



## **Exploring Green Investment in Agri-Food System: Pathways to Sustainability and Resilience – Indian Perspective**

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### **Article Info**

**Article History:***Published: 18 Nov 2025***Publication Issue:***Volume 2, Issue 11  
November-2025***Page Number:**  
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Dr Himanshu Rastogi***Abstract:***

The agri-food system, a cornerstone of global food security and rural livelihoods, is under increasing pressure from climate change, environmental degradation, and resource scarcity. In this context, green investment has emerged as a vital strategy to transition agricultural production and food systems toward sustainability, resilience, and inclusivity. Conventional agricultural models often rely heavily on fossil fuels, intensive chemical use, and linear supply chains, which contribute to greenhouse gas emissions, soil depletion, and water stress. A shift toward sustainable practices demands targeted financial flows into climate-smart agriculture, renewable energy, circular economy approaches, and green technologies. The objective of this paper is to analyze the role of green investment in promoting sustainable agri-food systems, assess its potential to reduce environmental risks, and highlight its socio-economic benefits for farmers and rural communities. The paper draws upon secondary data from government reports, FAO and World Bank publications, and peer-reviewed studies. A qualitative approach is applied to examine best practices, case studies, and policy interventions from India and other developing economies. The findings indicates that green investments such as solar-powered irrigation, organic farming, biofertilizers, waste-to-energy systems, and digital supply-chain platforms etc. not only reduce ecological footprints but also enhance productivity, market access, and income security for smallholders. However, gaps remain in financing mechanisms, awareness, and policy alignment. The paper concludes that green investment in the agri-food system offers a dual benefit of ecological sustainability and socio-economic resilience. Strengthening public-private partnerships, financial incentives, and capacity-building initiatives is essential to scale up these investments and achieve long-term food system transformation.

**Keywords:** Green investment, agri-food system, climate-smart agriculture, sustainability, rural livelihoods, food security

### **1. Introduction**

The global agri-food system is central to human well-being, providing food, employment, and economic stability. However, it faces increasing stress due to climate change, unsustainable practices, biodiversity loss, and natural resource depletion (FAO, 2021). Traditional agriculture, while instrumental in ensuring food security, has contributed significantly to greenhouse gas (GHG) emissions, soil degradation, and water pollution. In this context, green investment has emerged as a transformative tool to reorient agricultural systems toward sustainability, inclusivity, and resilience.

Green investment refers to financial flows directed toward projects that promote environmentally sustainable outcomes, such as renewable energy, climate-smart agriculture, and circular food systems. For the agri-food sector, it implies investing in practices and technologies that reduce ecological footprints, enhance productivity, and support livelihoods.

This paper examines the role of green investment in transforming agri-food systems, with emphasis on India and other developing economies, highlighting its objectives, potential benefits, methodological approaches, present status, findings, and policy recommendations.

## 2. Literature Review

Scholars have highlighted the dual role of agriculture as both a contributor to and victim of climate change. According to OECD (2022), agriculture accounts for nearly 24% of global GHG emissions. At the same time, climate shocks threaten productivity, food security, and rural incomes.

The concept of green investment has gained traction with global climate goals such as the Paris Agreement and the UN Sustainable Development Goals (SDGs). FAO (2021) notes that investments in climate-smart agriculture, renewable energy in irrigation, waste-to-energy systems, and organic farming have demonstrated measurable ecological and socio-economic benefits.

In India, NABARD's climate-resilient agricultural projects and the Government's push for solar-powered irrigation under PM-KUSUM highlight policy-driven green investment initiatives (NABARD, 2023). Studies (World Bank, 2022) suggest that smallholders benefit significantly when financial products are tailored to support sustainable farming practices.

## 3. Research Objectives

- To analyze the importance of green investment in building sustainable agri-food systems.
- To identify specific interventions where green investment can reduce environmental risks while improving farm productivity and rural livelihoods.
- To review best practices, financing mechanisms, and policy frameworks in India and globally.
- To suggest strategies for scaling up green investment in the agri-food sector.

## 4. Research Methodology

This paper is based on secondary research methods. Data sources include government reports (Ministry of Agriculture, Government of India), publications from the Food and Agriculture Organization (FAO), World Bank, and peer-reviewed journal articles (2018–2024). The methodology uses qualitative content analysis to identify trends, gaps, and impacts of green investment in the agri-food system. Case studies of India, Bangladesh, and selected African nations are examined to illustrate real-world practices.

## 5. Green Investment Initiatives in the Agri-Food System and Present Status

Green investment in agriculture is still at a nascent stage in developing economies, though momentum is growing. Key initiatives include:

- **Renewable Energy in Agriculture:** Solar irrigation pumps and biogas units reduce dependency on fossil fuels. In India, the PM-KUSUM scheme has targeted 3 million solar pumps for farmers.

