

Transforming Agriculture under Viksit Bharat 2047: Pathways to a Sustainable and Prosperous Agricultural Future

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Abstract

India's agricultural sector stands at a critical inflection point as the nation charts its course toward the Viksit Bharat 2047 vision an ambitious agenda to transform India into a fully developed nation by the centenary of its independence. Agriculture, which employs approximately 42% of the workforce and contributes nearly 18% to the gross domestic product (GDP), is central to this vision. However, persistent structural challenges including smallholder fragmentation, water scarcity, climate vulnerability, post-harvest losses, and inadequate market linkages continue to impede progress. This article examines the multidimensional transformation of Indian agriculture within the Viksit Bharat framework, analyzing key policy interventions, technological innovations, institutional reforms, and sustainability strategies. Drawing on secondary data, policy documents, and scholarly literature, the study identifies critical levers for agricultural modernization, including digital agriculture, precision farming, agri-value chain development, and climate-smart practices. The findings suggest that achieving the agricultural goals of Viksit Bharat 2047 requires an integrated approach that harmonizes technological advancement with social equity, environmental sustainability, and institutional capacity building.

1. INTRODUCTION

India's agricultural landscape is undergoing a profound transition, shaped by converging forces of demographic change, climate variability, technological disruption, and evolving policy paradigms. The Viksit Bharat 2047 initiative, formally articulated by the Government of India as a comprehensive national development blueprint, envisions a prosperous, inclusive, and globally competitive India by the year 2047 the centenary of India's independence (NITI Aayog, 2023). Within this overarching vision, agriculture occupies a pivotal role, not only as an economic sector but as the bedrock of rural livelihoods, food security, and ecological stewardship.

The agricultural sector in India has historically been characterized by a dual reality: remarkable achievements in food production India has emerged as one of the world's largest producers of rice, wheat, pulses, fruits, and vegetables

alongside persistent vulnerabilities including income inequity, resource degradation, and market inefficiencies (Chand, 2022). The Green Revolution of the 1960s and 1970s, while transformative in boosting yields and averting famines, also bequeathed a legacy of environmental stress, particularly in terms of soil health deterioration and groundwater depletion in key agricultural states (Kumar & Pathak, 2021).

Against this complex backdrop, the Viksit Bharat 2047 vision demands a paradigm shift from subsistence-oriented, resource-intensive farming to productivity-driven, sustainable, and market-integrated agriculture. Achieving this transformation by 2047 necessitates a comprehensive strategy that integrates advanced technologies, strengthened institutions, inclusive policies, and climate resilience measures. This article synthesizes current scholarship, policy frameworks, and empirical evidence to delineate the pathways through which

Indian agriculture can be fundamentally transformed in alignment with the Viksit Bharat mandate.

2. LITERATURE REVIEW

The discourse on agricultural transformation in the developing world has increasingly converged on the concept of sustainable agricultural intensification (SAI) achieving greater output from existing land while reducing negative environmental impacts (Pretty et al., 2018). In the Indian context, scholars have highlighted the importance of bridging the productivity gap between potential and actual yields through improved crop management, input use efficiency, and adoption of improved varieties (Pingali, 2020).

Digitalization has emerged as a transformative force in contemporary agricultural systems. The integration of information and communication technologies (ICTs) into agriculture often termed digital agriculture or Agriculture 4.0 encompasses precision farming, remote sensing, Internet of Things (IoT) enabled farm management, artificial intelligence-driven advisory services, and digital market platforms (Wolfert et al., 2017). Studies by BIRTHAL et al. (2020) demonstrate that digital interventions can significantly enhance farmer income through improved market access and reduced information asymmetries in Indian agricultural value chains.

Climate change poses an existential threat to Indian agriculture. Recent projections suggest that rising temperatures, erratic monsoons, and increased frequency of extreme weather events could reduce crop yields by 10-25% by mid-century under high-emission scenarios (Aggarwal et al., 2019). Climate-smart agriculture (CSA), which encompasses adaptation, mitigation, and food security objectives, has been proposed as a framework for building agricultural resilience in South Asia (Lipper et al., 2014).

