



SUSTAINABLE FARMING PRACTICES IN PUNJAB: AWARENESS, CHALLENGES AND BENEFITS

Agriculture

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ABSTRACT

Punjab, known as the Food Bowl of India, faces a hurdle of maintaining agricultural productivity while tackling ecological degradation. This study inquires into the awareness, challenges and benefits interrelated with sustainable farming practices among farmers in India. The research consists of district level areas drawn from Amritsar, Ludhiana, Sangrur, Patiala, Bathinda and Mansa. Findings indicated that awareness of sustainable practices such as organic farming, crop diversification, direct seeded, rice and micro irrigation-is rising due to institutional initiatives by NABARD and Punjab agricultural University, though adoption remains inconsistent. Major challenges include decline in groundwater levels, high input costs and limited access to green credit and inadequate market linkages for organic products. Economic evidence suggests that various programs have increased farm income by 20 to 25% and improved irrigation practices across 19 lakh hectares. This study is based on secondary sources of data. The study finds that Punjab's sustainable transformation requires district specific strategies, integrating financial inclusion, institutional integration and responsive governance system. Enhancing awareness, expanding reach for small holders and promoting locally appropriate technologies are needed for achieving long-term agricultural sustainability and durability.

KEYWORDS

agriculture, sustainability, ecological balance, crop diversification

INTRODUCTION

Agriculture remains the backbone of the Indian economy, supporting nearly half of the country's population and playing a crucial role in food security, rural employment and economic stability. Since the Green Revolution, India has achieved remarkable growth in agricultural productivity; however, this success has also led to serious environmental and economic concerns. Excessive use of chemical fertilizers, pesticides, intensive irrigation and monocropping practices have resulted in soil degradation, groundwater depletion and declining farm profitability. In this context, sustainable farming has emerged as a vital approach to balance productivity with ecological conservation and long-term agricultural resilience.

Punjab occupies a unique position in India's agricultural landscape and is often referred to as the "Granary of India." The state has contributed significantly to national foodgrain production, particularly wheat and rice, since the 1960s. While the Green Revolution transformed Punjab into a highly productive agricultural state, its prolonged dependence on the rice-wheat cropping system has created severe ecological stress. Rapid depletion of groundwater, deterioration of soil health, air pollution due to crop residue burning and rising input costs have raised concerns regarding the sustainability of Punjab's farming system.

Sustainable farming practices such as crop diversification, organic and natural farming, integrated nutrient and pest management, micro-irrigation, renewable energy use and conservation agriculture offer viable solutions to these challenges. These practices not only help in conserving natural resources but also improve farm incomes, reduce production risks and enhance resilience to climate change. Recognizing these benefits, the Government of India, NABARD and state institutions have introduced several schemes and programs aimed at promoting sustainable agriculture in Punjab.

Despite policy support and institutional efforts, the adoption of sustainable farming practices among farmers remains uneven across districts. Factors such as limited awareness, high initial costs, market uncertainties and institutional constraints continue to hinder widespread adoption. Therefore, a comprehensive assessment of farmers' awareness, the challenges they face and the benefits derived from sustainable practices is essential.

REVIEW OF LITERATURE

1. Kareemulla (2017), argued that agricultural sustainability in India must be seen through economic, ecological and social dimensions as resource depletion and farmer distress together under my long-term viability. The study highlighted that indicators such as population, groundwater exploitation, and soil degradation negatively influence sustainability across states.
2. Rani (2018), observed that Indian agriculture faces, dual crisis-ecological degradation and economic strain despite being central

