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SUSTAINABLE AGRICULTURE FOR CLIMATE ACTION

Unveiling the Role of Carbon Markets



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AUTHORS	**YES BANK** Food and Agribusiness Strategic Advisory & Research Team (FASAR), YES BANK	**FICCI** Ms. Jyoti Vij, FICCI Mr. Pravesh Sharma, FICCI Dr. S Baskar Reddy, FICCI Ms. Sarita Koli, FICCI Ms. Divya Chhabra, FICCI
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CONTACTS	**YES BANK Ltd.** Registered and Head Office YES BANK House, Off Western Express Highway, Santacruz (East), Mumbai–400055 Email : fasar@yesbank.in Website : www.yesbank.in	**FICCI** Agriculture Division Federation House, Tansen Marg New Delhi-110001, India Tel : +91-11-23487415 Email : agriculture@ficci.com Fax : +91 11 2376 5333, 23721504

MESSAGE



Agriculture and allied sectors form the fundamental strength of India's economy, enhancing rural income and sustaining food and nutritional security. Indian agriculture has witnessed a remarkable transformation over the years, from being a net importer of food grains at the time of independence, to becoming one of the global leaders in production of a number of agricultural products. While this growth appropriately addressed the food security of the nation, the agriculture sector faces new challenges of sustainable and climate resilient production. Sustainability is becoming imperative for agriculture's growth strategy and it is important to make sure that we use the available natural resources judiciously to protect human health and our environment.

The need to scale up agriculture is getting more critical with rising population and decreasing arable land. The growing global population has increased food demand resulting in carbon footprint from agricultural activities that continue to impact the environment. Agriculture is the 2nd largest contributor to GHG emissions globally. The agriculture sector contributed 14% of the total GHG emissions in the country with largest contribution from the livestock sector.

Agriculture has the potential to play a significant role in climate action, both through emission mitigation as well as carbon sequestration. Carbon markets present a promising pathway for incentivizing farmers towards climate action. They could be utilized to offer economic incentives to farmers to adopt sustainable practices. Initiatives adopted towards carbon credit generation directly contribute to the SDGs, particularly SDG 2 (Zero Hunger) and SDG 13 (Climate Action). The idea of carbon credits from agriculture presents an ideal solution to combat climate change while enhancing farmers' income.

FICCI's 3rd edition of Sustainable Agriculture Summit 2023 would help in understanding the agricultural innovations to accelerate agricultural sustainability and impact of carbon credits in agriculture. FICCI along with YES BANK is pleased to release this knowledge report on occasion of 3rd edition of Sustainability Agriculture Summit 2023.

Mr. TR Kesavan
Chairman, FICCI National Agriculture Committee &
Group President, TAFE Ltd.



FOREWORD

Driven by increased greenhouse gas emissions, climate change has become one of the most urgent global concerns. The Intergovernmental Panel on Climate Change (IPCC) has presented compelling evidence linking climate change to human activities, such as burning of fossil fuels, industrial processes, and deforestation, resulting in a 50% increase in atmospheric carbon dioxide since the pre-industrial era. The impact of these increased emissions is seen in terms of higher temperature, erratic rainfall patterns and increased incidence of extreme weather events.

Agriculture has the potential to play a significant role in climate action, both through emission mitigation as well as carbon sequestration. Sustainable farming practices and climate smart agricultural techniques can help in reducing emissions as well as increasing absorption of carbon dioxide from the atmosphere. However, such sustainable farm practices are associated with issues such as low yields, substantial increase in workload and absence of definitive economic rewards for farmers who adopt these practices, hence deterring farmers from adopting them. Carbon markets present a promising pathway for incentivising farmers towards climate action. They could be utilised to offer economic incentives for farmers to adopt sustainable farming practices. Moreover, carbon credits generated from agriculture-based projects have multidimensional socio-economic and environmental benefits, as they would also facilitate in improving crop quality, enhancing biodiversity, preventing soil erosion, increasing water use efficiency, and aiding in farmer income enhancement.

A nation-wide study carried out jointly by CIMMYT and University of Aberdeen suggests that Indian agriculture has the technical potential to mitigate GHG emissions of 85.5 megatonnes of carbon dioxide equivalent per year through adoption of various farm level mitigation practices. Harnessing such mitigation practices to generate carbon credits for farmers could become a pivotal step in combating climate change. While the Indian Government is championing the cause of climate action as well as sustainable agriculture development, there is a need for significant efforts from multiple stakeholders, including agribusinesses, verification bodies, financial institutions, and policymakers to create and promote a robust carbon market ecosystem catering to Indian agriculture.

YES BANK is sincerely committed to playing a catalytic role in the holistic development of the Indian agriculture sector and believes that the banking sector will have a critical role to play in building a low-carbon economy. YES BANK endeavours to work with various stakeholders to build knowledge frameworks and methodologies required to integrate sustainable agriculture with climate action, as well as to collaboratively implement climate positive interventions on ground. Towards this endeavour, YES BANK is pleased to collaborate with FICCI as a knowledge partner for the third edition of 'Sustainable Agriculture Summit & Awards 2023'; and for the report titled, 'Sustainable Agriculture for Climate Action: Unveiling the Role of Carbon Markets'. This report explores the intricate relationship between agriculture, climate change, and the potential role that carbon markets could play in promoting sustainable practices in Indian agriculture. Furthermore, it assesses the promising potential of Indian agriculture in engaging with carbon markets and discusses select areas of action that could facilitate the process of linking Indian farmers to carbon markets.

I sincerely hope that this Report will further contribute to the commendable efforts being taken by various stakeholders in shaping interventions that are instrumental in driving climate action through the agricultural ecosystem of India.

Sincerely,

Prashant Kumar
Managing Director & CEO
YES BANK Ltd.



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1 Executive Summary



The negative impact of climate change is being felt across the global agro-ecosystems, in the form of vagaries of monsoon, reducing soil carbon, soil erosion, invasive pests, and reduced crop yield. The Food and Agriculture Organization (FAO) estimates that climate change could push an additional 122 million people into extreme poverty by 2030, largely due to its impact on agriculture and food security[1]. In India, it is estimated that, between 2016-2021, extreme events such as cyclones, flash floods, floods, and landslides caused damage to crops over 36 million hectares and farmers lost about USD 3.75 billion during this period[2]. Smallholder farmers are on the forefront of facing this climate crisis. While on the one hand agriculture is adversely affected by climate change, on the other it is also a major contributor to the phenomenon. Various agricultural activities such as land clearing, cultivation of crops, irrigation, animal husbandry, fisheries and aquaculture have a significant impact on the emission of GHGs and the consequent climate change (IPCC, 2007). Consequently, agriculture is the 2nd largest contributor to GHG emissions globally[3]. In 2020, the global emissions released from agricultural land (including farm gate emissions, net forest conversion, fires in humid tropical forests and organic soils) were pegged at 10.5 Gt CO_2 eq of GHG. As per the Third Biennial Update Report submitted by the Government of India in 2021 to the United Nations Framework Convention on Climate Change (UNFCCC), the agriculture sector contributed 14% of the total GHG emissions in the country amounting to 2.53 Gt CO_2 eq (2016). Within the sector, over half (54.6%) of the emissions was attributed to enteric fermentation. The second largest category was fertilizer application contributing about 19.1%, followed by rice cultivation (17.5%). Other activities such as poor manure management and crop residue burning contributed 6.7% and 2.2%[4] respectively. Chapter one of this report touches upon the impact of climate change on agriculture, reflects on the contribution of agriculture to GHG emissions and ideates on the role that agriculture could play in mitigating climate change and delves on the idea of carbon markets being utilized as a lever to spur farmers' climate action.

Agriculture has the potential to play a significant role in climate action, both through emission mitigation as well as carbon sequestration. Sustainable farming practices (such as agroforestry, conservation tillage and cover cropping) can sequester carbon. Further, the adoption of climate smart agricultural techniques, improved livestock management and increased resource use efficiency can help in reducing emissions. Multiple practices when coupled together have the potential to aid in significant reduction of GHGs from the atmosphere while providing a source of additional income to the farmers. However, these practices are associated with issues such as low yields in the initial years, substantial increase in the workload and

[1] *https://www.fao.org/3/i6030e/i6030e.pdff*

[2] *Climate Transparency Report 2022*

[3] *www.climatewatchdata.org*

[4] *India Third Biennial Update Report to the United Nations Framework Convention on Climate Change (UNFCCC), Ministry of Environment, Forest and Climate Change, 2021*

unavailability of necessary guidance and materials for successful implementation. More importantly, the fundamental reason for the low adoption of sustainable farming practices is the absence of definitive economic rewards for farmers who adopt these practices. Farmers prioritize their immediate income and livelihood requirements over the need to adopt sustainable practices that could lead to yield drop. Providing required financial, technological, and infrastructural support to bridge the gap between farmers' income expectations and climate action requirements, could direct farmers on the path to sustainable farming. Carbon markets offer a promising avenue to provide economic incentives for farmers to adopt sustainable farming practices, encouraging climate action. Chapter two provides an in-depth examination of carbon markets, starting with their evolution and historical context. It categorizes these markets and delves into the role of third-party entities in certifying carbon credits. Furthermore, it elucidates the diverse factors that influence carbon prices and offers insights into the intricacies of this unique market. The chapter also provides an overview of trends in the global carbon markets and places particular emphasis on the state of carbon markets in India.

The potential for generating carbon credits in the Indian agriculture sector rests on two key pillars: reducing total emissions through optimized agriculture management activities and increasing carbon sinks through sustainable agricultural practices. Targeting activities such as optimizing fertilizer use, improving water management in rice cultivation, and adopting zero tillage methods can help reduce emissions. Practices like agroforestry, conservation agriculture, and crop diversification contribute to carbon sequestration. Findings of a nation-wide detailed study carried out jointly by the International Maize and Wheat Research Institute (CIMMYT) and University of Abardeen suggests that crop-based and livestock-based mitigation measures cumulatively offer a technical GHG emission mitigation potential of about 78.67 Megatonnes of carbon dioxide equivalent (Mt CO_2e) per year. If mitigation potential from restoring degraded land is added, technical GHG emission mitigation potential of Indian agriculture sector is estimated to be about 85.5 Mt CO_2e per year. Assuming that one megatonne of CO_2e mitigated would approximately yield one million carbon credits, it may be inferred that Indian agriculture has the technical potential to generate 85.5 million carbon credits by implementing select, cost-effective, emission mitigating agricultural practices alone[5]. This estimated carbon credit generation potential is over and above the established carbon credit generation through carbon sequestration activities such as agroforestry and other carbon sequestering agricultural practices. The third chapter establishes the crucial link between Indian agriculture and carbon markets. It explores the potential for carbon generation from various agricultural practices, highlighting how farmers can contribute to carbon projects. A detailed examination of the key stakeholders engaged and the process flow for carbon projects in agriculture is provided. In addition, a snapshot of India's policy measures focusing on reduction of carbon footprint and their impact on carbon credit generation from the agriculture sector is captured in detailed.

The benefits that carbon markets can offer to Indian farmers, challenges faced by farmers in accessing the carbon credit ecosystem and proposed pathways for farmers to overcome these obstacles and engage effectively in carbon markets is also captured in chapter three. While carbon credit markets have the potential to offer valuable supplementary income and also enabling sustainable agriculture; challenges such as high upfront adoption costs, lengthy time periods for carbon credit eligibility, limited knowledge, complex monitoring and verification processes, and inconsistent benefit-sharing approaches pose hurdles for farmers seeking access to the carbon credit ecosystem. In spite of these challenges, multiple projects are being registered under the voluntary carbon markets from India as evidenced by the status of applications across CDM, GS and Verra Standards. Empirical evidence suggest that the potential of this market could be leveraged by collective participation of farmers including 1) by utilizing the FPO pathway, 2) by associating with project partners and 3) by onboarding with NGOs or Corporates.

[5] *The number of carbon credits generated per megatonne of CO_2e mitigated can vary widely based on several factors, including the methodology applied, standards used for certification, type of carbon offset project etc.*

The concluding chapter offers a select set of recommendations aimed at creating an enabling ecosystem for linking farmers to carbon markets. They encompass a wide range of suggestions addressing four pivotal stakeholder levels namely: farmers, project developers, certification and verification agencies, and cross-cutting policy initiatives. A snapshot of recommendations across these levels is captured herewith:

Farmer Level

- Include and integrate diverse emission mitigating and carbon sequestering farm practices as eligible for carbon credit generation.
- Invest in creating farmer level awareness about carbon farming. Establish carbon market information hubs that serve as centres where farmers can access information, resources, and guidance on participating in carbon markets.
- Enable farmers access to carbon markets. Create accessible and user-friendly platforms or marketplaces in partnership with existing carbon trading platforms where farmers can register, certify, and trade carbon credits.
- Incentivizing FPOs or cooperatives to create carbon credit farming cohorts.

Project Developer Level

- Create awareness across society about broader benefits of carbon farming.
- Invest in farmer education, outreach programs and support the formation of farmers' cooperatives that collectively engage in carbon farming.
- Develop risk mitigation strategies for farmers participating in the carbon credit market.
- Encourage long-term contracts between farmers and carbon credit buyers to provide stability and predictability in income from carbon credits.
- Develop eco-labeling and certification programs that allow consumers to identify and support products derived from carbon-neutral farming practices.
- Develop robust and user friendly carbon accounting tools and apps for agriculture projects that allow farmers to measure and track their carbon emissions and sequestration.
- Institutionalizing access to carbon credits program by fostering partnerships.

Certification and Verification Agencies Level

- Develop Carbon Credit Standards for diverse agricultural crops and farming practices.
- Encourage the adoption of technology such as remote sensing, IoT devices, and blockchain for transparent and efficient tracking and verification of carbon credits.
- Facilitate collaborations with international organizations and other countries to harmonize standards and regulations, thus enabling trading of agricultural carbon credits across borders.

Other policy initiatives

- Establish clear and consistent regulations governing the creation, sale, and trading of agricultural carbon credits.
- Introduce intermediary organizations or aggregators that work with small-scale farmers to bundle carbon credits and simplify the process of selling them on the market.
- Recognise and promote initiatives of agribusiness companies that are focused on sustainable agriculture practices at farm level.
- Integrate specific courses on carbon credits as a part of undergraduate and graduate programmes in agriculture-based studies.
- Provide innovation grants for advancing science-based MRV technologies to improve the quality of carbon credits from agriculture in India.



1 Introduction



1.1 The phenomenon of climate change

Global warming and the resultant climate change is amongst the most pressing concerns of our times. Increased atmospheric concentration of carbon dioxide, the primary greenhouse gas in the atmosphere, warms the planet, causing significant vagaries in climate. Through extensive research, Intergovernmental Panel on Climate Change (IPCC) has provided compelling evidence that the warming of our planet is unequivocally linked to human activities that emit greenhouse gases (GHGs). Burning of fossil fuels for energy generation, industrial activities, deforestation, and changes in land use have been identified as primary contributors to GHG emissions. Human activities have resulted in rise of atmosphere's carbon dioxide by 50% since the pre-industrial era[6]. The concentration of CO_2, CH_4 and N_2O in the atmosphere has increased by about 1.5x, 2.5x and 1.2x respectively when compared to preindustrial levels[7]. The measurable impact of these changes is seen in terms of higher temperature, erratic rainfall patterns and increased incidence of extreme weather events. According to the UN, to keep global warming from increasing to not more than 1.5 °C (as called by the Paris Agreement to avert the worst impact of climate change), we need to decrease emissions by 45% by 2030 (from 2005 baseline) and reach net zero emissions by 2050.[8]

India is amongst the most affected countries due to climate change. As per various forecasts, the average temperature across India is projected to rise in the range of 2.4°C to 4.4°C by 2100. Increased incidence of localized extreme precipitation events has increased flood risks. Projections show increase in flood intensity in the Indus, Ganges, and Brahmaputra River basins. Estimates indicate that in 2021, the country suffered a loss of nearly 5.4 % of GDP on account of heatwaves[9] and 0.5 % of GDP on account of floods[10]. Another study indicates that air pollution alone resulted in a loss of 1.36% of GDP in the year 2019[11]. Climate change related events are estimated to cost India about USD 35 trillion over the next 50 years[12].

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[6] *climate.nasa.gov*

[7] *US EPA*

[8] *www.ipcc.ch*

[9] *https://thewire.in/environment/duration-of-heatwaves-in-india-has-increased-over-last-30-years-set-to-rise-further-imd*

[10] *https://www.lse.ac.uk/granthaminstitute/explainers/how-is-india-tackling-climate-change/*

[11] *https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(20)30298-9/fulltext*

[12] *https://www.lse.ac.uk/granthaminstitute/explainers/how-is-india-tackling-climate-change/*



1.1.1 Impact on agriculture

As climate change continues to accelerate, its impact on the agricultural sector has become a matter of grave concern. Climate change is projected to result in greater variability in temperature and precipitation, leading to less predictable seasonal weather patterns. Its negative impacts are already being felt across the globe, in the form of vagaries of monsoon, shifting agroecosystem boundaries, reducing soil carbon, soil erosion, invasive pests, and reduced crop yield. During 1961 to 2014, the combined effects of heat and drought decreased global average yields of maize, soybeans, and wheat by 11.6%, 12.4% and 9.2%, respectively[13]. Studies indicate that human-induced global warming has slowed down the growth of agricultural total factor productivity by 21% since 1961[14]. These changes that directly impact agricultural production, are bound to have a ripple effect on economies and societies, ultimately increasing the risk of food insecurity. The Food and Agriculture Organization (FAO) estimates that climate change could push an additional 122 million people into extreme poverty by 2030, largely due to its impact on agriculture and food security[15].

Indian agriculture is particularly vulnerable to climate change. On the demand side, while the sector contributes about 18.3% to the national GDP[16], nearly 11.8% to the national exports[17] and provides food security to more than 1.3 billion people[18], on the supply side, the sector is dominated by small and marginal farmers. 86% of total landholdings in India are held by small and marginal farmers typically owning less than 2 hectares of farmland individually. These farmers contribute to 74 million hectares of cultivated crop area (about 47% of total crop area[19]). Moreover, Indian agriculture is predominantly rain-fed.

According to an IPCC report, the predicted temperature rise for India is in the range of 0.88–3.16°C by 2050 and 1.56–5.44°C by the year 2080. Studies showed significant negative impacts of climate change, predicting yield reduction by 4.5% to 9.0%, depending on the magnitude and distribution of warming.[20] Overall, climate change adversely impacts both kharif and rabi crop yields across agro climatic zones in the country.

[13] *https://www.mdpi.com/2073-4441/11/10/2108#B25-water-11-02108*
[14] *Ortiz-Bobea, A., et al., 2021: Anthropogenic climate change has slowed global agricultural productivity growth. Nat. Clim. Change, 11 (4), 306–312, doi:10.1038/s41558-021-01000-1.*
[15] *https://www.fao.org/3/i6030e/i6030e.pdff*
[16] *Contribution of Agricultural Sector in GDP, 21 MAR 2023, PIB Delhi*
[17] *Provisional data, MoA&FW, GoI*
[18] *https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1831364*
[19] *https://www.livemint.com/Politics/k90ox8AsPMdyPDuykv1eWL/Small-and-marginal-farmers-own-just-473-of-crop-area-show.html*
[20] *Intergovernmental Panel on Climate Change Report (IPCC), 4th Assessment report*

Kharif crops are likely to be most affected by rainfall variance, while winter planted rabi crops face challenges with rise of minimum temperatures. Rice and wheat are expected to be the most impacted crops, therefore jeopardizing the country's food security. An IARI study suggests that for every one-degree change in temperature, wheat production loss will average at 4-5 Mn MT. Depending on the modeling technique, it has been estimated that the rice yields can be impacted by up to 40% while for wheat it can decrease by 52%[21]. An overview of the impact of climate change on Indian agriculture is provided in exhibit 1[22].