Policy scholarship has underscored the critical role of institutional reforms in driving agricultural transformation. Gulati et al. (2018) argue that reforming agricultural markets, rationalizing input subsidies, and strengthening rural infrastructure are prerequisites for improving the efficiency and competitiveness of Indian agriculture. The debate over the 2020 farm laws subsequently repealed highlighted the political economy complexities of agricultural reform in India, underscoring the need for inclusive policy processes that address the concerns of smallholder farmers (Narayanan, 2021).

The Viksit Bharat 2047 Vision and Agricultural Imperatives

The Viksit Bharat 2047 vision encompasses a broad developmental agenda organized around four pillars: Yuva (Youth), Garib (Poor), Mahila (Women), and Annadata (Farmer) (Government of India, 2023). The Annadata pillar explicitly recognizes farmers as the foundation of India's food security and rural economy, committing to doubling farmers' incomes, expanding irrigation coverage, promoting natural farming, and strengthening agricultural supply chains.

Key agricultural targets within the Viksit Bharat framework include achieving 100% crop insurance coverage, expanding the area under micro-irrigation to 10 million hectares, creating an integrated agricultural market network linking 10,000 Farmer Producer Organizations (FPOs), and transitioning 50 million hectares to natural or organic farming by 2047 (NITI Aayog, 2023). These targets are ambitious and will require sustained policy attention, investment, and institutional innovation.

The agricultural transformation agenda under Viksit Bharat is closely aligned with broader national goals, including achieving a \$30 trillion economy by 2047, eliminating extreme poverty, ensuring universal food and nutrition security, and meeting India's Nationally Determined Contributions (NDCs) under the Paris Agreement. Agriculture thus sits at the intersection of economic, social, and environmental objectives, requiring a carefully calibrated and multi-stakeholder approach to transformation.

Technology and Digital Agriculture

Digital technologies represent perhaps the most significant lever for agricultural transformation in India. The country's rapidly expanding digital infrastructure including the Unified Payments Interface (UPI), Aadhaar-linked financial services, the BharatNet rural broadband network, and the Agri Stack digital public infrastructure provides a robust foundation for deploying technology-enabled agricultural solutions at scale (Ministry of Electronics and Information Technology, 2022).

Precision agriculture, leveraging satellite imagery, drone-based monitoring, soil sensors, and data analytics, enables farmers to optimize input applications, monitor crop health, and forecast yields with unprecedented accuracy (Raj et al., 2021). Pilot projects under the Indian Council of Agricultural Research (ICAR) have demonstrated that precision agriculture interventions can reduce fertilizer use by 20-30% while maintaining or enhancing yields, with significant implications for both farmer profitability and environmental sustainability.

Artificial intelligence (AI) and machine learning (ML) applications are increasingly being deployed across the agricultural value chain. The Kisan AI initiative and platforms such as the Krishi Vigyan Kendras' digital advisory services use AI to provide personalized agronomic recommendations, pest and disease alerts, and weather-based crop management guidance to millions of farmers via mobile phones (Sharma & Tiwari, 2022). The integration of AI with remote sensing data has also enabled early warning systems for droughts and floods, enhancing disaster preparedness in vulnerable agricultural regions.

Blockchain technology is being explored for agricultural supply chain management, enabling transparent traceability from farm to fork, reducing post-harvest losses attributable to information asymmetries, and supporting premium pricing for certified agricultural products (Singh et al., 2020). The National Agri Stack initiative aims to create a unified digital agriculture ecosystem that integrates farmer data, land records, soil health information, weather data, and market intelligence, providing a data-driven foundation for precision policy interventions.

Climate-Smart Agriculture and Environmental Sustainability

Climate change poses an existential threat to India's agricultural system, with potentially catastrophic consequences for food security, farmer livelihoods, and rural economies. The Indian Meteorological Department projects a 1.5-2°C rise in average temperatures across major agricultural regions by mid-century, accompanied by increased rainfall variability and more frequent extreme weather events (IMD, 2021). Adapting Indian agriculture to these changes while simultaneously reducing its contribution to greenhouse gas (GHG) emissions agriculture accounts for approximately 18% of India's total GHG emissions is a central challenge of the Viksit Bharat agenda.

