



ASHOKA TRUST FOR RESEARCH IN
ECOLOGY & THE ENVIRONMENT

Scoping Investment Potential for Nature-based Solutions in the Indian Agriculture Sector



The
Food and Land Use
Coalition



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There is already a rich and extensive body of existing research and analysis concerning the role of nature-based solutions in the Indian agricultural sector. The bibliography at the end of the report details the key literature consulted by this report's authors.

The report has been designed by Mr. Teerath Rawat, ATREE

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FOREWORD

The challenges of climate change are increasing in every way, driven by the unrelenting accumulation of greenhouse gases (GHGs). The response so far, particularly of those responsible for the historical accumulation of the emissions, even after the adoption of United Nations Framework Convention on Climate Change (UNFCCC) and the delineation of obligations and responsibilities has been less than adequate. As a result, an ‘emissions ambition gap’ has been created, calling for enhanced global actions to address it. India, even though not part of the initial problem, has been an active and constructive participant in the search for solutions.

India is committed to engaging actively under the UNFCCC framework with the objective of establishing an effective, cooperative and equitable global architecture based on climate justice and the principles of Equity and Common But Differentiated Responsibilities and Respective Capabilities. India’s contribution takes into account its commitment to nature conservation as well as the imperatives of meeting the competing demand of resources for achieving the Sustainable Development Goals for its 1.4 billion people.

India is exceptionally vulnerable to the adverse consequences of climate change. Despite its limited contribution to anthropogenic emissions, Indian agriculture is most vulnerable to climate change, including both slow onset events and extreme events, and correspondingly, it is the most significant sector for adaptation. The country is intensifying its adaptation efforts to address the adverse impacts of climate change on agriculture as it is critical to the economy and to the livelihoods of about 70% of its people for whom it is literally an ‘adapt or perish’ situation.

However, global climate finance continues to be focussed towards mitigation efforts. According to the Climate Policy Initiative 2022 report, over 70% of climate finance globally was concentrated towards mitigation. This imbalance highlights a critical gap, as adaptation strategies are crucial for addressing the immediate climate impacts and building resilience against future risks.

In this context, Food and Land Use Coalition (FOLU) India is striving to create a mutually beneficial scenario for both the environment and farmers by leveraging the potential of Nature-based Solutions (NbS) for land resources that offer both mitigation and adaptation benefits through multiple pathways which include identifying mitigation potential in adaptation efforts (and viceversa). NbS are a critical part of the transformation agenda for food and land use systems to deliver better prosperity for people and the planet. This endeavour involves collaboration among various experts and agencies, including investors and policymakers at both national and sub-national levels.

This report represents a key effort by ATREE and FOLU India to strategize investor engagement by documenting stakeholders’ perspectives on increasing the scope and potential for using the land resource base as a carbon sink. It identifies barriers across demand, supply, and policy dimensions that hinder investment in land-based NbS. Additionally, the report outlines enabling conditions and opportunities to scale up such investments in India. The report has also attempted to make recommendations on efficient financial mechanisms to unlock the potential of various NbS to benefit the environment and community.

It is my hope that this crucial work will enable all those who use the land resource base, including first and foremost, the farming community, policymakers, investors, and other stakeholders to work towards accelerating investment in land-based mitigation and adaptation initiatives. My congratulations to all those who participated in this effort and brought in the much-needed fresh and innovative thinking into the sector.

Mr. S Vijay Kumar
Distinguished Fellow, The Energy and Resources Institute (TERI)
Lead, Food and Land Use Coalition (FOLU) India

WHO IS THIS REPORT FOR?

This report shows that there are significant gains to be had from catalysing investments into Nature-based Solutions (NbS) for effective climate change adaptation and mitigation in the agricultural sector in India. If the identified challenges in this report are surmounted by coordinated action, horizontally (across actors) as well as vertically (across scales), and future investment prospects are suitably addressed, a climate-resilient agricultural sector that delivers fair economic benefits for producers is possible.

This report is geared towards six key stakeholder groups in India:

1. Central and state government institutions in the agricultural sector;
2. Farmer collectives and farmer-facing organisations;
3. Representatives of forest, land and agriculture (FLAG) enterprises;
4. Investors and financial institutions supporting investments into the agricultural sector;
5. Participants in multi-lateral processes and multi-stakeholder partnerships, both nationally and internationally; and
6. Civil society groups, including advocacy, movement-building and philanthropic organisations.

These stakeholders are creating, or are capable of creating, waves of change: some driving regulatory reform, others encouraging producers to adopt alternative practices. What they can engender has the potential to create new financial norms, supported by technological, social and investment innovations. Their actions will be pivotal in sending strong signals that a new food and land use economy in India is forthcoming.

This report urges these actors to make an agricultural land use transformation an urgent priority and to grasp the opportunity that NbS interventions offer to make the transformation happen at scale. This involves understanding and acting on the inefficiencies, hidden costs, risks, and opportunities existing in the sector. However, seizing these opportunities, some of which require mental, regulatory, and business models that emphasise value, co-benefits, and a long-term outlook over short-term gains, would not be straightforward. It may require a significant shift in mindsets and leadership, while overcoming the fragmentation that currently exists. This is the challenge in front of us.

EXECUTIVE SUMMARY

The climate crisis is among the most significant challenges facing the world today.

Nature-based Solutions (NbS), defined as a set of conservation, restoration, and improved land management actions that can build climate resilience, increase carbon storage, avoid greenhouse gas (GHG) emissions, and yield multiple other environmental, social, and economic co-benefits, have emerged as a critical part of the transformation agenda for food and land use systems to respond to the climate challenge, while simultaneously safeguarding the lives and livelihoods of diverse stakeholders. The agricultural sector has a role to play in addressing this crisis through the implementation of several NbS at scale – both by building the climate resilience of producers who might be most affected and by providing opportunities to mitigate GHG emissions globally.

The case in India is no different. The country faces both a sustainability opportunity and a challenge in its agricultural sector. There is tremendous opportunity to widely implement NbS as part of the sector's transformation to advance climate action, economic prosperity, and ecological stewardship. The challenge is to undertake such a transformation by taking along the interests of all stakeholders, while recognising the current contexts and future vulnerabilities of producers, the bulk of whom are smallholder farmers cultivating less than a few acres of land.

Despite their importance, NbS in the agricultural sector receive limited funding in India. Investments in the agriculture sector in India have long been a fundamental part of state policy. Over time, as climate change considerations have gained attention in public sector investments, funds have been channelled to initiatives focussed on building adaptation capacities among farmers to respond to the climate risks that the agricultural sector faces. There are a number of policies and schemes currently operational in India which provide farmers material and knowledge support to safeguard

their incomes and practice farming in a climate-resilient manner. Meanwhile, climate change mitigation-focussed financing in India remains significantly under-funded. Even this limited sum has been predominantly utilised in other sectors, like energy and the built environment, leaving the mitigation financing needs of the agricultural sector behind.

