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The Impact of Drought Caused by Climate Change on Farmers in Jowhar District, Somalia

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The Impact of Drought Caused by Climate Change on Farmers in Jowhar District, Somalia

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Abstract
Climate change has become one of the most significant environmental challenges affecting agricultural production and rural livelihoods worldwide.
In Somalia, prolonged droughts and irregular rainfall patterns have severely affected agricultural communities, particularly in Jowhar District of the Middle Shabelle Region.
This study assessed the impact of drought caused by climate change on farmers in Jowhar District.
A descriptive survey research design was employed, and primary data were collected from 100 farmers using structured questionnaires selected through simple random sampling. Descriptive statistics were used to analyze the collected data.
The findings revealed that 88% of respondents experienced drought during the previous five years.
Water scarcity (95%), reduced crop production (90%), food insecurity (88%), reduced household income (85%), and livestock losses (70%) were identified as the major effects of drought.
Most respondents also observed increased rainfall variability (92%), reduced rainfall reliability (89%), and more frequent extreme weather events (85%).
Farmers adopted several coping strategies, including planting drought-resistant crops, borrowing money, and selling livestock. Long-term adaptation measures identified by respondents included improved irrigation systems, climate-smart agriculture, drought-resistant crop varieties, and water harvesting.
However, financial constraints, inadequate infrastructure, limited farmer training, and insufficient institutional support continue to hinder effective adaptation.
The study concludes that climate change-induced drought poses a serious threat to agricultural productivity, food security, and the livelihoods of farmers in Jowhar District.
Strengthening irrigation infrastructure, promoting climate-smart agricultural practices, improving access to extension services, and enhancing government and NGO support are recommended to improve resilience against future droughts.
Keywords: Climate change, drought, agriculture, food security, farmers, Jowhar District, Somalia.

1. Introduction
Climate change is increasingly recognized as one of the most serious global environmental challenges affecting agricultural production, rural livelihoods, and food security.
Rising temperatures, changing rainfall patterns, and the increasing frequency of extreme weather events have intensified drought conditions across many parts of Sub-Saharan Africa.
Because agriculture in the region depends heavily on seasonal rainfall, farming communities remain highly vulnerable to climate variability.
Somalia is among the countries most severely affected by climate change due to its predominantly arid and semi-arid climate. Agriculture remains a major source of livelihood for a large proportion of the population, making climatic shocks particularly damaging.
In recent years, recurrent droughts have reduced agricultural productivity, threatened livestock production, increased food insecurity, and weakened rural economies.
Jowhar District, located in the Middle Shabelle Region, is one of Somalia's most important agricultural areas. Farmers depend primarily on seasonal rainfall and the Shabelle River for crop production.

However, increasingly unpredictable rainfall patterns, prolonged dry spells, and occasional flooding have disrupted traditional farming systems, resulting in declining crop yields and increasing economic hardship among farming households.
Despite growing concern regarding climate change and drought in Somalia, limited research has focused specifically on farmers in Jowhar District.
Understanding how drought affects agricultural production, household income, food security, and farmers' adaptive capacity is essential for developing effective intervention strategies.

Therefore, this study aimed to assess the impact of drought caused by climate change on farmers in Jowhar District. Specifically, the study examined the effects of drought on crop production, household income, food security, and the adaptation strategies adopted by farmers to cope with changing climatic conditions.
The findings are expected to contribute to improved policy formulation and the development of sustainable agricultural practices that strengthen resilience to climate change in Somalia.

2. Materials and Methods

2.1 Study Area

The study was conducted in Jowhar District, located in the Middle Shabelle Region of Somalia. Jowhar is one of the country's major agricultural areas, where farming activities depend largely on seasonal rainfall and water from the Shabelle River.
The district is characterized by mixed farming systems involving crop cultivation and livestock production.
In recent years, the area has experienced increasing climate variability, including prolonged droughts, erratic rainfall, and occasional flooding, all of which have adversely affected agricultural productivity and farmers' livelihoods.

2.2 Research Design

A descriptive survey research design was employed to assess the impact of drought caused by climate change on farmers in Jowhar District.
This design was selected because it enables the collection of quantitative data from a large number of respondents and facilitates the description of existing conditions, experiences, and adaptation practices among farming households.

