

---

---

## Access to and Use of Agricultural Information for Smallholder Farmers' Adaptation to Climate Change in Iringa Rural District, Tanzania

Jackson R. Sawe 

Department of Geography, College of Social Sciences, University of Dar es Salaam,  
Tanzania

Email: [jacksonsawe@yahoo.com](mailto:jacksonsawe@yahoo.com)

### Abstract

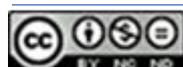
*This paper assesses how access to and use of agricultural information contributes to adaptation by smallholder farmers to climate change in Iringa Rural District, Tanzania. Specific objectives of this study were to examine types and sources of agricultural information, to explore the use of agricultural information in climate change adaptation, and to delineate factors affecting farmers' access to and use of agricultural information for climate change adaptation. The study used a mixed research approach and a sample of 87 heads of household was studied. In-depth interviews, focus group discussions, household survey and field observation were used to collect data. SPSS software was used to analyse quantitative data while content analysis was used to analyse qualitative data. The study has revealed that mass media is the most source of agricultural information used by smallholder farmers, followed by person-to-person interactions between farmers. These sources provide agricultural information that covers proper farming practices, the use of affordable farm implements, soil conservation methods, and use of improved seed varieties. Furthermore, the findings have revealed that a language barrier, unfavourably scheduled radio and television programmes, and insufficient budget to agricultural extension officers are factors affecting farmers' use of agricultural information. Therefore, smallholder farmers' ability to respond to climate change is largely dependent on access to and use of agricultural information. Consequent to the findings, it is recommended that collective efforts between the government and other stakeholders to ensure smallholder farmers' access to and use of agricultural information for climate change adaptation should be strengthened.*

**Keywords:** Agricultural information, smallholder farmers, adaptation, climate change, Iringa Rural District.

<https://dx.doi.org/10.4314/udslj.v17i2.5>

### Introduction

Due to greenhouse gases produced and released by human activities that use fossil fuels, global climate continues to change (Muema *et al.*, 2018). Climate change has been described by the Intergovernmental Panel on Climate Change (IPCC) as a state that can be identified using statistical tests that highlight changes in the mean and/or variability of climate properties and that persist for a decade or longer (IPCC 2018). Climate change denotes a process in which greenhouse gases released into the atmosphere result in global warming. As a result of climate change, mean global temperatures are expected to increase from 1.4 to 5.8 degrees Celsius by 2100 (IPCC, 2018). This increase has already resulted in erratic changes in rainfall and



temperature frequency, intensity of extreme weather events, and rising sea levels. These which will eventually affect agricultural systems in different parts of the world (Mwalusaka, 2021).

In Africa, if not mitigated, climate change is likely to exacerbate problems faced by smallholder farmers and create new risks for them (Hisali, Birungi, & Buyinza, 2021). The advanced vulnerability of Africa to climate change is partly caused by widespread poverty and dependence on the natural environment and agriculture by the majority of its people, complex governance and institutional systems, limited access to capital, markets and technology, poor infrastructure, ecosystem degradation, complex disasters and conflicts (Malekela & Yanda, 2021). The adverse impacts of climate change in developing countries are caused by low adaptive capacity levels, and limited access to and use of agricultural information to respond to the change (Sawe et al., 2018).

East African countries are among the most food insecure countries in the world (Gavin, 2018) because climate change, noticeable through a decrease in rainfall and increase in drought, as observed in Tanzania, Kenya and Uganda (Mwamfupe, 2014), has exacerbated a drop in harvest. Climate change has, in fact, caused changes in precipitation trends, where arid and semi-arid regions of Tanzania have become drier while other areas, especially mid to high latitudes are experiencing shortage of rainfall (Elia, 2017). Therefore, climate change is one of the major setbacks expected to affect the achievement of the first Sustainable Development Goal and the National Action Programme for Adaptation in Tanzania (Maddison, 2017). One of the reasons this is likely to happen is how these changes adversely affect agricultural production to result in poor household food security (Malekela & Yanda, 2021).

The relationship between climate change and agriculture has very detrimental effects on Tanzania because of her heavy reliance on agriculture for its GDP and the majority of employment opportunities. Agriculture contributes an estimated 26.7% of Tanzania's GDP and is responsible for up to 40% of export earnings (URT, 2020). Thus, changes in climate, which have resulted in prolonged dry periods, unpredictable rainfall, cropping uncertainties, and increased weeds, pests, and diseases (Paavola, 2015) are likely to shake the country's economy. This is because Tanzania's agricultural sector is majorly made of smallholder farmers, most of whom depend on rain-fed agriculture, which is highly vulnerable to climate change.

Smallholder farmers have been adopting different adaptation strategies to respond to the impacts of climate change, a process that is influenced by access to and use of agricultural information (Manda, 2017). Indeed, access to this information is very crucial in promoting smallholder farmers' adaptation to climate change (Mengistu, 2019). Moreover, Mwamfupe (2014) advised that if climate change adaptation and development are to be sustained, access to and use of agricultural information are going to play a pivotal role. With this understanding, this study was carried out to assess how access to and use of agricultural information contribute to smallholder farmers' adaptation to climate. Generally, the article is divided into five main sections. While the first section introduces the study, the second one presents a summary of the empirical literature and the study's theoretical framework. The third section presents the study's methodology while the fourth and fifth sections present results, discussion, implication of the study conclusion and recommendations, respectively.

## **Review of Related Literature**

This section constitutes three subsections. Sub-section one discusses sources of agricultural information while sub-section two explores farmers' access to and use of agricultural

---

information, and the last one describes factors that affect smallholder farmers' access to and use of agricultural information.

