

Climate Change and Crop Production in Somalia: Impacts and Adaptation Strategies-A Review

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Abstract: Climate change and climate variability are important challenges for crop production in Somalia, where agricultural systems are highly exposed to changes in rainfall and temperature. This review synthesizes published empirical studies, climate analyses, farmer-based studies, and relevant institutional evidence on the effects of climate variability on crop production and the adaptation strategies used or proposed in Somalia. The reviewed evidence shows that rainfall variability, rising temperature, drought, and flooding influence crop production, but the magnitude and direction of effects differ among crops and production systems. National and crop-specific studies indicate that sorghum, maize, wheat, beans, rice, and other crops respond differently to climatic conditions. The literature also identifies irrigation, water harvesting, climate-resilient and early-maturing varieties, crop diversification, intercropping, soil and water conservation, improved agronomic practices, and access to climate information as important adaptation measures. Farmers' ability to implement these practices is influenced by access to water, improved seed, finance, information, extension services, and appropriate technologies. Strengthening irrigation and water management, seed systems, agricultural research, extension services, climate information, and early-warning systems is therefore important for sustaining crop production and improving agricultural resilience in Somalia.

Keywords: Climate Change, Crop Production, Drought, Rainfall Variability, Temperature, Agricultural Adaptation, Climate Resilience, Somalia.

INTRODUCTION

Understanding the effects of climate change on crop production in Somalia requires attention to differences among crops rather than relying only on aggregate measures of agricultural production. A national empirical study based on data from 1985 to 2016 found that rainfall was positively associated with crop production in the long run but negatively associated in the short run, while temperature had negative effects in both periods (Warsame AA *et al.*, 2021). More recent crop-specific evidence using annual data from 1991 to 2019 similarly shows that climatic factors do not affect all crops in the same way: increased precipitation was associated with higher long-run production of sorghum, sugarcane, and bananas but lower bean production, while temperature increases negatively affected the long-run production of sorghum, rice, and beans (Abdi AH *et al.*, 2024).

The vulnerability of crop production to climate variability in Somalia is also evident from crop-level and field-based studies conducted in different agricultural environments. In southern Somalia, an analysis of ten years of climate and yield data showed that the success of rain-fed maize production was strongly related to the amount and timing of seasonal rainfall, while the local cowpea variety had a lower yield potential but a lower risk of crop failure because of its lower minimum water requirement (Rees DJ *et al.*, 1991). More recent evidence from national data covering 1980–2017 indicates that rising average temperature significantly reduced sorghum production in the long run, whereas average rainfall showed a positive, although statistically insignificant, relationship with sorghum output (Warsame AA *et al.*, 2022).

National-level analyses provide important evidence on the relationship between climate variables and crop production, but farm- and location-specific

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studies are also necessary to understand how climatic variability is experienced by farmers. In Afgooye District of Lower Shebelle, a survey of maize farmers found that changes in rainfall pattern, intensity, and frequency were associated with maize production, illustrating the importance of seasonal rainfall conditions at the local level (Ahmed AE, 2023). Similarly, research among sorghum farmers in Baki District, Awdal Region, found that 78% of respondents experienced a high level of drought impact on sorghum production, with crop failure identified as the most prominent impact; farmers identified drought-tolerant varieties, short-duration varieties, water harvesting, and improved weather information as important adaptation options (Ali MA *et al.*, 2023).

Climate-related effects on crop production in Somalia are closely connected with other agricultural and socioeconomic factors that influence farmers' ability to maintain production. A national study of maize production for 1980–2018 found that temperature, rainfall, and political instability significantly influenced maize production, although the effect of rainfall differed between the short and long run (Warsame AA *et al.*, 2023a). More recent evidence covering 1990–2022 also examined the relationship between climate change and crop production while considering broader economic factors, with the results showing a long-run relationship among the variables included in the model (Samatar EH, 2024).

Climate-related pressures on Somali crop production cannot be considered separately from environmental degradation and the broader agricultural production system. Evidence from Somalia indicates that environmental pollution and degradation are associated with crop-production challenges, including pressures linked to land and resource conditions (Warsame AA & Abdi AH, 2023). In addition, a recent VECM analysis found that rainfall, temperature, agricultural land, labour, and carbon dioxide emissions have different short- and long-run relationships with crop production, demonstrating the importance of considering climatic and production factors together (Nur AM & Sheikh Ali AY, 2025).

