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Factors Influencing Climate Information Access of the Farmers in Hiran Region, Somalia

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Abstract

Purpose: Like other poor states and post-conflict countries, Somalia faces significant challenges in achieving the SDGs, particularly concerning food security. Because agricultural productivity is compromised, it immediately and significantly jeopardizes the nation's food security. Adapting to climate change can maximize its benefits and lessen many of its horrendous side effects. However, Somalia does not address or cover farmers' access to climatic information, which is important when organizing policy responses. This study's goal was to assess the variables that affect farmers in Somalia's Hiran region's ability to obtain climate information.

Methodology: The target population of this study was smallholder farmers in the Hiran region, particularly in the Baladweyn and Bulaburte districts. Both purposive and random sampling were utilized. A questionnaire was used to gather data from 222 randomly chosen smallholder farmers as part of a survey research design. Descriptive statistics and binary logistic regression were used to test the data using STATA and SPSS. The data was presented using tables and figures.

Findings: Most farmers (78%) had access to climate information. The most common sources of information on climate crises were radio (95%), agricultural extension agents (80%), and firsthand observation (75%). Gender ($p = 0.020$), marital status ($p = 0.036$), education level ($p = 0.047$), farm size ($p = 0.000$), distance to the market ($p = 0.000$), and support from local and international agencies ($p = 0.013$) had a significant correlation with farmers access to climate information. The report advised Somalia's federal government and regional and foreign non-governmental organizations to proceed with intervention plans, focusing particularly on variables that were identified.

Unique Contribution to Theory, Practice, and Policy: Study outcomes contribute significant information to policymakers, professionals, and the federal government of Somalia to develop policies and regulations that are relevant to the farmer's needs to adapt to the negative impacts of climate crises. It will also lead to necessary coordination among different climate actors, stakeholders, and farming communities in the region to fill any climate information gap. This will finally allow farmers to access well-timed and dependable information regarding climate disasters.

Keywords: *Climate Change Information, Adoption of Climate Change Adaptation Strategies, Smallholder Farmers of Hiran Region, Somalia, Food Security, Sources of Climate Change Information*

JEL codes: Q01, Q15, Q56.

INTRODUCTION

The global climatic mean or variance has increased significantly, and further increases are still possible (IPCC, 2007). The majority of specialists anticipated a 2-4 °C increase in global temperatures, and maybe considerably more (Meinshausen, Meinshausen, Hare, Raper, Frieler, Knutti, Frame, & Allen, 2009). In addition, Nicholls & Cazenave (2010) forecasted a 0.5–1 m rise in sea level. Since 1960, Southeast Asia's average temperature has increased every ten years (Amit, 2018). Ten nations that suffered badly from climate change in the previous 20 years, such as Vietnam and Thailand (Eckstein, Winges, Künzel, & Schäfer, 2018). Africa is among the top regions that climate change could adversely impact due to rising temperatures and decreasing rainfall (IPCC, 2014). Africa's temperature will rise more quickly than anywhere else in the world by the end of the current century, reaching 4 °C (Niang, Ruppel, Abdrabo, Essel, Lennard, Padgham, & Urquhart, 2014).

Because agriculture—which is reliant on rain—makes up 30% of the GDP of almost all African nations and employs 70% of the workforce, it is essential to the continent's ability to sustain food security, a robust economy, and poverty reduction (Asafu-Adjaye, 2014). Numerous nations have already experienced detrimental effects from climate change in several economic areas, most notably agriculture (Ahsan, Chandio, & Fang, 2020). Additionally, it is anticipated that global temperatures and precipitation patterns may change the areas that are used for agricultural production (Ramirez-Villegas & Thornton, 2015). Like other parts of the world, Sub-Saharan Africa continues to be one of the places most severely susceptible to the negative effects of climate change (Esham & Garforth, 2013). Their poverty and lack of flexibility are the main causes of such susceptibility (Bagamba, Bashaasha, Claessens, & Antle, 2012).

About 75% of Somalia's GDP and 93% of all export earnings, respectively, come from the country's agricultural sector (FAO & World Bank, 2018). However, several obstacles, such as those related to politics, the economy, and the environment, prevent the growth of a prosperous agriculture industry (Warsame, Sheik-Ali, Ali, & Sarkodie, 2021). Furthermore, Somalia, one of the nations most susceptible to climate change worldwide, faces numerous challenges related to the environment, most notably climate change (Carty, 2017). Furthermore, as per the Food and Agricultural Organization and the World Bank (2018) temperature variations caused by climate change, in conjunction with patterns of precipitation, exacerbate the nation's precarious state, given its precarious economic, social, and environmental conditions.

The National Adaptation Action Programs of Somalia have determined that the country's main climate threats are strong winds, rising temperatures, substantial flooding, and drought, based on in-depth conversations with communities all around the country (FGS, 2013). According to the Food and Agricultural Organization and World Bank (2018) report, the 2017 drought cost Somalia $72 million in lost revenue from its four main crops: sesame ($28 million), cowpeas ($9 million), corn, and sorghum ($35 million). Another sort of climate change phenomenon that lowers agricultural output, destroys property, uproots communities, and occasionally results in the death of vulnerable individuals is flooding. This is frequently caused by downpours that, during rainy seasons, overwhelm pre-existing rivers (Warsame, Sheik-Ali, Ali, & Sarkodie, 2021). In 2019, floods in Somalia resulted in considerable crop loss, multiple fatalities, and 412,000 displaced people (GIEWS, 2020). High winds also damage soil fertility in Somalia, which has an impact on agricultural productivity (Waaben, Habimana, Joshi, & Mumuli, 2020). The laws and policies in Somalia that attempt to lessen the adverse consequences of the climate crisis on agriculture are insufficient (Warsame, Sheik-Ali, Ali, & Sarkodie, 2021). This may be due to both poor governance mechanisms and a dearth of

comprehensive empirical research examining the relationship between agriculture and climate change (FAO & World Bank, 2018).

Problem Statement

The agricultural sector is the lifeline of Somalia's economy and food security. It not only provides the necessary food for a great number of Somalis but also provides income via the sale of crops and the generation of employment. However, as a low-income and post-conflict nation, the country has been experiencing constant natural disasters and the destruction of natural resources, thus contributing to the reduction of crop productivity (Jama, Liu, Diriye, Yousaf, Basiru, & Abdi, 2020). By utilizing meteorological and climate data, farmers can lessen the adverse consequences of climate disasters on agricultural output (Domingo, Agbon, Olaguera, Umlas, Mae, Zuluaga, & Reyes, 2020). However, a lack of relevant information has made it more difficult for farmers to enhance agricultural production (Mwalukasa, 2013). Enhancing farmers' access to appropriate climate information services will help them meet their information needs and grow more crops (Mtega, 2012). To improve climate resilience, this study set out to assess farmers in the Hiran region's access to climate information and the sources of this information. The study also examined factors influencing the farmer's access to climate information in the region.

Objectives of the Study

This study investigated factors that influence smallholder farmers' access to climate information in the Hiran region of Somalia. To achieve this purpose, the following specific objectives were developed.

1. To examine farmers' access to climate information in the Hiran region, Somalia.
2. To investigate farmers' sources of climate information in the Hiran region, Somalia
3. To analyze the factors that determine climate information access of the farmers.

