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CARBON CREDIT IN AGRICULTURE AND ITS FINANCING

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ABSTRACT
India is primarily an agricultural country. Agriculture plays a significant role in India's economy, employing a large portion of the population and contributing notably to its GDP.Agriculture is dependent on climate and due to pollution the envoirnment is geeting affected. There are a number of areas in the country which lack sufficient water and lacks other agricultural alied services. Thus it is the time to take some action to save the envoinment as well as the agriculture.In order to achieve this objective agriculture methods may be changed which can help the envornment to maintain its quality and at the same time production of food grain also get increased.Among number of food grains in India,Rice is a staple food.Rice production from traditional method produces green house gas in the envoirnment.By changing the method of rice production from traditional method to Direct Seeded Rice(DSR) may lead to reduction in green house gases and can give an opportunity to farmers to earn income by selling carbon credit.This carbon credit market in India is in nascent stage.Government of India is also in favour of creating Voluntary carbon credit market which can help the farmers to earn additional income and keep their envoirnment clean.

KEYWORDS: Farmers Income ,Agriculture, Direct Seeded Rice(DSR), Voluntary Carbon Market, Carbon Credit,Carbon Credit..

INTRODUCTION

Approximately 85% of India's economy was primarily based on agriculture during British colonial control.The majority of people in the nation were rural dwellers who made their living either directly or indirectly from farming. Nevertheless, the agricultural sector continued to stagnate and occasionally deteriorate abnormally despite employing such a vast population. Even while agricultural productivity declined, the industry as a whole saw some growth as a result of the total area under cultivation increasing.The different land settlement schemes that the colonial government used were the primary cause of this agricultural sector stagnation. In particular, the zamindars, rather than the farmers, received the profits from the agricultural sector under the zamindari system, which was in place in the Bengal Presidency at the time and included portions of modern-day eastern state of India.

However, not only the colonial authority but also a sizable portion of zamindars took no action to enhance agricultural conditions. Regardless of the farmers' financial situation, the zamindars' primary goal was to collect rent. The latter experienced great suffering and societal unrest as a result. The conditions of the revenue settlement also played a significant role in the zamindars' adoption of policy where date for depositing certain amounts of revenue were set, and if they were not met, the zamindars would forfeit their rights. The poor level of agricultural output was also a result of low levels of technology, inadequate irrigation systems, and careless fertilizer use, all of which made farmers' conditions worse. Naturally, there was some indication that the production of cash crops was comparatively larger in some regions of the nation as a result of agricultural commercialization.The condition of agriculture sector improved after independence of India.

As per economic survey 2023-24,agriculture sector provides livelihood support to nearly 42.3% of the population and contribute 18.2 % in the country's GDP at current prices.In India agriculture sector provides livelihood to a large portion of the population.Thus emission from agriculture sector of India is required to be reduced.As per NITI Aayog Agriculture Emissions in 2019 Total Emission is 4,20,968.5(Gigagrams CO2e).Out of which Rice cultivation is 17.44% ie.73,436.73 Gigagrams CO2e.This Rice farming provides an opportunity to decrease the greenhouse effect.Global warming potential of rice(continuous flooding) is 3500-3700 (kg CO2 ha-1)(Adhya et al., 2000; Jain et al., 2000; Pathak et al., 2002; Gupta et al., 2009; SNC, 2012; Fain et al., 2014, as cited in Pathak, Bhatia, & Jain, 2014, p.34)

As per Final estimates of production of major crops released for the year 2022-23, It is projected that the total amount of rice produced in 2022–2023 is estimated to reach a record 1357.55 lakh tonnes. It is 62.84 lakh tonnes more than the previous year's production of 1294.71 lakh tonnes of rice and 153.65 lakh tonnes more than the average production of 1203.90 lakh tonnes over the previous five years.

Rice fields submerged under water are the potential source of CH4 production..In the coventional puddled transplanting system there is requirement of large amount of water and labours which results in decreasing of profit margin daya by day.Thus traditional system can be changed to Direct Seeded Rice(DSR).There are a number of reasons for this shift like water scarcity,rising cost of labour in peak season,adverse effect of puddling

etc.There are some benefits of DSR - Saving in irrigation water(25%-30%), Saving in labor(10%-15%), Reduction in emissions(70%-75%)(Pathak, Bhatia, & Jain, 2014, p. 36)

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

The entirety of the planet's heritage and all of its resources are referred to as the environment. It encompasses all of the interdependent biotic and abiotic elements. Air, water, land, and other elements are abiotic, whereas all living things—plants, animals, birds, forests, fisheries, etc.—are biotic. Abiotic components of the environment include things like sunlight and rocks.Studying the environment then necessitates studying how these biotic and abiotic elements interact with one another.

