



Carbon Farming as a Pathway to Sustainable and Climate-Smart Agriculture in India

*Raghavendra V C, Prem Sagar S P, Yashaswini R, Sridhara M R,
Sanjay M and Sharanabasava

University of Agricultural Sciences, Raichur-584104 (Karnataka), India

*Corresponding Author's email: raghuvvagri@gmail.com

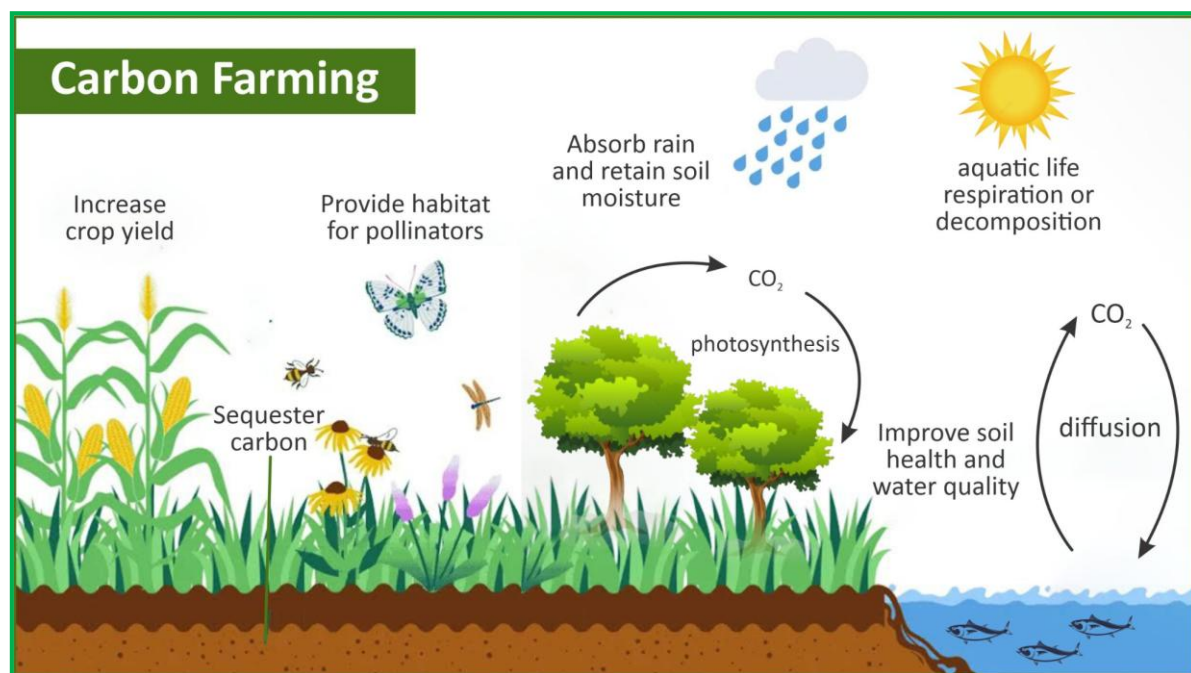
In response to growing environmental challenges and the urgent demand for climate-resilient agricultural systems, carbon farming has gained global importance as a vital approach within the agricultural sector. Carbon, a fundamental element of all living organisms and many minerals, plays a central role in essential biological processes such as photosynthesis and respiration. Agriculture, at its core involves the sustainable management of land, crops and livestock to produce food and maintain ecological balance.

Carbon Farming

Carbon farming is a sustainable agricultural approach focused on increasing carbon sequestration by adopting practices that enhance the uptake of carbon dioxide (CO₂) from the atmosphere and promote its storage in plant biomass and soil organic matter. It involves strategic planning, continuous monitoring and adaptation to local environmental conditions to effectively contribute to climate change mitigation. Carbon farming also referred to as carbon sequestration, is a sustainable agricultural approach that enhances the land's capacity to store carbon while reducing greenhouse gas emissions. Similarly, sustainable forest management contributes by capturing carbon dioxide in trees and minimizing emissions. In India, farmers and tribal communities can adopt practices such as managing grazing lands to restore vegetation and maintaining tree cover along waterways, which not only sequester carbon but also protect water resources. Additionally, reducing the use of chemical fertilizers through alternatives like compost and bio char improves soil health, increases crop productivity and further supports carbon storage in agricultural systems.

Significance of Carbon Farming

1. **Climate change mitigation:** Carbon farming plays a critical role in reducing atmospheric CO₂ levels by enhancing carbon sequestration in soils and vegetation, thereby lowering greenhouse gas emissions and contributing to global climate regulation.
2. **Soil health improvement:** Adoption of carbon farming practices improves soil structure, increases organic matter, enhances water-holding capacity, reduces erosion and promotes nutrient cycling collectively leading to higher crop productivity.
3. **Organic waste utilization:** The conversion of organic residues into compost serves as an effective soil amendment, enriching soil fertility, improving texture and increasing its carbon storage potential.
4. **Biodiversity enhancement:** Carbon farming encourages ecological diversity within agricultural landscapes by creating habitats for beneficial organisms, including pollinators and natural pest predators, reducing reliance on chemical inputs.
5. **Economic and livelihood benefits:** By integrating carbon farming techniques, farmers can access carbon credit markets and benefit from improved yields, thereby diversifying income sources and strengthening economic resilience.



