Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
July 2024 5(7), 1496–1500

LEVERAGING ECONOMIC INCENTIVES FOR SUSTAINABLE AGRICULTURE TO ACHIEVE FOOD SECURITY BY 2047

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DOI
10.29121/shodhkosh.v5.i7.2024.5944

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

India stands at a crucial crossroads in its agricultural evolution. With its population projected to reach 1.6 billion by 2047, ensuring food security while embracing sustainability is imperative. Agriculture, employing 42% of the workforce and contributing 17.8% to GDP, faces mounting threats from climate change, soil degradation, and water scarcity. The Green Revolution boosted food production but left a legacy of excessive chemical use, groundwater depletion, and declining soil fertility. To meet the projected food grain demand of 402-437 million tonnes by 2047, India must transition to sustainable agriculture without compromising productivity or farmer livelihoods.

Keywords: Sustainable, Agriculture, Food, 2047

1. INTRODUCTION

India stands at a crucial crossroads in its agricultural evolution. With its population projected to reach 1.6 billion by 2047, ensuring food security while embracing sustainability is imperative. Agriculture, employing 42% of the workforce and contributing 17.8% to GDP, faces mounting threats from climate change, soil degradation, and water scarcity. The Green Revolution boosted food production but left a legacy of excessive chemical use, groundwater depletion, and declining soil fertility. To meet the projected food grain demand of 402-437 million tonnes by 2047, India must transition to sustainable agriculture without compromising productivity or farmer livelihoods.

Despite producing 315 million tonnes of food grains in 2023-24, 14.5% of Indians remain undernourished, and 30% of arable land is degraded. Groundwater levels in key agricultural states like Punjab have dropped by 61% since 1970, while climate change has caused annual yield losses of 4-10%. Smallholder farmers, who manage 86% of total landholdings, often lack resources to shift to sustainable methods, making economic incentives critical.

Redirecting ₹71,309 crore in fertilizer and electricity subsidies toward organic fertilizers, bio-pesticides, and efficient irrigation can rejuvenate soils and conserve water. Adjusting the Minimum Support Price (MSP) to promote climate-resilient crops like millets and pulses can enhance nutrition and biodiversity. Payments for Ecosystem Services

(PES) could compensate farmers for soil conservation and carbon sequestration, while improved crop insurance can mitigate risks.

By aligning financial policies with ecological goals, India can secure food production, enhance farmer incomes, and build climate resilience. A balanced strategy will help achieve "Viksit Bharat" by 2047, ensuring food security while safeguarding natural resources. Economic incentives are key to making sustainability profitable and scalable.

2. REVIEW OF LITERATURE

Understanding Farmers' Adoption of Sustainable Agriculture Innovations (Agronomy, 2022):

This review by José Rosário, Lívia Carlos Marques, and Rui Silva systematically examines how sociopsychological factors influence farmers' adoption of sustainable agricultural practices. It explores the impact of perceptions, attitudes, and social norms on decision-making, identifying key motivators and challenges that affect the shift toward sustainable farming.

Sustainable Agriculture and Food Security (Springer): Edited by Rajeev K. Varshney, this book focuses on sustainable food production and security in Asia and Africa, aligning with SDG 2 (Zero Hunger). It discusses resilient crop breeding, efficient farming techniques, post-harvest processes, and food supply chains, highlighting research advancements and successful case studies in agricultural sustainability.

2.1. OBJECTIVES

1) To understand the current status of Sustainable Agriculture practices in India.
2) To explore the importance of Incentives for Sustainable farming practices in India.
3) To analyze the challenges associated with Sustainable Agriculture to Achieve Food Security by 2047.

3. METHODOLOGY

This study adopts a conceptual and qualitative research approach to explore an opportunities and challenges of Leveraging Economic Incentives for Sustainable Agriculture to Achieve Food Security by 2047. Data collected from credible secondary sources such as National Mission for Sustainable Agriculture (NMSA), , Ministry of Agriculture, Ministry of Environment, Forest and Climate Change and case studies and journals, this helps in understanding the current status of incentives for sustainable agriculture and opportunities and challenges to achieve food security by 2047.