### ***Sources of Agricultural Information for Climate Change Adaptation***

Information sources are crucial in equipping smallholder farmers with knowledge about proper ways to respond to climate change. Lack of relevant information sources has been found to constrain rural area farmers' efforts to increase agricultural outputs (Mwalusaka, 2021). Therefore, improving the provision of smallholder farmers with relevant agricultural information can improve crop production and address climate change-induced food shortages (Mtega, 2017). Due to differences in technology, education, and infrastructure advancements, the relevance of agricultural information sources differs between developed and developing countries (Singh, Kituyi, & Urquhart, 2016). Agricultural information sources commonly used by smallholder farmers in developed countries include the television, the Internet, printed materials such as newspapers, magazines and fliers (Muema et al., 2018; Elia, 2017). In contrast, smallholder farmers in developing countries use the radio, colleagues, village meetings, mobile phones, and extension officers (Mtega, 2017). These farmers prefer accessing agricultural information from informal interpersonal sources (Singh, Kituyi, & Urquhart, 2016; Oyekale, 2015). Rogers (2003) observed that interpersonal sources were effective in changing farmers' strongly embedded attitudes, beliefs and practices. These sources are preferred and trusted in developing countries due to their reliance on the word of mouth to interact and share information. The sources comparatively offer easy access to agricultural information which is affordable to resource-constrained farmers (Mudombi & Nhano, 2021). In contrast, mass media sources need higher initial investment to purchase equipment.

### ***Access to and Use of Agricultural Information for Climate Change Adaptation***

Manda (2017) reported that developing countries have been vulnerable to impacts of climate change because of poverty and poor access to agricultural information. Luckily, recent developments in the provision of agricultural information have created opportunities for smallholder farmers to integrate new farming methods into agricultural decision-making (Ahmed & Ouma, 2015). Therefore, in the context of climate change and high exposure of developing countries to climate change risks, plans that promote agricultural information access and dissemination to reduce risks and enhance utilization of opportunities are vital (Gavin, 2018). The impact of such plans is measured against their ability to ensure that information that is fit-for-purpose is produced and made available in right formats for integration into decision-making processes (Jack & Hewitson, 2020).

As emphasized by various scholars, access to and use of agricultural information for effective climate change adaptation should never be underestimated. For instance, Kandji and Verchot (2017) underscored the fact that access to agricultural information is a critical component of smallholder farmers' agricultural and other socio-economic decision making. Muema et al., (2018) add that smallholder farmers' access to agricultural information is crucial in seed selection, farm preparation and proper timing and planting of crops. Raju (2018) therefore proposes that the next step to ensure that farmers respond effectively to climate change is to invest in the accessibility of agricultural information. In a study carried out by Hisali, Birungi and Buyinza (2021) in Uganda, it was found that information is an essential factor that influences farmers' adaptation to climate change and variability. Therefore, climate adaptation efforts should ensure that smallholder farmers are provided with information that has practical value such as highlighting innovations like pest-resistant varieties and drought-tolerant crops (Hisali, Birungi, & Buyinza, 2021; Paavola, 2015).



---

## ***Factors Influencing Access to and Use of Agricultural Information***

Despite efforts to promote smallholder farmers' access to and use of agricultural information, the rate of utilization of the information to manage adverse effects of climate change is low (Serra & Mckune, 2016). This is because of unreliable agricultural information (Dang et al., 2019). According to Mudombi and Nhamo (2021), in order for agricultural information to be used by farmers, it needs to be reliable, trusted, and understandable. Also, effective communication is essential in making agricultural information usable in different contexts (Ambani & Percy, 2014). Moreover, language, style and type of media through which communication is managed are essential factors that make climate information usable by farmers (Muema et al., 2018) because the ability to access and make use of climate information varies significantly depending on people's literacy and fluency in a given language (Ambani & Percy, 2019). Similarly, lack of training on relevant technologies and untimely repackaging of relevant information affect access to such information (Elia, 2017). Furthermore, understanding the information needs of diverse user groups may enhance packaging of agricultural information.

Moreover, other factors that affect farmers' access to and use of agricultural information include social status, social networks, culture, and the availability of communication resources (Kalokola, 2016). For instance, farmers' access to relevant agricultural information will foster strong partnerships between them, researchers, meteorology experts and extension officers; this might further enhance access to and use of agricultural information for responding to climate change (Maddison, 2017). Additionally, socio-economic factors such as occupation, education and income affect access to and use of agricultural information (Dang et al., 2019; Muema et al., 2018; Mtega, 2017). The reviewed literature has established that access to and use of agricultural information is significant in climate change adaptation. However, the literature does not show how agricultural information is accessed and used by smallholder farmers to adapt to climate change. The objective of this study was therefore to address this knowledge gap.

### ***Theoretical Facts Underpinning the Study***

In this study, the Diffusion of Innovations (DOI) Model was used as the theoretical framework. DOI was primarily developed by Rogers (2003) to explain how information access influences farmers' adaptation to climate change. Rogers defines diffusion as the process of communicating innovation to society members throughout the time in life history. Innovation as a process constitutes five stages, which are knowledge, persuasion, decision, implementation as well as confirmation. Rogers (2003) urged that knowledge is when a farmer access information about an innovation, especially on how it works. Persuasion involves farmers' perception about the innovation; this involves assessment of the strengths and weaknesses of the innovation. On the other hand, decision is considered as stage three according to Rogers. This is a process in which a farmer is automatically led to agree or disagree with an innovation. The fourth stage is implementation, which occurs when a farmer applies the innovation. The last stage is confirmation, which involves farmers' evaluation of the outcomes of their choice regarding the innovation.

Therefore, in the context of this study, innovation is considered as 'new agricultural practice' and diffusion is 'how the new agricultural practice is accessed by smallholder farmers' in response to climate change. Further, in the study, adopters are 'smallholder farmers who use the introduced farming practice'. The assumption provided by Rogers' DOI is related