2.3 Target Population

The target population comprised farmers residing and practicing agriculture in Jowhar District.
The study included crop farmers and mixed farmers who had firsthand experience of drought and climate-related agricultural challenges.

2.4 Sample Size and Sampling Technique

A sample of 100 farmers was selected for the study.
The sample size was determined using Yamane's formula with a 5% margin of error. Simple random sampling was applied to ensure that every eligible farmer had an equal opportunity to participate in the study, thereby minimizing selection bias and improving the representativeness of the sample.

2.5 Data Collection

Both primary and secondary data were used in this study.
Primary data were collected through structured questionnaires administered directly to farmers. The questionnaire gathered information on demographic characteristics, experiences with drought, agricultural production, livelihood impacts, adaptation strategies, and institutional support.
Secondary information was obtained from published literature, journal articles, reports from government institutions, and publications by organizations such as the Food and Agriculture Organization (FAO) and the World Food Programme (WFP).

2.6 Data Analysis

The collected data were coded, entered, and analyzed using descriptive statistical techniques.

Frequencies and percentages were calculated to summarize respondents' characteristics, drought experiences, perceived impacts, and adaptation measures. The findings are presented using tables accompanied by descriptive interpretations.

2.7 Validity and Reliability

To enhance the validity of the research instrument, the questionnaire was reviewed by academic supervisors before data collection.

Reliability was promoted by administering the same structured questionnaire to all respondents using consistent procedures and standardized questions.

2.8 Ethical Considerations

Ethical principles were observed throughout the research process. Respondents were informed about the objectives of the study before participation, and informed consent was obtained from each participant.

Participation was voluntary, and respondents were assured that all information provided would remain confidential and would be used exclusively for academic research purposes.

3. Results

3.1 Demographic Characteristics of Respondents

A total of 100 farmers participated in this study.

The demographic characteristics of the respondents are presented in Table 1.

Table 1. Demographic Characteristics of Respondents (N = 100)

Variable	Category	Frequency	Percentage (%)
Gender	Male	60	60
	Female	40	40
Age (years)	18–35	50	50
	36–45	25	25
	46–60	25	25
Farming Experience	1–5 years	25	25
	6–10 years	25	25
	11–20 years	25	25
	Above 20 years	25	25

The results indicate that male respondents constituted the majority (60%), while females accounted for 40%.

Half of the respondents (50%) were aged between 18 and 35 years, suggesting active participation of young people in agricultural production.

Farming experience was evenly distributed across all categories, indicating that drought affects both inexperienced and experienced farmers.

3.2 Experience and Severity of Drought

Table 2 presents respondents' experience with drought during the previous five years and their assessment of drought severity.

Table 2. Experience and Severity of Drought

Variable	Category	Frequency	Percentage (%)

Experienced drought during the last five years	Yes	88	88
	No	12	12
Severity of drought	Very severe	38	38
	Severe	25	25
	Moderate	25	25
	Mild	12	12

The majority of respondents (88%) reported experiencing drought during the previous five years.
Furthermore, 63% described the drought as either severe or very severe, demonstrating that climate-related drought has become a major challenge for agricultural production in Jowhar District.

3.3 Effects of Drought on Farmers

The major impacts of drought reported by respondents are presented in Table 3.

Table 3. Effects of Drought on Farmers

Impact	Frequency	Percentage (%)
Water scarcity	95	95
Reduced crop production	90	90
Food insecurity	88	88
Reduced household income	85	85
Livestock loss	70	70

Water scarcity was identified as the most serious consequence of drought (95%), followed by reduced crop production (90%), food insecurity (88%), reduced household income (85%), and livestock loss (70%).
These findings demonstrate that drought has significant environmental, economic, and social impacts on farming households.

3.4 Changes in Rainfall Patterns

Respondents were asked about changes in rainfall patterns associated with climate change.

Table 4. Perceived Changes in Rainfall Patterns

Observation	Frequency	Percentage (%)
Increased rainfall variability	92	92
Reduced rainfall reliability	89	89
Increased extreme weather events	85	85

Most respondents observed increasing rainfall variability (92%), decreasing rainfall reliability (89%), and more frequent extreme weather events (85%).
These findings indicate that rainfall has become increasingly unpredictable, making agricultural planning more difficult.

