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INDIAN CHAMBER OF FOOD AND AGRICULTURE

Policy Report on

Framework For Carbon Market In The Agriculture Sector

*Mandate, Initiatives and Strategic Role of the
Ministry of Agriculture & Farmers Welfare in
Promoting Carbon Markets and Climate-Smart
Agriculture in India*



Towards a Farmer-Centric Agricultural Carbon Market

India's carbon market journey will be more inclusive and development-oriented when farmers, agricultural landscapes and climate-smart farming systems are placed at the centre of carbon finance.

Agriculture is not only a production system. It is also a land, water, soil, biodiversity and livelihood system. As India develops its carbon market architecture, the agriculture sector presents an opportunity to align climate action with farmer welfare, sustainable resource use and rural economic resilience. A well-designed agricultural carbon market can help mobilise climate finance for practices that reduce emissions, enhance soil and biomass carbon, improve water-use efficiency, and strengthen farm resilience and support additional income streams for farmers

Executive Summary

India's agriculture sector is closely linked with food security, rural livelihoods, natural resource management and climate resilience. It is also connected with the national greenhouse gas profile through methane emissions from paddy and livestock systems, nitrous oxide emissions from fertiliser use, emissions from manure management and crop residue burning. At the same time, agriculture and allied land-use systems can support carbon sequestration through improved soil management, agroforestry, biomass enhancement, crop residue utilisation, composting, biochar and regenerative farming practices.

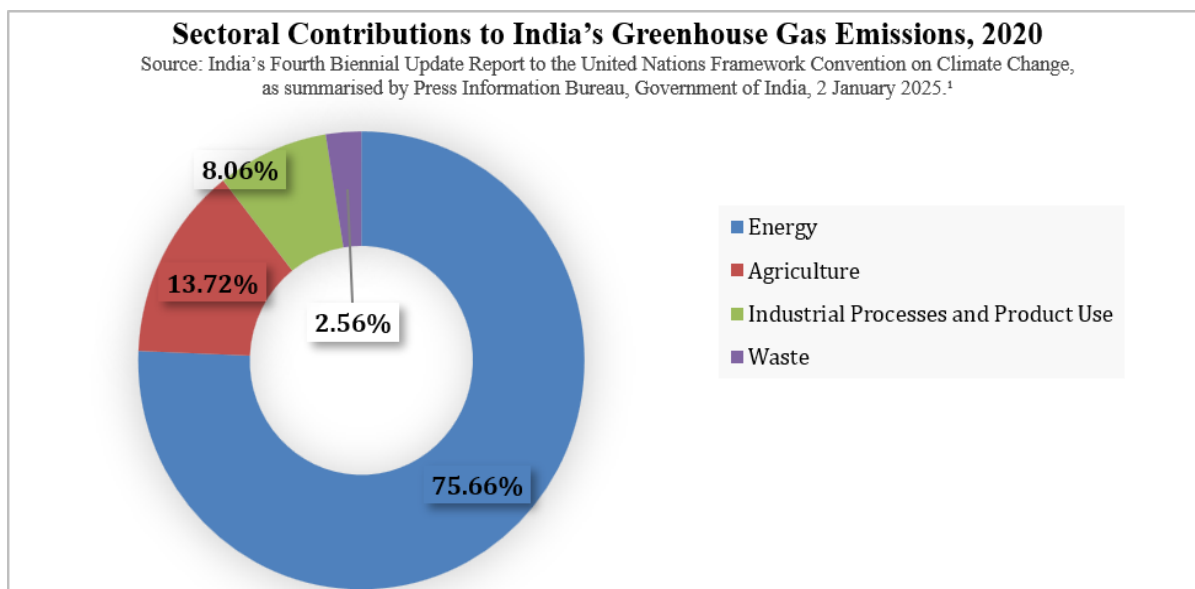
India's latest officially submitted national greenhouse gas inventory, presented through the Fourth Biennial Update Report to the UNFCCC, reports that in 2020 the country's total greenhouse gas emissions, excluding land use, land-use change and forestry, stood at 2,959 million tonnes of CO₂ equivalent. Agriculture contributed 13.72 per cent of these emissions.¹ This makes agriculture relevant both as a mitigation sector and as a carbon sequestration opportunity.

The Carbon Credit Trading Scheme and the Indian Carbon Market provide a national framework for carbon credit generation and trading. The framework includes a compliance mechanism for obligated entities and an offset mechanism through which non-obligated entities may voluntarily register projects that reduce, remove or avoid greenhouse gas emissions for issuance of Carbon Credit Certificates.² At the farm level, agriculture is more suited to offset and project-based models than direct compliance obligations, provided that approved methodologies, farmer aggregation, credible monitoring, reporting and verification systems, and transparent benefit-sharing arrangements are in place.

This report proposes a farmer-centric framework for agricultural carbon markets in India. It identifies priority carbon credit pathways, including soil organic carbon enhancement, agroforestry, paddy methane reduction, residue management, nutrient-use efficiency, biochar, biogas, manure management and natural or regenerative farming systems. It also maps relevant government schemes such as the National Mission for Sustainable Agriculture, Soil Health Card, Per Drop More Crop, National Mission on Natural Farming, crop residue management initiatives, Digital Agriculture Mission, agroforestry programmes, PM-KUSUM and GOBARdhan.

The central policy recommendation is to position the Ministry of Agriculture & Farmers Welfare as the enabling institution for agricultural carbon market development. Its role should include methodology support, scheme convergence, farmer aggregation, capacity building, digital MRV integration, safeguards, model contracts and coordination with carbon market institutions. Agricultural carbon markets should be designed not only to generate credits, but to strengthen climate-smart agriculture, soil health, water-use efficiency, farmer resilience and rural income support.

1. Policy Context and Need for Agricultural Carbon Markets



Agriculture has a direct bearing on India's climate and development priorities. The sector supports food production, rural employment, allied livelihoods and agro-based value chains. It is also highly sensitive to climate risks such as erratic rainfall, heat stress, droughts, floods, pest incidence, declining soil fertility and water stress. These risks affect crop productivity, input costs, farm income and long-term rural resilience.

Agriculture is also linked to greenhouse gas emissions through multiple biological and land-use processes. Paddy cultivation, livestock systems, manure management, fertiliser use and crop residue burning are among the major emission-linked areas. At the same time, improved agricultural and land-use practices can enhance carbon storage in soils, trees and biomass. This makes agriculture relevant not only as a source of emissions, but also as a sector with significant mitigation and carbon sequestration opportunities.