Farmers' ability to respond to climate variability is also influenced by access to timely and reliable climate information. In Hiran Region, research identified access to climate information as an important issue for smallholder farmers and examined the factors influencing their access to such information, particularly in relation to climate-change adaptation and food security (Odawa AA *et al.*, 2024). At the agricultural-system level, evidence from Somalia further shows that

compound climate hazards and existing socioeconomic vulnerabilities can constrain the capacity of affected populations to respond effectively to climate risks (Thalheimer L *et al.*, 2023).

Adaptation measures are increasingly being considered as an essential component of maintaining crop production under changing climatic conditions in Somalia. Evidence from the sorghum, maize, and sesame value chains indicates that farmers are already using practices such as irrigation, crop diversification, intercropping, and soil and water conservation, although access to irrigation facilities, quality seed, and appropriate technologies remains limited (Abdi NY, 2024). Somalia's climate policy also identifies climate-resilient crop varieties, diversified land-use practices, small-scale irrigation, water harvesting, and improved water-conservation technologies as important measures for strengthening the resilience of agriculture to climate-related stresses (Ministry of Environment and Climate Change, 2020).

2. CLIMATE CHANGE AND CLIMATE VARIABILITY IN SOMALIA

Rainfall in Somalia is characterized by substantial spatial and seasonal variability, with the main rainy periods occurring during the Gu and Deyr seasons. Analysis of rainfall data from 1991 to 2020 showed that the Deyr season generally had greater interannual variability than the Gu season, while annual rainfall exhibited a non-significant increasing trend at the national scale (Farah MM & Limbu PTS, 2023). In contrast, a more recent analysis of four important agricultural locations—Jowhar, Afgooye, Qoryoley, and Baydhabo—using rainfall data from 1981 to 2020 identified significant increasing trends in annual rainfall and in the Deyr season, whereas the increasing trend during the Gu season was not statistically significant (Ibrahim YM & Hashi MF, 2026).

Temperature change is an important component of climate variability in Somalia, with warming trends documented in several parts of the country. Analysis of 41 years of temperature records from stations in Puntland showed an overall warming trend between 1980 and 2020, with minimum temperatures increasing significantly at Bossaso, Qardho, and Garowe; the estimated increases were approximately 0.3°C, 0.2°C, and 0.4°C per decade, respectively (Muse NM *et al.*, 2023). At the crop-production level, recent evidence from Somalia indicates that higher temperatures are associated with reductions in the long-run production of several major crops, including sorghum, rice, and beans, although the magnitude and direction of the effect differ across crops and time horizons (Abdi AH *et al.*, 2024).