Exhibit 1: Impact of climate change on Indian agriculture

Crops

- Increased frequency and intensity of extreme weather events such as heat waves, droughts, floods and cyclones affecting production levels and threatening agricultural biodiversity.
- Reduction in yield in the rainfed areas due to increased crop water demand and changes in rainfall pattern.
- Heat stress due to higher temperature at critical stage of the crop growth impacting yields.

Pests

- Emergence of new pest problems and increased risk of invasion by migrant diseases and pests. Changes in population growth rates of pathogens and insect-pests.
- Reduced efficacy of different components of disease and insect-pest management.
- Changes in pathogen/insect-pest × host × environment interactions, and loss of resistance in cultivars containing temperature-sensitive genes.

Soil and Water

- Reduced quantity and quality of organic matter content, which is already quite low in Indian soil.
- Under elevated CO_2 concentration, crop residues have higher C:N ratio, which may reduce their rate of decomposition and nutrient supply.
- Change in rainfall volume and wind intensity alter the severity, frequency and extent of soil erosion.
- Rise in sea level leading to salt-water ingression in the coastal lands turning them less suitable for conventional agriculture.
- Declining water availability as result of changing rainfall patterns, alteration in stream flow and increase in crop water demand.
- Deterioration of water quality due to sea water intrusion and transport of salts from the deeper soil layers as a result of over exploitation of aquifers and faulty irrigation practices.

Source: Climate Change and Agriculture in India, Gupta and Pathak, Department of Science & Technology, Ministry of Science & Technology, Government of India

[21] *Climate Change and Indian Agriculture: Impact, Adaptation and Vulnerability – Salient Achievements from ICAR Network Project, 2012, Eds. S. Naresh Kumar, Anil Kumar Singh, P.K. Aggarwal, V.U.M. Rao and B. Venkateswarlu. IARI Publication*

[22] *Climate Change and Agriculture in India, Gupta and Pathak. Department of Science & Technology, Ministry of Science & Technology Government of India*

Smallholder farmers are on the forefront of facing the climate crisis as most of them practice rain-fed agriculture. Limited access to advanced infrastructure and resources further enhances their vulnerability to climate change. The success of their harvest is dependent on suitable climatic conditions and any extreme weather events could lead to destruction of an entire harvest, leaving farmers without a reliable source of income. It is estimated that Indian farmers lost about USD 3.75 billion in the period between 2016 and 2021[23], due to climate related extreme events such as cyclones, flash floods, floods, and landslides. Exhibit 2 below highlights how climate change is impacting small holder farmers in India.

Exhibit 2: Impact of climate change on the Indian small holder farmers



- **Reduced crop yields:** Projections show yields of India's crops falling by 1.8- 6.6% by mid-century (2041–60) and by 7.2-23.6% by end-century (2061–80) under a middle of the road scenario for climate change.
- **Water scarcity & irrigation challenge:** Climate change induced water stress is pegged at 48% at national level by 2051. Out of all regions , North India is expected to be most affected at ~90% water stress.
- **Soil degradation:** In India, by 2050, soil erosion can reduce up to 10% of crop yields, equivalent to removing millions of hectares of land from crop production.
- **Pest & disease outbreak:** An increase in levels of CO_2, heat and humidity may provide more suitable environment to increased pest and disease incidence. Higher temperatures combined with worsening pests make it difficult to reduce their postharvest losses.
- **Stress on livestock:** A study finds that increasing temperatures could reduce milk production by 25% by 2085 in India's arid to semi-arid areas.
- **Decline in labour productivity:** Labour productivity is projected to decline by 5% (from 1986-2006 levels) if temperature increases by 1.5°C. Further decline of 2.1x & 2.7x are projected for 2.5°C and 3°C scenarios.

Source: Global Food Policy Report, 2022; NITI Aayog-TERI report on "Study of Assessment of Water Foot Prints of India's Long Term Energy Scenarios", 2017; Lancet Study: Impacts of heat stress on global cattle production during the 21st century: a modelling study, March 2022; Climate Transparency Report

1.1.2 Agriculture as a contributor to climate change

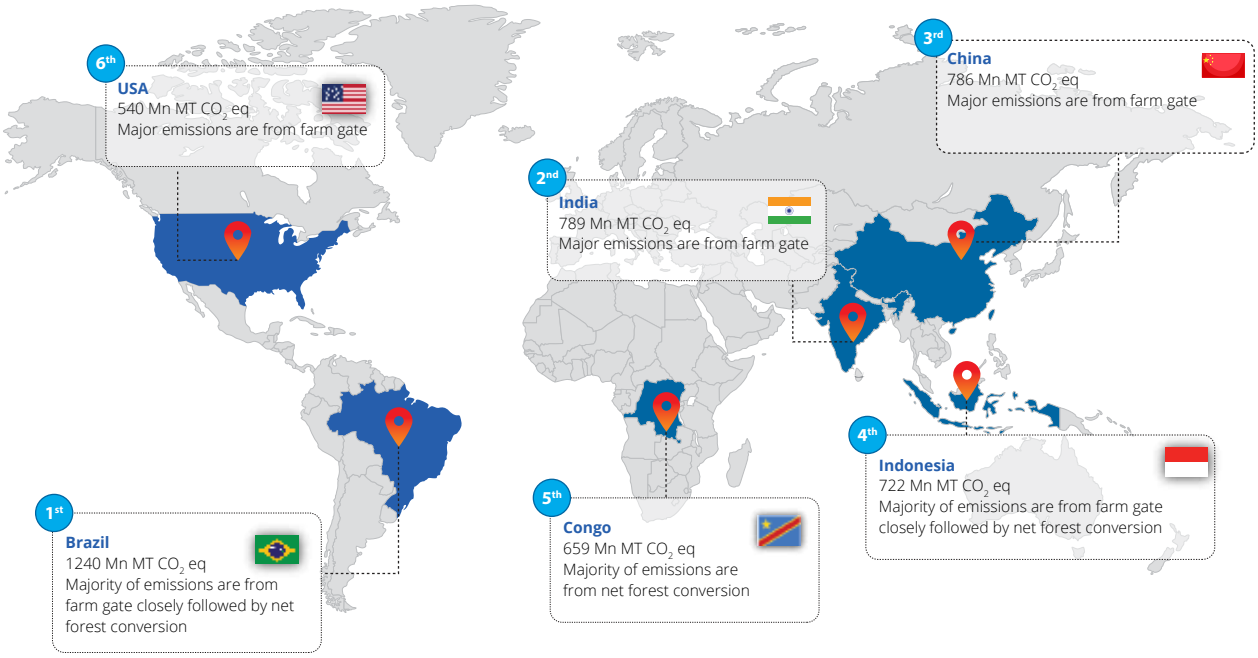
While on the one hand agriculture is adversely affected by climate change, on the other it is also a major contributor to the phenomenon. Global population growth and changes in per capita consumption of food, feed, fiber, timber, and energy have caused unprecedented rates of land and freshwater use and declining biodiversity. With large regional variations, these changes have contributed to increasing net GHG

[23] *Climate Transparency Report 2022*

emissions of natural ecosystems. Various agricultural activities such as land clearing, cultivation of crops, irrigation, animal husbandry, fisheries and aquaculture have a significant impact on the emission of GHGs and the consequent climate change (IPCC, 2007). Consequently, agriculture is the 2nd largest contributor to GHG emissions globally[24]. Emission is in the form of carbon dioxide, methane, and nitrous oxide emissions. Methane and nitrous oxide together contribute to 60%[25] of GHGs emitted by the agriculture sector. These two gases have up to 30 times and 273[26] times more global warming potential than carbon dioxide respectively.

In 2020, the global emissions released from agricultural land (including farm gate emissions, net forest conversion, fires in humid tropical forests and organic soils) were pegged at 10.5 Gt CO_2 eq of GHG. Brazil (12%) was the largest contributor followed by India (8%) (refer exhibit 3). At the global level, agriculture emissions within the farm gate (those related to the production of crops and livestock) grew by 13 percent between 2000 and 2020, to 7.4 Gt CO_2 eq.[27]

Exhibit 3: Country wise overview of GHG emissions from agricultural land



Source: FAO Statistical Year Book 2022, YES BANK analysis

As per the Third Biennial Update Report submitted by the Government of India in 2021 to the United Nations Framework Convention on Climate Change (UNFCCC), the agriculture sector contributed 14% of the total GHG emissions in the country amounting to 2.53 Gt CO_2 eq (2016). Within the sector, over half (54.6%) of the emissions was attributed to enteric fermentation. This is because India holds the largest global livestock population of 536.3 million[28] (comprising of cattle (192.49 million) and Buffaloes (109.85

[24] *www.climatewatchdata.org*

[25] *FAO, 2022, World food and agriculture – Statistical Year Book 2022, YES BANK Analysis*

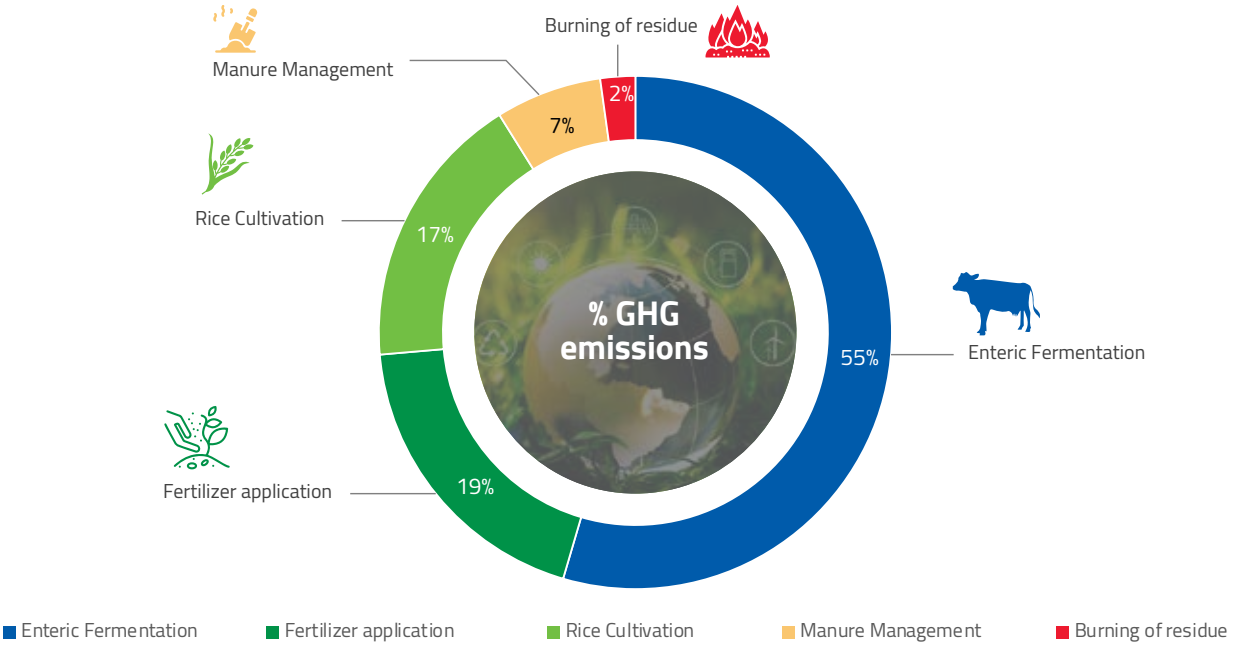
[26] *Calculated at Global Warming Potential for time period of 100 years, US EPA*

[27] *FAO, 2022, World Food and Agriculture – Statistical Yearbook 2022. Rome. https://doi.org/10.4060/cc2211en*

[28] *20th Livestock Census 2019, Ministry of Fisheries, Animal Husbandry and Dairying*

million)). The second largest category was fertilizer application contributing about 19.1%. The third largest contributing category was rice cultivation (17.5%). Paddy was cultivated in 46.3 million hectares in 2021-22. Other activities such as poor manure management and crop residue burning contributed 6.7% and 2.2%[29] respectively (Refer exhibit 4 below).

Exhibit 4: Indian agricultural GHG emissions through different activities



Source: India Third Biennial Update Report to the United Nations Framework Convention on Climate Change (UNFCCC), Ministry of Environment, Forest and Climate Change, 2021, YES BANK Analysis

1.1.3 Role of agriculture in climate action

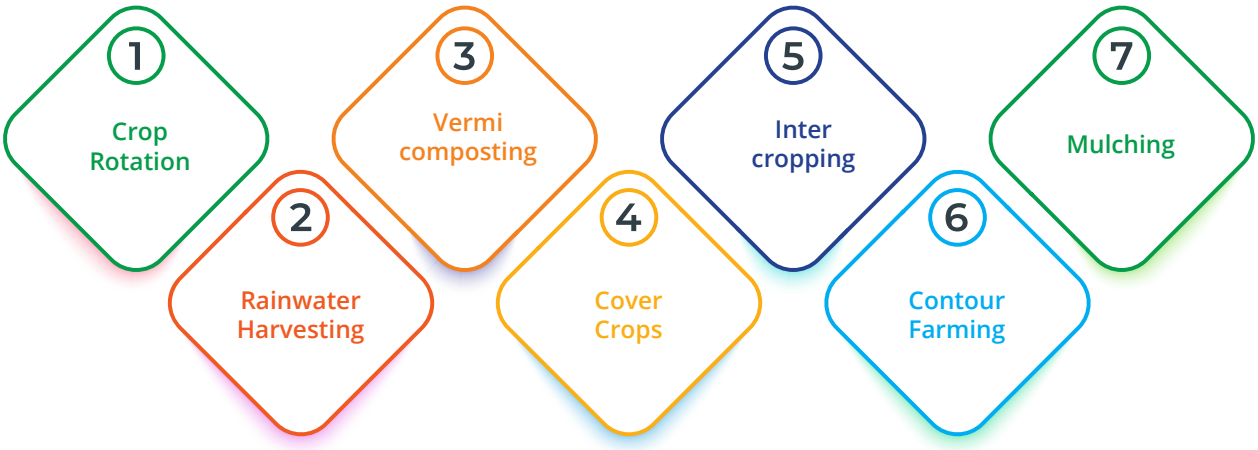
Agriculture has the potential to play a significant role in climate action, both through emission mitigation as well as carbon sequestration. Sustainable farming practices (such as agroforestry, conservation tillage and cover cropping) can sequester carbon. Further, the adoption of climate smart agricultural techniques, improved livestock management and increased resource use efficiency can help in reducing emissions. Multiple practices when coupled together have the potential to aid in significant reduction of GHGs from the atmosphere while providing a source of additional income to the farmers.

Sustainable farming practices focus on keeping soil protected, increasing water holding capacity and preventing pollution. These practices by working with nature, conserve environment, strengthen adaptability towards climate variability and increase availability of healthier produce. Although many practices are available, they are practiced by less than 4% of the total Indian farmers.[30] Some of the major practices followed currently are listed in exhibit 5.

[29] *India Third Biennial Update Report to the United Nations Framework Convention on Climate Change (UNFCCC), Ministry of Environment, Forest and Climate Change, 2021*

[30] *CEEW FOLU, Sustainable Agriculture in India: What we know and How to scale up, 2021*

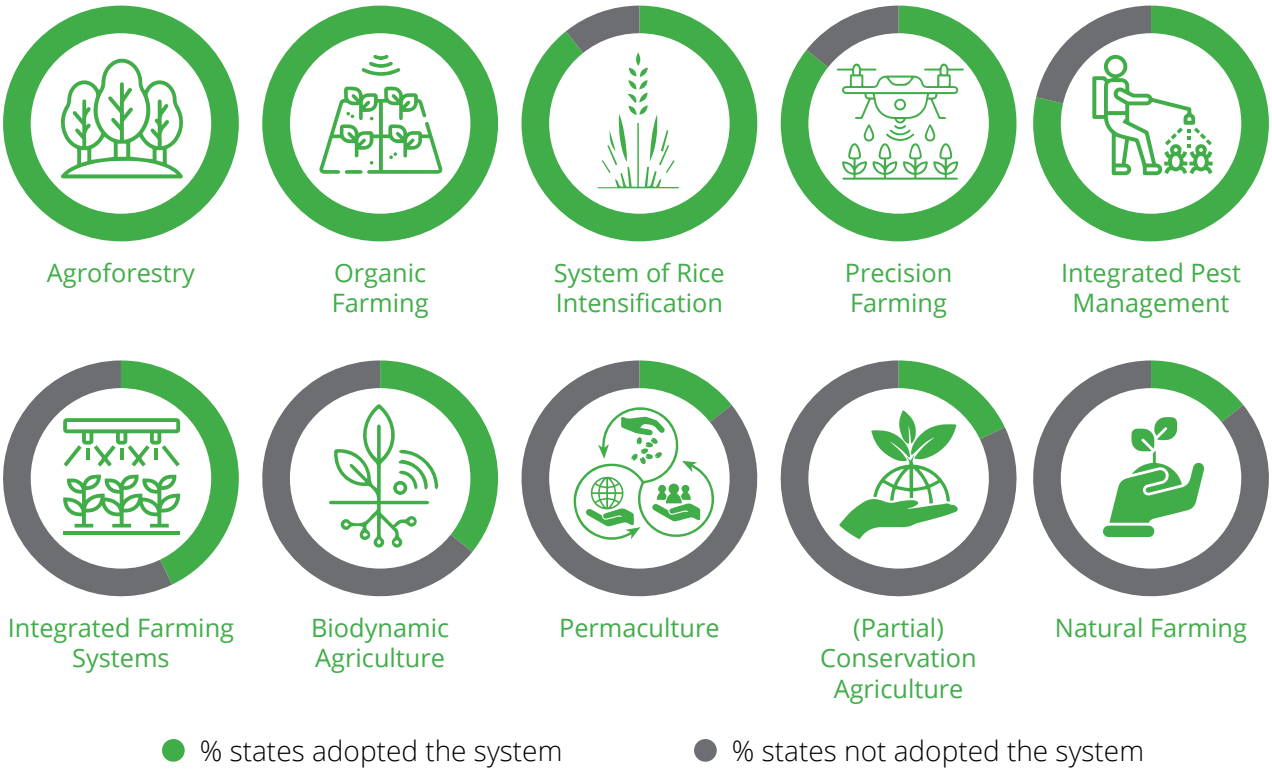
Exhibit 5: Popular sustainable agriculture practices in India



Source: CEEW FOLU, Sustainable Agriculture in India 2021, What We Know and How to Scale Up

Apart from such practices, there are sustainable agricultural systems which can be practiced. As per a study conducted by CEEW, practices such as agroforestry, organic farming, precision farming, integrated pest management and SRI method of rice cultivation are the most popular sustainable farming systems being adopted across several Indian states (refer to exhibit 6).

Exhibit 6: Geographical spread of sustainable agriculture systems in India (2021) (in terms of number of states)



Source: CEEW FOLU, Sustainable Agriculture in India 2021, What We Know and How to Scale Up

However, these systems are associated with issues such as low yields in the initial years, substantial increase in the workload and unavailability of necessary guidance and materials for successful implementation.

