salaam Library Journal
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Age	21-30	52	17.4
	32-40	92	30.6
	41-50	102	34.0
	>50	54	18.0
Marital status	Married	235	78.3
	Single	35	11.7
	Separated	6	2.0
	Divorced	10	3.3
	Widow	14	4.7

Source: Field Data, 2023

Types and Status of Agricultural Information Provided to Farmers

To gain an understanding of the accessibility status of different types of agricultural information for smallholder farmers about climate change adaptation, the farmers were asked about the status of various types of information received from different sources and channels. To gain a detailed understanding, a five-point Likert scale (Excellent, Very Good, Good, Fair, and Poor) was used to assess the status of agricultural information accessibility, as shown in Table 3.

Table 3: Types and Status of Agricultural Information Provided

Type of information	Excellent	Very good	Good	Fair	Poor
Weather condition	10(3.3%)	40(13.3%)	130(43.3%)	65(21.7%)	55(18.4%)
Improved seed	6(2.0%)	95(31.7%)	164(54.7%)	22(7.3%)	13(4.3%)
Drought-tolerant crops	8(2.6%)	45(15.0%)	158(52.7)	59(19.7%)	30(10.0%
Market information	6(2.0%)	22(7.3%)	35(11.7%)	62(20.7%)	175(58.3%)
Farming calendar	11(3.7%)	19(6.3%)	115(38.3%)	41(15.7%)	114(38.0%)
Conservation farming	5(1.7%)	54(18.0%)	190(63.3%)	40(13.3%)	11(3.7%)
Credits and loans	8(2.6%)	31(10.3%)	40(13.3%)	64(21.3%)	157(52.3%)
Fertilizers	7(2.3%)	38(12.7%)	142(47.3%)	59(19.7%)	54(18.0%)
Pesticides	3(1.0%)	40(13.3%)	171(57.0%)	68(22.7%)	18(6.0%)

Source: Field Data (2023)

The findings presented in Table 3 indicate that farmers hold different opinions about the accessibility of various types of agricultural information for climate change adaptation. Generally, the findings show that three-quarters of the respondents (63.3%) in the district reported that the accessibility of information on conservation farming was good; this was closely followed by information on pesticides (57.0%), improved seeds (54.7%), and the application of drought-tolerant crops (52.7%). Moreover, the findings revealed that smallholder farmers also received agricultural information on the use of fertilisers (47.3%), followed by weather conditions (43.3%), and the farming calendar (38.3%). On the other hand, findings from key informant interviews indicate that the agricultural information provided on conservation farming, weather conditions, and the use of improved seed was good

and essentially helped farmers respond to climate change. Furthermore, one of the key informants from Lubeho village gave the following admission:

> *For a long time, we have been receiving information about using improved seeds and cultivating drought-tolerant crops, such as millet and cassava, which have high adaptive capacity and can withstand drought conditions. This has been an essential climate change adaptation strategy because it has reduced the problem of household food insecurity for the majority of households in our village* **(Key informant interview with a village elder in Lubeho Village, 2023).**

> *As extension officers, we have various responsibilities, one of which is to provide farmers with agricultural information, particularly on the adoption of improved seeds, the use of fertilisers and pesticides, and production techniques. We also inform them about the proper time to start cultivation.* **(In-depth interview with Male, extension officer, aged 39 in Nyakafulu Village, 2023).**

On the other hand, the findings reveal that more than half (58.3%) of the respondents reported that the accessibility of market information for crops was poor; this was followed by information on the provision of loans and credit (52.3%), farming calendar (38%), weather conditions (18.4%) and fertilisers (18%). Other less significant issues included information on drought-tolerant crops, pesticides, and conservation farming, as indicated in Table 3. These results suggest that smallholder farmers held varying perceptions about the types of agricultural information available to them. Key informants reported that smallholder farmers were supplied with diverse agricultural information. The results also show that the farmers in the study area required additional types of agricultural information, such as agricultural inputs, information on climate change, seed varieties, and proper storage of crops after harvesting.