Review of Literature on Farmer's Access to Climate Information and Sources

Climate data is significant in terms of agricultural decision-making and adaptation and enhances agricultural outputs, resource utilization, and knowledge (Muema, Mburu, Coulibaly, & Mutune, 2018). Additionally, climate information sources are also contributing to farmers utilizing new information to tackle climate crises in a sustainable way (Evaristo & Emmanuel, 2020).

Research done by Chukwuji, Nwabueze, Aliyu, Sayudi, Yusuf, and Zakariya (2019) in Zamfara State, Nigeria, found that practically all farmers have access to climatic information. The most prevalent are anticipating animal illnesses, mitigation, aquaculture, improved variety of crops, erratic precipitation, flooding, and rainfall projections, and farming of short- and long-term crop types. Furthermore, Popoola, Yusuf, and Monde (2020) also reported in their research that farmers in the Amathole District of South Africa received climate information. However, Muema, Mburu, Coulibaly, and Mutune (2018) stated that although a large number of farmers in Makueni County, Kenya, received seasonal climate information services (CIS), the number of these farmers that utilized climate data to tickle climate disasters was less than 50 percent.

In terms of climate information channels, different sources of climate information were identified in different countries, such as newspapers, radio, neighbors, an extension agent, friends, other farmers, their own experiences at informal gatherings, and print media, as reported by Asadu, Ozioko, and Dimelu (2018), Evaristo and Emmanuel (2020), and Popoola, Yusuf, and Monde (2020).

Several studies have indicated that the socio-economic, demographic, and institutional features of farmers determine whether farmers access climate information or not. For instance, as reported by Muema, Mburu, Coulibaly, and Mutune (2018), as farmers get older, the likelihood of accessing climate information goes down, while an increased number of families and their income promote climate information uptake. In addition, education level leads to greater accessibility to climate information: it allows farmers to predict and schedule effective adaptation (Cheriotic, Saidu, & Bebe, 2012). Other socioeconomic, demographic, and institutional factors that contribute to climate information access include social and economic status, occupation, group memberships, culture, and communication resource access, as reported by Mtega (2012), Elia (2013), and Dang, Elton, Nuberg, & Bruwer (2019)

Conceptual Framework

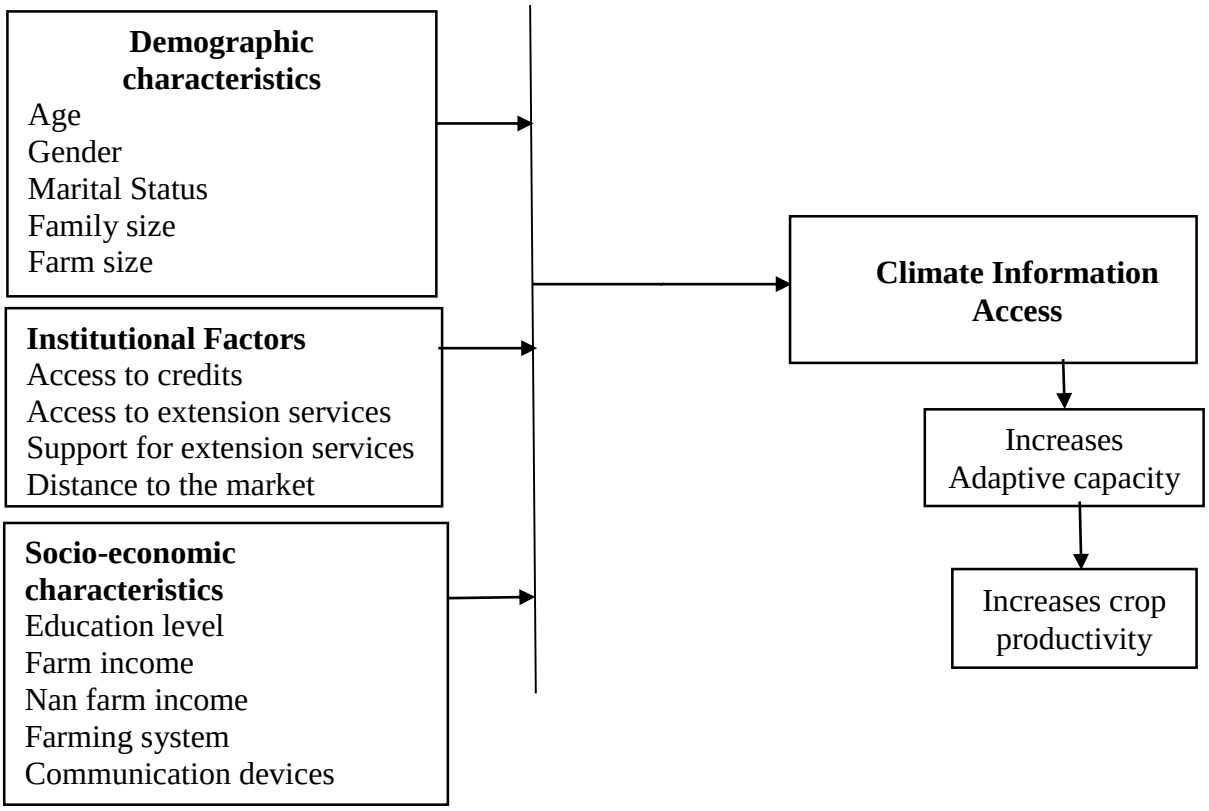

Figure 1: Conceptual Framework

As demonstrated in Figure 1, several kinds of factors may influence the access to climate information by farmers. These factors include demographic, socioeconomic, and institutional characteristics of the farmers, such as age, gender, marital status, experience, farm income, non-form income, farming system, accessibility of agricultural facilities, access to affordable loans, and proximity to markets. Farmers' access to well-timed and appropriate climate information will lead to an increase in their adaptive capacity for climate crisis consequences. Due to increased adaptive capacity, agricultural production increases.

Knowledge Gaps

Many studies, such as Muema, Mburu, Coulibaly, & Mutune (2018), Evaristo & Emmanuel (2020), and Popoola, Yusuf, & Monde (2020) analyzed the farmer's accessibility to climate information, which is crucial in the farmer's adaptation to climate change. However, these

researchers focused on specific farm-level targets at specific locations and production systems. Additionally, these studies provided limited information about some important climate information, such as the seasonal forecast, which provides estimates of rainfall and temperature in the upcoming two or three months. On the other hand, there is no empirical evidence regarding the access to climate information by the farmers in the study area. Other literature provided inadequate evidence and general information in other countries, yet climate information differs contextually and geographically (across communities and perhaps among individuals). Therefore, there exists a knowledge gap regarding farmers' climate information access and the factors influencing this climate information in Somalia, particularly in the Hiran region, which has been facing constant floods and droughts, which needs to be addressed to increase farmers' ability to adjust to climate change effects and hence increase their productivity and likelihood.

