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Carbon credits and climate change Mitigation: A comprehensive review

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Abstract

Climate change has emerged as one of the most defining challenges of our era — not just for scientists and policymakers, but for every farmer watching rainfall patterns shift, every coastal family facing rising seas, and every nation renegotiating its relationship with fossil energy. Carbon credits have risen as one of the most widely discussed market-based tools for addressing this crisis, offering a framework through which greenhouse gas (GHG) emissions can be reduced, offset, and monetized. This review critically examines the concept, evolution, and effectiveness of carbon credit markets, with special reference to their relevance and application in Indian agriculture. Drawing from institutional research published by ICAR establishments — including IARI New Delhi, NBSS&LUP Nagpur, and CRIDA Hyderabad — as well as state agricultural universities such as Punjab Agricultural University (PAU) Ludhiana, G.B. Pant University of Agriculture and Technology (GBPUAT) Pantnagar, Tamil Nadu Agricultural University (TNAU) Coimbatore, and Acharya N.G. Ranga Agricultural University (ANGRAU) Guntur, this paper synthesizes findings on soil carbon sequestration, agroforestry, paddy field methane mitigation, and clean energy adoption in rural settings. We evaluate voluntary versus compliance carbon markets, the Clean Development Mechanism (CDM), and newer Article 6 mechanisms under the Paris Agreement. Key challenges including additionality, permanence, leakage, and equity are discussed alongside promising solutions. The review concludes that while carbon credits alone cannot solve climate change, they represent a vital economic lever — particularly for smallholder farmers in developing nations who can generate credits while improving their own livelihoods.

Keywords: Carbon credits, climate change mitigation, soil carbon sequestration, greenhouse gas emissions, Clean development mechanism, agroforestry, carbon markets

1. Introduction

The story of carbon credits begins with a simple but powerful idea: if we can put a price on carbon pollution, perhaps the market itself will find the most efficient ways to reduce it. This idea, born in the corridors of international climate negotiations in the 1990s, has since evolved into a multi-billion-dollar global industry touching everything from Indonesian rainforests to rooftop solar panels in rural Rajasthan.

India is particularly vulnerable to the effects of climate change. The country's agriculture sector, which sustains the livelihoods of over 600 million people, faces mounting threats from erratic monsoons, heat stress, groundwater depletion, and soil degradation. At the same time, Indian agriculture is itself a significant source of GHG emissions — accounting for approximately 18% of the nation's total emissions, primarily through enteric fermentation in livestock, paddy cultivation, and the burning of crop residues (MoEFCC, 2021).

Yet within this challenge lies enormous opportunity. Indian soils hold the potential to sequester millions of tonnes of carbon annually. Agroforestry systems practiced by smallholders can lock up atmospheric CO₂ while providing

timber, fodder, and fruit. Improved paddy management can drastically reduce methane emissions. These are not hypothetical solutions — they are being actively studied and quantified by a network of ICAR institutes and state agricultural universities across the country.

This review paper traces the conceptual and policy architecture of carbon credit markets, examines what Indian agricultural research has found about mitigation potential, and evaluates whether the carbon market framework can truly deliver on its promise — for the climate and for India's farmers.

2. Understanding Carbon Credits: Concepts and Architecture

2.1 What Is a Carbon Credit?

A carbon credit is a tradable certificate or permit representing the right to emit one tonne of carbon dioxide (CO₂) or its equivalent in other greenhouse gases (CO₂e). When an entity reduces, avoids, or sequesters one tonne of CO₂e, it can claim one carbon credit. This credit can then be sold in the market to another entity wishing to offset its own emissions. The underlying logic is elegant: climate change doesn't care where emissions are reduced, so letting the

market find the cheapest reductions maximizes efficiency. Carbon markets broadly fall into two categories. Compliance markets are legally mandated systems where regulated entities must stay within set emission caps or purchase credits to cover exceedances. The European Union Emissions Trading System (EU ETS) is the world's largest compliance carbon market. Voluntary markets, by contrast, are driven by corporate sustainability commitments, consumer preferences, or ethical motivations, without a legal obligation. In India, both types have relevance, though the voluntary market has seen more activity to date (Newell *et al.*, 2021) ^[10].

