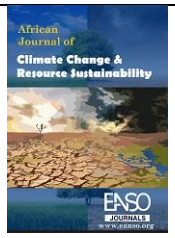
Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511



African Journal of Climate Change and Resource Sustainability
ajccrs.eanso.org
Volume 3, Issue 1, 2024
Print ISSN: 790-962X | Online ISSN: 790-9638
Title DOI: https://doi.org/10.37284/2790-9638

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Socio-Economic Factors Influencing Climate Change Perception of the Farmers in the Hiran Region of Somalia

Abdiwali Abdulle Odawa[1,2], Prof. Monicah Mucheru-Muna, PhD[1], Dr. Benson Kamau Mburu, PhD[3], Dominic Mutambu[1], & Erick Nyaboga Omari[1]*

[1] Kenyatta University, P. O. Box 43844-00100, Nairobi, Kenya.
[2] Benadir University, KM 5, Hodan District, Mogadishu, Somalia.
[3] Mama Ngina University College, P. O. Box 444-01030, Gatundu, Kenya.
[*] Author for Correspondence ORCID: https://orcid.org/0009-0007-4405-2207; Email: Shuutesom66@gmail.com

Article DOI: https://doi.org/10.37284/ajccrs.3.1.2511

Date Published:

10 December 2024

Keywords:

Socioeconomic Factors, Farmers' Perceptions, Climate Change, Probit Model, Smallholder Farmers, Food Security.

ABSTRACT

The accomplishment of sustainable development goals in Somalia remains severely hampered by changes in the climate, particularly when it comes to food security. It jeopardizes national food security by threatening agricultural productivity. Designing practical strategies and policies for agricultural development and food security requires an understanding of farmers' perceptions and the factors that influence their perception of climate change. Therefore, this study was designed to, (i) Evaluate farmers' perceptions of climate change, and (ii) identify the socioeconomic factors that influence farmers' perceptions of climate change in the Hiran region of Somalia. The study encompassed 222 respondents from six villages within two districts in the Hiran region. Gender, family size, farm size, and ownership of communication devices, significantly influenced farmers' perception of climate change. Therefore, the study recommended that the federal government of Somalia, and local/international NGOs, should design and implement intervention strategies for climate change cognizance of these factors.

APA CITATION

Odawa, A. A., Mucheru-Muna, M., Mburu, B. K., Mutambu, D. & Omari, E. N. (2024). Socio-Economic Factors Influencing Climate Change Perception of the Farmers in the Hiran Region of Somalia. *African Journal of Climate Change and Resource Sustainability*, *3*(1), 439-450. https://doi.org/10.37284/ajccrs.3.1.2511.

CHICAGO CITATION

Odawa, Abdiwali Abdulle, Monicah Mucheru-Muna, Benson Kamau Mburu, Dominic Mutambu and Erick Nyaboga Omari. 2024. "Socio-Economic Factors Influencing Climate Change Perception of the Farmers in the Hiran Region of Somalia", *African Journal of Climate Change and Resource Sustainability* 3 (1), 439-450. https://doi.org/10.37284/ajccrs.3.1.2511.

HARVARD CITATION

Odawa, A. A., Mucheru-Muna, M., Mburu, B. K., Mutambu, D. & Omari, E. N. (2024) "Socio-Economic Factors Influencing Climate Change Perception of the Farmers in the Hiran Region of Somalia", *African Journal of Climate Change and Resource Sustainability*, 3(1), pp. 439-450. Doi: 10.37284/ajccrs.3.1.2511.

IEEE CITATION

A. A. Odawa, M. Mucheru-Muna, M. Mburu, C. Mutambu & E. N. Omari "Socio-Economic Factors Influencing Climate Change Perception of the Farmers in the Hiran Region of Somalia", AJCCRS, vol. 3, no. 1, pp. 439-450, Dec.

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

MLA CITATION

Odawa, Abdiwali Abdulle, Monicah Mucheru-Muna, Benson Kamau Mburu, Dominic Mutambu & Erick Nyaboga Omari. "Socio-Economic Factors Influencing Climate Change Perception of the Farmers in the Hiran Region of Somalia". *African Journal of Climate Change and Resource Sustainability*, Vol. 3, no. 1, Dec. 2024, pp. 439-450, doi:10.37284/ajccrs.3.1.2511.