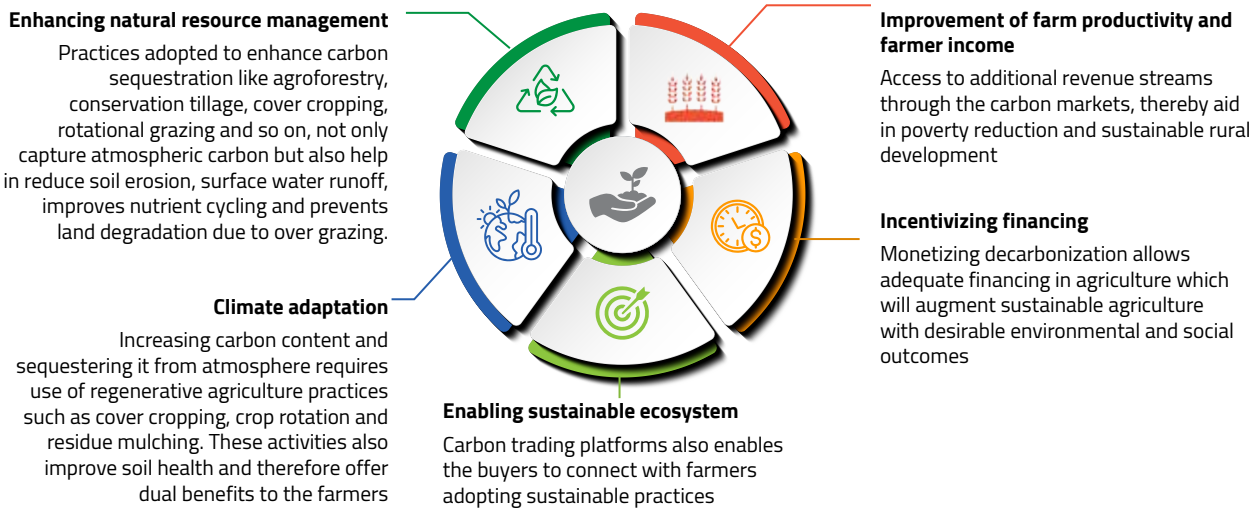
More importantly, the fundamental reason for the low adoption of sustainable farming practices is the absence of definitive economic rewards for farmers who adopt these practices. Farmers prioritize their immediate income and livelihood requirements over the need to adopt sustainable practices that could lead to yield drop. Providing required financial, technological, and infrastructural support to bridge the gap between farmers' income expectations and climate action requirements, could direct farmers on the path to sustainable farming.

1.1.4 Carbon markets as a lever to spur farmers' climate action

Carbon markets present a promising pathway for incentivizing farmers towards climate action. They could be utilized to offer economic incentives to farmers to adopt sustainable practices. Initiatives adopted towards carbon credit generation directly contribute to the SDGs, particularly SDG 2 (Zero Hunger) and SDG 13 (Climate Action).

Carbon emission mitigation in agriculture is not only limited to reducing emissions, but also includes improving resource use efficiency (reduction in consumption of irrigation water, efficient use of chemical fertilizers, use of renewable energy in production and harvest related activities) and reduction in wastage. In addition, sequestering carbon into agricultural soils is beneficial both for the farmers and the environment. Soil acts as a natural sink for carbon as it gets stored in the soil and assimilated by plants. Beyond improving crop quality, enhancing biodiversity, and preventing soil erosion; carbon sequestration can also aid farmers monetarily. Consequently, the social additionality of carbon emission mitigation and carbon sequestration through agriculture is much higher compared to other options (refer exhibit 7).

Exhibit 7: Role of carbon markets in promoting sustainable agriculture



Source: FICCI-YES BANK report on Promoting Sustainability in Indian Agriculture: Focus Areas for Responsible Growth; YES BANK Analysis

This report captures an overview of dynamics of the carbon market, assess the potential for Indian agriculture to address carbon markets and discusses select areas of action that could facilitate the process of linking Indian farmers to carbon markets.

2 Carbon Markets – An Overview



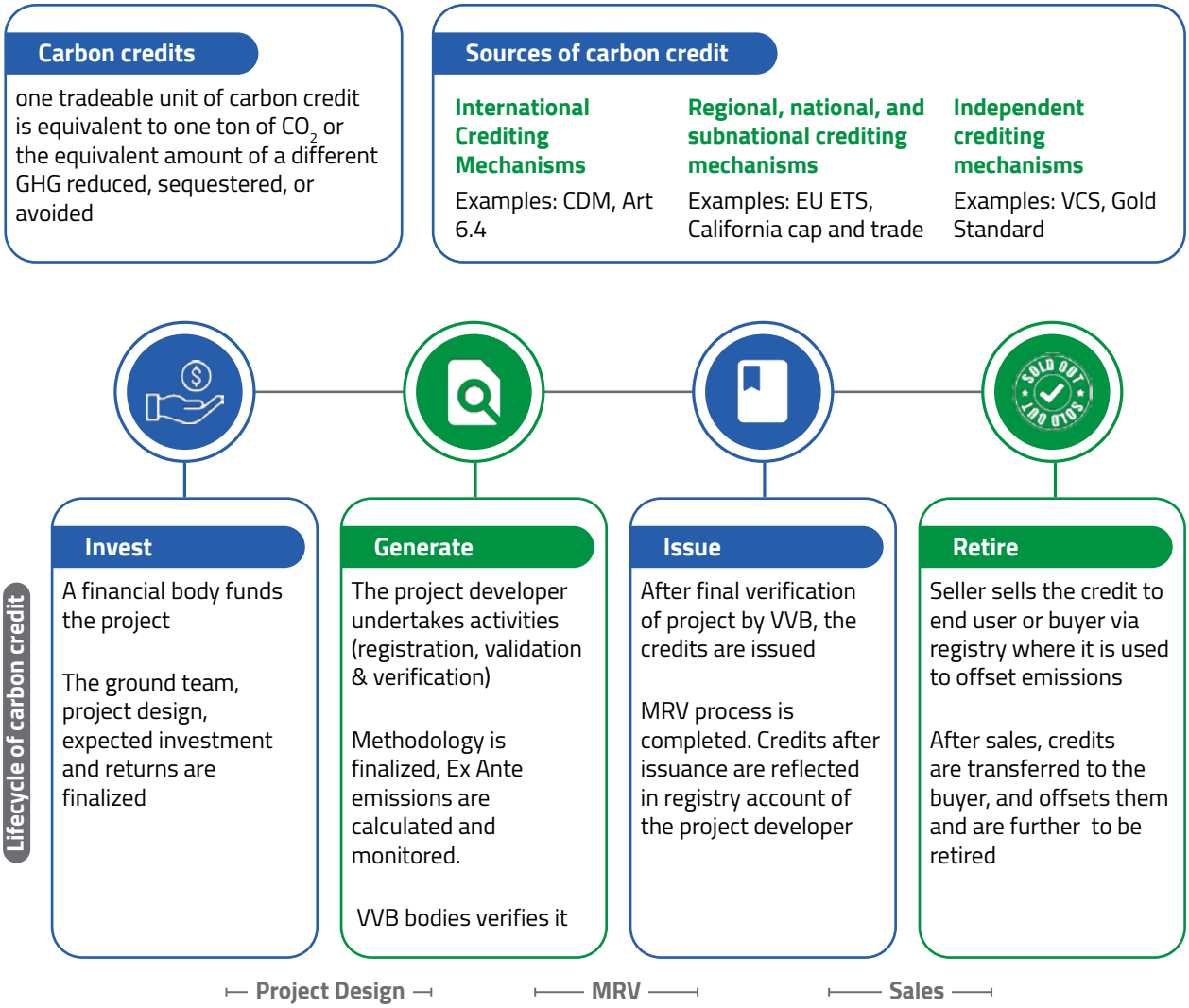
Carbon markets are systems in which carbon credits are traded, where a tradeable unit of carbon credit is equivalent to one ton of CO_2 (or the equivalent amount of a different GHGs) reduced, sequestered, or avoided. Once the unit credit is traded, it is retired and can no longer be available for further trade. These credits can help mobilize financial resources for countries and companies to ease into low-carbon transition. Carbon markets play a key role in implementation of Nationally Determined Contributions (NDCs), as the Paris Agreement enables the use of such market mechanisms through Article 6[31]. Globally, about 83% of NDCs declare the intent to make use of international market mechanisms (such as Emission Trading Systems (ETS) or Clean Development Mechanism (CDM) or Joint Implementation (JI)) to reduce GHG emissions. According to World Bank estimates, carbon credits could reduce the cost of implementing NDCs by more than USD 250 billion by 2030[32]. An outline of the carbon credit lifecycle is represented in exhibit 8 below.



[31] Article 6 of the Paris Agreement addresses international cooperation to reduce greenhouse gas emissions. It includes three market-based mechanisms, Emissions trading (Article 6.2), Sustainable Development Mechanism (SDM) (Article 6.4) and Results-based approaches.

[32] https://www.worldbank.org/en/news/feature/2022/05/17/what-you-need-to-know-about-article-6-of-the-paris-agreement

Exhibit 8: Overview of carbon credit generation



Source: Stakeholder consultations, S&P Global Commodity Insights, State and trends of Carbon Pricing 2022, YES BANK Analysis

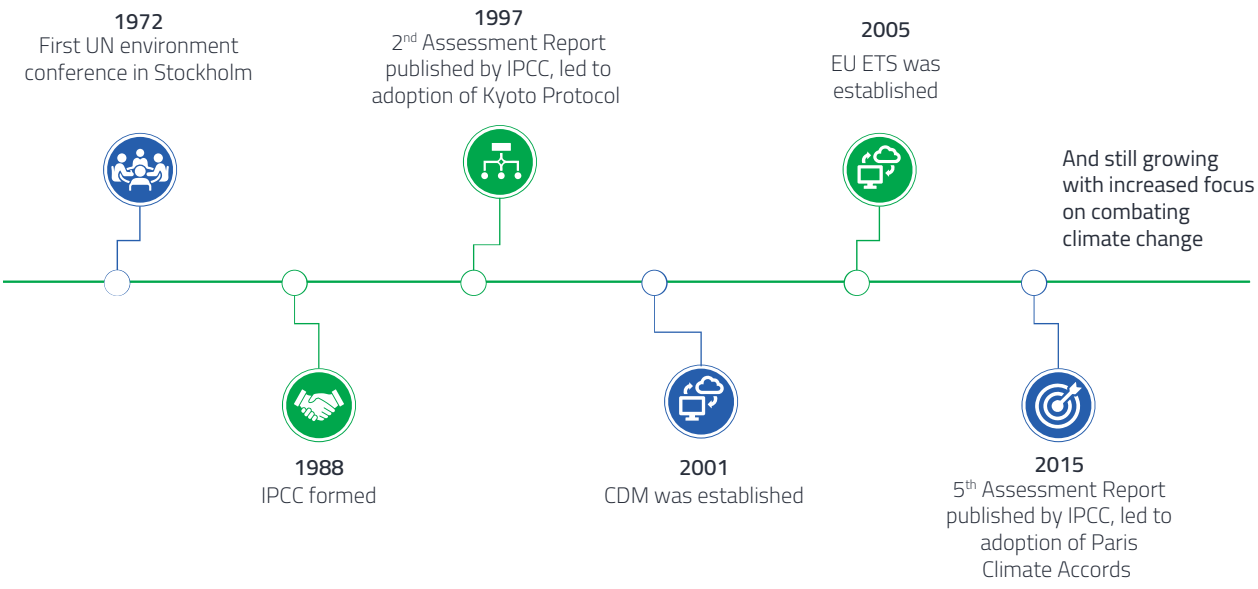
2.1 Evolution of carbon markets

The Intergovernmental Panel on Climate Change (IPCC) was established by United Nations Environment Programme (UNEP) and World Meteorological Organization (WMO) in 1988 to recognize the problem of potential global climate change, aid Governments around the world to understand its impacts and make efforts to adapt or mitigate climate change accordingly. IPCC's 1st Assessment Report published in 1990 stated that human activities were substantially increasing the atmospheric concentrations of GHGs. This

has caused temperature to increase by 0.3° to 0.6°C over the past century[33]. The 2nd Assessment Report provided key information that led to the development of the Kyoto Protocol in 1997 which initiated the process of reducing GHG emissions. It included targets for the first commitment period (2008-12) which covered emissions of the six main greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF6) and the concept of assigned a target to comply with. The Kyoto Protocol also laid down the foundation of Market Based Instruments for emission reduction, one of which was the Clean Development Mechanism (CDM), which allowed a country with an emission reduction or limitation commitment to implement or fund projects in the developing world that, in return, could earn saleable Certified Emission Reduction (CER) credits to meet Kyoto targets.

The 3rd assessment report focused on the impact of climate change and the need for adaptation, while the 4th assessment report laid the groundwork for a post-Kyoto agreement, focusing on limiting warming to 2°C[34]. The 5th Assessment Report released in 2014 was fundamental in providing scientific inputs for Paris Agreement. It critically emphasized the influence of anthropogenic activities on climate and highlighted that GHG emissions had been recorded at the highest in history. The report's findings aided in adoption of Paris Climate Accord, in which 196 parties committed to actions for limiting global warming to below 2°C above pre industrial levels and pursuing efforts to limit it to 1.5°C above pre-industrial levels, in an effort to avoid the most catastrophic impacts of climate change.[35] Since the adoption of the Accord, the carbon credit market has developed and grown significantly. This is evident from the surge in share of global emissions covered by carbon taxes and ETSs reaching 23% in 2023 from 7% a decade ago[36].

Exhibit 9: Key events that led to development of carbon markets



Source: https://www.ipcc.ch/about/history/ ; United Nations Conference on the Human Environment, Stockholm 1972 | United Nations; YES BANK Analysis

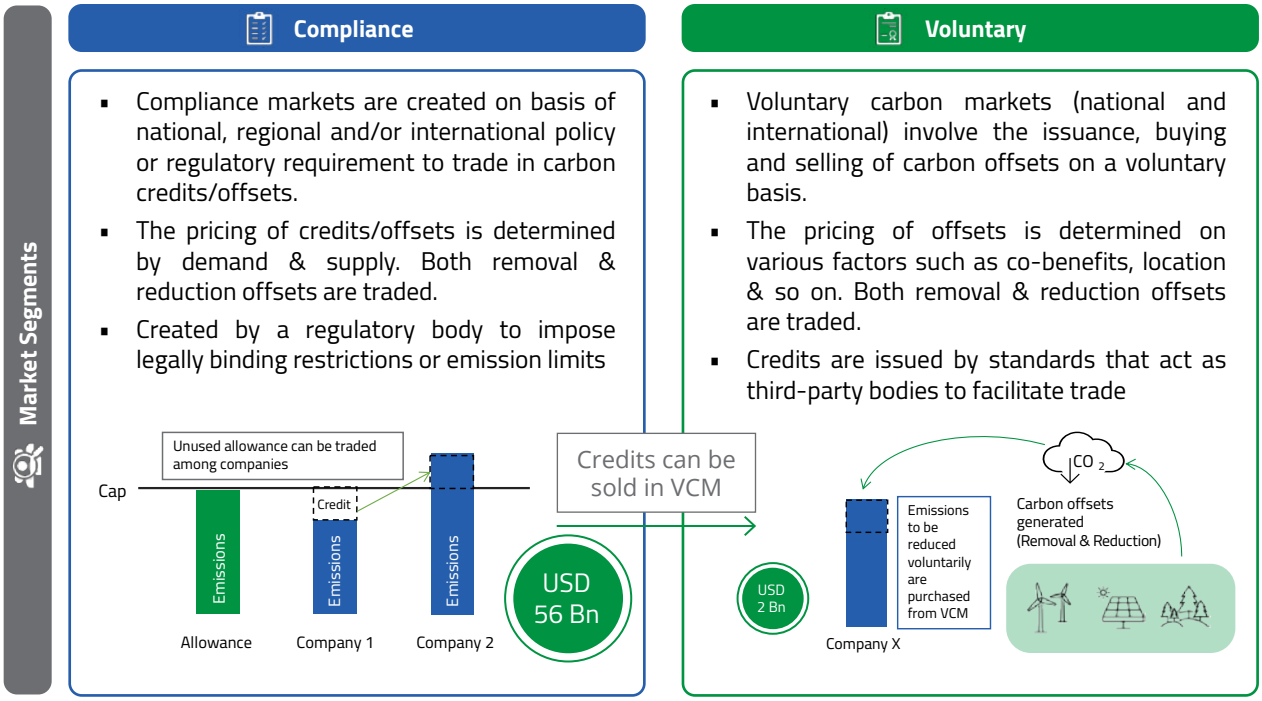
[33] *https://www.ipcc.ch/about/history/*
[34] *https://www.ipcc.ch/about/history/*
[35] *https://unfccc.int/process-and-meetings/the-paris-agreement*
[36] *State and Trends of Carbon Pricing 2023, report of World Bank*

2.2 Classification

Carbon markets are broadly classified into two types, compliance and voluntary (refer Exhibit 10). Compliance markets trade in carbon credits which are governed by a centralized law or an authority at the national, international, or regional level, responsible for putting a cap on emissions. As the credits are generated and traded for regulatory compliance, they typically experience commodity pricing, where all offset credits in a particular program are priced similarly based on the dynamics of supply and demand, regardless of project type and other characteristics.

On the other hand, voluntary carbon markets include all transactions of carbon credits/offsets purchased with the intent to re-sell or retire them or not to surrender them into an active regulated carbon market. This market is driven by companies and individuals inclined to offset their own emissions, and for entities that purchase offsets prior to regulatory requirement. As more and more companies adopt net zero emissions targets, the growth of voluntary carbon markets is also increasing.

Exhibit 10: Segments of carbon credit market



The green bubble represents the market size of respective market segments in 2021

Source: State and Trends of Carbon Pricing 2022; State of the Voluntary Carbon Market by Ecosystem Marketplace; Morgan Stanley; YES BANK Analysis

The structure of voluntary and compliance markets varies with respect to governance, trading principle, pricing and credit type being sold (refer exhibit 11).

Exhibit 11: Difference between voluntary and compliance carbon market

	Compliance Market	Voluntary Market
Governance:	Created by a regulatory body to impose legally binding restrictions or emission limits.	Does not have a central governing body, the credits are issued by standards that act as third-party bodies to facilitate trade and give credibility to the credits sold.
Trading Principle:	Known as Cap and trade markets where emission trading takes place. Examples: Europe ETS, California ETS, China ETS.	Trading is more flexible and motivated by goodwill motives, meeting internal ESG limits, etc
Pricing:	Commodity pricing is observed where credits follow the principle of demand and supply. Prices are higher when demand is more.	Commodity pricing is not seen. They are priced on the basis of the location of the project, the standard it belongs to, the co-benefits it offers, the reputation of the project developer, etc.
Primary type of credit sold:	Both offsets and credits are sold.	Project-based offsets are sold.

Source: State and Trends of Carbon Pricing 2022, State of the Voluntary Carbon Market by Ecosystem Marketplace, YES BANK Analysis

2.3 Role of third parties in certifying carbon credits

All carbon standards require independent third-party validation and verification of the carbon offset projects. Post third party validation, verification, and credit calculation, the units can be bought and sold by brokers to interested individuals or businesses. The role of third party verifiers is extremely important as they act as guiding agents in standardization of the framework of impact measurement, aiding in establishing trust and credibility (refer exhibit 12).

Exhibit 12: How does third-party certification help?

- **Adherence to rigorous standards and methodologies**
- **Validating the quantification of emissions reductions**
- **Integrity of carbon offset projects**

Source: State of the Voluntary Carbon Market by Ecosystem Marketplace

According to the State of Voluntary Carbon Markets report, in 2020 alone, third-party certifications (such as Verra, Gold Standard) represented 86% of all voluntary carbon offset transactions, underlining their pivotal role in maintaining transparency and accountability.

2.4 Factors impacting carbon pricing

The economic value of carbon credit is generally determined by "the importance, worth, or usefulness of the credit to people – including all relevant market and non-market values". According to World Bank's state and trends of carbon pricing report, 2022, carbon prices on the VCM start at less than USD 1 per ton CO_2e and increase to USD 137 per ton CO_2e. The price for almost half of emissions is at less than USD 25 per ton CO_2e[37]. As per OECD estimates, a price of USD 147 per ton is needed by 2030 to reach the target of net-zero emissions by 2050. The current price of EU ETS was around USD 59 per ton[38]. Factors impacting carbon credit pricing include site of project, vintage, methodology used for estimating reduction of emissions, quality of certification and co-benefits delivered (refer exhibit 13).