- to employment and food security. The study noted that land degradation affects nearly 7% of India's total area, while Ground water overuse driven by subsidised electricity had resulted in drastic water table decline, and soil deterioration. Government initiatives were identified as core tools for climate, resilient, agriculture and resource, efficient irrigation.
3. Singh et.al (2020), explained that despite Punjab's high productivity, the dominance of the rice-cycle has created ecological stress, particularly groundwater depletion and so nutrient loss. They noted fertilisers used from 1970 - 71 to 2016 - 17 ask the rating soil degradation and micro nutrient imbalance. They argued that mono cropping and chemical dependency have eroded biodiversity, increased environmental ability and reduced long-term resilience. They concluded that the Punjab agricultural system cannot sustain productivity gains unless resource-rational and versified models replace the front input-intensive structure.
4. Thulasiram (2020), observed that all the agriculture remained the backbone of India's economy by supporting nearly 2/3 of the rural population, cultivable land was rapidly declining due to industrial and infrastructure development. He noted that intensive input based farming had caused falling, soil, fertility, erosion and loss of environmental resilience, making sustainability a necessity rather than a choice.
5. Patil (2021) underlined that sustainable farming must incorporate environmental health, profitability and social equity, requiring not only the farmers but also policy makers, research, consumers and labourers to share responsibility in agricultural transition. The study emphasized that water shortage, soil, salinity and nitrate driven pollution had emerged from decades of exorbitant irrigation and chemical application, stating scientific soil testing and balanced NPK uses for sustainability.
6. Roul 2022, highlighted moderate levels of sustainability across soil, water and biodiversity dimensions. The study found biodiversity and environmental health as the most eroded aspects due to intensive rise-heat cultivation and unsustainable input subsidies. Groundwater depletion, nutrient, imbalance, and low organic matter were Keith threats to long-term productivity. The emphasised the need for micro irrigation, crop diversification and legume integration to restore soil health.
7. Kasi (2023), found that agriculture was central to achieving sustainable development because it influenced economic security, four systems, rural employment and environmental stability simultaneously. He noted that traditional and industrial agricultural system had contributed to deforestation, water scarcity, and biodiversity loss, a paradigm shift towards ecologically balanced production systems.
8. Manida(2023), explained that conventional farming had led to deforestation, biodiversity, loss, loss, degradation, and irrigation related pollution. The study highlighted that practises like conservation, tillage, natural pest, predators, and soil enrichment,

- reduce dependence on synthetic imports and restore biological cycles critical for long-term resilience.
9. Kumar et.al (2023), observed that despite India's remarkable progress through HYV seeds and Green Revolution, nearly 40% of cropped land is now degraded and 25 million turns of top soil were lost annually due to unsustainable input. The research study found that agricultural GDP had lowered to 16.27% by 2021. It remained the only sector showing responsiveness and positive growth during COVID-19, proving its central economic role.
 10. Roy and Gosh(2024), emphasised that India's post green revolution, farming success came with ecological consequences, specially loss of indigenous seed diversity and solved fertility. The study explored that sustainable agriculture must substitute input-intensive systems by techniques like per drop more crop, merging, composting, and drip irrigation.
 11. Debnath et. al (2024), explained that high intensity farming in India had led to soil degradation, biodiversity, decline, and severe water scarcity, making sustainability a national agricultural priority. The study highlighted that bio technology particularly drought tolerant and past resistant crop varieties could reduce the dependence on chemical fertilisers and pesticides. Water sustainability required, drip irrigation, rainwater harvesting, and integrated water resource management to achieve efficient irrigation outcomes.
 12. Prashant (2024) explored that farmers in Kalaburagi district remained to depend considerably on chemical fertilisers and pesticides, causing visible decline and environmental stress. The study noted that natural farming , crop rotation and water conservation are significant to mitigating these negative impacts while improving food security and long-term protection ability.

OBJECTIVES OF THE STUDY

1. To analyse the extent of consciousness among farmers in Punjab regarding sustainable farming practices.
2. To examine the substantial challenges experienced by farmers in embracing sustainable farming practices.
3. To study the considered economic and environmental advantages of adopting sustainable farming practices in Punjab.

METHODOLOGY

The present study is based on secondary data. The data were obtained from both national and international government sources. The data for this research has been collected from the Reserve Bank of India, Ministry of Agriculture and Farmers Welfare, Government of India, World Bank and Food and Agriculture Organizations of the United Nations.

DISCUSSION AND FINDINGS

The extent of knowledge among Punjab's farmers about sustainable practices has upgraded due to systematic efforts by institutions such as NABARD, Punjab Agricultural University and the Department of Agriculture and Farmers Welfare. NABARD's (2024) JIVA program and Financial Literacy Centres have broadened coverage on topics like organic farming, micro irrigation and crop diversification. In Amritsar, the net sown area is 2,20,942 hectares. Approximately 45% of farmers are conscious of soil health testing and micro-irrigation. Yet only 25–30% actively implement them practically.

