AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 06 Issue: 11 November 2025 Article No: 02

# Climate-Smart Agriculture and Resilience: A Sustainable Pathway for the Future of Indian Farming

**Tapomoy Ghosh**
Lovely Professional University, Punjab

**SUMMARY**

Climate change poses severe risks to global and Indian agriculture, causing unpredictable rainfall, prolonged droughts, floods, heat waves, and pest outbreaks. These climatic disruptions threaten food security, farmer livelihoods, and ecosystem stability. Climate-Smart Agriculture (CSA) is an integrated approach introduced by the Food and Agriculture Organization (FAO) to address these challenges. It focuses on three core pillars—sustainably increasing productivity, enhancing resilience (adaptation), and reducing greenhouse gas emissions (mitigation). This paper explores the need, significance, challenges, and management strategies of CSA with real-world examples from India, including BAIF's Climate Smart Village Programme, the women-led model in Marathwada, and water-management initiatives in Bundelkhand. The article concludes that scaling CSA practices, backed by policy support, technology, and community participation, is essential for achieving sustainable and resilient agriculture in India.

## INTRODUCTION

Agriculture is one of the most climate-sensitive sectors in the world. In India, where nearly 58% of the population depends on agriculture directly or indirectly, the effects of climate variability are becoming increasingly evident. Rising temperatures, erratic monsoons, water scarcity, soil degradation, and emerging pest and disease patterns are reducing productivity and profitability. To confront these threats, the FAO (2013) introduced the concept of *Climate-Smart Agriculture (CSA)* a holistic framework aimed at transforming and re-orienting agricultural systems to support food security under the new realities of climate change. CSA does not advocate a single practice but rather an adaptive, context-specific strategy that simultaneously promotes productivity, adaptation, and mitigation. In India, where diverse agro-climatic zones exist from flood-prone Bengal to drought-stricken Marathwada climate-smart solutions are vital for ensuring both resilience and sustainability in farming systems.

### Need for Climate-Smart Agriculture

The need for CSA arises from the growing gap between traditional farming practices and the changing climatic environment. Key reasons include:

1. **Increasing Climate Vulnerability:** Over the last few decades, India has witnessed more frequent droughts and floods. For instance, delayed monsoons in states like Bihar and Madhya Pradesh have reduced rice and maize yields by up to 20%.
2. **Declining Soil Fertility and Water Resources:** Intensive monocropping and overuse of chemical fertilizers have degraded soil health. Groundwater levels are declining in many parts of North and Central India, threatening future cultivation.
3. **Food Security and Livelihood Risks:** Climate shocks not only lower yields but also affect farmer incomes, leading to distress migration and reduced access to nutritious food.
4. **Emission Pressures:** Agriculture contributes around 18% of India's total greenhouse gas emissions, primarily from livestock and paddy fields. CSA offers methods to minimize these emissions while maintaining productivity.

### Significance of CSA and Building Resilience

The significance of CSA lies in its triple-win approach:

- **Productivity:** Sustains and increases yields under adverse climate conditions.
- **Adaptation (Resilience):** Enhances the ability of farmers and systems to absorb shocks like drought or floods.
- **Mitigation:** Reduces GHG emissions and increases carbon sequestration.

Resilience in agriculture refers to the capacity of systems to absorb stress, recover, and transform. In India, building resilience is crucial because 60% of the net sown area is rain-fed. CSA strengthens resilience through improved water management, diversified cropping, and better access to technology and climate information.

For example, BAIF's Climate Smart Village Programme in Bihar and Madhya Pradesh improved productivity by 140% and reduced carbon emissions by 55%, demonstrating how CSA practices directly enhance both resilience and environmental outcomes.