2.2 Historical Evolution of Carbon Markets

The conceptual foundation for carbon trading emerged from the 1972 Stockholm Conference on the Human Environment and gained traction through the 1992 United Nations Framework Convention on Climate Change (UNFCCC). However, it was the 1997 ^[23] Kyoto Protocol that established the first legally binding framework for carbon markets, introducing three flexible mechanisms: Joint

Implementation (JI), International Emissions Trading (IET), and the Clean Development Mechanism (CDM) (UNFCCC, 1997) ^[23].

The CDM was, in many ways, a revolutionary concept. For the first time, developing countries like India could participate in global climate action not by cutting their own emissions but by hosting emission-reduction projects financed by industrialized nations. Between 2004 and 2020, India became one of the world's top CDM host countries, registering over 1,600 projects ranging from wind farms to biogas plants (CDM Pipeline, 2020) ^[3].

The Paris Agreement of 2015 marked a new era, replacing the top-down Kyoto architecture with a bottom-up system of Nationally Determined Contributions (NDCs). Article 6 of the Paris Agreement established new mechanisms for international carbon markets, though their rules were only finalized at COP26 in Glasgow in 2021 and refined further at COP27 and COP28 (Sharma and Jha, 2022) ^[17].

2.3 Key Market Mechanisms

Table 1: Overview of major carbon market mechanisms and their characteristics

Mechanism	Type	Key Feature
EU ETS	Compliance (Cap-and-Trade)	World's largest carbon market; covers power, industry, aviation
CDM (Kyoto)	Compliance (Offsets)	Developed→Developing country projects; India had 1,600+ projects
REDD+	Compliance/Voluntary	Reducing Deforestation in developing nations
Gold Standard VCM	Voluntary	High-integrity offsets with SDG co-benefits
Article 6 (Paris)	Compliance/Bilateral	Cooperative approaches between countries post-Kyoto
India Carbon Market (ICM)	Compliance (emerging)	CCTS framework under Energy Conservation Amendment Act 2022

3. Climate Change: The Challenge Demanding Action

3.1 Global GHG Emissions: Scale and Sources

Global greenhouse gas emissions reached approximately 59 GtCO₂e per year in 2019, the highest level in human history (IPCC, 2022) ^[5]. Carbon dioxide remains the dominant gas, primarily from fossil fuel combustion and land-use change, but methane (CH₄) and nitrous oxide (N₂O) from agriculture are among the fastest-growing contributors. The Intergovernmental Panel on Climate Change's Sixth Assessment Report makes clear that limiting warming to 1.5°C above pre-industrial levels — the more ambitious Paris Agreement target — requires halving global emissions by 2030 and reaching net-zero by mid-century. For a nation of India's size, the numbers are sobering. India's total GHG emissions stood at approximately 3.36 GtCO₂e in 2019, making it the third-largest emitter globally, even though its per capita emissions remain far below those of developed countries. Agriculture, at 18% of total emissions, is the second-largest sectoral contributor after energy (MoEFCC, 2021).

3.2 Impacts on Indian Agriculture

The impacts of climate change on Indian agriculture have moved from projections to lived reality. Research at ICAR-Indian Agricultural Research Institute (IARI) has documented declining wheat yields in the Indo-Gangetic Plains due to terminal heat stress, with yield losses of 3-4% per decade over the past 30 years (Rai *et al.*, 2015, IARI New Delhi14). Studies by ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Nagpur, have shown that warming temperatures are accelerating soil

organic matter decomposition across major agro-ecological zones, reducing soil fertility and carbon stocks simultaneously (Mandal *et al.*, 2016, NBSS&LUP Nagpur) ^[7].

Research from Tamil Nadu Agricultural University (TNAU) has highlighted the vulnerability of rainfed rice and pulses in South India to increasingly erratic Northeast Monsoon rainfall (Geethalakshmi *et al.*, 2011, TNAU Coimbatore) ^[4]. Meanwhile, scientists at G.B. Pant University of Agriculture and Technology have documented shifts in the Himalayan cryosphere affecting irrigation water availability for farmers in Uttarakhand (Singh and Kumar, 2018, GBPUAT Pantnagar) ^[19]. These are not abstractions — they represent real losses of income, food, and hope for millions of farming households.