3.5 Crops Most Affected by Drought

Table 5 summarizes the crops reported to be most affected by drought.

Table 5. Crops Most Affected by Drought

Crop	Frequency	Percentage (%)

Maize	85	85
Sesame	80	80
Vegetables	78	78
Sorghum	65	65
Rice	60	60

Maize (85%) and sesame (80%) were reported as the crops most severely affected by drought, followed by vegetables (78%), sorghum (65%), and rice (60%).
The results suggest that drought threatens both household food security and farmers' incomes.

3.6 Coping and Adaptation Strategies

Farmers employed several strategies to cope with drought and improve resilience.

Table 6. Coping Strategies Used by Farmers

Strategy	Frequency	Percentage (%)
Planting drought-resistant crops	80	80
Borrowing money	75	75
Selling livestock	70	70

Planting drought-resistant crop varieties (80%) was the most commonly reported coping strategy.
Other measures included borrowing money (75%) and selling livestock (70%), indicating that many households relied on short-term survival mechanisms during drought periods.

3.7 Long-Term Adaptation Measures

Table 7 presents respondents' preferred long-term adaptation measures ▪

Table 7. Long-Term Adaptation Measures

Improved irrigation systems (90%) were identified as the most effective long-term adaptation strategy, followed by climate-smart agriculture (88%), drought-resistant crop varieties (85%), and water harvesting (78%).

Strategy	Frequency	Percentage (%)
Irrigation systems	90	90
Climate-smart agriculture	88	88
Drought-resistant crops	85	85
Water harvesting	78	78

3.8 Challenges to Climate Change Adaptation

The principal barriers to effective adaptation are presented in Table 8.

Table 8. Challenges Limiting Adaptation

Challenge	Frequency	Percentage (%)
Water shortage	92	92
Financial constraints	90	90
Poor infrastructure	85	85
Limited farmer training	80	80

Water shortage (92%) was the most significant challenge reported by respondents, followed by financial constraints (90%), poor infrastructure (85%), and limited training opportunities (80%).
These barriers reduce farmers' capacity to adopt effective adaptation measures.

3.9 Government and NGO Support

Respondents also assessed the level of support received from government institutions and non-governmental organizations.

Table 9. Perceived Institutional Support

Level of Support	Frequency	Percentage (%)
Sufficient	30	30
Insufficient	70	70

The majority of respondents (70%) believed that support provided by government institutions and NGOs was insufficient to effectively address the impacts of drought.
This finding suggests the need for stronger institutional interventions to enhance farmers' resilience to climate change.

4. Discussion

The findings of this study demonstrate that drought associated with climate variability has substantial effects on agricultural production, household livelihoods, and food security among farmers in Jowhar District.
The high proportion of respondents who experienced drought during the previous five years indicates that drought is a widespread challenge affecting farming communities in the study area.
Furthermore, the finding that 63% of respondents characterized drought conditions as severe or very severe demonstrates the magnitude of climate-related pressures facing agricultural households.

4.1 Drought Experience and Agricultural Vulnerability

The finding that 88% of respondents had experienced drought within the previous five years demonstrates the high exposure of farmers in Jowhar District to drought conditions.
This exposure is particularly important because agricultural production in the district depends heavily on rainfall and water from the Shabelle River.
Changes in rainfall timing and availability can therefore have immediate consequences for crop production. The reported severity of drought also suggests that farmers are not experiencing drought merely as an occasional environmental disturbance but as a recurring threat to agricultural livelihoods.
The vulnerability observed among farmers is further influenced by their dependence on agriculture as a source of food and income. When drought reduces water availability and agricultural production simultaneously, farmers may have limited alternatives for maintaining household livelihoods.

4.2 Effects of Drought on Agricultural Production and Livelihoods

Water scarcity emerged as the most frequently reported effect of drought, affecting 95% of respondents.
This finding demonstrates the central role of water availability in determining agricultural productivity in Jowhar District.
Reduced access to water can directly affect crop establishment, growth, and productivity while also limiting the availability of water for livestock and household needs.
Reduced crop production was reported by 90% of respondents.

