



POPULAR ARTICLE

Beyond subsidies: Strengthening Indian agriculture in an era of climate uncertainty

M.J.S.L. Naga Durga, M. K. Dara, Dr. V. K. Choudhary

Department of Agricultural Economics, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012 Chhattisgarh, India

Corresponding authors email: mjslnd0899@gmail.com

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Introduction and intricacies

Climate change is emerging as one of the greatest challenges facing Indian agriculture. While subsidies remain important, long-term agricultural sustainability requires investments in resilience-building measures. Climate-smart agriculture, water management, crop diversification, digital technologies, and crop insurance can help farmers adapt to increasing climate risks. Farmer Producer Organizations (FPOs) and collective action can strengthen farmers' capacity to withstand climatic and market shocks. Building resilience today is essential for ensuring food security, farmer welfare, and sustainable agricultural growth in the future.

Indian agriculture has always operated under conditions of uncertainty. Farmers routinely contend with fluctuations in rainfall, pest outbreaks, market volatility, and changing production costs. However, the scale and frequency of climate-related disruptions witnessed in recent years suggest that agriculture is entering a new era of uncertainty. Heat waves, prolonged dry spells, unseasonal rainfall, floods, cyclones, and extreme weather events are increasingly affecting agricultural production across the country. These events not only reduce crop yields but also disrupt supply chains, increase production costs, and threaten farm incomes. According to various national and

international assessments, climate change is expected to remain one of the most significant risks to agricultural sustainability in the coming decades. For many years, agricultural development has relied heavily on subsidies for fertilizers, irrigation, electricity, and other farm inputs. These support mechanisms have played an important role in improving productivity and ensuring food security. However, climate change presents challenges that subsidies alone cannot fully address. The future of Indian agriculture will increasingly depend on its ability to anticipate, absorb, adapt to, and recover from climatic shocks. In this context, strengthening resilience has become as important as enhancing productivity. Building climate-resilient agriculture requires a shift from short-term support measures toward long-term investments in sustainable farming systems, risk management, resource conservation, and technological innovation.

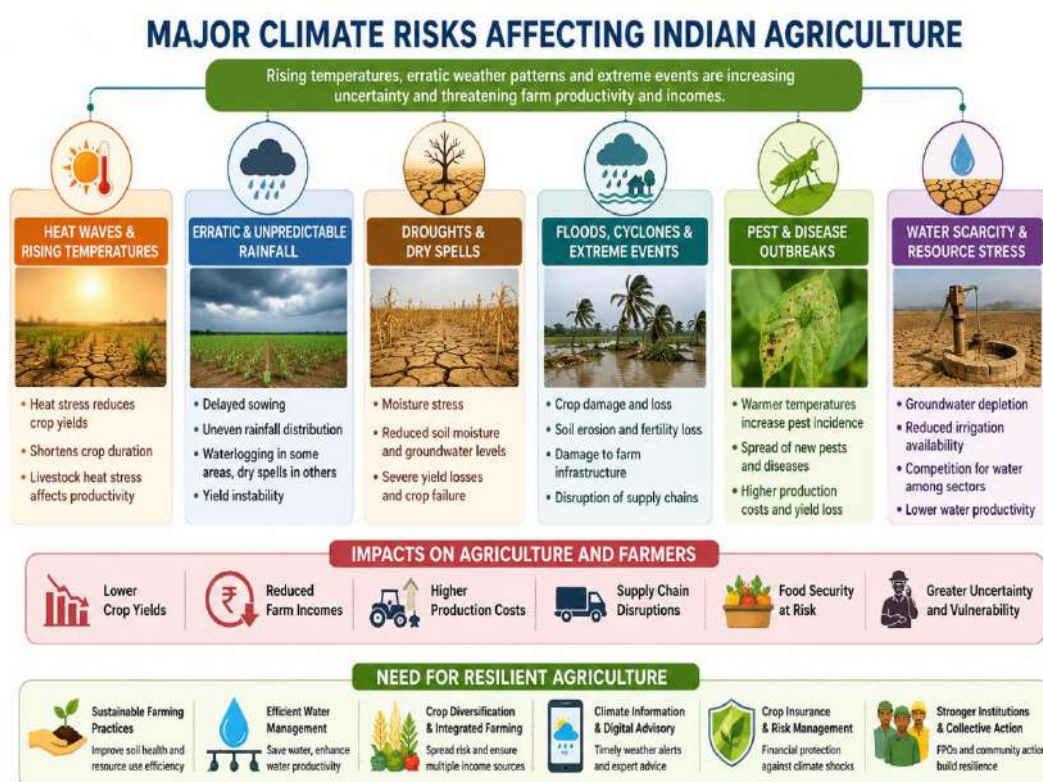
Why subsidies alone are no longer enough