Exhibit 13: Factors impacting carbon credit pricing

Size & Location

- As per location of project:
- Smaller projects are expensive to implement and the region of implementation

Vintage

- As per the age of of the carbon credits that is, when emission reduction took place.
- But the general thumb rule is the older the vintage, the cheaper the price per credit.

Quality

- As per the standard which certifies the project.
- Example: credits from Verra and Gold Standard fetch premium price

Value of beyond- carbon benefits

- As per the co-benefits delivered which have impacts beyond climate security in sustainable development

Differences in emission reduction methodologies

- As per methodology used in the project.

Source: State of the Voluntary Carbon Market by Ecosystem Marketplace; YES BANK Analysis

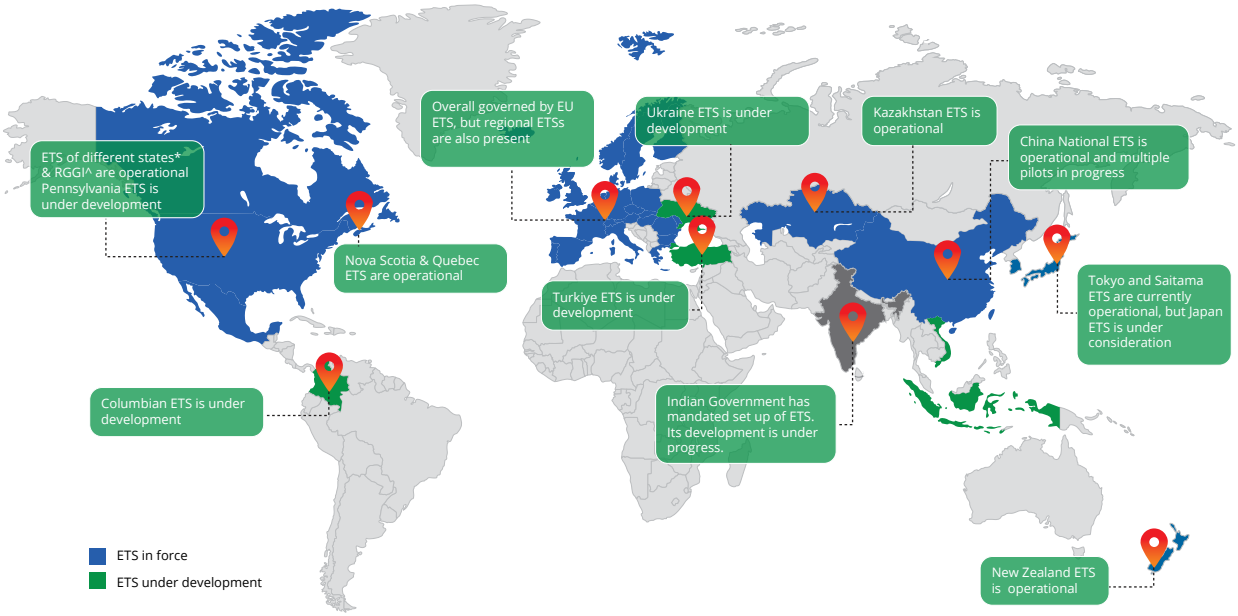
2.5 Overview of global carbon markets

Global carbon markets have evolved considerably over the years. The first carbon market established under Kyoto Protocol, the Clean Development Mechanism (CDM) (in 2001, Marrakesh Accords), allowed developed countries to meet their emission reduction requirements by financing mitigation in developing countries. Globally, the first compliance market for emissions was the EU ETS established in 2005. The last few years have seen an increasing interest and fund flow in the carbon markets. This has been mainly because these markets act as key tools for implementation of the Nationally Determined Contributions (NDCs) submitted by various countries in the Paris Agreement. Globally, about 83% of NDCs declare the intent to make use of international market mechanisms to reduce GHG emissions[39].

[37] *World Bank.2022, State and Trends of Carbon Pricing 2022. http://hdl.handle.net/10986/37455*
[38] *https://unfccc.int/news/investors-with-usd-6-trillion-call-for-a-global-price-on-carbon*
[39] *https://www.worldbank.org/en/news/feature/2022/05/17/what-you-need-to-know-about-article-6-of-the-paris-agreement*

Currently, the share of global GHG emissions covered by emissions trading is over 17%, more than triple the amount when the EU ETS was launched in 2005[40]. Changes over time are driven by the addition of new sectors and systems, as well as by the counteracting trends of declining caps in many systems and growing global emissions. Exhibit 14 below captures the status of countries across the world where emissions trading systems are currently in force, under development or under consideration. As of January 2023, there were 28 ETSs in force, another eight were under development and are expected to be in operation in the next few years[41].

Exhibit 14: Current state of world in cap-and-trade systems (2023)



**Different states in USA indicate: Washington, Oregon, California, Massachusetts*

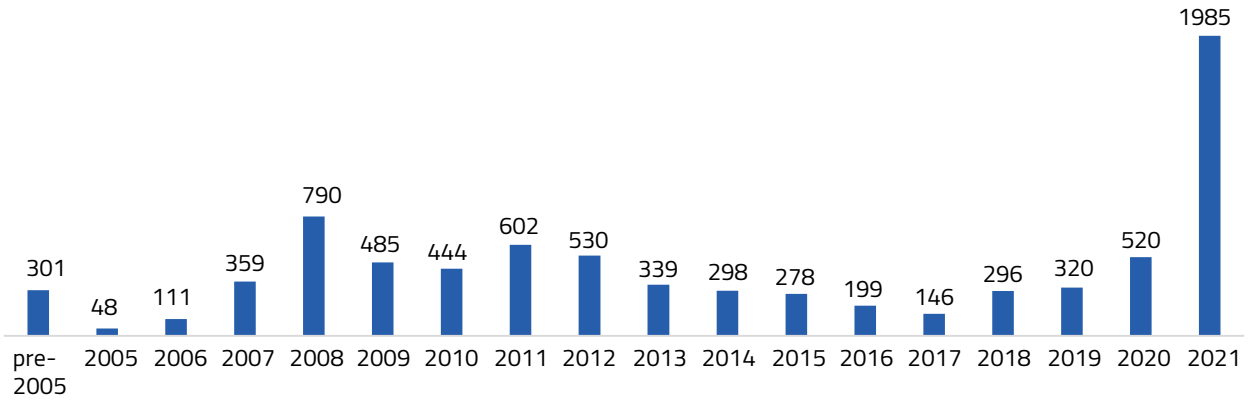
^include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont, Virginia

Source: ICAP Emissions Trading Worldwide 2023 Status Report, YES BANK Analysis

Apart from the compliance market, the voluntary market is also growing significantly, both in terms of value and the number of players involved. Currently, the compliance market is valued higher (about USD 56 billion) compared to voluntary market (about USD 2 billion)[42]. However, projected growth for voluntary market is pegged to be higher due to flexibility in terms of innovation, finance, monitoring and methodologies, when compared to compliance market. Overall, since the voluntary carbon markets picked up in the late 2000's, offset issuances and retirements have both increased dramatically. The voluntary market value has increased at 13% CAGR over last 10 years, while the increase has been 58% over the 5-year period from 2016 to 2021 (refer Exhibit 15). As per industry estimates, the voluntary carbon-offset market is expected to grow from USD 2 billion in 2021 to around USD 250 billion by 2050[43].

[40] *ICAP Emissions Trading Worldwide Status Report*
[41] *ICAP Emissions Trading Worldwide Status Report*
[42] *https://www.morganstanley.com/ideas/carbon-offset-market-growth*
[43] *https://www.morganstanley.com/ideas/carbon-offset-market-growth*

Exhibit 15: Voluntary carbon market* over the years (Annual Value USD Million)



**Includes Chicago Climate Exchange Traded till 2010*

Source: https://www.ecosystemmarketplace.com/articles/todays-vcm-explained-in-three-figures/

The global south[44] has assumed the role of the provider of carbon credits, whereas the global north identifies itself as the purchaser. The top carbon credit supplying countries are China, India, Brazil, Turkey and Vietnam contributing nearly 67% of the total voluntary carbon projects (refer exhibit 16). Although the domestic compliance market of India is in the process of being set up, the country has made significant progress in the issuance of credits in voluntary carbon market. The country hosts the second largest number of projects globally, with about 24.63% share of the total number of projects. By 2030, India's expected revenues from sales of voluntary carbon credits is expected to reach USD 20-40 billion[45].

Exhibit 16: Top 10 countries with highest number of projects across carbon markets



Source: CDM, Verra & GS registry (accessed as on 26-07-2023), YES BANK Analysis

[44] *As per the United Nations-The division of "North" and "South" is used to refer to the social, economic and political differences that exist between developed countries (North) and developing countries (South).*

[45] *https://www.spglobal.com/commodityinsights/en/ci/research-analysis/is-it-possible-that-indian-carbon-credit-exports-to-voluntary.html*

2.6 Carbon markets in India

India has been a significant carbon credit generator for nearly two decades in the voluntary carbon market mechanism. Nearly 5000 projects[46] have been registered by the country across various platforms. These projects span over various categories such as, afforestation/reforestation, forestry/agroforestry, clean energy mechanisms, waste management, renewable energy, alternate energy, biodiversity, water conservation & management and agriculture.

India's first project under CDM got approved in 2005[47] which marked the beginning of exports of carbon credits in various sectors such as renewable energy, forestry, bio-energy, water, waste management, biodiversity, biochar and agriculture, to the international trade mechanisms. Between 2010 and June 2022, India issued 35.94 million carbon credits (amounting to about 17% of total global VCM credits issued)[48]. Further, to boost its internal carbon credit market, India recognized carbon as a commodity and started its trade in 2008 over platforms such as MCX & NCDEX. Initial trade volumes although encouraging, were severely affected due to the global recession and economic slowdown affecting the global west. In another development, the PAT scheme (Perform, Achieve, Trade Scheme) was launched by Bureau of Energy Efficiency (BEE) in 2012 which allowed the trading of energy efficiency certificates.

On 2nd October 2015, India submitted its first set of NDCs committing towards reducing its carbon intensity and increasing the share of non-fossil fuel energy capacity. Subsequent to its commitment, the country launched Renewable Purchase Obligation (RPO) Compliance Market in 2016 for trade in renewable energy certificates.

During the CoP26 summit (2021), India pledged to reduce its emissions by 45% (from 2005 baseline) and set a target to achieve a total projected carbon emissions reduction by one billion tons by 2030[49]. In 2022, the Government of India announced an export restriction on carbon credits, with a view to meet the nation's own NDCs. Although timelines around the restriction have not been announced, it was clarified that export ban was not absolute and export of credits would be considered after India's NDCs are met. The country is in process of setting up of a domestic trading scheme for carbon credits as per the latest Energy Conservation (Amendment) Bill, 2022 passed by Govt. of India in June 2023.

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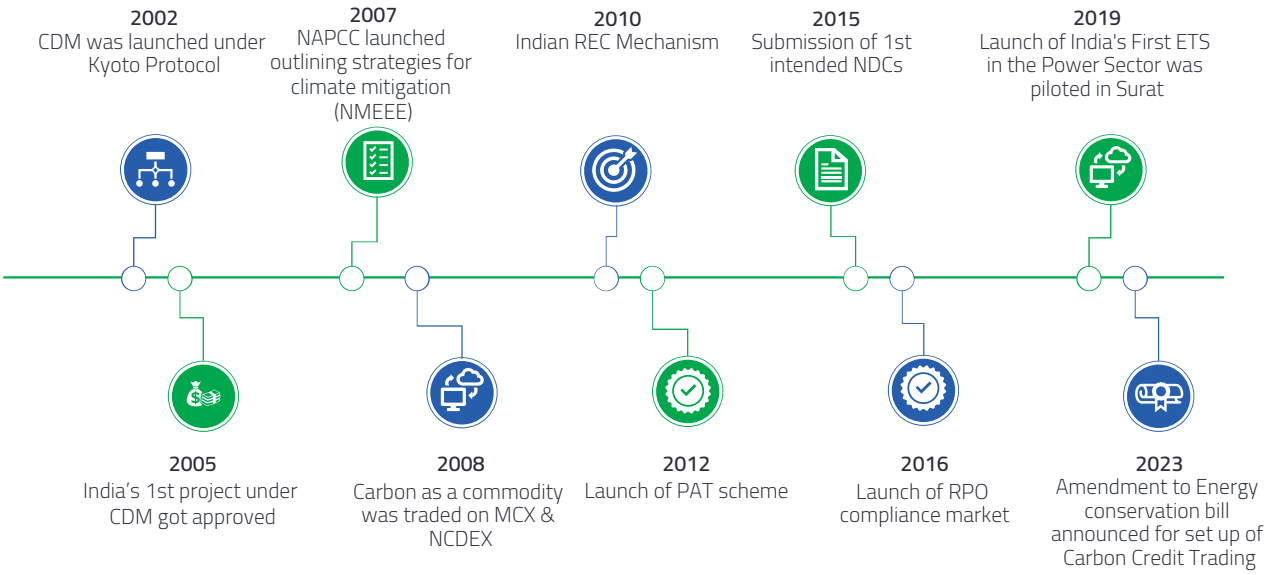
[46] *CDM, Verra & GS registry (accessed as on 26-07-2023) , YES BANK analysis*

[47] *https://www.downtoearth.org.in/news/indias-first-cdm-project-9597*

[48] *https://energy.economictimes.indiatimes.com/news/renewable/carbon-credit-understanding-the-concept-its-evolution-and-implications/99064759*

[49] *Ministry of Power & MoEFCC to develop carbon credit trading scheme for decarbonization (https://pib.gov.in/PressReleasePage.aspx?PRID=1923458)*

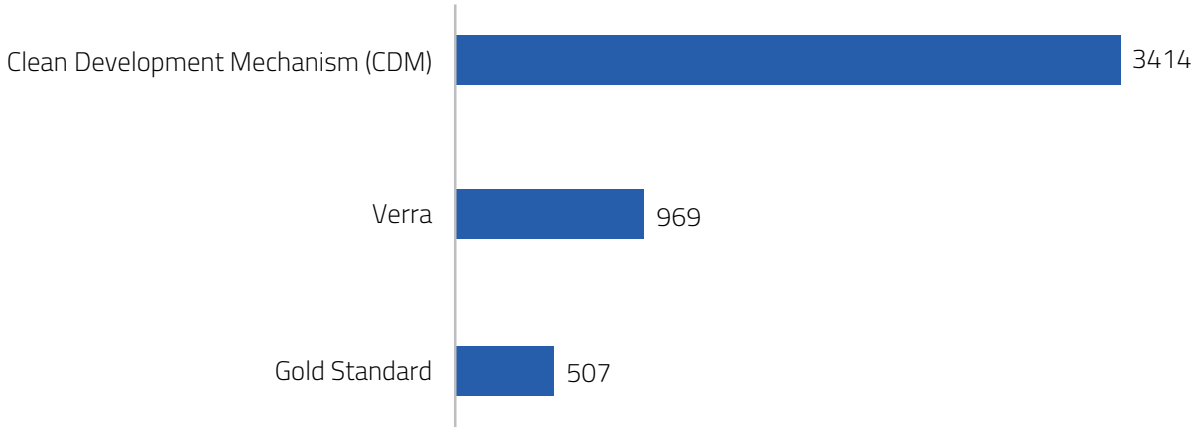
Exhibit 17: Timeline representation of development of carbon credit ecosystem in India



Source: https://www.livemint.com/science/news/india-launches-emissions-trading-programme-to-reduce-air-pollution-1559799447842.html; https://www.financialexpress.com/opinion/what-are-renewable-purchase-obligations-and-how-to-effectively-meet-rpo-targets/1374927/; Renewable energy certificate mechanism in India: A preliminary assessment; https://beeindia.gov.in/en/programmes/perform-achieve-and-trade-pat; PAT scheme: analysis, insights & way forward; YES BANK Analysis

Indian carbon credit market is still at a nascent stage and so is the issuance of credits. With a total of about 4,890 projects[50] (includes all sectors) registered across CDM (3,414 projects), Verra (969 projects) and Gold Standards (GS) (507 projects) (refer exhibit 18), India hosts the world's 2nd largest number of projects with about 24.63% share of total number of projects across countries.

Exhibit 18: India's projects (in number) registered across certifying agencies



Source: CDM, Verra & GS registry, YES BANK analysis (accessed as on 26-07-2023)

[50] *Calculated from the projects in India submitted for issuance across CDM, Verra and GS registries (data accessed as on 27/07/2023)*

About 6% of the total registered projects of India i.e., about 273 projects are registered under Agriculture, Forest, and Other Land Use (AFOLU) category[51]. India is yet to generate its agriculture carbon credits as all these projects are at various stages (implementation, evaluation, verification) of issuance. Verra hosts most of the improved management practices projects with 109 projects registered under AFOLU, with an estimated issuance of about 38 million credits[52]. Of these, 10.46 million credits (about 28% credits) are for issuance under methodology VM0042 (Improved agriculture land management) covering an area of about 3.84 million hectares[53].

With increasing awareness and visible effects of climate change, carbon markets are poised to grow. This provides India with a significant opportunity to harness the untapped potential of AFOLU sector in carbon credit generation. The market mechanisms offer a way to bridge the gap between environmental stewardship and farm level economic viability. As the integration of carbon credits in agriculture becomes a pivotal step towards combating the impacts of climate change, it becomes imperative for India to increase its efforts towards boosting carbon credits generated from AFOLU projects.

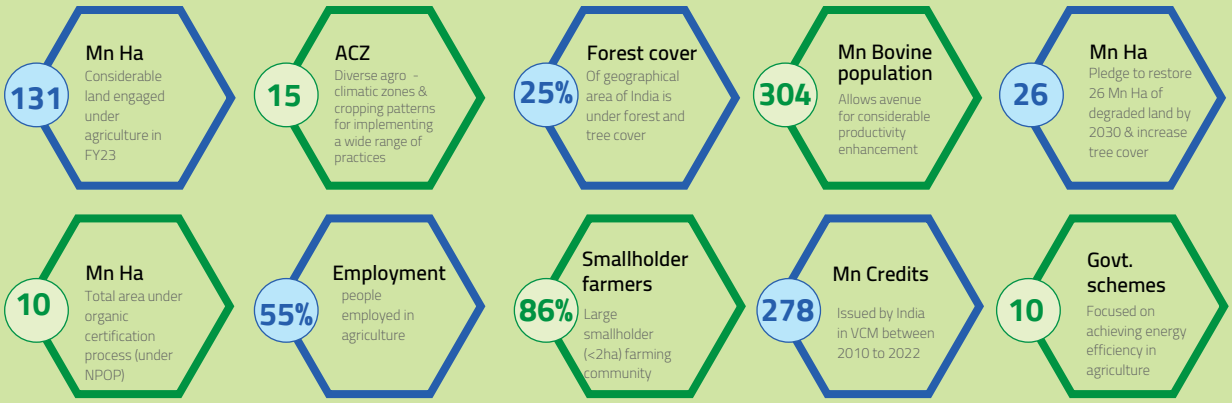


3 Indian Agriculture & Carbon Markets: Linkage & Opportunities



As India seeks to reduce carbon emissions in an efficient and impactful manner, the nation's robust agricultural sector offers a promising opportunity. The vast agricultural landscapes, diverse cropping patterns, and the potential for large-scale implementation of sustainable practices provide a fertile ground for carbon sequestration and mitigation initiatives (refer exhibit 19).

