

# Harnessing Carbon Markets for Farmer's Prosperity in India



The global voluntary carbon market (VCM) has emerged as a significant mechanism for addressing climate change while creating new economic opportunities. This research based article examines the potential of the VCM to benefit Indian farmers by incentivising sustainable agricultural practices. With agriculture contributing substantially to greenhouse gas emissions, the adoption of climate-smart techniques such as Direct Seeded Rice (DSR), Alternate Wetting and Drying (AWD), and Agroforestry can reduce emissions while enhancing carbon sequestration. The study highlights global and Indian carbon market trends, key emission sources in agriculture, and internationally recognised verification standards. It further explores India's policy initiatives, including the Green Credit Programme, and outlines practical strategies for farmer participation. The findings suggest that integrating farmers into carbon markets can not only contribute to climate mitigation but also promote rural income generation, environmental sustainability, and the transition towards greener villages in India.

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cross the globe, scientists and policymakers are actively working towards achieving sustainable development goals and ensuring environmental protection. In this context, a global carbon market has emerged rapidly over the past decade. According to a recent report by

Grand View Research, the global carbon credit market reached USD 887 billion in 2025 and is projected to reach at a compound annual growth rate (CAGR) of 25.9%, reaching USD 6,130 billion by 2033. In comparison, India's carbon credit market was valued at USD 4,010 million in 2023 and it is projected to reach USD 49,448 million by 2030 at a CAGR of 43.2%. The

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primary objective of this research paper is to examine the expanding role of the global carbon market and to identify strategies through which Indian farmers can derive potential economic benefits.

Agriculture forms a fundamental pillar of India's economy. The global population has now reached approximately 8.33 billion. To meet the food demands of this growing population, modern agricultural science embraced the Green Revolution.

Today, India's economy stands at a stage where agriculture is not merely a means of livelihood but a cornerstone of economic growth, rural stability, and food security. According to 2025–26 estimates, India ranks first globally in the production of pulses, milk, spices, jute, and millets, and second in the production of rice, wheat, fruits, vegetables, and sugarcane. These achievements have been made possible through the Green Revolution and the White Revolution. However, alongside these gains, pollution and carbon emissions in the agricultural sector have increased significantly.

At present, all countries share the critical responsibility of reducing carbon emissions to limit global temperature rise to below 1.5°C, as outlined in the Paris Agreement (2015). In this context, it has become essential to study the sources and processes of carbon emissions within agriculture.

### Carbon Emissions in Agriculture and Their Major Components

According to the Food and Agriculture Organization (FAO), approximately 18% of global carbon emissions originate from the agricultural sector, making their reduction a matter of urgent importance. These emissions arise primarily from five key components:

1. **Livestock digestion (enteric fermentation):** Emissions from the digestive processes of domestic and wild ruminants account for nearly 53%, releasing methane and carbon dioxide.
2. **Use of chemical fertilisers:** This contributes approximately 21% of total emissions.
3. **Rice cultivation:** Paddy cultivation worldwide accounts for about 17% of emissions.
4. **Mismanagement of manure and biomass:** Poor handling of animal waste and biomass contributes around 6.5% of emissions.
5. **Burning of agricultural residues:** The burning of crop residues in fields contributes roughly 2% of emissions.