The environment's functions include: The environment serves four essential purposes.(i)It provides resources, both non-renewable and renewable resources are included here. Resources that can be used again without running the risk of running out or being exhausted are known as renewable resources. In other words, there is a steady supply of the resource. The fish in the ocean and the trees in the forests are two examples of renewable resources. Contrarily, non-renewable resources are those that run out as a result of extraction and usage. For instance, fossil fuels (ii) absorb waste, (iii) support life by supplying genetic and biodiversity, and (iv) also give aesthetic services like scenery, etc.

The average temperature of the earth's lower atmosphere has been gradually rising since the Industrial Revolution due to an increase in greenhouse gases, a phenomenon known as global warming. A large portion of the recently noted and anticipated worldwide Warming is caused by humans. It is brought on by human activity, specifically the burning of fossil fuels and deforestation, which raises carbon dioxide and other greenhouse gases. The surface of our planet will warm if carbon dioxide, methane, and other gases with the capacity to absorb heat are added to the atmosphere without any further modifications. Since 1750, the amounts of carbon dioxide and CH4 in the atmosphere have risen by 31% and 149%, respectively, above pre-industrial levels. The temperature of the atmosphere has increased by 1.1°F (0.6°C) over the last century.The sea level has increased by a few inches. The melting of polar ice, which raises sea levels and causes coastal flooding, the disruption of drinking water supplies that depend on snowmelt, the extinction of species as ecological niches vanish, the occurrence of more frequent tropical storms, and the rise in tropical diseases are some of the longer-term effects of global warming.

Burning coal and petroleum products, which are sources of carbon dioxide, methane, nitrous oxide, and ozone; deforestation, which raises atmospheric carbon dioxide levels; methane gas released in animal waste; and increased cattle production, which fuels deforestation, methane production, and fossil fuel consumption are ome of the factors that may be causing global warming. In 1997, the UN hosted a conference on climate change in Kyoto, Japan.(Source: www.wikipedia.org)

SUSTAINABLE DEVELOPMENT

The economy and environment are linked and necessary for one another therefore, progress that disregards its.The environment that supports life forms will be destroyed by environmental effects. Sustainable development is required, which is development that will enable all future generations to potentially experience an average standard of living at least as high as that enjoyed by the current generation. The United Nations Conference on Environment and Development (UNCED) emphasized the idea of sustainable development, defining it as "development that meets the needs of the present generation without compromising the ability of the future generation to meet their own needs."

Purpose:

This study want to focus on how Indian farmers can adopt carbon-saving practices, such as Direct Seeded Rice (DSR), to reduce emissions, conserve resources, and create new income opportunities through the carbon credit market and opportnities available to entrepreneurs or start up.

Research Question:

Can adopting sustainable agricultural practices in rice cultivation help Indian farmers earn additional income through carbon credits, and provide new business sector to entrepreneurs ?

Methods:

The study uses information from government reports, carbon credit initiatives, and case studies on carbon offset markets.

Literature review

1. Chowdhury, M., Khura, T. K., Upadhyay, P. K., Parray, R. A., Kushwaha, H. L., Singh, C., Lama, A., & Mani, I. (2024). Assessing vegetation indices and productivity across nitrogen gradients: A comparative study under transplanted and direct-seeded rice. *Frontiers in Sustainable Food Systems*, *8*, 1351414. https://doi.org/10.3389/fsufs.2024.1351414.

The study finds that- how various nitrogen concentrations affect vegetative indicators, growth parameters, yield characteristics, and the financial aspects of growing rice by direct sowing and transplanting. Its results show that nitrogen has a major impact on plant height, LAI, grain yields, and vegetation indices.Interestingly, in both approaches, treatment N4 (160 kg N ha−1) consistently produced the most grain. Direct seeding with the recommended nitrogen level (120 kg N ha−1) was 16.96% more cost-effective than transplanting.

2. Zhao, Z., He, W., Chen, G., Yan, C., Gao, H., & Liu, Q. (2024). Dry direct-seeded rice yield and water use efficiency as affected by biodegradable film mulching in the northeastern region of China. *Agriculture, 14*(2), 170. https://doi.org/10.3390/agriculture14020170

The study finds that- The primary considerations for farmers when selecting crop cultivation techniques are planting inputs and economic rewards [53–55]. According to studies, using traditional or biodegradable mulch film can increase total profits while simultaneously raising rice growing costs. Although the acquisition of biodegradable mulch film is the main source of the increased expenses, it also lowers the need for pesticides by reducing the need for weed and pest control maintenance.As a result, combining biodegradable mulch film with dry-seeded rice growing has a lot of potential as an agricultural management technique. In Northeast China, it can boost rice yields, increase the effectiveness of water use, raise farmers' incomes sustainably, and guarantee food security.

3. Wu, L., Yu, K., Zou, J., Bao, X., Yang, T., Chen, Q., & Zhang, B. (2024). Management of seeding rate and nitrogen fertilization for lodging risk reduction and high grain yield of mechanically direct-seeded rice under a double-cropping regime in South China. *Agronomy, 14*(3), 522. https://doi.org/10.3390/agronomy14030522.