METHODOLOGY

Description of the Study Area

With 520,685 residents, Hiran is a region with administrative authority in central Somalia (UNFPA, 2014). Ethiopia borders Hiran on the northwest, the Somali areas of Galgaduud border it on the northeast, the middle Shabelle borders it on the south, the lower Shabelle borders it on the southwest, and Bay and Bakool border it on the west (Figure 1). Rainfall in Somalia is often low and irregular. On average, the country receives 250 mm of rain annually. Less than 250 millimeters of rainfall on average each year in the extremely arid and hot northern maritime lowlands, while 400 millimeters fall in the south (such as the Hiran region) and 700 millimeters fall in the southwest (Venema & Vargas, 2007).

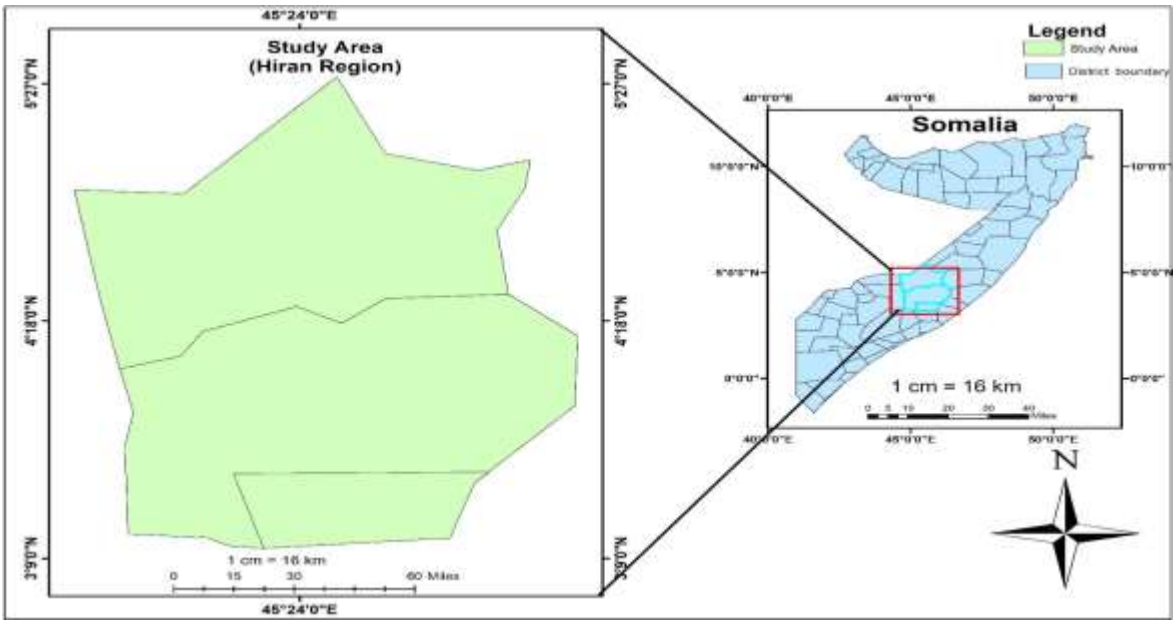

Figure 2: Map of the Study Area. Author's Source (2022)

Research Design and Target Population

To provide a complete and accurate picture of the topic at hand, this study used a descriptive survey approach. To fully comprehend the problem under investigation, this method entails the gathering and analysis of information. The study's main focus was on the several elements that affect farmers in Somalia's Hiran region's access to climate information. The study's target population was smallholder farmers in six villages in the Hiran region of Somalia. Due to

budgetary constraints and security concerns, smallholder farmers from six villages in the Baladweyne and Buloburte districts of the Hiran region of Somalia, which are projected to have 1000 households, were chosen.

Sample Size and Sampling Procedure

The Yamane formula was utilized to determine the sample size (Yamane, 1967).

$$n = \frac{N}{[1 + N(e)^2]} \qquad \textbf{(Equation 1)}$$

Where; **n** is the sample size, N = the target population, and e = alpha

Both purposive and random sampling techniques were used in this investigation. Six (6) villages, three from each district, were purposively chosen because of their riverfront location and history of exposure to severe weather conditions, including floods and droughts (Table 1). Each target village's sample size was determined per its population size. Lastly, the 222-person target sample was formed by randomly selecting houses from each of the villages that had been carefully selected (Table 1).

Table 1: The Distribution of the Sample Size by the Villages

Districts	Villages	N of the households	Sample Size
Beladwein	*Baareey*	200	50
	Camalow	155	35
	Bulo-xaabley	150	30
Buloburte	*Caag-bashiir*	200	50
	Jameeco-shiin	155	35
	Galmadoobe	140	22

Data Collection Instruments

A questionnaire was used in the collection of the primary data. Meeting with respondents in person during the survey allows researchers to explain the purpose of the study and assist them in completing the questionnaires.

Data Analysis

After being coded, the data were imported into SPSS version 26 and then moved to STATA version 14.1 for examination. To support the conclusions of econometric approaches, descriptive statistical tools including frequency, percentages, means, tables, and figures were used. In the Somali region of Hiiran, the binary logistic regression method was applied to identify the contributing elements influencing farmers' access to climatic information (Table 2).

The model is:

$$\frac{pi}{(1-pi)} = B_0 + B_1X_1 + B_2X_2 \ldots B_k X_k + e \qquad \textbf{(Equation 2)}$$

Where: Pi represents the dependent variables (The climate information access of the farmers). β0 is the intercept; β_1, β_2, ... β_k are parameter estimates; X_1, X_2, ... X_k, represent independent variables (in this case, the socio-economic and institutional traits of farmers) and the e error term.

Table 2: Definition of (Socioeconomic and Institutional Characteristics) Factors Influencing Access to Climate Information of the Farmers

Variables	**Climate information access 0= Accessed:1= Not accessed**	
	Category	**Unit of measurement**
Gender	Dummy	0= Male 1= Female
Age	Continuous	Number of years
Marital status	Dummy	0=Married 1= Unmarried
Family size	Continuous	Number of family members
Education level	Dummy	0= Formal edu, 1= non-formal
Farm income	Continuous	Monthly farm income (USD)
Farming experience	Continuous	Number of years in farming
Farm size	Continuous	Number of Hectors
Land acquisition	Dummy	1. Inherit 2. Purchase 3. Rent
Non-farm income	Dummy	0= Yes 1= No
Farming system	Dummy	1. Crop production only, 2. Livestock rearing 3. Mixed
Communication devices	Dummy	0= Yes 1= No
Types of communication devices	Dummy	1. Mobile and Radio 2. Radio and Tv, 3. Mobile 4. Mobile, Radio, and TV
Institutional Factors		
Access to credits	Dummy	0= Yes 1= No
Access to extension services	Dummy	0= Yes 1= No
Support for extension services	Dummy	0= Yes 1= No
Distance to the market	Continuous	number of the nearest market (KM)

RESULTS AND DISCUSSIONS

Socio-economics and Institutional Characteristics of the Farmers in Hiran Region, Somalia

According to the data, 83% of farmers were men, and only 17% were women. In addition, 80% of the farmers were married, and 20% were single. The result also revealed that (29%) of the farmers have formal education, while 71% have non-formal education. The average number of family members found in this study was 6, with the smallest family having 2 members and the largest having 12. The average age of the participants in this study was 39 years, with the youngest participant being 20 years old and the oldest being 65. The respondents' average experience in farming was 20 years, ranging from 2 years for the least experienced to 30 years for the most experienced. The participants' average monthly household income in the Hiran region of Somalia was 180 USD; the lowest was $100, and the highest was $250. Additionally, 77% of the farmers had a source of income other than farming, and 23% of them only had farming as their source of income (Table 3).