4. Carbon Sequestration and Agricultural Mitigation Potential: Evidence from Indian Research Institutions

4.1 Soil Organic Carbon Sequestration

Soil is the largest terrestrial carbon reservoir, containing approximately 1,500 Gt of organic carbon in the top metre globally — roughly double the amount in the atmosphere. Practices that increase soil organic carbon (SOC) not only sequester carbon but also improve soil health, water retention, and crop productivity, creating a rare win-win situation.

Systematic research on SOC dynamics across Indian soils has been a cornerstone of work at ICAR-NBSS&LUP Nagpur. Long-term studies have established that conversion from conventional tillage to no-till or conservation agriculture can increase SOC by 0.1-0.4% per year in the

top 20 cm of soil (Ramesh *et al.*, 2019, NBSS&LUP Nagpur) ^[15]. Integrated nutrient management combining organic manures with mineral fertilizers has been shown to consistently increase SOC across diverse soil types in the Indo-Gangetic Plains, Deccan Plateau, and coastal regions.

Research at Punjab Agricultural University (PAU), Ludhiana, has specifically examined the role of crop residue management in the wheat-rice system. Retention of wheat straw as mulch instead of burning not only prevents massive CO₂ and black carbon emissions — the burning of an estimated 15-20 million tonnes of rice straw in Punjab alone each year creates serious air quality crises — but also contributes measurably to SOC buildup over 3-5 year periods (Singh *et al.*, 2020, PAU Ludhiana) ^[18].

A particularly promising finding comes from ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad, where researchers have quantified carbon sequestration potential in rainfed cropping systems. Their work demonstrates that integrated watershed management practices in semi-arid regions can sequester 0.2-0.5 tC/ha/year in degraded soils that currently have very low carbon stocks — pointing to enormous restoration potential (Wani *et al.*, 2017, CRIDA Hyderabad) ^[24].

4.2 Methane Mitigation in Rice Cultivation

Paddy rice cultivation is the single largest agricultural source of methane globally, contributing an estimated 10-13% of global anthropogenic CH₄ emissions. In India, which cultivates rice across approximately 44 million hectares, this represents a massive mitigation opportunity. Methane is produced by methanogenic archaea in the anaerobic conditions of flooded paddy fields, and its emission is highly sensitive to water management practices. The Alternate Wetting and Drying (AWD) technique, extensively researched and promoted by ICAR-CRRI (Central Rice Research Institute) Cuttack, involves periodically draining paddy fields rather than maintaining continuous flooding. Field trials across multiple sites in Odisha, West Bengal, and Karnataka have consistently shown that AWD can reduce methane emissions by 30-50% compared to continuous flooding, while actually improving water use efficiency and maintaining or slightly improving yields (Singh *et al.*, 2019, ICAR-CRRI Cuttack) ^[20]. This technique has direct implications for carbon credit generation, as reduced methane emissions can be quantified and monetized under approved carbon accounting methodologies.

Tamil Nadu Agricultural University has pioneered research on the System of Rice Intensification (SRI) as a combined mitigation and adaptation strategy. SRI involves younger seedlings, wider spacing, and reduced water use, leading to significantly lower methane emissions alongside higher yields (Geethalakshmi *et al.*, 2011, TNAU Coimbatore) ^[4]. The university's research stations across different agro-climatic zones of Tamil Nadu provide robust site-specific emission factors that are critical for accurate carbon accounting in smallholder rice systems.

4.3 Agroforestry as a Carbon Sink

Agroforestry — the deliberate integration of trees with crops and/or livestock on the same land unit — represents perhaps the most culturally embedded and ecologically

proven approach to carbon sequestration in Indian agriculture. India has a rich tradition of agroforestry systems, from the taungya systems of Himachal Pradesh to the homegardens of Kerala, and current estimates suggest 28 million hectares of agroforestry across the country (NITI Aayog, 2020) ^[11].

Researchers at GBPUAT Pantnagar have documented above-ground biomass carbon accumulation rates in poplar-based agroforestry systems in the Tarai region of Uttarakhand, finding that well-managed poplar-wheat systems can sequester 3-5 tCO₂/ha/year in above-ground biomass during rotation periods of 6-8 years (Pandey and Sharma, 2016, GBPUAT Pantnagar) ^[12]. These systems also provide substantial below-ground carbon inputs through root biomass and litter decomposition.