Unlike industrial emissions, which are often concentrated in factories or plants, agricultural emissions and mitigation opportunities are distributed across millions of farms. They vary according to soil type, cropping pattern, irrigation practice, livestock system, land-use practice and farmer behaviour. This distributed nature makes agriculture more complex for carbon markets, but not unsuitable.

Agricultural carbon markets can work when they are designed around:

- farmer aggregation;
- approved and India-relevant methodologies;
- credible monitoring, reporting and verification;
- transparent carbon revenue sharing;
- low transaction costs;
- integration with existing schemes and extension systems;
- safeguards for small, marginal, tenant and women farmers.

India's smallholder structure makes aggregation especially important. According to the latest completed and published All India Agriculture Census, 2015–16, small and marginal operational holdings together constituted 86.21 per cent of total operational holdings.³ Individual farm-level participation in carbon markets is therefore unlikely to be viable without FPOs, cooperatives, state agencies, panchayats, dairy networks, agritech platforms or other aggregation models.

Table 1: Agricultural Emission Sources and Carbon Market Opportunities

Area	Climate Linkage	Carbon Market Opportunity	Key Requirement
<i>Paddy cultivation</i>	<i>Methane from flooded fields</i>	<i>Alternate wetting and drying, direct seeded rice, improved irrigation scheduling</i>	<i>Water monitoring, farmer training and field-level verification</i>
<i>Fertiliser use</i>	<i>Nitrous oxide emissions</i>	<i>Soil testing, balanced fertiliser use, precision nutrient management, biofertilisers</i>	<i>Soil health data and advisory systems</i>
<i>Crop residue burning</i>	<i>Avoidable emissions and air pollution</i>	<i>Residue incorporation, mulching, biomass utilisation, biochar</i>	<i>Machinery access, biomass value chains and local aggregation</i>
<i>Soil management</i>	<i>Loss of soil organic carbon</i>	<i>Composting, cover crops, crop rotation, regenerative practices</i>	<i>Soil carbon monitoring and long-term incentives</i>
<i>Agroforestry</i>	<i>Carbon storage in trees and biomass</i>	<i>Boundary plantations, farm forestry, bamboo and tree-based systems</i>	<i>Nursery support, species selection and benefit-sharing models</i>
<i>Livestock and manure</i>	<i>Methane and manure-related emissions</i>	<i>Biogas, manure management, improved feed and herd practices</i>	<i>Dairy/cooperative aggregation and technical support</i>

Agricultural carbon markets should therefore be treated as a policy and implementation opportunity, not merely as a trading mechanism. Their success will depend on whether carbon finance can be connected with existing agricultural schemes, farmer institutions, digital monitoring systems, scientific methodologies and transparent benefit-sharing arrangements.

1.1 Ministry of Agriculture Policy-Making Perspective

From the policy-making perspective of the Ministry of Agriculture & Farmers Welfare, agricultural carbon markets should be treated as an enabling instrument for climate-smart agriculture, farmer welfare, resource-use efficiency and additional climate finance. The Ministry's role is not to directly regulate carbon trading, but to create the agricultural policy conditions required for credible farmer participation, scheme convergence, scientific methodologies, aggregation models, digital monitoring and safeguards.

Since agricultural implementation depends strongly on States and local institutions, the Ministry can support agricultural carbon market development through model guidelines, pilot frameworks, scheme alignment, technical protocols, capacity building and coordination with State Agriculture Departments, Indian Council of Agricultural Research institutions, Krishi Vigyan Kendras, Farmer Producer Organisations and carbon market institutions.

2. India's Carbon Market Framework and Agriculture-Sector Entry Points

India is building a formal domestic carbon market through the Carbon Credit Trading Scheme and the Indian Carbon Market. The framework has been designed to price greenhouse gas emissions through Carbon Credit Certificates and create a structure for credit generation, issuance and trading.

The institutional structure of the Indian Carbon Market includes a National Steering Committee co-chaired by the Secretaries of the Ministry of Power and the Ministry of Environment, Forest and Climate Change. Grid Controller of India functions as the Registry, while the Bureau of Energy Efficiency acts as the Administrator.² The Central Electricity Regulatory Commission provides regulatory support for carbon credit certificate trading.²

The CCTS operates through two main mechanisms:

1. **Compliance mechanism:** Emission-intensive industries designated as obligated entities are required to meet assigned greenhouse gas emission intensity targets. Entities that outperform their targets may receive Carbon Credit Certificates.
2. **Offset mechanism:** Non-obligated entities may voluntarily register approved projects that reduce, remove or avoid greenhouse gas emissions for issuance of Carbon Credit Certificates.²

As of the January 2026 notified expansion, the compliance mechanism of the Indian Carbon Market covers 490 obligated entities across major energy-intensive sectors, including

aluminium, cement, chlor-alkali, pulp and paper, petroleum refineries, petrochemicals, textiles and secondary aluminium.⁴ Agriculture is not currently positioned as a direct farm-level compliance sector. Its stronger entry point is through offset and project-based models.

2.1 Agriculture-Specific Voluntary Carbon Market Framework

The Ministry of Agriculture & Farmers Welfare has developed a Framework for Voluntary Carbon Market in the Agriculture Sector to encourage small and marginal farmers to access carbon credit benefits. Under the offset mechanism of the Carbon Credit Trading Scheme, agriculture is one of the selected sectors where entities and farmers can register greenhouse gas mitigation projects for issuance of Carbon Credit Certificates, subject to approved methodologies and required parameters.¹⁶

This aligns with India's broader carbon pricing architecture, which includes a rate-based emissions trading system and voluntary carbon crediting mechanisms. In this structure, agriculture should be developed mainly through voluntary, project-based and aggregation-led models, rather than through direct compliance obligations.¹⁷

Table 2: CCTS Components and Relevance to Agriculture

CCTS Component	Description	Relevance to Agriculture	Policy Implication
<i>Compliance mechanism</i>	<i>Obligated entities meet emission intensity targets</i>	<i>Agriculture has indirect relevance through fertiliser, food processing, energy use and future supply-chain links</i>	<i>Farm-level compliance should not be the immediate policy route</i>
<i>Offset mechanism</i>	<i>Non-obligated entities register projects that reduce, remove or avoid emissions</i>	<i>Strong entry point for agricultural carbon projects</i>	<i>Agriculture-specific methodologies and project pipelines are needed</i>
<i>Carbon Credit Certificates</i>	<i>Tradable certificates issued for verified mitigation outcomes</i>	<i>Can create value for agricultural mitigation and sequestration</i>	<i>Farmer benefit-sharing rules are essential</i>
<i>ICM Registry</i>	<i>Registry for carbon credit certificate issuance and tracking</i>	<i>Important for transparency and avoiding double counting</i>	<i>Agriculture projects should be traceable and registry-linked</i>
<i>Verification agencies</i>	<i>Validate and verify project outcomes</i>	<i>Essential for credibility of soil carbon, methane and agroforestry credits</i>	<i>Agriculture-focused verifier capacity is needed</i>
<i>Trading platform</i>	<i>Electronic trading of certificates</i>	<i>Can support price discovery and liquidity</i>	<i>Farmer-facing projects need transparent pricing and offtake arrangements</i>

3. Agricultural Carbon Credit Opportunities in India

Agricultural carbon credit opportunities in India should be prioritised based on climate relevance, farmer benefit, measurement feasibility, scalability and policy alignment. Not all practices will be equally ready for carbon markets. Some may be suitable for immediate pilots, while others may require stronger methodologies and monitoring systems.