A total of 19% of the farmers bought their land, 14% rented it, and the majority—67%—inherited it. Additionally, only 2% of farmers raise animals exclusively, 52% specialize in crop production, and 46% engage in mixed farming. Furthermore, the respondents' average farm size was 3 hectares, ranging from 1 hectare to 8 hectares for the largest farm. 15% of farmers do not possess a communication device, compared to 85% who do. Of people with

communication devices, (67%) own both a mobile phone and a radio, (4%) have a radio and a TV, (10%) have just a cell phone, and (19%) have a mobile phone, radio, and TV. In addition, while 23% of the farmers in Somalia's Hiran region lack access to credit or loans, the bulk of them—77%—do. 73% of farmers have access to services provided by agricultural extension. 44% of those with access to extension services say that they receive assistance from extension agencies. With the closest market being 2 kilometers away and the farthest being 20 kilometers away, the respondents' mean distance between the farmer and the closest market was 6.5 kilometers (Table 3).

In Somalia's Hiran region, men predominated in the farming industry. This is probably due to the fact that men are more suited than women to perform the arduous tasks involved in farming (Adesiji, Matanmi, Onikoyi, & Saka, 2012). This result is consistent with previous research (Okoro, Agwu, & Anugwa, 2016) and (Kimaru-Muchai, Ngetich, Baaru, & Mucheru-Muna, 2020), which also found that men participate in farming activities at a higher rate than women. Furthermore, most of the farmers in Somalia's Hiran region were married (Table 3), adding to their burden of providing for their families and making it necessary to search for technology and climate crises to enhance the well-being of their households. Therefore, the appropriate use of agricultural and climate technologies and information was tied to marital status (Idrisa, 2009).

Table 3: Socio-economic and Institutional Characteristics of the Farmers in Hiran Region, Somalia

Variables	Descriptions	Frequency	Percentage (%)
Gender			
	Male	184	83
	Female	38	17
Marital status of the farmer			
	Married	178	80
	Unmarried	44	20
Educational Level of the Farmer			
	Formal Education	65	29
	Non Formal Education	157	71
Land acquisition of the farmer			
	Inherited	149	67
	Purchased	41	19
	Rented	32	14
Non-farm income of the farmer			
	Yes	170	77
	No	52	23
Farming system of the farmer			
	Crop cultivation only	116	52
	Livestock keeping only	4	2
	Mixed farming system	102	46
Communication devices			
	Yes	188	85
	No	34	15
Types of communication devices			
	Mobile and Radio	129	67
	Radio and TV	8	4
	Mobile	19	10
Access to any credits/loan			
	Yes	171	77
	No	51	23
Access to agricultural advisory services			
	Yes	161	73
	No	61	27
Support from the agricultural extension agencies			
	Yes	121	54
	No	101	46

	Mean	Minimum	Maximum
Age of the respondent (in years)	39	20	65
Number of total family members	6	2	12
Farming experience	20	2	30
Farm size in Hector	3	1	8
Mean monthly household income (In USD)	180	100	250
Distance from the market in Km	6.5	2	20

Non-formal schooling was possessed by the majority of the farmers in the studied area (Table 3). Since education improves farmers' capacities for information acquisition, processing, and application, it is essential to the adoption of new technology and techniques. According to Ayal, Tilahun, Ture, and Terefe-Zeleke, (2021), education can improve farmers' capacity for information analysis and interpretation as well as their ability to employ resources effectively. Furthermore, compared to farmers with lower levels of education, those with higher degrees tend to be less risk-averse and more open to implementing climate-smart agriculture (CSA) methods (Kifle, Ayal, & Mulugeta, 2022). Higher education, according to Kim & Moses (2016), is probably going to expose farmers to greater information about climate crises. The average size of the household was 6.5, which is the same as the average family size in Somalia, which is 5.9 (FGS, 2013). This suggests that the majority of households had a sizable number of domestic labor resources, which are important for networking, facilitating farmers' access to information, and diversifying their sources of income. All of these factors help households better adapt to the effects of climate change. Families with larger sizes are more likely to participate in CSA activities, which raises the likelihood that they will adopt new technology and become more resilient to the effects of climate change (Kifle, Ayal, & Mulugeta, 2022).

The bulk of participants were within the active working age range and old enough to have noticed the climatic changes, according to the age results. Thus, by extending farmlands and supplying labor for crop planting, farming, weeding, fertilizer application, harvesting, and other associated agricultural tasks, they can contribute significantly to the region's production of food crops. Because they have longer planned horizons, younger farmers, in particular, are more likely to be prepared to take risks and adopt improved agricultural techniques. They also tend to have a greater understanding of farming operations. The farmers have been farming for an average of 20 years, which is important for recognizing and implementing locally smart technologies. Experience is the source of wisdom for farmers, which makes it a crucial component in determining locally wise techniques. Furthermore, since they have higher proficiency in agricultural methods and management than less experienced farmers, experienced farmers may be better equipped to transfer risk when faced with climate variability among crops, livestock, and off-farm activities (Ndambiri, Ritho, & Mbogoh, 2014).

The majority of farmers in Somalia's Hiran region have access to loans and credit. (Fosu-Mensah, Vlek, & MacCarthy, 2012) state that increased loan availability enables farmers to purchase improved hybrid seeds as well as inputs like fertilizer, crop types that are more productive, and irrigation systems that lessen the unfavorable consequences of climate change on food production. Furthermore, Kifle, Ayal, and Mulugeta (2022) suggested that having access to financing raises the likelihood that smallholder farmers will implement climate-smart agriculture (CSA) techniques, which in turn contributes to increased food security and revenue. According to the study, farmers' average farm income was $180, which suggests that their low family income may be impeding their ability to adjust to the problems posed by climate change. One major barrier to getting and using knowledge of climate hazards is poverty (Arokoyo, 2005). In other cases, among smallholder farmers, awareness of and reaction to the effects of climate crises are strongly correlated with income levels (Tesso, Emana, & Ketema, 2012). But aside from farming, the majority of farmers in Somalia's Hiran region also had other means of income. According to Ojo & Baiyegunhi (2020), smallholder farmers who engage in off-farm activities might be able to get above their financial constraints and invest in improved crop types, buy chemical inputs, and protect the soil.

Farmers in Somalia's Hiran region had access to services for agricultural extension (Table 3). The utilization of agricultural extension services by farmers enhances their availability of

climatic data and offers them customized and regional information, encompassing details regarding climate change and its potential impact on their particular region. Just half of the farmers in the Hiran region reported receiving assistance from these organizations, even so, given that a sizable portion of them have access to extension services. This can suggest that there are problems that need to be fixed with the availability or caliber of extension services in the research region. According to Kimaru-Muchai, Ngetich, Baaru, & Mucheru-Muna (2020), giving support through training and assistance from extension services, NGOs, and international agencies is crucial to promoting farmers' access to knowledge and raising their likelihood of adopting agricultural innovations.