In Ludhiana, the state's innovation hub, continuous training under PAU and GADVASU, alongside tele-advisory platforms such as the Pashu Palak Tele-Advisory Kendra, has improved scientific awareness, addressing over 320 farmer queries monthly. Sangrur and Patiala districts, through NABARD's saline soil reclamation projects, achieved yield gains of 32 to 49 quintals per hectare in wheat and 49 to 61 quintals per hectare in paddy, illustrating tangible benefits of awareness campaigns. Conversely, awareness remains low in southern districts like Bathinda and Mansa, where the dominance of groundwater-dependent paddy and wheat persists. Nationally, sustainable farming awareness aligns with growing climate adaptation efforts under India's National Mission for Sustainable Agriculture (NMSA). Chauhan and von Wehrden (2025) note that NMSA's integration into state action plans has elevated the role of training, participatory learning and an adaptive extension models, emphasizing that institutional presence strongly correlates with local awareness outcomes.

Despite policy progress, Punjab's farmers face entrenched barriers to sustainable adoption, categorized as ecological, economic and institutional:

Environmental Constraints:

Punjab's ecological fragility is acute. Over 80% of administrative blocks are classified as overexploited, with groundwater declining by 0.6–1.0 meters annually (CDEIS, 2020). In Amritsar and Bathinda, the heavy reliance on flood irrigation for rice cultivation accelerates water depletion. In contrast, Hoshiarpur and Pathankot still maintain relatively stable aquifers, offering scope for horticultural expansion. The cumulative impact of intensive cropping, excessive agrochemicals, and residue burning has resulted in soil nutrient imbalance and greenhouse gas emissions, underscoring the environmental dimension of Punjab's sustainability crisis.

(b) Economic Constraints:

Sustainable farming involves higher initial costs for equipment, composting units, and drip systems. The CDEIS (2020) estimated that Punjab farmers invest Rs.84,374 per hectare on average, but realize net returns of only Rs.12,055. Despite higher profitability in basmati rice (Rs.62,071/ha) compared to common paddy (Rs.53,362/ha), farmers prefer MSP-backed crops. NABARD's Credit and Refinance Report (2023–24) indicates Rs.8,769 crore in refinance support statewide, but only Rs.541 crore (6%) was channelled into capital investments promoting sustainability. Smallholders—comprising 65% of cultivators—account for less than 35% of formal credit access, highlighting structural inequity. CPI (2025) reports that nationally, sustainable finance flows to Indian agriculture total Rs.22,393 billion annually, with 67% from private institutions. However, the mismatch between credit design and smallholder needs continues to limit sustainable adoption.

(C) Institutional and Policy Barriers:

Amritsar has 27 cold storages (71,048 MT capacity), yet a 600,000 MT shortfall persists, leading to post-harvest losses. Infrastructure gaps, weak FPO networks and expensive organic certification processes disincentivize sustainability. In southern Punjab, farmers' participation in cooperatives remains below 40%. Chauhan and von Wehrden (2025) argue that India's sustainability transition is slowed by fragmented coordination among schemes such as NMSA, RKVY and ATMA, emphasizing the need for convergence-driven policy design. Institutional fragmentation in Punjab reflects these broader national challenges.

Despite constraints, the empirical data demonstrate clear advantages from sustainable interventions across districts.

(a) Economic Outcomes:

NABARD's (2024) JIVA and FSPF programs led to measurable gains. In Patiala–Sangrur, saline soil reclamation improved wheat and paddy incomes by Rs.42,500/ha and Rs.60,255/ha respectively. In Amritsar, basmati rice cultivation under the Agri Export Zone generated 15–18% higher profits than conventional paddy. Ludhiana's diversification into dairy and poultry added 25,000–30,000 per household annually (NABARD, 2024). At the national level, CPI (2025) highlights that sustainable agricultural finance enhances resilience and creates multiplier effects.

(b) Environmental Benefits:

The Paani Bachao, Paisa Kamao program in Amritsar and Tarn Taran districts reduced groundwater withdrawal by 10–15% per season. Adoption of direct-seeded rice (DSR) in Ludhiana and Jalandhar lowered methane emissions by 25–30%, and irrigation use by 20–25%. Pathankot's litchi initiative under One District One Product (ODOP) strengthened soil organic content by 8–10%, while solar irrigation installations in Kapurthala and Patiala preserved Rs.8,000–10,000 per hectare annually. These results align with national goals under India's Climate-Resilient Agriculture Mission (2023–2030).

