

Agriculture under a Changing Climate: Challenges and Impacts in Jammu and Kashmir

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Agriculture is the backbone of the economy of Jammu & Kashmir, supporting nearly 70% of the rural population directly or indirectly. The region is known for the cultivation of rice, maize, wheat, pulses, saffron, apple, walnut, almond and citrus crops such as kinnow in the subtropical belt of Jammu. However, agriculture in J&K is predominantly climate-sensitive and heavily dependent on rainfall and snowmelt. During the last few decades, noticeable changes in temperature, rainfall distribution, snowfall intensity and the frequency of extreme weather events have been observed. These changes have created serious challenges for crop production, horticulture, livestock and natural resources. Therefore, understanding these changing climatic trends and adopting climate-resilient agricultural practices has become essential for ensuring food security and sustainable agricultural development.

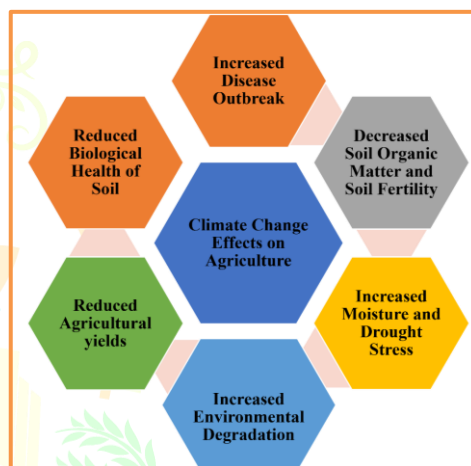


Figure 1: Climate change effect on agriculture

Signs of a Changing Climate in Jammu and Kashmir

Several indicators clearly demonstrate that climate change is already affecting the region through:

- **Rising Temperature:** Jammu and Kashmir has seen a notable increase in temperatures, with maximum temperatures rising by 0.04 to 0.05°C/year in Kashmir and 0.03 to 0.08°C/year in Jammu (Dar and Gupta, 2024). Mean annual temperature has increased over recent decades. Winters have become warmer, while summer heat waves are becoming more frequent. Reduced chilling hours affect temperature fruit crops such as apple, pear, peach, and cherry.
- **Changing rainfall Pattern:** The total annual rainfall may not show a dramatic decline everywhere, its distribution has changed considerably, making agriculture more vulnerable. Recent meteorological observations indicate increased variability in annual rainfall and increased probability of flash floods. The devastating 2014 Kashmir floods and the 2025 Jammu floods clearly demonstrate that Jammu and Kashmir is becoming

increasingly vulnerable to extreme weather conditions. These disasters emphasize the urgent need for improved flood forecasting, watershed management, resilient agricultural practices and climate-adaptive infrastructure to reduce future risks and protect farmers' livelihoods.