Climate-smart agriculture encompasses a suite of practices and technologies designed to increase productivity, enhance resilience to climate shocks, and reduce or remove GHG emissions. In the Indian context, key CSA interventions include the promotion of drought-tolerant and heat-resistant crop varieties, the adoption of direct-seeded rice (DSR) to reduce methane emissions and water use, the scale-up of agroforestry systems, and the expansion of conservation agriculture practices such as zero tillage and crop residue management (Jat et al., 2019).

Natural farming, championed under the *Viksit Bharat* vision through the Pradhan Mantri Prakriti Krishi initiative, seeks to reduce dependence on synthetic chemical inputs by harnessing traditional knowledge systems and on-farm biological resources. Evidence from Andhra Pradesh's large-scale natural farming program covering 600,000 farmers across 700,000 hectares suggests that natural farming can reduce input costs by 30-50%, improve soil health, and maintain competitive yields in many crop-soil-climate combinations, while enhancing long-term agricultural sustainability (Bharucha et al., 2020).

Water management is a critical dimension of climate-smart agriculture in India, where agriculture accounts for approximately 80% of total freshwater withdrawals. The expansion of micro-irrigation drip and sprinkler systems under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) aims to achieve 'More crop per drop,' improving water productivity and reducing the energy costs of irrigation (Ministry of Agriculture, 2023). Watershed development programs and rainwater harvesting initiatives complement micro-irrigation investments by enhancing groundwater recharge and reducing surface runoff.

Market Reforms and Agricultural Value Chain Development

Transforming Indian agriculture from a subsistence-oriented system to a commercially vibrant sector requires fundamental reforms in agricultural markets and value chains. Despite significant investments in agricultural infrastructure, India continues to lose an estimated 15-20% of food production to post-harvest losses annually amounting to approximately \$12.6 billion due to inadequate cold chain infrastructure, fragmented logistics networks, and market inefficiencies (Ghosh, 2022).

The e-National Agricultural Market (e-NAM) platform, launched in 2016, represents a landmark initiative to integrate fragmented state-level agricultural markets into a unified national market, enabling transparent price discovery and reducing the role of intermediaries. By 2023, e-NAM had onboarded over 1,000 mandis (wholesale markets) across 18 states, facilitating trade worth over ₹3 trillion (Ministry of Agriculture, 2023). However, challenges related to platform adoption, quality standardization, and last-mile connectivity continue to limit the platform's transformative potential.

Farmer Producer Organizations (FPOs) have emerged as a critical institutional mechanism for aggregating smallholder production, improving collective bargaining power, and enabling access to formal credit, inputs, and markets. The Government of India's initiative to establish 10,000 FPOs by 2027, with financial support of ₹6,865 crore, reflects the strategic importance accorded to collective farming institutions in the *Viksit Bharat* framework (Singh & Bhattarai, 2022). Evidence suggests that well-functioning FPOs can increase member farmer incomes by 20-40% through economies of scale in procurement and marketing.

Agri-food value chain modernization encompassing investments in primary processing, cold storage, packaging, and logistics is essential for reducing post-harvest losses, improving product quality, and capturing higher value along the supply chain. The Production Linked Incentive (PLI) scheme for food processing, with an outlay of ₹10,900 crore, aims to attract investments in modern food processing infrastructure and create new markets for agricultural produce (Ministry of Food Processing Industries, 2022). Strengthening linkages between agricultural production and food processing can significantly enhance the realized prices for farmers and expand employment in rural areas.

Social Equity, Inclusion, and Rural Development

Agricultural transformation under *Viksit Bharat* cannot be conceived solely in terms of productivity and market efficiency; it must be fundamentally anchored in principles of social equity and inclusion. India's agricultural workforce is characterized by pronounced inequalities along the dimensions of landholding size, caste, gender, and geographic location. Small and marginal farmers those with landholdings below 2 hectares constitute over 86% of the farming community and contribute approximately 51% of total agricultural output, yet they remain disproportionately vulnerable to income shocks, market failures, and climate risks (NSSO, 2019).