Innovative investment models are emerging, both in the public and the private sector, that aim to leverage the opportunities that NbS can provide. These models include state-led impact bonds for improved nutrient management, the provision of financing support to agricultural value chains through debt co-financing among commercial banks and Non-Banking Financial Institutions (NBFCs), equity investments in the agri-tech start-up environment as well as blended financing arrangements between development finance organisations and other private investors. These models have shown promise and provided useful sandboxes to highlight NbS investment opportunities. Other investment opportunities which can support on-farm NbS adoption are emerging in post-harvest processing, transport, and entrepreneurship.

There exist a few systemic barriers in scaling these NbS investments. In spite of widespread acknowledgement of NbS investments making business, strategic, and reputational sense, the creation of enabling conditions for transformation remains challenging since the adoption and scaling of NbS is also perceived to be risky and technically-complex. Farmers may encounter several implementation risks which may impact crop yields and incomes. Meanwhile, investments may be inhibited by the relative lack of predictability of long-term outcomes because of policy shifts, market fluctuations and climate change. Moreover, conventional forms of investment and credit do not, at the moment, account for long-term biophysical and socio-ecological

risks, since they are often not perceived as material risks. This needs to change, as part of a renewed attention towards the risk and returns profile of NbS projects and the development of a vision for a sustainable agricultural land use transition in India.

These barriers are surmountable, and enabling conditions for scaling NbS investments are being created in India. To act on the abundant NbS investment opportunities emerging in India, conceptual clarity on terms and approaches, the release of sectoral transition goals, a responsive policy environment, as well as backward and forward linkages across agricultural supply chains would be crucial. Implementing NbS at scale would require a range of public and private capital providers with diverse investment strategies and risk profiles to come together to create the conditions for scaling. Here, government support to provide early impetus and low-risk early-stage capital would be useful in building the technical capacity of all stakeholders. Nature credit markets also show promise in delivering economic and climate benefits, on the back of project developers using a diversity of strategies to respond to the fragmented and complex nature of land-based credit markets today.

Given the diversity of agricultural contexts in India, it is fundamental to design tailored NbS investment strategies. These investment strategies may be diversified on the basis of geography, the kind of crop being cultivated, the structure of the agricultural value chain, or the part of the value chain where investments may demonstrate the largest impact potential. These investment strategies would have to take into account diverse socio-ecological and agrarian contexts across India, as well as the specific barriers and enabling conditions present for scaling investments.

This analysis is an essential first step in unlocking the multitude of benefits India could receive through implementing NbS. However, more needs to be done to support the transition. Insights from this report can therefore be followed by further engagements across all stakeholders to make sure that each stakeholder understands their distinct roles, charts out short and long-term investment strategies, and designs robust pathways to ensure investments into NbS at scale in a manner which can respond to the climate action context of the agricultural sector in India.





INTRODUCTION

Strategic Context

Land – including agricultural land, forest land, and other terrestrial ecosystems – provides the basis of terrestrial life. These ecosystems are vulnerable to climate change and, at the same time, provide essential opportunities to advance climate resilience actions for the natural and human systems that depend on it – both from a climate change adaptation and mitigation standpoint.

Twenty different land sector climate action opportunities – referred to here as '**Nature-based Solutions**' (hereafter, referred to as NbS) – have been highlighted as essential to meet the Paris Agreement's temperature goals while safeguarding human and natural systems globally (Roe et al., 2021). These NbS can be defined as a set of conservation, restoration, and improved land management actions that can build climate resilience, increase carbon storage, avoid greenhouse gas (GHG) emissions, and yield multiple other environmental, social, and economic co-benefits (Griscom et al., 2017; IORA Ecological Solutions and Vertiver, 2021; Ellis et al., 2024). Agricultural land, as part of our food systems, remains a fundamental part of the NbS-led climate action agenda (Clark et al., 2020).

Here, India presents a unique challenge. There exists significant climate change mitigation impact potential from the agricultural sector - it contributes 18% of all GHG emissions in India (Sapkota et al., 2019). Estimates suggest an average mitigation potential of 476 MtCO₂e/year can be realised by 2030 by investing less than USD 100/tCO₂e, which is 5% of the global average potential (Roe et al., 2021).

However, the overarching priority and the arguably bigger challenge in the sector in India is the development of climate change resilience and adaptation capacities of its farming-dependent households. This is borne out by the farming context in the country and the recent policy actions that are responding to it.

Approximately 55% of its population has agriculture as its primary source of livelihood, while the sector contributes to 16% of the country's GDP (Green Climate Fund, 2023). More than 86% of farming households are small or marginal, owning less than 2 ha (Bisht et al., 2020). It is also now well-recognised that climatic variability and the occurrence of extreme events will be major concerns in the future, in addition to other indirect and lagged influences on agricultural land use. These effects are expected to disproportionately impact farming households, necessitating the need to develop resilience-building initiatives in policy and practice (Mall et al., 2006). For example, estimates from the Ministry of Agriculture and Farmers Welfare (MoA&FW) suggests that in the absence of climate adaptation measures, rice yields in India are projected to reduce by 3.5-20%, wheat yields by 20%, and kharif maize yields by 18% by 2050, while corresponding impacts by 2080 may be even stronger (Ministry of Agriculture & Farmers Welfare, 2023).

During COP26 in Glasgow, India set ambitious goals for adaptation strategies regarding climate change (Ministry of External Affairs, Government of India, 2021). This is consistent with its long-standing focus on securing the livelihoods of farming households and enhancing their ability to cope with climate impacts through investments in improved water, soil, and crop management practices (Ministry of Agriculture & Farmers Welfare, 2023; Ministry of Finance, 2024a).

Prioritising adaptation does not mean ignoring mitigation in agriculture. Instead, a phased approach where adaptation measures are implemented first to cater to the immediate needs of the agricultural sector, followed by the gradual introduction of specific emissions reduction and carbon sequestration practices may be a useful approach. In practice, agriculture-focussed NbS can potentially address both adaptation and mitigation needs. Introducing NbS in input-intensive agrarian contexts can serve as a viable climate change mitigation strategy, while its application in fragile rainfed zones can act to increase climate change resilience (Suryakumar, 2024).

NbS also have the potential to address several other key challenges in India, including land degradation, biodiversity loss, and the overuse of freshwater resources (Griscom et al., 2017; FOLU Coalition, 2019; IORA Ecological Solutions and Vertiver, 2021; Roe et al., 2021), thereby creating the conditions for a widespread social, environmental and economic transformation in India. Ultimately, since each region in the country presents unique challenges, it is crucial that climate actions are compatible with local agricultural contexts.

If thoughtfully planned and efficiently executed, a large body of NbS-focussed climate finance can be mobilized to support this transformation. The rationale for scaling up this finance is two-fold: (1) any sustained and deep climate action cannot be achieved without including the agricultural sector, and (2) given that a majority of farmers are small and marginal, their own ability to invest in NbS and climate-resilient practices may be limited.

