



## Adapting Agriculture: Navigating the Impact of Climate Change on Productivity

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### Introduction:

Agriculture, the bedrock of human civilization, faces unprecedented challenges in the wake of climate change. As temperatures soar, weather patterns shift, and extreme events become more frequent, farmers around the world find themselves on the frontline of this crisis. In this article, we'll explore how agriculture is being reshaped by climate change and delve into innovative strategies and recent data that are steering the sector towards greater resilience and productivity.

### Climate Change and Agriculture

The Government of India acknowledges the profound impact of climate change on agriculture and the livelihoods of farmers. Extensive studies, both in the field and through simulations, have been conducted across various regions of the country. These assessments utilized crop simulation models to project the climates of 2050 and 2080. Without the implementation of adaptation measures, it is projected that rainfed rice yields in India could decrease by 20% in 2050 and 47% in 2080 scenarios. Similarly, irrigated rice yields are anticipated to decrease by 3.5% in 2050

and 5% in 2080 scenarios. The impact of climate change on wheat yield is estimated to be a reduction of 19.3% in 2050 and 40% in 2080 scenarios by the end of the century, with notable spatial and temporal variations. Additionally, climate change is expected to lead to an 18% and 23% reduction in kharif maize yields in 2050 and 2080 scenarios, respectively. This shift in climate patterns not only decreases crop yields but also affects the nutritional quality of produce.

Extreme events such as droughts further exacerbate challenges faced by farmers in terms of food and nutrient consumption. The Government of India has established schemes and plans to enhance the resilience of agriculture to climate change. One such initiative is the National Mission for Sustainable Agriculture (NMSA), which operates within the framework of the National Action Plan on Climate Change (NAPCC). The mission's goal is to develop and implement strategies to bolster the resilience of Indian agriculture in the face of changing climate conditions.

In response to the need for sustaining

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domestic food production amidst a changing climate, the Indian Council of Agricultural Research (ICAR), under the Ministry of Agriculture and Farmers Welfare, launched the flagship research project 'National Innovations in Climate Resilient Agriculture' (NICRA) in 2011. This project aims to create and promote climate-resilient technologies in agriculture, targeting vulnerable areas across the country. The outcomes of the project benefit districts and regions susceptible to extreme weather events such as droughts, floods, frost, and heatwaves, enabling them to better cope with these challenges. Comprehensive research programs, spanning both short and long-term perspectives, have been initiated on a national scale, encompassing adaptation and mitigation strategies for crops, horticulture, livestock, fisheries, and poultry. Key focus areas include identifying the most vulnerable districts/regions, developing crop varieties and management practices for adaptation and mitigation, and assessing the impacts of climate change on livestock, fisheries, and poultry while identifying corresponding adaptation strategies. Since 2014, a total of 1888 climate-resilient varieties have been developed, alongside 68 location-specific climate-resilient technologies, which have been demonstrated for broader adoption within farming communities.

## Effects of Climate Change

**Changing Temperature Trends:** Over the last century, average global temperatures have risen by approximately 1.2 degrees Celsius above pre-industrial levels. This has led to altered growing seasons, affecting the timing of planting and harvesting.

**Erratic Precipitation Patterns:** Uneven distribution of rainfall and increased drought conditions are becoming more common. Some regions face prolonged dry spells, while others experience intense rainfall events and flooding.

**Extreme Weather Events:** Hurricanes, heatwaves, floods, and wildfires are occurring with greater intensity and frequency. These events can devastate crops, livestock, and infrastructure.

**Shifts in Pest and Disease Dynamics:** Rising temperatures can alter the distribution and behaviour of pests and diseases, posing new challenges for farmers.

## Strategies for Climate-Resilient Agriculture: Recent Innovations

**Diversification of Crops and Livestock:** Recent studies show that diversified farming systems are more resilient to climate variability. Crop rotations, intercropping, and mixed farming provide a buffer against weather-related risks.

**Utilization of Climate-Resistant Crop Varieties:** Advances in breeding programs have led to the development of

climate-resilient crop varieties. These strains are better equipped to withstand drought, heat, and changing pest pressures.

#### **Water Management and Irrigation:**

Recent data demonstrates the effectiveness of precision irrigation techniques in conserving water and improving crop yields. Rainwater harvesting systems are also proving invaluable in water-scarce regions.

#### **Soil Health and Conservation**

**Practices:** Studies indicate that sustainable soil management practices, such as no-till farming and cover cropping, enhance soil health and water retention. This, in turn, boosts crop resilience.

#### **Weather Monitoring and Early**

**Warning Systems:** Recent advancements in weather monitoring technology and early warning systems enable farmers to make timely decisions in response to changing weather conditions, minimizing losses.

#### **Crop Rotation and Intercropping:**

Recent research highlights the benefits of crop rotation and intercropping in improving nutrient cycling, reducing pest pressures, and enhancing overall productivity.

**Agroecological Approaches:** Recent studies underscore the ecological benefits of agroecological practices. These approaches promote biodiversity, natural pest control, and sustainable resource use.

### **Recent Success Stories: Showcasing Climate-Resilient Agriculture**

#### **India's performance in Climate change performance index**

India has secured a position among the top five countries globally and is leading among the G20 nations for its commendable performance in addressing climate change. This achievement marks a notable jump of two spots, placing India at the eighth position in the Climate Change Performance Index (CCPI) for 2023, as published by German Watch, New Climate Institute, and Climate Action Network International in Germany.

According to the latest report unveiled at COP 27 in November 2022, Denmark, Sweden, Chile, and Morocco were the only four smaller nations ranked higher than India, claiming the 4th, 5th, 6th, and 7th positions respectively. Notably, the top three positions were not awarded to any country. Therefore, India's ranking stands as the best among major economies.

The evaluation is based on four main categories: Greenhouse Gas (GHG) Emissions (accounting for 40% of the overall score), Renewable Energy (20% of the overall score), Energy Use (20% of the overall score), and Climate Policy (20% of the overall score). India received high ratings in GHG Emissions and Energy Use, while achieving moderate scores in Climate Policy and Renewable

Energy. India's proactive policies in swiftly adopting renewable energy sources and establishing a robust framework for energy efficiency programs have demonstrated substantial impact. According to the CCPI report, India is on course to meet its 2030 emissions targets in alignment with the goal of keeping global temperature rise well below 2°C.

### **Case Study: Resilience in California's Central Valley**

Recent data from California's Central Valley, once stricken by severe drought, demonstrates how precision irrigation and crop diversification are revitalizing agriculture in the region.

### **Case Study: Sustainable Farming in Bangladesh**

Recent initiatives in Bangladesh are empowering smallholder farmers with climate-smart practices like raised-bed gardening, which improves drainage during floods, and salt-tolerant crop varieties to combat soil salinity.

### **Conclusion**

**A Path Forward** The nexus of agriculture and climate change is a critical frontier in our battle for a sustainable future. The strategies and recent data discussed here exemplify the ingenuity and resilience of farmers and scientists working hand in hand. As we navigate the impacts of climate change,

it is clear that a collective effort, grounded in science and innovation, is essential to secure the future of agriculture and food security for generations to come.