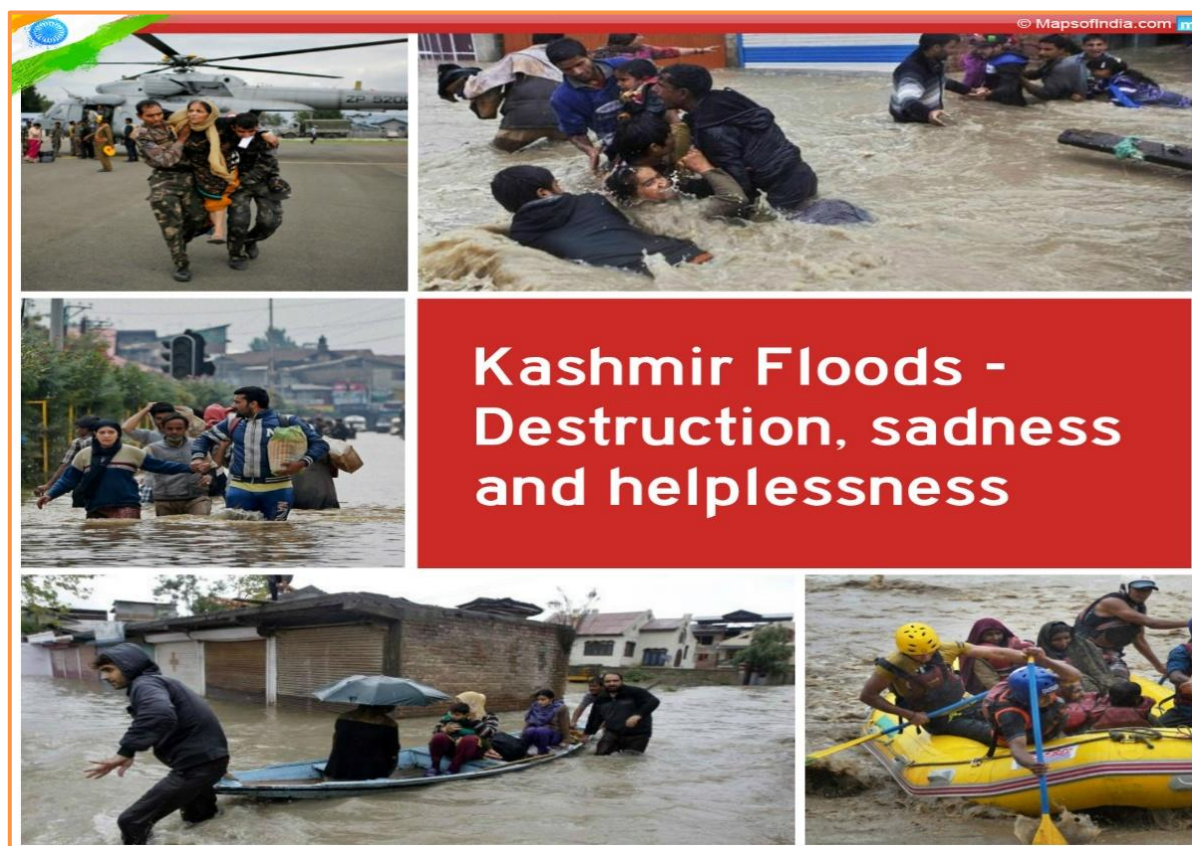


Figure 2: Maps of India. (2014). *Kashmir floods- A picture of Devastation*

Impact on Agriculture

Agriculture in Jammu and Kashmir is highly weather-dependent. The diverse agroclimatic zones of the region support a wide variety of crops and horticultural products, ranging from the sub-tropical plains of Jammu to temperate and cold dry areas in Kashmir and Ladakh. However, rising temperatures, unpredictable rainfall, decreasing snowfall and extreme weather have severely impacted agricultural production, crop quality and farmers' livelihoods.

- **Impact on Crop Yields:** Climate change-related changes in temperature, precipitation, and growing season length have an effect on agricultural yields. Rising temperatures accelerate crop development, alter blooming and fruiting patterns, and reduce yields in heat-sensitive crops like wheat, maize, and rice. Variations in precipitation patterns, such as droughts and floods, can impact planting schedules, water availability, and soil moisture levels, which can lead to crop failures and yield losses (Lesk *et al.*, 2022). Storms, hurricanes, and cyclones are examples of extreme weather that can physically damage crops and infrastructure, exacerbating production problems.
- **Effect on Livestock Productivity:** Climate change impacts cattle productivity in a number of ways, including pasture quality, water availability, and temperature stress. Heat stress can affect cattle performance, reduce milk and meat production, and increase their susceptibility to disease. Water scarcity affects animal hydration, feed availability, and grazing behaviors, necessitating improved water management strategies and alternative feeding practices. Additionally, altered pest and disease dynamics brought on by changing climate conditions pose a further threat to cattle productivity and health. (Verma *et al.*, 2024).

- **Impact on Horticulture:** The economy of Jammu and Kashmir is mostly dependent on horticulture, especially when it comes to crops like apple, walnut, almond, pear, saffron, and citrus fruits. For this industry, climate change has become a major worry. The number of winter chilling hours needed for temperate fruit crops to properly blossom and set fruit has decreased due to rising temperatures. Fruit size, color, quality, and market value are ultimately negatively impacted by rainfall during flowering, hailstorms prior to harvest, and heat stress throughout fruit development. (Yeshiwas *et al.*, 2026).