INTRODUCTION

Climate change refers to any shift in world climate at a time, induced by anthropogenic or natural activity (IPCC, 2007). Due to these human activities, climate changes could be seen as fluctuations in temperature and precipitation, as well as a rise in greenhouse gas emissions (GHG) (Bharat *et al.,* 2022). According to Kumar *et al.* (2013), severe weather conditions including hurricanes, winds, and drought will be increasing as the planet remains warm up at a worrying scale. As predicted by many experts, an increase of 2-4 °C or more in temperature would be expected, with far-reaching consequences (Meinshausen *et al.,* 2009). Climate catastrophes have challenged numerous nations over the past 20 years, including Southeast Asian nations like Vietnam and Thailand (Eckstein *et al.,* 2018). One of the economic sectors devastated by climate disasters in many nations throughout the world is agriculture *(Ahsan et al.,* 2020). Predictions indicate that in India agricultural production will be devastated by climate catastrophes, leading to food insecurity by the year 2050 according to Dahal (2008). Furthermore, an increase in temperature has already been felt in the Horn of Africa regions as reported by the IPCC (IPCC, 2007). Additionally, according to projections by Climate Risk Profile Somalia (2022) predicted a temperature increase at a maximum of 3.2 °C in Somalia by 2080.

According to Adger *et al.* (2003), climate catastrophe is affected similarly in both developed and underdeveloped countries. However, due to poverty, little infrastructure and technological development, as well as high reliance on rain-fed agriculture, farmers in Sub-Saharan Africa, are more susceptible to the deteriorating consequences of climate (Adimassu, & Kessler, 2016; Lipper *et al.,* 2014; Nelson *et al.,* 2014). Additionally, according to Mucheru-Muna *et al.* (2014) and Zake, & Hauser (2014), Sub-Saharan African agricultural production is majorly rainfed. Therefore, it is understandable that developing nations, where farming is the primary source of income and poverty is widespread, are concerned about the negative impact of the climate crisis (Fahad, & Wang, 2018; Thi Lan Huong *et al.,* 2017).

In Somalia, agriculture contributes a major part to the nation's food security and economic prosperity (Boitt *et al.,* 2018). Around seventy-five percent (75%) of the nation's GDP and around 93% of total export incomes are counted by the sector (FAO, & World Bank, 2018). However, climate change impacts such as temperature increases and rainfall trends, contribute to unpredictable and unsustainable conditions for a country already struggling with significant economic, social, and environmental vulnerability (FAO, & World Bank, 2018). For instance, the country experienced extreme floods that led to the deaths of many people, displaced approximately 412,000 people, and damaged crop production in 2019 (GIEWS, 2022). Additionally, soil fertility has also been degraded through soil erosion due to strong winds, which affect agricultural output in the country (Waaben *et al.,* 2020). Due to insufficient institutions, as well as the absence of research studies, the adaptation policies and regulations to mitigate these climate catastrophes are inadequate in Somalia (FAO, & World Bank, 2018).

Climate change impacts are likely to impact disproportionately rainfed agricultural farmers as well as those with low income and access to financial services or credits (Castells-Quintana *et al.,* 2018; Quiroga *et al.,* 2015; Skoufias *et al.,* 2011). Therefore, it is necessary to take policy and public interventions to encourage and foster adaptation to catastrophes caused by climate hazards (Kumar *et al.,* 2013). However, according to Silvestri *et al.* (2012), Simelton *et al.* (2013), and Meldrum *et al.* (2018) farmers' adaptation

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

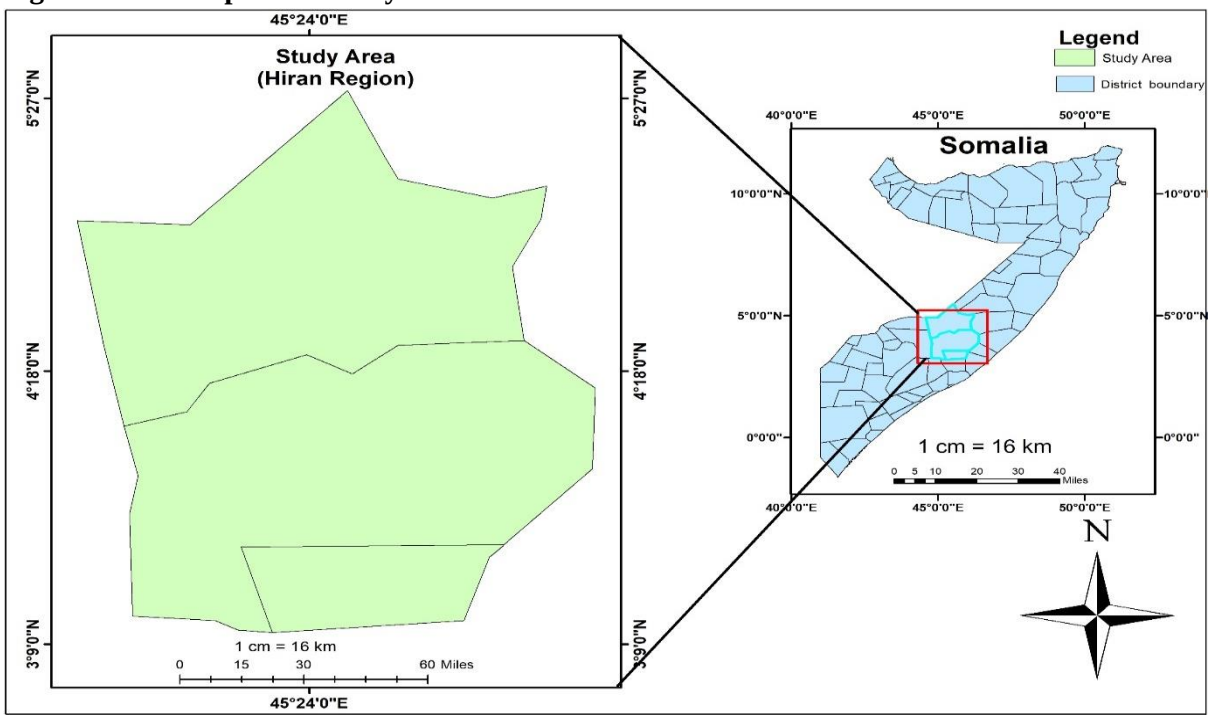
measures can influence their comprehension and understanding of the detrimental impacts of climate crises. Regarding this, farmers' perception of climate crises determines whether or not they employ adaptation strategies (De Matos Carlos *et al.*, 2020; Meldrum *et al.*, 2018). Considering farmers' perspectives on climate change effects is, therefore, a significant factor in designing effective adaptation policies in agriculture (De Matos Carlos *et al.*, 2020; Hansen *et al.*, 2004; Silvestri *et al.*, 2012). Therefore, this study was carried out to (i) Evaluate farmers' perceptions of climate change; and (ii) Identify how the socioeconomic characteristics of the farmers influence their perception of climate change in the Hiran region of Somalia.