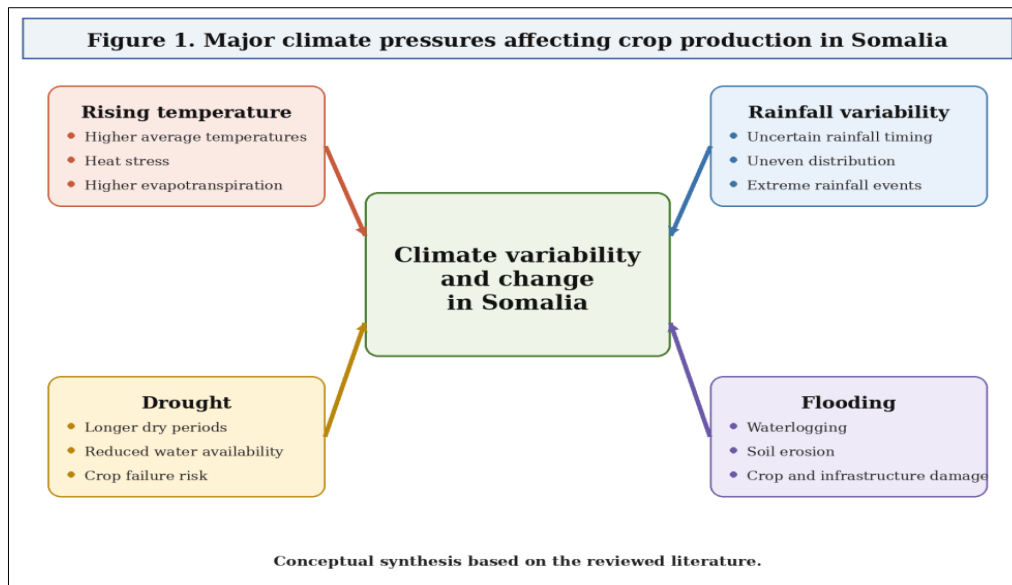


Figure 1: Major climate pressures affecting crop production in somalia

Drought is one of the major climatic stresses affecting crop production in Somalia, with prolonged water shortages contributing to reduced agricultural productivity and crop failures. A review of drought impacts in Somalia found that recurrent droughts have affected agricultural production through reduced crop output, declining water availability, and disruption of rural livelihoods, with the prolonged drought of 2022 producing particularly severe agricultural and food-security consequences (Ahmed AH & Ali II, 2024). Flooding presents a contrasting but related challenge, especially in riverine agricultural areas such as Jowhar in Hirshabelle, where both drought and flood conditions influence crop production; a recent mixed-method study found that farmers used measures such as contour plowing, bunds, early-maturing varieties, and mulching to respond to these hazards (Olaniyan AO *et al.*, 2025).

3. Impacts of Climate Change on Crop Production in Somalia

Climate variability has measurable effects on the productivity of Somalia's agricultural sector, although the magnitude of the effect differs according to the climate variable and crop considered. Using annual data from 1990 to 2021, Abdi *et al.*, found that rainfall contributed positively to food production, while higher temperatures reduced agricultural output, indicating that changes in climatic conditions can influence overall production performance (Abdi AH *et al.*, 2025). More recent evidence covering seven strategic crops—maize, sorghum, cowpea, sesame, rice, banana, and lime—showed that rainfall anomalies were positively associated with crop profitability, while climate and conflict conditions jointly influenced the economic performance of these crops (Mohamud MH & Abukar BY, 2026).

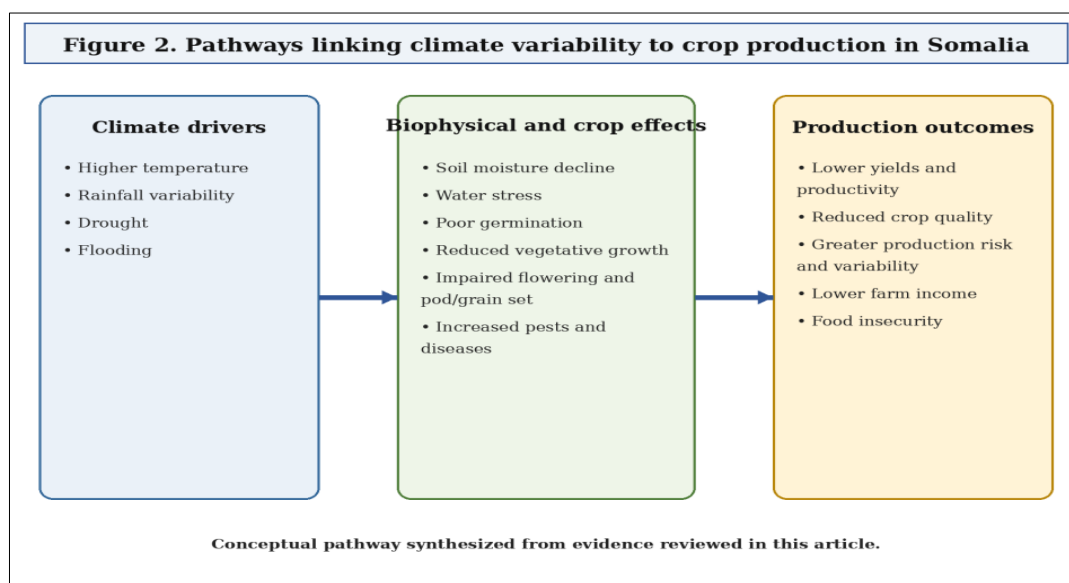


Figure 2: Pathways linking climate variability to crop production in Somalia

Somalia's crop production includes both rainfed and irrigated systems, but water availability remains a major factor determining production performance. The National Water Resource Strategy estimates that about 2.3 million hectares of cultivable land could be used under dryland conditions, while around 700,000 hectares have potential for irrigation, of which less than 115,000 hectares were being cultivated under irrigation at the time of the strategy (Ministry of Energy and Water Resources, 2021). In the major-crop literature, irregular precipitation is identified as a particular constraint for rainfed crops such as sorghum, maize, millet, beans, and vegetables, while water-intensive crops such as rice and sugarcane are more dependent on reliable water supplies (Abdi AH *et al.*, 2024).

