

Carbon Credits in India: Turning Sustainable Farming into a New Source of Income

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ABSTRACT

This article examines the emerging role of carbon credits in India as a tool for linking climate change mitigation with sustainable agricultural development. Rapid industrialization and rising greenhouse gas emissions have intensified global warming, creating serious challenges for agriculture and rural livelihoods. Carbon credit mechanisms, introduced under international agreements such as the Kyoto Protocol and strengthened through the Paris Agreement, allow emission reductions to be traded in global markets. The article highlights how Indian farmers can generate carbon credits by adopting climate-smart practices such as agroforestry, conservation agriculture, zero tillage, direct seeded rice, cover cropping, and biochar application. These practices enhance soil carbon sequestration, improve soil health, and increase farm resilience while providing farmers with an additional source of income through participation in emerging carbon markets.

INTRODUCTION

Rapid industrialisation is a defining feature of modern civilisation and has significantly contributed to economic growth, technological advancement, and improved living standards. However, while industrialisation is necessary for socio-economic development, it must not come at the cost of environmental sustainability. In recent decades, industries and profit-seeking organisations have increasingly recognised the importance of protecting the environment in which they operate. Sustainable development has therefore become essential to maintain ecological balance while ensuring continued economic progress.

Rapid industrialisation has increased employment and economic growth but has also caused environmental challenges. The most serious issue is global warming, caused by the accumulation of greenhouse gases (GHGs) in the atmosphere, mainly due to carbon dioxide (CO₂) emissions from burning fossil fuels, deforestation, and wildfires. Today, global CO₂ emissions are about 37 billion tonnes annually, accelerating climate change (Khan *et al.*, 2023).

Climate change has particularly serious implications for agriculture and farmers, as it affects rainfall patterns, crop productivity, soil fertility, and water availability. Farmers are among the most vulnerable to climate variability, making sustainable agricultural practices essential for both environmental protection and rural livelihoods (Yadav, 2010).

To address global emissions, the international community adopted the **Kyoto Protocol on 11 December 1997 in Kyoto, Japan**, under the **United Nations Framework Convention on Climate Change (UNFCCC)** (UNFCCC. The Kyoto Protocol). Involving more than 140 countries, it came into force on **16 February 2005** and aimed to reduce greenhouse gas

emissions through legally binding targets and market mechanisms such as carbon credits and carbon trading, where **one carbon credit equals the reduction of one tonne of CO₂ equivalent**. The Kyoto Protocol laid the foundation for global carbon markets, while the **Paris Agreement (2015)** now guides global climate action to limit temperature rise (UNFCCC – Paris Agreement framework). As a result, carbon trading has expanded rapidly, and the global carbon market is expected to reach about 950 billion US dollars by 2025 (Gupta *et al.*, 2007).

Major greenhouse gases include **Hydrofluorocarbons (HFCs)** from refrigeration leaks, **Carbon dioxide (CO₂)** responsible for 50–60% of global warming, **Methane (CH₄)** from agriculture, fossil fuels and waste, and **Sulphur hexafluoride (SF₆)** from magnesium and electronics industries.

Carbon credits are certificates issued to countries or organisations that reduce greenhouse gas emissions, where one credit equals one tonne of CO₂ equivalent reduced. Under the Kyoto Protocol, developing and least-developed countries had no binding emission reduction targets and could participate voluntarily in carbon markets. Under the Paris Agreement, India aims to reduce emissions intensity by 45%, generate 50% of electricity from renewable sources, and achieve net-zero emissions by 2070. India has issued about 35.94 million carbon credits, accounting for around 17% of global voluntary carbon market credits (2010–June 2022). The global carbon credit market grew 164% in 2021 and is expected to reach about \$100 billion by 2030 (Agrawal, 2006).

The Indian government is developing a structured Indian Carbon Market under the **Energy Conservation (Amendment) Act, 2022**, initially covering sectors such as power,

cement, steel, fertilizer, and petrochemicals. The government is also strengthening the domestic carbon market and limiting large-scale export of credits to support India's emission reduction goals and improve demand and price discovery. Agriculture and agroforestry have strong potential to generate carbon credits through practices like tree-based farming, conservation agriculture, organic farming, better soil management, and efficient water use, which increase carbon sequestration and reduce emissions. With its vast agricultural land, **India could generate 200–300 million carbon credits annually by 2030** (Sethi, 2007).

For farmers, carbon markets can create new income opportunities while improving soil health, biodiversity, and water conservation, making agriculture more sustainable and climate-resilient while supporting India's climate goals.

What is carbon credit?

The concept of carbon credit was introduced as part of international efforts to control greenhouse gas (GHG) emissions. A carbon credit is a tradable certificate which represents a Ton removal or reduction of CO₂ or equivalent greenhouse gas from atmosphere. Credits are awarded to countries or companies/organisations that reduce their emissions below their allotted quota, and these credits can be traded in international markets at prevailing prices. This system encourages industries and businesses to adopt low-carbon practices and benefit by selling their surplus credits. Thus, the mechanism of GHG control has led to carbon trading, which promotes emission reduction across industries. Companies can earn carbon credits by adopting eco-friendly technologies that reduce emissions.