Despite their massive potential, NbS remain chronically underfunded in India (Climate Policy Initiative, 2021). It is essential to increase the levels of NbS-focussed finance in India to create robust pathways for sustainability, prosperity, food security and resilience. Momentum towards enabling such a shift is building up. Government initiatives like the National Innovations on Climate Resilient Agriculture (NICRA) programme and recent announcements of encouraging 10 million farmers to adopt natural farming practices and promoting 10,000 need-based bio-resource centres serves as the latest evidence of this shift (Ministry of Finance, 2024a).

From a private investment perspective, however, progress has been slow. One reason for the lack of investment and motivation is the scarce knowledge of different investment models for NbS in India, many of which can provide direct or indirect economic returns or significant cost savings (Cariappa et al., 2024; Singh et al., 2024a; FOLU Coalition, in prep.). Substantial efforts are required to better inform the decision-making of Indian stakeholders, including policymakers, regarding the economic and project-level opportunities associated with different NbS activities. A special focus is needed to underscore both climatic and non-climatic (food security, livelihoods and biodiversity) benefits. However, there is currently no study in India that maps optimal financial strategies to unlock the potential of NbS, and puts forth the unique opportunities and challenges that NbS investments in India have to address.

The FOLU Coalition and the NCMA Project

The Food and Land Use Coalition (FOLU) is a global community of country platforms, partner organizations, and Ambassadors working to advance sustainability, equity, and resilience in food and land use systems. Created in 2017, FOLU supports diversity, embraces disruptive thinking and forges consensus through an evidence-based approach. It aims to empower farmers, policymakers, businesses, investors, and civil society to unlock collective action at scale.

FOLU also places a strong focus on country-led efforts. Developing strong partnerships, recognising local contexts, and capacity building for modelling national-level financing strategies to unlock and scale NbS has been at the core of these efforts. Building on

two country-based assessments for financing NbS in Kenya and Colombia (Smith et al., 2022, 2023), this initiative has now been extended to India, with FOLU India as its anchor.

FOLU India's vision is a nutritionally secure, healthy and prosperous India, which is sustainably managing its food and land use systems, supported by a productive, efficient and inclusive economy. FOLU India has initiated the 'Nature-based Solutions for Climate Mitigation and Adaptation' (NCMA) initiative with a four-pronged approach:

1. Data consolidation to conduct a cost-benefit analysis of NbS potentials for climate mitigation and adaptation actions in India.
2. Tailoring of existing methodologies for the Indian context to bridge the gap between opportunities for unlocking finance and policies.
3. Participatory approach to catalyse action from governments (national and subnational), investors and civil society organizations.
4. Development of stakeholder engagement strategy for mainstreaming NbS for climate mitigation and adaptation actions.

A prominent project under the NCMA initiative is the 'Financing Nature-based Solutions: a path to prosperity, food security and resilience', which is being done in partnership with Systemiq (a FOLU global partner). It aims to create an action plan for unlocking climate mitigation financing potential of the land-based NbS initiatives in India. It intends to widen the NbS landscape beyond its current limited scope of conservation opportunities to include specific areas such as food security and livelihoods, which can be supported by public and private grants, investments, and other financial instruments. The project is designed to respond to current knowledge gaps in the NbS investment ecosystem – including its total impact potential, evidence of its co-benefits, the costs of implementation, existing funding gaps, and potential financing mechanisms.

Activities envisaged under the project will help in sensitizing and motivating public and private investors to unlock investments in India by highlighting viable investment opportunities and financial strategies in NbS. The action plan for climate change mitigation and adaptation developed in this project is expected to also create and nurture a business environment for investing in NbS in India, ultimately catalysing large-scale investments.

The NCMA initiative is steered by a Technical Steering Committee (TSC), made up of several experts cutting across policymakers, researchers, field-level implementation organisations, and climate entrepreneurs (**Annexure 1**). Over the course of the initiative, the TSC has been at the forefront of setting the research, practice and policy agenda,

identifying relevant data sources, guiding the analysis, validating results, and translating the knowledge on NbS potentials to action.

Context of the Study

Current agricultural production and consumption practices in India are economically- and ecologically-unsustainable (Paul et al., 2023). A transition to alternative agricultural practices by adopting NbS practices means that farmers can generate fair returns from their farming activities, while also promoting land stewardship (Prabhu, 2022). These practices are known to simultaneously benefit local land systems and local economies while contributing to local, national, and international climate action efforts.

How can this transition be accelerated? Public and private investments will have a key role to play as these principles and practices establish and scale across agricultural land uses in India to respond to the climate adaptation and mitigation challenges that Indian farmers face. Accelerated financial flows into this sector will enable its transition to a low-carbon model, while simultaneously building climate resilience and providing economic benefits (Sapkota et al., 2019; Bisht et al., 2020).

To further scope and understand the opportunities and challenges for investments into implementing these principles and practices, the Ashoka Trust for Research in Ecology and the Environment (ATREE) initiated conversations with stakeholders across the investment spectrum in India. This included demand-side investment providers, supply-side investment recipients as well as policy intermediaries in India. The conversations used 4 promising NbS for the Indian context as an entry point (**Annexure 2**). These 4 NbS can form part of a substantive climate adaptation strategy for producers, with potential mitigation co-benefits.

This work identifies the status, emerging trends, barriers, enabling conditions, and potential public and private sources of finance that may increase investments into adopting NbS for climate and economic benefits at scale in India. As such, this work scopes the investment potential for NbS in the Indian agricultural sector. This will enable growing investments in a way that is compatible with the economic and ecological challenges facing the agricultural sector in India. This work also helps with identifying finance gaps, specifying narratives for change, and designing future investment strategies.

METHODOLOGY OF THE STUDY

Stocktaking Review

We conducted a quick stocktaking review of the status of agricultural climate investments in India. This review draws on published and grey literature to frame the investment potential for NbS in the Indian agricultural sector. The review thereby covers the current status of agricultural financing, the challenges in mobilizing the needed investments, and the future opportunities that can be harnessed to support a NbS-led transformation at scale in India.

Demand-Supply and Policy-side Stakeholder Engagement Process

To scope the investability in NbS in the Indian context, we undertook purposive conversations with stakeholders across the NbS investment landscape. We conducted interviews across the investment spectrum – investment providers (demand-side) on the one hand, and investment recipients (supply-side) on the other. Additionally, we gathered the perspectives of stakeholders privy to the policy and decision-making process of agricultural land use-relevant ministries and departments at the national level. The purpose of these interviews was to gain a deeper understanding on the current status and emerging trends of investments into NbS projects, how financial flows can be further catalysed, and the challenges that exist in actualising these flows. We explored how these topics are integrated into lending and investing practices, and what the potential barriers for implementation are.

The investor engagement process started with the identification and categorization of different stakeholders. Three sets of stakeholders were thus identified, including:

1. Demand-side stakeholders, who either provide investment funds themselves or guide the channelling of investments into NbS projects, or both.
2. Supply-side stakeholders, who either are recipients of investment funds or steer on-ground implementation of NbS projects, or both.