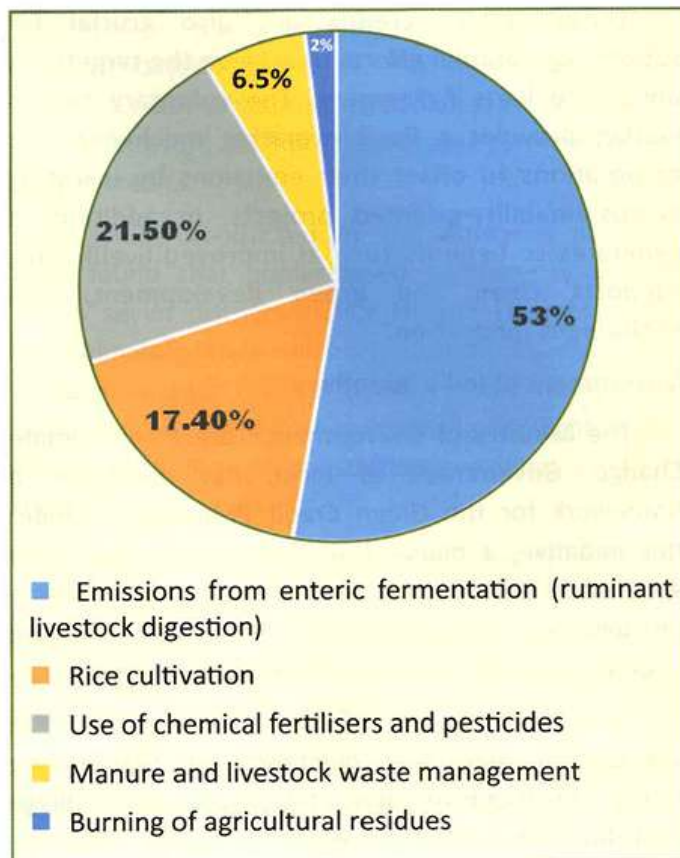


Figure 1: Major Sources of Carbon Emissions in Agriculture

To address the threat of climate change and regulate global temperatures, countries worldwide are implementing a range of clean and green development mechanisms.

### Voluntary Carbon Market (VCM)

In response to the global climate crisis, numerous efforts are being undertaken worldwide, commonly referred to as *clean and green projects*. At the international level, the compliance market includes mechanisms such as the Kyoto Protocol (1997), which introduced the Clean Development Mechanism (CDM).

At present, several developed countries and corporate entities are promoting these clean and green initiatives by providing funding or grants. In return, they receive carbon credits. This process has led to the emergence of a global *Voluntary Carbon Market (VCM)*.

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These carbon credits are also crucial for supporting national efforts to achieve the targets set under the Paris Agreement. The voluntary carbon market provides a flexible market mechanism for corporations to offset their emissions by investing in sustainability-oriented projects. In addition, it generates co-benefits such as improved livelihoods, supports clean and green development, and encourages innovation.

### Government of India Initiatives

The Ministry of Environment, Forest and Climate Change, Government of India, has developed a framework for the *Green Credit Programme*. Under this initiative, a market-based mechanism has been established to promote activities such as tree plantation on degraded land, where “Green Credits” (GCs) are issued for environmentally positive actions.

It is well recognised that practices such as afforestation (including plantation of fruit-bearing trees), regenerative agriculture, and zero tillage contribute to carbon sequestration in soil. Voluntary carbon markets can play a significant role in financing such climate solutions.

However, the success of the voluntary carbon market depends on the presence of clear and robust regulatory frameworks to ensure genuine emission reductions. Equally important is the need to educate farmers and other stakeholders about these mechanisms and their benefits.

### What is a Carbon Credit?

A carbon credit is a certification that represents the removal, reduction, or avoidance of one metric tonne of carbon dioxide (or its equivalent in other greenhouse gases) from the atmosphere.

**Carbon Credit = 1 metric tonne of CO<sub>2</sub> equivalent (tCO<sub>2</sub>e) reduced, avoided, or removed**

Carbon credits present a significant opportunity to strengthen India’s rural economy, as they incentivise farmers to adopt practices such as natural farming, agroforestry, and improved biomass management that reduce emissions or enhance carbon sequestration in soil.

Such approaches not only improve soil health and promote water conservation but also contribute to mitigating global temperature rise and generating green employment opportunities.

Currently, there is strong demand for carbon credits in developed countries, particularly among corporate sectors. In recent years, major buyers of carbon credits have included the United States, China, Japan, and the United Kingdom.

### Global Standards for Carbon Offset Projects

At present, *Verra* and the *Gold Standard* are among the leading global standards for the verification of carbon offset projects.

#### 1. Verra (Verified Carbon Standard – VCS)

The Verified Carbon Standard (VCS) is administered by Verra, an organisation based in Washington, D.C., USA. It is one of the most widely used global standards, focusing on the reduction and removal of greenhouse gas emissions through a diverse range of project types.

These include projects in renewable energy, forestry (including REDD+), biochar, and waste management. Verra is the largest voluntary carbon market standard in terms of volume and is widely recognised at the international level.

#### 2. Gold Standard

The Gold Standard is a premium certification framework that places strong emphasis not only on climate impact but also on sustainable development co-benefits, particularly alignment with the Sustainable Development Goals (SDGs).