Studies suggest that India and China may become major sellers of carbon credits, while

Europe may be the largest buyer in the near future. Carbon trading allows countries or industries that exceed their emission limits to purchase credits from those with surplus reductions. As a developing country, India can benefit in several ways: funds from carbon trading can support renewable energy projects, encourage energy-saving initiatives, and generate employment through industries manufacturing renewable energy technologies.

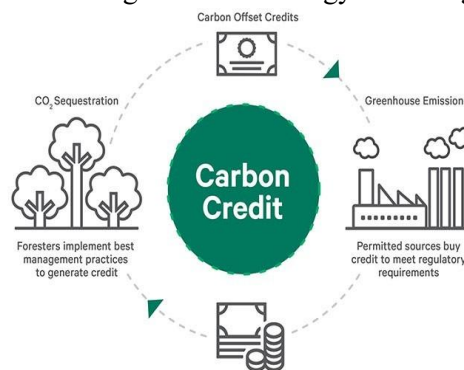


Figure 1. Carbon credit generation and trading mechanism between farmers, project developers, and industries.

Present Scenario of carbon credit and carbon trading in india

The carbon credit and carbon trading landscape in India is undergoing a major transition with the shift from international mechanisms like the Kyoto Protocol to the newer global framework under the Paris Agreement. Historically, India was one of the largest participants in the Clean Development Mechanism, ranking second globally in the number of projects and generating millions of Certified Emission Reductions through renewable energy, biomass, and energy-efficiency initiatives. In recent years, India has begun establishing its own domestic carbon trading system through the Indian Carbon Market, introduced under the Energy Conservation (Amendment) Act, 2022. The government released the operational framework between 2023 and 2024, and carbon trading is expected to start fully around 2026, initially covering sectors such as power,

cement, steel, fertilizer, and petrochemicals. At the global level, the carbon market has expanded rapidly and is valued at nearly \$950 billion in 2025, with rising demand for both compliance and voluntary carbon credits as countries and corporations pursue net-zero targets. India is also emerging as a key supplier of nature-based carbon credits through agroforestry, biochar, soil carbon sequestration, and renewable energy projects, with an estimated potential to generate around 200–300 million carbon credits annually by 2030. Consequently, carbon trading is becoming an important policy tool for India to achieve its climate commitments while simultaneously creating new economic opportunities in sustainable agriculture, forestry, and clean energy sectors.

How Farmer of India can Benefit from carbon credit?

Farmers in India can benefit significantly from carbon credit mechanisms because agriculture and land-use practices both emit and absorb greenhouse gases. By adopting climate-friendly farming methods that reduce emissions or capture carbon in soil and vegetation, farmers can generate carbon credits that are sold to companies to offset their emissions. With the development of the Indian Carbon Market and the global framework under the Paris Agreement, Indian farmers are expected to play an important role in the emerging carbon economy.

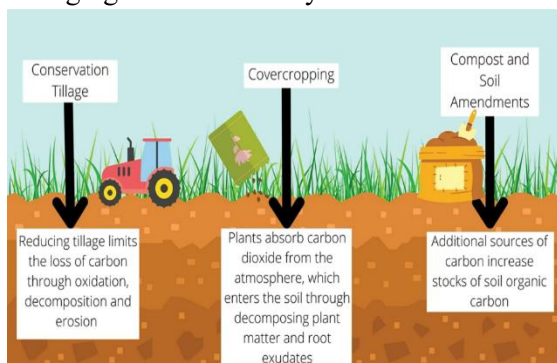


Figure 2. Climate-smart agricultural practices that increase soil carbon sequestration and generate carbon credits.

Farmers can generate carbon credits through agroforestry, where trees are integrated with crops or livestock systems. Trees absorb carbon dioxide through photosynthesis and store it in biomass and soil, increasing carbon sequestration. Agroforestry also improves biodiversity, reduces soil erosion, and provides additional products like timber, fruits, and fodder, making it a widely used practice in carbon credit programs in India (Oswald, 2009).

Another major opportunity is soil carbon sequestration through climate-smart cultivation methods. Traditional farming practices such as excessive tillage, residue burning, and heavy chemical input use often release large amounts of carbon stored in soil. In contrast, several improved cultivation methods reduce emissions and increase soil carbon storage. These include:

- **Zero tillage or no-till farming-** In this method farmers avoid ploughing the soil. Traditional ploughing exposes soil organic carbon to oxygen, which results in carbon dioxide emissions. No-till farming helps maintain soil carbon, improves soil structure, and reduces fuel consumption from tractors.
- **Conservation agriculture-** This system combines minimum soil disturbance, permanent soil cover using crop residues, and diversified crop rotations. By leaving crop residues on the field rather than burning them, farmers reduce carbon emissions and improve soil organic matter.
- **Cover cropping-** Growing cover crops such as legumes during the off-season helps capture atmospheric carbon and add organic matter to the soil. These crops also reduce erosion and improve soil fertility.
- **Crop rotation and intercropping-** Rotating different crops and growing multiple crops together improves soil

health and reduces the need for chemical fertilizers, which are a major source of greenhouse gas emissions.