Techniques involved in Carbon Farming

Forest management: Sustainable forest practices such as afforestation, reforestation and improved harvesting enhance carbon storage in vegetation and soil. Avoiding deforestation and promoting forest regeneration are key strategies for long-term carbon sequestration and ecosystem stability.

Agroforestry: Integrating trees into farming systems captures carbon in biomass and soil while improving soil fertility and biodiversity. It also diversifies farm income and reduces pressure on natural forests.

Grassland conservation: Protecting native grasslands prevents carbon loss from soil and root systems while maintaining biodiversity. Conservation efforts reduce land conversion and sustain natural carbon sinks.

Renewable energy integration: Using solar and wind energy in agriculture lowers greenhouse gas emissions by replacing fossil fuels. Such projects generate certified carbon credits and promote sustainable energy use.

Conservation agriculture: Practices like zero tillage, crop rotation and cover cropping enhance soil carbon storage and fertility. These methods minimize soil disturbance and strengthen ecosystem resilience.

Rotational grazing: Periodic livestock movement allows pasture recovery and enhances carbon capture through vegetation regrowth. This improves soil structure, reduces erosion and supports sustainable livestock production.

Potential opportunities for carbon farming in India

India's vast agricultural landscape offers immense potential for carbon farming, with an estimated economic opportunity of around USD 63 billion across nearly 170 million hectares of cultivable land. By integrating carbon credit systems, farmers can generate additional income through verified carbon sequestration and environmental service contributions. Indian agricultural soils have the capacity to sequester 3-8 billion tonnes of CO₂ equivalent annually over the next two to three decades, positioning the nation as a key player in global carbon markets. The Indo-Gangetic Plains and the Deccan Plateau are particularly suitable for large-scale implementation of carbon farming practices due to their fertile soils and extensive cultivation areas. In contrast, regions such as the Himalayan foothills and coastal zones present specific challenges, including steep terrain and soil salinization, necessitating region-specific strategies to optimize carbon farming outcomes.

Challenges associated with carbon farming

Soil composition: Soils with poor structure or low organic matter have limited carbon storage capacity. They often require organic amendments and improved management to enhance fertility and sequestration potential.

Geographic location: Terrain factors such as elevation, slope and proximity to water bodies influence land productivity. High-altitude areas face cold conditions limiting crop options, while coastal regions struggle with salinity and saltwater intrusion.

Crop varieties: Selecting crops suited to local soils and climates is vital for productivity and carbon storage. However, limited access to diverse or improved varieties reduces farmers' ability to fully benefit from carbon farming.

Water scarcity: Adequate water is essential for photosynthesis and biomass growth. In arid and semi-arid regions, water shortages restrict plant growth, thereby lowering carbon sequestration potential.

Financial constraints: Many small-scale farmers face high initial costs for adopting sustainable practices and lack access to financial support or incentives, hindering the implementation of carbon farming methods.

Policy and institutional gaps: Weak policy frameworks, limited awareness, and inadequate institutional support slow down the large-scale adoption of carbon farming practices across different regions.

Carbon credit trading scheme (CCTS)

The Government of India introduced the Carbon Credit Trading Scheme (CCTS) on June 28, 2023, to establish a national carbon credit market. The scheme, framed under the Energy Conservation (Amendment) Act, 2022, empowers the Central Government, in consultation with the Bureau of Energy Efficiency (BEE), to regulate carbon trading. Under the CCTS, an Accredited Carbon Verifier approved by BEE validates and verifies carbon reduction activities. Certified entities receive Carbon Credit Certificates, each representing the reduction or removal of one tonne of carbon dioxide equivalent (tCO₂e). The Indian Carbon Market Governing Board (ICMGB) has been constituted to oversee the functioning of the Indian Carbon Market (ICM), with representation from various central ministries and agencies. While the CCTS primarily serves the compliance market, it also allows integration of Voluntary Carbon Market (VCM) activities on the same platform.

Carbon farming contributes to the following UN Sustainable Development Goals (SDGs)



Conclusion

Carbon farming offers a promising pathway to sustainable and climate-resilient agriculture in India. By enhancing carbon sequestration, improving soil health, promoting biodiversity and providing economic incentives through carbon credits, it addresses both environmental and livelihood challenges. While opportunities are immense, successful implementation requires region-specific strategies, access to resources, supportive policies, and farmer engagement. Integrating carbon farming into India's agricultural systems can significantly contribute to climate change mitigation and the achievement of national and global sustainability goals.

References

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