3.1 Emission Sources and Carbon Market Linkages in Agriculture

Agricultural carbon market opportunities should be understood in relation to the main emission sources in crop production and allied sectors. Paddy cultivation is linked with methane emissions, livestock systems with enteric methane, manure management with methane and nitrous oxide, nitrogen fertiliser use with nitrous oxide, crop residue burning with avoidable emissions and air pollution, and farm energy use with carbon dioxide emissions.²⁰ Poultry systems are not a major source of enteric methane like ruminant livestock, but poultry litter and waste management can create manure-related, air-quality and waste-management concerns.²¹

These emission sources can become carbon market opportunities only when they are linked with approved methodologies, measurable mitigation outcomes, farmer aggregation and credible monitoring, reporting and verification systems. The following subsections discuss the main agricultural carbon pathways in this context.

NOTE 1: Linking Emissions with Carbon Credits

Agricultural carbon credits should not be framed only around “carbon storage.” They can also arise from measurable emission reduction in paddy methane, livestock and manure systems, fertiliser-related nitrous oxide, crop residue burning, poultry waste management and low-carbon farm energy, subject to approved methodologies and credible MRV.

3.2 Soil Organic Carbon and Regenerative Agriculture

Soil organic carbon enhancement is one of the most important agricultural carbon pathways. It is linked with soil fertility, water retention, microbial activity and climate resilience. Relevant practices include:

- compost and organic amendments;
- cover crops;
- crop rotation and diversification;
- residue incorporation;

- reduced disturbance where suitable;
- mulching;
- natural farming and regenerative practices;
- integrated nutrient management.

Conservation agriculture practices such as zero or reduced tillage, residue retention, direct-seeded rice, raised-bed planting, crop diversification, relay cropping and intercropping may also be considered where they are suitable to local agro-climatic conditions. These practices can support soil organic carbon improvement, water-use efficiency, reduced field disturbance and residue recycling. However, they should be linked with carbon crediting only where emission reduction or carbon sequestration outcomes can be measured, modelled or verified through approved methodologies.²⁰

Policy relevance:

- Links with Soil Health Management, Soil Health Card, National Mission on Natural Farming and National Mission for Sustainable Agriculture (NMSA).
- Requires long-term monitoring because soil carbon changes gradually.
- Needs low-cost sampling and digital MRV protocols.

3.3 Agroforestry and Farm Forestry

Agroforestry offers biomass carbon benefits and livelihood co-benefits. It can include boundary plantation, block plantation, tree-crop systems, bamboo, horticulture-linked systems and farm forestry. India has a policy base for agroforestry through the National Agroforestry Policy and subsequent agroforestry-related interventions under agriculture programmes.¹²

Policy relevance:

- Strong carbon sequestration potential through biomass.
- Can diversify farmer income.
- Requires clarity on species selection, felling/transit rules, markets and benefit sharing.
- Suitable for cluster-based and landscape-based project models.

3.4 Paddy Methane Reduction

Continuously flooded paddy fields generate methane. Improved water management practices such as alternate wetting and drying, direct seeded rice and better irrigation scheduling can reduce methane emissions while also improving water-use efficiency.

Policy relevance:

- Highly relevant for irrigated paddy-growing regions.
- Needs field-level water management protocols.
- Requires farmer training and monitoring.
- Can be linked with water-use efficiency programmes and climate-resilient agriculture initiatives.

3.5 Crop Residue Management and Biochar

Crop residue burning causes avoidable emissions and contributes to local air pollution. Alternatives include residue incorporation, mulching, ex-situ biomass use, pelletisation, composting and biochar. The Government has supported crop residue management machinery and custom hiring models in key states.⁸

Policy relevance:

- Strong link with air quality, soil health and biomass value chains.
- Carbon benefits can come from avoided burning and biochar application, subject to approved methodology.
- Requires machinery access, local aggregation and biomass markets.

3.6 Nutrient Management and Fertiliser Efficiency

Inefficient nitrogen use can contribute to nitrous oxide emissions. Better nutrient management can reduce emissions and input costs. Relevant practices include:

- soil-test-based nutrient application;
- balanced fertilisation;
- micro-irrigation and fertigation;
- biofertilisers;
- integrated nutrient management;
- advisory-based input planning.

Policy relevance:

- Links with Soil Health Card and Soil Health Management under NMSA.
- Requires advisory systems and farmer adoption tracking.
- Can generate climate and economic co-benefits.

3.7 Livestock, Manure and Biogas-Based Interventions

Livestock systems are linked with methane emissions and manure-related emissions. Carbon market opportunities may include manure management, biogas, compressed biogas, improved feed practices and dairy cooperative-led aggregation. GOBARdhan (Galvanizing Organic Bio-Agro Resources Dhan) provides a policy platform for converting cattle dung, agricultural residues and other biomass into biogas, compressed biogas and organic manure.¹¹

Policy relevance:

- Strong fit with dairy networks and cooperative structures.
- Supports circular bioeconomy.
- Can create energy, manure and sanitation benefits.
- Needs aggregation and verified methane-reduction methodologies.