- **Climate-Smart Practices:** Adoption of drought-resistant seeds, organic fertilizers, and agroforestry practices.
- **Circular Economy in Food Systems:** Waste-to-compost and food waste recycling projects.
- **Digital Innovations:** Agri-tech startups providing precision farming solutions using IoT and AI, supported by impact investors.
- **Institutional Support:** NABARD's Green Climate Fund projects and multilateral aid (World Bank, Asian Development Bank) for climate adaptation in agriculture.
- **Micro-irrigation + irrigation scheduling (drip/sprinkler + soil-moisture or tensiometer):** Cuts water withdrawals and energy use, reduces salinization & nitrate
- **On-farm rainwater harvesting & recharge (farm ponds, contour trenches, check dams):** Lowers drought and flood risk, improves groundwater tables. Stabilizes yields; supports a second crop; enables livestock/fish.
- **Precision nutrient management:** Reduces N<sub>2</sub>O emissions and water eutrophication, improves soil health.
- **Integrated pest management (pheromone traps, biocontrol agents, trap crops, scouting):** Lowers pesticide load and resistance risk, protects biodiversity & pollinators. Reduces input costs 20–40%, avoids crop loss spikes.
- **Solar irrigation pumps with smart controllers (pre-paid or community solar):** Replaces diesel requirements and avoids groundwater over-extraction with flow caps.
- **Climate-resilient seeds & varietal diversification:** Reduces climate-induced crop failure risk. Stabilizes yields, enables flexible sowing windows.

## 6. Barriers to Green Investment in India's Agri-food System

Despite these advances, barriers remain which hamper the growth of green investment in India's agri-food system. The major ones are highlighted below:

- **Fragmented & Non-bankable Projects:** Millions of small plots, no aggregation, weak pipelines. Investors face high transaction costs and low-ticket sizes.
- **Land Fragmentation & Tenure Uncertainty:** Disputes, multiple ownership, and small holdings complicate CAPEX-heavy projects.
- **Policy Distortions (Subsidies & Tariffs):** Free power, fertilizer subsidies, and MSP signals weaken incentives for efficiency.
- **Limited Access to Finance:** Smallholders lack collateral; few green microfinance products.
- **Measurement & Verification Gaps:** Carbon/eco-credit systems remain complex and inaccessible to smallholders.
- **Infrastructure & Market Linkages:** Cold chain, storage, and logistics gaps reduce the payoff of green tech.
- **Capacity & Adoption Risks:** Limited extension and farmer training; risk aversion to new practices.
- **Regulatory & Institutional Fragmentation:** Overlapping state/central agencies; inconsistent policies create investor uncertainty.

## 7. Suggestive Future Actions

- **Aggregation & Pipelines:** Strengthen Farmer Producer Organization (FPOs) to improve bargaining power of small farmers, customized hiring centers to bundle smallholder projects.
- **Blended Finance:** Use first-loss guarantees, concessional debt, and CSR to de-risk private investment.

- **Smart Subsidy Reform:** Shift to targeted vouchers/PAYGo tied to efficient pumps, drip, and IPM adoption.
- **Innovative Finance:** Scale green microcredit, promote pay-as-you-go solar pumps, and insurance-credit bundles.
- **Inclusive Carbon Finance:** Simplify MRV via satellite + sampling, support farmer-friendly carbon methodologies.
- **Infrastructure Co-Investment:** PPPs for decentralized cold chains, dryers, and rural logistics hubs.
- **Capacity Building:** Digital + field extension, women-focused training, results-based advisory contracts.
- **Regulatory Clarity:** One-window approvals, standardized tendering, and state-level green finance roadmaps.

## 8. Findings

The analysis highlights the following key findings:

- **Environmental Benefits:** Green investments significantly reduce GHG emissions, conserve soil and water, and enhance biodiversity. For instance, FAO (2021) reports that climate-smart irrigation can reduce water usage by up to 30%.
- **Socio-Economic Impact:** Farmers adopting solar irrigation in India have reduced costs by 20–40%, improving income security. Women farmers involved in SHG-led organic farming projects report greater empowerment.
- **Institutional Challenges:** Financial institutions are often reluctant to fund smallholder farmers due to perceived risks.
- **Global Trends:** Countries like Kenya and Bangladesh have successfully mobilized green finance for smallholder-friendly innovations, providing replicable models for India.
- **Need for Policy Integration:** A unified framework aligning agricultural policy, climate goals, and financial systems is necessary for scaling impact.

## 8. Conclusion

Green investment in the agri-food system holds transformative potential to reconcile environmental sustainability with food security and rural development. The findings suggest that while pilot projects and government initiatives have shown promise, mainstreaming green investments requires overcoming barriers of financing, capacity-building, and policy fragmentation. Strengthening public-private partnerships, incentivizing sustainable farming through subsidies and credit, and enhancing farmer awareness are essential. Ultimately, sustainable food systems will depend on mobilizing financial resources at scale to ensure that agriculture not only feeds the growing population but also safeguards the planet.

## References

1. FAO (2021). *The State of Food and Agriculture 2021: Making agri-food systems more resilient to shocks and stresses*. Rome: Food and Agriculture Organization.
2. NABARD (2023). *Annual Report 2022–23*. National Bank for Agriculture and Rural Development, India.

3. OECD (2022). *Agricultural Policy Monitoring and Evaluation 2022*. Paris: OECD Publishing.
4. World Bank (2022). *Transforming Food Systems under Climate Change*. Washington, DC: World Bank.
5. United Nations (2020). *Sustainable Development Goals Report 2020*. New York: United Nations.