Exhibit 19: Key advantages of agriculture in carbon credit generation



Source: Agricultural Statistics at a Glance 2022, UNNATEE report, PIB, YES BANK Analysis

Measures such as agroforestry, afforestation and conservation agriculture projects have shown promise in enhancing carbon storage in soil and biomass. Additionally, promoting the use of organic fertilizers, improving water management techniques, and incentivizing the establishment of carbon-rich vegetation can further bolster carbon sequestration efforts. Farm management practices such as Alternate Wetting and Drying (AWD) and Direct Seeded Rice (DSR) in rice cultivation, crop diversification, proper land management, judicious use of fertilizers, adequate waste management and enhanced diet for livestock have the potential to mitigate carbon emission. Collaborative initiatives led by the various stakeholders can aid the farmers in adopting these practices while creating opportunities for carbon credit generation. Several pilot projects (such as agroforestry pilot project by social forestry division of Gujarat Government) and carbon credit certification programs have already been initiated in various states, demonstrating the nation's resolve to harness the potential of agriculture.

3.1 Potential for carbon credit generation from Indian agriculture

Carbon credits can be generated under two categories of agriculture management activities:

1. **By reducing the total emissions** – involves implementing agriculture management activities which either avoid or reduce the GHG emissions. These practices include optimizing the nitrogen use efficiency (NUE) of the fertilizers, improving water management in rice, crop residue management, livestock feed management and animal waste management among others.

2. **By increasing the carbon sink** – involves implementing agricultural practices such as zero tillage or reduced tillage, cover crops, diversified cropping, agro-forestry, conservation agriculture that lead to carbon sequestration.

Studies indicate that rice cultivation, livestock production, fertilizer use and burning of crop residues are the four major activities responsible for most of the agricultural GHG emissions[54].

A nation-wide study was jointly carried out by International Maize and Wheat Improvement Centre (CIMMYT) and University of Aberdeen (funded by CGIAR research program on Climate Change, Agriculture and Food Security (CCAFS)) to assess "cost-effective opportunities for climate change mitigation in Indian agriculture"[55]. This study has identified select cost-effective options for mitigation of carbon emission in Indian agriculture. The options identified in this study for crop-based activities include a range of improved agronomic practices that increase crop yields, promote soil carbon storage, as well as ensure best management practices for fertilizer, water, and other resources, thereby reducing emissions associated with production inputs. Options identified for livestock-based activities included adding green fodder supplements to ruminant's diet, feed additives and improved diet management of small ruminants.

For assessing the overall mitigation potential, the research team[56] carried out a cumulative analysis of individual mitigation potential of various agricultural practices across crops at the national level. The technical GHG emission mitigation potential for Indian Agriculture was estimated for the identified agricultural activities using large datasets of India's Cost of Cultivation and 19th livestock census together with soil, climate and farm management data across locations[57]. The starting point for assessing the mitigation potential of the agricultural sector was to quantify baseline emissions and analyze the major sources contributing to these emissions. Appropriate mitigation strategies were developed based on available technical options. Three scenarios were taken for major crops (which contributed 80% of crop-based emissions) and major livestock (which contributed 99% of emissions livestock-based emissions): baseline emissions and business-as-usual (BAU) emissions scenario in 2030 were arrived at against which mitigation scenario options were assessed assuming that political and institutional conditions were in favor of wide scale adoption.

Findings of this study suggest that crop-based and livestock-based mitigation measures cumulatively offer a technical mitigation potential of about 79 Megatonnes of Carbon dioxide equivalent (Mt CO_2e)

[54] India Third Biennial Update Report to the United Nations Framework Convention on Climate Change (UNFCCC), Ministry of Environment, Forest and Climate Change, 2021

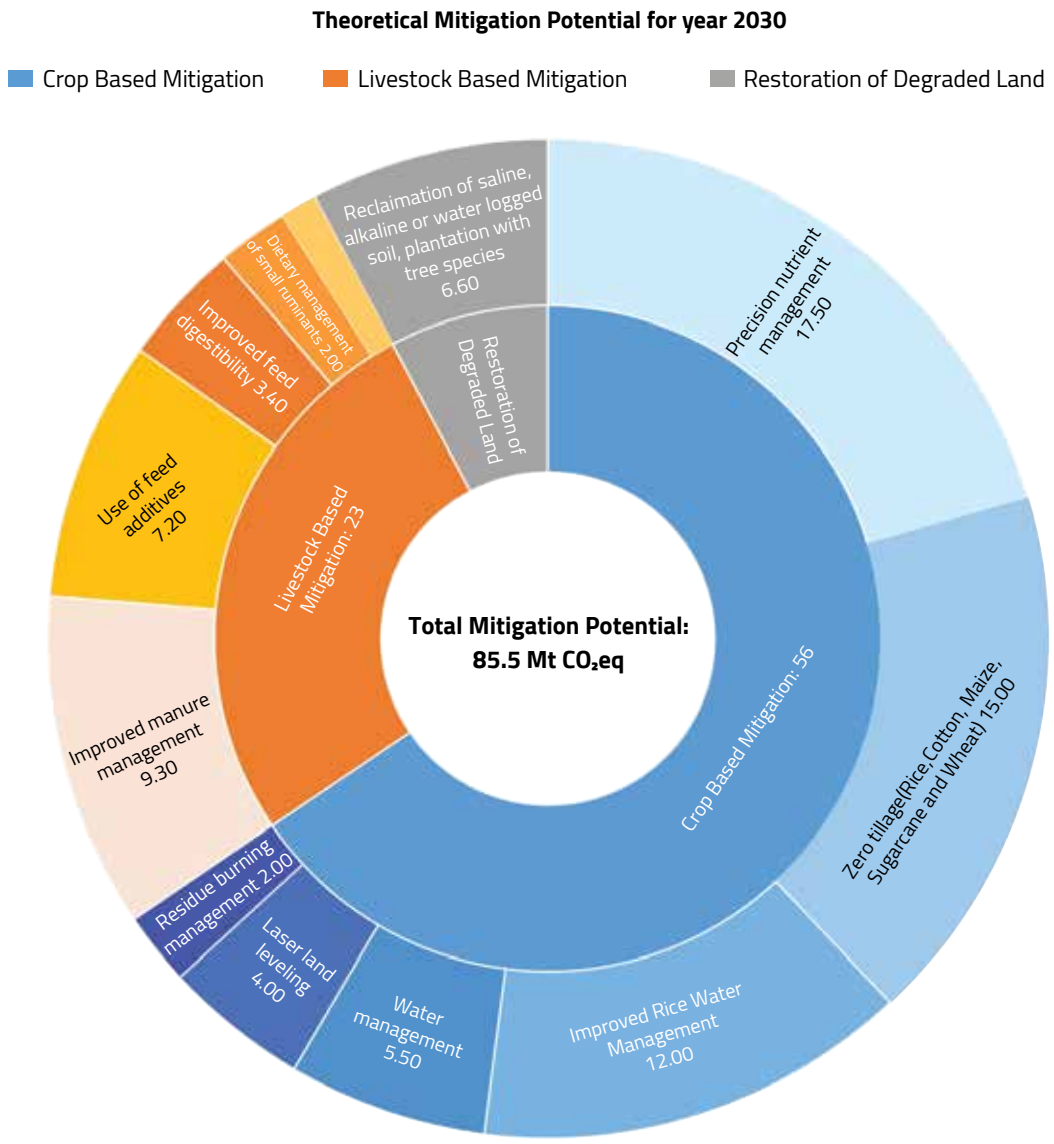
[55] Sapkota, T.B. et al., 2019: Cost-effective opportunities for climate change mitigation in Indian agriculture. Sci. Total Environ., 655, 1342–1354, doi:10.1016/j.scitotenv.2018.11.225.

[56] Research team refers to CIMMYT & University of University of Aberdeen team

[57] The method used by the research team for emission calculation is the Cool farm tool in a MATLAB script which is modified according to farm conditions. State level mean emissions were computed using spatial models and the aggregates of all states were used to further determine national level estimates with 95% confidence interval being used to account for uncertainties if any.

per year. If mitigation potential from restoring degraded land is added, Indian agriculture sector has the mitigation potential of about 85.5 Mt CO_2e per year (refer exhibit 20). Livestock production and rice cultivation were the major contributors of agriculture emissions. Highest mitigation potential was observed in Rice (about 36 Mt CO_2e per year) followed by Buffalo (about 14 Mt CO_2e per year), Wheat (about 11 Mt CO_2e per year) and Cattle (about 7 Mt CO_2e per year). Assuming that one megatonne of CO_2e mitigated would approximately yield one million carbon credits, it may be inferred that Indian agriculture has the technical potential to generate 85.5 million carbon credits by practicing emission mitigation measures alone[58].

Exhibit 20: Estimated Technical mitigation potential of GHG emissions through improved management practices (Mt CO_2e)



Source: Adapted from a CIMMYT & University of Aberdeen study titled "Cost effective opportunities for climate change mitigation in Indian agriculture"

[58] *The number of carbon credits generated per megatonne of CO_2e mitigated can vary widely based on several factors, including the methodology applied, standards used for certification, type of carbon offset project etc.*

3.1.1 Potential mitigation options in crops

The CIMMYT & University of Abardeen study estimated that technical GHG mitigation potential of crop production in India was 55.5 Megatonnes CO_2e (Mt CO_2e) per year under mitigation scenario. Select agronomic practices and their mitigation potential is captured herewith.

Zero tillage

Conservation tillage encompasses a range of practices which minimize soil disturbance and retain previous crop residue on the soil surface. In the Indian context where the rice-wheat-maize systems are predominant, zero tillage method is suggested as the most effective alternative to crop burning[59]. Zero tillage refers to the agronomic practice where no tillage is taken up between harvest of previous crop and sowing of the next crop. Estimates indicate that zero tillage has the potential to cut farm-related GHG emissions by up to 75% and has a mitigation potential in the range of 0.52 to 1.80 t CO_2e per hectare per year. It is estimated that this practice provides a technical GHG mitigation potential of about 15 Mt CO_2e per year[60].

Further the other types of conservation tillage such as reduced tillage, strip tillage, mulch tillage, ridge tillage and rotational tillage can also be effective basis the soil type, crop sown, water availability and primary purpose of the tillage. Additionally, the adoption of innovative practices such as laser levelling can potentially mitigate about up to 3.1 t CO_2e per hectare per year.[61] Adoption of laser levelling in rice-wheat areas would result in a potential mitigation of about 4 Mt CO_2e per year.

Improved water management in rice

Rice cultivation is one of the major sources of GHG emissions due to flooding and puddling of the fields. To mitigate greenhouse gas emissions from rice cultivation, particularly methane (CH_4) associated with anaerobic conditions, water management practices such as intermittently drying the fields could be being followed.

A meta-analysis on multiple drainage systems found that Alternative Wetting and Drying (AWD) with irrigation management can reduce CH_4 emissions by 20–30% and improve water usage by 25.7%, though this resulted in a slight yield reduction (5.4%). Water management for both single and multiple drainage has the potential to reduce methane emissions by about 35% but results in an increase in N_2O emissions by about 20%. However, N_2O emissions occur only under dry conditions, therefore total reduction in terms of net Global Warming Potential (GWP) is approximately 30%. It is estimated that improved water management in rice cultivation has a technical potential of mitigating emission of 12 Mt CO_2e per year[62].

[59] *https://www.cgiar.org/innovations/zero-tillage-to-reduce-air-pollution-in-india/*
[60] *Cost effective opportunities for climate change mitigation in Indian agriculture, CIMMYT|University of Abardeen*
[61] *Cost effective opportunities for climate change mitigation in Indian agriculture, CIMMYT| University of Abardeen*
[62] *Cost effective opportunities for climate change mitigation in Indian agriculture, CIMMYT| University of Abardeen*

Efficient fertilizer usage

Improved fertilizer application techniques, such as using slow-release fertilizers and targeted nutrient-specific application, can enhance nutrient uptake efficiency and reduce N_2O emissions. By deploying improved and precision nutrient management technologies, using bio-fertilizers, neem coated urea and other improved supplements, emissions of almost up to 0.20 t CO_2e per hectare per year could be potentially mitigated[63] leading to emission mitigation of 17.5 Mt CO_2e per year[64].

In addition, cost incurring activities such as application of biochar, on an average, results in significant GHG abatement, in the range of 10.3 to 15.7 t CO_2e per hectare per year[65]. Further, the usage of biofertilizers can help restore soil health by increasing soil organic matter while sequestering about 1.4 t C per hectare per year[66].

Other water management options such as sprinkler, or micro-sprinkler irrigation and fertigation together, offering a technical potential to mitigate emission of 5.5 Mt CO_2e per year.[67]

Burning of crop residues

Indian agriculture produces about 500-550 million tons of crop residues annually. A large portion of this, about 90-140 million tons, is burnt on-farm primarily to clear the field for sowing of the succeeding crop[68]. This practice is more prominent in rice-wheat-maize systems where large areas are subject to combine harvesters, leaving behind crop residues that are burnt in the field. This biomass burning has considerable impact on the overall emissions. With proper regulations in place and with reducing incidences of field burning of the residues about 2 Mt CO_2e of GHG emission could potentially be mitigated per year.

Proper residue management, such as avoiding burning and instead incorporating stubble into soil or baling crop residues, helps to retain carbon in the soil and minimize CH_4 emissions. Crop residues could also be used in production of soil amendments such biochar and organic amendments, that if applied to soils, can also contribute to CH_4 and N_2O mitigation by improving soil conditions and nutrient availability.

3.1.2 Potential mitigation options in livestock

The CIMMYT and University of Abardeen study estimated that technical GHG emission mitigation potential from livestock in India was 23.17 Mt CO_2e per year under mitigation scenario. Efficient management of nutrients, feed supplements and manure management reduce emissions from livestock.

[63] *Cost effective opportunities for climate change mitigation in Indian agriculture, CIMMYT|University of Abardeen*
[64] *Cost effective opportunities for climate change mitigation in Indian agriculture, CIMMYT |University of Abardeen*
[65] *World Bank report on carbon sequestration in agricultural soils*
[66] *World Bank report on carbon sequestration in agricultural soils*
[67] *Cost effective opportunities for climate change mitigation in Indian agriculture, CIMMYT| University of Abardeen*
[68] *NAAS (2002) National Academy of Agricultural Sciences (2012) Management of crop residues in context of conservation agriculture. Policy paper No. 58, NAAS, New Delhi, 12 p*

Enteric fermentation

Enteric fermentation from livestock was identified as the largest contributor to the emissions from agriculture sector. Most of the CH_4 from ruminant livestock originates from microbial fermentation of carbohydrates in the rumen and the lower digestive tract, referred to as enteric CH_4 emission. CH_4 production in ruminants depends upon quality, quantity of feed, type of animal and digestibility of pasture and feeds. Thus, efficient management of feed was identified as a key contributor to reduction of emissions.

Mitigating CH_4 emissions from enteric fermentation can be direct (i.e., targeting ruminal methanogenesis and emissions per animal or unit of feed consumed) or indirect, by increasing production efficiency (i.e., reducing emission intensity per unit of product). The two main measures identified to reduce enteric fermentation include,

1. Improved animal diets (higher quality, more digestible livestock feed), supplements, and feed additives (reduce methane by changing the microbiology of the rumen) such as methane inhibitors (certain type of tannins or lipid supplements).
2. Animal management and breeding (improve husbandry practices and genetics) – this includes breeding and selecting animals with lower methane emission characteristics.

Improved feed digestibility through the provision of highly digestible fodder (e.g. green fodder) and inclusion of energy-dense food (i.e. increased concentrate feeding) was estimated to have a mitigation potential of 3.4 Mt CO_2e per year. Use of feed additives such as monensin pre-mix and molasses urea products for ruminants together offered a technical mitigation potential of 7.4 Mt CO_2e per year. Other GHG mitigation options identified for the livestock sector in India included dietary management of pigs and small ruminants (2 million credits per year) and improved manure management through vermicomposting (1 million credits per year).

In addition, the study findings suggest that improved manure management through establishment of large biogas plants had the potential to mitigate 9.37 Mt CO_2e per year.

Manure management measures identified include,

1. **Anaerobic Digestion**: Implementing anaerobic digestion systems[69] can help capture and utilize the biogas produced during the decomposition of manure, reducing CH_4 emissions. This process also reduces the potential for N_2O emissions by providing controlled conditions for the decomposition of organic matter.
2. **Inhibitor Application**: Applying nitrification or urease inhibitors to stored manure or urine patches can help minimize the conversion of nitrogen compounds to N_2O. These inhibitors reduce the microbial processes responsible for N_2O production, thereby mitigating emissions.
3. **Composting**: Composting manure can promote aerobic decomposition, reducing CH_4 emissions compared to anaerobic decomposition. Proper management practices during composting can also minimize N_2O emissions.
4. **Improved Storage and Application Practices**: Implementing proper manure storage and handling practices, such as covering storage facilities to reduce exposure to air, can minimize CH_4 emissions. Precise application techniques that avoid excessive nutrient deposition and reduce nitrogen losses can also help mitigate N_2O emissions.

[69] *Anaerobic Digestion Systems use digestion process through specific bacteria which breakdown organic matter such as animal manure, food wastes etc., in the absence of oxygen to produce biogas.*

5. **Grazing Practices**: Adopting appropriate grazing practices, such as rotational grazing, can help minimize manure deposition in concentrated areas, reducing CH_4 and N_2O emissions associated with manure deposition and nutrient runoff.
6. **Alteration of Livestock Diets**: Modifying livestock diets to reduce nitrogen excretion can contribute to mitigating N_2O emissions. Balanced and optimized diets can enhance nutrient utilization, reducing the amount of nitrogen excreted in manure.

The aforementioned carbon credit generation potential in lieu of the estimated GHG emission mitigation potential is over and above the established carbon credit generation through carbon sequestration activities such as agroforestry, forestry and other land use methodologies or solutions. Select agronomic activities that could generate carbon credits through carbon sequestration include:

Agroforestry

The carbon sequestration in agroforestry is quite significant due to its large time-averaged biomass, which is at least five times higher than the per-hectare rates of enhanced annual cropping practices without trees[70]. The carbon sequestered differs greatly depending on region, types of species, system, site quality, and previous land-use. The contribution of agroforestry in soil carbon sequestration can be up to 3.98 t C per hectare per year[71].

Improved cropping pattern & cover cropping

Practices such as crop rotation, inter cropping & cover cropping can be instrumental in improving soil health, thereby, improving soil organic carbon. Crop rotation with nitrogen fixing crops or green manuring crops can aid in nitrogen fixation while improving nutrient availability for the plants. Intercropping allows two or more crops to be grown on the same patch of land with an aim to obtain greater yield. Cover crops provide multiple benefits ranging from soil conservation, moisture regulation and reduced incidence of pathogens. They act as mulch and can be further used as fodder for livestock. The GHG abatement of cover crops is estimated at 1.7 to 2.4 t CO_2e per hectare per year, while that of crop rotation is 0.7 to 1.5 t CO_2e per hectare per year[72].

Crop diversification

It refers to the addition of new crops or cropping systems in a given area. It can entail addition of varietal, species or allied activities. This boosts resource efficiency, dietary diversification and augments farmer income. For instance, a meta-analysis of soil organic carbon reserve changes in Indo Gangetic Plains showed that crop diversification resulted in an incremental reserve of soil organic carbon in the range of 0.16 and 0.49 t C per ha per year[73].