- **Direct Seeded Rice (DSR)**- Traditional rice cultivation requires flooded fields that produce large amounts of methane. Direct seeded rice reduces water use and methane emissions because fields are not continuously flooded.
- **System of Rice Intensification (SRI)**- This method uses less water and improved planting techniques that reduce methane emissions from paddy fields while increasing productivity.
- **Precision agriculture**- Using technologies such as soil testing, drip irrigation, and controlled fertilizer application reduces unnecessary input use and therefore lowers emissions associated with fertilizer production and application.

Farmers can also benefit through **biochar** production and application, where agricultural residues such as crop waste are converted into biochar through controlled heating. Biochar is a stable form of carbon that can remain in soil for hundreds of years, effectively locking carbon away from the atmosphere (Lehman *et al.*, 2015). It also improves soil fertility, water retention, and crop productivity. Another area is **livestock and manure management**. Agriculture produces methane emissions from livestock digestion and manure decomposition. Improved feeding practices, biogas production from animal waste, and better manure storage systems can reduce methane emissions while also providing renewable energy for rural households (Raj *et al.*, 2025).

Participation in carbon credit programs usually takes place through aggregated projects managed by companies, NGOs, or carbon project developers who work with groups of farmers. These organizations measure emission reductions and register projects under

recognized carbon standards such as **Verra** or **Gold Standard**. After verification, carbon credits are issued and sold in voluntary or compliance carbon markets, and the generated revenue is shared with participating farmers. The potential for farmers in India is significant. Experts estimate that India could generate 200–300 million carbon credits annually by 2030, mainly from agriculture, agroforestry, and land-use projects. If carbon credit prices range between \$10 and \$20 per credit, farmers can earn additional income while making their farms more sustainable. Besides financial benefits, these climate-friendly practices improve soil fertility, water retention, and resilience to climate change while reducing input costs. Thus, carbon credit programs provide Indian farmers an opportunity to combine environmental sustainability with economic benefits, helping them diversify income while contributing to climate change mitigation and long-term agricultural productivity (Purswani, 2008, Sethi, 20007).

Estimated carbon credit income for farmers

Carbon sequestration varies with crop type, soil, and farming method. On average, sustainable farming practices can capture 1–4 tonnes of CO₂ per hectare per year.

Table1- Estimated carbon credit income for farmers in a year depending upon land area

Land Area	Estimated Carbon Credits Generated	Carbon Price (avg \$10–\$20 per credit)	Extra Annual Income
1 hectare (2.47 acres)	1–4 credits/year	\$10–\$20 per credit	₹800 – ₹6,500
2 hectares	2–8 credits/year	\$10–\$20 per credit	₹1,600 – ₹13,000
5 hectares	5–20 credits/year	\$10–\$20 per credit	₹4,000 – ₹32,000
10 hectares	10–40 credits/year	\$10–\$20 per credit	₹8,000 – ₹65,000

(Conversion approx: \$1 ≈ ₹83)

Table 2- Carbon Credit Income for framers from Low-Carbon Farming Methods (Per Acre)

Cultivation Method (per acre)	Estimated CO ₂ Reduction / Sequestration	Carbon Credits Generated (per year)	Estimated Additional Income (₹)	Key Notes
Agroforestry (trees + crops)	~2-4 tonnes CO ₂ per year	2-4 credits	₹1,600-₹6,500/year	Trees absorb CO ₂ and store carbon in biomass and soil. Also provides additional income from timber, fruits, and fodder.
Direct Seeded Rice (DSR)	~0.4-1.2 tonnes CO ₂ reduction	0.4-1.2 credits	₹300 - ₹2,000/year	Rice fields are not continuously flooded, reducing methane emissions and saving water and labour.
No-Till / Zero-Tillage Farming	~0.5-1.5 tonnes CO ₂ stored in soil	0.5-1.5 credits	₹400 - ₹2,500/year	Avoids ploughing which prevents soil carbon loss and reduces tractor fuel consumption.
Cover Cropping	~0.5-1 tonne CO ₂ captured	0.5-1 credit	₹400 - ₹1,600/year	Growing crops like legumes during off-season increases soil organic carbon and fertility.
Biochar Application	~1-3 tonnes CO ₂ stored long-term	1-3 credits	₹800 - ₹5,000/year	Agricultural residues are converted into biochar and added to soil, locking carbon for hundreds of years.
Improved Fertilizer Management (Precision farming)	~0.3-1 tonne CO ₂ reduction	0.3-1 credit	₹250 - ₹1,600/year	Using soil testing, drip irrigation, and controlled fertilizer application reduces emissions and input costs.

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