The majority of farmers in the Hiran region possess communication gadgets, including TVs, radios, and cell phones. The availability of climate information may be significantly impacted by this. Via communication devices, farmers who may be at risk from climate change can receive information about the changing climate. Farmers can receive weather predictions, early warning systems, and other pertinent climatic information by using this equipment. This can help them lower the risks connected with extreme weather occurrences by enabling them to make educated decisions about planting, harvesting, and applying pesticides. Owning a communication device, such as a television or radio, improved the availability of climatic projections in the Limpopo River region of South Africa and sub-Saharan Africa, respectively, as revealed by Hampson, Chapota, Emmanuel, Tall, Huggins-Rao, Leclair, Perkins, Kaur, & Hansen (2015), and Oyekale (2017). According to the study, most farmers inherited their land and only produced crops on an average of 3 hectares. These findings are consistent with the study by Kim and Moses (2016). In addition, the bulk of the farmers in the area reside 6.5 kilometers from the closest market. Vorley, Lundy, & Macgregor (2009) stated that farmers who are closer to markets have a higher chance of implementing new ideas since it allows them to share and exchange information with other farmers and service providers. Additionally, the market has a significant role in determining the adaptation strategy since it facilitates information sharing among farmers (Maddison, 2006).

Access to Climate Information in Hiran, Region, Somalia

Results showed that, in contrast to just 22% of farmers surveyed, 78% of farmers had access to some information about climate change (Table 4). This implies that a sizable portion of farmers in the Hiran Region are typically knowledgeable about the local climate as well as additional environmental elements that may have an impact on their farming methods and means of subsistence. This result is consistent with the findings of Hassan and Nhemachena (2008) and Coulibaly, Birachi, Kagabo, and Mutua (2017), who found that knowledge of climate change projections is crucial for evaluating the use of different adaptation techniques and making farming decisions.

Table 4: **Access to Climate Information by Respondents**

		Frequency	Percent (%)
Access to Climate Information	Yes	173	78
	No	49	22
	Total	**222**	**100**

Sources of Climate Information by the Farmers in Hiran Region, Somalia

Farmers in Somalia's Hiran region reported that radio (95%), agricultural extension agents (80%), and firsthand observation (75%), were the most prevalent sources of information on

climate crises. For these farmers, television (28%), social media (51%), and NGOs and international agencies (68%) were additional sources of data regarding climate change.

The findings indicate that among farmers in the Hiran region of Somalia, radio, agricultural extension officers, and firsthand observation were the most frequently utilized sources of information regarding climate change. Conversely, NGOs and international agencies, television, and social media were the least frequently used sources of information (Figure 3). According to the results of these studies, Csótó (2011), Okoro, Agwu, & Anugwa (2016), and Limantol, Keith, Azabre, & Lennartz (2016) found that radio, television, and extension services were the primary means of accessing climate forecasts in rural regions, which is consistent with our current findings.

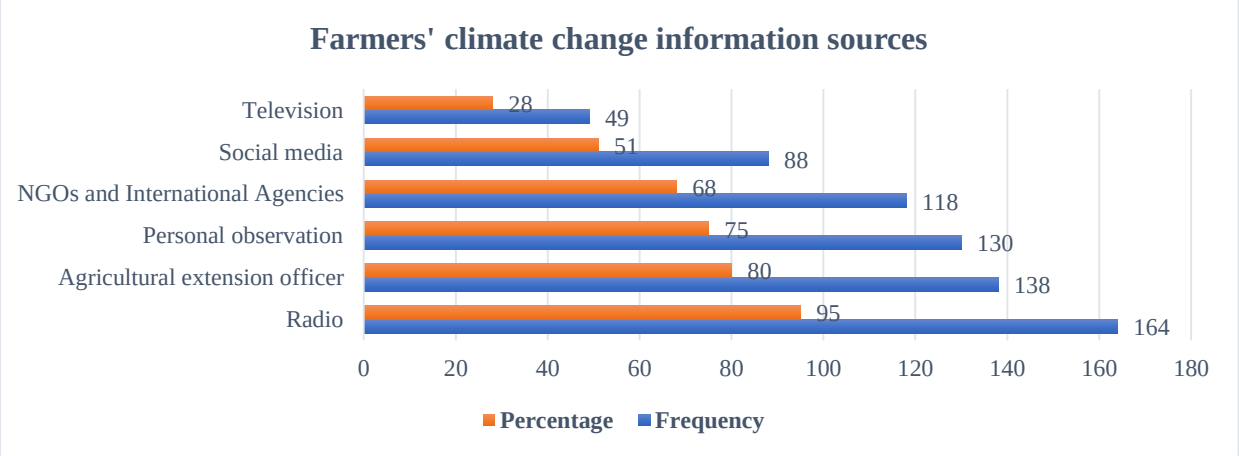

Figure 3: Sources of Information on Climate Change by the Farmers

Farmers choose radio over other media because of its availability, affordability, and ease of use when seeking information about climate change (Kimaru-Muchai, Ngetich, Baaru, & Mucheru-Muna, 2020). Additionally, radio has been connected to low maintenance expenses, low expenditures, and extensive information on climate change coverage (Oyekale, 2017). Furthermore, the information that farmers require to make educated decisions about which climate change adaptation strategies to use is made available to them through interactions with extension agents (Ojo & Baiyegunhi, 2020).

Factors Influencing Access to Climate Information in Hiran Region, Somalia

The results of the binary regression model showed that access to climate information was significantly influenced by the following factors: gender, level of education, marital status, size of farm, distance to the closest market, and support from international agencies, NGOs, and extension agencies (Table 5). In the Hiran Region, however, there was no statistically significant correlation found between the number of family members, farming experience, non-farm income, farming system, communication devices, extension services, and credits/loan facilities available to the farmers and their access to climate information.

Information regarding climate change availability was positively and significantly correlated with gender (marginal effects =0.064, p = 0.021) (Table 5). This implies that men farmers in the Hiran Region were more likely than female farmers to receive information on climate hazards. The absence of economic or educational prospects for women in the agricultural industry, as well as the underrepresentation of women in extension services and other sources of climate knowledge, could be used as justifications for its significance. Additional justifications for this could include the fact that more men than women own radios, cell phones,

and internet connections, or that males may have greater access to meetings and seminars where information about climate change is presented. Men are viewed as the main proprietors and decision-makers in agriculture on a social level (Mwangi & Kariuki, 2015). They consequently and frequently enjoy greater control over the data that is accessible and applied in farming. These findings support the claims made by these studies (Coulibaly, Birachi, Kagabo, & Mutua, 2017) and (McCarthy, Lipper, & Zilberman, 2018) that more male farmers receive climate information than female farmers.

According to the findings, there is a statistically significant correlation (marginal effects =0.069, p = 0.036) between having access to climatic information and one's marital status. This implies that married farmers have a higher chance of receiving climatic information than single farmers. Farmers in low-income nations engage in traditional and community farming, with varying levels of production depending on family size and gender (Mwalukasa, 2013). Due to their larger social networks, married people are more likely than single people to get a wider range of information, including climate-related information (Sanga & Elia, 2021). Furthermore, Deressa, Hassan, Alemu, Yesuf, & Ringler (2008) contended that since married farmers in underdeveloped countries frequently come from extended families, each one could be a source of information. Consequently, married farmers might know more about climate change than single farmers (Sanga & Elia, 2021). The resources and support a spouse provides, as well as the joint decision-making and communication among married farmers, are potential justifications for this importance.

