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Carbon Farming and Agri-Tech: Paving the Way for Sustainable Agriculture in India

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Abstract

With the growing impetus on sustainable and environmentally feasible agricultural practices, carbon farming has emerged as a viable option for the cultivators globally. Through its carbon-positive approach, carbon farming aids in carbon sequestration, while generating a secondary source of income to the beneficiaries. However, there are numerous challenges associated with its successful implementation, which can be mitigated by proper agri-tech interventions. This article, thus, provides insights on the importance of carbon farming in the present era, and the role of agri-tech in making it a successful venture in the context of sustainable agriculture.

Introduction

With the increase in global carbon emissions and resulting climate change, it becomes crucial to incorporate carbon-positive agricultural practices which would help sequester (store) carbon within the soil and biomass. Carbon farming refers to the agricultural practices and land management techniques which increase and encourage carbon sequestration. These include practices such as no-till, vegetable mulch, agroforestry, cover cropping, rotational grazing, crop rotation, biochar, etc. Carbon farming is associated with numerous benefits such as climate change mitigation, soil health improvement, generation of alternative income, building resilience as well as encouraging biodiversity. India has an average carbon sequestration potential of 0.21 Mg C $ha^{-1}yr^{-1}$ (Ajit et al., 2017), while the soil carbon sequestration in India is 92 Tg C yr^{-1} (Newaj & Dhyani, 2020). However, the intervention of agri-tech is crucial in mitigating the challenges associated with successful adoption of carbon farming. An additional boost can be provided by the implementation of suitable government initiatives and policies.

1. Challenges in carbon farming

Carbon farming (CF) presents itself with a number of challenges, which needs to addressed

for wider acceptability of the initiative.

1.1. Lack of awareness: Majority of the farmers lack general awareness regarding the procedure and benefits associated with carbon farming. Often, the complex scheme- design and implementation of new farm management practices, acts as deterrents towards CF adoption. Furthermore, the fear of financial losses and tendency of risk aversion among small and marginal farmers limits CF usage.

1.2. Financial consequences: Carbon farming is a cost-intensive venture, with high capital investment in the initial years. However, the instability of carbon markets, uncertainty regarding the selling price and its unsustainability with traditional practices are a cause of concern for the farmers. Additionally, regular estimation of carbon sequestered is an expensive venture as well.

1.3. Lack of homogeneous carbon quantification methods: Although a number of techniques are used for measuring among of carbon sequestered, the methods rely of various forms of destructive sampling or allometric equations, which vary based on the species, climate, soil, age of the species, etc.

1.4. Regulatory barriers: The legal and regulatory frameworks for carbon farming varies from region to region. For example, Verra's Verified Carbon Standard (VCS) and Gold Standard are global standards for carbon credit quantification, However, it is based on the large-scale farming practices observed in the US, while small and marginal farmers with scattered land holdings are more prevalent globally. The complex certification and reporting aggravate the problem further.

1.5. Equity issues: The marginalized and small farmers lack land tenure, which makes them reluctant in adopting long term ventures such as carbon farming.

2. Role of agri-tech in popularising carbon farming

Carbon farming is a data-driven venture which relies on accurate monitoring, data collection, analysis and access (Abdul Wahab et al., 2024). Agri-tech is thus an essential tool for successful carbon farming, as highlighted below.

2.1. Monitoring and verification: The tracking of biomass changes, vegetation cover, soil moisture, pH, is possible using numerous tools such as remote sensing, satellite imagery, IoT sensors, and AI. Additionally, it also helps in forecasting the carbon sequestered based on meteorological parameters, and crop type.

2.2. Farmer training: To equip farmers with proper awareness and training regarding Carbon farming, agri-tech satrtups can be utilised. Through these customized guidance platforms, knowledge can be disseminated on carbon-positive practices, agro-siliviculture, soil health, etc.

2.3.Inaccessible carbon markets: The lack of digital literacy has led to inadequate access to carbon markets. Agri-tech startups can bridge this gap by developing blockchain-based carbon credit registers, aggregating farmers for carbon certification as well as developing carbon market platforms.

2.4.Data collection: Since data is the backbone of carbon farming, agri-tech can improve farm digitization by tracking inputs, regular soil health monitoring, carbon- positive practices such as no-till, and forecasting carbon potential based on climate and agronomic practices.

3. Agri-tech startups associated with carbon farming in India

Currently, India has over 1500 agri-tech startups which are working diligently towards improving the agriculture scenario in our country.

- Agri-tech startups such as **CropIn** provides crop monitoring and satellite based advisory, which can be utilised for tracking carbon sequestration in the farms.
- **DeHaat** farmer app provides frequent advisories, weather reports and crop reminders in vernacular languages, for increasing the digital literacy among the farmers.
- Startup **Digital Green** uses Generative AI to offer climate smart advisories to farmers, resulting in manifold reduction in crop losses.
- **Boomitra** has combined satellite imagery and machine learning to develop a remote sensing methodology for measuring soil organic carbon at scale.
- **Grow Indigo** helps empower small-holder farmers with science-backed monitoring and verification of carbon credits generated. It creates awareness regarding the need and the methods of regenerative agriculture, thus making it simple to register, monitor, verify the good agricultural practices.

4. Government initiatives and policies

- The Ministry of Agriculture & Farmers Welfare has developed a framework for Voluntary Carbon Market (VCM) in India to incentivize the small and medium farmers through carbon trading mechanism.
- Through its 'National Innovations in Climate Resilient Agriculture' (NICRA) project, the government of India promoted climate resilient agricultural technologies such as intercropping systems, conservation agriculture, crop diversification, agroforestry
- ystems, zero-till sowing, green manuring, etc. which would contribute to carbon positive agricultural practices.
- The government launched Paramparagat Krishi Vikas Yojana to encourage organic farming and improve soil health.

5. Conclusion

Carbon farming provides dual benefit of alternate incentivisation and climate change mitigation. But incorporating agricultural practices with carbon-positive practices, it helps sequester carbon while improving soil health, water retention as well as farm resilience. In the Indian context, carbon farming, backed by agri-tech innovations, can empower farmers manifold. However, challenges such as lack of awareness, inadequate policy frameworks, and digital literacy needs to be addressed to unlock the full potential of carbon farming.

6. References

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