[70] *https://www.cropin.com/blogs/carbon-farming*
[71] *https://krishi.icar.gov.in/jspui/bitstream/123456789/67642/1/2016_6.22_Potential%20of%20AF_Indian%20Journal%20of%20Agricultural%20Sciences.pdf*
[72] *World Bank report on carbon sequestration in agricultural soils*
[73] *TERI Policy brief, September 2020 (Estimation of the Current Emission and Sequestration, As Well As Future Potential of Sequestration/Emission Reduction to Achieve Land Degradation Neutrality in India); https://www.teriin.org/sites/default/files/2021-02/estimation-current-emission.pdf*

Protecting/restoring wetlands & peatlands

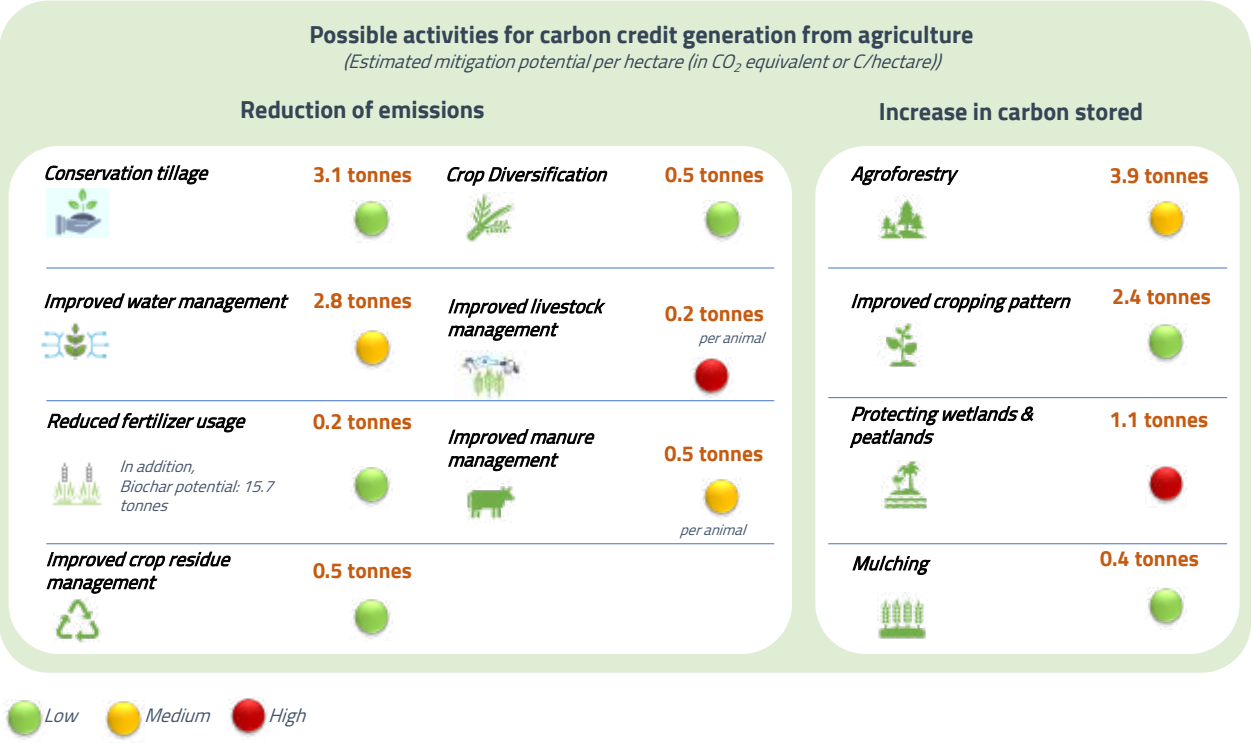
Stopping drainage and rewetting of wetlands & peatlands can aid in storage of carbon. It also helps in biodiversity enhancement and reduction of flood risks. Restoration of wetlands can over time become net carbon sinks with sequestration rates ranging from 0.35 to 1.10 t C per hectare per year.[74]

Mulching

Mulching refers to the practice of covering the soil for better plant growth & yield. As the biomass in the soil increases, it allows significant soil organic carbon sequestration. A study suggests that a combination of conservation tillage with mulching sequestered nearly 0.4 t C per hectare per year[75].

Various cost-effective measures described above for carbon credit generation from agriculture are mentioned in Exhibit 21 below.

Exhibit 21: Options for carbon credit generation from agriculture



Colour of bubble represents the relative average cost per unit of CO_2 abated

Source: Various research study reports available in public domain, Industry sources; YES BANK Analysis

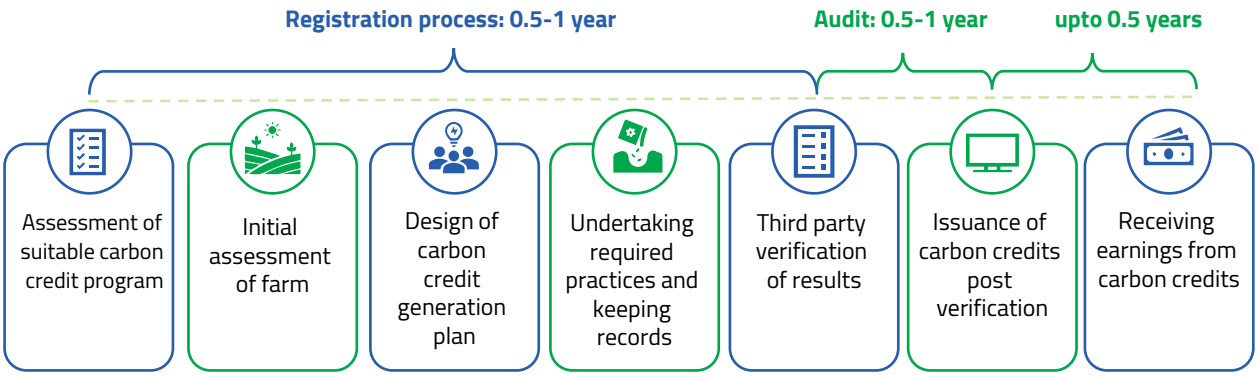
[74] https://www.sciencedirect.com/science/article/pii/S2772656822000367

[75] https://www.sciencedirect.com/science/article/pii/S0167880919300258

3.2 Carbon projects in agriculture: process flow and timelines

Generating carbon credits at the farm level involves multiple stages, including assessing the appropriate carbon credit program, initial assessment of the farm, designing the carbon credit generation plan, undertaking required practices and keeping records, third party verification of the results, issuance of carbon credits post verification and receiving earnings from carbon credits (refer exhibit 22)

Exhibit 22: Indicative process flow and timeline# of carbon credit project



#Timeline will vary as per project type. For the first time applicant the total duration could be upto 3 years

Source: Industry discussions, YES BANK analysis; C-GEM website

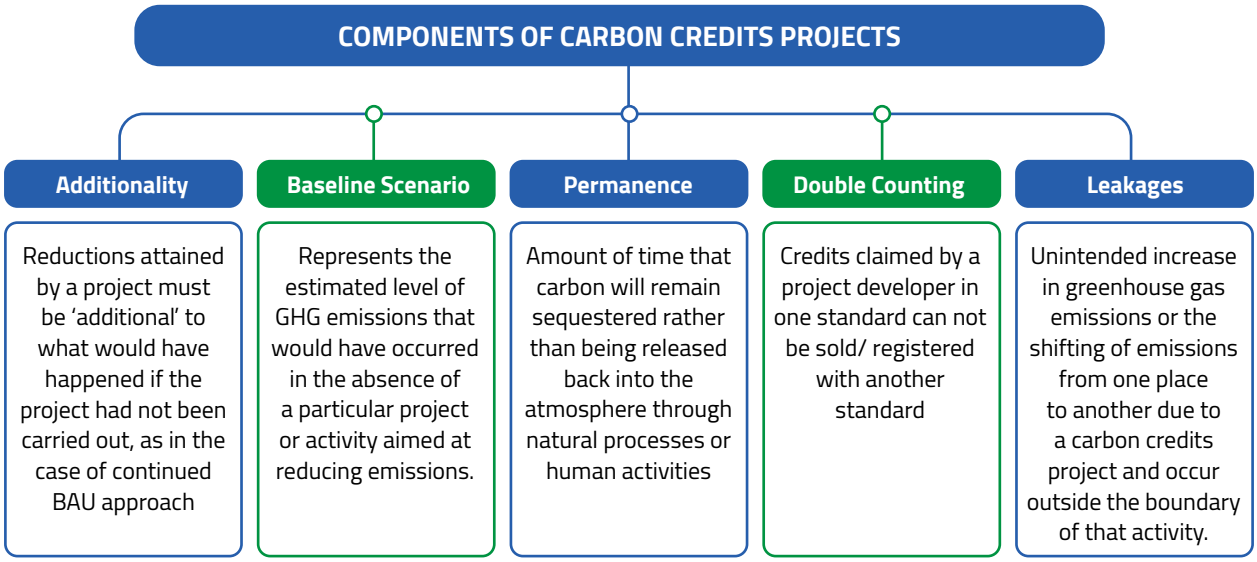
As per Industry sources, the registration of the project on an average takes up to 1 year, followed by the third-party verification which takes about 0.5 to 1 year.

The generation of carbon credits is followed by its assessment which entails its measurement, reporting, verification and finally its sale in the market mechanism. Carbon assessment is done via standards and has two key aspects: the methodology used by the project developer to develop the project and the validation/ verification bodies (third-party auditors) to assess the authenticity of the project.

Each standard has its own methodology that helps quantify a project's actual GHG benefits and provides guidance to help project developers determine project boundaries, set baselines, assess additionality, and ultimately quantify the reduced or removed GHG emissions. The key components such as, additionality, baseline scenario, permanence, double counting and leakage (refer exhibit 23) are assessed in each methodology and are integral in determining the quality and price of the offsets[76]. Other components can also be added depending on the project type and its purpose.

[76] *https://www.worldwildlife.org/publications/what-makes-a-high-quality-carbon-credit*

Exhibit 23: Components of carbon credits projects which are assessed



Source: Carbon Credit Guidance for Buyers by WWF 2020, YES BANK Analysis

The carbon credits generated are measured in terms of volume (carbon sequestered/GHG abated), impact (economic, environmental and social) and co benefits generated. The most commonly used tools for carbon assessment in agriculture are listed in the exhibit 24.

Exhibit 24: Carbon assessment tools in agriculture

Life Cycle Assessment

Evaluation of environmental impacts of agricultural activities throughout their entire life cycle, from production to consumption

Limitations:

Requirement of intensive data

Data variability on location basis

Assessment issues based on project boundaries

Soil Carbon Modeling

Estimation of carbon sequestration in soils based on factors such as soil type, land management practices, and climate conditions

Limitations:

Influence of external & uncertain factors Local variation in soil properties due to site specificity

Emission Factors

Estimation of GHG emissions from specific agricultural activities

Limitations:

Average values used in calculation can lead to less accurate estimations

Carbon Footprint Calculators

User-friendly tools for farmers to estimate the farm's carbon footprint based on inputs

Limitations:

Oversimplification of complex agri-systems Limited scope of estimation

Agroforestry and Reforestation Models

Assessment of carbon sequestration potential of agroforestry practices and reforestation projects

Limitations:

Long term predictions can be altered by uncertain factors

Crop-Specific Models

Evaluation of emissions and sequestration related specific crop types

Limitations:

Models for specific crops may not cover the full range of crop varieties and practices limiting applicability

Remote Sensing & GIS

Monitoring of land-use changes, deforestation, and other activities affecting carbon stocks

Limitations:

Cloud cover can hinder data collection consistency

Availability of open-source data with fine scale features

Integrated Assessment Models

Comprehensive tools that combine climate, economic, & agricultural data to analyze the potential impacts of different policy scenarios on agricultural emissions & sequestration

Limitations:

Requirement of high technical expertise

Validity of assumptions depends on interactions between factors

Customized Farm Audits

Detailed assessments conducted by experts or certification bodies to evaluate a farm's carbon emissions and sequestration potential

Limitations:

Cost & time intensive

Potential subjectivity in assessments

Source: ILCD Handbook- European Commission - Joint Research Centre - Institute for Environment and Sustainability; FAO; US EPA; Coolfarm.org; NICRA Technical Bulletin; UNFCCC REDD; UNFCCC; Climatexchange.org.uk; YES BANK Analysis

These tools are used in appropriate combinations depending on the specific goals and characteristics of the agricultural project under assessment for obtaining accurate and reliable carbon assessments they comprise of diverse methodologies each offering valuable insights into specific aspects of agricultural emissions.

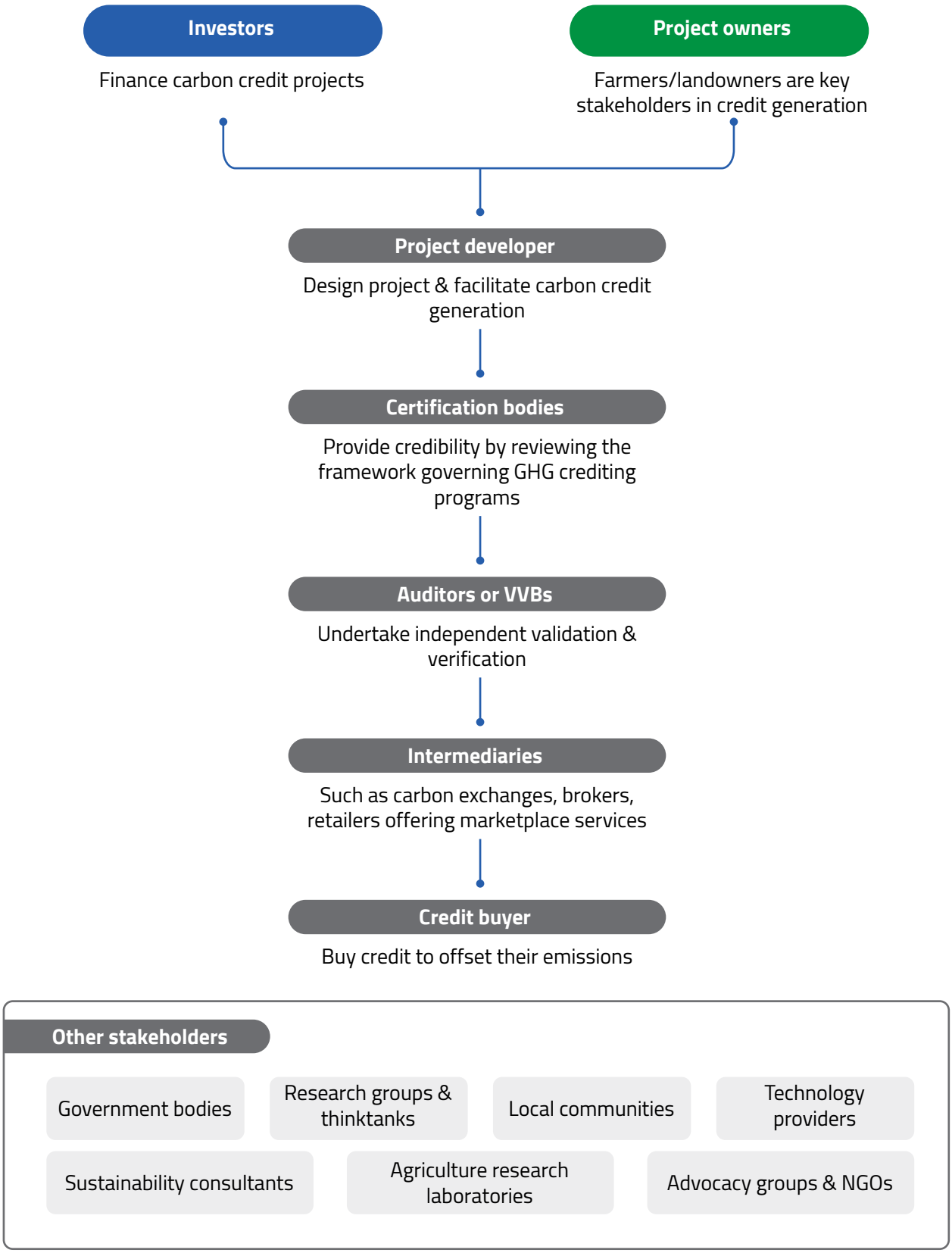
Several internationally recognized validation verification bodies (such as Verra, the Gold Standard, Plan Vivo) emphasize on the need for effective methodologies accounting for short-term and long-term carbon dynamics in diverse agricultural landscapes and robust tools which incorporate site-specific data to enhance the accuracy and credibility of agricultural carbon assessments.

Tackling the limitations of carbon assessment tools (refer exhibit 24) in agriculture necessitates a collaborative effort among various stakeholders as it requires investment in research, data collection, capacity building and technology development. As the agricultural sector plays an indispensable role in climate change mitigation and adaptation, development of advanced carbon assessment tools is of paramount importance, reinforcing the foundation of carbon credit projects and fostering sustainable and resilient agriculture.

3.3 Stakeholders engaged in carbon projects

Establishing a robust supply chain for carbon credit generation in the agricultural sector requires collaborative action of a multitude of stakeholders, ranging from farmers to government agencies, project developers, NGOs, financial institutions and local communities (refer exhibit 25). A snapshot of key stakeholders involved and their roles in the ecosystem are captured herewith.

Exhibit 25: Overview of key stakeholders in the carbon market ecosystem



Source: Industry Sources, YES BANK Analysis

- **Farmers / landowners** are the key stakeholders of the supply chain who need to implement recommended agronomic practice that stores carbon or reduces carbon emissions.
- **Project developer/ Credit aggregator** are the organizations that serves as the support system for farmers in identification, creation and delivery of the carbon farming opportunities. They create and sell the offset. They act as facilitators for carbon credits generation by supporting at all stages from contacting the farmers, helping them select practices for carbon sequestration, arranging the fees for standards/certification bodies, and facilitating the sales of the offsets. Project developers mostly own the credits and share of the benefit is passed to the farmers.
- **Agriculture research labs and laboratory** provide technical and operational support to the project developers for administering the program, collecting and testing soil samples, establishing the carbon content, and undertaking other field-based measurements.
- **Standards or certification bodies** are responsible for confirming that the practice of carbon mitigation or sequestration is as per protocols, thereby establishing the credibility of the generated carbon credits. These oversight bodies are responsible for reviewing initial project design, as well as evaluating and approving the verification of carbon credits. Projects seeking certification from reputable standards programs are subject to meticulous scrutiny, ensuring that the carbon offsets generated meet stringent criteria. These criteria include being additional, accurately quantified, permanent, unclaimed by other entities, and free from any negative social or environmental impacts.
- **Validation and Verification Bodies (VVBs) or Auditors:** Qualified, independent third-party auditors known as validation or verification bodies (VVBs) are tasked with assessing projects against the standard's rules and the requirements of the applied methodology. After a project implements its activities and monitors progress – documented in monitoring reports – a VVB undertakes verification, to confirm that all emission reductions or removals are quantified according to the standard's requirements.
- **Intermediaries** include exchanges, brokers and retailers who provide market place services.
- **Purchaser** is an organisation or entity that is the end buyer of the carbon offset. In other words, they buy the listed carbon credit to offset their emissions and hence now "own" the carbon credit.

Other key stakeholders involved in the carbon credits market who also play an integral role in its functioning include:

- **Governments and Regulatory Bodies** play a crucial role in designing, implementing, and enforcing carbon credit policies and trade practices. They establish policies, set emission reduction targets, and create regulations to govern the carbon market. For instance, UNFCCC is the international body that governs regulations of CDM at a global level while the Bureau of Energy Efficiency (BEE) along with Ministry of Environment, Forests and Climate Change (MoEFCC) approves CDM projects in India.
- **Investors and other Financial Partners** are external partners such as VC funds, agri-business organizations, Financial Institutions or other investors who fund the project developer.
- **Research and Think Tanks** such as the World Resources Institute (WRI) and the Council on Energy, Environment and Water (CEEW), play a significant role in advancing the understanding, development, and implementation of carbon credits. They do it via policy advisory and advocacy, thought leadership and knowledge sharing. They conduct in-depth research, analysis, and share recommendations, knowledge, best practices, and lessons learned to empower project developers, governments, and other stakeholders to effectively participate in the carbon market.
- **Sustainability Consultant** provides end-to-end carbon credit consulting services for handholding project developer to implement projects.