3.1. THE ROLE OF ECONOMIC INCENTIVES IN TRANSFORMING INDIAN AGRICULTURE

Economic incentives—financial tools aimed at influencing behavior—are instrumental in motivating farmers to adopt sustainable practices that boost productivity while conserving natural resources. These incentives encompass subsidies, tax reliefs, payments for ecosystem services, and market-driven rewards, aligning farmers' economic interests with national priorities of sustainability and food security.

3.2. CURRENT LANDSCAPE OF INDIAN AGRICULTURE AND FOOD SECURITY

India has significantly increased agricultural production, with food grain output reaching 330.5 million tonnes in 2022-23, as reported by the Ministry of Agriculture and Farmers Welfare. Rice and wheat, crucial for food security, dominate this production; however, issues of malnutrition and unequal food distribution persist. The Global Food Security Index 2022 places India at 68th among 113 nations, underlining gaps in affordability and nutrition despite sufficient supply. The National Family Health Survey (NFHS-5, 2019-21) indicates that 35.5% of children under five are stunted, emphasizing the need to broaden food security to include nutritional aspects.

Environmental degradation remains a pressing concern. The India State of Forest Report 2019 estimates that 29% of India's land is degraded, and the Central Ground Water Board notes that 17% of groundwater blocks are overexploited.

Excessive fertilizer use—averaging 175 kg per hectare—worsens soil acidity and water contamination. Sustainable agricultural practices such as agroecology, organic farming, and agroforestry can mitigate these challenges, and economic incentives can help bridge the financial gap between farmers' short-term costs and long-term societal benefits.

3.3. DESIGNING EFFECTIVE ECONOMIC INCENTIVES

To achieve food security by 2047, India must implement diverse economic incentives categorized into direct financial support, market-driven mechanisms, and regulatory incentives.

4. DIRECT FINANCIAL SUPPORT

Government subsidies play a crucial role in Indian agriculture, with INR 71,309 crore allocated to fertilizer subsidies annually (Union Budget 2021-22). However, these often encourage overuse, causing environmental harm. Redirecting these funds towards sustainable farming is a viable alternative. The Paramparagat Krishi Vikas Yojana (PKVY), initiated in 2015, offers INR 50,000 per hectare over three years to farmers transitioning to organic farming, covering 6.8 lakh hectares by 2023—just a fraction of India's 140 million hectares of arable land.

Expanding such initiatives can accelerate adoption. Council on Energy , Environment and Water (CEEW) (2021) study found that agroforestry and the System of Rice Intensification (SRI) boosted farmer incomes by 15-20% while cutting water use by 30%. Offering annual incentives of INR 10,000-15,000 per hectare could encourage millions of smallholder farmers, who make up 86% of India's farming community (Agriculture Census 2015-16).

4.1. MARKET-BASED MECHANISMS

Premium pricing for sustainably grown produce can drive widespread adoption. India's organic food market, valued at USD 1.2 billion in 2022, is projected to reach USD 4.6 billion by 2030 (Statista, 2023). The Participatory Guarantee System (PGS) facilitates low-cost organic certification, enabling small farmers to access premium markets. Nature Sustainability study (2020) found that economic incentives linked to sustainability increased adoption rates by 20% compared to ecological messaging alone.

Payments for ecosystem services (PES) offer another solution. Farmers maintaining soil carbon or conserving water could be compensated through carbon credits or public-private partnerships. Karnataka's "Bhoochetana" project, focused on soil health management, increased yields by 20-66%. Scaling PES (Payments for ecosystem services) nationwide may require an initial investment of INR 50,000 crore annually, with long-term benefits in productivity and climate resilience.

4.2. REGULATORY INCENTIVES AND TAX RELIEFS

Tax exemptions on sustainable technologies like drip irrigation and solar pumps (currently taxed at 12-18% GST) could reduce costs by 10-15%, making them more accessible to small farmers. The National Mission for Sustainable Agriculture (NMSA) has a budget of INR 1,136 crore in 2023-24 (0.8% of the Agriculture Ministry's total). Increasing this allocation to INR 7,100 crore—about 5% of the total—could benefit 10 million farmers annually.