Gender equity in agriculture is a critical dimension of inclusive agricultural transformation. Women constitute approximately 33% of India's agricultural workforce rising to over 70% in specific states yet face significant barriers to land ownership, credit access, and technology adoption. Studies demonstrate that eliminating gender-based disparities in access to agricultural resources and services could increase farm productivity by 20-30%, with significant implications for household food security and child nutrition (FAO, 2020). The *Viksit Bharat* vision's focus on Mahila (Women) includes targeted programs for women farmer groups, women-led FPOs, and gender-responsive extension services.

Agricultural education and extension services play a foundational role in driving agricultural transformation by building the knowledge and skills of farming communities. India's extensive network of Krishi Vigyan Kendras (KVKs) farm science centers currently covers all 731 districts, providing technology demonstration, training, and advisory services. However, the reach and quality of extension services remain uneven, with significant gaps in coverage of remote areas, tribal communities, and marginal farmers (Sulaiman & Davis, 2019). Strengthening digital extension platforms and community-based advisory networks can significantly enhance the scale and effectiveness of agricultural knowledge services.

Challenges and the Way Forward

Despite the promise of the *Viksit Bharat* agricultural vision, significant challenges must be addressed to translate aspiration into reality. First, the structural challenge of land fragmentation with average farm size declining to 1.08 hectares in 2015-16 limits the economic viability of individual farming operations and constrains adoption of mechanization and modern technologies (Agricultural Census, 2016). Land consolidation policies, while politically sensitive, and innovative tenure arrangements such as land leasing must be explored to address this structural constraint.

Second, agricultural credit availability and affordability remain a persistent challenge. Despite institutional credit flows to

agriculture exceeding ₹18 trillion in 2022-23, a significant proportion of small and marginal farmers continue to rely on informal moneylenders at usurious interest rates (Reserve Bank of India, 2023). Expanding the reach of formal agricultural credit through Kisan Credit Cards, microfinance institutions, and digital lending platforms is essential for enabling farmer investment in productivity-enhancing technologies and practices.

Third, rural infrastructure gaps including inadequate rural roads, electricity supply, storage facilities, and digital connectivity continue to impede agricultural market integration and technology adoption. The Pradhan Mantri Gram Sadak Yojana (PMGSY) has made significant progress in rural road connectivity, with over 800,000 km of rural roads constructed by 2023, but gaps remain in the most remote areas. Accelerated investment in rural infrastructure, with particular attention to digital connectivity through BharatNet, is critical for unlocking the transformative potential of agricultural digitalization.

Fourth, achieving the sustainability objectives of Viksit Bharat requires a fundamental rethinking of agricultural incentive structures. Current subsidy regimes particularly for electricity and water used in agriculture incentivize resource overuse and environmental degradation. Transitioning toward more targeted, direct benefit transfers and market-based pricing for agricultural resources, while politically challenging, is necessary for promoting sustainable resource management and long-term agricultural viability (Gulati & Juneja, 2021).

3. CONCLUSION

The transformation of Indian agriculture under the Viksit Bharat 2047 vision represents one of the most complex and consequential development challenges of the twenty-first century. Success will require not a single breakthrough but rather the simultaneous and coordinated advance along multiple fronts: technological innovation, institutional reform, market development, climate adaptation, and social equity.

The pathways analyzed in this article digital agriculture, climate-smart farming, value chain modernization, and inclusive rural development are not mutually exclusive but deeply interconnected. Realizing their transformative potential demands an integrated policy architecture that aligns financial incentives, institutional capacities, and governance frameworks. The Government of India's Viksit Bharat 2047 agenda provides an overarching framework and political mandate for this transformation, but translating vision into ground-level impact requires sustained commitment, adaptive learning, and genuine partnership between government, research institutions, private sector actors, civil society, and farming communities.

As India approaches the centenary of its independence, the opportunity to build an agricultural system that is productive, sustainable, equitable, and resilient has never been greater nor have the stakes. The transformation of Indian agriculture is, ultimately, the transformation of rural India and, by extension, the realization of the Viksit Bharat promise for every citizen. Achieving this vision will require bold, evidence-based, and inclusive action beginning now.

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