Table 3: Priority Agricultural Carbon Pathways for India

Practice Area	Carbon Benefit	Farmer Benefit	MRV Complexity	Policy Support Required
<i>Soil organic carbon</i>	<i>Carbon storage in soils</i>	<i>Better soil health, moisture retention and resilience</i>	<i>High</i>	<i>Soil testing, digital records, long-term monitoring</i>
<i>Agroforestry</i>	<i>Biomass carbon storage</i>	<i>Timber, fruit, fodder, shade and diversified income</i>	<i>Medium to high</i>	<i>Nursery systems, market linkage, land-use clarity</i>
<i>Paddy methane reduction</i>	<i>Reduced methane emissions</i>	<i>Water saving and possible lower input costs</i>	<i>Medium</i>	<i>Water protocols, farmer training, field monitoring</i>
<i>Residue management</i>	<i>Avoided burning and soil improvement</i>	<i>Reduced burning risks, biomass value, soil benefits</i>	<i>Medium</i>	<i>Machinery access, custom hiring, biomass markets</i>
<i>Biochar</i>	<i>Carbon storage and soil amendment</i>	<i>Soil improvement and residue value addition</i>	<i>Medium to high</i>	<i>Technology standards, methodology development</i>
<i>Nutrient management</i>	<i>Reduced nitrous oxide emissions</i>	<i>Lower fertiliser cost and improved nutrient efficiency</i>	<i>Medium</i>	<i>Soil Health Card integration and advisory systems</i>
<i>Biogas and manure management</i>	<i>Reduced methane and fossil fuel substitution</i>	<i>Energy, manure and sanitation benefits</i>	<i>Medium</i>	<i>Dairy/cooperative aggregation and plant-level monitoring</i>

4. Current Status and Market Readiness

India's carbon market is evolving rapidly under the Carbon Credit Trading Scheme (CCTS). The compliance mechanism is currently focused on energy-intensive and industrial sectors. Agricultural carbon market activity is more relevant through voluntary, offset, supply-chain and project-based routes.

The agriculture carbon market landscape remains at an early stage and is not yet supported by a single public database that consolidates all agriculture-related carbon projects by status, methodology, geography, area, farmer coverage and credit issuance. Therefore, this report avoids unsupported project counts. The current status should be understood through market readiness rather than unreliable numerical claims.

Key observations:

- Agricultural carbon markets in India are emerging, not mature.
- The strongest near-term opportunity is through offset and voluntary project-based models.
- Farmer aggregation is essential for scale.
- Digital agriculture infrastructure can reduce MRV costs if properly aligned.
- Soil carbon, agroforestry, paddy methane reduction, residue management, biochar and livestock systems require practice-specific methodologies.
- Transparent public information on project status and farmer benefit sharing is currently limited.

Table 4: Agricultural Carbon Market Readiness Assessment

Segment	Current Status	Readiness Level	Key Gap	Scaling Requirement
Soil carbon	<i>Strong policy relevance but complex measurement</i>	<i>Medium</i>	<i>Cost and reliability of soil carbon MRV</i>	<i>Standard protocols and digital monitoring</i>
Agroforestry	<i>Policy base exists and carbon pathway is clear</i>	<i>Medium to high</i>	<i>Long project duration and market linkage</i>	<i>Nursery quality, land-use clarity and buyer confidence</i>
Paddy methane reduction	<i>High relevance in paddy belts</i>	<i>Medium</i>	<i>Water monitoring and farmer compliance</i>	<i>Cluster pilots and irrigation-linked MRV</i>
Residue management	<i>Government support exists in priority states</i>	<i>Medium to high</i>	<i>Biomass logistics and sustained adoption</i>	<i>Custom hiring, biomass markets and carbon methodology</i>
Biochar	<i>Promising but still developing</i>	<i>Medium</i>	<i>Technology standards and credit methodology</i>	<i>Pilot projects and verified application protocols</i>
Nutrient management	<i>Strong link with soil health systems</i>	<i>Medium</i>	<i>Attribution and measurement of nitrous oxide reduction</i>	<i>Advisory integration and modelling tools</i>
Livestock and manure	<i>Biogas and manure pathways are policy-aligned</i>	<i>Medium</i>	<i>Aggregation and methane accounting</i>	<i>Dairy/cooperative-led project models</i>
Digital MRV	<i>Strong emerging base through Digital Agriculture Mission</i>	<i>Medium to high</i>	<i>Integration with carbon market requirements</i>	<i>Farmer-consent-based data architecture</i>

4.1 Rate of Carbon Credits in India

India does not currently have one fixed uniform official rate for carbon credits. Under the Carbon Credit Trading Scheme, Carbon Credit Certificates will be traded through regulated market mechanisms. The market price of Carbon Credit Certificates will be discovered through Power Exchanges or other entities permitted by the Central Electricity Regulatory Commission.¹⁸

Under the Carbon Credit Certificate regulations, one Carbon Credit Certificate is equivalent to one tonne of carbon dioxide equivalent reduction, removal or avoidance. The market price is to be discovered at the respective Power Exchange or permitted entity through a process approved by the Central Electricity Regulatory Commission. Under the compliance mechanism, certificates will be exchanged within a floor price and forbearance price approved by the Commission on a proposal submitted by the Bureau of Energy Efficiency.¹⁸

In the voluntary carbon market, indicative private-market sources suggest that carbon credit prices in India may vary depending on project type, certification standard, verification quality and buyer demand. One private market source reports 2026 voluntary carbon credit rates in India in the range of ₹1,200–₹2,800 per tonne of CO₂ equivalent, with agroforestry-related credits indicated at around ₹1,400–₹1,900 per tonne. These values should be treated as indicative market observations, not official government-notified rates.¹⁹

For agricultural carbon credits, the actual value may vary depending on project type, approved methodology, permanence risk, transaction cost, monitoring and verification cost, aggregator share and benefit-sharing arrangement. Soil carbon, agroforestry, paddy methane reduction, biochar, manure management and biogas-linked projects may therefore receive different market values depending on credibility and demand.

For policy purposes, carbon credit price should not be presented as a guaranteed farmer-income figure. Pilot projects should disclose the carbon price received, deductions made, project development cost, monitoring and verification cost, aggregator share and net farmer benefit in a transparent manner.

NOTE 2: Carbon Credit Price and Farmer Benefit

India has a regulated price-discovery framework, not one fixed carbon credit rate. Private voluntary-market sources may provide indicative price ranges, but farmer-level benefit should be assessed only after accounting for project development, monitoring, verification, registry, transaction and aggregator costs.

5. Government Policies, Schemes and Programme Convergence

Agricultural carbon markets should not be developed as a separate parallel system. India already has several schemes that support practices relevant to climate-smart agriculture, carbon sequestration, resource conservation, renewable energy and circular bioeconomy. The policy opportunity is to align these schemes with carbon market pathways.

