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Understanding Carbon Farming and Carbon Credit for Sustainable Environment

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ABSTRACT
Carbon farming is a single change to land management practices, such as minimal cultivation, agroforestry and methane-reducing additives to feed, or stubble retention, that maximizes carbon absorption while minimizing emissions. Carbon farming lowers CO2, CH4, and N2O levels as soil C sinks rise because adding organic carbon to the soil encourages soil aeration, which reduces denitrification and increases the sink capacity for CH4. Soil organic carbon increases soil redox potential and provides electron acceptors, which lowers the soil's ability to act as a source of N2O. When available N2 is microbially immobilised by carbon farming, soil's capacity to deliver N2O is diminished. Carbon farming is deemed productive when it produces a net gain of carbon when combined with better land management and/or conservation practices. Among the benefits are decreased greenhouse gas emissions, sequestered carbon, improved biodiversity, tolerance to drought, and more effective use of water. Landowners and government agencies will find it easier to buy and exchange carbon credits with the launch of several projects. Landowners store carbon in the soil, which is turned into credits that are collected and sold at specific intervals to offset emissions. These credits have the potential to enhance the client's financial circumstances and demonstrate that their actions help mitigate the negative effects of the industrial society. They are regularly bought without requiring an exchange.

KEYWORDS: *Carbon farming, Carbon credit, Greenhouse gas, Financial, Industrial*

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INTRODUCTION

A collection of environmentally friendly techniques known as "carbon farming" has the potential to increase the amount of carbon sunk, or sequestered, in the soil. Reducing the amount of CO2, CH4, and N2O released into the atmosphere can be achieved by improving the soil's C sink. Abatement activities are those that, like carbon farming, lower greenhouse gas emissions. It reduces greenhouse gas emissions and stores carbon in plants and soil. A carbon offset credit is a payment granted to the owner or developer of a carbon sequestration method (owner of a forest reserve, developer of a biochar project, etc.) by an emitter of carbon (a power station, mine, oil refinery, etc.) (Woolf et al., 2010; Bhandari, 2014). A few practical strategies for reducing greenhouse gas emissions in carbon farming include planting

and regrowing trees and forests to store carbon in soils and degraded rangelands, including carbon-negative biochar to store carbon, and switching to biofuels in place of fossil fuels. Through carbon farming, land managers can obtain carbon credits by sequestering carbon or reducing greenhouse gas emissions within their boundaries (Das & Avasthe, 2015; Bhardwaj & Wadadekar, 2010; Das & Mukherjee, 2020). To offset the emissions, carbon credits can be sold to the government-designated entity. Carbon farming, essentially a voluntary carbon offset program, may provide financial benefits to landowners who commit to reducing greenhouse gas emissions. Carbon farming cuts emissions by hiding carbon on the soil and preventing emissions of greenhouse gases from invading the environment. It involves using methods that accelerate the process of removing CO2 from the atmosphere and converting it into plant matter or organic matter for the soil.

CARBON FARMING

"Carbon farming" is the application of agricultural techniques that reduce greenhouse gas emissions and/or sequester and retain carbon in soil and vegetation. Carbon farming can incorporate minimal changes to land management, such as stubble retention, agroforestry, no-till crop introduction, or feed additives that reduce methane levels (Das, 2024). On the other hand, to reduce emissions and maximise carbon absorption, it would require developing an integrated plan for the entire farm. It includes the activities that qualify for units of Indian carbon credits under the fund for emissions reduction. The second-largest source of carbon dioxide emissions is land management techniques. Agriculture is the only sector managed by humans that can transition from being a net emitter of CO2 to a net sequesterer. Common agricultural practices including using tractors, tilling the land, overgrazing, and applying fertilisers and herbicides that come from fossil fuels all result in significant emissions of carbon dioxide. Soil carbon sequestration is an alternate technique for advantageously storing carbon in soils for extended periods—decades to millennia or more. Utilising methods that have been demonstrated to quicken the process of extracting CO2 from the atmosphere and converting it to plant matter and/or organic matter in the soil is known as carbon farming (Das, 2024). Carbon farming is deemed effective when carbon benefits from better land management and/or conservation efforts surpass carbon losses.

