ISSN (Online): 3107-5347
IJAD 2026; 2(2): 12-14
2026 January - February
www.allagriculturejournal.com

Received: 10-11-2025
Accepted: 08-12-2026
Published: 03-01-2026

Impact of Climate Change on Crop Yield in Semi-Arid Regions

Rajesh Sharma
Department of Agriculture, Green University, Delhi, India

Corresponding Author; **Rajesh Sharma**

Abstract
Climate change has emerged as one of the most significant challenges to global agriculture, particularly in semi-arid regions where water scarcity and climatic variability are already prevalent. Rising temperatures, irregular rainfall patterns, prolonged droughts, and increased frequency of extreme weather events have substantially affected crop productivity. Semi-arid regions are highly vulnerable due to their dependence on seasonal rainfall and limited irrigation resources. This article examines the impact of climate change on crop yield in semi-arid areas, identifies major challenges faced by farmers, and discusses adaptation strategies that can enhance agricultural resilience. The study highlights the importance of climate-smart agriculture, drought-resistant crop varieties, efficient water management, and policy interventions to ensure sustainable food production in these fragile ecosystems.

Keyword: Climate Change, Crop Yield, Semi-Arid Regions, Drought, Sustainable Agriculture, Food Security, Climate-Smart Agriculture

Introduction
Agriculture forms the backbone of livelihoods for millions of people living in semi-arid regions worldwide. These regions are characterized by low and erratic rainfall, high evaporation rates, and fragile ecosystems. Climate change has intensified environmental stressors, making agricultural production increasingly uncertain. Changes in temperature and precipitation patterns directly influence crop growth, soil fertility, water availability, and pest dynamics, resulting in reduced yields and economic losses for farmers.

The growing concern over food security and sustainable development has intensified research on understanding the relationship between climate change and agricultural productivity. Semi-arid regions, due to their ecological sensitivity, serve as critical areas for studying these impacts.

Climate Change and Its Manifestations
Climate change refers to long-term alterations in global and regional climate patterns caused primarily by increased greenhouse gas emissions. Key manifestations affecting agriculture include:

- Rising average temperatures
- Irregular and unpredictable rainfall
- Increased drought frequency and intensity
- Heat waves during critical crop growth stages
- Increased incidence of pests and diseases
- Soil degradation and desertification

These factors collectively influence agricultural productivity and sustainability.

Impact on Crop Yield
1. Water Stress and Drought
Water scarcity remains the most significant challenge in semi-arid agriculture. Reduced rainfall and prolonged drought periods decrease soil moisture availability, negatively affecting crop germination, flowering, and grain filling stages.

2. Temperature Stress
Elevated temperatures accelerate crop maturation, reducing the duration available for biomass accumulation. Heat stress during flowering can significantly lower pollination efficiency and grain formation.

3. Soil Degradation
Climate change contributes to soil erosion, nutrient depletion, and salinity buildup. Reduced soil fertility limits crop growth and lowers productivity over time.

4. Increased Pest and Disease Pressure
Warmer temperatures create favorable conditions for the proliferation of insects, pathogens, and invasive species. This increases crop damage and production costs.

5. Extreme Weather Events
Floods, storms, and heat waves can destroy standing crops, damage infrastructure, and disrupt agricultural activities, leading to severe economic losses.

Major Crops Affected
Several crops cultivated in semi-arid regions are highly vulnerable to climate variability:

- Wheat
- Maize
- Sorghum
- Millet
- Chickpea
- Groundnut
- Cotton

Yield reductions have been reported in many regions due to prolonged drought and heat stress conditions.

Socioeconomic Consequences
The decline in agricultural productivity has far-reaching consequences:

- Reduced farmer income
- Increased food insecurity
- Higher rural poverty rates
- Migration from rural to urban areas
- Increased dependence on external food supplies

Smallholder farmers are particularly vulnerable because of limited access to resources and adaptation technologies.

Adaptation Strategies

1. **Climate-Smart Agriculture**
   Climate-smart agriculture promotes sustainable farming practices that improve productivity while enhancing resilience to climate change.
2. **Drought-Resistant Varieties**
   Developing and adopting drought-tolerant crop varieties can significantly reduce yield losses under water-stressed conditions.
3. **Efficient Water Management**
   Techniques such as drip irrigation, rainwater harvesting, and soil moisture conservation improve water-use efficiency.
4. **Diversification of Crops**
   Growing multiple crops reduces risk and improves farm resilience against climate-related shocks.
5. **Agroforestry**
   Integrating trees with crops enhances soil fertility, improves water retention, and provides additional income sources.
6. **Early Warning Systems**
   Weather forecasting and climate information services help farmers make informed decisions regarding planting and harvesting.