The study finds that- According to the research lodging resistance can be improved while rice grain production is increased by raising Seeding rates SR and lowering N nitrogen fertilization. Maintaining lodging resistance and enhancing grain production may be achieved by lowering N application rates and optimizing grain yield by raising SR.

4. Sarma, H. H., & Paul, A. (2024). Diversification of establishment techniques in direct-seeded rice. *Vigyan Varta, 5*(5), 22-25.

The study finds that Direct-seeded rice offers labor, energy, and water savings, making it a competitive alternative to conventional techniques. Although issues like increased seed rates and weed control need to be addressed, dangers can be reduced with the right methods. DSR has the potential to transform rice farming through effective management techniques, fostering sustainability and increasing farmers' profits.Adopting DSR could result in notable improvements in farming methods that would help the environment and the farming community.

5. Kumar, B., Meena, R. S., Supriya, R., Kumar, R., Chaudhary, A., & Patel, G. (2024). Influence of different fertility levels on yield and nutrient status in zero till direct-seeded rice cultivation. *Journal of Cereal Research, 16*(3), 278-286. https://doi.org/10.25174/2582-2675/2024/154756

The study finds that- In direct-seeded rice farming, the use of macro and micronutrients offers itself as a viable way to correct nutrient deficiencies, conserve resources, and maybe increase yields. Additionally, the results of this study indicate that switching to Zero-tillage Direct-Seeded Rice (DSR) from the traditional transplanting method may save money on labor and water.

6. Adarsh, A., Kumar, T., Kumari, K., Singh, R., Kundu, M. S., Jha, R. K., Prasad, J., Kumari, A., Pratap, T., & Tiwari, R. K. (2024). Enhancing sustainability and productivity of rice–wheat–green gram cropping system through alternative tillage and crop establishment approaches in North Bihar. *International Journal of Plant Production*. https://doi.org/10.1007/s42106-024-00296-1

The report highlights a number of issues facing agriculture, especially in North Bihar, including declining productivity, a lack of water, a manpower shortage, and the consequences of climate change. As a result, conservation agriculture (CA) shows promise as a means of improving environmental health and sustainability while preserving or even increasing agricultural yields. Making the switch from conventional farming to CA, especially with the Rice–Wheat Green Gram-based Cropping System (RWCS), has several advantages, including lower costs, more profitable operations, and the preservation of soil structure. Notably, switching from traditional puddling to Direct Seeded Rice (DSR) requires modifications to agronomic operations; zero-tillage first exhibits lower yields in humid circumstances before catching up to conventional techniques.

7. Sandhu, N., Yadav, S., Kumar Singh, V., & Kumar, A. (2021). Effective crop management and modern breeding strategies to ensure higher crop productivity under direct seeded rice cultivation system: A review. *Agronomy, 11*(7), 1264. https://doi.org/10.3390/agronomy11071264

The study finds that -Major abiotic stresses brought on by climate change, including flood, drought, salinity, cold, and high temperatures, are thought to pose serious risks to rice production and result in a considerable reduction in yield. With less water and manpower consumption and manufacturing costs, DSR has become a more effective, financially feasible, and environmentally promising substitute for PTR.A convergence of genetic, agronomic, and other approaches is required for the continuous large-scale transition towards DSR in order to sustain it and maximize the advantages to the environment and natural resources. It is crucial to pay attention to the proper pairings of DSR cultivars and technologies that enable farmers to reap the substantial financial benefits of DSR production while using less water, labor, energy, and nutrients. The auxiliary technologies, such as automated