MATERIAL AND METHODS

Study area

The Hiran region is situated in central Somalia. The Galguduud region borders the region to the north, the Middle Shebelle region to the south, and the Bay and Bakol regions to the southwest. The region is also home to several towns and villages, including Beledweyne, the largest town in the region and serves as the administrative centre. The region is also known for its rich agricultural and livestock resources. The region has vast areas of fertile land, with a favourable climate and abundant rainfall, making it ideal for growing crops like maize, beans, and sorghum and a variety of fruits, including mangoes, bananas, and papayas, which are popular in the local market as well as in other parts of the country (Odawa *et al*, 2024). Additionally, the region is home to vast herds of cattle, sheep, and goats, making it a significant contributor to the livestock sector of Somalia (Figure 1).

Figure 1: The Map of the Study Area



Sampling design and sample size

The study adopted a descriptive survey design. Both purposive and random sampling procedures were also employed. Initially, due to security concerns, the study selected two districts (*Baladwein and Buloburte*) in the Hiran region purposively. Six villages within these two districts (three from each district) with a population of 1200 households were selected purposively, based on their vulnerability to extreme weather conditions and location along the riverbank. The Yamane (1967) formula was developed to compute sample size 222, Equation 1. A simple random method was employed in each village, which was previously selected purposefully to meet the target sample size of 222 farmers.

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

Finally, the data was collected from the sample farmers using a questionnaire.

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

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

Data Analysis

The probit model was applied to examine the influence of socioeconomic characteristics on farmers' perceptions of the changing climate. Frequency, percentages, and means were utilized to further reinforce the results from the econometrics. The probit model is a statistical model used to analyze the correlation between the dependent and explanatory factors. In this example, the dependent variable is "Farmer Perception," while the explanatory variables are " The Farmers' Socioeconomic Characteristics" (Equation 2).

$$Y = a_i + X_I B_i + E_i ... \qquad \textit{(Equation 2)}$$

Where: Y = Farmer's Perception (the dependent variable), $\alpha\, i$ = a constant value (the intercept), $X\, i$ = the value of the independent variables (Socio-Economic Characteristics), $\beta\, i$ = the coefficients of the independent variables (representing the impact of each independent variable on the dependent variable), $\mathcal{E}\, i$ = the error term (representing the difference between the observed value of the dependent variable and the value predicted by the model). Multicollinearity can be found when there is a linear correlation among variables Okeyo, (2020). Therefore, multicollinearity was tested using the Variance Inflation Factor (VIF), and the variables with values greater than ten were eliminated (Kumari, 2008).

RESULTS

Characteristics of the Respondents

Table 1 shows the summary of farmers' socio-economic and demographic characteristics in the Hiran region of Somalia. The result indicates that 83% of respondents were male. This means more male farmers were engaged in farming activities in the Hiran region compared to female farmers. Eighty percent (80%) of respondents were married and 71% of the participants had non-formal education. The low education level of the farmers could have led to a lower perception of the farmers about the implications of climatic change and its adaptation methods. The average family size and age were 6.5 and 20 years, respectively, with the mean farmer possessing 20 years of agricultural expertise. This implies that most participants were in a good position to notice climate crises and observe their unfavourable outcomes. The mean monthly income of the farmers was 180$. This suggests that farmers in the Hiran region are in a low-income category which could affect their ability to engage in sensible adaptation plans to deal with the consequences of climate catastrophe, however, 77% of them had a source of income other than farm income. This could be a survival strategy to supplement the low income (Table 1).

