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# Carbon Credits in Agriculture: A Path to Sustainable Farming

**Aakash Sunaratiya[1*] and Shraddha Katre[2]**

[1]Project Manager, Watershed Management, People's Action for National Integration-PANI, Ayodhya, Uttar Pradesh
[2]ICAR PG Research Scholar, Department of Agronomy, Dr Rajendra Prasad Central Agricultural University, Pusa, Bihar



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## INTRODUCTION

A carbon credit is a tradable permit that allows the holder to emit a certain amount of carbon dioxide or other greenhouse gases (GHGs). Each carbon credit typically represents one metric ton of carbon dioxide equivalent ($CO_2e$). The concept was born out of the Kyoto Protocol and later reinforced by the Paris Agreement, aiming to cap and reduce global carbon emissions through market-based mechanisms. The emissions from crop residue burning alone have surged by 75% from 19,340 Gigagram (Gg) per annum in 2011 to an alarming 33,834 Gg in 2020. Declining groundwater levels, land degradation, and excessive use of chemical fertilizers are exacerbating emission surges, while sustainably increasing food production amid these depleting resources poses a significant challenge for governments and R&D organizations.

In essence, carbon credits enable organizations that exceed their emission limits to offset their excess emissions by purchasing credits from entities that have reduced or sequestered emissions. This system creates financial incentives for industries and sectors, including agriculture, to adopt practices that minimize or capture GHG emissions.

### Understanding of Carbon Footprint

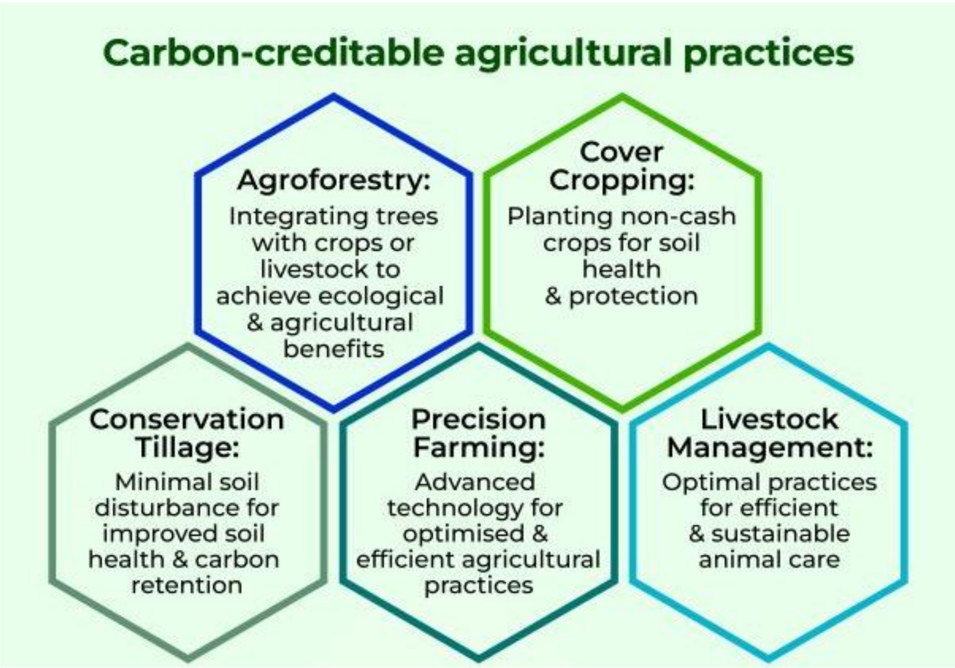
A carbon footprint is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions. The average carbon footprint for a person in the United States is 16 tons, one of the highest rates in the world. Globally, the average carbon footprint is closer to 4 tons. To have the best chance of avoiding a 2℃ rise in global temperatures, the average global carbon footprint per year needs to drop to under 2 tons by 2050.

## Agriculture's Role in Carbon Emission and Sequestration

Agriculture is both a source of GHG emissions and a potential solution. The sector is responsible for about 10-12**%** of global anthropogenic GHG emissions, primarily due to practices like deforestation, soil degradation, livestock production, and the use of synthetic fertilizers. However, agriculture also holds immense potential for carbon sequestration the process of capturing and storing atmospheric carbon dioxide.

## Carbon Credits in Agriculture

Agricultural carbon credits, also known as "carbon farming," involve the adoption of practices that either reduce emissions or enhance carbon sequestration in the soil and biomass. Farmers who implement these practices can generate carbon credits, which can then be sold in carbon markets, providing an additional revenue stream.




## Key Agricultural Practices to Mitigate Carbon Emissions

**1. Conservation Tillage:** Traditional tilling practices disturb the soil, releasing stored carbon into the atmosphere. Conservation tillage, including no-till and reduced-till methods, minimizes soil disturbance, helping to retain carbon in the soil.