Level of Farmers' Satisfaction with Agricultural Information Provided

This section presents findings on the satisfaction of smallholder farmers with various types of agricultural information accessed for climate change adaptation. Farmers expressed their satisfaction levels with the agricultural information provided to them, focusing on its appropriateness in addressing climate change challenges and enhancing their livelihoods. The assessment used an ordinal scale: 1 (very satisfied), 2 (satisfied), 3 (neither satisfied nor dissatisfied), 4 (dissatisfied), and 5 (very dissatisfied). Table 4 presents the levels of satisfaction with various types of agricultural information. More than half (56.7%) of respondents expressed satisfaction with conservation farming information, which emphasised mixed cropping, mulching, and crop rotation. Farmers found this information particularly useful because it directly contributed to improved soil fertility, increased moisture retention, and higher crop yields. Similarly, 49.3 per cent of the farmers were satisfied with information on drought-tolerant crops and weather conditions. These types of information enabled them to make informed decisions about crop selection and planting schedules, helping them mitigate the effects of climate change.

Focus group discussions revealed that farmers valued agricultural information because it improved their farming practices, provided new knowledge, and raised awareness of climate

change adaptation techniques. Many farmers stated that timely and relevant information played a crucial role in their ability to plan effectively and adapt to changing climatic conditions. These findings align with interviews and focus group discussions, which confirmed that access to agricultural information enhanced farmers' practical skills and techniques. Farmers emphasised that training sessions and hands-on demonstrations contributed significantly to their understanding and application of new farming methods.

Conversely, dissatisfaction levels were highest for market information (58.3%), followed by fertiliser use (48.7%) and farming calendars (41.7%). Farmers expressed frustration over the lack of timely and accurate market data, which limited their ability to sell produce at competitive prices. Many stated that unreliable market information led to post-harvest losses and financial instability. The high dissatisfaction with fertiliser information suggests that farmers either received inadequate guidance on proper application techniques or struggled with accessibility and affordability.

Notably, 52.3% of farmers were very dissatisfied with the information on credit and loans, indicating a significant gap in the financial support services provided. Farmers reported that credit facilities were either inaccessible or came with high-interest rates that made borrowing unsustainable. Many also pointed out that they lacked sufficient knowledge about loan application processes and repayment structures, which discouraged them from seeking financial assistance.

Table 4: Level of Farmers' Satisfaction with Types of Agricultural Information Provided

Type of information	Very satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	P value
Weather condition	7(2.3%)	148(49.3%)	25(8.3%)	65(21.7%)	55(18.4%)	0.04
Improved seed	6(2.0%)	75(25.0%)	155(51.7%)	42(14.0%)	22(7.3%)	0.26
Drought-tolerant crops	8(2.6%)	158(52.7)	45(15.0%)	59(19.7%)	30(10.0%	0.02
Market information	4(1.3%)	22(7.3%)	37(12.3%)	175(58.3%)	62(20.7%)	0.15
Farming calendar	11(3.7%)	19(6.3%)	41(15.7%)	125(41.7%)	104(36.0%)	0.08
Conservation farming	5(1.7%)	170(56.7%)	74(24.7)	40(13.3%)	11(3.7%)	0.01
Credits and loans	8(2.6%)	31(10.3%)	40(13.3%)	64(21.3%)	157(52.3%)	0.18
Fertilizers	5(1.6%)	40(13.3%)	59(19.7%)	146(48.7%)	50(16.7%)	
Pesticides	2(0.7%)	44(14.6%)	168(56.0%)	68(22.7%)	18(6.0%)	0.09

Source: Field Data (2023)

A chi-square test was used to analyse satisfaction levels to see if there is a connection between satisfaction levels and the type of agricultural information received. The analysis revealed a strong association ($p < 0.05$) between farmer satisfaction and three factors: conservation farming, drought-resistant crops, and access to weather information, with p-values of 0.01, 0.02, and 0.04, respectively. This suggests that such information is crucial in helping farmers adapt to climate change and enhance their productivity. Moreover, the inferential analysis indicates that farmers value conservation farming, weather condition updates, and drought-tolerant crop information because these directly impact their farming success. However, the dissatisfaction with market, fertiliser, and credit information suggests the need for policy interventions to improve agricultural extension services and financial support for smallholder farmers.

Factors for Farmers' Dissatisfaction with Agricultural Information Provided

The results in Table 4 indicate mixed satisfaction among smallholder farmers with the agricultural information they receive. While some farmers are satisfied with the information, others express dissatisfaction, especially in areas such as marketing, farming calendars, pesticides, and access to credit and loans. Table 5 presents the reasons why people are dissatisfied with agricultural information. It highlights the problems with the way information is currently shared. Therefore, the data in Table 5 reveal that approximately 34% of farmers are dissatisfied due to a lack of sufficient agricultural information. This indicates a significant gap in the quantity of information provided to farmers, which is crucial for effective decision-making, particularly in the context of climate change adaptation. Smallholder farmers often rely heavily on timely, accurate, and comprehensive information to modify their farming practices, cope with climatic fluctuations, and optimise productivity. The insufficient provision of information, therefore, impedes their ability to effectively adapt to changing environmental conditions, worsening vulnerability to climate-related risks.

