

Sowing the Future: Why India Needs a Second Green Revolution Now

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Abstract

The Green Revolution of the 1960s and 70s marked a significant milestone in India's agricultural history, transforming the nation from a food-deficient country to a self-sufficient one through the adoption of high-yielding crop varieties, chemical fertilizers and expanded irrigation. However, this transformation came with unintended consequences: soil degradation, depletion of groundwater resources, loss of crop biodiversity and increased regional disparities. These challenges have been further intensified by climate change, land fragmentation and escalating nutritional demands. Despite being a global leader in food production, India faces persistent issues of farmer distress and nutritional insecurity. The imperative for a Second Green Revolution is more pressing than ever—one that emphasizes sustainability, resilience and inclusivity over mere yield enhancement. This new revolution should integrate advanced technologies such as precision agriculture, artificial intelligence, genomics and climate-resilient crop breeding with eco-friendly practices like organic farming, agroforestry and efficient water management. It must focus on empowering smallholder farmers, promoting agri-entrepreneurship and revitalizing rainfed regions that were previously overlooked. Additionally, comprehensive policy reforms, improved market access and substantial investment in rural infrastructure are essential to ensure the success and longevity of this transformation. By adopting a multidimensional approach, the Second Green Revolution can secure India's food future, alleviate rural poverty and address environmental challenges concurrently. It is not merely an option but it is an urgent necessity.

Keywords: Second Green Revolution, sustainability, climate-resilient agriculture, biotechnology, food security and farmer empowerment

Introduction

India's first Green Revolution, initiated in the 1960s, was a transformative response to a looming food crisis. By introducing high-yielding varieties (HYVs) of wheat and rice, expanding irrigation infrastructure and promoting the use of chemical fertilizers and pesticides, the country achieved remarkable increases in food grain production. This agricultural breakthrough turned India from a food-deficient nation into a net exporter, with regions like Punjab, Haryana and western Uttar Pradesh becoming the epicenters of this productivity surge.

However, the long-term consequences of these practices have raised significant concerns. The intensive use of chemical inputs has led to soil degradation, water table depletion and reduced biodiversity. Moreover, the benefits of the Green Revolution were unevenly distributed, leaving regions such as eastern India and parts of the Deccan Plateau with lower productivity gains. These challenges are now compounded by climate change, which brings erratic rainfall patterns, increased frequency of droughts and rising temperatures, further threatening agricultural sustainability (Chand, 2020 and FAO, 2022).

Contemporary Indian agriculture faces additional hurdles, including nutritional insecurity, farmer indebtedness, shrinking land holdings and the migration of rural youth to urban areas. Traditional agricultural approaches are proving inadequate in addressing these multifaceted issues. There is an urgent need for a Second Green Revolution—one that emphasizes sustainability, inclusivity and resilience (Swaminathan, 2006). This article delves into the pressing need for a renewed agricultural transformation in India. It examines the key drivers behind this necessity, explores innovative strategies and technologies and offers insights into the future trajectory of Indian agriculture.

The Need for a Second Green Revolution

India's agricultural sector is facing a multitude of interconnected challenges that underscore the urgent need for a Second Green Revolution. One of the most pressing concerns is the growing impact of climate change, which is manifesting through rising average temperatures, irregular rainfall patterns and an increase in extreme weather events like floods and droughts. These changes are not only reducing crop productivity but also threatening the livelihoods of millions of farmers. Building climate-resilient agricultural systems through stress-tolerant crop varieties, better water management and adaptive practices has become a necessity.

Equally concerning is the unsustainable exploitation of natural resources. Decades of intensive farming, characterized by heavy dependence on chemical fertilizers, pesticides and excessive groundwater extraction have led to soil degradation, water scarcity and ecosystem damage. Transitioning to sustainable farming methods such as organic agriculture, integrated nutrient management and conservation farming can help to restore the ecological balance.

Another critical issue is the stagnation in crop yields, especially in rainfed and resource-poor areas. While certain regions have seen agricultural advancements, others remain underserved, resulting in regional disparities. To bridge this gap, location-specific innovations and targeted interventions are required to uplift productivity and equity across the country.