Agricultural subsidies have contributed significantly to the growth of Indian agriculture by improving farmers' access to critical inputs and reducing production costs. Fertilizer subsidies, irrigation support, and electricity subsidies have helped millions

of farmers sustain agricultural production under diverse agro-climatic conditions. However, climate-related risks differ fundamentally from traditional production constraints. Subsidies can lower input costs, but they cannot prevent droughts, floods, heat stress, or erratic rainfall. Similarly, financial support alone cannot compensate for declining groundwater resources, soil degradation, or increasing weather variability. As climate

uncertainty intensifies, agricultural policy must move beyond a narrow focus on production support and incorporate measures that strengthen resilience at the farm, community, and institutional levels. Investments in adaptation and risk management are increasingly becoming essential complements to conventional support systems.

Fig 1: Infographics representing major climate risks affecting Indian agriculture and their economic consequences



The rising cost of climate risks

The economic consequences of these risks extend beyond individual farms. Climate-related disruptions affect food supply chains, market prices, employment opportunities, and national food security. Climate change is affecting agriculture through multiple channels:

- Increased frequency of heat waves and temperature stress
- Erratic and unpredictable rainfall patterns

- More frequent droughts and floods
- Increased pest and disease incidence
- Soil degradation and declining water availability
- Greater production and income instability

As agricultural risks increase, farmers face greater uncertainty regarding crop choices, investment decisions, and income prospects. Climate resilience is therefore not merely an environmental concern; it is an economic necessity for sustaining agricultural growth and rural livelihoods.



Produce more with greater resilience

Climate-Smart Agriculture (CSA) has emerged as one of the most promising approaches for addressing the dual challenge of agricultural productivity and climate adaptation. Rather than relying solely on higher input use, CSA emphasizes farming practices that improve productivity while conserving natural resources and reducing vulnerability to climatic shocks. Several climate-smart practices are already being adopted across different regions of India. These include conservation agriculture, integrated nutrient management, precision farming, agroforestry, crop residue management, and improved water-use efficiency. Such practices can help improve soil health, enhance moisture retention, reduce production risks, and increase farm resilience. Diversified farming systems that combine crops, livestock, horticulture, fisheries, and agroforestry can also provide multiple income streams, thereby reducing dependence on a single crop and improving household stability during adverse climatic events. Importantly, climate-smart agriculture should not be viewed as a single technology but as a broader framework that enables farmers to adapt agricultural practices according to local agro-ecological conditions.

The foundation of climate resilience

Water is likely to become one of the most critical constraints facing Indian agriculture in the coming decades. Rising temperatures, changing rainfall patterns, and increasing groundwater depletion are intensifying pressure on already stressed water resources. Improved water management can significantly enhance agricultural resilience. A combination of technological, infrastructural, and management interventions can help address this challenge. Micro-irrigation systems such as drip and sprinkler irrigation enable farmers to use water more efficiently while maintaining crop productivity. Similarly,

rainwater harvesting structures, farm ponds, watershed development programmes, and groundwater recharge initiatives can enhance water availability during periods of moisture stress. Farm-level practices such as mulching, conservation agriculture, soil moisture conservation, and the cultivation of drought-tolerant crop varieties further strengthen resilience by reducing water demand and improving moisture retention. In addition, timely weather advisories and precision irrigation technologies can support more informed water management decisions. The future sustainability of Indian agriculture will increasingly depend on the ability to produce more with less water. Strengthening water management therefore represents not only an adaptation strategy but also a long-term investment in agricultural resilience and food security.

Crop diversification as a risk management strategy

Excessive dependence on a limited number of crops can increase farmers' vulnerability to climate and market shocks. Crop diversification provides an important pathway for spreading risk and enhancing resilience. The promotion of pulses, oilseeds, millets, horticultural crops, medicinal plants, and integrated farming systems can help diversify income sources while improving resource-use efficiency. Diversification also contributes to nutritional security and environmental sustainability. The International Year of Millets and subsequent policy emphasis have renewed interest in climate-resilient crops that require fewer inputs and can withstand harsh environmental conditions. Millets, in particular, offer considerable potential in drought-prone and resource-constrained regions. A diversified agricultural system is generally more resilient because risks are distributed across multiple enterprises rather than concentrated in a single crop.



Digital agriculture and climate information services

Technological innovation is playing an increasingly important role in climate adaptation. Advances in digital agriculture are enabling farmers to make more informed decisions regarding crop management, weather risks, irrigation scheduling, and market opportunities. Weather forecasting systems, mobile-based advisory services, satellite monitoring, remote sensing technologies, and artificial intelligence-based decision-support tools are becoming valuable components of modern agricultural risk management. Timely access to climate information can help farmers adjust planting dates, manage irrigation efficiently, anticipate pest outbreaks, and reduce losses from extreme weather events. The continued expansion of digital infrastructure in rural areas presents significant opportunities for improving climate resilience through knowledge dissemination and real-time advisory services.