This finding indicates that drought represents a major constraint on agricultural productivity in the district.
Insufficient rainfall, declining water availability, and prolonged dry conditions can disrupt planting and harvesting cycles and increase the likelihood of crop failure.
The economic consequences were also substantial.
Approximately 85% of respondents reported reductions in household income.
Because agricultural production represents an important livelihood activity for the farmers included in the study, reductions in crop production can translate directly into declining household earnings.

Food insecurity was reported by 88% of respondents, further demonstrating the connection between drought, agricultural productivity, income, and household welfare.

When households experience declining production and reduced purchasing power simultaneously, their ability to obtain sufficient food becomes increasingly constrained.

Livestock losses were reported by 70% of respondents.

Although crop farming represents a major component of agricultural production in the study area, livestock also contributes to household livelihoods. Consequently, drought can create multiple pressures by affecting both crop and livestock production.

Taken together, these findings demonstrate that drought is not simply an agricultural production problem. Rather, its impacts extend across water availability, household income, food security, and livestock assets, creating interconnected vulnerabilities among farming households.

4.3 Climate Change and Rainfall Variability

The results indicate considerable changes in farmers' perceptions of rainfall patterns.

Increased rainfall variability was reported by 92% of respondents, while 89% indicated that rainfall had become less reliable.

Furthermore, 85% reported increased extreme weather events.

These observations demonstrate the difficulties farmers face when making decisions regarding planting, crop selection, irrigation, and harvesting.

Traditional agricultural calendars depend on a certain degree of predictability in the timing and distribution of rainfall. When rainfall becomes increasingly irregular, farmers face greater uncertainty when deciding when to prepare land and plant crops.

The findings also indicate that agricultural challenges in Jowhar are associated with climatic instability rather than drought alone.

Farmers reported experiences involving both prolonged dry conditions and extreme weather events.

Such variability increases the complexity of agricultural adaptation because farming systems must become resilient to different forms of climatic stress.

4.4 Effects of Drought on Major Crops

The results revealed variation in the reported effects of drought across major crops cultivated in the study area.

Maize was identified as the most affected crop, reported by 85% of respondents, followed by sesame at 80%, vegetables at 78%, sorghum at 65%, and rice at 60%.

The reported effects across all five crop categories indicate that drought represents a broad agricultural challenge rather than one restricted to a particular crop.

The high reported impact on maize is especially important because reductions in staple crop production can directly affect household food availability.

At the same time, drought impacts on sesame, vegetables, sorghum, and rice may affect both household consumption and income-generating opportunities.

Consequently, repeated drought conditions have the potential to weaken agricultural livelihoods through simultaneous reductions in food production and farm income.

4.5 Farmers' Coping Strategies

Farmers in Jowhar District have developed different strategies to manage the immediate impacts of drought.

Planting drought-resistant crops was reported by 80% of respondents, while 75% relied on borrowing money and 70% reported selling livestock.

The adoption of drought-resistant crops demonstrates farmers' willingness to adjust agricultural practices in response to changing environmental conditions.

Such adjustments represent an important component of agricultural adaptation because they attempt to maintain production under conditions of reduced water availability.

However, borrowing money and selling livestock represent coping mechanisms with potential long-term economic consequences. Borrowing may provide immediate financial resources during periods of crop failure, but it may also increase household financial obligations. Similarly, selling livestock can provide short-term income but reduces productive household assets.

The findings therefore indicate that although farmers are actively responding to drought, some of their responses primarily address immediate survival needs rather than strengthening long-term resilience.

4.6 Long-Term Adaptation Strategies

Respondents identified several measures that could strengthen long-term resilience to drought.

Improved irrigation systems were supported by 90% of respondents, making them the most frequently identified adaptation measure.

Climate-smart agriculture was identified by 88%, drought-resistant crops by 85%, and water harvesting by 78% of respondents.

The strong preference for irrigation reflects farmers' concerns regarding unreliable rainfall and water scarcity. Improving irrigation could potentially reduce dependence on rainfall by providing farmers with alternative sources or mechanisms for supplying water to crops.