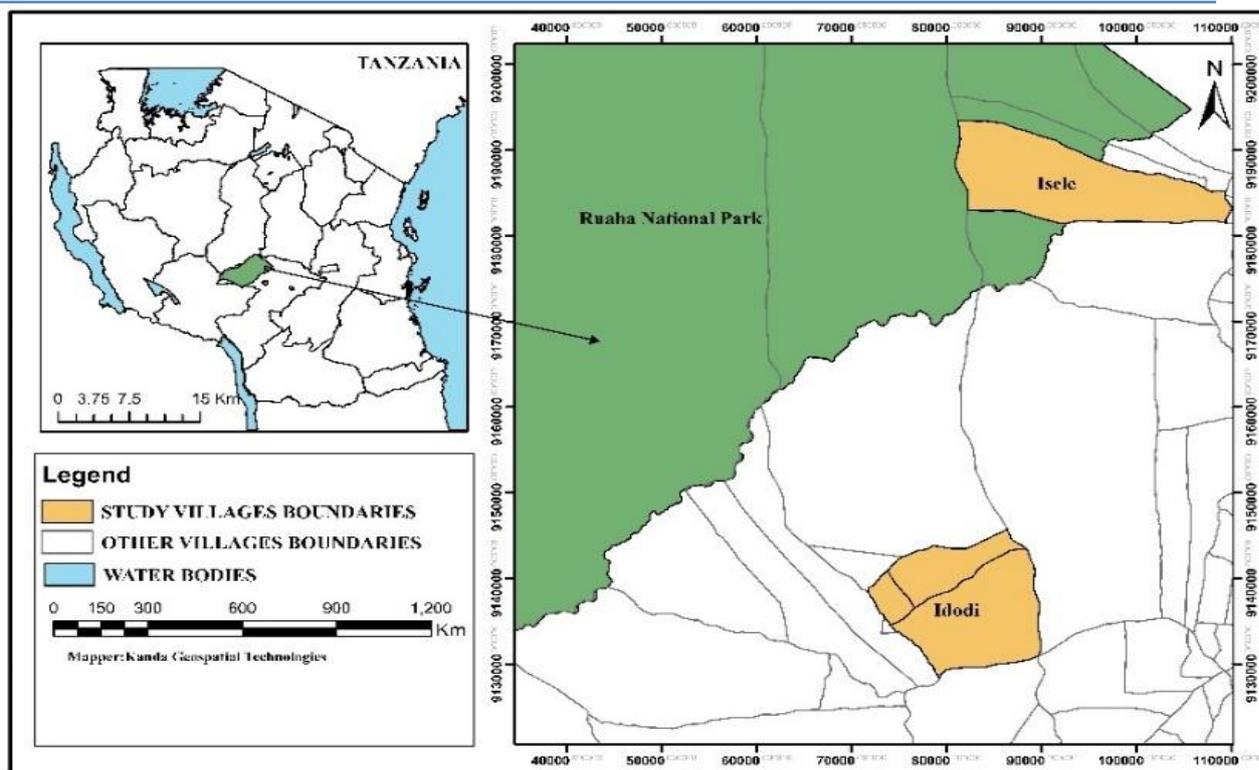
to the major themes of this study, hence its adoption. Generally, the model was used to assess the extent to which agricultural information is accessed and used by smallholder farmers to respond to impacts of climate change. Moreover, the model was used to determine factors that affect small holder farmers' access to and use of agricultural information in responding to climate change.

## **Research Methodology**

### *Description of the Study Area*

The study was conducted in Iringa Rural District in Idodi and Isele villages (Figure 1). The district is bordered to the north by Dodoma Region, to the east by Kilolo District, to the south by the Mufindi District, to the southwest by Mbeya Region, to the northwest by Singida Region and it encircles Iringa Urban District. It is located between latitudes 6° 55' and 10° 30' south of the Equator and between longitudes 33° 45' and 36° 55' east of Greenwich. The district covers an area of 20,414 km<sup>2</sup>. The altitude of the district's largest part ranges from 800 to 1,800 meters above sea level.

The district receives about 600 to 1000 millimetres (mm) of rainfall annually, distributed over two seasons. The first season, from May to November, has low rainfall and is hotter than the second one. The second season, from November to April, is rainy, cooler, and of primary importance for agricultural production. Also, the temperatures of the area range from 15.2°C to 23.3°C. The district, which has a total population of 10,873 (URT, 2020) was selected purposively because the majority of its population are involved in small-scale agriculture compared to other districts in the region. Similarly, Idodi and Isele villages were selected through purposive sampling based on the same criteria. The second reason why these villages were selected was the higher vulnerability of the smallholder farmers to climate change. It was important to study how they access and use agricultural information to respond to the change.



**Figure 1:** Location of Idodi and Isele Villages in Iringa Rural District, Tanzania  
 Source: Geography Lab- UDSM (2021)

### *Research Design and Approach*

This study employed a descriptive research design to determine types, sources, access and use of agricultural information in climate change adaptation, and factors affecting the use of agricultural information in climate change adaptation. The study used both qualitative and quantitative data in a mixed approach, in order to gain a broad and deep understanding of the phenomenon while offsetting the weaknesses inherent in using each approach by itself. A quantitative approach was used to collect and analyse quantitative data while a qualitative approach was used to collect and analyse qualitative data.

### *Sample Size and Sampling Procedures*

In order to determine sample size, a list of households engaged in crop production was requested from village executive officers. The data obtained from these officers indicated that Isele Village had 293 households while Idodi Village had 377 households engaged in agriculture. The total number of households from both villages was 670. This number was used to determine the sample size for this study using Yamane Formula (1967). A confidence level of 90% was used to calculate sample size as indicated below.

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

Where  $n$  = sample size,  $N$ = total number of households (670), and  $e$ = Allowable error.

$$n = \frac{670}{1 + 670(0.1)^2}$$

$$n \approx 87$$

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

$$nh = \frac{Nh}{N} \dots \dots \dots \text{Equation}$$

Whereby;

$Nh$  = Number of households of each village

$nh$  = Proportional sample size of each village

$N$  = Total number of households of the villages

$n$  = Total sample size of the study population

Therefore

$$nh = \frac{293}{670} \times 87 = 38.05 \text{ The sample size of Isele village is 38 households.}$$

$$nh = \frac{377}{670} \times 87 = 49 \text{ The sample size of Idodi village is 49 households.}$$

**Table 1:** Distribution of sample size in the study area

Villages	Number of Households	Sample size	Percentage
Isele	293	38	43.7%
Idodi	377	49	56.3%
<b>Total</b>	<b>670</b>	<b>87</b>	<b>100</b>

**Source:** Field data, 2021

Simple random sampling was used to select household survey respondents for quantitative data collection. A list of names of heads of household was obtained from the village executive officers and used to select respondents for the study. The names were written on pieces of paper that were folded and placed in a box before the researcher picked one at a time to determine respondents of the study until the required sample size of 87 was reached. The names from each village were treated separately to ensure proportional samples of 38 for Isele village and 49 for Idodi villages were included. Purposive sampling was used to select key informants for in-depth interview to generate qualitative data.