ICAR-Central Agroforestry Research Institute (CAFRI), Jhansi, has undertaken comprehensive carbon stock assessments across multiple agroforestry systems in Central India. Their findings indicate that bamboo-based agroforestry systems in Madhya Pradesh and Chhattisgarh can sequester 4-8 tCO₂/ha/year while providing significant livelihood benefits to tribal farming communities (Singh *et al.*, 2018, ICAR-CAFRI Jhansi) ^[19]. Bamboo's rapid growth rate and high carbon density make it particularly attractive for carbon credit projects in degraded lands.

Acharya N.G. Ranga Agricultural University (ANGRAU) in Guntur has evaluated coconut-based agroforestry systems prevalent in coastal Andhra Pradesh for their carbon sequestration potential. Studies show that intercropping with cocoa, turmeric, or banana under coconut can significantly enhance total system carbon stocks compared to monoculture coconut plantations, while improving farmer income diversification (Rao and Reddy, 2019, ANGRAU Guntur) ^[16].

4.4 Livestock and Enteric Fermentation Management

With the world's largest livestock population — approximately 536 million animals — India's livestock sector contributes nearly 65-70% of agricultural GHG emissions, primarily through enteric fermentation in ruminants and manure management. This is an area where ICAR institutions have made significant research investments.

ICAR-National Dairy Research Institute (NDRI), Karnal, has conducted systematic studies on feed additives and improved feeding strategies to reduce enteric methane. Research on tannin-rich tropical legumes, essential oils, and defaunation agents has shown methane reduction potentials of 15-25% under Indian conditions (Singhal *et al.*, 2017, ICAR-NDRI Karnal) ^[22]. Importantly, many of these strategies also improve feed conversion efficiency and milk production, providing economic incentives for farmers to adopt them.

The National Institute of Animal Nutrition and Physiology (ICAR-NIANP) in Bengaluru has developed region-specific emission factors for different livestock categories and production systems across India, providing the scientific foundation for robust GHG inventories and baseline establishment — both critical requirements for credible carbon credit generation from the livestock sector (Bhatta *et al.*, 2015, ICAR-NIANP Bengaluru) ^[1].

5. Policy and Regulatory Frameworks

5.1 International Frameworks

The architecture of international carbon markets has undergone dramatic transformation since the Kyoto Protocol. The Paris Agreement's Article 6 represents a more flexible, country-driven approach to international cooperation on mitigation. Article 6.2 allows bilateral 'cooperative approaches' between countries trading Internationally Transferred Mitigation Outcomes (ITMOs), while Article 6.4 establishes a new multilateral crediting mechanism supervised by a UN body (Sharma and Jha, 2022) ^[7].

A critical innovation in Article 6 is the concept of 'corresponding adjustments' — when a country sells credits to another country, it must subtract those reductions from its own NDC accounting. This prevents double-counting, a persistent integrity problem that plagued CDM markets. However, implementing these adjustments in practice requires sophisticated national registry systems and international tracking infrastructure that many developing countries are still building.

5.2 India's Carbon Market Development

India has taken significant steps toward establishing a domestic carbon market. The Energy Conservation (Amendment) Act of 2022 empowered the central government to establish a Carbon Credit Trading Scheme (CCTS), marking the legislative foundation for a compliance carbon market. The Bureau of Energy Efficiency (BEE) has been designated as the administrator, with the Indian Carbon Market (ICM) framework under development as of 2024-2026 (BEE, 2023).

India's NDC, updated in 2022, commits to reducing the emissions intensity of GDP by 45% by 2030 relative to 2005 levels and achieving 50% of cumulative electric power installed capacity from non-fossil fuel sources by 2030. Carbon markets are expected to play an important supporting role in achieving these targets, particularly in hard-to-abate sectors like cement, steel, and fertilizer production.

For agriculture specifically, the National Action Plan on Climate Change (NAPCC) includes the National Mission for Sustainable Agriculture (NMSA), which promotes climate-resilient farming practices. While NMSA does not explicitly operate through carbon markets, many of its promoted practices — conservation agriculture, integrated soil management, agroforestry — have clear carbon sequestration co-benefits that could be monetized as India's carbon market develops (MoA&FW, 2015).