planting, accurate laser land leveling, appropriate water-nutrient-weed control, and mechanized. The successful and efficient proliferation and widespread acceptance of appropriate DSAR varieties and technologies may be made possible by harvesting and threshing.
8. Jat, R. K., Meena, V. S., Kumar, M., Jakkula, V. S., Reddy, I. R., & Pandey, A. C. (2022). Direct seeded rice: Strategies to improve crop resilience and food security under adverse climatic conditions. *Land*, *11*(3), 382. https://doi.org/10.3390/land11030382
This study finds- The yield advantage of direct seeded rice (DSR) over mechanically transplanted rice is about 10%. The findings indicate that up to 70% of crop lodging in unfavorable weather conditions could be prevented by DSR technology. By reducing the amount of time needed for land preparation, DSR helps to advance the planting dates of subsequent rabi crops by at least 7 to 10 days. The farming community is increasingly using direct seeding planting techniques for rice since they are more economical, efficient in terms of inputs, energy, and time, and they are an environmentally benign substitute for the conventional puddled transplanted rice planting method.
9. Chaudhary, A., Venkatramanan, V., Mishra, A. K., & Sharma, S. (2023). Agronomic and environmental determinants of direct seeded rice in South Asia. *Circular Economy and Sustainability*, *3*, 253–290. https://doi.org/10.1007/s43615-022-00173-x
This study finds -DSR is a more sustainable, resource-efficient, and climate-resilient alternative agricultural system, many agronomic. DSR methods have lost their effectiveness due to a lack of mechanization, accurate application, and enough training. Therefore, it is crucial to implement appropriate management procedures.In DSR, blast and root-knot nematode infestations can be resolved with the aid of efficient management techniques, sophisticated biotechnological and genetic methods, and a deeper comprehension of pest and disease dynamics.
10. Singh, S., Maurya, D. K., Sahoo, M., Mourya, P. K., Singh, S., & Singh, J. K. (2025). Weed management in direct seeded rice using different herbicide combinations and their effect on growth and yield parameters. *Plant Archives*, *25*(Supplement-1), 137. https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.137.
This study finds- Every herbicide combination had a major impact on crop output and weed growth. Of all the species, monocot weeds—especially sedges—were the most prevalent. Higher weed-control index (WCI) in DSR indicated improved weed control with combined applications of ready-mix herbicides.
11. Kumar, A., Verma, R. L., Sah, R. P., Satapathy, B. S., Mohanty, S., Tripathi, R., Chattopadhyay, K., Samantaray, S., & Nayak, A. K. (n.d.). *Direct seeded rice: A technology for enhancing climate resilience* (NRRI Research Bulletin No. 50, p. 25). ICAR-National Rice Research Institute.
This study finds-As direct-seeded rice creates non-puddled soil, water percolation rates are better, soil macro-porosity is higher, and soil pore continuity is improved. These elements promote methane (CH_4) oxidation and improve gas diffusivity. On the other hand, the puddled conditions in transplanted rice with continuous flooding (TPR-CF) limit water percolation and produce anaerobic conditions that favor CH_4 emissions (Kumar et al., 2019). Anoxic conditions created in flooded puddled rice with continuous flooding (FPR-CF) allow methanogens to produce CH_4 through the anaerobic breakdown of organic molecules. Methane emissions were lower in all DSR demo plots under wet/dry and zero tillage conditions than under the traditional TPR, according to research findings from ICAR-NRRI, Cuttack. Compared to wet and/or zero tillage DSR, the emissions were even lower under dry DSR. Significant methane reductions of 40–50% are possible with careful land and water management in DSR, combined with the right wetting and drying sequence.
The goal of economic growth was to boost the output of products and services in order to satisfy the demands of an expanding population, the ecosystem is under more stress. Demand for environmental resources was lower than supply in the early phases of development. The globe is currently dealing with a rise in demand for environmental resources, yet overuse and misuse are limiting their supply. The goal of sustainable development is to encourage the kind of growth that minimizes environmental issues and satisfies current needs without endangering the capacity of future generations to satisfy their own.

Carbon Credit

A carbon credit is like a permission slip for spewing out one metric ton of carbon dioxide (CO_2) or a similar amount of some other greenhouse gas.Carbon credits are usually acquired by companies or people who lower or compensate for their greenhouse gas emissions by engaging in actions such as renewable energy projects, reforestation, or adopting cleaner technologies.The concept of permanence refers to the long-term removal of carbon from the atmosphere from carbon offsets. In order to generate a carbon offset, a farmer can use a carbon aggregator to convert 100 acres of rice fields to the new technique and start storing carbon. Therefore, contracts that farmers sign to guarantee that a practice remains in place for 10, 20, 50, or whatever the term length of that contract is, are the foundation of carbon credits. The purpose of the contract is to prevent the carbon from being released back into the atmosphere during that period.
As there were no laws or regulatory bodies limiting carbon dioxide emissions from businesses in industrialized nations, it became crucial for these countries to swiftly decarbonize and reduce their emissions to combat climate

change. With time running out and no advanced technology at hand, the United Nations and the European Union devised a solution: the Kyoto Protocol.
The idea of establishing a cap-and-trade system for carbon emissions was introduced through the Kyoto Protocol, a United Nations treaty adopted in Kyoto, Japan, in 1997 to address climate change. The Paris Agreement introduced a net-zero carbon emission goal, leading to a more dynamic carbon credit market.
Carbon credits are issued by government bodies at both national and international levels. The Kyoto and Paris agreements set up the first global carbon markets. Generally, the number of credits issued each year is based on emissions targets. These credits are often distributed under a "cap-and-trade" system, where authorities set a limit on carbon emissions, referred to as the cap. This cap decreases over time, making it progressively harder for companies to comply.