Additionally, there was a positive correlation between a farmer's level of education and whether or not they were receiving climatic information (p = 0.046**,** marginal effects = 0.085) (Table 5). This suggests that respondents who claimed to have greater education were presumably receiving more knowledge on climate change than respondents who had less education. Farmers with higher levels of education likely have greater access to knowledge resources and information, or they are aware of the significance of climate information for their farming practices. Through more efficient climate monitoring, education increases understanding of the best agricultural practices for mitigating the harmful effects of climate change (Sanga & Elia, 2021). This corroborates the finding of this study by Adolwa, Okoth, Mulwa, Esilaba, Mairura, & Nambiro (2012) that a certain level of literacy and expertise is frequently necessary in order to access information and participate in the information-seeking process.

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Table 5: Factors Determining How Farmers Get Information on Climate Change

Explanatory variables	Climate information access		
	Coeff. (SE)	Marginal effects (SE)	p-value
Gender	2.444(1.119)	.0641(.0276)	0.021**
Total family	.4071(.2405)	.01068 (.0060)	0.077
Marital status	2.659(1.330)	.0697(.0332)	0.036**
Education level	3.275 (1.731)	.0859(.0431)	0.046**
Farming experience	-.0258 (.1202)	-.0006(.0031)	0.829
Farm size	-1.654 (.5446)	-.0434(.0117)	0.000*
Non-farm income	1.013(1.076)	.0265(.0278)	0.340
Livestock rearing only	-1.147(14.150)	-0259(.3165)	0.935
Mixed farming	2.349(1.894)	.0614(.0457)	0.179
Communication devices	1.255(1.1899)	.0329(.0303)	0.278
Distance to the market	.5292 (.1571)	.0138(.0032)	0.000*
Access to credits/loan	1.284 (1.159)	.0336(.0295)	0.255
Access to extension	1.655 (1.057)	.0434(.0261)	0.097
Support extension agencies	3.307 (1.426)	.0867(.0345)	0.012**
Prob > chi²		**0.0000**	
Pseudo R²		**0.8303**	
Number of obs		**222**	

Coeff*: Coefficient: SE: Standard Error: *, **, = 99%, and 95%, confidence intervals, respectively. Values in brackets are SE*

It was found that the number of farmers and their access to climate data were negatively correlated. (marginal effects = -0.043, p = 0.000) (Table 5). This implies that farmers' access to climate information declines with farm size. These results contradict the study of Rehman, Muhammad, Ashraf, Mahmood, Ruby, & Bibi (2013), which found that a larger farm increases the likelihood of receiving accurate agricultural information, including climate data. Muema, Mburu, Coulibaly, & Mutune (2018) have reported elsewhere that large farm households can raise demand for climate information by spreading the risks associated with climatic unpredictability and diversifying crop possibilities. Similarly, because of the magnitude of the projected losses connected to the changing climate, large-scale farmers have an even greater need for climate information (Oyekale, 2017). However, the negative correlation shown in this study can be explained by the possibility that larger farms tend to have better access to resources and information through their networks, which reduces the need for them to look for additional sources of climate data.

Farmers' access to climate information was positively connected with the distance to the closest market ($p < 0.000$, marginal effects = 0.013) (Table 5). This implies that, in comparison to their counterparts, farmers who reside nearer to the market have greater exposure to climate information. This could be the case because farmers who reside nearer to the market might have greater opportunities to network with other farmers and extension agents, increasing their access to resources and knowledge. According to Hassan and Nhemachena (2008), having access to markets encourages farmers to produce surplus crop yields and other agricultural products that can be easily sold, boosting their income and improving their capacity to adjust to the harm of climate change.

According to this study, access to climate information is significantly positively correlated with support for international organizations, NGOs, and extension services (marginal effects =

0.086, p = 0.012) (Table 5). indicating that farmers receive more climate information than their rivals when they receive assistance from NGOs, foreign agencies, and agricultural extension services. By providing resources like information and training, farmers can be supported in maintaining and increasing their production even with the effects of climate change (Nhemachena & Hassan, 2007).

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study shows that the majority of the farmers in the Hiran region had access to climate information, and the most significant climate information channels were radio, agricultural extension agents, and firsthand observation. Access to climatic information was highly impacted by several elements, such as gender, marital status, education level, farm size, distance to the closest market, and support from foreign agencies, NGOs, and extension agencies.

Implications and Policy Recommendations

Information Channels: The fact that radio, agricultural extension agents, and firsthand observation are the most significant sources of climate information implies that these channels should be prioritized for communication strategies. Investing in these channels can enhance the effectiveness of delivering crucial climate-related information to farmers.

Targeted Outreach: The identification of factors such as gender, marital status, education level, farm size, distance to the closest market, and support from external agencies impacting access to climate information suggests the need for targeted outreach programs. Tailoring information dissemination strategies to address these specific factors can ensure that a broader range of farmers have access to essential climate information.

Gender Considerations: Since gender is identified as a factor influencing access to climate information, there may be a need for gender-sensitive approaches in communication strategies. Ensuring that climate information reaches both male and female farmers can contribute to more inclusive and effective agricultural practices.

Education and Training: The influence of education level on access to climate information implies that investing in education and training programs for farmers can have positive effects. Educated farmers may be better equipped to understand and utilize climate information for decision-making on their farms.

Infrastructure and Market Access: The impact of factors like farm size and distance to the closest market on access to climate information highlights the interconnectedness of agricultural practices with broader infrastructure and market accessibility. Improving infrastructure and market access could indirectly contribute to enhancing the dissemination and utilization of climate information.

REFERENCES

Adesiji GB, Matanmi BM, Onikoyi MP, & Saka MA. (2012). Farmers' Perception of Climate Change in Kwara State, Nigeria. *World Rural Observations*, *4*(2). http://www.sciencepub.net/rural

Adolwa, I. S., Okoth, P. F., Mulwa, R. M., Esilaba, A. O., Mairura, F. S., & Nambiro, E. (2012). Analysis of Communication and Dissemination Channels Influencing the Adoption of Integrated Soil Fertility Management in Western Kenya. *Journal of Agricultural Education and Extension*, *18*(1), 71–86. https://doi.org/10.1080/1389224X.2012.638782

Ahsan, F., Chandio, A. A., & Fang, W. (2020). Climate change impacts on cereal crop production in Pakistan: Evidence from cointegration analysis. *International Journal of Climate Change Strategies and Management*, *12*(2), 257–269. https://doi.org/10.1108/IJCCSM-04-2019-0020

Amit, P. (2018*). The Impact of Climate Change in Southeast Asia – IMF Finance & Development (n.d.)* from:https://www.imf.org/external/pubs/ft/fandd/2018/09/southeastasia-climate-change-and-greenhouse-gas-emissions-prakash.htm

Arokoyo, T. (2005). *ICT's Application in Agricultural Extension Service Delivery. In F. Adedoyin, Agricultural Extension in Nigeria.* Ilorin: AESON

Asadu, A. N., Ozioko, R. I., & Dimelu, M. U. (2018). Climate change information source and indigenous adaptation strategies of Cucumber farmers in Enugu State, Nigeria. *Journal of Agricultural Extension*, *22*(2), 136–146. https://doi.org/10.4314/jae.v22i2.12.