Table 5: Factors Hindering Farmers' Satisfaction with Agricultural Information

Variable	Number of respondents	Percentage
Insufficient information	102	34
Unreliable information	72	24
Untimely provided	57	19
Not site-specific	38	12.7
Unfriendly language	20	6.6
High costs	11	3.7
Total	300	100

Source Field Data (2023)

The second most mentioned reason for dissatisfaction (24%) is unreliable information. Farmers need trustworthy information to make critical decisions regarding climate adaptation strategies. If the information provided is inconsistent or inaccurate, it may lead to misguided farming practices that ultimately worsen outcomes. For instance, unreliable data on climate

trends or pest control methods may lead farmers to adopt inappropriate practices, which could result in crop failure or increased exposure to climate risks.

Timeliness of information is also a critical factor, with 19 per cent of respondents indicating dissatisfaction due to the late delivery of agricultural information. Delayed information is particularly problematic in the context of climate change, as timely guidance is crucial for effective early planning and decision-making. For example, information on planting times, pest outbreaks, or weather forecasts must be provided at the appropriate time to enable farmers to take proactive measures. Without timely information, farmers may miss key opportunities to adapt their practices in response to climate fluctuations, leading to suboptimal productivity or even crop losses.

Another notable barrier is the lack of site-specific information, which 12.7 per cent of respondents reported as a factor of dissatisfaction. This highlights the need for agricultural advice tailored to local conditions, considering regional variations in climate, soil, pests, and other environmental factors. Generalised information may not be effective in addressing the specific challenges that farmers face in different areas, which limits its practical value.

However, to a lesser extent, farmers also reported the use of unfriendly language (6.6%) and high costs (3.7%) as barriers. The use of unfriendly language could potentially alienate farmers, making it challenging for them to understand or implement the provided advice. This highlights the importance of making agricultural information accessible and easy to understand, particularly for smallholder farmers with varying levels of education and literacy. High costs of information access, whether due to the price of materials or the fees for extension services, further exacerbate the difficulties farmers face in obtaining the necessary guidance to adapt to climate change. One key informant, who provided further details, supports these findings thusly:

> *Indeed, farmers often do not receive timely agricultural information, and when provided, the information is neither sufficient nor site-specific. This is an excellent barrier for most farmers who rely on agriculture for their livelihoods. This has also affected their decisions and practices regarding climate change adaptation* ***(Interview with Ward Agricultural Officer*****, 2023).**

Discussion of Results

This study assessed the extent to which smallholder farmers are satisfied with the agricultural information they receive for climate change adaptation. The findings reveal that farmers access a variety of agricultural information, including weather conditions, improved seeds, drought-tolerant crops, market availability, farming calendars, conservation farming practices, credit and loan information, fertilisers, and pesticides. These results align with Sawe (2022), who found that smallholder farmers frequently access information on drought-resistant crops, conservation farming, and market trends. The consistency between these findings suggests that farmers actively seek agricultural knowledge to enhance their resilience to climate change. Similarly, a study by Chetri et al. (2021) emphasises that access to

information is a direct and significant contributor to enhancing farmers' adaptive capacity to climate risks.

The existing literature widely supports the significance of access to agricultural information. Ndimbwa et al. (2021) argue that knowledge of the farming calendar is crucial because it enables farmers to align their agricultural activities with climatic conditions and use appropriate fertilisers. Magesa et al. (2024) note that access to a variety of agricultural information enables farmers to make informed decisions about which crops to plant, the optimal planting time, where to sell their produce, and how to negotiate better prices. These perspectives affirm the importance of timely and relevant agricultural information in improving productivity. Similarly, Mbwangu (2022) emphasises that agricultural production improves when farmers receive timely and reliable information. Malekela and Nyomora (2020) also highlight that access to agricultural information enhances farmers' awareness of climate change adaptation strategies, strengthening their resilience to environmental challenges. Furthermore, a study by Mitter et al. (2024) suggests that the adaptation intentions and behaviours of smallholder farmers are significantly influenced by their access to and understanding of agricultural information.