**2. Cover Cropping:** Growing cover crops during off-seasons can improve soil health, reduce erosion, and enhance carbon sequestration. Cover crops capture carbon dioxide through photosynthesis and store it in plant biomass and roots, which eventually decomposes into organic matter.

**3. Agroforestry:** Integrating trees and shrubs into agricultural landscapes can significantly increase carbon sequestration. Trees absorb $CO_2$ from the atmosphere and store it in their biomass, while also providing shade, shelter, and nutrients to crops.

**4. Nutrient Management:** Optimizing the use of fertilizers through precision agriculture techniques can reduce the release of nitrous oxide, a potent greenhouse gas, from agricultural soils. Proper nutrient management also enhances plant growth, leading to greater carbon uptake.

**5. Methane Reduction in Livestock:** Livestock, especially ruminants, are a significant source of methane emissions. Strategies to reduce methane emissions include improving feed quality, using feed additives, and adopting rotational grazing practices.

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**6. Wetland Restoration:** Restoring wetlands on agricultural land can help sequester carbon in waterlogged soils and plant material while enhancing biodiversity and water quality.

**7. Direct Seeded Rice (DSR):** Traditional methods of rice cultivation involve flooding fields, which leads to significant methane emissions due to anaerobic conditions. Direct Seeded Rice is a water-efficient alternative that reduces the need for continuous flooding. By sowing rice seeds directly into the field without the need for a nursery and transplanting, this method reduces methane emissions, conserves water, and reduces labor costs.

**8. Alternate Wetting and Drying (AWD):** AWD is a water management practice in rice cultivation that involves periodically drying the field instead of keeping it continuously flooded. By allowing the soil to dry between irrigation events, AWD reduces methane emissions by limiting anaerobic decomposition. Additionally, this method conserves water, making it an efficient practice for both carbon emission reduction and sustainable water use.

**Verra's VM0042 Methodology for Improved Agricultural Land Management**

The VM0042 methodology by Verra is designed to measure the reduction in greenhouse gas (GHG) emissions achieved by using better farming practices. These practices can include improving how nutrients, water, and crop residues are managed, changing how crops are planted and harvested (like using agroforestry, rotating crops, or planting cover crops), and adjusting grazing methods.

To follow this methodology, projects must meet certain conditions. These include using acceptable data sources to estimate emissions, making adjustments for accuracy, and considering changes in land use. The steps to prove additionality are:

**1. Regulatory Surplus:** The project must show that its activities are not required by any laws. For example, if a project reduces emissions by stopping crop residue burning in an area where it is already illegal, it must show that it's going above and beyond what the law requires to be eligible for carbon credits.

**2. Barrier Analysis:** The project must identify any obstacles that would have prevented these improved farming practices from being adopted without the project. This helps prove that the project is necessary.

**3. Common Practice Analysis:** The project must show that the practices it uses are not already widespread. For example, if less than 20% of farmers in an area are using a specific method, it's not considered "common practice." If the project uses multiple methods (like zero-tillage combined with better irrigation), the average adoption rate must still be below 20%.

Additionally, the project shouldn't cause a lasting drop in crop yield of more than 5%. This rule is based on scientific studies or research in the region. Projects that involve changes like reducing fertilizer use must show a significant change, with a reduction of more than 5% compared to the baseline.

**Challenges and Opportunities**

While the potential of carbon credits in agriculture is promising, there are challenges to be addressed. These include the need for robust measurement, reporting, and verification (MRV) systems to ensure the credibility of carbon credits, as well as the initial costs associated with adopting sustainable practices. Moreover, smallholder farmers may face barriers to entering carbon markets due to lack of resources or knowledge. However, these challenges are not insurmountable. Governments, NGOs, and private sector actors are increasingly investing in capacity-building programs and financial incentives to support farmers in transitioning to carbon-friendly practices. Additionally, advances in technology, such as remote sensing and blockchain, are enhancing the accuracy and transparency of carbon credit transactions.

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**The Path Forward**

Integrating carbon credits in agriculture represents a significant step toward a more sustainable and climate-resilient food system. By adopting carbon-sequestering practices, farmers can play a crucial role in mitigating climate change while also benefiting economically from their environmental stewardship. As carbon markets continue to evolve, the agricultural sector stands to gain from its dual role as both a provider of food and a guardian of the planet.

## CONCLUSION

Carbon credits in agriculture offer a powerful tool for aligning economic incentives with environmental sustainability. By embracing this opportunity, the agricultural sector can contribute meaningfully to global climate goals, ensuring a healthier planet for future generations. The journey toward a low-carbon future is complex, but with the right strategies, support systems, and collaborative efforts, agriculture can become a cornerstone of climate action.

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