**Challenges in Implementing CSA**

Despite its promise, the widespread adoption of CSA faces multiple challenges:

1. **Financial Constraints:** Small and marginal farmers, who make up over 80% of India's farming population, lack access to credit and funds to invest in CSA technologies like drip irrigation or precision tools.
2. **Knowledge and Capacity Gaps:** Lack of awareness, technical know-how, and limited extension services slow the adoption of CSA practices.
3. **Data and Information Barriers:** Many farmers lack access to real-time climate and market information that could support decision-making.
4. **Institutional and Policy Limitations:** CSA adoption requires coordinated policies across water, energy, and agriculture sectors—something still lacking in most Indian states.
5. **Socio-Economic Inequalities:** Gender gaps, land fragmentation, and poverty further hinder the implementation of large-scale CSA programmes.

**Solutions and Management Strategies**

To overcome these challenges, an integrated management approach is required. Some key strategies include:

1. **Water Resource Management:** Efficient irrigation, rainwater harvesting, and watershed management can reduce drought vulnerability. *Example:* In Bundelkhand, constructing check-dams and percolation tanks significantly improved soil moisture and crop productivity.
2. **Crop Diversification and Climate-Resilient Varieties:** Promoting short-duration, drought-tolerant, and flood-resistant varieties helps farmers adapt. Rotating cereals with pulses and millets improves soil fertility and reduces risk.
3. **Soil Health Improvement:** Adopting conservation agriculture minimum tillage, organic amendments, and cover cropping enhances soil carbon and water retention.
4. **Use of ICT and Early-Warning Systems:** Digital weather advisories and mobile-based tools can inform farmers about rainfall, pest attacks, and market trends. *Example:* Studies in Haryana found that farmers using ICT tools were more adaptive to climate risks.
5. **Policy and Financial Incentives:** Governments can promote CSA through crop-insurance schemes, low-interest green loans, and carbon credit markets.
6. **Community-Based Models:** Empowering local communities, particularly women, ensures sustainable adoption. *Example:* In Maharashtra's Marathwada region, a women-led CSA model improved food security and soil health across 800 villages.

**Benefits of Climate-Smart Agriculture**

- **Sustainability:** Maintains long-term productivity without depleting natural resources.
- **Economic Stability:** Increases income through efficient resource use and diversification.
- **Environmental Protection:** Reduces emissions, improves biodiversity, and restores degraded land.
- **Social Inclusion:** Empowers smallholders, especially women, to participate in decision-making.
- **Food Security:** Ensures availability and accessibility of food even under climate stress.

Overall, CSA bridges the gap between agricultural productivity and environmental conservation.

**CONCLUSION**

Climate-Smart Agriculture represents the future of sustainable farming. In the face of escalating climate threats, India's agricultural sector must transition from reactive crisis management to proactive resilience building. CSA provides the framework to achieve this by integrating productivity, adaptation, and mitigation into a single, coherent strategy. Scaling CSA requires collaborative efforts among farmers, researchers, policymakers, and financial institutions. When supported by strong policy, local innovation, and education, CSA can transform Indian agriculture making it not only more climate-resilient but also economically and environmentally sustainable for generations to come.

**REFERENCES**

ArXiv (2021). *ICT Access and Climate Adaptation in Haryana Agriculture.* https://arxiv.org/abs/2108.09766

BAIF Development Research Foundation. (2024). *Climate Smart Village Programme.* https://baif.org.in

CDKN (2024). *Women-Led Climate Smart Agriculture Model, Marathwada.* https://cdkn.org

FAO. (2013). *Climate-Smart Agriculture Sourcebook.* Rome: Food and Agriculture Organization. https://csaguide.cgiar.org

ICRISAT (2023). *Water Harvesting Interventions in Bundelkhand Region.* https://oar.icrisat.org/11634

MANAGE (2023). *Strategies for Climate Risk Management and Resilient Farming.* Hyderabad: National Institute of Agricultural Extension Management. https://www.manage.gov.in

SpringerLink (2024). *Finance Constraints in Adoption of CSA in Indo-Gangetic Plains.* https://link.springer.com/article/10.1007/s11027-024-10127-3