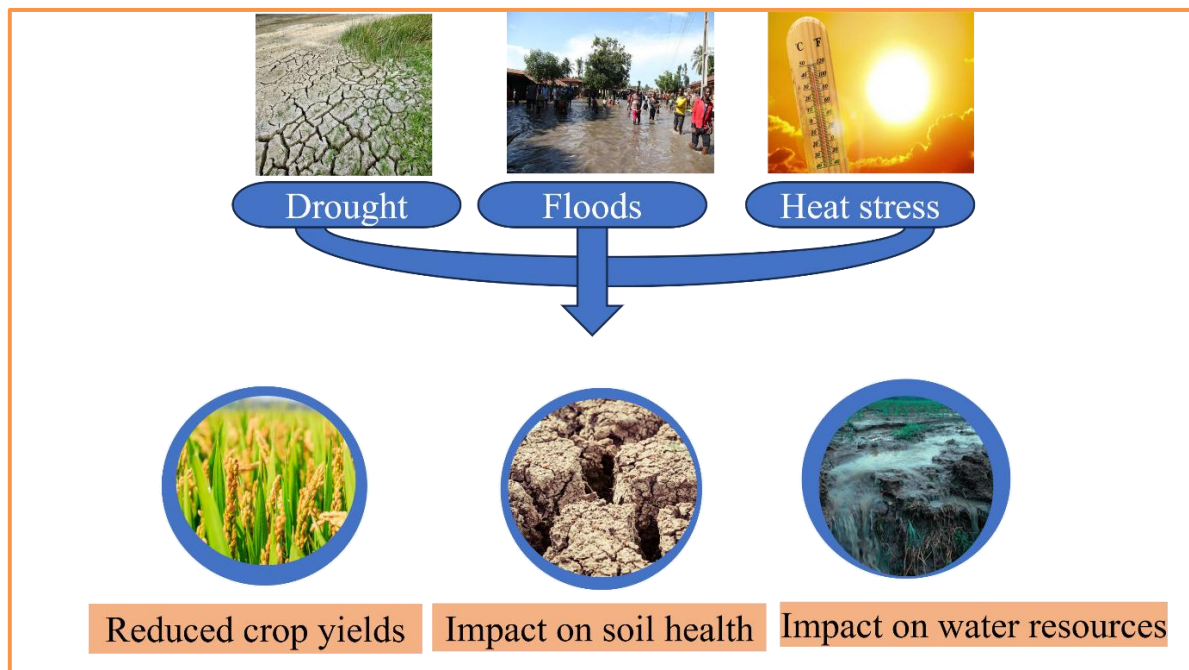


Figure 3: Different climate changing factors affecting yields, soil health and water.

Soil and Water Under Stress

- **Impact on Soil Health:** Extreme rainfall events contribute to soil degradation, erosion, and nutrient depletion, compromising soil health and fertility. Changes in temperature and precipitation patterns affect soil moisture levels, organic matter decomposition rates, and nutrient cycling processes. Prolonged drought reduces microbial activity and slows nutrient mineralization, limiting the availability of essential nutrients such as Nitrogen and phosphorous. Moreover, extreme weather events such as heavy rainfall and flooding increase soil erosion rates, leading to loss of topsoil, reduced soil fertility, and increased sedimentation in water bodies (Spandana *et al.*, 2026). Sustainable soil management practices, including conservation tillage, cover cropping, and agroforestry, are essential for mitigating soil degradation and enhancing soil resilience to climate change.
- **Implications for Water Resources:** In agricultural areas, competition for water resources and water scarcity are made worse by climate change. Melting glaciers have an impact on crop water requirements, irrigation systems, and water availability. Changes in precipitation patterns can increase evaporation rates. Extreme weather conditions like droughts and floods also affect water quality, destroy infrastructure, and interfere with water supply systems. Rainwater collection, water-saving devices, and effective irrigation systems are examples of sustainable water management techniques that are crucial for adjusting to shifting water conditions and guaranteeing agricultural sustainability (Chaturvedi *et al.*, 2026).