CARBON CREDIT

The amount of greenhouse gases that each country is allowed to emit is capped by treaties; this also applies to corporations. To try to solve the issue, instruments like carbon offsets and credits were created to incentivise companies to operate in a more ecologically conscious way. One tonne of CO2 or an equivalent quantity of additional greenhouse gasses may be discharged into the environment for each carbon credit. Businesses who emit more than the allowed quantity must purchase carbon credits; those that do not can sell the additional credits. Credit-exchanging between these corporations has increased worldwide carbon trading.

These credits can be traded between enterprises or purchased and sold on international markets at the current rate at the European Climate Exchange and the Chicago Climate Exchange. The Multi-Commodity Exchange of India (MCX) looks to be poised to become the world's third market for carbon credits trading. The carbon trading system enables global regulation of greenhouse gas emissions by buying and selling carbon credits. Since carbon credits are exchanged on an open market, purchasing them from different corporations is fairly simple and convenient, just like purchasing any other financial instrument. When a business emits more than its allocated amount of carbon credits, it must participate in carbon trading to purchase extra credits from other businesses. As a result, worldwide carbon emissions stay within permissible limits, and the companies develop ecologically friendly ways to operate. The scheme also encourages the organisations to be more environmentally friendly by allowing them to sell carbon credits and increase their earnings. Businesses may simply comply with the program because carbon credits are readily swapped on the market. The existing carbon credit market has a direct impact on the firm's financial analysis. Because of this, companies are

actively searching for ways to lower their emissions and transition to more environmentally friendly operations. Thus, the system as a whole encourages governments and corporations to support environmentally friendly activities that reduce greenhouse gas emissions. Emissions dealing, or carbon trading is the cooperative effort to lower the amount of carbon that businesses, organisations, and other entities release over a specified period. The companies that use clean technologies are the sellers, while the purchasers are the global polluters. In the future, this strategy can be applied to successfully counteract the threat posed by global warming.

WIN-WIN CARBON FARMING PRACTICES

By increasing soil organic carbon levels, the following farming practices—pertaining to energy consumption, trees, animals, fertiliser, and soils—when incorporated into existing farming systems can increase production.

Soils

By boosting soil organic matter, decreasing nitrogen and carbon losses from the soil, and enhancing soil structure, implementing the following strategies can help improve soil health. Increasing crop and pasture productivity as well as optimizing nitrogen use efficiency can directly boost agricultural businesses' bottom lines.

- In cropping operations, employ controlled traffic strategies and conservation tillage.
- When possible, keep stubble and prunings; burn agricultural leftovers should be avoided.
- Avoid tilling overly damp or dry soils unless cultivation is absolutely necessary.
- Steer clear of times of bare fallow and, if at all possible, maintain continual plant cover.
- To lessen waterlogging, control soil drainage and irrigation.
- Crop rotation should include rotations of legumes and perennial pastures.
- When feasible, add composted material.
- Control the structure of the soil to increase plant uptake and reduce nitrogen loss (apply gypsum on sodic soils, for example).
- Control the excrement and urine of livestock to reduce the amount of nitrous oxide released.
- In order to control soil nutrient levels, set nutrient targets, fill out a nutrient budget to ascertain fertilizer needs, match nutrients to nitrogen input, and then keep those targets met.
- Don't graze pastures too much. Maintain enough groundcover all year long.
- Reduce compaction and the deterioration of soil structure in overgrazed paddocks by managing livestock movement and paddock rotations.

Livestock

Methane is a significant waste in livestock farming systems. Methane accounts for 6% to 10% of animals' entire energy intake, or 40 days for milk cows and 55-60 days for ewes and steers. Ruminants excrete 70% to 95% of the nitrogen they ingest, adding to the loss. When used correctly, it may improve crop or grazing development rather of being wasted to the atmosphere. The following methods can help cut down on these losses:

- Maximize the digestibility (quality) of feed.
- Utilize and reduce excretion of nutrients.
- Improved reproductive efficiency, selective culling, genetic optimization to facilitate quicker finishing, and other techniques like early joining and early weaning can all be used to manage flock or herd performance.
- To boost reproduction rates and reduce completing times, implement a genetic enhancement program.
- Control the excrement and urine of livestock to reduce the amount of nitrous oxide released.

