



The Emergence of Carbon Credits in Indian Agriculture: A Strategic Opportunity

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Agriculture significantly contributes to greenhouse gas (GHG) emissions in India, with Arice cultivation, enteric fermentation in livestock, and manure management being the primary sources. As the world's third-largest emitter of GHGs, India faces increasing pressure to reduce its carbon footprint. Carbon credits present a strategic opportunity for mitigating emissions while generating new revenue streams for farmers. By adopting sustainable practices such as improved water management in rice fields, agroforestry, and enhanced soil carbon sequestration, farmers can generate carbon credits, which can be traded in emerging carbon markets. India has made significant strides in promoting carbon credit systems, including regulatory developments like the Energy Conservation (Amendment) Bill, 2022, which aims to develop a domestic carbon market. However, challenges remain, including high transaction costs, complex certification processes, and a lack of awareness among farmers. To fully harness the potential of carbon credits in agriculture, policy interventions such as capacity building, financial support, and streamlined certification processes are essential. With the right support, carbon credits could transform Indian agriculture, offering both environmental and economic benefits, positioning India as a leader in sustainable development and the green economy.

Introduction

In recent years, the global discourse on climate change has increasingly focused on the role of agriculture in greenhouse gas (GHG) emissions and the potential for carbon credits to mitigate these emissions. Carbon credits represent a financial instrument allowing the owner to emit a certain amount of carbon dioxide or other greenhouse gases. In India, where agriculture plays a pivotal role in the economy and is a significant contributor to GHG emissions, the adoption of carbon credit systems offers a strategic opportunity to both reduce emissions and create new revenue streams for farmers.

The Indian Context: GHG Emissions in Agriculture

India is the world's third-largest emitter of greenhouse gases, with agriculture contributing significantly to this output. According to a report by the Indian Council of Agricultural Research (ICAR), agriculture is responsible for about 17.6 per cent of the country's total GHG emissions, primarily through activities such as rice cultivation, enteric fermentation in livestock, and manure management. The distribution of GHGs across the agricultural sector in India includes emissions from rice cultivation (21%), enteric fermentation (54%), and direct emissions from agricultural soils (15%).

Enteric fermentation, which occurs in the digestive systems of ruminant animals such as cattle and buffalo, is the largest single source of methane emissions in India. Similarly, rice

cultivation produces significant methane emissions due to the anaerobic conditions created when paddy fields are flooded. In light of these challenges, there is a growing recognition that agriculture must play a central role in India's efforts to reduce its carbon footprint.

Table 1: Clean Development Mechanism Methodologies for the Agriculture Sector
Source: (UNFCCC, 2014)

Type	Sub-type	Methodologies
GHG avoidance/ destruction	Rice cultivation	AMS-III.AU (reduced CH ₄ by adjusted water management practice in rice cultivation)
	Livestock	AMS-III.BK (reduced CH ₄ by strategic feed supplementation for large ruminants)
	Waste management	AMS-III.D, AMS-III.R, ACM0010, AM0073 (destruction of CH ₄ from animal manure)
		AMS-III.F and ACM0022 (Avoidance of CH ₄ through composting) etc
	Fertilizer	AMS-III.BF (reduced N ₂ O by use of Nitrogen Use Efficient seeds that require less fertilizer application)
		AMS-III.A (reduced CO ₂ by use of inoculant on legumes that displaces synthetic nitrogen fertilizers)
	Mulching	AMS-III.BE (reduced N ₂ O and CH ₄ by mulching)
Energy efficiency		AMS-II.P (energy efficient pumping)
		AMS-II.F (energy efficiency and fuel switching)

Carbon Credits: An Overview

Carbon credits are generated through activities that reduce or remove carbon dioxide from the atmosphere. For instance, practices such as improved water management in rice fields, adoption of agroforestry, and enhanced soil carbon sequestration can generate carbon credits. These credits can then be traded in carbon markets, providing an additional income source for farmers.

Globally, the carbon credit market was valued at USD 760.28 billion in 2021 and is expected to grow at a compound annual growth rate (CAGR) of 21.14 per cent during the forecast period of 2023-2028, driven by increasing corporate commitments to net-zero emissions. In India, the potential for carbon credits to contribute to both environmental and economic goals is significant, especially as the country strives to meet its Nationally Determined Contributions (NDCs) under the Paris Agreement.

Indian Agriculture and Carbon Credit Generation

The Indian government has recognized the potential of carbon credits in agriculture and has initiated several measures to promote their adoption. The Energy Conservation (Amendment) Bill, 2022, which was introduced in the Lok Sabha, incorporates provisions for the development of a domestic carbon market. This could directly benefit Indian farmers, who stand to gain financially from participating in carbon credit programs.