Emerging Challenges for Farmers

- **Unpredictable weather** disrupts sowing, irrigation, and harvesting schedules, leading to production losses.
- **Declining crop productivity** due to heat stress, drought and erratic rainfall reduces farm income.

- **Frequent floods, drought and landslides** cause severe damage to crops, orchards and agricultural infrastructure.
- **Increasing pest and disease** outbreaks raise pesticide use and the cost of cultivation.
- **Water scarcity** during critical crop growth stages limits irrigation and reduce yields.
- **Soil degradation and nutrient loss** caused by erosion and extreme weather lower long-term soil fertility.
- **Lack of timely weather information** hampers effective farm planning.

Building Climate-Resilient Agriculture

It is essential to reduce the adverse effects of climate change on farming systems in Jammu and Kashmir. Climate resilience refers to the ability of agricultural systems to withstand, adapt to and recover from climate-related stresses such as droughts, floods, heat waves and erratic rainfall while maintaining productivity and sustainability. For this, adaptive measures are:

- ✓ **Adoption of climate-smart agricultural practices:** Conservation agriculture, crop diversification, integrated nutrient management and integrated pest management can improve farm productivity while conserving natural resources. The application of organic amendments like farmyard manure (FYM), compost, biochar and vermicompost enhances soil organic carbon, improves soil structure, increases water holding capacity and supports beneficial microbial activity making soils more resilient to climatic stresses.
- ✓ **Efficient water management:** It is another key component of climate resilience. Techniques like rainwater harvesting, drip irrigation, mulching, farm ponds and watershed management help conserve water and improve irrigation efficiency, particularly during prolonged dry periods. The cultivation of climate-resilience crop varieties that are tolerant to drought, heat, floods and emerging pests can minimize yield losses under changing climate conditions.
- ✓ **Weather-based Agro-advisory services:** Digital technologies and early warning systems enable farmers to make timely decisions regarding sowing, irrigation, fertilizer application and pest control. Promoting agroforestry, strengthening farmer training programmes and providing access to crop insurance and government support schemes can future enhance the adaptive capacity of the farming communities.

Together, these measures can ensure sustainable agricultural production, improve farmers' livelihoods and strengthen food security in the face of climate change.

The Way Forward

1. **Promote Climate-Smart Agriculture:** Adopt climate-smart farming techniques that will boost productivity and help us adjust to fluctuating weather patterns.
2. **Enhance Soil and Water Conservation:** Encourage the use of organic amendments, rainwater harvesting, and efficient irrigation systems to preserve natural resources.
3. **Develop Climate-Resilient Crop Varieties:** Encourage the use of heat, drought, flood and pest resistant crop varieties to reduce yield losses caused by climate change.
4. **Strengthen support systems for farmers:** Improve weather-based alerts, extension services, farmer training and crop insurance to build farmers' resilience.
5. **Encourage Collaborative Initiatives:** Farmers, researchers, legislators and government agencies should work together to promote sustainable agricultural development in Jammu and Kashmir.

Conclusion

Thousands of farmers' livelihoods in Jammu and Kashmir are at risk due to the disruption of traditional farming methods caused by climate change. Reduced crop yields, degraded soil, and water scarcity are being caused by rising temperatures, unpredictable rainfall, glacier melting, and an increase in pest infestations. The region's economy depends on staple crops like saffron and apples, which are especially susceptible to these shifts. Adapting climate-resilient agricultural practices, encouraging water conservation, and making investments in

cutting-edge farming methods are essential to reducing these difficulties. To guarantee sustainable agriculture in the area, government regulations, scientific studies, and farmer education initiatives must collaborate. The long-term impact of climate change could negatively affect Jammu and Kashmir's food security and economic stability if prompt action is not done. It will be feasible for countries to increase agricultural productivity by enhancing the skills and knowledge of our farmers. The most challenging issue confronting humanity is climate change, yet together we have the creativity to find a solution for this problem of climate change.

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