Changes in water availability can directly influence crop growth, yield, and irrigation requirements in Somalia, particularly in semi-arid production areas. A recent study in Beledweyne District estimated the water requirements of tomato, maize, sweet pepper, and sorghum using 20 years of meteorological data and showed that crop water requirements and irrigation schedules vary according to climatic conditions and crop characteristics (Osman HM, 2026). Experimental evidence from Mogadishu also found that reducing irrigation levels affected carrot growth and yield, while full irrigation produced higher growth and yield outcomes and deficit irrigation influenced water-use efficiency (Warsame SA *et al.*, 2026).

4. CROP-SPECIFIC IMPACTS

4.1 Sorghum

Sorghum is one of the principal cereal crops grown in Somalia and is widely cultivated under semi-arid conditions because of its relatively strong tolerance to water limitation. National crop-level analysis indicates that changes in temperature and precipitation affect sorghum production, with higher temperature associated with lower long-run output, while rainfall has a positive

but statistically insignificant long-run relationship with production (Abdi AH *et al.*, 2024). Field-based research in Burao District, Somaliland, further reports that inconsistent rainfall, prolonged dry periods, and drought have contributed to declining sorghum yields in predominantly rainfed production systems (Ahmed SM *et al.*, 2025).

4.2 Maize

Maize production in Somalia is sensitive to both climatic and non-climatic conditions, particularly changes in rainfall and temperature. Using data from 1980–2018, an ARDL-based study found a long-run relationship between maize production, rainfall, temperature, and political instability, with the estimated effects varying between the short and long run (Warsame AA *et al.*, 2023a). More recent research on cereal production in Somalia also found significant relationships between climate variables and cereal output, with temperature and rainfall contributing to changes in production over both short- and long-term periods (Ali DA *et al.*, 2023).

Evidence on crops beyond maize and sorghum indicates that climate effects vary considerably among crop types. A recent ARDL study of wheat production in Somalia, using data from 1986–2019, found a significant long-run relationship between wheat yield and climatic and non-climatic factors; in the short run, increases in both temperature and rainfall were associated with lower wheat yields, indicating the sensitivity of wheat production to climatic variability (Osman MA *et al.*, 2026). In addition, research examining maize, sesame, sorghum, and wheat production in Somalia found significant relationships among environmental conditions and crop production, with sesame, sorghum, and wheat production forming part of the long- and short-run interactions affecting maize and sorghum production (Warsame AA *et al.*, 2023b).

Figure 3. Crop-specific climate sensitivities reported in the literature		
Crop	Main climate sensitivities	Illustrative reported impacts
Sorghum	High temperature • Drought • Erratic rainfall	Reduced yield • Poor grain filling • Shorter growing period
Maize	Rainfall variability • High temperature • Drought	Lower grain yield • Poor pollination • Increased pest pressure
Wheat	High temperature • Rainfall variability • Terminal drought	Yield reduction • Heat stress during grain filling • Lower grain quality
Beans	High temperature • Irregular rainfall • Drought	Poor germination • Reduced pod/grain yield • Greater pest and disease pressure
Rice	Temperature increase • Water availability • Flooding and drought	Reduced yield • Sensitivity to water stress • Damage from floods

Conceptual synthesis of crop-specific sensitivities described in the reviewed studies.

Figure 3: Crop specific climate sensitivities report in the literature

5. ADAPTATION STRATEGIES

5.1 Climate-Resilient Crop Varieties

The use of improved and climate-resilient crop varieties is one of the adaptation measures identified for reducing production losses associated with drought and other climate stresses in Somalia. A study of 222 smallholder farmers in Hiran Region found that 58% of respondents used improved or resistant varieties, while 65% used early-maturing crops as part of their adaptation practices (Odawa AA *et al.*, 2024). More recently, FAO-supported research in Somalia tested sorghum and cowpea varieties for their ability to withstand climate stresses such as heat, pests, and variable rainfall, with the aim of identifying varieties that are better suited to local climatic and soil conditions (FAO, 2026)

5.2 Irrigation and Water Management

Improving access to irrigation and water-management technologies can help farmers reduce dependence on uncertain rainfall and maintain crop production during periods of water stress. A recent study of urban farmers in Mogadishu found that greenhouses and drip irrigation were among the most frequently adopted climate-smart agricultural practices, while inadequate water access remained one of the major constraints to sustained adoption (Nur AH *et al.*, 2026). Similarly, research among smallholder farmers in the Gabiley Region found that farmers adopted water harvesting and irrigation techniques as key adaptation strategies, and farmers' education and farm characteristics influenced their adoption decisions (Omer MA *et al.*, 2025).