Table 1: Socio-economic Characteristics of the Farmers in the Hiran region

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

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

Variables Descriptions	Frequency	Percentage (%)
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
	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
Monthly household income (In USD)	180	250	100

Farmers' Perception of Climate Change

Table 2 shows the responses to the farmer's perception toward climate change. The majority (78%) of farmers in the Hiran region of Somalia perceived climate change whereas 22% did not, and most (86%) of them reported that temperature has been escalating. Furthermore, (84%) also observed prolonged periods of rainfall, while (87%) observed a reduction in rainfall intensity in the Hiran region of Somalia in the last 20 years.

Table 2: Perception of The Farmers of Climate Change

Perception of the farmers on climate change	Frequency	Percentage
Aware of the presence of Climate change	173	78%
Not aware of climate change	49	22%
Climatic parameters	**(%) of Respondents**	
	Increased	**Decreased**
Increased temperature/decreased temperature	86	14
Prolonged periods of rainfall/ shortened length of rainfall	16	84
Increased rainfall intensity/reduced intensity of the rainfall	13	87

Determinants of Farmer's Climate Change Perceptions

The chi-squared statistic (LR chi^2 (8) = 153.99) and (the prob > chi^2 is 0.0000), indicate that the model was highly significant and had strong explanatory power (Table 3). The log-likelihood value is (-40.180), and the pseudo R^2 is (0.657), which shows that the model has a satisfactory level of predictive ability, with an approximate 65% competency in explaining the variation within the outcome variable. Overall, the Probit regression model fit the data well and effectively explained the association between the predictor variables and the outcome variable.

The probit regression analysis revealed four independent variables that significantly influenced smallholder farmers' perception of climate change (Table 3). Smallholder farmers' gender, number of family members, farm size, and ownership of communication devices predicted farmers' perception of climate change effects.

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

Table 3: Probit Regression Model Based on Farmers' Perception of Climate Change in Hiran Region, Somalia

Explanatory Variables	Perception		
	Coeff. (SE)	Marginal effects (SE)	p-value
Gender	.9077 (0.383)	.1221(.0622)	**0.050****
Total family	.1642 (0.075)	.0176(.0077)	**0.023****
Marital status	.7566 (0.372)	.0932(.0512)	0.069
Education level	1.1757 (0.406)	.0187(.0430)	0.663
Farm size	-.7316 (0.133)	-.0783(.0119)	**0.000***
Non-farm income	.2122 (0.352)	.0234(.0399)	0.558
Farming system	.1844 (1.406)	.0237 (.1872)	0.899
Communication devices	1.1379 (0.382)	.1595(.0664)	**0.016****
Prob > chi^2 =		**0.0000**	
Pseudo R^2 =		**0.6571**	
Number of obs =		**222**	

*Coeff: Coefficient SE: Standard Error in parentheses: *, **, = significant at 1%, and 5%, probability level, respectively*

The Negative Effects of Long-term Climate Change

The results indicated that climate change impacted farmers in the Hiran region of Somalia. The majority of farmers perceived these impacts as extremely severe to very severe. These include changes in the timing of rain (86%), poverty and food shortages (76%), high incidence of drought and yield loss (62%), lack of potable water (58%), and high accuracy of flood frequency and farm destruction (55%). This suggests that farmers in the region are facing unprecedented and substantial challenges posed by changing climate such as poverty, lack of food, floods, drought, and fluctuation of climate patterns. These negative impacts are observed from severe to extremely severe by a greater number of farmers and will have serious implications for the farmers and their ability to adapt to climate change.

Table 4: The Negative Effects of Long-term Climate Change

Negative Effect	ES (%)	VS (%)	S (%)	SI (%)	SS (%)	I (%)	D (%)
Changed timing of rain	37	49	10	4	0	0	0
High accuracy of flood frequency and farm destruction	27	28	15	11	6	9	4
High incidence of drought and yield loss	30	32	16	13	5	3	1
Poverty and food shortages	46	30	24	0	0	0	0
Lack of potable water	31	27	17	10	4	5	6

***ES**= extremely severe, **VS**= very severe, **S**=severe, **SI**= significant, **SS**= somewhat significant, **I** = irrelevant **D**= Don't know*