Despite the availability of agricultural information, farmers' satisfaction levels vary. The findings indicate that while smallholder farmers appreciate information on drought-tolerant crops and weather conditions, they express dissatisfaction with information related to market trends, farming calendars, fertilisers, and financial support. Notably, most farmers are highly dissatisfied with the information they receive regarding loans and credit access. These results align with those of Ramli et al. (2013). They reported that farmers were more satisfied with weather information and drought-resistant crops because these helped them adapt to climate change. However, similar to this study, Sharma et al. (2012) found that farmers were dissatisfied with market information, fertiliser guidelines, and financial support services. Additionally, a study by Chetri et al. (2021) found that, despite the growth in the use of information and communication technologies, small farmers still lack access to information, which hinders their ability to respond to climate risks.

Access to agricultural information plays a crucial role in improving farming techniques, acquiring new knowledge in agriculture, and enhancing decision-making processes. Sharafi et al. (2021) assert that agricultural information not only raises awareness but also strengthens farmers' ability to adapt to changing climatic conditions. However, the findings of this study highlight a gap between the availability of agricultural information and farmers' satisfaction with it. While some farmers benefit from reliable agricultural knowledge, others struggle with inadequate and untimely information that does not meet their specific needs for climate change adaptation. This disparity underscores the need for more tailored and accessible information dissemination strategies. A study by Chetri et al. (2021) emphasises the importance of understanding the mechanisms that can facilitate the exchange and use of information in the farming community more effectively.

Several factors contribute to smallholder farmers' dissatisfaction with agricultural information services. Unreliable, insufficient, and untimely information prevents farmers from making effective agricultural decisions. Additional barriers include the high costs of information services and language differences, which hinder comprehension and the practical application of information. These findings align with Msoffe and Ngulube (2016), who

suggest that people are dissatisfied with information services because extension officers do not provide sufficient assistance, reliable sources are lacking, and there is insufficient awareness of the available agricultural information. Furthermore, Chetri et al. (2021) highlight that, despite the exponential growth in the use of technology, particularly information and communication technologies (ICTs), small farmers still lack access to information, which hinders their capacity to respond to weather and climate-related risks.

These findings support Msoffe's (2015) idea that the usefulness and suitability of information affect how satisfied farmers are and how they use that information. This study confirms that farmers who receive timely and relevant agricultural information are generally satisfied, whereas those who encounter delays or insufficient details tend to express dissatisfaction. This distinction highlights the need to enhance agricultural information delivery systems, ensuring that farmers receive precise, practical, and accessible climate change adaptation strategies. Additionally, Zambrano et al. (2024) suggest that developing a sound agricultural information dissemination system is likely to help farmers better respond to a changing climate in the future.

Study Implications

The findings indicate that Tanzania has not conducted sufficient studies examining the satisfaction of smallholder farmers with agricultural information to enhance climate change adaptation. As such, this study expands the existing knowledge on this matter. The findings of this study are expected to inform policymakers and decision-makers about the role of agricultural information in facilitating smallholder farmers' adaptation to climate change, a significant challenge facing smallholder farmers worldwide. Moreover, the findings will assist the government in improving information dissemination channels to ensure that the information is specific, reliable, and timely, and is provided to support farmers' adaptation. Moreover, the study will influence the realisation of the National Climate Change Response Strategy (2021) and the Five-Year Development Plan (2022-2025/26). Moreover, at the international level, the study will accelerate the realisation of Sustainable Development Goal Number One on the elimination of poverty, Goal Number Two on eradicating hunger, and Goal Number Thirteen on organising climate action.

Conclusion and Recommendation

It has been noted that the extent of smallholder farmers' satisfaction with agricultural information for climate change adaptation largely depends on the types of information, reliability, adequacy, and timeliness. It is contemplated that satisfaction with the information is an important determinant of informed and rational decision-making in agriculture. Satisfaction with and of agricultural information helps smallholder farmers uptake innovative farming techniques, which translates into sustainable production. However, it has been observed that some of the agricultural information farmers access falls short of their expectations. Therefore, there is a need to develop accessible and reliable platforms to enhance market information systems and provide farmers with real-time market data. Moreover, there is a need to improve access to agricultural credit by strengthening the role of financial institutions in providing affordable credit and loans tailored to smallholder farmers. By addressing these gaps, policymakers and agrarian stakeholders can enhance smallholder farmers' ability to adapt to climate change while improving their overall livelihoods.

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