Trees

Trees store carbon in their leaves and timber until they die (e.g., by fire) or degrade. When planted properly, trees may boost agricultural output by reducing water and soil requirements while also providing habitat for animals. The local lands care system may be useful in knowing what resources and money are available in a particular location.

- Locate potential habitats for wildlife, woodlots, and shelterbelts. These places may

be less productive or deteriorated, such as erosion gullies.
- Start fresh tree plantings, selecting species and preparing the site to maximize growth and survival.

- Think about woodlots with tree species that are useful for farming (such as firewood, fence posts, poles, or feed), but be careful not to employ any weed species.
- For example, by fencing off existing native vegetation, you can promote the regeneration of native trees and shrubs.
- Defend against extinction or harm to existing native shrubs and trees.
- Examine your possibilities for using the Carbon Farming Initiative to create and exchange carbon credits.

Fertilizer

Improving nitrogen fertiliser application efficiency not only produces immediate financial benefits but also reduces emissions of nitrous oxide and nitrate discharge into streams. You may boost output, reduce nitrous oxide emissions, and save money by adhering to best management practices for fertiliser rates, sources, timings, and placement.
- Utilize decision support tools and seasonal forecasts in conjunction with soil and plant tests to evaluate the availability of nitrogen and match it to crop or pasture demand.
- Refrain from applying large amounts of nitrogen in a single application.
- Applying nitrogen fertilizers—especially nitrate—to soggy soil is not recommended.
- When it's raining, don't till the soil.
- Fertilizer should be added to raised beds or ridges at the top to prevent soggy spots.
- Select the highest-quality nitrogen source. Urea and DAP will lose less nitrate and nitrous oxide during the wet season than fertilizers based on nitrate.
- Fertilizer should ideally be applied below the soil's surface.
- When feasible, use an inhibitor-coated fertilizer to minimize ammonia loss in the summer and nitrate leaching and nitrous oxide losses in the winter.

Energy

Increasing energy costs will affect farmers no matter how the law and policy pertaining to carbon trading turn out. If farmers increase their energy efficiency and find inexpensive fuel, heat, and power substitutes, they might eventually see an increase in their profits. Energy consumption reduction can be significantly impacted by reasonably complex and affordable changes.
- By keeping an eye on soil moisture, you can monitor irrigation efficiency and lower the energy required to run pumps.
- Insulate buildings, HVAC systems, and refrigeration and storage equipment.
- Paint walls and roofs with light-colored, heat-reflective paint.
- Make the most of natural ventilation and light in agricultural buildings.
- Investigate possibilities for substitute fuel and energy sources, such as green electricity, bioenergy, and renewable sources.

LOW CARBON FARMING (LCF) STRATEGY

By encouraging farmers to use methods that raise soil carbon content and reduce or do away with the need for synthetic fertilisers, it supports sustainable farming. This is achieved by a range of techniques, including mulching, anaerobic composting, reduced tillage, mulching, intercropping, multicropping, and the use of organic fertilisers that are especially designed for various regions, populations, and climate zones.
- Establishing fruit, fuel, and fodder trees on farms while safeguarding the existing ones.
- Diversity is supported when different crops are planted on the same land.
- A balanced farm ecology and a lower chance of crop failures from pest assault are two ways that appropriate crop mixtures, which are grounded in research and empirical evidence, enhance resilience. Farmers' susceptibility to risk from unpredictable and uneven rainfall is further decreased by multiple cropping.

OPPORTUNITIES IN CARBON FARMING

Farmers and landowners who participate in the voluntary "carbon farming initiative" scheme are compensated for reducing greenhouse gas emissions. Farmers and landowners are free to choose to join or not. Carbon farming techniques that reduce greenhouse gas emissions are called abatement activities. Either carbon or other harmful greenhouse gas emissions are reduced (emission reduction or avoidance programs) or carbon is sequestered in plants or soil (sequestration projects) to reduce emissions. They might be able to obtain carbon credits under the carbon farming projects scheme by engaging in things like:

- lowering emissions from cattle
- maximizing fertilizer use efficiency
- raising the amount of carbon in soil for agriculture
- carbon storage by replanting and re-vegetating