DISCUSSION

Farmers' Perception of Climate Change

According to the findings, most of the farmers had noticed that the climate was changing. This suggests that farmers in the Hiran region were aware of climate-related changes, and most of them observed fluctuations in temperature and rainfall patterns, two critical characteristics of climate crises. According to Maddison (2006), a farmer's understanding of the changing climate is a crucial requirement in employing adaptation methods. This could be explained by the fact that rain-fed agriculture is the primary means of income for the greater number of farmers, therefore, any shifts regarding climate would be quickly recognized by local farmers in the region. Farmers' perceptions of climate change may thereby improve their likelihood of implementing adaptive actions in response to observable changes. All these alterations are expected to result in low and insufficient crop production and negatively affect livelihoods if no adaptation strategies are implemented. Kassie *et al.* (2014),

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

Coulibaly (2017), Parameswaranaik (2019), Fourment *et al.* (2020), and Mehmood *et al.* (2020), similarly stated that most farmers were aware of climate crises, and demonstrated that temperatures have risen while rainfall duration and intensity have decreased in Ethiopia, Rwanda, India, Uruguay, & Pakistan, respectively.

The Negative Effects of Long-term Climate Change

Overall, the data suggest that farmers in the Hiran region of Somalia were facing significant challenges imposed by climate crises, including disruptions to local weather patterns, flooding, drought, poverty, food shortages, inability to acquire clean water, and the loss of livestock (Table 4). These negative effects are perceived as being severe or extremely severe by a large percentage of respondents and could have serious implications for the well-being and livelihoods of farmers in the region. The current study's findings are supported by Macharia *et al.* (2012) and Obiora (2013) who reported that climate change has resulted in poverty and food shortages, increased frequency of drought, a shift in the planting season, a decline in agricultural output, and increased insects and diseases. The findings showed the likelihood for climate change to have severe economic and social consequences throughout the region unless action is made to promote small-scale farmers in coping with and responding to these alterations.

Determinants of Farmer's Climate Change Perceptions

The probit regression analysis revealed four explanatory variables significantly predicted smallholder farmers' perceptions of the consequences of climate crises. The findings revealed that farmers' gender positively and significantly correlated with their perception of changing climate *($p<0.05$).* This states that the probability of perceiving climate change was higher for male farmers than it was for female farmers. This is because the males have more opportunities to acquire information regarding to adverse consequences of climate crises via formal education, as well as participation in community meetings. They are also likely to expose climate information and resources like extension services or weather forecasts, leading to increased awareness and comprehension regarding the detrimental consequences of changing climate on agriculture. Furthermore, the negative influence of cultural norms, especially in Africa may affect the way the responsibility is divided between males and females. According to Suvedi *et al.* (2017), female farmers are less likely to satisfy investment needs and typically have less access and control over productive and financial resources compared to males.

The study also identified a positive and significant correlation between farmers' perception and family size *($p<0.05$),* thus, agreeing with Falaki *et al.* (2013), Ndambiri *et al.* (2014), and Oluwatusin (2014). This means the probability of the larger families perceiving climate change was higher compared to the smaller families. This could be explained in several ways, for instance, larger families require huge amounts of food and can reduce, their food demand and likelihood, thus, easily perceiving climate change impacts on their farms. Further, larger families also have huge social and economic connections in their communities, thereby exposing them to relevant and appropriate information regarding climate change impacts via discussions. Additionally, due to their labour resource availability, larger families can engage in large-scale agricultural land and livestock production, making them highly prone to the adverse consequences of changing climate.

The model showed a negative and significant association between farm size and the farmers' perception *($p<0.05$).* This means that having bigger farms reduces farmers' chances of perceiving the detrimental consequences of climate crises. The negative correlation identified in this study between farmer perception and farm size is in line with the results of Sanog *et al.* (2017) and Uddin *et al.* (2017) in studies of Southern Mali and the Coastal Region of Bangladesh, respectively. This could be because larger farm owners have the financial capabilities and resources to invest in more sustainable approaches such as irrigation, and, diversifying

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

their means of revenue, therefore reducing their perceptions of climate change impacts on their farms.

The Ownership of communication devices such as radios, televisions, and mobile phones was positively and significantly associated with farmers' perception of the consequences of changing climate *(p<0.01)*. This suggests that having communication devices enhances the chances of perceiving the changing climate by the farmers. This result is similar to an earlier study conducted by Howlader, & Akanda (2015), and Odawa *et al.* (2024) which showed that access to information and communication technology may significantly increase farmers' awareness and comprehension of climate change. Ownership of communication devices facilitates information access for farmers. For instance, using mobile phones, farmers can access a huge information about local meteorological data about climate change.