5.1 Ministry of Agriculture & Farmers Welfare Schemes

Key schemes and programmes relevant to agricultural carbon markets include:

- **National Mission for Sustainable Agriculture:** Supports climate-resilient agriculture through water-use efficiency, soil health, rainfed agriculture and integrated farming systems.
- **National Innovations in Climate Resilient Agriculture:** Can support climate-risk assessment, field validation and demonstration of climate-resilient agricultural practices relevant to agricultural carbon market pilots.
- **Rainfed Area Development:** Promotes integrated farming systems suited to agro-climatic conditions.
- **Per Drop More Crop:** Promotes micro-irrigation and water-use efficiency.
- **Soil Health Card and Soil Health Management:** Support soil testing, fertility mapping and balanced nutrient use.
- **National Mission on Natural Farming:** Supports chemical-free, ecosystem-based natural farming, soil health and climate resilience.
- **Crop Residue Management initiatives:** Support in-situ and ex-situ residue management through machinery and custom hiring approaches.
- **Sub-Mission on Agricultural Mechanization:** Can support machinery access, Custom Hiring Centres and equipment-based interventions for crop residue management, biomass collection, composting and biochar-linked models.
- **Digital Agriculture Mission:** Provides digital public infrastructure such as AgriStack, Crop Sown Registry, Farmers Registry, Digital Crop Survey, Krishi-DSS and soil fertility mapping.
- **Agroforestry under agriculture programmes:** Supports tree plantation on farmland and agroforestry expansion.
- **FPO promotion initiatives:** Can support farmer aggregation for carbon projects.
- **Agricultural Technology Management Agency and Krishi Vigyan Kendras:** Can support farmer awareness, extension, training, field demonstrations and carbon literacy at district and block levels.
- **Agriculture Infrastructure Fund:** Can support infrastructure for residue management, biomass value chains, storage, processing and related activities where eligible.²³

5.2 Allied and Cross-Ministerial Programmes

Other programmes that can support agriculture-linked carbon market development include:

- **Green Credit Programme:** Encourages voluntary plantation activity and issuance of Green Credits through a registry-based system.⁹
- **PM-KUSUM:** Supports decentralised renewable energy, solar pumps and solarisation of agricultural pumps.¹⁰
- **GOBARdhan:** Supports conversion of cattle dung, agricultural residues and organic waste into biogas, compressed biogas and organic manure.¹¹
- **Sustainable Alternative Towards Affordable Transportation (SATAT) Initiative:** Supports compressed biogas production from agricultural residues, cattle dung and other biodegradable waste, and can complement GOBARdhan, residue management and manure-based carbon mitigation pathways.²⁴
- **State Action Plans on Climate Change:** Can support state-level climate-smart agriculture planning.
- **NABARD climate finance and rural infrastructure instruments:** Can support financing and aggregation models.
- **ICAR and State Agricultural Universities:** Can support methodology development, field validation and extension.

Circular Bioeconomy Linkage

GOBARdhan and SATAT can together support agriculture-linked circular bioeconomy models by converting cattle dung, crop residues and other biodegradable waste into biogas, compressed biogas, organic manure and bio-slurry. This is relevant for agricultural carbon markets because it connects residue management, manure management, methane reduction, renewable energy generation and nutrient recycling. Such models can work especially well through FPOs, dairy cooperatives, panchayats, Custom Hiring Centres, biogas entrepreneurs and village-level aggregation systems. For carbon crediting, these interventions should be linked with approved methodologies, measurable emission reduction outcomes and credible MRV systems.¹

Table 5: Scheme Convergence Matrix for Agricultural Carbon Markets

Scheme / Programme	Current Focus	Carbon Market Relevance	Possible Convergence Action	Lead / Support Institution
NMSA	Climate-resilient agriculture, soil health, water-use efficiency	Supports core climate-smart practices	Align NMSA interventions with carbon project pipelines	MoA&FW, State Agriculture Departments
Rainfed Area Development	Integrated farming systems in rainfed areas	Supports resilience and diversified land-use systems	Develop rainfed carbon-resilience clusters	MoA&FW, ICAR, States
Per Drop More Crop	Micro-irrigation and water-use efficiency	Supports paddy methane and energy-water efficiency pathways	Link water-saving data with carbon MRV where applicable	MoA&FW, States
Soil Health Card / SHM	Soil testing and nutrient recommendations	Supports soil carbon and nutrient management	Use soil health data for baseline and advisory systems	MoA&FW, Soil Testing Labs
NMNF	Natural farming, soil health, input reduction	Supports soil organic matter and low-input farming	Pilot natural farming carbon-plus models	MoA&FW, States, KVKs

Crop Residue Management	In-situ and ex-situ residue management	Avoided burning and biomass utilisation	Link residue management clusters with carbon methodologies	MoA&FW, States, FPOs
Digital Agriculture Mission	Digital public infrastructure for agriculture	Can reduce MRV cost and improve traceability	Integrate farm, crop, soil and geospatial data for carbon MRV	MoA&FW, States
Agroforestry programmes	Tree plantation on farmland	Biomass carbon and livelihood diversification	Develop agroforestry carbon clusters	MoA&FW, State Forest/Agriculture Departments
PM-KUSUM	Solar pumps and decentralised renewable energy	Reduces fossil energy use in agriculture	Link solarised pump clusters to eligible mitigation pathways	MNRE, States, DISCOMs
GOBARdhan	Biogas, CBG and organic manure	Methane reduction and circular bioeconomy	Build dairy/manure carbon project models	Ministry of Jal Shakti, DA&FW, States
SATAT Initiative	Compressed biogas from biomass and organic waste	Supports conversion of agricultural residues, cattle dung and other biodegradable feedstocks into CBG and manure-linked by-products	Link residue, manure and biomass aggregation with CBG-based mitigation pathways	Ministry of Petroleum and Natural Gas, Oil Marketing Companies, States, FPOs, dairy cooperatives

6. Institutional and Regulatory Framework

Agricultural carbon markets will require coordination between carbon market institutions and agriculture-sector institutions. Carbon market institutions will provide the framework for credit generation, verification, registry and trading, while agriculture-sector institutions will support farmer mobilisation, practice adoption, field implementation and benefit sharing.

6.1 Institutional Coordination

The key carbon market institutions include the Ministry of Power, Ministry of Environment, Forest and Climate Change, Bureau of Energy Efficiency, National Steering Committee for Indian Carbon Market, Grid Controller of India as Registry, Central Electricity Regulatory Commission, accredited verification agencies and approved trading platforms.

For agriculture-sector implementation, the key institutions include the Ministry of Agriculture & Farmers Welfare, State Agriculture Departments, Indian Council of Agricultural Research, State Agricultural Universities, Krishi Vigyan Kendras, Farmer Producer Organisations, cooperatives, dairy unions, panchayats, NABARD, agritech platforms and carbon project developers.

Their combined role will be to create a bridge between national carbon market rules and field-level agricultural implementation. This will require carbon market institutions to provide credible procedures for methodologies, verification, registry linkage and trading, while agriculture-sector institutions enable farmer participation, practice adoption, technical guidance and local monitoring.