Climate-smart agricultural practices and drought-resistant crops were also considered important because they can support farming under changing climatic conditions.

Water harvesting could further improve resilience by allowing available water to be captured and stored for periods when rainfall becomes insufficient.

These findings indicate that effective adaptation requires a combination of improved agricultural practices and stronger water-management systems rather than dependence on a single intervention.

4.7 Barriers to Effective Adaptation

Despite farmers' awareness of potential adaptation measures, several major barriers limit their ability to implement these strategies.

Water shortage was reported as a challenge by 92% of respondents, followed by financial constraints at 90%, poor infrastructure at 85%, and limited farmer training at 80%.

These findings demonstrate an important difference between farmers' awareness of adaptation strategies and their ability to implement them.

For example, although improved irrigation was identified as the preferred adaptation strategy, establishing or improving irrigation systems requires financial resources, infrastructure, technical expertise, and reliable access to water.

Similarly, adopting climate-smart agricultural practices may be difficult when farmers have limited access to training and agricultural extension services.

Therefore, strengthening farmers' resilience requires addressing the structural barriers preventing them from adopting appropriate adaptation strategies.

4.8 Government and NGO Support

Institutional support represents another important component of climate change adaptation.

However, 70% of respondents considered the support received from government institutions and NGOs to be insufficient, compared with only 30% who considered it sufficient.

This finding suggests a gap between the level of assistance available to farmers and the scale of the drought-related challenges they experience.

Farmers require support that extends beyond emergency responses during periods of severe drought. Long-term interventions addressing irrigation infrastructure, farmer training, access to agricultural resources, water management, and financial assistance are necessary for improving resilience.

Stronger coordination among government institutions, NGOs, development partners, and farming communities could therefore improve the effectiveness and sustainability of adaptation interventions.

4.9 Overall Implications of the Findings

Overall, the findings demonstrate that drought represents a multidimensional challenge to farmers in Jowhar District. Its effects extend beyond declining agricultural production to include water scarcity, food insecurity, reduced household income, livestock losses, and financial vulnerability.

Farmers are already adopting different coping and adaptation strategies, but their ability to build long-term resilience remains constrained by inadequate financial resources, poor infrastructure, limited training, water shortages, and insufficient institutional support.

Addressing these interconnected challenges therefore requires an integrated approach combining improved irrigation and water management, climate-smart agricultural practices, drought-resistant crop varieties, farmer capacity building, financial assistance, and strengthened institutional support.

Such interventions could reduce farmers' vulnerability to drought while supporting more resilient and sustainable agricultural production in Jowhar District.

5. Conclusion

This study assessed the impact of drought caused by climate change on farmers in Jowhar District, Somalia.

The findings demonstrate that drought has become a major challenge affecting agricultural production, household livelihoods, and food security in the study area.

Most respondents reported experiencing drought during the previous five years, with many describing the drought as severe or very severe.

The increasing variability and unpredictability of rainfall have significantly disrupted farming activities and reduced agricultural productivity.

The study identified water scarcity, reduced crop production, food insecurity, declining household income, and livestock losses as the principal effects of drought on farming communities.

These impacts indicate that climate change is affecting not only agricultural output but also the socio-economic well-being of rural households that depend on agriculture for their livelihoods.

Farmers have adopted several coping and adaptation strategies, including planting drought-resistant crops, borrowing money, selling livestock, improving irrigation systems, practicing climate-smart agriculture, and implementing water-harvesting techniques.

However, the effectiveness of these measures is limited by persistent challenges such as water shortages, financial constraints, poor infrastructure, limited access to agricultural training, and inadequate institutional support.

The findings further reveal that government and NGO assistance is widely perceived as insufficient to address the increasing impacts of drought .

Strengthening institutional support through improved agricultural extension services, investment in irrigation infrastructure, farmer capacity building, and climate adaptation programs will be essential for enhancing resilience among farming communities.

Overall, the study concludes that climate change-induced drought poses a serious threat to sustainable agriculture in Jowhar District.

Addressing this challenge requires coordinated efforts among government agencies, development partners, non-governmental organizations, and local communities to promote climate-resilient agricultural practices, improve water resource management, strengthen farmers' adaptive capacity, and ensure long-term food security and sustainable rural development.