CONCLUSIONS

The findings revealed that most smallholder farmers are cognizant of the changing climate and observed that temperatures increased with decreased rainfall duration and intensity in the region in the past 20 years. Several negative climate change impacts were observed by the smallholder farmers including lack of drinking water, destruction of infrastructure like farms, roads, and houses, frequencies of drought and crop loss as well as floods. Gender, farm size, ownership of communication devices, and family size are socio-economic factors significantly influenced by the smallholder farmer's perception of the detrimental consequences of climate crises. Therefore, the study recommended that the federal government of Somalia, and local/international NGOs, move forward with intervention policies, concentrating especially on identified factors: This may include, providing support for farmers such as improved seeds, training, and water management techniques to enhance farmer's ability to adapt climate change effectively. Supporting farmers with poverty reduction initiatives such as creating income-generating activities and credits. Provide education and training for female farmers and promote fair access to information, resources, and participation in climate-related discussions and seminars.

Ethical Approval/ Statement

Following a joint discussion with village elders, we determined that the data collected would only be utilized for academic purposes, and consent statements were obtained from the participants as well as the Ministry of Education, culture, and Higher Education of the Federal Republic of Somalia. Volunteerism and participant anonymity were preserved throughout the procedure.

REFERENCES

Adger, W. N., Huq, S., Brown, K., Declan, C., & Mike, H. (2003). Adaptation to climate change in the developing world. Progress in Development Studies, 3(3), 179–195. https://doi.org/10.1191/1464993403ps060oa.

Adimassu, Z., & Kessler, A. (2016). Factors affecting farmers' coping and adaptation strategies to perceived trends of declining rainfall and crop productivity in the central Rift Valley of Ethiopia. Environmental Systems Research, 5(1). https://doi.org/10.1186/s40068-016-0065-2.

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.

Bharat, K., Chapke, R. R., & Kammar, S. (2022). Farmers' Perception about Climate Change and Response Strategies. Indian Journal of Extension Education, 58(1), 7–11. https://doi.org/10.48165/IJEE.2022.

Boitt, M. K., Langat, F. C., & Kapoi, J. K. (2018). Geospatial agro-climatic characterization for assessment of potential agricultural areas in Somalia, Africa. Journal of Agricultural

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

Informatics, 9(3). https://doi.org/10.17700/jai.2018.9.3.479

Castells-Quintana, D., Lopez-Uribe, M. del P., & McDermott, T. K. J. (2018). Adaptation to climate change: A review through a development economics lens. World Development, 104, 183– 196. https://doi.org/10.1016/J.WORLDDEV.2017.11.016.

Climate Risk Profile Somalia, (2022). Risk Profile for Somalia reveals high exposure to future climate change impacts, https://www.pik-potsdam.de/en/news/latest-news/somalia-high-exposure-to-future-climate-change-impacts (accessed October 12, 2023).

Coulibaly, JY., Birachi, EA., Kagabo, DM., 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). https://hdl.handle.net/10568/80820.

Dahal, N. (2008). Understanding climate change adaptation issues in Nepal, National Trust for Nature Conservation, Kathmandu, Nepal. Journal Environmental Earth Science, 8((4),), 1– 6. DOI: https://doi.org/10.3126/init.v2i1.2536

De Matos Carlos, S., Da Cunha, D. A., Pires, M. V., & Do Couto-Santos, F. R. (2020). Understanding farmers' perceptions and adaptation to climate change: the case of Rio das Contas basin, Brazil. GeoJournal, 85(3), 805–821. https://doi.org/10.1007/S10708-019-09993-1

Eckstein, D., Künzel, V., Schäfer, L., & Winges, M. (2018). Global climate risk index 2020: who suffers most from extreme weather events. Weather-related loss events in, 44.

Fahad, S., & Wang, J. (2018). Farmers' risk perception, vulnerability, and adaptation to climate change in rural Pakistan. Land Use Policy, 79, 301–309. https://doi.org/10.1016/j.landusepol.2018.08.018

Falaki, A. A., Akangbe, J. A., & Ayinde, O. E. (2013). Analysis of Climate Change and Rural Farmers' Perception in North Central Nigeria. Journal of Human Ecology, 43(2), 133–140. https://doi.org/10.1080/09709274.2013.11906619.

Food Agricultural Organization & World Bank. (2018). Rebuilding Resilient and Sustainable Agriculture in Somalia Somalia Overview. http://www.fao.org/3/i8842en/I8842EN.pdf. (accessed September 30, 2023).

Fourment, M., Ferrer, M., Barbeau, G., & Quénol, H. (2020). Local Perceptions, Vulnerability and Adaptive Responses to Climate Change and Variability in a Winegrowing Region in Uruguay. Environmental Management, 66(4), 590–599. DOI: 10.1007/s00267-020-01330-4.

GIEWS global information and early warning system on food and agriculture GIEWS Country Brief Somalia. (2022). Available at: https://www.fao.org/giews/en/

Hansen, J. W., Marx, S. M., & Weber, E. U. (2004). The Role of Climate Perceptions, Expectations, and Forecasts in Farmer Decision Making: The Argentine Pampas and South Florida: Final Report of an IRI Seed Grant Project. https://doi.org/10.7916/D8N01DC6.