In practical terms, this coordination should focus on:

- identifying agricultural practices that can be developed into credible carbon projects;
- aligning these practices with approved carbon market methodologies;
- developing scientific protocols for soil carbon, agroforestry, paddy methane reduction, residue management, nutrient management and livestock-related interventions;
- supporting farmer aggregation through Farmer Producer Organisations, cooperatives, dairy unions and local institutions;
- enabling field-level adoption of climate-smart practices through extension systems;
- building farmer awareness on carbon markets, project terms and expected benefits;
- supporting Monitoring, Reporting and Verification (MRV) through digital tools, field records, soil data and remote sensing where applicable;
- ensuring transparent benefit sharing with farmers;
- maintaining environmental integrity by preventing double counting, weak claims and unverifiable credits;

6.2 Regulatory Issues to be addressed

Agricultural carbon markets should be scaled only with clear rules on farmer rights, carbon ownership, benefit sharing and accountability. Key issues include:

- ownership of carbon credits between farmers, landowners, aggregators and project developers;
- inclusion of tenant farmers, sharecroppers and women farmers;
- informed consent before farmer enrolment;
- transparent sharing of carbon revenue, prices, deductions and transaction costs;
- responsibility for MRV costs;
- treatment of reversal risk in soil carbon and tree-based projects;
- prevention of double counting;
- protection of farmer data;
- accountability of project developers and aggregators;
- grievance redressal for participating farmers.

A clear institutional and regulatory framework will help protect farmer interests, improve buyer confidence and ensure that agricultural carbon credits from India are credible, transparent and socially inclusive.

7. Strategic Role of the Ministry of Agriculture & Farmers Welfare

The Ministry of Agriculture & Farmers Welfare should not be treated as a peripheral stakeholder in agricultural carbon markets. It should be the central enabling institution for farmer-centric carbon market development.

From a Ministry policy-making perspective, the role of the Ministry of Agriculture & Farmers Welfare is to enable agricultural carbon market participation through scheme convergence, farmer aggregation, technical support, digital monitoring, safeguards and coordination with carbon market institutions. This role is enabling and coordinating in nature, while carbon credit issuance, registry and trading will remain linked to the national carbon market framework.

7.1 Policy Leadership

The Ministry can:

- develop a national agriculture carbon market strategy;
- align carbon finance with climate-smart agriculture and farmer welfare;
- define principles for farmer participation and benefit sharing;
- identify priority crops, regions and practices for pilot projects;
- ensure that carbon projects do not conflict with food security or local livelihood priorities.

7.2 Methodology Support

The Ministry can work with ICAR, State Agricultural Universities, Bureau of Energy Efficiency (BEE) and technical institutions to support methodologies for:

- soil organic carbon;
- agroforestry and farm forestry;
- paddy methane reduction;
- residue management;
- nutrient-use efficiency;
- biochar;
- livestock and manure management;
- biogas-linked agricultural systems.

7.3 Farmer Aggregation

The Ministry can promote aggregation through:

- FPOs;
- cooperatives;
- dairy unions;
- panchayat-level clusters;
- KVK-supported farmer groups;
- state agriculture department networks;
- agritech platforms under appropriate safeguards.

Aggregation is essential because small and marginal farmers cannot carry the transaction cost of carbon markets individually.

7.3.1 How Farmers Can Participate in the Carbon Economy

Farmers can participate in the carbon economy mainly through aggregated project models rather than as individual sellers of carbon credits. Small and marginal farmers may participate through Farmer Producer Organisations, cooperatives, dairy unions, panchayats, state-supported clusters, agritech platforms or credible project developers.

A practical farmer participation pathway may include:

- farmer awareness and voluntary enrolment;
- informed consent and simple contract terms;
- baseline assessment of current farming practices;
- adoption of eligible climate-smart practices;
- field-level monitoring and digital record keeping;
- verification through approved systems where required;

- issuance and sale of carbon credits through approved or voluntary market channels;
- transparent sharing of net carbon revenue with farmers.

Farmers should be clearly informed about expected benefits, practice changes required, contract duration, data use, revenue-sharing formula, deductions, risks and grievance redressal before enrolment. This is important to ensure that farmers are not merely used as carbon-credit suppliers, but become genuine beneficiaries of climate finance.

7.4 Digital MRV and Data Systems

The Digital Agriculture Mission can be aligned with agricultural carbon MRV requirements. Its components, including AgriStack, Crop Sown Registry, Farmers Registry, Digital Crop Survey, Krishi-DSS and soil fertility mapping, can support project identification, baseline development, practice tracking and monitoring, subject to farmer consent and data protection.⁶

Where feasible, agricultural carbon MRV systems may also be linked with weather advisories, satellite monitoring, pest alerts, crop advisories and AI-based decision-support tools. However, the carbon accounting layer should remain auditable, methodology-based and clearly separated from general advisory services so that carbon credit claims remain credible.

7.5 Scheme Convergence

The Ministry can issue convergence guidelines to align carbon market opportunities with:

- NMSA;
- Rainfed Area Development;
- Per Drop More Crop;
- Soil Health Card;
- National Mission on Natural Farming;
- crop residue management;
- agroforestry programmes;
- FPO promotion initiatives;
- organic and natural farming programmes.

7.6 Capacity Building

Carbon markets will not scale without awareness and capacity. The Ministry can support:

- carbon literacy modules for farmers;
- FPO and cooperative training;
- KVK extension modules;
- state-level training for agriculture officials;
- model project documentation;
- simplified guidance on carbon contracts.

8. Key Challenges and Implementation Gaps

Agricultural carbon markets can support climate-smart agriculture, but only if implementation challenges are addressed early.

8.1 Technical Challenges

- Soil carbon measurement is complex and often costly.
- Changes in soil carbon take time to establish.
- Baseline setting differs by crop, region and soil type.
- Additionality can be difficult to prove for practices already promoted by schemes.
- Permanence risk is high in soil and tree-based systems.
- Leakage may occur if emissions shift outside the project boundary.
- MRV systems must be credible but affordable for smallholders.

NOTE 3: NAAS-Identified Policy Cautions for Agricultural Carbon Markets

The National Academy of Agricultural Sciences has highlighted that agricultural carbon economy requires full carbon-cycle assessment, reliable emission estimates, simple measurement methods, farmer incentives and clear policies for carbon-offset activities. Agricultural carbon credits should therefore be based on credible accounting of emissions reduced and carbon sequestered, including hidden carbon costs from fertiliser, pesticides, tillage, irrigation, machinery and other inputs.²⁰

NAAS also identifies important mitigation options such as intermittent drying and dry seeded rice for paddy methane, balanced feeding and efficient animals for livestock methane, site-specific nitrogen use for nitrous oxide reduction, and conservation agriculture and organic farming for soil carbon improvement. However, these options have practical constraints such as assured irrigation, machinery access, farmer awareness, cost, manure availability, small holdings and continuity of practice.²⁰

8.2 Institutional Challenges

- Carbon market institutions and agriculture institutions operate through different systems.
- Agriculture-specific verifier capacity is limited.
- State-level readiness varies.
- Farmers and FPOs have low carbon market awareness.
- Public information on agriculture carbon projects is fragmented.
- Standard templates for farmer contracts and project documents are needed.