Agriculture offers several pathways for generating carbon credits. These include:

Improved water management in rice cultivation: By shifting from continuous flooding to alternate wetting and drying (AWD), farmers can reduce methane emissions by up to 40%. This technique has been successfully piloted in Telangana through the Core CarbonX project.

Agroforestry and afforestation: Planting trees in and around farmland can sequester carbon in biomass, thereby generating carbon credits.

Soil carbon sequestration: Implementing practices such as no-till farming, crop rotation, and cover cropping can increase the amount of carbon stored in agricultural soils.

These activities not only reduce emissions but also improve soil health, enhance biodiversity, and increase crop resilience, providing long-term benefits to farmers.

The Carbon Credit Market in India

The Indian carbon credit market is still in its nascent stages but is growing rapidly. India is already among the world’s leading exporters of carbon credits, having issued nearly 35.94 million credits as of 2023. This places India in a strong position to capitalize on the growing demand for carbon credits, both in the domestic and international markets.

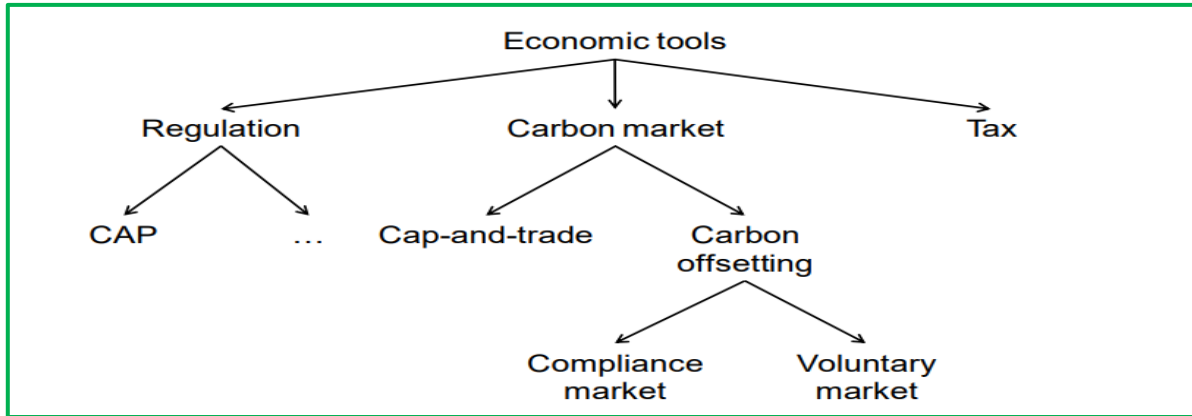


Fig. 1: Economic tools for reducing emissions (Source: CDC Climate Research)

Carbon markets are one of the three major economic tools that enable emissions to be reduced, the other two being regulation and taxation. They come in two forms: —cap-and-trade schemes and carbon offset mechanisms, which generate credits. Cap-and-trade schemes include whole sectors of the economy, where every installation must surrender the same number of allowances as the amount of GHG it has emitted. To achieve that goal, installations that have excess allowances relative to their emissions can sell them to installations with an allowance deficit. None of the current cap-and-trade schemes actually includes agriculture.

Table 2: List of Carbon trading companies in India Source: (Yukiko Nozaki, 2021)

Sl. No.	Company	Year established	Head Office	Summary
1	Boomitra Inc	2016	US	Company is also involved in projects in Latin America and East Africa. In India, the company is collaborating with Kirishitan (formerly Carbon Farming India)
2	Grow Indigo Private Ltd	2018	Mumbai	The company is a joint venture between US-based methodology developer Indigo Agriculture and Indian seed giant Mahyco Grow. Mahyco Grow sells genetically modified cotton seeds through Mahyco Monsanto Biotech, a joint venture with Bayer.
3	Sagri Bengaluru Private Limited	2019	Japan	The company is a subsidiary of the Japanese company Sagri. It has a track record in the data business in the Indian agricultural sector, and entered the carbon farming business as an extension of this experience. Its strength lies in its proprietary satellite data technology, the capability to capture data on carbon, nitrogen, and other elements in soil with high accuracy in the non-visible light regions.

4	Nurture Agtech Private Limited	2020	Mumbai	The company is a subsidiary of UPL, India's largest agrochemical company. It has submitted India's first project for crediting for the avoidance of
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Key Developments in the Indian Carbon Market

- **Multi Commodity Exchange (MCX):** In a landmark development, India's largest commodity exchange, MCX, has introduced futures trading in carbon credits, making it one of the few exchanges globally to offer such trades. This will provide Indian companies and farmers with better opportunities to trade their carbon credits at competitive prices.
- **National Commodity and Derivatives Exchange (NCDEX):** NCDEX has also started trading carbon credit futures, which is expected to help Indian farmers, especially those involved in agroforestry and organic farming, earn additional income.