Howlader, M. S., & Akanda, M. G. R. (2015). Coastal Farmers' Perception of Climate Change Effects on Agriculture at Galachipa Upazila under Patuakhali District of Bangladesh. Global Journal of Science Frontier Research, 15(D4), 31–39. https: //journalofscience.org/index.php/GJSFR/article/view/1508/3-Coastal-Farmers-Perception_html (accessed October 1, 2023).

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

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

[Core Writing Team, Pachauri, R.K & Reisinger, A. (eds.)], Geneva, Switzerland, 104 pp. Available at: https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf

Kassie, B. T., Rötter, R. P., Hengsdijk, H., Asseng, S., Van Ittersum, M. K., Kahiluoto, H., & Van Keulen, H. (2014). Climate variability and change in the Central Rift Valley of Ethiopia: challenges for rainfed crop production. The Journal of Agricultural Science, 152(1), 58–74. https://doi.org/10.1017/S0021859612000986.

Kumari, S.S. (2008). Multicollinearity. Journal of Contemporary Research in Manag. Available at: https://www.semanticscholar.org/paper/Multicollinearity- %3A- Estimation- and- Elimination- Kumari/bb8c12b0ad53039606558bdda7aa2c730f89decb

Kumar B, T., Tiwari, K., R., & Mcdonald, M. A. (2013). People's local Knowledge of climate change in the Middle Hills of Nepal Carbon sequestration potential of Tropical forests in Bangladesh: A case study in Sitapahar Reserve Forest View project Climate Change Impact and Adaptation Strategies in Rural Livelihood: Evidence from the High Mountain of Hindu Kush Himalaya (HKH) region (Bhutan, Nepal and Pakistan) View project. In Article in Indian Journal of Traditional Knowledge. https://www.researchgate.net/publication/257528818

Lipper, L., Thornton, P., Campbell, B. M., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., Henry, K., Hottle, R., Jackson, L., Jarvis, A., Kossam, F., Mann, W., McCarthy, N., Meybeck, A., Neufeldt, H., Remington, T., … Torquebiau, E. F. (2014). Climate-smart agriculture for food security. Nature Climate Change 2014 4:12, 4(12), 1068–1072. https://doi.org/10.1038/nclimate2437.

Macharia, P. N., Thuranira, E. G., Ng'ang'a, L. W., Lugadiru, J., & Wakori, S. (2012). Perceptions and adaptation to climate change and variability by immigrant farmers in semi-arid regions of Kenya. African Crop Science Journal, 20, 287–296. Available at: https://www.ajol.info/index.php/acsj/article/view/81720

Maddison, D. (2006). The Perception of Adaptation to Climate Change in Africa, Pretoria. Available at: https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-4308

Mehmood, M. S., Li, G., Khan, A. R., Siddiqui, B. N., Ul, W., Tareen, H., Kubra, A. T., & Ateeq-Ur-Rehman, M. (2020). An evaluation of farmers' perception, awareness, and adaptation towards climate change: a study from Punjab province Pakistan. 52(3), 2022. https://doi.org/10.1590/0103-8478cr20201109.

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

Meldrum, G., Mijatović, D., Rojas, W., Flores, J., Pinto, M., Mamani, G., Condori, E., Hilaquita, D., Gruberg, H., & Padulosi, S. (2018). Climate change and crop diversity: farmers' perceptions and adaptation on the Bolivian Altiplano. Environment, Development and Sustainability, 20(2), 703–730. DOI: https://doi.org/10.1007/s10668-016-9906-4

Mucheru-Muna, M., Mugendi, D., Pypers, P., Mugwe, J., Kung'U, J., Vanlauwe, B., & Merckx, R. (2014). Enhancing maize productivity and profitability using organic inputs and mineral fertilizer in central Kenya small-hold farms. Experimental Agriculture, 50(2), 250– 269. https://doi.org/10.1017/S0014479713000525

Odawa A. A., MucheruMuna M., Dominic M., Mburu B. K., Omari E. N. (2024). Determinants of the Adoption of Climate Change Adaptation Strategies by the

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

Smallholder Farmers in Hiran region, Somalia, J. Mater. Environ. Sci., 15(4), 564-578.

