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The Role of Sustainable Agriculture in Viksit Bharat 2047: Pathways Toward Food Security and Inclusive Rural Growth

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1. Introduction

India's development trajectory has always been closely intertwined with agriculture. From being a subsistence-oriented agrarian economy at the time of independence to achieving food self-sufficiency through the Green Revolution, agriculture has shaped India's economic, social, and political landscape. Even in the era of rapid industrialization and digital transformation, agriculture continues to support nearly half of India's population and remains the primary livelihood source for rural households.

However, the success of input-intensive agriculture has also generated structural challenges. Excessive dependence on chemical fertilizers and pesticides, unsustainable groundwater extraction, monocropping, declining soil fertility, and rising production costs have weakened the ecological foundation of Indian agriculture. These challenges are further aggravated by climate change, manifested in erratic rainfall, prolonged droughts, floods, and rising temperatures. Consequently, Indian agriculture today faces the dual challenge of ensuring food security for a growing population while preserving environmental sustainability.

The Government of India's vision of Viksit Bharat 2047 aims to transform India into a developed, inclusive, and environmentally sustainable nation by the centenary of independence. This vision recognizes that economic growth alone is insufficient unless it is accompanied by ecological balance and social equity. Within this framework, agriculture is not merely a sector of production but a strategic instrument for achieving food security, poverty reduction, employment generation, and rural transformation.

Sustainable agriculture offers a holistic solution to these challenges by integrating economic efficiency, environmental stewardship, and social inclusiveness. It emphasizes optimal use of natural resources, climate resilience, biodiversity conservation, and farmer welfare. In the Indian context, sustainable agriculture draws from traditional ecological practices while incorporating modern innovations such as precision farming, digital extension services, and climate-smart technologies.

This study argues that sustainable agriculture is central to the realization of Viksit Bharat 2047, as it directly contributes to food security, rural income stability, environmental sustainability, and inclusive growth. By examining economic, environmental, and social dimensions, this paper seeks to demonstrate how sustainable agriculture can serve as a transformative pathway toward a resilient and developed India.

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2. Need for the Study

The need for this study arises from multiple interrelated factors:

- **Ecological Degradation**: Nearly 30 per cent of India's land is degraded, and more than half of groundwater resources are under stress. Unsustainable farming practices threaten long-term agricultural viability.
- **Food Security Concerns**: With a growing population and changing consumption patterns, India must increase food production without compromising environmental sustainability.
- **Farmer Distress and Rural Inequality**: Small and marginal farmers face rising input costs, income instability, and market risks. Sustainable agriculture can reduce costs and improve income resilience.
- **Climate Change Vulnerability**: Agriculture is highly sensitive to climate variability. Sustainable and climate-resilient practices are essential for adaptation and mitigation.
- **Alignment with National Vision**: Viksit Bharat 2047 emphasizes inclusive growth, green development, and self-reliance. Agriculture must align with these objectives.

Despite various government initiatives such as the National Mission for Sustainable Agriculture (NMSA), PMKSY, PKVY, and Soil Health Card Scheme, adoption remains uneven. A comprehensive study linking sustainable agriculture with Viksit Bharat 2047 is therefore necessary to guide policy and practice.

3. Review Of Literature

The concept of sustainable agriculture has evolved through extensive academic and policy discourse. Early contributions by Pretty (1995) emphasized sustainability as a balance between productivity and ecological preservation. FAO (2018) defines sustainable agriculture as a system that ensures food security while maintaining the economic, social, and environmental bases for future generations.

In the Indian context, Swaminathan (2010) highlighted the need for an "ever-green revolution," advocating productivity growth without ecological harm. Studies by Chand (2017) underline the importance of diversification, water efficiency, and income security for sustainable agricultural development. NITI Aayog (2023) stresses that sustainable agriculture is essential for achieving long-term economic resilience and climate adaptation.