3. Policy-side stakeholders, who regulate, mediate and guide investments across demand and supply-side stakeholders.

Demand and supply-side stakeholders were further categorized on the basis of their structure, mandate, and function within NbS projects (**Box 1**). The interviews were framed around several themes that we wanted to investigate (**Table 1**). The list of stakeholders interviewed is given in **Annexure 3**.

Potential respondents among the stakeholder types were identified based on suggestions from the TSC and leveraging existing networks of some current TSC members. Potential respondents were sent a background note and a tentative list of questions around the themes to be covered by email.

We were able to engage with a total of 22 stakeholders. These included 8 demand-side stakeholders (36.4% of the total), 12 supply-side stakeholders (54.5% of the total) and 2 policy-side stakeholders (9.1% of the total).

All but one of the stakeholders opted for sharing their perspectives in an online semi-structured interview, with one stakeholder replying in writing. Online meetings were organised at a date and time which was mutually convenient to the respective stakeholders and to the project team. A total of 21 such online meetings were held between February and August 2024. These meetings were attended by at least 1 of the 3 project team members from ATREE. 3/21, or 14.3%, of these meetings were attended by all 3 team members, while 9/21, or 42.8%, were attended by 2 out of the 3 project team members.

In a review meeting among the project team members midway through the interviewing process, it was highlighted that respondents were finding it hard to engage with terminologies and contexts around NbS in the agriculture sector. There was also significant confusion about the relationship between NbS and other allied concepts like ‘organic agriculture’ and ‘sustainable agriculture’, their implementation potential at scale, and their contribution to climate action and farmer wellbeing. As a result, the background note was modified and based around the term ‘Regenerative Agriculture’, and the focal NbS were bundled together as ‘Regenerative Agriculture practices’ during conversations with respective stakeholders. For this report, we describe these practices as NbS to maintain consistency with the framing of the NCMA initiative. The diversity of overlapping terms and narratives has been further highlighted as a constraint to investment, and described further in the Sub-section ‘**Sectoral needs and future prospects for scaling investments into NbS**’ of this document.

Box 1: Stakeholder types consulted

Demand-side investment providers:

1. Local, regional and national government agencies.
2. National development banks and financing institutions.
3. Financial regulators and decision-influencing financial institutions and advisory firms.
4. Private financing agencies, i.e., social impact funds, foundations and philanthropic

Supply-side investment recipients:

5. Farmer collectives and farmer-focussed organisations.
6. Agricultural input and crop care enterprises.
7. Forest, land and agriculture (FLAG) enterprises.
8. NbS project advisory and implementation agencies.

Policy:

9. Policy representatives

Table 1: Themes covered in the stakeholder interviews.

For demand-side stakeholders	For supply-side stakeholders
Scope for investing in regenerative agricultural practices.	Challenges to adopting regenerative agricultural practices.
Potential to attract investment.	Challenges in measuring incremental benefits.
Risk mitigation & management.	Current trends and opportunities in adopting regenerative agricultural practices.
Organizational investment processes and management.	Nature of financing that would incentivise adoption.
Enablers to make regenerative agriculture investments wide-spread.	
For policy-side stakeholders: Both sets of themes	

A photograph of a farmer in a field, wearing a light-colored shirt, dark pants, and a colorful turban. The farmer is carrying a large blue backpack sprayer and is spraying a fine mist of pesticide onto a lush green field of crops. The background is a vast expanse of green grass under a clear sky.

THE STATUS OF AGRICULTURAL CLIMATE INVESTMENTS IN INDIA

The Challenge

India's transition to a low-carbon and climate-resilient economy will require finance compatible with the climate targets set by the country. Knowing the origin of the finance in pursuit of the intended target, however, remains a central question. Despite the agricultural sector not explicitly mentioned in the country's climate action commitments under the Paris Agreement and a binding emissions reduction target not currently set for this sector – agricultural land use activities are undeniably relevant in view of the country's emissions profile and the vulnerability of farming households, and, as such, provide the basis for an increase in investments into this sector (Sapkota et al., 2019).

Agriculture remains the sector most vulnerable to climate change, evident in the dependence of production on climatic factors like the Indian Monsoon (Paul et al., 2023). Conversely, the sector is one of the biggest sources of GHG emissions in India, driven by the effects of excessive use of synthetic fertilisers and unsustainable production practices, among others (Sapkota et al., 2019). This threatens the socio-ecological resilience of the Indian agri-food system and the future of food security in India. The influence of the agriculture sector in terms of contribution to India's GDP, the dependence of the workforce, the skewed agricultural land distribution and the predicted adverse impacts of climate change further illustrate the case for transforming agricultural practices. Opportunities for reform already exist, are achievable, and are being implemented in some parts of the country (GIST Impact Report, 2023; Singh et al., 2024a). Investments into this sector can accelerate such a transition at scale.

The investment ecosystem for agricultural land use in India is complex, with no shortage of stakeholders and institutional arrangements of different kinds at the national and state levels. While there is a strong expectation that the country will be eventually successful in attracting large volumes of national and international finance to the climate agenda, the

numbers show that the current inflow of finance remains far below its full potential (Climate Policy Initiative, 2021).

In this context, the challenge remains - how can investments, both public and private, be mobilised, sustained, and scaled towards agricultural land use approaches that provide climate, environmental, and economic benefits?

The Current Paradigm of Public Agricultural Financing in India

The agricultural financing landscape in India has grown and diversified tremendously over the last decades. Traditionally, institutional sources of finance have been co-operative societies, Primary Agricultural Credit Societies (PACS) as well as co-operative banks at the central and state levels. These sources of finance have contributed to realising the agricultural policy priorities of the government over time (Kambali and Niyaz, 2021). These priorities have been:

1. Increasing input productivity through innovations in seeds and inputs.
2. Improving intrinsic worth per capita through improvements in yield and resource use.
3. Protecting smallholder producers through agricultural subsidies and broadening institutionalized financial access.
4. Upgrading farming production through the use of technology in agricultural operations.
5. Arresting ecological degradation through natural resource management initiatives.
6. Promoting cutting-edge research and development.
7. Encouraging financial independence through support to local financial institutions and self-help groups.

These priorities have been operationalised through initiatives like watershed development programmes, which have a long history in India going back to the 1980s. In this case, issues related to improved soil and water management have remained integral to watershed development guidelines.

It has only been since the turn of the century that there has been a focus on responding to impending climatic challenges and increasing the climate resilience of the agricultural sector in India. Even in this case, climate resilience-focussed investments in India's agricultural sector have been focussed on climate adaptation initiatives, and till now, have largely been financed by domestic budgets through a combination of policy action and market instruments.

For example, the National Action Plan on Climate Change (NAPCC) was launched in 2008 with 8 Missions designed to address climate change, with policy and fiscal support also clustered in these Missions. One of these Missions is the National Mission on Sustainable Agriculture (NMSA), which aims to enhance agricultural productivity and conserve natural resources in rainfed areas by promoting integrated farming, water use efficiency, soil health management and livelihood diversification through various strategies and programmes.