5.3 Agronomic Practices and Crop Diversification

Crop diversification and improved agronomic practices can help farmers reduce the risk associated with climatic variability by spreading production across crops with different environmental requirements. In Somalia, farmers in major sorghum, maize, and sesame production areas have adopted crop diversification and intercropping cereals with legumes as measures to reduce the risk of complete crop failure, while soil and water conservation practices have also been introduced in some farming areas (Abdi NY, 2024). In addition, a spatial assessment of soil erosion and aridity in Somalia identified extensive areas with dry conditions and substantial variation in rainfall erosivity, highlighting the importance of soil-conservation and improved land-management practices for maintaining agricultural productivity under climatic stress (Nur AH *et al.*, 2024).

5.4 Climate Information and Early-Warning Systems

Access to timely and usable weather and climate information can support farmers in making decisions about planting, crop management, and preparation for drought or excessive rainfall. A 2026 study involving 60 smallholder farmers in Gedo, Lower Juba, and Lower Shabelle found that many farmers did not receive critical weather and climate information, while the study identified locally relevant communication channels as an important way of improving the usefulness and accessibility of such information (Anderson S *et al.*, 2026). Seasonal forecasting can also support anticipatory action before drought develops; research using seasonal rainfall forecasts found opportunities for forecast-based early action during the October–December season in Somalia and other parts of the Horn of Africa (Busker T *et al.*, 2023).

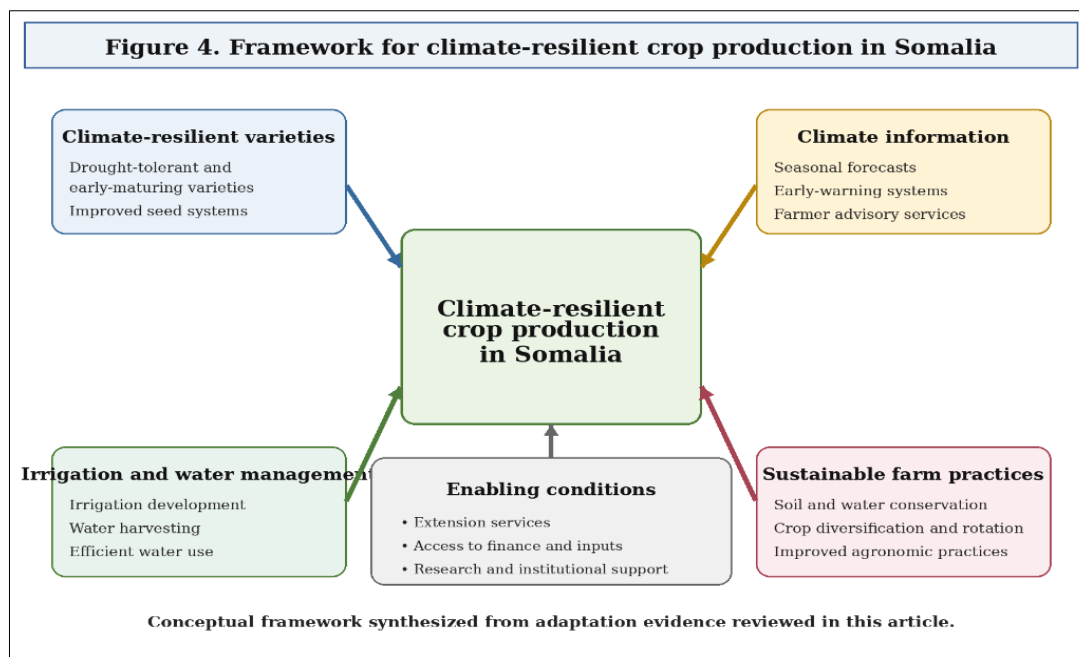


Figure 4: Framework for climate resilient crop production in Somalia

6. FARMERS' ADAPTATION AND AGRICULTURAL RESILIENCE

Farmers' capacity to adapt to climate variability is influenced not only by the availability of adaptation options but also by household resources, knowledge, experience, and access to information. A study of smallholder fodder producers in northwestern Somalia found that household income and climate-change awareness were associated with greater adoption of adaptation measures, while recurrent drought, unpredictable weather, and limited access to timely weather information were reported as major constraints (Hussein J *et al.*, 2024). Similarly, research among 193 farming households in Gabiley Region found high awareness of climate variability and widespread experience of drought, but adoption of adaptation practices remained uneven, with education, market access, household characteristics, and direct experience of climate events influencing adaptation decisions (Omer MA *et al.*, 2025).