Strengthening agricultural risk management through crop insurance

Even with improved adaptation measures, some degree of climate risk will remain unavoidable. Effective risk-transfer mechanisms therefore remain essential components of a resilient agricultural system. Crop insurance schemes such as the Pradhan Mantri Fasal Bima Yojana have expanded risk coverage for millions of farmers across India. Recent efforts to integrate satellite imagery, remote sensing technologies, and digital claim processing are improving transparency and efficiency. However, increasing climate variability may require further innovations in agricultural insurance, including weather-index insurance products, faster claim settlement mechanisms, and improved farmer awareness. Insurance should be viewed not as a substitute for adaptation but as a

complementary tool that helps farmers recover more quickly from climatic shocks.

The role of farmer producer organizations in building resilience

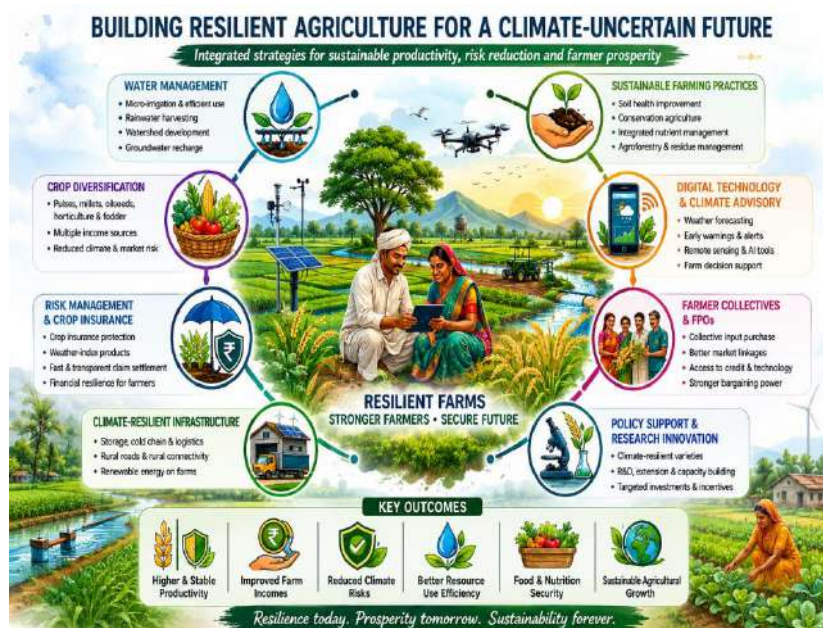
Individual smallholders often face significant constraints in accessing technology, finance, markets, and climate information. Collective action through Farmer Producer Organizations (FPOs) can help overcome many of these challenges. FPOs enable farmers to aggregate produce, access quality inputs, negotiate better prices, adopt improved technologies, and strengthen market linkages. They can also serve as platforms for disseminating climate adaptation practices and facilitating access to insurance, credit, and government support programs. As climate risks become more complex, farmer institutions are likely to play an increasingly important role in enhancing adaptive capacity at the community level. Well-functioning FPOs can transform resilience-building from an individual effort into a collective strategy.

Policy priorities for a climate-resilient agricultural future

Building resilience requires coordinated action across multiple fronts. Key policy priorities include:

- Expanding investments in climate-resilient infrastructure
- Strengthening agricultural research and innovation
- Promoting water-efficient farming systems
- Supporting crop diversification and integrated farming
- Enhancing digital climate advisory services
- Improving crop insurance effectiveness
- Strengthening Farmer Producer Organizations
- Encouraging sustainable natural resource management

Fig 2: Resilient agriculture in action: India's policy and programme landscape



Future agricultural policy must balance productivity goals with resilience objectives. The challenge is no longer simply to increase production but to ensure that agricultural systems remain productive under increasingly uncertain climatic conditions.

Hence in conclusion climate uncertainty is redefining the challenges facing Indian agriculture. While subsidies will continue to play an important role in supporting farmers, they cannot by themselves address the growing risks associated with climate change. Long-term agricultural sustainability requires

investments that enhance resilience, improve adaptive capacity, and reduce vulnerability to climatic shocks. Climate-smart agriculture, efficient water management, crop diversification, digital technologies, crop insurance, and strong farmer institutions collectively offer a pathway toward a more resilient agricultural future. Building resilience today is not merely an environmental imperative; it is essential for safeguarding farmer livelihoods, ensuring food security, and sustaining agricultural growth in the decades ahead.

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