3.4 India's policies environment: positives for agriculture

India has continued to demonstrate climate leadership and a firm commitment in achieving its climate targets. India's emission intensity has reduced by 24% between 2005 and 2016 keeping itself on track to meet its voluntary declaration to reduce the emission intensity by 20% to 25% from 2005 levels by 2020[77]. Additionally, the Government has been continuously working to frame policies in accordance with global climate targets and its NDCs. To achieve these ambitious targets, India would need diverse decarbonization efforts on a larger scale. The agriculture sector has significant potential to act as a key driver in the country's efforts to achieve the updated NDC goal of reducing emission intensity of the GDP by 45% by 2030 against 2005 levels. A snapshot of India's policy measures focusing on reduction of carbon footprint and their impact on carbon credit generation from the agriculture sector is captured in the exhibit 26 below.

Exhibit 26: Snapshot of India's policies regarding carbon credits and their impact on agriculture sector

Policy measures and their features	How it impacts agriculture sector?
National Action Plan on Climate Change (NAPCC) ▪ National-level plan that outlines India's climate change mitigation and adaptation goals Includes eight missions under it, one of them is National Mission on Sustainable Agriculture (NMSA), that focuses on sustainable development of agriculture through use of improved crop seeds, water use efficiency, integrated pest management, credit support and improved access to markets.	Includes components such as rainfed area development, sub mission on agroforestry, national bamboo mission, soil health management, climate change and sustainable agriculture: monitoring, modeling & networking which help achieve sustainability in agriculture.
Establishment of National CDM Authority (NCDMA) ▪ To comply with the Kyoto Protocol, NCDMA was established to facilitate a streamlined process for approving CDM projects in the country	Aids in approval of AFOLU CDM projects
India's alignment with commitments under Paris Agreement ▪ In alignment with its commitments under the Paris Agreement, the MoEFCC has recently constituted the high-level inter-ministerial Apex Committee for Implementation of the Paris Agreement (AIPA), chaired by the Secretary of MoEFCC. The assigned responsibilities of the committee include serving as the national authority responsible for overseeing carbon markets, formulating guidelines for evaluation of projects, carbon pricing and market mechanisms in India under Article 6 of the Paris Agreement.	Could possibly consider carbon credit generating projects in agriculture as key contributors to climate action.

[77] *India Third Biennial Update Report to the United Nations Framework Convention on Climate Change (UNFCCC), Ministry of Environment, Forest and Climate Change, 2021*

The Energy Conservation (Amendment) Bill, 2022 ▪ The amendment to the Energy Conservation Act, 2001, provides for establishment of a carbon credit market in India with the objective of incentivizing actions for emission reduction. The carbon credit certificate (CCCs) will be issued by the central government. Any other person or entity may also purchase ESCerts or carbon credit certificates on a voluntary basis. ▪ It seeks to improve energy efficiency by mandating non fossil fuel-based energy sources for decarbonization of the economy. The amendment focused on meeting the nationally determined contribution and COP-26 commitments.	Carbon credit generation related activities can be taken up by farmers as an added revenue source. Set up of the domestic carbon market further expands the opportunity for Indian farmers to address carbon markets.
Green Credit Programme (GCP) ▪ The program proposes set up of Carbon Credit Trading Scheme including all its associated bodies such as accredited carbon verification agency or VVB bodies and registry. ▪ This market will replace the existing schemes, namely the Perform Achieve and Trade (PAT) Scheme, Renewable Energy Certificates (REC), and Clean Development Mechanism (CDM). ▪ The market mechanism will be bifurcated into two segments, o The compliance market, which will transition from the PAT scheme, and o The offset market, which will move from project-based REC/CDM to a carbon credit trading mechanism. ▪ Within the domestic carbon market, Carbon Credit Certificates (CCCs) will play a significant role and will be issued in three distinct types based on specific conditions. They include, converted CCCs (converted from ESCerts and RECs), offset CCCs (O-CCC) for entities operating under the carbon offset mechanism and mandatory CCCs (M-CCC) for achieving targets set in phase II of the Indian Carbon Market. ▪ The draft paper released for stakeholder consultation by Ministry of Power proposes the establishment of the domestic carbon market will be carried out through a phased approach, with phase-I spanning from 2023 to 2025, and phase-II starting from 2026 onwards. ▪ Eight sectors are identified under the Green Credit Program and thresholds and benchmarks would be eventually developed for each of these sectors.	Sustainable agriculture has been identified as a key sector for generation of green credits. This will promote natural & regenerative agriculture and land restoration. Apart from this the remaining sectors (such as tree plantation, water and waste management) are indirectly linked to agriculture & allied sector as well. This will foster increased adoption of sustainable agriculture practices.

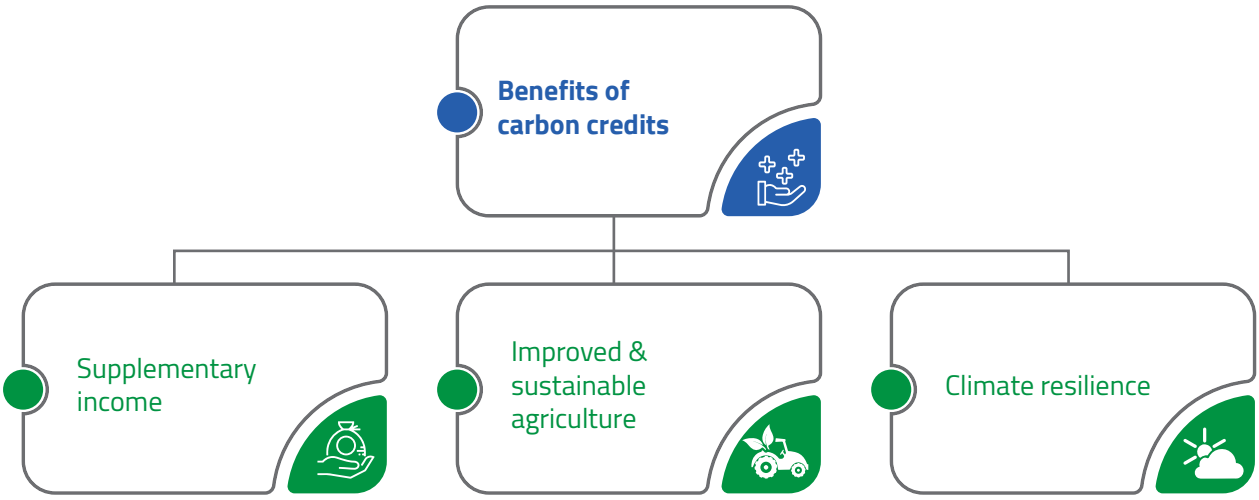
Source: NAPCC PIB; PIB; PIB; Economic times; PRS India; YES BANK Analysis

3.5 Benefits of carbon credits for farmers

Carbon credit markets provide financial incentives to the farmers through the trade of carbon credits. The effectiveness of this incentivization can be seen by the growing registrations of private projects in the Voluntary Carbon Markets.

The other indirect benefits that farmers gain is the improvement in the soil health due to the carbon sequestered. Higher soil carbon leads to the increased water holding capacity of the soils, lowering soil densities, improved nutrient availability and increased soil biodiversity. By adopting sustainable farming practices such as agroforestry, organic farming, and efficient irrigation methods, farmers can significantly reduce their carbon footprint and generate carbon credits. A snapshot of benefits from carbon credit markets that could accrue to farmers is captured herewith (refer exhibit 27).

Exhibit 27: Benefits from carbon credits to farmers



Source: Industry Sources, YES BANK analysis

1. **Supplementary Income:** Farmer households in the country have an average monthly income of about Rs. 10,218[78]. Income generated from trade of carbon credits could act as supplementary income to these farmers. By 2030, the global demand for CO_2 offset (of about 1.1 Gt) is expected to exceed the carbon credit supply, resulting in a significant price increase of voluntary carbon credits[79].
2. **Improved and Sustainable Agriculture:** Extensive use of chemical farm inputs, coupled with mono-cropping and intensive irrigation methods, has led to increased land degradation. Inefficient irrigation practices have resulted in waterlogging and increased salinity in agricultural lands, further deteriorating soil health. Conventional agricultural practices have had a detrimental impact on the long-term sustainability of Indian agriculture, highlighting the need for a shift towards eco-friendly and sustainable farming practices. About 60% of the geographical area in India faces soil degradation (waterlogging, salinity, and alkalinity).[80]

[78] *Income of Farmers, Ministry of Agriculture & Farmers Welfare (PIB dated, 16th Dec, 2022)*
[79] *https://agriculturepost.com/opinion/how-carbon-credit-programmes-can-benefit-farmers-while-combating-climate-change/*
[80] *R.B Singh, Environmental consequences of agricultural development: a case study from the Green Revolution state of Haryana, India, Agriculture, Ecosystems & Environment, Volume 82, Issues 1–3, 2000, Pages 97-103, ISSN 0167-8809, https://doi.org/10.1016/S0167-8809(00)00219-X.*

Practices adopted for carbon credit generation are mostly regenerative agriculture practices, having positive impact on natural resources (improved water-holding capacity of soil, increase in soil organic carbon, better nutrient availability, water use efficiency). Studies indicate that a 1% increase in soil organic matter helps soil hold 20,000 gallons more water per acre[81]. Climate resilient practices also reduce the need for chemical fertilizers and pesticides in the long run. These practices help farmers optimize production costs.

3. **Climate Resilience:** Adopting climate positive practices help farmers adapt to the vagaries of climate events better, reducing their risk of loss due to climate events.

3.6 Challenges faced by farmers to access carbon credit ecosystem

An overview of challenges faced while facilitating farmers access carbon markets is captured herewith.

High upfront adoption cost

The high initial cost associated with adoption of sustainable processes makes it economically unviable for farmers to take up climate positive agronomic activities, unless incentivized appropriately. Additionally, the adoption of climate smart agricultural activities could lead to reduction in farmer income compared to that that farmers could earn using conventional agricultural practices.

Long time period

Farmers need to continue carbon sequestration activities for a number of years (depending on the projects) to be eligible for receiving carbon credits.

Lack of knowledge

Limited information on appropriate carbon credit related cultivation methodologies & techniques suitable for local conditions, market access and price discovery is a major hurdle for the producers to address the carbon markets opportunity.

Complex monitoring and verification process

The processes involved in the measurement and validation of carbon credits are complex, cost intensive, time consuming and highly technical. These exhaustive protocols can be overwhelming for the farmers if not provided with adequate financial support & handholding.

Low scalability

The local variation of agroclimatic zones in the Indian ecosystem could lead to low scalability, making it less viable for project developers to consider vis-à-vis other carbon credit generation opportunities.

Structural barrier

Factors such as absence of property rights, unclear documentation regarding land & tree tenure and farm size hinder the viability of executing carbon projects in agriculture. The impact of these problems is significant particularly in case of long-term agroforestry projects.

Inconsistent approaches to benefits & risk sharing

The complexity and diversity of the projects may create confusion among the farmers. This is further exacerbated by the information asymmetry at various stakeholder levels.

[81] *Bryant, Lara. "Organic Matter Can Improve Your Soil's Water Holding Capacity." NRDC, 27 May 2015, www.nrdc.org/bio/lara-bryant/organic-matter-can-improve-your-soils-water-holding-capacity.*

3.7 Pathways for farmers to access carbon markets

Carbon markets generally involve high costs of registration with standards, strenuous monitoring and verification process and complex technicalities associated with the emission monitoring process, thereby making it difficult for individual farmers to address opportunities arising out of these markets. However, Multiple projects are being registered under the voluntary carbon markets from India as evidenced by the status of applications across CDM, GS and Verra Standards. Projects for India show the highest estimated emission reductions among countries, particularly under VM0042, improved agriculture land management projects (refer exhibit 28).

Exhibit 28: Indian projects submitted for certification under VM0042, Verra

Project	Estimated Annual Emission Reductions (metric ton of CO_2 equivalents)
Varaha ClimateAg Private Limited	4796219
Grow Indigo Private Ltd	4267622
Boomitra Inc	750000
Suminter India Organics	275748
Greneity Infocom Service Pvt Ltd	173250
Mahanadi Compressed Biogas (CBG) Private Limited	64457
Landmark Agri Exports Private Limited	58722
Multiple Proponents	52520
Biowin Agro Research	26639
Total	**10465177**

Source: Verra registry (accessed on17th July, 2023), YES BANK analysis

The potential of this market could be leveraged by collective participation including:

1. **By utilizing the Farmer Producer Organizations (FPOs) pathway:** FPOs provide a collective platform to access carbon markets, by serving as a medium of knowledge transfer, lowering the transaction costs and providing community support. FPOs could provide farmers with training on climate-friendly practices that are suitable for their farm, facilitate in large scale monitoring of emissions and facilitate in verification and sale of carbon credits. Exhibit 29 captures a case study of how FPOs can facilitate farmers access carbon markets.

Exhibit 29: Case study of Kosher Climate's rice project with FPOs

Kosher Climate India Private Limited – Improved Agricultural Practices for Rice Cultivation in India

Kosher Climate's Improved Agricultural Practices for Rice Cultivation in India project aims at generating multiple co-benefits for the farmers including improvement of soil health, reducing pest attacks, reducing water usage, and economic incentives for implementing the project. The project covers a total area of 16,000 ha across West Bengal and Assam with an aim to reduce the CH_4 emissions through improved water management practices involving Alternate Wetting and Drying (AWD) of paddy fields.

Kosher on boarded FPOs acting as their implementation partners on-ground. The farmers of these FPOs are smallholder farmers practicing traditional continuous flooding method of rice cultivation.

Farmers are first registered under the project and further supported at field level through farm advisory, data collection and monitoring. Kosher further provides support in documentation and registration of the project.

Source: Kosher Climate India Private Limited

2. **Associating with Project Partners:** Project developers help manage the carbon credit generation end to end from advising on best farming practices, to registration in voluntary carbon standards and the registration costs. Technical assistance is also provided in the form of soil sapling, seeds etc.

   Farmers could associate with project developers in two ways. One, where the farmer sells the entire project, control, and credits to the aggregator as per the terms and conditions set up in a contract. The aggregator then has complete control over carbon credits, when to sell, price, and data shared. The farmer gets paid initially and all the investment and risk of the project including the sales of carbon credits is borne by the project developer. Second, where the project developer is merely a facilitator and the final ownership of carbon credits along with its income go to the farmers. Here, however farmer need to bear the initial cost and risk.

Exhibit 30: Case study of Grow Indigo's regenerative agriculture in rice-wheat-maize systems

Grow Indigo Private Limited – Regenerative agriculture in Rice-Wheat-Maize system for income generation

Grow Indigo's Regenerative agriculture in Rice-Wheat-Maize system for income generation project aims at enabling additional income sources to smallholder farmers by linking them to carbon markets. The project is operational in Haryana, Punjab and NCR region. It aims to support the farmers to overcome critical barriers in practicing regenerative agriculture like access to agronomic advisory and cost of technology adoption thus leading to emission reduction & removal by 4.2 Mt CO_2e each year.

Grow Indigo's technological innovation allows small farmers to group into a single project delivering the benefits of economies of scale. Contracts and tailored agronomic support help farmers get the most value out of carbon farming in long-term, both from carbon credit income and from soil health improvements. In partnership with leading organizations in the value chain, Grow Indigo uses its digital agronomy capabilities and satellite imagery analysis to measure and verify soil carbon sequestration and on-farm GHG emission levels. Once the impact has been verified, farmers are paid based on the amount of Carbon sequestration/GHG reduction.

To enhance the understanding about carbon farming amongst farmers, Grow Indigo launched 'Carbon Kaksha' initiative. It is a series of short videos that talk about carbon farming, to build awareness and vocabulary around carbon and regenerative agriculture on the ground.

Source: Grow Indigo Private Limited

3. **Onboarding with NGOs/Foundations or Corporates:** NGOs/Foundations & Corporates could act as project developers and provide handholding to farmers for developing carbon credit projects. They could provide technical assistance, market linkages and cover the financial costs to help the farmer. (refer Exhibit 32 and 33).

Exhibit 31: Case study of CGEM regenerative cotton project

Centre for Grower-centric Eco-value Mechanisms, known as C-GEM is the world's first farmer-centric non-profit platform incubated under Aga Khan Rural Support Programme (India)'s Climate Change vertical, aiming to accelerate the adoption of agroecology by leveraging ecosystem markets (Carbon, water, biodiversity) for farmers transitioning toward agroecology. C-GEM aims to incentivize farmers to take up agroecological transformations while de-risking and supporting transitioning farmers by providing additional revenue streams to compensate for ecosystem services provided by such transition.

C-GEM onboard, handhold, and negotiate climate market mechanisms for grassroots communities and maintain accountability and transparency in the carbon markets and other climate financing mechanisms for public stakeholders. C-GEM portfolio includes three high-value projects with nine partners in 4 states, covering 60,000 farmers and 75,000 ha for Natural Farming, Agroforestry, and Social Forestry projects.

As part of their regenerative cotton project, they are working with 25,000 farmers covering 30,000 hectares in the Saurshtra region for transitioning them to adopt regenerative practices with the support of Aga Khan Rural Support Programme (India) as the proponent and implementation partner while Varaha Pvt Ltd as the Carbon Programme Consultant and tech partner. This programme is unique in that it explicitly emphasizes the principles of data rights and protection, in the Carbon Sharing Agreements. C-GEM will serve as a facilitator and accountability partner in the supply chain to ensure the production of high-quality carbon credits, which will be sold to premium and ethical buyers."

Source: C-GEM

Exhibit 32: Case study of Bayer India's sustainable rice project

Bayer India – Sustainable Rice Project

Bayer India's Rice Sustainability Initiative aims to combat climate change by helping farmers adopt new techniques like Direct Seeded Rice (DSR) and Alternate Wetting & Drying (AWD) in rice cultivation. Through these techniques the program targets to mitigate greenhouse gases released into the atmosphere and reduce the water consumption, while giving farmers transparently priced rewards for reduced emissions.

The company has on boarded farmers jointly with their implementation partners and individuals by signing an agreement for a long-term commitment with a minimum of 10 years to be part of this project. These farmers are provided advisory support and handholding support throughout the project. The project promotes climate smart practices specific to the region. Through this project the farmers gain transparently priced rewards for reduced emissions. Other benefits for farmers included substantial reduction in water usage thus reducing GHG emissions, improved soil health, optimal utilization of fertilizers thereby also reducing N_2O emissions and also reduction in labour costs.

Source: Bayer India

4 Linking Farmers to Carbon Markets



Linking Farmers to Carbon Markets – Select Ecosystem Enabling Actions

Developing a robust carbon credit market for the agriculture sector requires careful planning, stakeholder engagement, and supportive policies. Major stakeholders including farmers, agribusinesses, verification bodies, financial institutions, and policymakers should be involved in the design and governance of the carbon credit market to address their challenges. Key recommendations at various stakeholder levels to create and promote a robust carbon market ecosystem catering to Indian agriculture are mentioned below.

1. Farmer Level

Project developers, certification agencies, agri-business corporates as well as policy makers could work in partnership mode to create an enabling ecosystem to link farmers to carbon markets. Initiatives that could be taken in partnership mode at farm level include:

- **Include and integrate diverse emission mitigating and carbon sequestering farm practices as eligible for carbon credit generation:** Recognize and accommodate various agricultural practices, including crop farming, livestock management, agroforestry, and conservation efforts. Policies should allow flexibility to reward diverse emission mitigation and carbon sequestration methods. Recognize and integrate indigenous and traditional farming systems that have sustainable land management practices which contribute to carbon sequestration.
- **Create farmer level awareness about carbon farming.** Knowledge sharing regarding best practices, techniques and technologies of the carbon credit generation will help in lowering the cost of accessing the markets and aiding to overcome the challenge of information asymmetry. Initiating farmer support & education program to improve awareness about farm-based carbon credits and other benefits such as climate resilience, livelihoods, food security and ecosystem. Encourage farmers to incorporate carbon farming into their long-term planning and crop management strategies, considering the multi-year nature of carbon sequestration.
- **Establish carbon market information hubs:** These regional or local hubs could serve as centres where farmers can access information, resources, and guidance on participating in carbon markets. These hubs can serve as knowledge centers and support networks. The KVK network could serve as the local hubs.