8.3 Financial Challenges

- Per-farmer carbon revenue may be modest unless projects are aggregated.
- Farmers may face upfront transition costs.
- Credit issuance may be delayed.
- Carbon prices can be uncertain.
- Project developers may capture a large share of value if safeguards are weak.
- Smallholders may not be able to bear monitoring and verification costs.

8.4 Farmer Protection Challenges

- Carbon rights are often unclear.
- Tenant farmers may be excluded if benefits are tied only to landowners.
- Farmers may enter long-term contracts without fully understanding risks.
- Data ownership and privacy require clear rules.
- Reversal risk should not be unfairly transferred to farmers.
- Benefit-sharing arrangements must be transparent.

Table 6: Challenges and Policy Responses

Challenge	Risk	Affected Stakeholder	Policy Response
<i>High MRV cost</i>	<i>Projects become unviable for smallholders</i>	<i>Farmers, FPOs</i>	<i>Digital MRV, sampling protocols, public data integration</i>
<i>Weak farmer awareness</i>	<i>Poor consent and low adoption</i>	<i>Farmers</i>	<i>Carbon literacy through KVKs and FPOs</i>
<i>Unclear benefit sharing</i>	<i>Low farmer trust</i>	<i>Farmers, aggregators</i>	<i>Model contracts and disclosure norms</i>
<i>Fragmented data</i>	<i>Poor project planning</i>	<i>Government, developers</i>	<i>Public project dashboard and data standards</i>
<i>Lack of methodologies</i>	<i>Limited credit generation</i>	<i>Project developers, farmers</i>	<i>India-specific methodology development</i>
<i>Carbon price uncertainty</i>	<i>Weak farmer incentive</i>	<i>Farmers, aggregators</i>	<i>Advance payments, blended finance and offtake agreements</i>
<i>Tenancy and land rights issues</i>	<i>Exclusion of actual cultivators</i>	<i>Tenant farmers, women farmers</i>	<i>Inclusive eligibility and consent protocols</i>
<i>Permanence and reversal risk</i>	<i>Credit integrity concerns</i>	<i>Buyers, developers, farmers</i>	<i>Buffer mechanisms and clear risk allocation</i>

9. Policy Recommendations

The following recommendations are framed as practical policy actions that can be enabled by the Ministry of Agriculture & Farmers Welfare in coordination with States, technical institutions, farmer organisations and carbon market institutions.

9.1 Establish a Dedicated Agricultural Carbon Market Programme

A dedicated programme or cell under the Ministry of Agriculture & Farmers Welfare should coordinate agricultural carbon market development. It should not duplicate the CCTS architecture, but should act as the agriculture-sector interface with carbon market institutions.

Core functions:

- identify priority agricultural carbon pathways;
- support pilot projects;
- coordinate with BEE, MoEFCC, ICAR and states;
- issue farmer safeguard guidance;
- align schemes with carbon project development;
- support capacity building.

9.2 Develop India-Specific Agricultural Carbon Methodologies

Priority methodologies should be developed or adapted for:

- soil organic carbon;
- agroforestry;
- paddy methane reduction;
- crop residue management;
- biochar;
- nutrient management;
- livestock and manure management;
- biogas-linked agricultural systems.

These methodologies should be scientifically robust but simple enough for smallholder implementation.

9.3 Create Farmer Protection and Benefit-Sharing Guidelines

The Government should develop model principles covering:

- informed consent;
- contract duration;
- revenue-sharing formula;

- disclosure of carbon price and transaction costs;
- farmer exit conditions;
- data rights;
- grievance redressal;
- treatment of tenant farmers and women farmers;
- responsibilities in case of reversal or non-performance.

9.4 Build a National Digital MRV Backbone for Agriculture

Agricultural carbon markets require low-cost and credible MRV. The Digital Agriculture Mission can support this by linking:

- crop data;
- soil fertility maps;
- Digital Crop Survey;
- remote sensing;
- land and farmer registries;
- farm practice records;
- climate and weather data.

The system should be consent-based and designed to protect farmer data.

9.5 Launch Priority Carbon Project Pilots

Pilot projects should be launched in selected agro-climatic and farming systems where policy support, farmer aggregation and MRV feasibility are relatively strong.

Priority pilots:

- paddy methane reduction clusters;
- agroforestry carbon clusters;
- soil carbon and natural farming clusters;
- residue management and biochar clusters;
- dairy manure and compressed biogas clusters linked with circular bioeconomy models;
- rainfed integrated farming carbon-resilience clusters.

9.6 Align Existing Schemes with Carbon Market Pathways

Existing public expenditure can reduce the cost of carbon project development. Scheme convergence should support:

- baseline data collection;
- farmer mobilisation;

- practice adoption;
- training and extension;
- soil and crop monitoring;
- aggregation and institutional support.

9.7 Enable Blended Finance and Advance Payment Models

Farmers should not have to wait several years for uncertain carbon revenue before changing practices. Financing models may include:

- advance payments;
- results-based finance;
- CSR-supported transition finance;
- NABARD-supported aggregation finance;
- buyer offtake agreements;
- blended finance for FPO-led projects.

Priority under blended finance and CSR-supported transition finance may also be given to FPOs, cooperatives, self-help groups and women-led rural enterprises engaged in composting, vermicomposting, bio-input preparation, silage preparation, slurry processing, biomass aggregation and other climate-smart value-chain activities linked with credible mitigation outcomes.

9.8 Mobilise Corporate CSR and ESG Funds for Agricultural Carbon Mitigation

Corporate India can support agricultural carbon mitigation through Corporate Social Responsibility, ESG and sustainability-linked funding. CSR funds can support activities such as climate-smart agriculture, agroforestry, soil health improvement, water conservation, crop residue management, composting, biochar, biogas, farmer training, carbon literacy and digital monitoring, where such activities meet applicable CSR rules.²²

However, CSR spending should not automatically be treated as carbon offsetting. A company should claim carbon offset benefits only when the project follows an approved methodology, undergoes credible monitoring, reporting and verification, generates valid carbon credits, and ensures proper ownership, transfer or retirement of credits.