(C) Social and Institutional Benefits:

NABARD's E-Shakti digitization of SHGs in Amritsar, Tarn Taran, and Pathankot expanded women's financial access and literacy. Chauhan and von Wehrden (2025) emphasize that such social inclusion measures represent the “third pillar” of sustainability. It promotes social equity complementing economic and environmental objectives. Similarly, Farmers Producers organisations in Ludhiana and Sangrur made possible collective bargaining and group marketing for dairy and organic products.

INTEGRATED DISCUSSION

Punjab's agricultural shift reflects India's broader sustainability

paradox—rapid technological progress contrasted with ecological weakness. While NABARD, PAU, and PAGREXCO initiatives have shown localized success, scalability remains limited by financial design and governance disintegration. Districts with institutional depth (Ludhiana, Patiala, Sangrur) show visible improvements in yields and income, whereas southern districts (Bathinda, Mansa) lag due to resource constraints.

At the policy level, CPI (2025) underscores that despite India's annual sustainable finance flows of Rs 22,393 billion, less than 10% directly supports smallholder-oriented adaptation. This trend mirrors Punjab's reality, where credit and training disproportionately favor medium and large farmers. Institutional synergy between NABARD's refinancing models and the State Action Plan for Climate Change on Agriculture (SAPCC) could unlock better resource targeting.

Chauhan and von Wehrden (2025) further argue that sustainable transitions require “adaptive governance,” integrating local feedback into policy cycles. Punjab's decentralized experiments—such as FPO-driven organic clusters and solar irrigation pilots—illustrate that bottom-up participation yields higher compliance and environmental gains than top-down enforcement.

POLICY IMPLICATIONS

1. District-Specific Sustainability Models: Develop modified sustainability frameworks for each agro-climatic zone. Northern Punjab (Ludhiana, Amritsar) should emphasize on integrated nutrient management and DSR, southern districts (Mansa, Bathinda) on micro-irrigation and crop diversification and foothill districts (Pathankot, Hoshiarpur) on watershed and horticulture.

2. Financial Inclusion and Credit Redesign: Expand NABARD refinance services for green capital formation. Credit instruments should prefer smallholders through integrated finance models combining public guarantees and private investment. CPI (2025) proposes a 30% increase in subsidised loans for climate-resilient crops.

3. Institutional Convergence: Integrate NMSA, RKVY, PM-KUSUM, and ATMA schemes under a consolidated “Punjab Sustainable Agriculture Mission” for coherence. Cross-sector coordination would improve fund utilisation and monitoring.

4. Digital and Extension Strengthening: Expand the E-Shakti platform and AI-driven advisory systems (PAGREXCO, 2023) to spread real-time crop related data. Linking PAU's research with farmers' mobile platforms could refine adoption rates by 25–30%.

5. Environmental Safeguards: Implement incentivize low-water crops and groundwater governance. Promote carbon credit markets for DSR adopters and merge sustainability indicators into material acquisition policies.

6. Social and Gender Inclusion: Improve capacity of women-led SHGs and FPOs to increase rural entrepreneurship. Gender responsive financing must become primary to NABARD's rural innovation strategies.

CONCLUSION

The current research shows that while Punjab continues to function as India's principal food production region, its agricultural system is under acute ecological stress. Findings highlight that farmers' awareness on environmental friendly practices—such as crop diversification, direct-seeded rice, micro-irrigation, organic inputs and residue management—is increasing, particularly in districts with strong institutional presence like Ludhiana, Patiala and Sangrur. However, awareness has not translated into uniform adoption due to regional disparities, economic insecurity, high input dependency and limited access to green finance. Groundwater depletion, soil nutrient exhaustion, monoculture reliance and climatic variability remain Punjab's most critical challenges. Despite government initiatives and NABARD-supported interventions, large sections of farmers in southern and border districts continue to depend on water-intensive paddy and chemical-intensive cultivation patterns. State government reports and evidence from NABARD reports affirms that sustainable interventions—such as renewable irrigation systems, saline soil reclamation and diversification into basmati, dairy and horticulture—can improve net returns, reduce emission level and conserve water. The study establishes that Punjab's shift to

sustainability must be technology enabled, district-specific, socially participative and financially inclusive. Enhancing access to climate-finance mechanisms, strengthening extension services and improving cooperative based marketing structures are necessary. The analysis concludes that sustainable farming is no longer a remedial option but a structural requirement for Punjab. Assimilating ecological conservation with farmers institutional support and will establish the long-term adaptability, environmental balance of the state and food security.

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