### *Sources and Methods of Data Collection*

This study used both primary and secondary data sources. While primary data was collected from household heads through a survey, in-depth interview, focus group discussions, and observation methods, secondary data was collected from various published and unpublished documents such as articles, reports and online sources. From secondary data sources, information on types and sources of agricultural information, role of agricultural information and factors affecting access to and use of agricultural information was reviewed. The methods



used to collect primary data complemented each other. A household survey was conducted to all heads of household selected, to collect data through questionnaires. All the selected household heads were provided with questionnaires and all of them completed them, giving a 100% response rate. Both open-ended and closed-ended questions were included in these questionnaires. Quantitative information collected from the household surveys included demographic characteristics, sources of agricultural information, types of agricultural information accessed by smallholder farmers and use of agricultural information in adaptation to climate change.

In-depth interviews were used to gather qualitative data from key informants. This was done in order to get a deep understanding and more clarification on different issues such as types and sources of agricultural information, smallholder farmers' access to and use of agricultural information for climate change adaptation, as well as factors affecting farmers' access to and use of agricultural information for this purpose. 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 because of their privileged position and experience, which allowed them to possess knowledge on the study topic.

Furthermore, focus group discussions were used to generate qualitative data from participants that comprised men and women. FGDs helped the researcher to quickly get more detailed information on respondents' beliefs, ideas or opinions on the research topic so as to validate information obtained through questionnaires. Two focus group discussion sessions were held in each village, each comprising 8 participants, which was considered a good number of participants since Kothari (2014) suggest that FGDs should consist of 6-10 members for effective discussion, administration and efficient management of time. Given the nature of smallholder farmers in Tanzania, the discussions were conducted in Kiswahili language and then information was translated into English.

Field observation was used in order to capture what smallholder farmers were doing in given geographical settings and the assumptions they made. Specifically, observations focused on adaptation practices resulting from access to agricultural information. This helped to verify and validate information collected through other methods. Document review was used to collect secondary data.

### ***Data Analysis and Presentation***

Quantitative data analysis was done after the data was proven and verified. Generally, the study used Statistical Product and Service Solution (SPSS) software version 23 to generate percentages and frequencies from quantitative data. The outputs of the analysis have been presented in tables. On the other hand, qualitative data was analysed through content analysis. This involved organizing the specific objectives into themes and sub-themes. This was done to assist the participants to discuss and authenticate the data before further analysis. After this, the ranking of themes and sub-themes was done. Qualitative data is presented through direct quotes and narrative summaries.

## **Results**

---

Access to and Use of Agricultural Information for Smallholder Farmers' Adaptation to Climate Change in Iringa Rural District, Tanzania

### ***Demographic Profile of Respondents***

The results obtained indicated that there was a higher percentage of males (60.9%) involved in the study than females (39.1%). This reflects a normal African tradition of households being led by males. Education-wise, the results show that over to-thirds (64.4%) of the household heads involved in the study had not acquired formal education. Those that had some education included primary school leavers (24.1%), those that had attained O-level education were 8.1%, and those that had completed A-level education were above (3.4%). Moreover, over a third of the respondents were aged between 46 and 55 (39.1%), followed by those aged between 36 and 45 (25.3%), those who were 55 and above (18.3%), and between 30 and 35 (17.2%). Overall, these findings suggest that almost all respondents had enough farming experience that might have enabled them to feel the need to access and use information for climate change adaptation. Crop farming was the dominant livelihood source in the study area as acknowledged by 73% of the respondents. Again, this provided a virtuous platform for this study. Other sources of livelihood were business 21.8%, agro-pastoral 16.1%, casual labour 10.3%, and employment 4.6%.

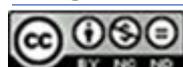
**Table 1: Demographic Profile of Respondents**

Respondents' characteristics		% of respondents in villages		Total %
		Isele (n=38)	Idodi (n=49)	
Sex	Male	60.5	57.1%	60.9
	Female	39.5	42.9%	39.1
	Not attended	57.8	69.4%	64.4
Education	Primary	28.9	20.4%	24.1
	O-level	7.9	8.2%	8.1
	A-level and above	5.2	2.0%	3.4
Age	30-35	15.8	18.4%	17.2
	36-45	29.0	22.4%	25.3
	46-55	36.8	40.8%	39.1
	>55	18.4	18.4%	18.3
Livelihood source	Crop farming	76.3	73.5%	73.0
	Business	5.3	4.1%	21.8
	Agro-pastoral	10.5	14.3%	16.1
	Casual Labour	5.3	2.0%	10.3
	Employed	2.6	6.1%	4.6

**Source:** Field data, 2021

### ***Types of Agricultural Information Accessed by Smallholder Farmers***

With regard to types of agricultural information accessed by smallholder farmers, the findings revealed that agricultural information about climate change adaptation had been provided to smallholder famers. This information covered the use of new affordable farm implements, improved drought-tolerant and early-maturing seed/ crop varieties, and farming calendar changes. Smallholder farmers' access to information on new farm implements (soil tillage



implements) was also confirmed by all FGD participants and key informants interviewed. For instance, one FGD participant had the following to say:

*In our village, for a long period of time, we have been receiving different types of agricultural information such as changing the farming calendar in relation to onset and cessation of rainfall. This has enabled us to schedule our agricultural activities properly, to cope with climate change. Moreover, we normally receive information about cultivation of drought tolerant crops such as millet and cassava because they have high adaptive capacity and can withstand drought conditions. This has been a very important climate change adaptation strategy because it has reduced the problem of household food insecurity for the majority of households in our village. (Focus group discussion in Isele village, 2021).*

Moreover, the findings indicated that smallholder farmers received agricultural information on the use of fertilizers, nutrient retention practices, and proper farming practices in response to climate change. Additionally, the findings revealed that smallholder farmers were being given information regarding plant spacing, inter-cropping, the nature of the soil, and proper use of pesticides. The farmers reported that they use this information to respond to climate change. One of the key informants from Idodi village gave the following admission:

*The type of agricultural information that we are receiving has helped us very much in adapting to climate change disasters. We are also taught about proper farming practices that retain soil moisture and nutrients. An example such farming practices is mixed cropping in which we normally combine cereal crops such as maize with legumes such as cowpeas or groundnuts, because in addition to the different adaptive capacity of these crops to climate change, legumes tend to increase soil fertility. Moreover, we have been using improved seed varieties such as maize called Staha and Situka, which tend to mature within a short period of time. Now we are a bit happy with the agricultural improvement initiatives that have been extended to us by the government. (In-depth interview with Village elder in Idodi, 2021).*

Moreover, field observation was also carried out in the study areas. During this observation, it was noted that different drought tolerant crops such as cassava and millet were planted in different farms at Isele village. As stated earlier, this type of crops has high adaptive capacity to drought and therefore ensures adequate crop yield even with climate change. Moreover, it was observed that early maturing crop varieties such as Situka and Staha for maize were planted at Idodi village. These enabled the researcher to verify the information collected from the household survey, key informant interviews and FGDs.

### ***Sources of Agricultural Information for Smallholder Farmers***

As pointed out in the earlier part of this article, access to and use of agricultural information from different sources is important as far as farmers' adaptation to climate change is concerned. In other words, smallholder farmers' adaptation to climate change is mostly dependent on the availability of and accessibility to relevant and practical agricultural information. The results of this study, regarding sources of agricultural information indicate that mass media (television and radio) were ranked as the most important source of agricultural information with a mean score of 1.14 and a standard deviation of 0.83. Personal interactions were ranked second, with a mean score of 1.03 and a standard deviation of 0.80; while village meetings were in the third

position with a mean score of 0.71 and a standard deviation of 0.61. In the fourth place, were extension officers, with a mean score of 0.35 and a standard deviation of 0.48 (see Table 2). Other agricultural information sources mentioned included farmers associations and non-governmental organizations. These results imply that mass media and personal interactions play more significant roles in disseminating agricultural information in the study area and influence smallholder farmers' climate change adaptation decisions.

**Table 2:** Sources of Agricultural Information to Smallholder Farmers

Source of Information	Never	Yes		Mean score	SD	Rank
	Never %	Rarely %	Often %			
Mass media (Radio &TV)	30	20	50	1.14	0.83	1
Person to person interactions	36	28	36	1.03	0.80	2
Village meetings	50	33	17	0.71	0.61	3
Agric extension officers	62	28	10	0.35	0.48	4
Farmers' association	79	15	6	0.19	0.33	5
NGOs	100	0	0	0.00	0.00	7
Cellphones	100	0	0	0.00	0.00	7
Agric. research institutes	100	0	0	0.00	0.00	7

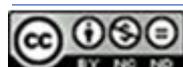
Source: Field data, 2021

Findings in Table 2 have also revealed that person-to-person interaction was ranked as the second frequently used source of agricultural information by smallholder farmers in their response to climate change. This was face-to-face interaction between smallholder farmers who found themselves in the street, church, mosque, market, farm, pub and during other public meetings, in which agricultural information, such as proper farming methods, use of improved seeds, and planting of drought-tolerant crops was shared. In support of this finding, a key informant interviewed conceded the following:

*I normally acquire varied agricultural information through interaction with different people in the street, market and formal and informal meetings. When we meet, we actually discuss different things about family and village development. Since most people in our village are smallholder farmers, most of our discussions are generally based on agriculture. The discussions are usually dominated by topics such as when to start farming, and availability of seeds. This has been very helpful because I normally consider this information. (In-depth interview with Village elder in Isele Village, 2021).*

Moreover, findings in Table 2 indicate that village meetings were the other important sources of agricultural information. Farmers perceived village meetings as reliable platforms from which they could acquire new climate adaptation strategies. The meetings were mostly used to create awareness about what crops to cultivate in a season, and to educate farmers on new farming methods. These findings were supported by focus group discussion participants as exemplified here:

*We always access agricultural information through our scheduled village meetings, which are also attended by agricultural extension officers. They normally advise us about proper seed selection, use of affordable farm implements, and planting early-maturing crops. Apart from agricultural information, during these meetings, we normally discuss various security and development issues. (Focus group participants at Idodi Village, 2021).*



In addition, agriculture extension officers were ranked as the fourth source of agricultural information by smallholder farmers (see Table 2). It is understandable that, despite their role in providing agricultural services and dissemination of agricultural information, these officers play an exceedingly limited role in educating smallholder farmers about agricultural matters and equipping them with appropriate adaptation responses. Farmers associations were ranked the fifth in the provision of agricultural information to smallholder farmers. However, in the target study villages, there were no farmers associations reported. Those who accessed information from farmers associations were those who had connections with relatives in neighbouring villages. Therefore, farmers associations provided little agricultural information in the study area. However, the establishment of farmers associations is very important, especially in expanding producers' prospects for economic growth.

Non-governmental organizations (NGOs), cell phones, and agricultural research institutes were ranked the lowest in the provision of agricultural information to smallholder farmers. Nevertheless, there is a great need to synergize the efforts of multiple stakeholders and create an active support system for agricultural information dissemination to farmers. The findings in this study have indicated that there is disconnection between research institutions and the communities from which they obtain a significant proportion of their research data. For instance, universities have become a "cyclic burden" to the communities, often sourcing information amongst communities but never giving it back. There is, thus, a great need to encourage strong collaboration between public and private sectors to assist in disseminating agricultural information to smallholder farmers in order to promote agricultural development in poor farming communities.