To meet the challenges of sustaining domestic food production in the face of changing climate, a flagship network research project 'National Innovations in Climate Resilient Agriculture' (NICRA) in 2011 was also launched. The project aims to develop and promote climate resilient technologies in agriculture, which addresses vulnerable areas of the country prone to extreme weather conditions (Ministry of Agriculture & Farmers Welfare, 2023).

Further, the Indian government, in August 2015, launched the National Adaptation Fund on Climate Change (NAFCC) with NABARD as its National Implementing Entity (NIE). Till 2023, more than 30 climate adaptation projects with an outlay of INR 8,470 million are under implementation (Reddy and Lingareddy, 2024).

Since 2020-21, the *Bhartiya Prakritik Krishi Paddhati (BPKP)*, a scheme focused on encouraging natural farming practices, aims to provide financial assistance of INR 12,200/ha over 3 years for cluster formation, input and post-harvest capacity building as well as certification. It has till now covered more than 0.4 million hectares nationwide, with total funds released of approximately INR 458 million. Currently, several states are undertaking the popularization and propagation of natural farming practices through central programmes like the BPKP as well as other state-specific programmes. These efforts have meant that the diversity of practices that come under natural farming are now employed by more than 1.65 million farmers over a total of 1 million hectares across 15 states in India (Singh et al., 2024a). From 2023-24, the BPKP has been upscaled as a separate and independent scheme as the National Mission on Natural Farming (NMNF) with a budgetary allocation of INR 4,590 million (Ministry of Agriculture & Farmers Welfare, Government of India, 2023).

The predominant focus on climate adaptation is reflected more broadly in the budgetary allocations of the MoA&FW as well. The Ministry was allocated INR 1.2 trillion in 2023-24, 5% greater than the revised estimates for 2022-23 and accounting for 2.8% of the total Union Budget. Approximately 77% of the MoA&FW's estimated expenditure is allocated towards three schemes itself (Vipra, 2023):

1. **The Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)**, which provides regular financial support to farmer families and is the largest scheme under the MoA&FW;
2. **The Pradhan Mantri Fasal Bima Yojana, which provides crop insurance.**
3. Interest subsidies for short-term and long-term investment credit taken by farmers.

The budgetary allocation for the Ministry has further increased to INR 1.52 trillion under the Union Budget 2024, with increasing productivity and resilience in the agricultural sector a stated priority (Ministry of Finance, 2024b).

Recently, there are green shoots of international climate funding in the agricultural sector emerging. For example, NABARD is the NIE for the Adaptation Fund (AF) under the Kyoto Protocol, wherein six projects with an outlay of INR 98 million (USD 1.2 million) are currently under implementation. Moreover, of the seven Green Climate Fund (GCF) projects under implementation in India, two are in the agricultural sector with a total investment of INR 24.2 billion (USD 296.5 million) (Green Climate Fund, 2023).

The ask for climate adaptation finance remains much bigger. In India, the cumulative requirement of adaptation finance is estimated at around INR 85 trillion for 2030 at 2011-12 prices (approx. USD 1 trillion) (Department of Economic Affairs, Ministry of Finance, 2020). There are no comprehensive estimates available for tracking the actual flow of funds to agriculture, particularly for adaptation. However, a partially tracked estimate of finance for adaptation covering (1) disaster, monitoring and emergency response systems, (2) flood mitigation and (3) drought management stood at about INR 360 billion per year during 2019-20 (Khanna et al., 2022).

Current climate action investments have had limited focus on mitigation opportunities in the agricultural sector. A majority of the mitigation-focussed climate finance has rather been channelled to energy efficiency, clean transportation and clean energy projects (Srinivasan et al., 2023) to address India's 2070 net-zero pledge. A recent estimate indicates that India needs more than INR 800 trillion (more than USD 10 trillion) between 2020 and 2070 to achieve its net-zero target (Singh and Sidhu, 2021). Conventional sources of capital are expected to provide USD 6.6 trillion, leaving a substantial investment gap of approx. USD 3.5 trillion. To help bridge this gap, India requires investment support worth USD 1.4 trillion until 2070, with an annual average of USD 28 billion over the next 50 years (Singh and Sidhu, 2021).

Given this policy context, it remains crucial to frame NbS interventions in a manner that may allow the leveraging of current missions, schemes, and programmes. This is important for not only implementing on-farm NbS interventions, but also addressing the

supporting infrastructure needs (access to information, credit, and markets) that would provide a robust platform for change. Some such initiatives are already underway across several states in India (FAO, 2024), potentially providing useful models for further expansion.

Public and Private Agricultural Investment Innovations

Innovative investment models led by both the public and private sectors can play key roles in scaling NbS in India.

One emerging model builds on the idea of a 'pay for success' social impact bond. An example of such an 'environmental impact bond' is currently being implemented by the central government. Under the Prime Minister's Programme for Restoration, Awareness, Nourishment, and Amelioration of Mother Earth (PM-PRANAM) scheme, central and state governments act as investors, implementers, and monitors of projects to reduce fertilizer use (Patel and Thallam, 2024). The scheme is expected to initially run for 3 years (from FY 2023-24 to FY 2025-26), and provides a useful model of bringing together investors, service providers, independent evaluators, and outcome payers to solve an agricultural challenge.

Previous studies suggest that such initial public expenditures can have a significant crowding-in effect on private on-farm investment over the short and long run (Akber et al., 2022). Other factors that may stimulate private investment in Indian agriculture include institutional credit, favourable agricultural terms of trade, and future demand for food (Akber et al., 2022). Such investments may be focussed across all aspects of pre-sowing and on-farm interventions, eventually leading to an incremental benefit on on-farm income (Ramasamy and Malaiarasan, 2023).

Innovations in private investments in the agricultural sector are being led by both traditional and new-age finance providers. These institutions have, over the last decade, extended financing support to the sector via debt financing, equity investments as well as innovative co-financing solutions and collaborations. Useful sandboxes of such innovations have emerged, providing a pathway for channelising further investments into NbS interventions (CFA Institute, 2021). While national and private sector banks have long been extending credit to agricultural borrowers through debt financing in the form of working capital funding and asset-backed financing across agricultural value chains, some of these banks with a strong intent and reach are now seen entering into collaborations and partnerships that can help reach producers with renewed efficiency.

One approach has been co-lending arrangements between banks and Non-Banking Financial Institutions (NBFCs). This approach harnesses the complementary strengths of both these stakeholders. It allows banks to leverage the presence and network of NBFCs at the farm level to fulfil sourcing requirements. On the other hand, NBFCs are able to access vast resources and capital available with larger banking institutions at relatively lower costs as risks are shared. The guidelines on the Co-Lending Model between Scheduled Commercial Banks and NBFCs for lending in priority sectors (Reserve Bank of India, 2020) has aided the development of such an approach.