Empirical research by Kumar and Singh (2022) shows that sustainable practices significantly reduce input costs and improve farm profitability, particularly for smallholders. World Bank (2021) emphasizes that climate-smart agriculture can increase productivity by 20–30% while reducing emissions. ICAR (2023) finds that integrated nutrient management and micro-irrigation improve soil health and water use efficiency.

However, several studies also highlight constraints. Reddy and Mishra (2020) argue that limited access to credit, weak extension services, and market uncertainties restrict adoption. EPW (2021) notes regional disparities in sustainable practice adoption, favouring irrigated and better-connected regions.

While existing literature discusses sustainability, food security, and rural development separately, there is a notable research gap in linking sustainable agriculture explicitly with the Viksit Bharat 2047 vision. This study attempts to bridge this gap by integrating sustainability, policy frameworks, and development outcomes within a single analytical framework.

4. Objectives Of The Study

The specific objectives of the study are:

- To examine the concept and importance of sustainable agriculture in the Indian context.

- To analyse the role of sustainable agriculture in ensuring food security.
- To assess the contribution of sustainable agriculture to inclusive rural growth.
- To evaluate economic and environmental impacts using secondary data.
- To suggest policy measures for strengthening sustainable agriculture under Viksit Bharat 2047

5. Research Methodology

The study adopts a descriptive and analytical research design based entirely on secondary data.

5.1 Sources of Data

- Government of India reports (Ministry of Agriculture, NITI Aayog, ICAR)
- FAO and World Bank publications
- Research articles and policy papers
- Official scheme documents (NMSA, PMKSY, PKVY)

5.2 Tools of Analysis

- Descriptive statistics
- Comparative analysis
- Tabular presentation
- Interpretation based on sustainability indicators

6. Analysis and Interpretation

The below Table 1 presents the extent of adoption of various sustainable agricultural practices across India, reflecting the current status of India's transition toward environmentally responsible and economically viable farming systems. The adoption levels vary significantly across practices, highlighting both progress and persistent constraints in mainstreaming sustainability within Indian agriculture.

Table 1: Adoption of Sustainable Agricultural Practices in India

Practice	Adoption %	Key impact
Organic / Natural farming	26	Soil fertility improvement
Integrated nutrient management	48	Reduced fertilizer use
Micro irrigation	32	Water Saving
Crop diversification	45	Income stability
Agro forestry	22	Biodiversity conservation

Source: Indian Council of Agricultural Research ICAR (2022-24), NITI Aayog-2023- (Strategy for New India @75 and Viksit Bharat 2047 vision documents.

The adoption rate of Integrated Nutrient Management (INM) is the highest at 48 per cent, indicating relatively greater acceptance among farmers. INM's higher adoption can be attributed to its flexibility and compatibility with existing farming systems. By combining chemical fertilizers with organic manures and bio-fertilizers, INM allows farmers to gradually reduce chemical dependency without risking yield loss. Government initiatives such as the Soil Health Card Scheme and extension programs have played a crucial role in popularizing INM by improving awareness about balanced nutrient application and cost reduction.

Crop diversification, with an adoption rate of 45 per cent, represents another widely practiced sustainability strategy. Farmers are increasingly moving away from monocropping toward diversified cropping patterns involving pulses, oilseeds, horticulture crops, and allied activities. Diversification helps reduce income risk, enhances soil fertility through crop rotation, and supports nutritional security. The relatively higher adoption reflects farmers' response to market volatility and climate uncertainty, as diversification offers both economic and ecological resilience.

The adoption of micro-irrigation practices, including drip and sprinkler systems, stands at 32 per cent. While the benefits of micro-irrigation in terms of water savings and yield improvement are well established, its adoption remains constrained by high initial investment costs, uneven access to subsidies, and limited technical support in certain regions. Nonetheless, regions with better institutional support under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) show significantly higher uptake, indicating the importance of targeted policy interventions.

Organic and natural farming practices have an adoption rate of 26 per cent, reflecting growing but still limited acceptance. Organic farming demands a transition period during which yields may temporarily decline, and farmers often face challenges related to certification, marketing, and price realization. However, increasing consumer demand for organic produce, along with government programs such as Paramparagat Krishi Vikas Yojana (PKVY), has contributed to gradual expansion, particularly in states like Sikkim, Andhra Pradesh, and Telangana.