Asafu-Adjaye, J. (2014). The economic impacts of climate change on agriculture in Africa. *Journal of African Economies*, *23*(SUPPL.2). https://doi.org/10.1093/JAE/EJU011

Ayal, D. Y., Tilahun, K., Ture, K., & Terefe-Zeleke, T. (2021). Psychological dimensions of climate change: perceptions, collective efficacy, and responses in Berehet District, north Shoa, Ethiopia. *Climatic Change*, *165*(1–2). https://doi.org/10.1007/S10584-021-03033-Z

Bagamba, F., Bashaasha, B., Claessens, I., & Antle, J. (2012). Assessing climate change impacts and adaptation strategies for smallholder agricultural systems in Uganda. *African Crop Science Journal*, *20*, 303–316. https://www.ajol.info/index.php/acsj/article/view/81691

Carty, T. (2017). *A Climate in Crisis: How climate change is making drought and humanitarian disaster worse in East Africa*. Retrieved January 15, 2024, from https://climexp.knmi.nl/.

Cheriotic, V.F., Saidu, O., & Bebe, B.O. (2012). Access to climate change information and support services by vulnerable groups in Semi-Arid Kenya for adaptive capacity development. *African Crop Science Journal*, 20 (2), 169-180.

Chukwuji, C., Nwabueze, T., Aliyu, G., Sayudi, S., Yusuf, Z., & Zakariya, J. (2019). Awareness, Access and Utilization of Information on Climate Change by Farmers in Zamfara State, Nigeria. *Library Philosophy and Practice (e-journal)*. 2106.

Coulibaly, JY., Birachi, EA., Kagabo, D.M., & Mutua, M. (2017). Climate services for agriculture in Rwanda: Baseline survey report. CCAFS Working Paper no. 202**.** Copenhagen, Denmark: CGIAR Research Program on Climate Change, *Agriculture and Food Security (CCAFS).*

Csótó, M. (2011). Information flow in agriculture – through new channels for improved effectiveness. *Journal of Agricultural Informatics, 1*(2). https://doi.org/10.17700/JAI.2010.1.2.17

Dang, H., Elton, Li., Nuberg, I., & Bruwer, J. (2019). Factors influencing the adaptation of farmers in response to climate change: A review, *Climate, and Development,* 11(9), 765-774.

Deressa, T. T., Hassan, R. M., Alemu, T., Yesuf, M., & Ringler, C. (2008). *Analyzing the determinants of farmers' choice of adaptation methods and perceptions of climate change in the Nile basin of Ethiopia*. International Food Policy Research Institute. https://hdl.handle.net/10568/21517

Domingo, S. N., Agbon, A. D., Olaguera, M. D., Umlas, A. J. L., Mae, K., Zuluaga, C., & Reyes, C. M. (2020). *Barriers to Application of Weather and Climate Information in Smallholder Vegetable Farming in Benguet*. Discussion Papers DP 2020-14, Philippine Institute for Development Studies.

Eckstein, D., Winges, M., Künzel, V., & Schäfer, L. (2018). *Global Climate Risk Index 2020 Who Suffers Most from Extreme Weather Events? Wether-Related Loss Events in 2018 and 1999 to 2018.*

Elia, E. (2013). *Information dissemination for adaptation to climate change and variability in the agricultural sector: the case of Maluga and Chibelela villages, Central Tanzania. Ph.D. thesis*. *Pietermaritzburg*: University of KwaZulu-Natal.

Esham, M., & Garforth, C. (2013). Agricultural adaptation to climate change: Insights from a farming community in Sri Lanka. *Mitigation and Adaptation Strategies for Global Change*, *18*(5), 535–549. https://doi.org/10.1007/S11027-012-9374-6

Evaristo, E. S. & Emmanuel, F. E. (2020)**.** Socio-demographic determinants of access to climate change information among tomato growing farmers in Mvomero district, Tanzania. *University of Dar es Salaam Library Journal* Vol 15, No 2

Federal Republic of Somalia (2013). *Ministry of National Resources National Adaptation Programme of Action on Climate Change (NAPA).*

Food Agricultural Organization & World Bank. (2018). *Rebuilding Resilient and Sustainable Agriculture in Somalia SOMALIA OVERVIEW*. http://www.fao.org/3/i8842en/I8842EN.pdf.

Fosu-Mensah, B. Y., Vlek, P. L. G., & MacCarthy, D. S. (2012). Farmers' perception and adaptation to climate change: A case study of Sekyedumase district in Ghana. *Environment, Development and Sustainability*, *14*(4), 495–505. https://doi.org/10.1007/s10668-012-9339-7

GIEWS (2020). *Global Information and Early Warning System on Food and Agriculture | Food and Agriculture Organization of the United Nations*. Retrieved January 15, 2024, from https://www.fao.org/giews/en/

Hampson, K. J., Chapota, R., Emmanuel, J., Tall, A., Huggins-Rao, S., Leclair, M., Perkins, K., Kaur, H., & Hansen, J. (2015). *Delivering climate services for farmers and pastoralists through interactive radio*. www.ccafs.cgiar.org

Hassan, R. and Nhemachena, C. (2008*). Determinants of African Farmers' Strategies for Adapting to Climate Change Multinomial Choice Analysis. African Journal of Agricultural and Resource Economics, 2, 83-104. - References - Scientific Research Publishing*. Retrieved January 15, 2024, from https://www.scirp.org/reference/referencespapers?referenceid=1635608

Idrisa, Y. (2009*). Analysis of the Determinants of Soybean Production Technology Adoption by Farmers in Southern Borno, Nigeria. A Ph.D. Thesis Submitted to the School of Postgraduate Studies, University of Maiduguri.*

IPCC. (2007). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K & Reisinger, A. (eds.)]*.

IPCC. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)*. https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_Front_matters.pdf

Jama, O.M., Liu, G., Diriye, A.W., Yousaf, B., Basiru, I., & Abdi, A.M. (2020). Participation of civil society in decisions to mitigate environmental degradation in post-conflict societies: evidence from Somalia. *J. Environ. Plann. Manag.* 63 (9), 1695–1715.

Kifle, T., Ayal, D. Y., & Mulugeta, M. (2022). Factors influencing farmers' adoption of climate-smart agriculture to respond to climate variability in Siyadebrina Wayu District, Central highland of Ethiopia. *Climate Services*, *26*, 100290. https://doi.org/10.1016/J.CLISER.2022.100290

Kim, I., & Moses, M. (2016). Access and Utilization of Climate Change Information and Support Services among Vulnerable Communities in Agatu LGA, Benue State, Nigeria. *International Journal of Science for Global Sustainability*, *2*(2), 18–18. https://fugus-ijsgs.com.ng/index.php/ijsgs/article/view/254

Limantol, A. M., Keith, B. E., Azabre, B. A., & Lennartz, B. (2016). Farmers' perception and adaptation practice to climate variability and change: a case study of the Vea catchment in Ghana. *SpringerPlus*, *5*(1). https://doi.org/10.1186/S40064-016-2433-9

Maddison, D. (2006). *The Perception of Adaptation to Climate Change in Africa*.