One example of such a co-lending arrangement is between the State Bank of India (SBI) and Samunnati, a leading NBFC in India (Samunnati, 2022). The agreement focusses on mainstreaming Farmer Producer Organizations (FPOs) as an asset class, and an initial amount of INR 1 billion has been agreed for this arrangement. Key features of this arrangement are increased credit penetration for FPOs and a shared risk-sharing mechanism that makes extending loans to farmers easier. Similar forms of debt financing have also been advanced by other agri-focussed NBFCs, which offer working capital loans (India Blended Finance Collaborative, 2023). This type of credit can be used to finance NbS supporting technologies like solar irrigation systems, biodigesters, and portable solar pumps as well as the provision of bio-inputs (The Economic Times, 2024).

A second approach involves private sector investments. Agri-tech companies have demonstrated the potential for climate-linked technological innovations to help mitigate climate risks as well as adapt to climate change. These innovations exist across the agricultural value chain - from pre-sowing to post-harvest - helping overcome several constraints that currently affect efficiencies and price realisation for farmers. The solutions include the creation of input marketplaces, on-farm data analytics, financial services, warehousing, and provision of market linkages. These innovations also offer a capability to build greater organization in the value chain, thereby empowering farmers with greater agency. Several such agri-tech companies exist across the country, with some of the prominent ones being DeHaat, Fasal, Jai Kisan, Waycool and Ninjacart, among others (Ernst & Young LLP, 2020; Paranjpe, 2023).

A third approach involves the blending of efforts, expertise and finances which leverages the investment outlook and risk profiles of different types of investors. This approach, called Blended Finance, is aimed at improving the technical and financial capacity of different stakeholders within the agricultural sector, while creating on-ground impact on fighting climate change and increasing farmer incomes (**Box 2**).

Box 2: Case studies illustrating the potential of the blended finance approach

From India:

1. The USAID Guarantee for Agroforestry and Sustainable Landscape Sector aimed to support local financing for agroforestry, sustainable forest management and low-emissions agriculture. Underpinned by partial credit guarantees by the Rabobank Foundation and USAID; a fund of more than INR 1.2 billion (USD 15.3 million) was created in 2018 with a tenure of 10 years for loans to be offered in coordination with NBFCs like Ananya Finance for Inclusive Growth and Samunnati for projects that practice low-emissions land use and land management (Parti, 2018).
2. GIZ India has been working with FPOs and farmer-support institutions to assess climate risks to agriculture, develop appropriate business models, and identify relevant financing instruments as well as financial institutions in the district of Mandla in Madhya Pradesh. The project has been initially supported through public financing in the form of grants and subsidies. GIZ India has then enabled a platform for dialogue, built capacities, and supported financial negotiations among demand- and supply-side stakeholders (India Blended Finance Collaborative, 2023).

International examples:

1. The Agri3 Fund provides credit enhancement and technical assistance to investment projects and businesses in the agricultural sector. It provides guarantees to financial institutions (FIs) which provide credit to support eligible projects and businesses, while a Technical Assistance (TA) facility supports the development of investable opportunities and maximises their impacts (UN Department of Economic and Social Affairs, 2023).

In the future, these approaches could respond to the specific financing opportunities presented by on-ground NbS programmes in India. For example, evidence from the Andhra Pradesh Community Managed Natural Farming (APCNF) programme, considered the world's largest agroecology programme with over a million smallholder farmers in its network (APCNF, 2024), has earmarked five priority financing areas (Ramdas and Pimbert, 2024):

1. The aggregation of small producers into FPOs to perform a range of business services.
2. The development of public goods (irrigation services, pond rehabilitation, storage, logistics, and processing facilities) for pre-sowing and post-harvest support.
3. The enhancement of market efficiency by supporting market information systems.
4. The promotion and capacity building of women Self-Help Groups (SHGs).
5. The promotion of climate-resilient agricultural practices in its farmer network.

There are other enablers and investment opportunities emerging in the agricultural sector, encompassing aspects across on-farm interventions and post-harvest processing, transport, and entrepreneurship (**Box 3**). These opportunities may provide further impetus to private investors looking to invest in farmer producer organisations and agricultural enterprises.

Box 3: Promising upcoming investment enablers (IBEF, 2024)

- India's organic food market size reached a size of more than INR 120 billion (USD 1,582 million) in 2023, driven by a CAGR of more than 10% over the previous decade. In the next decade, the market is expected to grow at a CAGR of 21% to reach a size of more than INR 700 billion (more than USD 8,900 million) by 2032 (IMARC Group, 2023).
- The processed food market in India is expected to grow to INR 3.4 trillion by 2025, from INR 1.9 trillion in 2020 on the back of government initiatives such as planned infrastructure development and policies like the Pradhan Mantri Kisan Sampada Yojana, focussed on the development of agro-processing clusters.
- From 2017 to 2020, India received more than INR 80 billion in agri-tech funding. With significant interest from investors, India ranks third in terms of agri-tech funding and the number of agri-tech start-ups.
- As per the Economic Survey 2022-23, INR 136 billion was sanctioned for Post-Harvest Support and Community Farms under the Agriculture Infrastructure Fund.
- The Ministry of Civil Aviation (MoCA) launched the Krishi UDAN 2.0 scheme in October 2021. The scheme proposes assistance and incentive for the movement of agri-produce by air transport. It will be implemented at 53 airports across the country, largely focusing on Northeast and tribal regions, and is expected to benefit farmers and processors.
- Under component schemes of Pradhan Mantri Kaushal Vikas Yojana (PMKVY), the Ministry of Food Processing Industries (MoFPI) mostly provides financial assistance in the form of grants-in-aid to entrepreneurs for the creation of modern infrastructure and setting up of food processing/preservation industries including cold chains with associated infrastructure like primary processing facilities, pre-conditioning, pre-cooling, ripening and packing.

SCOPING POSSIBILITIES AND CHALLENGES TO NBS INVESTMENT IN INDIA



Building on the insights from our conversations with stakeholders, this section scopes the possibilities and challenges to NbS investments in India.

Table 2 summarises the major insights from our conversations with demand-, supply- and policy-side stakeholders. We categorize these insights into two clusters and subsequently discuss each insight in more detail:

- Current perspectives and challenges in scaling investments into NbS
- Sectoral needs and future prospects for scaling investments into NbS.

Table 2: Insights from conversations with demand-, supply- and policy-side stakeholders. The key for identifying stakeholders in column 3 is given in Box 1.

S. No.	Major Insights	Identified by which stakeholder type? ¹
Current perspectives and challenges in scaling investments into NbS		
1	Investing in NbS makes strategic sense but translating intention to action has been slow	1, 2, 5, 7, 8
2	Perceptions of risk and uncertainty are currently hard to overcome	1, 2, 3, 7
3	Lack of visibility of investments on demand-side meets credit access issues on the supply-side	3, 4, 5, 7, 8
Sectoral needs and future prospects for scaling investments into NbS		
1	Conceptual clarity and a stable regulatory environment for NbS projects	2, 3, 4, 9
2	Demand and supply-side integration to go from niche innovation to scaling	1-9
3	An enabling policy environment to cater to risk management, incentive and signalling mechanisms	1, 2, 3, 4, 5, 9
4	Need for early-stage risk capital which is adaptive in nature	3, 4, 5, 8
5	Clarity on the role and impact potential of nature markets	3, 5, 6, 8

¹ Indicative as only 22 stakeholders consulted. See Box 1 on Page 15 for the key to identifying stakeholder types.