### *Use of Agricultural Information for Smallholder Farmers' Adaptation to Climate Change*

Smallholder farmers were asked whether they used the agricultural information received from different sources to adapt to climate change. The findings show that the agricultural information accessed by smallholder farmers was used in line with innovations introduced to adapt to climate change. Results from the household survey show that 90.8% of smallholder farmers admitted they were using agricultural information to adapt to climate change (see Table 3). The same result was reported during key informant interviews as evident in the statement below:

*Agricultural information has been very helpful in improving our livelihood. The majority of people in our village are smallholder farmers, a sector that is largely affected by climate change. In order to understand what to do and at what time, we normally use agricultural information accessed from different sources. For instance, we use drought tolerant crops and mulching as a way of preserving soil nutrients and moisture after receiving information from the mass media, agriculture extension officers and village meetings. This has improved our livelihood despite the ongoing climate changes. (In-depth interview with Village Executive Officer in Idodi, 2021).*

Responses	Frequency	Percentage
Admitted to use	79	90.8%
Not admitted to use	10	9.2%

<b>Total</b>	<b>87</b>	<b>100</b>
--------------	-----------	------------

**Table 3:** Response on the Use of Agricultural Information

Source: Field Data, 2021

***Usefulness of Agricultural Information Accessed by Smallholder Farmers***

Smallholder farmers were asked about the usefulness of the agricultural information provided regarding climate change adaptation. Household survey results indicate that the majority of the farmers confessed that the information was very useful. Moreover, 39.1% of the farmers stated that the information provided was useful. Those who were unsure about the usefulness of such information constituted 10.3% while those who were of the opinion that the agricultural information was fairly useful constituted 4.6%. In contrast, no one said the information was not useful (see Table 4).

**Table 4:** Usefulness of Agricultural Information

<b>Usefulness of Agriculture Information</b>	<b>Frequency</b>	<b>Percentage</b>
Very useful	40	46.0%
Useful	34	39.1%
Neither useful nor not useful	9	10.3%
Fairly useful	4	4.6%
Not useful	0	0.0%
<b>Total</b>	<b>87</b>	<b>100%</b>

Source: Field data, 2021

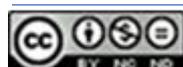
It should be noted that the information provided has helped smallholder farmers to make choices on proper adaptation practices to climate change. These include the use of modified seeds such as those that mature early, drought-tolerant seeds, and soil conservation methods. Generally, these findings validate the appropriateness of the agricultural information provided because it finally led to producing positive outcomes for smallholder farmers' response to climate change. These findings were supported by one of the interviewed key informants who had the following opinion:

*Dear researcher, the agricultural information provided is very useful and helpful as all farmers in our village have been using various farming systems to respond to climate change because of such information. You can even see that production has increased after the adoption of modified seeds, and fertilizers. For sure, we currently do not suffer climate change effects that much; therefore, I suggest that information dissemination should be strengthened (In-depth interview with key informant at Isele Village 2021).*

***Factors Affecting Access to and Use of Agricultural Information***

The study has identified broadcasting time, language barriers, and feedback as the major constraints that prevent the majority of smallholder farmers from having effective access to and use of agricultural information. Mass media programmes were described as too short and unfavourably scheduled. It was observed that radio programmes were scheduled during the day time when farmers were busy in their farms, thus making them unable to listen. This was also supported by key informants during the in-depth interviews as follows:

*We have been facing different challenges in the access to agricultural information from the mass media because most of the important programmes are scheduled during the afternoon when most farmers are in their farms or other places. Therefore, we don't know what to do in order to be able to access and use agriculture information so that*



*we can at least increase our crop production and overcome food insecurity due to the increase in temperature. (Interview with village elder in Idodi Village, 2021).*

Moreover, the findings have revealed that extension officers were not disseminating agricultural information to smallholder farmers effectively because of financial challenges caused by insufficient funds received from the government. This hinders farmers' information access and use for climate change adaptation as confirmed by one interviewee as follows:

*Farmers claim that they don't receive agricultural information on time; but to be honest, this is due to the insufficient budget that is allocated by the government for agricultural related activities which makes it is difficult for us to visit smallholder farmers on a daily basis due to high operational costs. That's why sometimes we normally use village meetings to provide agricultural information such as proper planting time, types of crops to be cultivated and fertilizers to be used (Interview with Idodi Ward Agricultural officer, 2021).*

### **Discussion of Results**

Results from the household survey and key informant interviews have indicated that the majority of farmers, access information about climate change through the radio. Although farmers use the radio more, other sources such as person-to-person interaction, village meetings, and extension officers are used for this as sources of agricultural information for climate change adaptation. Access to information through the radio has been linked to low purchase cost, low maintenance cost, and wide coverage (Oyekale, 2015). Smallholder farmers prefer the radio to access agricultural information on climate change adaptation than other sources because of its affordability, availability, and accessibility (Singh, Kituyi, & Urquhart, 2016). Unlike television and some mobile phones, a radio set is cheaper to purchase; it also allows farmers to continue getting information even when on the move. This offers them convenience since most of their time is spent on the farm. Moreover, as most farmers in Tanzania practise subsistence farming (Gavin, 2018), they experience resource constraints, so they lack sufficient funds to purchase other gadgets which could provide them with climate change information.

Moreover, these results correspond with Manda's (2017) observation made in Central Tanzania. From his study, smallholder farmers accessed information about proper farming practices such as intercropping and use of modified seed varieties for climate change adaptation from the radio. Moreover, lack of proper infrastructure such as electricity in rural areas and the initial cost required to purchase articles such as television sets and smartphones could prevent farmers from using other tools to access agricultural information. Prakash and Anand (2016) were of the opinion that the mass media are the most powerful and speedy means of information transmission and are very significant in shaping farmers' perceptions and decisions on climate change adaptation. Besides, a study conducted in Ghana by Jack and Hewitson (2020) revealed that television and radio broadcasts were the major sources of agricultural information used by smallholder farmers to understand proper climate change adaptation strategies. Adam et al. (2015) admitted that communication via the radio was a major source of agricultural information for the majority of rural smallholder farmers in Africa, regardless of the various challenges associated with it.

Apart from the mass media, findings have revealed that personal interactions play a significant role in disseminating agricultural information and influence smallholder farmers' climate change adaptation decisions. The results are in line with Oluwabunmi's (2019) findings, which showed that person-to-person interaction was an important and reliable source

of agricultural information to smallholder farmers in Eastern Cape Province to respond to climate change. Mengistu (2019) commented that initiating and changing intense attitudes is best achieved through interpersonal interactions, which involve face-to-face interactions of two or more individuals, allowing more information to be shared. This simplifies decision making processes and adoption of new farming practices for smallholder farmers. Ahmed and Ouma, (2015) add that person-to-person interaction is the most suitable method for agricultural information dissemination as it focusses on individual demands and specific types of climate change adaptation strategies.