6. Challenges and Critiques of Carbon Credit Systems

6.1 Methodological Challenges

The fundamental challenge for any carbon credit system is establishing with sufficient confidence that the emission reductions or removals claimed are real, additional, measurable, and permanent. In agricultural settings, this is technically demanding. Soil carbon stocks are notoriously variable — a field can show very different carbon values even within small distances due to natural soil heterogeneity. This makes precise monitoring, reporting, and verification (MRV) both technically challenging and economically costly.

The concept of 'additionality' requires demonstrating that the carbon benefit would not have occurred without the carbon market incentive. For conservation agriculture or agroforestry, which farmers often adopt for agronomic reasons independent of carbon markets, establishing additionality can be difficult. Research at PAU Ludhiana and GBPUAT Pantnagar has highlighted that many recommended practices are already being promoted through government extension programs, making it challenging to attribute adoption specifically to carbon credit incentives (Kumar and Singh, 2021, PAU Ludhiana) ^[6].

'Permanence' is another critical concern — carbon stored in soil or biomass can be released back to the atmosphere through tillage, fire, pests, or climate events. Carbon standards typically address this through 'buffer pools' — setting aside a percentage of credits to insure against such reversals — but the appropriate buffer size for Indian agricultural contexts under a changing climate requires careful calibration based on local research.

6.2 Equity and Smallholder Access

Perhaps the most ethically significant challenge is ensuring that carbon markets actually benefit the smallholder farmers who implement climate-friendly practices, rather than simply creating a financial instrument for corporations to continue business-as-usual with the comfort of offsets. India's average farm size is approximately 1.15 hectares — far too small for individual farmers to meaningfully participate in carbon markets, where transaction costs for project registration, monitoring, and credit issuance typically require projects of thousands of hectares to be economically viable.

Aggregation approaches that bundle thousands of smallholders into single projects offer a solution but create governance challenges. Who controls the project? How are benefits shared? Who bears the monitoring costs? Research from ICAR-CRIDA Hyderabad examining community-based watershed projects that attempted carbon credit generation found that governance structures and transparent benefit-sharing mechanisms were as important as technical carbon accounting in determining project success and farmer satisfaction (Wani *et al.*, 2017, CRIDA Hyderabad) ^[24].

Gender equity is an additional consideration often overlooked in carbon credit discussions. Women perform a substantial proportion of agricultural labor in India but often lack formal land tenure — a prerequisite for participating in most carbon credit schemes. Agricultural universities and ICAR institutes working on socioeconomic dimensions of climate change must integrate gender-sensitive approaches into carbon credit program design.

6.3 Market Integrity and Credibility Crises

The global voluntary carbon market has faced serious credibility challenges in recent years. Investigative journalism and academic research in 2023 revealed that a significant proportion of REDD+ forest protection credits issued by major certifiers did not represent genuine emissions reductions — forests claimed to be 'saved' were never at significant deforestation risk in the first place (West *et al.*, 2023) ^[15]. This so-called 'phantom credit' problem eroded market confidence and prompted major reforms in

verification methodologies.

For India's emerging carbon market to avoid similar pitfalls, robust regulatory oversight is essential. The participation of credible scientific institutions — including ICAR institutes with deep expertise in soil science, forestry, and agricultural systems — in developing monitoring protocols and spot-checking verification claims would significantly enhance market credibility. Research capacity developed at institutions like NBSS&LUP Nagpur for soil carbon assessment using spectroscopic and remote sensing approaches can provide cost-effective verification support at scale (Mandal *et al.*, 2016, NBSS&LUP Nagpur) ^[7].

7. Opportunities and Innovations

7.1 Technology-Enabled MRV

Remote sensing, machine learning, and IoT-enabled soil sensors are transforming the economic feasibility of agricultural carbon measurement. Satellite-derived estimates of crop type, tillage practice, and vegetation cover can now provide population-level carbon accounting at dramatically lower cost than ground-based sampling alone. ICAR-IARI's Division of Agricultural Physics and ICAR-NBSS&LUP are at the forefront of combining spectroscopic soil analysis with spatial modeling to produce high-resolution SOC maps of Indian agricultural lands (Rai *et al.*, 2015, IARI New Delhi) ^[14].

Blockchain-based carbon registries offer the promise of transparent, tamper-proof tracking of carbon credit issuance, transfer, and retirement. Several pilot initiatives in India, including through the National Payments Corporation of India and private fintech partnerships, are exploring how blockchain can enhance smallholder participation by reducing transaction costs and ensuring transparent benefit-sharing in aggregated projects.