In sum, demand-, supply- and policy-side stakeholders variously report a need for a shift in emphasis around the adoption of NbS practices in India (Table 3).

Table 3: Shifts in emphasis needed for catalysing investments into the agricultural sector for simultaneous climate and economic benefits

Policy-side	From multiple policies that are contradictory and address only symptoms of agricultural land degradation.	To effective cross-sectoral policies that are targeted and address land degradation, climate resilience and economic security among farmers. To mainstreaming of policies, strategies, laws and regulations on agriculture, trade, markets and public expenditure frameworks within and across national and sub-national levels.
Demand-side	From inadequate and contradictory economic and pricing policies that discourage investments.	To the rapid development of enabling and innovative financial incentives to facilitate and encourage investments.
Supply-side	From farmers with insecure near, medium and long-term user rights and invisibility of long-term benefits, leading to inertia in investing in sustainable agricultural land use.	To locally-negotiated and monitored regulations, land use plans and user rights which provide farmers with the security and resources needed to become agricultural land stewards, while benefiting economically from it.

Current perspectives and challenges in scaling investments into NbS

1. Investing in NbS makes strategic sense but translating intention to action has been slow

We find consensus among respondents that business-as-usual in the agricultural sector in India is no longer an option. All respondents noted that the need and investment case for investing into implementing NbS at scale in the agricultural sector in India is clear. As the push towards climate action and sustainability increasingly gains traction across policy, business, and practice and ultimately converges into mainstream thinking, respondents noted that it has become easier to make a case for investments into promoting NbS practices at scale in India. Such a push is being driven by a diversity of factors:

1. Climate change fundamentally threatens the ecological and economic viability of agriculture in India, necessitating the need for resilience-building measures.
2. Switching to more sustainable practices makes business, strategic, operational, and reputational sense for actors across agricultural value chains. There appear significant opportunities to get viable financial returns from NbS interventions if strategic investments are made and followed through. This is coupled with increasing consumer interest towards traceability and a willingness to pay for healthier, chemical-free products.
3. Sustainability and net-zero commitments across the private sector is driving a switch across some agricultural value chains. Over the medium and long-term, the need to operationalise India's net-zero commitments would also start to be seen in agricultural policy and practice on the ground, while resilience-building policies will continue to be expanded.

However, it is often challenging to translate intentions into actions and tackle the inertia in current production regimes. Demand- and supply-side stakeholders noted that governmental policies and regulations on agriculture appear to be in a constant state of flux. This makes it difficult to anticipate whether or not it will be economically favourable, or even viable, to switch investment and adoption practices. In many cases, existing national or state-level incentive mechanisms are mismatched, for instance regarding nutrient management practices.

Investors may be inhibited by a lack of long-term visibility on the outcome of their investments and the estimated time period of returns. Currently, there is a lack of strong guidelines or long-term incentives to support private sector investments into NbS projects, making it difficult for stakeholders on both sides of the investment

spectrum to navigate this space. On the demand side, concerns around resource mobilization and impact monitoring were highlighted. On the supply-side, issues persist around skewed incentives and subsidies directed towards ecologically-harmful practices (Singh et al., 2024b).

Some respondents noted the success of the APCNF (Andhra Pradesh Community-Managed Natural Farming) programme being implemented in Andhra Pradesh, a policy and practice push that has encouraged more than a million farmers in semi-arid regions of the state to switch to alternative, non-chemical input based approaches (APCNF, 2024). By switching to alternative practices (including some NbS), farmers working with some civil society organisations (CSOs) in other states like Madhya Pradesh have also achieved lower input costs from improved nutrient management. These savings are not offset by the higher operational costs and labour requirements that farms practising alternative agricultural approaches may typically require, while yields have been maintained over the medium and long-term (Singh et al., 2024a). These developments have also been reflected in policy in some other parts of the country, including the shift to 100% organic production in the state of Sikkim (Government of Sikkim, 2015).

Some respondents concede, however, that despite such examples, creating similar conditions for transformation is difficult and time-consuming. In addition, there remains a relative lack of 'investment best practices' and so-called 'model value chains' that could be used as examples of viable business cases, inspiring others to follow suit.

A promising opportunity lies in FLAG enterprises promoting sustainable agricultural practices, both in terms of their Corporate Social Responsibility (CSR) activities and as part of their responsible sourcing strategies. The latter is of particular significance. Several enterprises currently sourcing at scale have signed up for ambitious commitments. Based on climate action strategies and net-zero roadmaps, these commitments aim to reduce GHG emissions, protect farmer livelihoods, conserve agro-biodiversity, and support a transition to nature-positive supply chains, among other goals. The successes, unintended consequences, and trade-offs of these commitments would depend on whether these commitments would be able to interact with other business and operational aspects like the need to assure consistent supply of raw materials and protect financial revenues. These commitments could be immensely beneficial for producers within these value chains, helping them produce sustainably, conserve resources, enhance biodiversity in and around farms, limit on-farm and post-harvest losses, differentiate themselves, and enjoy better market access to more informed consumers. However, they may also result in paradoxical outcomes - increasing dependencies among these actors in terms of inputs, expertise, and market

connections, thereby exacerbating existing inequalities. As these commitments take shape and the target years of these commitments come into view, this would be something to closely observe.

In future, the possibility of attaining direct benefits like price premiums for sustainably-grown produce could also prove to be attractive, and may be realised if alternative value chains are adequately promoted and developed. Respondents note how recent developments in the sector, for example, the revenue generated from the monetary valuation of additional carbon sequestered or avoided carbon emissions can further increase the attractiveness of adopting NbS. This can engender a long-term land use transition at scale in India.

2. Perceptions of risk and uncertainty are currently hard to overcome

Perceived risks and uncertainties surrounding NbS projects is another hurdle mentioned by several respondents (**Table 4**) (UN Environment Programme, 2023). Climate change acts both as a threat per se (because of climate variabilities and the occurrence of extreme events) and as a threat multiplier (increasing existing biophysical and socio-ecological vulnerabilities). Respondents noted that frequent and severe weather changes, already widespread across several agrarian regions in the country, may increasingly become the norm. This will directly impact land productivity, yields and farming revenues, including in farms where NbS practices have been adopted.

From a farmer perspective, on-ground NbS implementation is often technically complex, leading to higher implementation risks and a greater need for accompanying technical assistance, transition support, and impact assessment research. Even though some NbS may show demonstrable economic potential from the year of initiation itself, their benefits may often take a few years to accrue when balanced against land productivity. This particular facet comes up repeatedly during the discussion on potential yield losses in the short term. Here, respondents indicate a possible reduction in yields in the short-term from the transition to alternative approaches, making farmers reluctant to switch because of perceived threats to farm revenues. In practice, however, this is very contextual, and yields can bounce back within a period of 3-5 years, while initiatives like multi- and inter-cropping, the development of bio-resource centres and strong FPO support can further support farmers and ease the transition to safeguard revenues during as well as after the transition (Singh et al., 2024a). One supply-side respondent mentioned a key focus for them in the future would be the development of 'Centres of Excellence' and information repositories which can collect experiences and provide a platform for sharing context-based knowledge and solutions among farming communities in their areas of operation and future expansion.