McCarthy, N., Lipper, L., & Zilberman, D. (2018). Economics of climate-smart agriculture: An overview. *Natural Resource Management and Policy*, *52*, 31–47. https://doi.org/10.1007/978-3-319-61194-5_3/COVER

Meinshausen, M., Meinshausen, N., Hare, W., Raper, S. C. B., Frieler, K., Knutti, R., Frame, D. J., & Allen, M. R. (2009). Greenhouse gas emission targets for limiting global warming to 2 degrees C. *Nature*, *458*(7242), 1158–1162. https://doi.org/10.1038/NATURE08017

Mtega, W. P. (2012). Access to and Usage of Information among Rural Communities: a Case Study of Kilosa District Morogoro Region in Tanzania. *Partnership: The Canadian Journal of Library and Information Practice and Research*, *7*(1). https://doi.org/10.21083/PARTNERSHIP.V7I1.1646

Kimaru-Muchai, S. W., Ngetich, F. K., Baaru, M., & Mucheru-Muna, M. W. (2020). Adoption and utilization of Zai pits for improved farm productivity in drier upper Eastern Kenya. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, *121*(1), 13–22. https://doi.org/10.17170/KOBRA-202002281030

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. https://doi.org/10.1016/J.HELIYON.2018.E00889

Mwalukasa, N. (2013). Agricultural information sources used for climate change adaptation in Tanzania. *Library Review*, *62*(4), 266–292. https://doi.org/10.1108/LR-12-2011-0096

Mwangi, M., & Kariuki, S. (2015). Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. *Journal of Economics and Sustainable Development*.

Ndambiri, H.Ritho, C., & Mbogoh, S. (2014). An Evaluation of Farmers' Perceptions of and Adaptation to the Effects of Climate Change in Kenya. *International Journal of Food and Agricultural Economics.*, *1*, 75–96.

Nhemachena, C., & Hassan, R. (2007). *Micro-level analysis of farmers' adaptation to climate change in Southern Africa | IFPRI : International Food Policy Research Institute*. https://www.ifpri.org/publication/micro-level-analysis-farmers'-adaptation-climate-change-southern-Africa

Niang, I., Ruppel, O. C., Abdrabo, M. A., Essel, A., Lennard, C., Padgham, J., & Urquhart, P. (2014). Africa. *Climate Change 2014: Impacts, Adaptation, and Vulnerability: Part B: Regional Aspects: Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 1199–1266. https://doi.org/10.1017/CBO9781107415386.002

Nicholls, R. J., & Cazenave, A. (2010). Sea-Level Rise and Its Impact on Coastal Zones. *Science*, *328*(5985), 1517–1520. https://doi.org/10.1126/SCIENCE.1185782

Ojo, T. O., & Baiyegunhi, L. J. S. (2020). Determinants of climate change adaptation strategies and its impact on the net farm income of rice farmers in south-west Nigeria. *Land Use Policy*, *95*, 103946. https://doi.org/10.1016/J.LANDUSEPOL.2019.04.007

Okoro, J. C., Agwu, A. E., & Anugwa, I. Q. (2016). Climate change information needs of rural farmers in Enugu State. *Journal of Agricultural Extension*, *20*(2), 215–232. https://doi.org/10.4314/JAE.V20I2.16

Oyekale, A. S. (2017). Factors explaining farm households' access to and utilization of extreme climate forecasts in Sub-Saharan Africa (SSA). *Environmental Economics*, *6*(1), 91–103. https://www.businessperspectives.org/index.php/journals/environmental-economics/issue-229/factors-explaining-farm-households-access-to-and-utilization-of-extreme-climate-forecasts-in-sub-saharan-africa-ssa

Popoola, O., Yusuf, F., & Monde., N. (2020). Information Sources and Constraints to Climate Change Adaptation amongst Smallholder Farmers in Amathole District Municipality, Eastern Cape Province, South Africa. *Sustainability.* 12. 5846. https://doi.org/10.3390/su12145846.

Ramirez-Villegas, J., & Thornton, P.K. (2015*). Climate change impacts African crop production. CCAFS Working Paper no. 119. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).*

Rehman, F., Muhammad, S., Ashraf, I., Mahmood, C. K., Ruby, T., & Bibi, I. (2013). Effect of farmers' socioeconomic characteristics on access to agricultural information: empirical evidence from Pakistan. *Journal of Animal and Plant Sciences*.

Sanga, E. E., & Elia, E. F. (2021). Socio-demographic determinants of access to climate change information among tomato growing farmers in Mvomero district, Tanzania. *University of Dar Es Salaam Library Journal*, *15*(2), 121–136. https://journals.udsm.ac.tz/index.php/lj/article/view/3991

Singh, C., Kituyi, E., & Urquhart, P. (2016*). From pilots to systems: Barriers and enablers to scaling up the use of climate information services in smallholder farming communities. CARIAA Working Paper # 3. Collaborative adaptation research initiatives in Africa and Asia, IDRC, Ottawa, Canada. Available at: https://www.ccardesa.org/knowledge-products/pilots-systems-barriers-and-enablers-scaling-use-climate-information-services*

Tesso, G., Emana, B., & Ketema, M. (2012). Econometric analysis of local level perception, adaptation and coping strategies to climate change induced shocks in North Shewa, Ethiopia. *International Research Journal of Agricultural Science and Soil Science*.

The United Nations Population Fund (UNFPA) (2014). *The Population Estimation Survey (PESS) for Somalia. Available on: https://somalia.unfpa.org/sites/default/files/pub-pdf/Population-Estimation-Survey-of-Somalia-PESS-2013-2014.pdf. Accessed on 1/20/2022.*

Venema, J.H., & Vargas, R. (2007). *Land suitability assessment of the Juba and Shabelle riverine areas in Southern Somalia. FAO-SWALIM. Project Report No. L-09. Nairobi, Kenya.*

Vorley, B., Lundy, M., & Macgregor, J. (2009). Business models that are inclusive of small farmers. *Agro-Industries for Development*, 186–222. https://doi.org/10.1079/9781845935764.0186

Waaben Thulstrup, A., Habimana, D., Joshi, I., & Mumuli Oduori, S. (2020). Uncovering the challenges of domestic energy access in the context of weather and climate extremes in Somalia. *Weather and Climate Extremes*, *27*, 100185. https://doi.org/10.1016/J.WACE.2018.09.002

Warsame, A. A., Sheik-Ali, I. A., Ali, A. O., & Sarkodie, S. A. (2021). Climate change and crop production nexus in Somalia: an empirical evidence from ARDL technique. *Environmental Science and Pollution Research International*, *28*(16), 19838–19850. https://doi.org/10.1007/S11356-020-11739-3

Yamane, T. (1967). *Statistics An Introductory Analysis.* (2nd Editio). : Harper and Row. https://www.scirp.org/(S(i43dyn45teexjx455qlt3d2q))/reference/ReferencesPapers.aspx?ReferenceID=1440506