Policy Recommendations
Governments and stakeholders should focus on:

1. Investing in climate-resilient agricultural research.
2. Expanding irrigation infrastructure.
3. Promoting sustainable land management practices.
4. Strengthening agricultural extension services.
5. Providing financial support and crop insurance schemes.
6. Encouraging adoption of renewable energy in agriculture.

Conclusion
Climate change poses a significant threat to agricultural productivity in semi-arid regions. Rising temperatures, erratic rainfall, droughts, and extreme weather events are reducing crop yields and threatening food security. However, the adoption of climate-smart agricultural practices, improved crop varieties, efficient water management, and supportive policy frameworks can mitigate these impacts. Sustainable adaptation strategies are essential to ensure resilient agricultural systems and secure livelihoods for future generations.

References

1. Intergovernmental Panel on Climate Change. Climate Change 2023: Synthesis Report. Geneva: IPCC; 2023.
2. Food and Agriculture Organization. The State of Food and Agriculture 2022. Rome: FAO; 2022.
3. Lal R. Soil degradation and food security in developing countries. Science. 2001;294(5540):1623-1627.
4. Lobell DB, Schlenker W, Costa-Roberts J. Climate trends and global crop production since 1980. Science. 2011;333(6042):616-620.
5. Wheeler T, von Braun J. Climate change impacts on global food security. Science. 2013;341(6145):508-513.
6. Porter JR, Xie L, Challinor AJ, Cochrane K, Howden SM, Iqbal MM, et al. Food security and food production systems. In: Climate Change 2014: Impacts, Adaptation and Vulnerability. Cambridge: Cambridge University Press; 2014.
7. Rosenzweig C, Elliott J, Deryng D, Ruane AC, Müller C, Arneth A, et al. Assessing agricultural risks of climate change in the 21st century. Proc Natl Acad Sci USA. 2014;111(9):3268-3273.
8. Challinor AJ, Watson J, Lobell DB, Howden SM, Smith DR, Chhetri N. A meta-analysis of crop yield under climate change and adaptation. Nat Clim Change. 2014;4(4):287-291.
9. Nelson GC, Rosegrant MW, Koo J, Robertson R, Sulser T, Zhu T, et al. Climate Change: Impact on Agriculture and Costs of Adaptation. Washington DC: International Food Policy Research Institute; 2009.
10. Rockström J, Falkenmark M. Agriculture: increase water harvesting in Africa. Nature. 2015;519(7543):283-285.
11. Vermeulen SJ, Campbell BM, Ingram JSI. Climate change and food systems. Annu Rev Environ Resour. 2012;37:195-222.
12. Thornton PK, Ericksen PJ, Herrero M, Challinor AJ. Climate variability and vulnerability to climate change. Glob Change Biol. 2014;20(11):3313-3328.
13. Morton JF. The impact of climate change on smallholder and subsistence agriculture. Proc Natl Acad Sci USA. 2007;104(50):19680-19685.
14. Cooper PJM, Dimes J, Rao KPC, Shapiro B, Shiferaw B, Twomlow S. Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa. Agric Ecosyst Environ. 2008;126(1-2):24-35.
15. FAO. Climate-Smart Agriculture Sourcebook. Rome: Food and Agriculture Organization; 2017.
16. United Nations Environment Programme. Adaptation Gap Report 2023. Nairobi: UNEP; 2023.

17. United Nations Development Programme. Human Development Report 2024. New York: UNDP; 2024.
18. World Bank. Climate-Smart Agriculture Investment Plan. Washington DC: World Bank; 2022.
19. International Crops Research Institute for the Semi-Arid Tropics. Annual Report 2023. Hyderabad: ICRISAT; 2023.
20. United Nations. Sustainable Development Goals Report 2024. New York: United Nations; 2024.

How to Cite This Article
Sharma R. Impact of Climate Change on Crop Yield in Semi-Arid Regions. International Journal of Agriculture Development. 2026; 2(1): 12-14.