At the same time, the nutritional landscape of the population is shifting. Despite improvements in food production, malnutrition and hidden hunger persist, especially among vulnerable communities. Diversifying agricultural systems to include nutrition-rich crops like pulses, millets, fruits and vegetables is vital to enhance dietary quality and public health.

Farmers also continue to grapple with economic distress, driven by falling income levels, fluctuating market prices, high input costs and inadequate institutional support. Addressing this crisis demands comprehensive policy reforms and the development of alternative income sources, including agro-processing, value addition and rural entrepreneurship (ICAR, 2023).

Finally, the emergence of cutting-edge technologies such as biotechnology, artificial intelligence and precision agriculture holds immense promise for transforming farming practices. However, their true potential can only be realized if they are made accessible, affordable and relevant to small and marginal farmers who form the backbone of Indian agriculture. A Second Green Revolution must integrate these drivers to ensure a more sustainable, equitable and resilient future for the sector (Gulati and Fan, 2007; IPCC, 2021).

Components of the Second Green Revolution

The Second Green Revolution envisions a holistic transformation of agriculture by incorporating advanced technologies, sustainable practices and inclusive development strategies.

1. Climate Change

A key pillar of this transformation is the development and widespread dissemination of climate-resilient crop varieties. Through cutting-edge techniques such as CRISPR gene editing and modern plant breeding, scientists are creating crops that can withstand drought, extreme heat and pest infestations, helping farmers adapt to changing climate conditions while maintaining productivity (MoAFW, 2022).

2. Agro-ecological approaches

It is important to promote the agro-ecological approaches that prioritize environmental sustainability. Practices such as organic farming, crop diversification, integrated pest management and conservation of soil and water resources are being encouraged to reduce dependency on synthetic inputs and enhance long-term farm health. These methods not only safeguard ecosystems but also improve soil fertility and resilience (Reddy and Mishra, 2010).

3. Precision agriculture

It is another transformative component. The integration of drones, sensors, satellite imagery and artificial intelligence allows farmers to apply water, fertilizers and pesticides more efficiently, reducing waste and maximizing yields. These tools also enable early detection of crop diseases and pests, leading to timely interventions and better crop outcomes.

4. Digital extension services

They are playing a growing role in bridging the knowledge gap. Mobile applications and online

platforms now offer real-time updates on weather forecasts, market prices and crop advisory services, empowering farmers with timely and location-specific information. These services enhance decision-making and reduce risks associated with farming.

5. Market Reforms

Reforming agricultural markets is also crucial. Strengthening farmer-producer organizations (FPOs), expanding digital marketplaces, and investing in cold-chain logistics help farmers access better prices, reduce post-harvest losses, and improve market linkages. Transparent and efficient supply chains can significantly boost farm incomes and reduce exploitation by middlemen (Singh, 2000).

6. Capacity building

It is essential to ensure that farmers, particularly women and youth, are equipped to participate in this new agricultural landscape. Training programs focusing on modern technologies, sustainable practices, agribusiness and value-added production are helping create a new generation of skilled rural entrepreneurs. By integrating innovation with sustainability and inclusiveness, the Second Green Revolution aims to create a resilient, productive and equitable agricultural system for the future.

Future Perspectives

The Second Green Revolution must evolve as a movement that aligns ecological health with economic growth. Future developments should include:

- **National Soil and Water Mission:** Mapping and rejuvenating India's degraded soils and depleting aquifers.
- **Smart Villages:** Integrating renewable energy, internet access and value-addition industries into rural areas.
- **Urban Agriculture and Vertical Farming:** Bringing food production closer to cities and reducing the urban-rural divide.
- **Agri-tech Startups and R&D Investment:** Fostering innovations that are scalable and adaptable to local conditions.

- **Global Partnerships:** Leveraging global research, climate finance and trade for sustainable food systems

Conclusion

India stands on the cusp of a new agricultural revolution. The first Green Revolution achieved food security, but its one-size-fits-all approach cannot address the multifaceted challenges of today. A Second Green Revolution, rooted in sustainability, inclusiveness, and innovation, is not just an aspiration but an urgent need. Empowering farmers, restoring ecosystems and ensuring nutrition for all are the pillars on which the future of Indian agriculture must be built. With the right policies, investments and public support, India can sow the seeds of a brighter, greener, and more equitable future.

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