Declarations;

Ethics approval and consent to participate:

Ethical principles were observed throughout the research process.

All participants were informed about the purpose of the study before participation , and informed consent was obtained from all participants.

Participation was voluntary and participants were assured that the information provided would remain confidential and would be used solely for academic research purposes.

Consent for Publication;

Not applicable

Competing interests:

The authors declare that they have no competing interest

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6. Recommendations
Based on the findings of this study, the following recommendations are proposed:

Strengthen Irrigation Infrastructure:
Government agencies and development partners should rehabilitate and expand irrigation systems to ensure a reliable water supply for agricultural production during drought periods.

Promote Climate-Smart Agriculture:
Agricultural extension services should encourage the adoption of climate-smart farming practices, including conservation agriculture, efficient water management, and sustainable soil management.

Improve Access to Drought-Resistant Crops:
Farmers should be supported through the distribution of improved drought-resistant crop varieties such as maize, sorghum, and sesame to enhance agricultural productivity under changing climatic conditions.

Enhance Farmer Training and Extension Services:
Regular training programs should be provided to improve farmers' knowledge and skills in drought preparedness, climate adaptation, irrigation management, and sustainable agricultural practices.

Increase Financial and Institutional Support:
Government institutions, non-governmental organizations (NGOs), and development partners should expand access to agricultural credit, subsidies, and climate adaptation funding to enable farmers to invest in resilience-building measures.

Strengthen Early Warning Systems:
Reliable weather forecasting and early warning systems should be improved to provide farmers with timely information on rainfall patterns, drought risks, and appropriate adaptation measures.

Promote Water Harvesting Technologies:
Investment in water harvesting and storage facilities should be encouraged to improve water availability during prolonged dry seasons.

Support Climate Adaptation Policies:
Policymakers should develop and effectively implement agricultural climate adaptation policies that strengthen resilience, improve food security, and promote sustainable rural development in Somalia.

References
Akanbi, A. K., & Masinde, M. (2018).
Drought early warning systems using indigenous knowledge.
Biasutti, M., & Sobel, A. H. (2009).
Delayed seasonal cycle and African monsoon in a warmer climate.
Boyd, E. (2019).
Climate change and the politics of adaptation. Routledge.
Di Baldassarre, G., et al. (2018).
Drought and flood risk management in changing climates.
Nature Climate Change, 8(7), 638–643.
Food and Agriculture Organization (FAO). (2025).
Seeds of Resilience: Supporting Farmers in Somalia.
Food and Agriculture Organization (FAO). (2026).
FAO Somalia: Emergency and Resilience Programme.
Food and Agriculture Organization (FAO). (2026).
Anticipatory Action and Climate Resilience in Somalia.
Funk, C., Peterson, P., Landsfeld, M., et al. (2015).
The climate hazards infrared precipitation with stations (CHIRPS) dataset.
Scientific Data, 2, 150066.
Hussein, J., Gidey, E., Bilotto, F., Mbui, D., & Sircely, J. (2025).

Spatiotemporal variability of meteorological droughts and pasture resilience in Somalia.
Discover Sustainability.
Kaabe, A. A. O., Hassan, S. M., & Mohamed, M. J. (2022).
Drought effects in Somalia and solution proposals.
African Journal of Climate Change and Resource Sustainability.
Morton, J. F. (2007).
The impact of climate change on smallholder and subsistence agriculture.
Proceedings of the National Academy of Sciences, 104(50), 19680–19685.
Nicholson, S. E. (2017).
Climate and climatic variability of rainfall over eastern Africa.
Climate Research, 69(2–3), 111–134.
Ogallo, L. A., Omondi, P., Ouma, G., & Wayumba, G. (2018).
Climate change projections and associated impacts for Somalia.
American Journal of Climate Change.
Washington, R., & Harrison, M. (2013).
Climate change in East Africa:
Rainfall and drought patterns.
Philosophical Transactions of the Royal Society A, 371(2002), 20120496.
World Food Programme. (2024–2026).
Somalia Food Security Reports.
World Weather Attribution. (2023). *Climate change behind the Horn of Africa drought.*