Odawa, A., Mucheru-Muna, M., Mburu, B., & Omari, E. (2024). Factors Influencing Climate Information Access of the Farmers in Hiran Region, Somalia. International Journal of Environmental Sciences,7(1), 1–20. https://doi.org/10.47604/ijes.2318

Parameswaranaik, J. (2019). Factors Affecting the Perception of Farmers about Climate Change in Agriculture. Journal of Agricultural Extension Management, 19, (2), 55-62. Available at: https://www.researchgate.net/publication/337707219_Factors_affecting_the_Perception_of_Farmers_about_Climate_Change_in_Agriculture

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. Available at: https://ideas.repec.org/a/ags/ijfaec/156144.html

Nelson, G. C., van der Mensbrugghe, D., Ahammad, H., Blanc, E., Calvin, K., Hasegawa, T., Havlik, P., Heyhoe, E., Kyle, P., Lotze-Campen, H., von Lampe, M., Mason d'Croz, D., van Meijl, H., Müller, C., Reilly, J., Robertson, R., Sands, R. D., Schmitz, C., Tabeau, A., Willenbockel, D. (2014). Agriculture and climate change in global scenarios: why don't the models agree. Agricultural Economics, 45(1), 85–101. https://doi.org/10.1111/AGEC.12091

Obiora, C. J. (2013). Assessment: Overview from Women Farmers in Anambra State, Nigeria. Greener Journal of Agricultural Sciences, 3(8), 618– 622. Available at: https://gjournals.org/GJAS/GJAS%20Pdf/2013/August/HTML/071113718%20Obiora.htm

Oluwatusin, F. M. (2014). The Perception of and Adaptation to Climate Change among Cocoa Farm Households in Ondo State, Nigeria. Academic Journal of Interdisciplinary Studies. https://doi.org/10.5901/AJIS.2014.V3N1P147

Okeyo, S. O., Ndirangu, S. N., Isaboke, H. N., & Njeru, L. K. (2020). Determinants of sorghum productivity among small-scale farmers in Siaya County. (Thesis). Available at: http://repository.embuni.ac.ke/handle/embuni/2437

Quiroga, S., Suárez, C., & Solís, J. D. (2015). Exploring coffee farmers' awareness about climate change and water needs Smallholders' perceptions of adaptive capacity. Environmental Science and Policy, 45, 53–66. https://doi.org/10.1016/J.ENVSCI.2014.09.007

Sanog, K., Binam, J., B. J., Villamor, G. B., Kalinganire, A., & Dodiomon, S. (2017). Farmers' Perceptions of Climate Change Impacts on Ecosystem Services Delivery of Parklands in Southern Mali. Agroforestry Systems, 1– 17. https://doi.org/10.1007/s10457-016-9933-z

Silvestri, S., Bryan, E., Ringler, C., Herrero, M., & Okoba, B. (2012). Climate change perception and adaptation of agro-pastoral communities in Kenya. Regional Environmental Change, 12(4), 791–802. DOI: https://doi.org/10.1007/s10113-012-0293-6

Suvedi, M. Ghimire, R. Kaplowitz, M. (2017). Farmers' participation in extension programs and technology adoption in rural Nepal: a logistic regression analysis, Journal of Agricultural Education and Extension. 23351– 371. https://doi.org/10.1080/1389224X.2017.1323653.

Simelton, E., Quinn, C. H., Batisani, N., Dougill, A. J., Dyer, J. C., Fraser, E. D. G., Mkwambisi, D., Sallu, S., & Stringer, L. C. (2013). Is rainfall really changing? Farmers' perceptions, meteorological data, and policy implications. Climate and Development, 5(2), 123– 138. https://doi.org/10.1080/17565529.2012.751893

Article DOI : https://doi.org/10.37284/ajccrs.3.1.2511

Skoufias, E., Rabassa, M., & Olivieri, S. (2011). The poverty impacts of climate change: A review of the evidence. https://doi.org/10.1596/1813-9450-5622

Suvedi, M., Ghimire, R., & Kaplowitz, M. (2017). Farmers' participation in extension programs and technology adoption in rural Nepal: a logistic regression analysis. Journal of Agricultural Education and Extension, 23(4), 351– 371. https://doi.org/10.1080/1389224X.2017.1323653

Thi Lan Huong, N., Shun Bo, Y., & Fahad, S. (2017). Farmers' perception, awareness and adaptation to climate change: evidence from northwest Vietnam. International Journal of Climate Change Strategies and Management, 9(4), 555– 576. https://doi.org/10.1108/IJCCSM-02-2017-0032

Uddin, M. N., Bokelmann, W., & Dunn, E. S. (2017). Determinants of farmers' perception of Climate change: A case study from the coastal region of Bangladesh. American Journal of Climate Change, 06(01),), 151–165. DOI: 10.4236/ajcc.2017.61009

Waaben T. A., Habimana, D., Joshi, I., & Mumuli O. 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

Yamane, T. (1967). Statistics An Introductory Analysis. (2nd Edition).: Harper and Row. https: //www.scirp.org/(S(i43dyn45teexjx455qlt3d2q))/ reference/ReferencesPapers.aspx?ReferenceID=1440506 (accessed September 30, 2023).

Zake, J., & Hauser, M. (2014). Farmers' perceptions of the implementation of climate variability disaster preparedness strategies in Central Uganda. Environmental Hazards, 13(3), 248– 266. https://doi.org/10.1080/17477891.2014.910491