Carbon credit Organisation (An example)
One of the world's first carbon market is EU Emissions Trading System (EU ETS) established in the year 2005,operating in all EU countries and Iceland, Liechtenstein and Norway.It covers power genration,industrial manufacturing and aviation sector also.It now also included maritime transport from 2024.
The EU ETS operates on a "cap and trade" system, where a maximum limit is set on the total greenhouse gas emissions allowed for installations and operators. This cap decreases each year in alignment with the EU's climate goals, ensuring a gradual reduction in overall emissions. The EU ETS cap is represented by emission allowances, each permitting the release of one tonne of CO_2 equivalent. These allowances are auctioned and can be traded. As the cap declines, the availability of allowances in the EU carbon market also reduces.
Companies under the system are required to track and report their emissions annually and submit sufficient allowances to cover their total emissions. Failure to comply results in substantial fines. The carbon price encourages companies to lower emissions in a cost-effective manner while also influencing the revenue generated from allowance sales.
Other players-Carbon credit registries and standards bodies: VERRA's Verified Carbon Standard (VCS), Gold Standard, Climate Action Reserve, American Carbon Registry(ACR),Puro. Earth, and Isometric.

Voluntary carbon credit market
A number of companies now have have adopted "net zero" policy.As per dictionary "net zero" means a target of completely negating the amount of greenhouse gases produced by human activity, to be achieved by reducing emissions and implementing methods of absorbing carbon dioxide from the atmosphere.
According to the Press Information Bureau (2024), the carbon trading mechanism in the agriculture sector is being developed. The Ministry of Agriculture & Farmers Welfare has established a framework to support the Voluntary Carbon Market (VCM) in India's agricultural sector, enabling small and marginal farmers to benefit from carbon credits. Integrating carbon markets into farming can promote the adoption of environmentally friendly agricultural practices while boosting farmers' earnings. By implementing sustainable practices, farmers can not only gain extra income through carbon credits but also enhance natural resources like soil, water, and biodiversity.
The framework for voluntary carbon markets in agriculture aims to encourage the farming community to engage in carbon trading while providing incentives and financial support for sustainable farming practices. Its primary goal is to raise awareness, build stakeholder capacity, and motivate farmers to adopt eco-friendly agricultural methods. Over time, this initiative will contribute to sustainable development goals, enhance rural livelihoods, and strengthen agricultural resilience.

Carbon credit market participants
1.Farmers-Those who have agricultural land and ready to adopt new regenerative practices and make a make a commitment for fixed number of years to continue to benefit from Carbon Credit payments.
2. Facilitator-The company or group that acts as a mediator between the farmer and the offset's final buyer. The offset is made and sold by them. Because the offset's final buyer does not want to purchase carbon credits from thousands of landowners, the aggregator does so before selling the buyer the bundled credits.
3. Verifier The carbon credit generated is to be validated and verified by globally recognized third party agencies.
4.Buyer- A business or organization that buys carbon credits to make up for their emissions.

Chaleenges-
1.Indian agriculture is highly fragmented
2.it takes a considerable amount of time to receive the monetary benefits
3.Transaction costs – in the form of measurement, monitoring, third party verification and certification etc – too add to the challenge. These costs may be very high, resulting in limited net monetary benefits for farmers.
4.Accurate measurement of carbon in the soil, before and after the implementation of proposed practices, is another major problem.
5.Availability of technology, data and trained personnel

6.Carbon credit market in agriculture is in its nascent stage and requires a strict monitoring and regulatory system the same time, concerns regarding the calculation of credits need to be addressed.
7.Lack of DSR-adaptive varieties.
8.Lack of effective herbicides for weed management.
9. Nematodes are microscopic worms that can cause significant damage to rice crops.
10.Lack of Iron in DSR soils.
11.Avilaibility of specialized equipment for seeding rice.
12.Lack of awareness of DSR cultivation methods.