Opportunities for Farmers

For farmers, carbon credits represent an important new revenue stream, particularly in a country like India where smallholder farmers often struggle with low margins and unpredictable market conditions. By participating in carbon credit programs, farmers can earn financial rewards for adopting sustainable practices that reduce GHG emissions.

For example, a project in Telangana has introduced the AWD method of rice cultivation, which reduces methane emissions while maintaining yields. Farmers participating in the project have been able to increase their income by selling carbon credits generated from their reduced methane emissions. Similarly, agroforestry projects in states like Karnataka and Madhya Pradesh are helping farmers generate carbon credits by planting trees on their land.

Opportunities in Carbon Farming

New Technologies: The growing demand for carbon credits is driving innovation in agricultural technology. For example, companies are developing soil sensors and remote-sensing technologies that can accurately measure carbon sequestration in soils.

Sustainable Inputs: The shift toward carbon farming is creating demand for sustainable agricultural inputs such as biofertilizers, organic pesticides, and drought-resistant crop varieties. These inputs can help farmers reduce their carbon footprint while maintaining or even increasing productivity.

Challenges in the Carbon Credit Market

Despite the opportunities, several challenges remain in making carbon credit markets accessible to Indian farmers. One of the primary challenges is the complexity of carbon credit certification processes, particularly under the Clean Development Mechanism (CDM). Smallholder farmers, who make up 70% of India's farming population, often lack the technical knowledge and financial resources needed to participate in carbon credit programs.

Key Challenges

- 1. High transaction costs:** The cost of verifying, certifying, and selling carbon credits can be prohibitive for small-scale farmers, making it difficult for them to access carbon markets without external support.
- 2. Awareness and education:** Many farmers are unaware of the potential benefits of carbon credits and lack the knowledge needed to participate in these programs.
- 3. Regulatory hurdles:** While the Indian government is making efforts to develop a domestic carbon market, regulatory challenges persist, particularly in terms of ensuring the integrity and transparency of carbon credit transactions.

Case Studies: Success Stories in Indian Carbon Farming

1. Core Carbon Sustainable Rice Productions (Telangana)

- **Project Developer:** Core CarbonX Solutions Pvt Ltd
- **Project Type:** Agriculture (Rice Cultivation)
- **Emission Reduction:** 52,920 tonnes of CO₂ per year
- **Methodology:** Alternate wetting and drying method in rice fields
- **Impact:** This project, implemented across 50,000 hectares, has successfully reduced methane emissions by optimizing water management in rice cultivation. Farmers participating in the project have benefited from both increased yields and the potential to earn carbon credits.

2. Dissemination of Improved Cookstoves (Karnataka)

- **Project Developer:** Greenway Grameen Infra Pvt Ltd
- **Project Type:** Household and Community
- **Emission Reduction:** 39,126 tonnes of CO₂ per year
- **Methodology:** Distribution of improved cookstoves to reduce firewood consumption
- **Impact:** By distributing 15,500 improved cookstoves, this project has not only reduced CO₂ emissions but also provided health benefits to rural households by decreasing indoor air pollution.

The Way Forward: Policy Recommendations

To fully harness the potential of carbon credits in agriculture, several policy interventions are needed:

- 1. Capacity Building:** Farmers, particularly smallholders, need access to training and education on carbon farming practices and carbon credit markets. Extension services and farmer producer organizations (FPOs) can play a critical role in disseminating knowledge and best practices.
- 2. Financial Support:** The government should consider providing financial incentives for farmers to adopt carbon-friendly practices, such as subsidizing the cost of equipment needed for practices like AWD or offering low-interest loans to support the transition to sustainable farming.
- 3. Streamlining Certification:** Simplifying the process of certifying carbon credits for small-scale projects will be crucial in ensuring that farmers can participate in carbon markets. The government should work with international bodies like Verra and the Gold Standard to develop streamlined certification processes for smallholders.

Conclusion

The integration of carbon credits into Indian agriculture presents a unique opportunity to address the dual challenges of climate change and rural development. By promoting sustainable farming practices and providing access to global carbon markets, India can position itself as a leader in the emerging green economy. However, to fully realize this potential, it is crucial to address the challenges of market accessibility, regulatory complexity, and farmer education. With the right policies and support mechanisms in place, carbon credits could become a powerful tool for transforming Indian agriculture and driving sustainable development.

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