Moreover, findings have indicated that village meetings are the other important source of agricultural information. Manda (2017) opines that village meetings are the sole channel that brings together community members, leaders and agriculture extension officers hence provide an ample platform for discussion and dissemination of important agricultural information. Findings also indicate that farmers look up to extension officers as a source of agricultural information. This is attributed to the fact that extension officers are reliable sources of agricultural information on climate change adaptation. Moreover, the education provided via extension services is an extremely significant driver of farmers' adaptation to climate change. Furthermore, it is perceived that the strength of public extension systems is their wide reach and broad networking potential, which make it an engine for promoting agricultural information diffusion (Mchombu, 2021). In addition, the study has found that farmers associations were used by the minority as a source of agricultural information despite of their usefulness in information dissemination. According to Elia (2017), farmers associations are active, independent and democratic forms of social enterprise and one of their primary functions is educating and spreading agricultural information to members. Sawe et al. (2018) advise that there is a need to motivate farmers to establish cooperative societies and farmers' associations in their communities, particularly for the purpose of bolstering climate change adaptation.

The findings on the usefulness of agricultural information indicated that the majority of the farmers acknowledged that the information provided was useful for climate change adaptation. Most of the smallholder farmers were using such information to plant drought tolerant crops, early maturing crops, and to adjust their farming calendar in relation to the onset or cessation of rainfall. This has ensured food security to the majority of smallholder farmers in the study area.

As pointed out earlier, the results are also in line with those reported by Elia (2017), that farmers in Central Tanzania have been using agricultural information as a catalyst for making decisions on climate change adaptation. Moreover, smallholder farmers acknowledged that information received was useful and had helped them to adapt to climate change. These findings also confirm those reported by Elia, that access to relevant, credible, up-to-date information improved smallholder farmers' confidence and promoted their adaptation to climate change. These results also confirm those by Mwalusaka (2021). Moreover, Gavin (2018) reported that agricultural information accessed and utilized by smallholder farmers is very useful in climate change adaptation as it influences farming decisions. Overall, the results confirm Kalokola's (2016) argument that smallholder farmers' effective climate change adaptation relies on the usefulness of the agricultural information they receive.

However, it was exposed that access to and use of agricultural information was affected by several factors such as broadcasting time, language barriers, and feedback. For instance, radio programmes were scheduled during the day when farmers were busy with farming activities, thus, making them unable to listen. These findings are in line with Agwu et al.'s (2018) who showed that unfavourable scheduling of radio programmes, the language used in presenting them, the inability of farmers to ask relevant questions and poor feedback from radio



presenters affected farmers' access to and use of agricultural information for climate change adaptation. Since most farmers in rural areas rely on the radio for awareness and access to agricultural information for climate change adaptation, poorly structured radio programmes and inadequate feedback deny farmers the opportunity to access and use information to enhance their knowledge (Kalokola, 2016).

Besides, the findings have revealed that extension officers were not disseminating agricultural information to smallholder farmers effectively because of financial challenges caused by insufficiency of funds received from the government. This finding corresponds with Agwu et al's., (2018) statement that performance of the agricultural sector in developing countries is still poor due to the existence of a high level of poverty that affects daily agricultural activities. Maddison (2017) recommended that in order to ensure smallholder farmers' proper access to and use of agricultural information, investment in agriculture extension officers should be given first priority because farmers mostly believe and rely on the information provided by such personnel.

Theoretically, the findings of this article are supported by the Innovation Diffusion Model developed by Rogers (2003). As it has been noted, smallholder farmers can only adapt to a new agricultural practice once they are exposed to it through agricultural information dissemination. This has been reflected in this article as most of the farmers admitted to have used several climate change adaptation strategies such conservation farming, use of improved seed varieties that mature early and tolerate drought. According to the Innovation Diffusion Model, these groups of farmers are called adopters. However, it was noted that not all smallholder farmers reported to have adapted the introduced innovations; some are laggards as they are reluctant to adapt any introduced technology even if they have access to information. Such people can only adapt an innovation after it has spread and become mainstreamed.

### **Study Implications**

It is worth noting that studies to examine access to and use of agricultural information for climate change adaptation have not been sufficiently conducted in Tanzania. As such, this study expands the existing knowledge on this subject. The findings of this study are expected to inform policy and decision makers on the importance of agricultural information for smallholder farmers' adaptation to climate change which is one of the major global challenges in the current era. Also, the findings will help the government to improve information dissemination channels in order to make sure that the information is specific, reliable and timely provided for farmers' adaptation. Moreover, the proposed study will influence the achievement of different national and global development goals. For instance, at national level, the study will facilitate the realization of the National Climate Change Strategy (2012), Tanzania Health National Adaptation Plan 2018-2023, and Five-Year Development Plan (2022 - 2025/26). Moreover, at international level, the study will facilitate the realization of Sustainable Development Goal number one on elimination of poverty, goal number two on erasing hunger as well as goal number thirteen on organizing climate action.

### **Conclusion and Recommendations**

Access to and use of agricultural information has proved to be an important factor in smallholder farmers' adaptation to climate change. As observed in the study area, smallholder farmers depend on various sources for agricultural information to respond to climate change, a global challenge affecting crop production, especially in arid and semi-arid areas like Iringa Rural District. It is considered that access to agricultural information has influenced smallholder farmers' attitudes to undertake different adaptation responses to climate change.

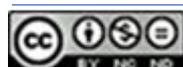
---

Access to and Use of Agricultural Information for Smallholder Farmers' Adaptation to Climate Change in Iringa Rural District, Tanzania

These adaptation strategies employed by smallholder farmers appear to be very useful in increasing crop production and responding to climate change. However, despite the importance of agricultural information to smallholder farmers, its access and use have not been impressive due to various impediments that need to be addressed. Therefore, it is recommended that efforts to promote smallholder farmers' access to and use of agricultural information should be strengthened through enhanced use of the mass media, agricultural extension officers, village meetings and research institutions. In addition, smallholder farmers should be given farming education and frequently update their knowledge on proper farming practices that address climate change.