Opportunities in emerging sector of carbon credit in agriculture sector-
For Farmers-
Additional Income-Extra earnings can be generated by farmers through the implementation of sustainable techniques like decreased tilling, planting cover crops, and effectively managing water resources to capture carbon and diminish greenhouse gas emissions. These actions have the potential to acquire carbon credits, which can then be sold for additional revenue. For example, programs such as those offered by Grow Indigo have allowed farmers to generate extra income by selling carbon credits.
Enhanced Soil Health and Yields-Implementing sustainable practices helps not just with capturing carbon, but also enhances soil fertility and water retention, resulting in increased crop yields and improved resilience to changes in climate. Tools such as those provided by Boomitra have helped farmers embrace these methods, leading to enhanced soil quality and higher crop production.
Access to Resources and Training-Engaging in carbon credit programs frequently gives farmers the opportunity to receive technical assistance, training, and resources for successfully adopting sustainable practices. Businesses such as nurture.farm have played a key role in offering farmers the necessary assistance to shift towards sustainable methods.
For Companies:
Market Expansion-Participating in carbon credit trading enables businesses to access a developing market, particularly as worldwide and local commitments to carbon neutrality increase in importance. The Indian government's efforts, like the introduction of the Carbon Credit Trading Scheme in December 2023, are intended to create a strong carbon trading market, offering chances for companies to engage and put money in.
Corporate Social Responsibility (CSR)- Investing in carbon credits from agriculture allows companies to balance out their carbon emissions while achieving sustainability objectives, thereby improving their corporate social responsibility standings. This supports both environmental conservation and rural livelihoods, in line with larger social responsibility goals.
Technological Innovation-Creating technologies to precisely measure and confirm carbon sequestration, like satellite tracking and AI analysis, provides companies with opportunities for advancement and dominance in the industry. Boomitra and similar companies have used satellite and artificial intelligence (AI) technology for tracking carbon levels and validating carbon credits, making the process more efficient and cost-effective.
Government Incentives-The focus of the Indian government on sustainable agriculture and carbon credit trading creates a conducive setting for companies to engage and invest in this field. The Green Credit Programme, introduced in October 2023, seeks to encourage environmentally-friendly practices in different industries, such as agriculture, providing companies with chances to participate in sustainable projects.
Conclusion-This is one area where farmers can be supported with contribution to nature by reducing the emission of greenhouse gases.There a number of agricultural colleges in India which can help this sector by proving technical knowledge to local farmers for upgradation in rice production act as facilitator for carbon credit earning for farmers.Government should also provide grant to such universities.Apart from this Public Sector undertaking should also be asked to collaborate with universities for such acvivities under their Corporate Social Resposibility.Government should also encourage start up in this sector by providing tax exemption.

Case Study

Case Study 1: Indian Farmers Rack Up Carbon Credits with Climate-Conscious Practices
Overview
In addition to improving their agricultural output, Indian farmers are increasingly implementing climate-conscious farming practices, which also make a substantial contribution to the worldwide effort to combat climate change. Farmers are benefiting from this change in farming practices by obtaining carbon credits, a new market mechanism that incentivizes sustainable activities. One prominent illustration of this change is the adoption of Direct Seeded Rice (DSR) planting by Haryana farmer Jitendra Singh. This case study investigates how Indian farmers are producing carbon credits and reaping financial and environmental rewards through their creative methods.
Statement of the Problem

Rice paddies account for about 12% of worldwide methane emissions, making agriculture and rice farming in

particular a major contributor to greenhouse gas emissions. Rice growing has historically required a lot of water as well as chemical fertilizers and herbicides. These methods cause soil erosion and water resource depletion in addition to raising farming's carbon footprint. Indian farmers must balance preserving their output with reducing their negative effects on the environment. Farmers must immediately use more sustainable farming methods as climate change continues to worsen.

Examination

The use of Direct Seeded Rice (DSR) cultivation is one of the main alternatives that have surfaced in India. Farmers like Jitendra Singh employ this technique, which reduces the requirement for irrigation water by 12–35% by planting rice seeds straight into the ground without flooding the fields. DSR is a more sustainable alternative to conventional rice farming techniques since it also cuts labor expenses and lessens the need for chemical inputs like fertilizers and pesticides.

Indian farmers are now able to receive carbon credits for implementing climate-conscious agricultural methods, such as DSR. In the global carbon market, carbon credits are given to people or organizations that lower their carbon footprint. In order to help farmers in India make money off of their sustainable agricultural methods, private companies have teamed up with them to create these carbon credits. Farmers like Singh who participate in such programs not only help to lower greenhouse gas emissions worldwide, but they also make extra money by selling carbon credits.

The efficacy and transparency of the voluntary carbon market, which makes it easier to purchase and sell carbon credits, have come under fire. Nonetheless, the model's success in India shows that, with the right implementation, it may provide farmers with a strong financial incentive to switch to environmentally friendly techniques. Additionally, farmers are restoring soil fertility and lessening the wider effects of climate change by lowering their carbon footprint.

Suggestions

The following suggestions can be made in order to expand the use of sustainable farming methods and boost involvement in the carbon credit market:

1. Greater Awareness and Training: Farmers will be better able to comprehend the economic and environmental advantages of using sustainable agricultural practices if they receive instruction on these methods and the carbon credit market.
2. Government Support: To encourage the adoption of low-carbon agricultural practices, such as DSR, and other climate-friendly farming approaches, the government should establish regulations and provide subsidies.
3. Growth of Carbon Credit Markets: Farmers can benefit from more revenue and wider recognition for their environmental initiatives by having more access to carbon credit markets.
4. Partnerships with Private Companies: To boost the market's size and influence, additional partnerships between farmers and private businesses that enable the creation of carbon credits should be promoted.

In conclusion

Indian farmers' adoption of climate-conscious farming techniques, such Direct Seeded Rice cultivation, presents a viable way to address the problems of environmental degradation and global warming. Farmers like Jitendra Singh are not only helping to lower greenhouse gas emissions but also reaping financial rewards by obtaining carbon credits through sustainable methods. This model's success shows how sustainability can be incorporated into farming methods, and with sustained government and private sector assistance, it can be expanded to have a big influence on the environment and farmers' lives.