The adoption of agro forestry is the lowest at 22 per cent, despite its substantial long-term benefits such as carbon sequestration, biodiversity conservation, and diversified income sources. The low adoption rate is largely due to long gestation periods, land tenure issues, and limited awareness among farmers. Inadequate market linkages for tree-based products further discourage farmers from adopting agroforestry systems. This indicates the need for stronger incentives and extension support under the National Agroforestry Policy.

Overall, the adoption pattern reflected in Table 1 reveals a preference for practices that offer immediate economic benefits with minimal risk, while practices requiring long-term investment or structural change show slower adoption. This underscores the importance of aligning sustainability initiatives with farmers' short-term economic needs.

From the perspective of Viksit Bharat 2047, these findings suggest that sustainable agriculture is at a critical transition stage. While awareness and adoption are increasing, large-scale transformation will require enhanced policy support, financial incentives, capacity building, and market integration. Strengthening institutional mechanisms and addressing regional disparities will be essential to accelerate adoption and ensure that sustainable agriculture becomes a cornerstone of India's journey toward food security and inclusive rural growth.

Table 2: Economic Impact of Sustainable Agriculture

Indicator	Conventional	Sustainable	% change
Yield (q/ha)	22	25.5	+15.9
Input cost (Rs/ha)	45,000	37,000	-17.8
Net income (Rs/year)	95,000	1,28,000	+34.7

Source: Ministry of Agriculture & Farmers welfare (2022), ICAR (2023) Impact Assessment Studies on sustainable farming practices.

Table 2 presents a comparative analysis of key economic indicators between conventional and sustainable agricultural systems. The results reveal that sustainable agriculture not only enhances productivity but also significantly improves farm-level economic outcomes.

The average yield under sustainable practices increases from 22 quintals per hectare to 25.5 quintals per hectare, representing a 15.9 per cent improvement. This increase challenges the common perception that sustainable or organic practices necessarily lead to yield reductions. The observed yield gains can be attributed to improved soil structure, enhanced microbial activity, balanced nutrient management, and better water retention capacity. Healthier soils improve nutrient uptake efficiency, resulting in more stable and resilient crop production.

A major economic advantage of sustainable agriculture lies in the reduction of input costs, which decline by 17.8 per cent, from ₹45,000 per hectare under conventional farming to ₹37,000 per hectare under sustainable systems. This reduction is primarily due to decreased reliance on chemical fertilizers, pesticides, and energy-intensive irrigation practices. The use of organic manures, bio-fertilizers, and integrated pest management lowers expenditure while reducing farmers' vulnerability to fluctuating input prices.

The combined effect of higher yields and lower input costs leads to a substantial increase in net farm income, rising from ₹95,000 to ₹1,28,000 per year—an increase of 34.7 per cent. This income enhancement is particularly significant for small and marginal farmers, for whom even modest income gains can substantially improve living standards. Stable and higher incomes reduce indebtedness, enhance consumption capacity, and promote investment in education and health, thereby supporting inclusive rural growth.

Overall, Table 2 demonstrates that sustainable agriculture strengthens economic viability and resilience, making it a critical instrument for income security and poverty reduction in rural India, which is central to the Viksit Bharat 2047 vision.

Table 3: Environmental Impact

Indicator	Conventional	Sustainable
Ground water use (m/ha)	6200	4400
Fertilizer use (kg/ha)	260	180
GHG emission (CO2eq./ha)	3.1	2.2

Source: ICAR (2022-24), Soil Health, water use efficiency and Resource conservation reports. Intergovernmental Panel on Climate Change (IPCC) 2019.

Table 3 highlights the environmental impacts of sustainable agriculture by comparing key resource-use and emission indicators between conventional and sustainable farming systems. The findings clearly indicate that sustainable agriculture significantly reduces pressure on natural resources while mitigating environmental degradation.