Projects under this standard require a higher level of stakeholder engagement, monitoring, and verification. Due to its rigorous processes and high credibility, Gold Standard-certified credits often command higher prices in the market.

Studies on international carbon credit trading indicate that voluntary carbon markets can play a crucial role in linking climate action with agricultural communities in developing countries such as India. In particular, they hold significant potential to integrate Indian farmers into global climate mitigation efforts.

### Strategies for Reducing Carbon Emissions

#### 1. Reducing Carbon Emissions in Rice Cultivation

**Direct Seeded Rice (DSR)** : Direct Seeded Rice (DSR) is a cultivation method in which rice seeds are sown directly into the field, eliminating the need for nursery raising and transplanting. This approach saves time, labour, and water, making it a more cost-effective and modern alternative to traditional transplanting

methods. Sowing can be carried out either manually or using seed drills.

In this method, pre-germinated seeds are directly sown in the field approximately 20–30 days earlier than the conventional transplanting schedule, often using tractor-operated machinery. Compared to traditional practices, DSR can reduce water usage by approximately 15–20%.

Under conventional rice production systems, approximately 1,500 to 2,000 litres of water are required to produce one kilogram of rice. Typically, rice cultivation in India requires 25–27 irrigation cycles; however, with DSR, this can be reduced to around 15–18 irrigations.

In addition to water savings, DSR reduces labour requirements and enables the crop to mature 7–10 days earlier. This provides farmers with additional time for effective management of rice straw residues.

**Alternate Wetting and Drying (AWD) :** Alternate Wetting and Drying (AWD) is an advanced irrigation management technique in which fields are not kept continuously flooded. Instead, irrigation is applied only after the water level has receded to a certain threshold.

This method significantly reduces water consumption compared to conventional flooding practices and, importantly, lowers methane emissions from paddy fields. In recent years, AWD has been widely promoted across Asia and has been extensively adopted in countries such as China, the Philippines, and several Southeast Asian nations.

Over the past decade, millions of smallholder farmers in Maharashtra have actively adopted AWD to address water scarcity challenges, demonstrating its practical relevance in Indian conditions.

## 2. Agroforestry

Agroforestry refers to the integration of trees with agricultural crops, often in the form of row-based cropping systems where crops are cultivated between rows of trees. This approach offers multiple ecological and economic benefits.

Agroforestry plays a vital role in improving soil health, enhancing biodiversity, and conserving land resources. It promotes local biodiversity and reduces pressure on natural forests by providing alternative sources of fodder and fuelwood.

Through photosynthesis, agroforestry systems increase oxygen levels in the atmosphere while simultaneously enhancing carbon sequestration in the soil. As a result, such projects enable farmers to earn carbon credits.

A study conducted in the northern plains of India found that poplar-based agroforestry systems across seven districts in Punjab and Haryana stored approximately 9.946 million tonnes of CO<sub>2</sub> equivalent. In Yamunanagar district alone, carbon storage was estimated at 3.026 million tonnes, highlighting the significant carbon sequestration potential of these systems.

Furthermore, agroforestry models involving species such as eucalyptus and poplar can generate additional income of up to ₹25,000 per hectare per year for farmers. Similarly, forests across the country also exhibit high carbon storage capacity.

Overall, agroforestry presents substantial potential across all regions of India as a sustainable climate-smart agricultural practice.

## Conclusion and Recommendations

The global voluntary carbon market presents a significant opportunity for Indian farmers to enhance their incomes while contributing to climate change mitigation. However, to effectively participate in this market, farmers need to organise themselves collectively through Farmer Producer Organisations (FPOs), cooperatives, or government-supported institutions. Such collective approaches are essential for registering agricultural land and farming practices in accordance with international standards.

Once registered, farmers can actively participate by adopting sustainable agricultural practices. These include agroforestry, organic farming, and climate-smart rice cultivation techniques such as Direct Seeded Rice (DSR) and Alternate Wetting and Drying (AWD). In addition, improved livestock feed management, utilisation of renewable energy sources such as solar energy and biogas, efficient manure management, and proper handling of crop residues (including stubble management) can be incorporated as carbon offset projects.

Adoption of these practices will not only promote sustainable agriculture but also enable farmers to receive financial incentives in the form of carbon credits, aligned with international market standards. Moreover, lower methane emission helps in reducing pollution. □