- **Enable carbon market access:** Create accessible and user-friendly platforms or marketplaces where farmers can register, certify, and trade carbon credits. Minimize administrative barriers and reduce transaction costs.
- **Incentivizing FPOs or cooperatives to create carbon credit farming cohorts:** This can create a significant impact in improving accessibility, cost economics and building resilience in the ecosystem.

2. Project Developer Level

Project developers could contribute by taking up the following initiatives

- **Create awareness across society about broader benefits of carbon farming:** Highlight and quantify the broader benefits of carbon farming, including improved soil health, water quality, and biodiversity conservation, to gain support from local communities.
- **Invest in farmer education and outreach programs** to raise awareness about the benefits of participating in the carbon credit market. Provide training on sustainable farming practices that contribute to carbon sequestration such as agroforestry, cover cropping, and reduced tillage.
- **Support the formation of farmers' cooperatives that collectively engage in carbon farming**. This can provide economies of scale and increase bargaining power in carbon credit negotiations.
- **Promote climate-resilient farming practices** that not only sequester carbon but also enhance the agricultural sector's capacity to adapt to climate change.
- **Develop risk mitigation strategies for farmers** participating in the carbon credit market, particularly in the face of climate variability and market fluctuations.
- **Encourage long-term contracts between farmers and carbon credit buyers** to provide stability and predictability in income from carbon credits.
- **Develop eco-labeling and certification programs** that allow consumers to identify and support products derived from carbon-neutral farming practices
- **Develop robust and user friendly carbon accounting tools and apps for agriculture projects** that allow farmers to measure and track their carbon emissions and sequestration. These tools should be easily accessible and tailored to different types of farming operations.
- **Institutionalizing access to carbon credits program by fostering partnerships:** FPOs, FPCs, NGOs and other social organizations along with project developers can help form partnership for implementing projects and accessing carbon credits market. These partnerships will enable farmers overcome issues in accessing carbon market due to land size constraint, lack of know-how and implementation.

3. Certification and Verification Agencies

Certification and verification agencies play a crucial role in the carbon credits ecosystem. They could contribute by taking up the following initiatives:

- **Develop Carbon Credit Standards for diverse agricultural crops and farming practices**: Develop and maintain robust, science-based standards for measuring and verifying carbon sequestration and emissions reductions in agriculture. These standards should be transparent, credible, and internationally recognized, covering a diverse set of agricultural crops and practices.
- **Encourage the adoption of technology** such as remote sensing, IoT devices, and blockchain for transparent and efficient tracking and verification of carbon credits.
- **Facilitate collaborations with international organizations and other countries to harmonize standards and regulations**, thus enabling trading of agricultural carbon credits across borders.

4. Other cross-cutting policy initiatives

Strong government support is required to promote the generation of carbon credits from agriculture through clear policy goals, adequate funding, and regular progress reporting to inspire confidence that carbon credit markets could work for agricultural projects. Select suggestions for boosting an enabling carbon market ecosystem for agriculture are captured herewith:

- **Establish clear and consistent regulations governing the creation, sale, and trading of agricultural carbon credits**. This framework should provide certainty and stability for market participants. Implement adaptive management approaches that allow policies and standards to evolve as new knowledge and technologies emerge.
- **Promote carbon credit aggregators:** Introduce intermediary organizations or aggregators that work with small-scale farmers to bundle carbon credits and simplify the process of selling them on the market.
- **Recognise and promote initiatives of agribusiness companies** that are focused on sustainable agriculture practices at farm level. This could include supporting research and development of climate resilient farm inputs (such as development of climate resilient seed varieties, low pollutant fertilizers including nano-fertilisers, green-chemistry and biological crop protection solution etc). Offer financial incentives such as subsidies, grants, or tax breaks to encourage companies or project developers to promote and encourage farmers adopt sustainable practices. These incentives can help offset initial costs.
- **Provide innovation grants for advancing science-based MRV technologies** to improve the quality of carbon credits from agriculture in India.
- **Fund supporting infrastructure that enables functioning of carbon programs**, like equipment for soil carbon analysis, easy access to weather and satellite data.
- **Enable research to generate data on soil carbon sequestration, methane, and nitrous oxide emissions from field-level experiments** to strengthen the power of quantification.

- **Integrate specific courses on carbon credits** as a part of undergraduate and graduate programmes in agriculture-based studies across the country to improve capacity building of local institutions for managing programs.

Actioning on these focus areas could enable a supportive ecosystem for farmers to actively engage in carbon markets, helping them mitigate climate change while improving their livelihoods through sustainable agricultural practices.



5 Annexure



5.1 Select Policy Initiatives in India

Government of India has been continuously working to frame its policies in accordance with global climate targets and its NDCs. A snapshot of India's commitments on climate targets is shown in the exhibit 34 below. To comply with the Kyoto Protocol, India established the National CDM Authority (NCDMA) within the Ministry of Environment, Forest, and Climate Change (MoEFCC) in December 2003[82] thus facilitating the development of a streamlined process for approving Clean Development Mechanism (CDM) projects in the country.

In alignment with its commitments under the Paris Agreement adopted during COP 21, the MoEFCC has constituted a high-level inter-ministerial Apex Committee for Implementation of the Paris Agreement (AIPA) in November 2020, chaired by the Secretary of MoEFCC.[83] AIPA's will serve as the national authority responsible for overseeing carbon markets in India under Article 6[84] of the Paris Agreement. Additionally, AIPA will be entrusted with formulating guidelines for the evaluation of projects or activities under Article 6 of the Paris Agreement, as well as issuing guidelines on carbon pricing and market mechanisms.

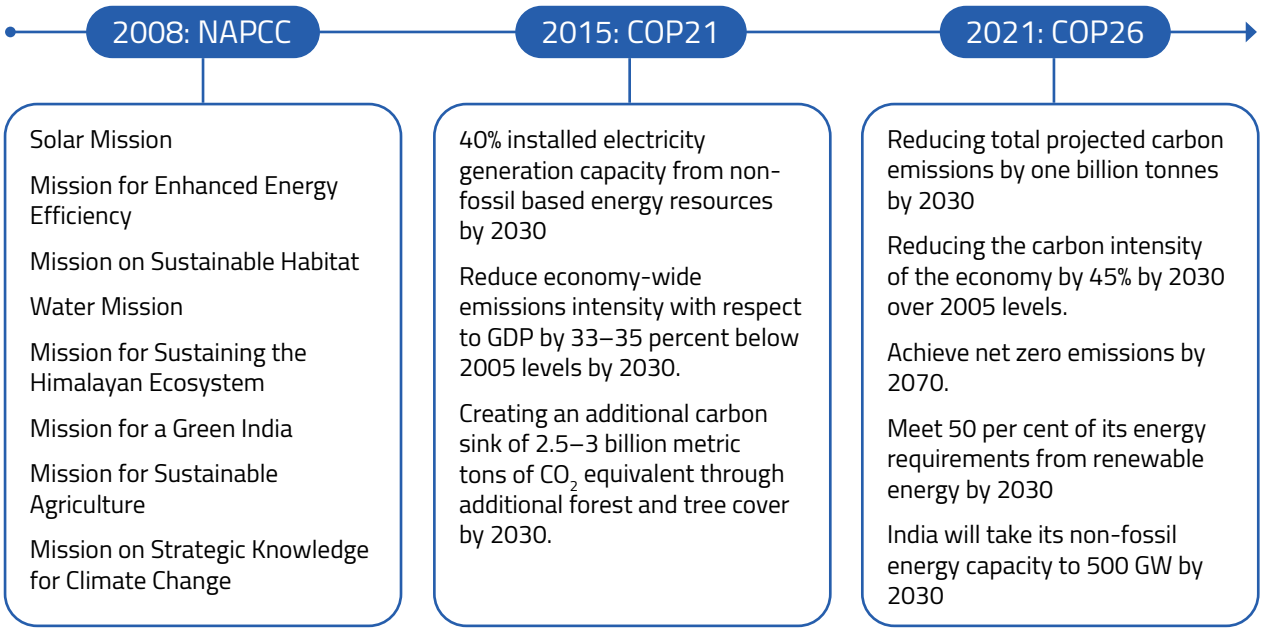


[82] *https://pib.gov.in/newsite/PrintRelease.aspx?relid=130132*

[83] *https://static.pib.gov.in/WriteReadData/userfiles/AIPA%20Gazette%20Notification.pdf*

[84] *Article 6 of the Paris Agreement is about international cooperation to reduce greenhouse gas emissions. It includes three market-based mechanisms, Emissions trading (Article 6.2), Sustainable Development Mechanism (SDM) (Article 6.4) and Results-based approaches.*

Exhibit 33: India's commitments on climate targets



Source: NAPCC, India at COP (PIBs); YES BANK Analysis;

With a view to optimize the emission reductions in the country, several vulnerability assessment and adaptation studies of climate change were carried out in various areas such as water resources, agriculture, forests, natural eco-systems, coastal zones, health energy and infrastructure as a part of the Initial National Communication of India to the United Nations Framework Convention on Climate Change (UNFCCC). The Expert Committee on Impact of Climate Change set up by the Ministry of Environment & Forests in June 2007, assessed the impact of climate change on six areas, including water resources, agriculture, natural ecosystem, health, coastal zone management and climate modelling. Reports of the Expert Committee were then prepared, and a range of policies and programmes were initiated to address the problem of climate change in the context of sustainable development. An overview of select policy measures are captured herewith.

National Action Plan on Climate Change (NAPCC)

The National Action Plan on Climate Change (NAPCC) is a national-level plan that outlines India's climate change mitigation and adaptation goals. NAPCC was launched in 2008 and is designed to help India meet its commitments under the UNFCCC. There are eight "National Missions" which form the core of the NAPCC (refer exhibit 34). They focus on promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation.

The Energy Conservation Act, 2001

The energy conservation act of 2001 and the measures it suggested via Bureau of Energy Efficiency included market mechanism for trading of energy saving certificates, resembling carbon credits. Perform Achieve Trade ("PAT") Scheme under the National Mission for Enhanced Energy Efficiency was launched in 2012, as a market-based compliance mechanism to accelerate improvements in energy efficiency in energy intensive industries. Under this program, designated consumers were assigned specific energy efficiency improvement targets, and those who exceed their targets earned Energy Saving Certificates (ESCerts) issued by the Bureau of Energy Efficiency, could be traded at Power Exchanges. Similar to PAT, Renewable Energy Certificate (RECs) under the Electricity Act, 2003, is also a trading scheme operational in the energy sector in India.

The Energy Conservation (Amendment) Bill, 2022

The Government of India has passed an amendment to the Energy Conservation Act, 2001, which leads to establishment of a carbon credit market in India (The Energy Conservation (Amendment) Bill, 2022). The amendment provides a legal framework for a carbon market with the objective of incentivizing actions for emission reduction. Under the Indian carbon credit market, entities can register themselves as "Registered Entities" for the carbon credit trading scheme. The carbon credit certificate (CCCs) will be issued by the central government. Any other person or entity may also purchase ESCerts or carbon credit certificates on a voluntary basis.

This is the successor to the Energy Conservation Act, 2001 with a vision to empower the central government to specify carbon credit trading scheme and improve energy efficiency by mandating non fossil fuel-based energy sources for decarbonization of the economy. The amendment focused on meeting the nationally determined contribution and COP-26 commitments.



Exhibit 34: Overview of India's Energy Conservation Act

The Energy Conservation (Amendment) Bill, 2022

Vision to facilitate achievement of India's commitments at COP26

- To establish a carbon credit trading scheme, allowing registered entities to trade tradeable permits for a specified amount of greenhouse emissions.
- Setting energy standards and requirement that designated consumers meet minimum share of energy consumption from non-fossil sources.
- **Energy Conservation and Sustainable Building Code:** provide norms for energy efficiency and conservation to buildings including residential and offices having load of 100 Kilowatt or more.
- **Standards for vehicles and vessels:** Extends energy consumption standards to vehicles and vessels, with penalties for non-compliance.
- **Composition of BEE's governing council:** increases the governing council of the Bureau of Energy Efficiency to include 31 to 37 members, with 12 secretaries and representation for industries and consumers.

Source: PRS India; YES BANK Analysis

Green Credit Programme (GCP)

Government of India introduced a mass movement LiFE – "Lifestyle for Environment" for combating climate change and an innovative market-based mechanism is required to promote this movement. To enable this, a Green Credit Program was announced at the Annual Union Budget 2023-2024 and on 26th June 2023, the government, in consultation with the Bureau of Energy Efficiency (BEE), released its draft GCP Rules for 2023 focusing on the Carbon Credit Trading Scheme (CCTS).

To overlook the governance of the Indian carbon market, a National Steering Committee will be constituted including key representatives from power, environment, forest and climate change, steel, finance and agriculture ministries. The committee will also provide recommendation to the Energy Efficiency Bureau for rules and regulations to be formed regarding carbon credits market in India.

The Bureau shall be the Administrator for the Indian carbon market. As the administrator Bureau will identify sectors with potential for emission reductions, develop targets for obligated entities under the

compliance mechanism and issue carbon credit certificates based on recommendations from the National Steering Committee. It also determines the procedure including eligibility criteria for accreditation of any agency to function as accredited carbon verification agency or VVB bodies.

The position of registry will be filled by the Grid Controller of India Limited, where it will function as a meta registry by performing the functions of,

i. Data management by maintaining database of carbon credit certificate and other market based mechanisms;
ii. Establishing the linkages with any national or international registry of any market-based mechanism.

The Central Electricity Regulatory Commission shall be the regulator for the trading activities under the Indian Carbon Markets. It will safeguard interest of both buyers and sellers via providing market oversight and taking necessary preventive and corrective actions to prevent fraud or mistrust. Apart from this Ministry of Power has released Policy Paper Draft on Carbon Market for stakeholder consultation. The provisions given here are,

i. The establishment of the domestic carbon market will be carried out through a phased approach, with phase-I spanning from 2023 to 2025, and phase-II starting from 2026 onwards.
ii. This market will replace the existing schemes, namely the Perform Achieve and Trade (PAT) Scheme, Renewable Energy Certificates (REC), and Clean Development Mechanism (CDM).
iii. The market will be bifurcated into two segments:
    - The compliance market, which will transition from the PAT scheme, and
    - The offset market, which will move from project-based REC/CDM to a carbon credit trading mechanism.
iv. Within the domestic carbon market, Carbon Credit Certificates (CCCs) will play a significant role and will be issued in three distinct types based on specific conditions.
    - First, Converted CCCs (C-CCC) will be provided to entities after converting Energy Savings Certificates (ESCerts) and RECs.
    - Second, Offset Carbon Certificates (O-CCC) will be issued to entities operating under the carbon offset mechanism.
    - Third, Mandatory Carbon Credit Certificates (M-CCC) will be granted to entities that achieve the targets set in phase II of the Indian Carbon Market (ICM).
v. To facilitate international linkage of the domestic Indian Carbon Market, the policy document proposes the establishment of an Apex Committee for the Implementation of the Paris Agreement (AIPA). The AIPA will oversee the governing board responsible for administering the domestic carbon market. Regulatory authority, registry agency, and trading exchanges will be assigned to the Central Electricity Regulatory Commission (CERC), Grid Controller of India (erstwhile POSOCO), and Power Exchange (IEX/PXIL) respectively. These entities will play crucial roles in ensuring the smooth functioning and regulation of the domestic carbon market.

Eight sectors are identified under the Green Credit Program and thresholds and benchmarks would be eventually developed for each of these sectors. The eight sectors include,

i. **Tree Plantation-based Green Credit:** To promote activities for increasing the green cover across the country through tree plantation and related activities.
ii. **Water-based Green Credit**: To promote water conservation, water harvesting and water use efficiency/savings, including treatment and reuse of wastewater.
iii. **Sustainable Agriculture based Green Credit**: To promote natural and regenerative agricultural practices and land restoration to improve productivity, soil health and nutritional value of food produced.
iv. **Waste Management based Green Credit:** To promote sustainable and improved practices for waste management, including collection, segregation and treatment.
v. **Air Pollution Reduction based Green Credit:** To promote measures for reducing air pollution and other pollution abatement activities.
vi. **Mangrove Conservation and Restoration based Green Credit**: To promote measures for conservation and restoration of mangroves.
vii. **Ecomark based Green Credit**: To encourage manufacturers to obtain Ecomark label for their goods and services.
viii. **Sustainable building and infrastructure based Green Credit**: To encourage the construction of buildings and other infrastructure using sustainable technologies and materials.

6 Abbreviations



Abbreviation	Extension
AFOLU	Agriculture, Forest and Other Land Use
AIPA	Apex committee for Implementation of Paris Agreement
AWD	Alternate Wetting and Drying
BAU	Business – as – usual Scenario
BEE	Bureau of Energy Efficiency
Bn	Billion
°C	degree Celcius
CAGR	Compounded Annual Growth Rate
CCAFS	Research program on Climate Change, Agriculture and Food Security
CCCs	Carbon Credit Certificates
CCTS	Carbon Credit Trading Scheme
CDM	Clean Development Mechanism
CEEW	Council on Energy, Environment and Water
CER	Certified Emission Reduction
CERC	Central Electricity Regulatory Commission
C-GEM	Centre for Grower-centric Eco-value Mechanisms
CH_4	Methane
CIMMYT	International Maize and Wheat Improvement Center
CO_2	Carbon dioxide
CO_2 eq / CO_2 e	Carbon dioxide equivalent
COP	Conference of the Parties
DSR	Direct Seeded Rice
ESCerts	Energy Saving Certificates
ETS	Emissions Trading Scheme

Abbreviation	Extension
EU	European Union
FAO	Food and Agriculture Organization
FPOs	Farmer Producer Organizations
GCP	Green Credit Programme
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GS	Gold Standards
Gt	Giga tonnes
GWP	Global Warming Potential
Ha	Hectare
HFCs	Hydrofluorocarbons
IARI	Indian Agricultural Research Institute
ICM	Indian Carbon Market
IEX/PXIL	Indian Energy Exchange/Power Exchange of India
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
LiFE	Lifestyle for Environment
M-CCC	Mandatory Carbon Credit Certificates
MCX	Multi Commodity Exchange
Mn	Million
MoEFCC	Ministry of Environment, Forest & Climate Change
MT	Metric Ton
Mt	Megatonnes
N_2O	Nitrous Oxide
NAPCC	National Action Plan on Climate Change
NCDEX	National Commodity & Derivatives Exchange
NCDMA	National CDM Authority
NDCs	Nationally Determined Contributions
NGOs	Non-Governmental Organizations
NMEEE	National Mission for Enhanced Energy Efficiency
NMSA	National Mission for Sustainable Agriculture
NUE	Nitrogen Use Efficiency

Abbreviation	Extension
O-CCC	Offset Carbon Credit Certificates
OECD	Organization for Economic Cooperation and Development
PAT	Perform Achieve Trade
PFCs	Perfluorocarbons
RECs	Renewable Energy Certificates
RPO	Renewable Purchase Obligation
SDGs	Sustainable Development Goals
SDM	Sustainable Development Mechanism
SF_6	Sulfur Hexafluoride
SRI	System of Rice Intensification
Tn	Trillion
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
VCM	Voluntary Carbon Markets
VVBs	Validation and Verification Bodies
WMO	World Meteorological Organization
WRI	World Resources Institute

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