CARBON CREDIT IMPLICATION

Stopping the increase in carbon dioxide emissions is its main goal. Countries are expected to reduce greenhouse gas emissions and boost carbon storage as part of the Kyoto Protocol. One nation may be able to reimburse another nation for reducing emissions by a specific amount if it is difficult for that nation to reduce its greenhouse gas emissions. The mechanism for carbon credits was adopted in conjunction with the Kyoto Protocol. If an environmental organisation plants enough trees, for example, to offset one tonne of emissions, it will get credit. Even if its allocation is 10 tonnes, a steel mill may purchase this carbon credit from the environmental organisation if it expects to produce 11 tonnes of emissions. Indian initiatives in environmental management carbon credit mechanism are designed to decrease emissions by monitoring emission limits and rewarding those who exceed them. Simply explained, one carbon credit equals one tonne of CO2 or a similar greenhouse gas (GHG).

INDIAN INITIATIVES FOR ENVIRONMENTAL MANAGEMENT

India doesn't seem to be inside the global carbon trading range. On the other hand, the government's 1992 policy statement on pollution abatement promotes the use of MBIs for pollution management whenever it is feasible. One very good step in the right direction towards lowering air pollution in recent years is the necessity to follow Euro II emission regulations. These days, it is essential for businesses to consider the environment while making decisions. With the passage of the Information Technology Act, of 2000, the industry, which had traditionally conducted its commercial operations solely on paper, was able to start employing electronic mode as a legitimate legal medium. This includes initiatives like SEBI Reporting, Income Tax e-filing, MCA e-filing, and other electronic communications like email and video conferencing. By industry estimates, the money earned by Indian firm's amounts to at least $8.5 billion, assuming that the prevailing rate for certified emission reductions (CERTs) is $10 per tonne. For their waste heat recovery plant in Orissa, Tata Sponge Iron Ltd. was granted a clean development mechanism (CDM) certificate by the United Nations. Process development and energy efficiency CDM initiatives are already underway at Reliance Energy. Now is the moment to take action and seriously examine ways to slow down environmental degradation by rigorous adherence to, implementation of, and development of innovative protocols and containment tactics. To protect the remaining ozone layer, which serves as a shield between life and the sun's damaging UV radiation, we must push for a radical reduction in carbon footprints (Das, 2023). If not, famine, sunburn, blindness, scary noises, and a host of other irreversible illnesses will soon overtake the world.

CAN 'CARBON FARMING' SUSTAINABLY REDUCE GREENHOUSE GAS EMISSIONS?

Soils are key components of the carbon cycle on Earth, especially when examined through the

lens of global climate change. They are the world's second-largest pool after the oceans, absorbing more carbon than the environment and all plants combined. Soil management strategies, on the other hand, may either emit extra carbon into the atmosphere through activities such as cattle overgrazing and heavy ploughing, or absorb it through sustainable agriculture and agroforestry. Soils are not always climate-neutral. Farms, however, may be effective tools in the battle against global warming provided they are properly managed. The "technical potential" of agricultural soils has been calculated to be 3 to 8 gigatons (billion metric tonnes) of CO2 equivalent each year for 20 to 30 years. This is enough to close the gap between what can be accomplished through carbon reductions and what is needed to stabilize the climate. In other words, while raising soil organic matter may have appeared like a good agricultural approach in the past, boosting soil carbon today looks to be essential to planetary survival. Supporters of carbon farming acknowledge that carbon markets are only one of many important ways to increase soil carbon storage, just as soil carbon sequestration is only one of many crucial methods for combating climate change.

CONCLUSION

Land managers in India may be able to earn carbon credits by lowering emissions of greenhouse gases and hiding carbon in soil and plants through carbon farming. Furthermore, owners who participate in carbon-sequestering or emission-reduction operations may be eligible to obtain offset credits. The production of carbon credits will help the largest emitters reach their emission reduction commitments. Applying biochar generated from agricultural waste to soil may have environmental and economic benefits. After a proper incorporation of the environment cost of based on carbon emissions of greenhouse gases, efficient market dynamics and pricing mechanisms should emerge. Given the need to take action to address climate change, it is recommended that carbon farming be included in the mitigation efforts. Thus, carbon farming could prove to be a workable mitigation approach that merits further research, among many other geoengineering options.

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