References

Economic Times. (2023, Nov.21). *Indian farmers rack up carbon credits with climate-conscious ways*. The Economic Times. https://economictimes.indiatimes.com/news/economy/agriculture/indian-farmers-rack-up-carbon-credits-with-climate-conscious-ways/articleshow/105380884.Cms ?from = mdr

Case Study 2: Carbon Farming Projects in Maharashtra and Telangana

Introduction

Two ongoing carbon farming initiatives in the Indian states of Telangana and Maharashtra are examined in this case study. The initiatives seek to produce carbon credits, boost agricultural output, and lower greenhouse gas emissions. These initiatives encourage farmers to use sustainable farming methods like vermicomposting, composting, and the Alternate Wetting and Drying (AWD) method for paddy production. However, issues like low financial returns, ignorance, and the lack of a controlled carbon market have made these programs less financially viable.

State ment of problem

Rice cultivation, which releases methane emissions into the atmosphere, is one of the main ways that Indian

agriculture contributes to climate change. Farmers have the chance to reduce these emissions through carbon farming and possibly make money from carbon credits. However, the viability of carbon farming initiatives in Telangana and Maharashtra has been severely hampered by issues with financial sustainability, lack of awareness, and the complexity of revenue-sharing schemes. Furthermore, farmers' lack of understanding about carbon credits and climate-resilient agriculture has prevented these techniques from being widely adopted.
Important Results:
1. Limited Knowledge and Financial Incentives:
According to both studies, farmers know very little about carbon credits and climate-resilient agriculture. Even if there are environmental advantages, the absence of clear financial rewards has made people less inclined to participate consistently.
2. Revenue Sharing Models: Since the Maharashtra project is based on an already-existing watershed program, it does not provide revenue sharing with farmers. The Telangana initiative, on the other hand, gives participating farmers a percentage of the profits, which encourages their participation but also presents issues with the sustainability of carbon credits.
3. Social and Environmental Benefits: Both initiatives have boosted biodiversity, soil fertility, and water availability. In addition, there has been more cultivation during the Rabi season and an increase in the involvement of women in agriculture.

4. Financial Sustainability Challenges: The projects' low carbon credit prices, high operating expenses, and absence of a regulated carbon market pose financial sustainability challenges. Due to these obstacles, the initiatives find it challenging to sustain their momentum and offer farmers long-term financial rewards.
Suggestions

Boost Knowledge and Instruction:
It is imperative that farmers receive more training on climate-resilient farming methods and the carbon credit market. Programs to raise awareness can boost involvement and increase the projects' impact.

Incentivize Financial Benefits:
Projects should offer more observable financial benefits, either in the form of direct payments or stronger revenue-sharing arrangements.

Regulation of Carbon Markets:
The long-term sustainability of these initiatives would be supported by a stable and regulated carbon market, which would also increase the legitimacy of carbon credits and yield more reliable financial returns.
Government Support:
The success of carbon farming initiatives depends on the government's participation, particularly in creating a domestic carbon market and guaranteeing the legitimacy of carbon credits.
In conclusion

The case study demonstrates how carbon farming initiatives in India have the ability to both mitigate the effects of climate change and enhance farmers' standard of living. Even while the projects in Telangana and Maharashtra have demonstrated positive social and environmental effects, their financial viability is still a problem. Raising awareness, encouraging involvement, and developing a regulated carbon credit market are essential for success. For these programs to continue to be adopted and effective in the future, government support and open communication will be crucial.

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Financing Carbon Credit Projects for Emission Reduction through Direct Seeded Rice (DSR)
Introduction
Carbon finance, often referred to as carbon money, plays a crucial role in supporting the financial sustainability of emission reduction projects. By offering a financial incentive for the reduction of greenhouse gas emissions, carbon finance can provide a stable revenue stream for projects that contribute to environmental sustainability. This is especially pertinent in the context of agricultural projects like Direct Seeded Rice (DSR) farming in India, where the adoption of sustainable techniques can generate carbon credits. These carbon credits can then be sold to businesses or organizations seeking to offset their own carbon emissions.

Carbon Finance and Carbon Credits

Carbon finance is a mechanism that enables businesses to purchase carbon credits to offset their emissions. These credits are generated through projects that reduce or avoid emissions, and payment is made annually to the project partners in exchange for the emissions reductions achieved. By participating in such projects, businesses can meet emission allowances and comply with environmental regulations. Carbon finance enhances the financial feasibility of such projects by offering an additional income source and facilitating the transfer of technologies and expertise.

Financing for DSR Adoption

Farmers adopting Direct Seeded Rice (DSR) methods can benefit from carbon credits generated by reducing greenhouse gas emissions. However, the adoption of this technique requires substantial financial investment. To facilitate the adoption of DSR farming and support the financial sustainability of these projects, several stakeholders—banks, non-banking financial companies (NBFCs), the government, and private entities—can provide financing options.