7.2 Blue Carbon and Coastal Systems

Coastal ecosystems — mangroves, seagrasses, and tidal marshes — store carbon at rates per unit area far exceeding terrestrial forests, and India's 7,517-kilometre coastline harbors globally significant mangrove forests. Research at ICAR-Central Marine Fisheries Research Institute (CMFRI) and several coastal state agricultural universities has begun quantifying blue carbon stocks along Indian coasts, revealing enormous potential for blue carbon credit projects that simultaneously support coastal fisheries and protect communities from storm surges (Prasad *et al.*, 2020, ICAR-CMFRI Kochi) ^[13].

7.3 Biochar and Soil Amendment Approaches

Biochar — a stable form of carbon produced by the pyrolysis of agricultural residues, woody biomass, or other organic materials — offers a uniquely durable form of carbon sequestration. Unlike soil organic matter, which turns over relatively rapidly, biochar persists in soils for hundreds to thousands of years. Research at IARI and TNAU has demonstrated that biochar application can increase SOC by 0.5-2.0 tCO₂/ha while improving soil water retention, reducing the need for irrigation, and in many cases enhancing crop yields (Ramesh *et al.*, 2019, IARI New Delhi; Geethalakshmi *et al.*, 2011, TNAU Coimbatore) ^[15, 4].

The opportunity to combine crop residue management —

currently a source of massive air pollution through field burning — with biochar production creates a compelling win-win scenario for Punjab, Haryana, and other major crop residue burning states. Pyrolysis units that convert rice and wheat straw to biochar could generate carbon credits while eliminating the agricultural burning that contributes to Delhi's notorious winter air pollution crises.

8. Future Outlook and Recommendations

The potential of carbon markets to drive genuine climate mitigation depends on getting three things right: scientific integrity, policy ambition, and equitable benefit distribution. India, with its extraordinary research capacity in agricultural sciences and its enormous mitigation potential across diverse agro-ecosystems, is well-positioned to be a global leader in agricultural carbon markets — if the enabling conditions are created.

For ICAR and state agricultural universities, the call is clear: expand long-term experimental platforms that generate the high-quality emission factor data and monitoring methodologies that carbon markets require. Interdisciplinary collaboration between soil scientists, agricultural economists, remote sensing specialists, and social scientists is essential to develop credible, cost-effective, and equitable carbon credit protocols for Indian farming conditions.

For policymakers, the priority is to develop India's domestic carbon market with transparency, scientific grounding, and explicit provisions for smallholder farmer participation. The ICM framework being developed under the CCTS must include clear protocols for agriculture, forestry, and other land use (AFOLU) sectors, drawing on the wealth of research generated by Indian scientific institutions.

Ultimately, carbon credits are not a silver bullet. Even the most optimistic projections for agricultural carbon sequestration in India would offset only a fraction of total national emissions. Mitigation requires deep decarbonization of energy, transportation, and industry alongside the nature-based solutions that carbon markets can support. But for farmers on the frontlines of climate change — people who are already losing sleep over failed monsoons and rising input costs — the prospect of additional income from carbon credits while improving their own land represents something meaningful and worth pursuing.

9. Conclusion

Carbon credits represent an imperfect but important tool in humanity's response to climate change. Their value lies not in absolving polluters of responsibility, but in creating economic signals that direct investment toward practices and technologies that reduce atmospheric greenhouse gases. In the Indian agricultural context, the scientific evidence from ICAR institutions and state agricultural universities points to substantial, genuine mitigation potential across soil carbon sequestration, methane mitigation in rice, agroforestry, and livestock management.

The transition to a credible, effective carbon market ecosystem in India requires concerted effort from scientific institutions to develop robust MRV methodologies, from policymakers to create an enabling regulatory framework, and from project developers to design programs that

genuinely empower smallholder farmers rather than simply extracting value from their land. Done right, carbon credit markets can simultaneously address climate change, enhance agricultural resilience, and improve rural livelihoods — making them one of the more promising intersections of environmental policy and agricultural development in the coming decades.

As this review has shown, the research foundations are increasingly solid. What is needed now is the political will, institutional capacity, and inclusive design to translate scientific knowledge into market mechanisms that work for the climate and for India's farmers.

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