Case Studies: Successful Models and Lessons

India has seen success in incentivizing sustainable farming. The Zero Budget Natural Farming (ZBNF) initiative in Andhra Pradesh, launched in 2016, eliminates chemical inputs in favor of natural fertilizers. By 2023, it reached 7 lakh farmers, reducing costs by 15-20% and increasing net incomes by 10% (Rythu Sadhikara Samstha, 2022). The state's INR 16,000 per farmer subsidy over five years illustrates how targeted financial support can drive sustainable transitions.

Punjab's Preservation of Subsoil Water Act (2009) encourages delayed rice planting to curb groundwater depletion. Farmers complying receive priority access to canal water and electricity subsidies, cutting groundwater use by 25-30% annually (IWMI, 2019). Global examples, such as Brazil's Low-Carbon Agriculture Plan, which offers low-interest loans for sustainable farming, provide further inspiration. Since 2010, this model has increased productivity by 15% while cutting carbon emissions by 30 million tonnes (World Bank, 2021).

5. ECONOMIC AND ENVIRONMENTAL IMPACT

A well-structured incentive framework could revolutionize Indian agriculture by 2047. A 2016 Agricultural and Food Economics study estimated that sustainable practices could boost GDP growth by 1-2% annually while creating 5-7 million rural jobs. If 50% of Indian farmers adopt sustainability measures, food grain production could reach 450 million tonnes, meeting the projected needs of 1.64 billion people (U.N. Population Division, 2022).

On the environmental front, CEEW's 2021 report suggests agroecology could lower agriculture-related greenhouse gas emissions (currently 17% of India's total) by 25% and restore 10-15% of degraded land. Water-efficient techniques like SRI and drip irrigation could conserve 1,500 billion cubic meters of water annually, critical as 54% of India faces high water stress (NITI Aayog, 2018).

5.1. CHALLENGES AND POLICY RECOMMENDATIONS

Despite their potential, economic incentives face hurdles. Small landholdings (average size 1.08 hectares) limit economies of scale, while awareness of sustainable practices remains low—only 30% of farmers recognize the benefits of organic farming (NFHS-5). Transitioning to organic farming initially reduces yields by 10-20% (ICAR, 2020), deterring adoption.

To overcome these challenges, India should:

Increase NMSA's budget to INR 7,100 crore and expand PKVY to 20 million hectares by 2030.

Train 1 million agricultural extension workers by 2047 using digital platforms like e-NAM.

Expand PGS certification to 10 million farmers and establish 5,000 rural agri-markets by 2047.

Launch PES pilot projects in 10 states by 2027, offering INR 5,000-10,000 per hectare for carbon sequestration.

Integrate sustainability criteria into Kisan Credit Card loans, targeting 50 million farmers with low-interest financing by 2047.

Vision 2047: A Sustainable Agricultural Future

India's food security in 2047 depends on a sustainable agricultural revolution driven by economic incentives. Achieving this requires INR 2-3 lakh crore annually—less than 2% of India's projected GDP of USD 26 trillion by 2048 (EY, 2023). The potential rewards include a resilient food system, reduced rural poverty, and a healthier environment.

Aligning with India's net-zero commitment by 2070 and Sustainable Development Goals (SDGs), policies supporting crop diversification, millets promotion, and water-efficient techniques are essential. Increasing the MSP for millets by 20% could boost production from 17 million tonnes (2022-23) to 50 million tonnes by 2047.

6. CONCLUSION

Sustainable agriculture is vital for ensuring India's long-term food security and economic stability. By strategically leveraging economic incentives—such as subsidies, tax benefits, and market-driven mechanisms—India can accelerate the adoption of environmentally sustainable farming practices. A comprehensive approach that integrates policy support, technological advancements, and active stakeholder collaboration will be key to achieving a resilient agricultural sector.

While economic incentives alone cannot address all challenges, they serve as a powerful catalyst for change. By aligning financial support with sustainable practices, India can create a balanced framework that promotes both economic growth and ecological preservation. The path to a food-secure and sustainable future by 2047 requires coordinated efforts from policymakers, farmers, researchers, and the private sector. Through well-designed economic interventions and collective commitment, India can build an agricultural system that ensures prosperity while safeguarding natural resources for future generations.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

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