## References

- Adam, P., Eitland, E., Hewitson, & Zebiak, S. (2015). *Toward an ethical framework for climate services*. A White Paper of the Climate Services Partnership Working Group on Climate Services Ethics. Geneva, Switzerland.
- Agwu, A. E., Ekwueme, J. N., & Anyanwu, A. C. (2018). Adoption of improved agricultural technologies disseminated via radio farmer programme by farmers in Enugu state, Nigeria. *African Journal of Biotechnology*, 7(9), 1277–1286.
- Ahmed, A. & Ouma, C. (2015). Agricultural information diffusion and food security in Tanzania: Analysis of current knowledge and research gaps. *Journal of Agricultural Sciences*, 14(1), 21–33.
- Ambani, K., & Percy, L. (2019). Information transfer and the adoption of agricultural innovations. *Journal of the American Society for Information Science*, 41(1), 1–12.
- Dang, H., Elton, L., Nuberg, I., & Bruwer, J. (2019). Factors influencing the adaptation of farmers in response to climate change. *Journal of Climate and Development*, 11(9), 765–774.
- Elia, E. F. (2017). Farmers' awareness and understanding of climate change and variability in Central semi-arid Tanzania. *University of Dar es Salaam Library Journal*, 12 (2), 124–138.
- Gavin, N. T. (2018). Pressure group direct action on climate change: The role of the media and the Web in Britain: A case study. *Britain Journal of Politics*, 12, 459–475.
- Hisali, E., Birungi, P., & Buyinza, F. (2021). Adaptation to climate change in Uganda: Evidence from micro level data. *Global Environmental Change*, 2(1), 1245–1261.
- Inter-governmental Panel on Climate Change (IPCC) (2018). Working group fourth report climate change impacts, adaptation and vulnerability. Contribution of Working Group II to the fourth assessment report of the IPCC. <http://www.ipcc.ch> accessed 14.9.2021.
- Jack, L., & Hewitson, G. (2020). Public understanding of climate change as social dilemma. *Sustainability*, 5, 3484–3501.
- Kalokola, R. D. (2016). Possibilities of delivering demand-driven climate information for rural climate change adaptation: A case of Longido District. [Masters Dissertation, University of Dar es Salaam, Tanzania]. <http://repository.udsm.ac.tz:8080/xmlui/>
- Kandji, S., & Verchot, L. (2017). Impacts of and adaptation to climate variability and climate change in the East African Community: A focus on the agricultural sector. *International Journal Multidiscipline Studies*, 2, 110–125.
- Maddison, V. T. (2017). Climate change impacts and adaptation in the agricultural sector: The case of smallholder farmers in Zimbabwe. *Journal of Sustainable Development in Africa*, 11(2), 237–256.
- Malekela, A. A., & Yanda, P. (2021). Extreme weather events and their impacts on urban crop production: A case of Kinondoni District Tanzania. *International Journal of Agronomy and Agricultural Research*, 37(2) 140–147.



- Manda, P. (2017). Information and agricultural development in Tanzania: A critique. *Information Development*, 18, 181–189.
- Mchombu, K. J. (2021). Sharing knowledge for community development and transformation: A handbook. Oxfam.
- Mengistu, D. (2019). Farmers' perception and knowledge of climate change and their coping strategies to the related hazards: A case study from Adiha, Central Ethiopia. *Journal of Agricultural Sciences*, 2 (3), 138–145.
- Mtega, W. P. (2017). Access to and usage of Information among rural communities. *Journal of Alternative Perspective*, 4, 688–710. (DOI: 10.21083/partnership.v7i1.1646 accessed 18.11.2021).
- Mudombi, S., & Nhano, G. (2021). Access to weather forecasting and early warning information by communal farmers in Seke and Murewa districts, Zimbabwe. *Journal of Human Ecology*, 48(3), 357–366.
- Mwalusaka, N. (2021) Agricultural information sources used for climate change adaptation in Tanzania. *Library Review*, 62(4), 66–292. <https://doi.org/10.1108/LR-12-2011-0096>
- Muema, E., Mburu, J., Coulibaly, J., & Mutune, J. (2018). Determinants of access and utilization of seasonal climate information services among smallholder farmers in Makueni County, Kenya. *Heliyon*, 4(11), e00889. Doi: 10.1016/j.heliyon.2018.e00889
- Mwamfupe A. O. (2014). Assessment of local perceptions and potential roles of local institutions in climate change adaptation in Rufiji District. Tanzania. [Doctoral Thesis, University of Dar es Salaam, Tanzania]. <http://repository.udsm.ac.tz:8080/xmlui/>
- Oluwabunmi, O. P. (2019). Information sources and constraints to climate change adaptation amongst smallholder farmers in Amathole District, Eastern Cape Province, South Africa. *Journal of Sustainability*, 18(1), 70–88.
- Oyekale, A. S. (2015). Factors explaining farm households' access to and utilization of extreme Climate access in Sub-Saharan Africa (SSA). *Environmental Economics*, 6(1), 91–103.
- Paavola, J. (2015). Inside the search process: Information-seeking from the user's perspective. *Journal of the American Society for Information Science*, 42(5), 361–371.
- Prakash, G., & Anand, E. (2016). Indian news media and natural calamities: Case of Chennai Floods. *International Journal of Multidiscipline*, 3(2), 166–177.
- Raju, K. (2018). Towards access to information in rural India. *Journal of Information Services and Use*, 20(1), 31–46.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Sawe, J., Claude, G. M., & Godfrey, F. K. (2018). The impacts of climate change and variability on crop farming systems in Semi-Arid Central Tanzania: The case of Manyoni District, Tanzania. *African Journal of Environmental Science and Technology*, 40(3), 195–210.
- Serra, Z., & Mckune, P. (2016). Communicating climate change: Why frames matter for public engagement. *Environment: Science and Policy for Sustainable Development*, 51(2), 12–23.
- Singh, C., Kituyi, E., & Urquhart, P. (2016). The role of experience in the information search process of an early career information worker: Perceptions of uncertainty, complexity, construction and sources. *Journal of the American Society for Information Science*, 50(5), 399–412.
- United Republic of Tanzania (2020). Population and housing census. National Bureau of Statistics, Ministry of Finance, Dar es Salaam.
- Yamane, T. (1967). *Statistics, an Introductory Analysis*, 2<sup>nd</sup> ed. Harper and Row Limited.