7. Recommendations

Improving the resilience of crop production in Somalia requires stronger investment in water and agricultural infrastructure. Irrigation systems should be rehabilitated and expanded in suitable agricultural areas, while small-scale irrigation should be promoted among farmers who depend heavily on uncertain rainfall. Water harvesting, storage facilities, farm ponds, and efficient irrigation methods can help farmers maintain crop production during periods of inadequate rainfall. Greater attention should also be given to proper operation and maintenance of existing irrigation infrastructure so that available water resources can be used efficiently. In rainfed areas, soil and water conservation practices should be promoted to improve moisture retention and reduce losses caused by runoff and soil erosion.

The availability of suitable planting materials is another important area requiring attention. Farmers should have better access to improved, drought-tolerant, heat-tolerant, and early-maturing crop varieties that are appropriate for the different agricultural environments of Somalia. Seed production and distribution systems should be strengthened so that quality seed is available when farmers need it. Research institutions should work more closely with farmers to identify crop varieties that perform well under local conditions and changing rainfall and temperature patterns. Crop diversification and intercropping should also be encouraged where appropriate because depending on a single crop can increase production risks when climatic conditions become unfavorable.

Agricultural extension and climate-information services should be strengthened to improve farmers' ability to respond to changing weather conditions. Extension workers should provide practical training on planting dates, water management, soil conservation, crop diversification, pest management, and other

production practices suitable for climate-stressed environments. Farmers should also receive timely and understandable information on seasonal rainfall forecasts, drought conditions, and flood risks through communication channels that are accessible at the local level. Early-warning information is most useful when it is delivered in time to support decisions on land preparation, seed selection, planting, irrigation, and harvesting.

Greater investment in agricultural research and institutional coordination is also needed to support long-term climate adaptation. Research should focus on developing and testing crop varieties and production practices under the different agroecological conditions found in Somalia, while greater attention should be given to measuring the costs and benefits of adaptation practices at farm level. Government institutions, universities, research organizations, farmers, and development partners should strengthen collaboration in agricultural research, extension, water management, and climate services. In addition, improved agricultural and climate data collection is needed to support evidence-based planning and to monitor changes in crop production over time. These measures can contribute to more resilient and sustainable crop production under increasing climatic uncertainty.

8. CONCLUSION

Climate change and climate variability represent important challenges for crop production in Somalia, particularly because many agricultural systems depend on seasonal rainfall and have limited capacity to compensate for climatic stress through irrigation and other technologies. The literature reviewed in this article indicates that rainfall variability, increasing temperature, drought, and flooding can influence crop production, while the magnitude of these effects differs among crops and production environments. Evidence from national and crop-specific studies shows that sorghum, maize, wheat, beans, and other crops can respond differently to changes in rainfall and temperature, highlighting the importance of considering crop-specific characteristics when assessing climate-related production risks.

The review also shows that adaptation to climate variability involves a combination of crop, water, and farm-management practices. Climate-resilient and early-maturing varieties, irrigation, water harvesting, improved water management, crop diversification, intercropping, soil and water conservation, and improved agronomic practices are among the approaches identified in the literature. Access to timely climate information, agricultural extension, suitable inputs, and appropriate technologies is also important for enabling farmers to adjust production practices in response to changing climatic conditions.

Strengthening climate resilience in Somali crop production therefore requires coordinated action across

farmers, government institutions, research organizations, universities, and development partners. Greater investment in irrigation and water management, climate-resilient seed systems, agricultural research, extension services, climate information, and early-warning systems can support more stable crop production under increasing climatic variability. Continued efforts to improve agricultural infrastructure, technical capacity, and access to appropriate production technologies are important for sustaining crop production and strengthening food security in Somalia.

Conflict of Interest: The authors declare that they have no relevant conflict of interest concerning the content of this review.

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