CSR funds can be used as transition finance to reduce the upfront burden on farmers. For example, CSR support may be used for baseline studies, soil testing, farmer training, machinery access, biochar or composting pilots, biogas units, digital MRV systems and advance payments to farmers before carbon revenue is realised.

NOTE 4: CSR and Carbon Offset Caution

CSR funds can support agricultural carbon mitigation, but CSR spending is not the same as carbon offsetting. Offset claims should be made only after verified carbon credits are issued and properly transferred, retired or claimed under applicable carbon market rules.

9.9 Create a Transparent Agricultural Carbon Project Dashboard

A transparent agricultural carbon project dashboard should be developed to improve public visibility, buyer confidence, farmer trust and policy monitoring. The dashboard should not only record carbon credits issued, but should also show whether projects are delivering credible mitigation outcomes, farmer benefits and resource-use improvements.

The dashboard may track project-level information under broad categories rather than presenting fragmented data. Key information may include:

- **Project identity and location:** project name, location, practice area, methodology used, aggregator or implementing agency, project status and farmer coverage where disclosed.
- **Carbon and MRV indicators:** estimated emission reductions, removals or avoided emissions, credits issued, verification status, MRV approach and registry linkage.
- **Resource and circular economy indicators:** soil organic carbon indicators, water-use efficiency indicators, residue utilisation or avoided burning outcomes, renewable energy or compressed biogas generated, nutrient recycling and organic manure output, where applicable.
- **Farmer benefit and inclusion indicators:** net farmer benefit, benefit-sharing approach, participation of small, marginal, tenant and women farmers, and grievance redressal mechanism where disclosed.
- **Transparency and safeguard indicators:** carbon price received, deductions made, aggregator share, project development cost, monitoring and verification cost, and any reversal or permanence-risk provisions.

Such a dashboard will help reduce greenwashing, improve project accountability and support evidence-based policy decisions. It can also help the Ministry, States, carbon market institutions and buyers identify which agricultural carbon pathways are working effectively and which require further policy or technical support.

Table 7: Policy Action Matrix

Recommendation	Lead Institution	Supporting Institutions	Expected Outcome
<i>Agricultural carbon market programme</i>	<i>MoA&FW</i>	<i>BEE, MoEFCC, ICAR, States</i>	<i>Coordinated national approach</i>
<i>Methodology development</i>	<i>ICAR / technical bodies</i>	<i>BEE, SAUs, MoA&FW</i>	<i>Credible agriculture-specific crediting pathways</i>
<i>Farmer safeguard guidelines</i>	<i>MoA&FW</i>	<i>States, FPOs, legal experts</i>	<i>Fair and transparent participation</i>
<i>Digital MRV backbone</i>	<i>MoA&FW</i>	<i>States, Digital Agriculture Mission, BEE</i>	<i>Lower monitoring cost and better traceability</i>
<i>Pilot projects</i>	<i>State Agriculture Departments</i>	<i>FPOs, KVKs, project developers</i>	<i>Tested implementation models</i>
<i>Scheme convergence</i>	<i>MoA&FW</i>	<i>State departments, NABARD</i>	<i>Reduced transaction cost</i>
<i>Blended finance</i>	<i>NABARD / financial institutions</i>	<i>CSR, buyers, FPOs</i>	<i>Reduced upfront farmer burden</i>
<i>Project dashboard</i>	<i>MoA&FW / BEE</i>	<i>Registry, states, project developers</i>	<i>Greater transparency and credibility</i>

10. Strategic Roadmap

The roadmap for agricultural carbon markets should be phased by action priority rather than fixed dates, as implementation will depend on methodology approval, state readiness, institutional coordination and market demand. The focus should be on building the institutional foundation first, testing models through pilots, scaling successful approaches and then integrating carbon finance into mainstream climate-smart agriculture planning.

Table 8: Strategic Roadmap for Agricultural Carbon Markets in India

Action Phase	Key Actions	Lead / Supporting Institutions	Expected Output
<i>Institutional foundation</i>	<i>Establish an agriculture carbon market coordination cell; identify priority carbon pathways; develop farmer safeguard and benefit-sharing principles; prepare model farmer contracts; map scheme convergence opportunities; develop farmer participation guidelines and CSR-supported transition finance models</i>	<i>Ministry of Agriculture & Farmers Welfare, Bureau of Energy Efficiency, Ministry of Environment, Forest and Climate Change, Indian Council of Agricultural Research, State Governments</i>	<i>Clear policy direction, institutional coordination and farmer protection framework</i>
<i>Pilot and demonstration</i>	<i>Launch pilots for paddy methane reduction, agroforestry, soil carbon, residue management, biochar and dairy manure systems; test digital MRV tools; assess FPO-led, cooperative-led and state-supported aggregation models</i>	<i>State Agriculture Departments, ICAR, Krishi Vigyan Kendras, FPOs, cooperatives, project developers</i>	<i>Tested project models, field evidence and practical understanding of costs, risks and farmer benefits</i>

<i>Scale-up</i>	<i>Expand successful pilots into larger state-level programmes; develop standard operating procedures; build agriculture-focused verification capacity; integrate scheme monitoring with carbon MRV needs; create a public project dashboard</i>	<i>MoA&FW, BEE, State Governments, verification agencies, NABARD, project developers</i>	<i>Expanded implementation capacity, improved transparency and stronger market confidence</i>
<i>System integration</i>	<i>Mainstream carbon finance into climate-smart agriculture planning; align domestic agricultural credits with high-integrity standards; integrate carbon, soil health, water conservation, nutrient recycling, renewable energy, circular bioeconomy, biodiversity and resilience outcomes</i>	<i>MoA&FW, MoEFCC, BEE, ICAR, States, financial institutions</i>	<i>Mature, credible and farmer-centric agricultural carbon market ecosystem</i>

11. Conclusion

Agricultural carbon markets can become an important instrument for linking climate finance with sustainable agriculture in India. The opportunity is not limited to carbon credit generation. It lies in using carbon finance to support soil health, water-use efficiency, residue management, agroforestry, natural farming, biogas, climate resilience and supplementary farmer income.

However, the agriculture sector requires a distinct approach. Direct farm-level compliance obligations are not appropriate at this stage. The stronger pathway is through offset and project-based models built around farmer aggregation, approved methodologies, digital MRV, transparent benefit sharing and institutional safeguards.

The Ministry of Agriculture & Farmers Welfare should play a central role in shaping this transition. By aligning existing schemes, digital infrastructure, research institutions, extension networks and farmer organisations with the Indian Carbon Market framework, India can build a credible, inclusive and scalable agricultural carbon market. Such a framework can support national climate goals while ensuring that farmers are not merely participants in carbon markets, but genuine beneficiaries of carbon finance.

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