Groundwater extraction declines sharply from 6,200 m^3 per hectare per year under conventional farming to 4,400 m^3 per hectare per year under sustainable practices. This reduction of nearly 29 per cent reflects the adoption of micro-irrigation, rainwater harvesting, and improved soil moisture retention. Given that groundwater depletion is one of the most critical challenges facing Indian agriculture, this reduction is vital for long-term water security and intergenerational equity.

Chemical fertilizer usage decreases from 260 kg per hectare to 180 kg per hectare, indicating a shift towards integrated nutrient management and organic inputs. Excessive fertilizer use has been a major contributor to soil degradation, water pollution, and declining nutrient efficiency. Reduced fertilizer application not only lowers production costs but also improves soil health and reduces nitrate contamination of water bodies.

Greenhouse gas (GHG) emissions decline from 3.1 to 2.2 tonnes of CO_2 equivalent per hectare, underscoring the climate mitigation potential of sustainable agriculture. Lower emissions result from reduced chemical input use, improved energy efficiency, and enhanced carbon sequestration through practices such as agro forestry and organic matter incorporation. This aligns agricultural development with India's Nationally Determined Contributions (NDCs) under the Paris Agreement.

The environmental gains observed in Table 3.3 illustrate that sustainable agriculture supports green growth by decoupling agricultural productivity from environmental degradation. These outcomes are essential for achieving environmental sustainability under the Viksit Bharat 2047 framework.

Table 4: Correlation between Sustainability and Income

Indicator	Correlation (r)
Soil health	0.68
Water efficiency	0.73
Crop diversification	0.59

ICAR (2023) integrated Farming Systems and Income Stability Studies.

Table 4 examines the relationship between sustainability indicators and farm income stability using correlation analysis. The results show a strong and positive association between sustainable practices and income resilience, reinforcing the argument that environmental sustainability and economic prosperity are complementary rather than conflicting goals.

The soil health index exhibits a correlation coefficient of 0.68 with farm income, indicating a strong positive relationship. Improved soil health enhances nutrient availability, water retention, and crop resilience, leading to consistent yields and reduced production risks. Farmers with healthier soils are better equipped to withstand climatic shocks, thereby ensuring income stability.

Water-use efficiency demonstrates the strongest correlation with farm income at 0.73. Efficient water management reduces irrigation costs and crop stress, especially in water-scarce regions. This strong correlation highlights the centrality of water conservation strategies such as drip irrigation and moisture management in improving agricultural profitability and sustainability.

The crop diversification index shows a positive correlation of 0.59 with farm income. Diversification reduces dependence on a single crop, spreads risk, and enables farmers to tap into high-value crops and allied activities. It also enhances nutritional security and creates additional employment opportunities in rural areas.

Together, these correlations confirm that investments in sustainable agriculture generate long-term economic benefits by stabilizing incomes and reducing vulnerability. This reinforces the view that sustainable agriculture is a powerful pathway for inclusive rural growth under Viksit Bharat 2047.

7. Findings

- Sustainable agriculture enhances long-term food security through yield stability and resource conservation.
- It significantly improves farmer incomes and reduces vulnerability to market and climate risks.
- Environmental benefits support climate adaptation and mitigation objectives.
- Institutional gaps and uneven access limit large-scale adoption.
- Sustainable agriculture strongly aligns with the developmental vision of Viksit Bharat 2047.

8. Conclusions

Sustainable agriculture is indispensable to India's aspiration of becoming a developed nation by 2047. It integrates economic growth with environmental responsibility and social equity, ensuring that development is both inclusive and resilient. The study concludes that mainstreaming sustainable agriculture into national development strategy is essential for achieving food security, rural prosperity, and ecological balance.

For Viksit Bharat 2047 to become a reality, agricultural policies must prioritize sustainability through technological innovation, institutional convergence, financial inclusion, and capacity building. Sustainable agriculture is not merely an agricultural reform but a national development imperative that holds the key to India's long-term prosperity.

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