1. Banks, NBFCs, and Financial Institutions

Financial institutions, including banks and NBFCs, can play a pivotal role in financing DSR adoption by providing loans to farmers for equipment, seeds, and working capital. Specific financing avenues include:

Equipment for Direct Seeding: Farmers require specialized equipment for DSR, which can be financed by banks just like any other asset, such as cars or machinery. Banks can provide up to 85% to 90% of the cost of equipment through loans with the equipment hypothecated as collateral.

- **Seeds for DSR:** The purchase of suitable seeds for the DSR method can be financed through Kisan Credit Cards, which may include specific provisions for DSR seeds.
- **Working Capital:** As carbon credits are generated only after the adoption of emission-reducing techniques and may take time to materialize, farmers may need working capital to bridge the gap between the upfront investment and the delayed income from carbon credits. Banks can offer loans for working capital, using verified carbon credits as collateral. To mitigate risk, banks could collaborate with government-funded verifiers, like NABARD, to assess the quantity of carbon credits generated before providing loans based on the assessment report.

2. Government Support

Both central and state governments are responsible for ensuring environmental sustainability and increasing food grain production. The government can support DSR financing through various channels:

- **NABARD Financing:** The National Bank for Agriculture and Rural Development (NABARD) has expertise in Indian agriculture and can contribute to financing DSR adoption. Through NABARD, the government can extend financial support to farmers adopting sustainable practices like DSR.
- **Issuance of Bonds:** The government can issue bonds, such as green bonds or DSR-specific bonds, to raise long-term funds for carbon credit projects. These funds can be allocated to support the financing of DSR adoption. The interest paid on such bonds could be used as margin money to mitigate risk.
- **World Bank Support:** The central government can approach the World Bank for funding dedicated to environmental clean-up activities and sustainable agriculture projects like DSR.

3. Private Sector Involvement

Private companies, particularly those with net-zero policies, can play a significant role in financing DSR projects. These companies may be interested in funding projects that contribute to emission reductions to meet their sustainability goals. The private sector can contribute through:

- **Corporate Social Responsibility (CSR):** Many companies are required to invest in social and environmental initiatives as part of their CSR obligations. Government regulations could include DSR project funding as a permissible CSR activity, providing tax exemptions to encourage private sector investment in such projects.
- **Tax Exemptions for Private Companies:** Companies involved in financing DSR projects could be granted tax exemptions, creating an incentive for them to invest in environmental initiatives.

4. NGO Involvement

Non-governmental organizations (NGOs) can also play a role in financing carbon credit projects. NGOs, especially those focused on environmental sustainability, may have the capacity to fund DSR projects as part of their broader mission. These NGOs can collaborate with farmers and other stakeholders to facilitate the adoption of sustainable agricultural practices.

Potential Mechanisms for Fund Generation

To finance carbon credit projects like DSR, several innovative funding mechanisms can be explored:

1. **Issuance of Bonds:**
   - **Green Bonds/DSR Bonds:** These bonds are issued to raise funds from the public and can be used specifically for financing carbon credit projects. The interest paid on these bonds can be structured to reflect the margin money required for risk-taking.
2. **Issuance of Shares:**
   - Banks and financial institutions may issue special-purpose equity shares to fund carbon credit projects, providing a direct investment opportunity for stakeholders.
3. **Loan by Mortgage:**
   - Farmers can mortgage their assets, such as land or equipment, to obtain loans for DSR adoption. This can help generate the required capital for implementing the project.
4. **World Bank Loans:**
   - The government can seek loans from international institutions like the World Bank to fund carbon credit and sustainable agriculture projects.
5. **Private Sector Financing:**
   - Private companies, particularly those seeking to offset their emissions, can contribute funding to DSR projects. These companies can benefit from tax exemptions provided by the government.
6. **NGO Contributions:**
   - NGOs can provide financial support for DSR projects through grants and donations, focusing on the environmental and social benefits of the projects.

Conclusion

The financing of Direct Seeded Rice (DSR) adoption through carbon credits is essential for the long-term sustainability of the project. By leveraging multiple sources of funding, such as banks, government agencies, private companies, and NGOs, carbon credit projects can be financially viable and contribute to reducing emissions in India's agriculture sector. Collaboration between stakeholders, combined with innovative financing mechanisms like bonds, share issuance, and loans, will ensure the widespread adoption of DSR and other sustainable farming practices, ultimately contributing to both environmental and economic sustainability.

An opportunity to save the envoinment through agriculture is a "Achieve two goals with one effort" movement.By adopting envoirnment based method of agriculture will clean our climate and also can remove the poverty from the farmers of India.By adoption of new technology in agriculture will also increase the food grain production.Again India has to look into the agriculture for the betterment of the country.This will sure, create a win win situation for Indian envornment and agricultural sector.

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