From an investment perspective, respondents also noted that successful projects require data and technical expertise of various kinds to guide, complement and/or supplement financial investments. Success rates of NbS projects may vary even when essential investment conditions are met, and outcomes can be difficult to predict due to various factors, including policy shifts, market fluctuations, and climate change. Because of such risks, a technical assistance facility may be built into financial solutions to act as a bridge between demand- and supply-side stakeholders, which can help increase the likelihood of success. This has been the case with some domestic blended finance instruments (*see Section: Public and Private Agricultural Investment Innovations*) as well as international funds like the AGRI3 Fund, the ecoBusiness Fund and the &Green Fund.

Financial institutions may be inhibited by the long-term time horizon for economic benefits to accrue. In this accrual time period, the risks faced by these projects - including climate, operational and political risks, or a combination of these risks - may also need to be addressed. One respondent mentioned their own efforts in creating space for financing activities not supported by mainstream financing institutions, but emphasized that such mainstreaming has been slow because of the relatively risk-averse outlook of many investment entities.

This may change in the near future because of two processes operating in parallel:

1. Successful investment cases for NbS implementation are demonstrated – first as pilots and sandboxes, and then at scale across a landscape.
2. The plan to operationalise net-zero commitments gains ground across the public and private sector

Till these processes mature, a policy-level respondent noted that public-private partnership (PPP) models may be useful in filling these investment gaps. PPP models, they note, enable a consistent investment stream through the public partner at the outset, while the private partner progressively increases their investment load. To safeguard these investments from a policy perspective, the public partner can also serve as an intermediary to the national or a state-level policy environment. Such a model can typically allow for scale and long-term sustainability.

Table 4: Risks for financing of NbS projects.

Project-level risks	Financial absorption risks
Business risks: New under-explored business models or unknown transition risks.	Smallholder farmers operating in the informal sector: A significant proportion of farmers in India operate in the informal sector and lack access to formal channels of credit and finance.
Agronomical risks: Unpredictable farm output and revenue due to transition to alternative practices (short-term and context-specific). Uncertain motivation of the farmer to continue practices.	Lack of category-customised terms of credit: In formalised channels, a current lack of distinction between credit taken for conventional agricultural approaches and for adopting NbS.
Natural hazards: High exposure to climatic variability and increased frequency and intensity of extreme climate events like droughts and floods.	Small ticket size: The average ticket size for agriculture credit is small and there is often a term mismatch between accrual of benefits and repayment cycles.
Commodity market risks: Increased volatility of commodity prices in domestic markets; pressures to maintain low consumer prices and limit inflationary pressures on consumers, which affect costs, revenues, and profitability for producers. Moreover, a small demand pool for produce that factor in price premiums.	Under-developed domestic financial markets: Local climate action-focussed financial resources are under-supplied, and then only small amounts are available to NbS adoption.

3. Lack of visibility of investments on demand-side meets credit access issues on the supply-side

The position of financial institutions in the value chain also plays a role when it comes to financing NbS projects. Several respondents noted that it is often difficult to track and monitor impacts which can be attributed to the adoption of NbS because of prohibitive costs and lack of adequate approaches and monitoring technologies. This is especially true for direct investments (private sector) as well as indirect investments (for example, carbon credits) which need clear metrics and indicators that can be directly attributed to the activity itself, and whose impacts need to be shown as ‘additional’, i.e., over and above the climate impact or the revenue that might have been generated anyway.

Thus, positive climate and ecological outcomes may feel very distant from the financing structures that fund them, although evidence is emerging on the quantification of social, ecological and environmental benefits, for example, from the APCNF programme (GIST Impact Report, 2023). Newer tools would make Monitoring, Reporting and Verification (MRV) processes even quicker and cheaper, but several of them remain as yet untested at scale. These solutions include decision-support systems based on Internet of Things (IoT) sensors, artificial intelligence (AI) algorithms and individual farmer data (Paranjpe, 2023).

The lack of credit access, or conversely, the need for easy credit access to drive NbS projects came up frequently during stakeholder interactions. *Respondents noted how current financial risk models for agricultural loans (whether they be for conventional or alternative agricultural practices) do not always include long-term biophysical and socio-ecological risks, since they are often not perceived as material risks.* This is despite recent on-ground evidence that farms employing alternative agricultural practices, including NbS, may be more resilient to these risks (Singh et al., 2024a).

Implementation of NbS, as part of a push towards alternative sustainable practices, in turn, asks for a different understanding of risk and returns from investors and a clear vision for sustainable transition pathways. Such an agricultural land use transition asks for a long horizon and patient capital, with a time horizon of maturity of a decade or more. Furthermore, given the general high-risk low-return character of agricultural investments, organisations with patient capital, like pension funds, governments, and foundations, might be particularly well-suited to play an important role in the transition. Domestic markets for such patient capital, at the moment, remain under-developed.

Some respondents note that infrastructure investments are needed both in capital and operational expenditures to future-proof projects against not only socio-

ecological and biophysical risks, but also operational risks. This may typically involve investments in nurseries, water infrastructure, and solar pumps. They also noted that engaging with FPOs and other farmer collectives seems to be a common way of offering finance for widespread NbS interventions. Here, debt instruments are common – usually loans are given out (average ticket size dependent on the size of the FPO, but can be in the range of INR 20-30 million) on a revolving basis (for example, 90 days) at interest rates ranging from 10-16%.

The lack of a standardised framework for ease of credit access remains a significant challenge. Two developments that can remove this bottleneck are (1) the provision of credit guarantees by institutions like development finance organisations to incentivize lending by NBFCs/banks and (2) the initiation of credit ratings for some established FPOs (to begin with), where these FPOs can become partners to financial organizations - fintech enterprises, microfinance institutions or NBFCs - and leverage their operational credibility. Here, the immediate focus may be on managing relationships with such on-ground partners to create feasible performance indicators that align the incentives of both financiers and the recipients of the financing at farm-level. However, respondents admit that there exists limited confidence in FPOs as a system among some demand-side stakeholders, since finding FPOs with strong operational capabilities remains a challenge.

Sectoral needs and future prospects for scaling investments into NbS

1. Conceptual clarity and a stable regulatory environment for NbS projects

One bottleneck noted by several respondents was the lack of conceptual clarity surrounding the concept of what constitutes ‘nature-based solutions’ in the agricultural sector, and how it differs from ‘organic farming’, ‘natural farming’, ‘regenerative agriculture’, ‘biodynamic farming’, ‘agroecology’ and other overlapping terms. Respondents noted that these terms are often used interchangeably in practice. In reality, however, there are also some important distinctions between all of these approaches (Olsson et al., 2022; Singh et al., 2024a) concerning the nature and extent of use of organic inputs, which demand-side respondents often find difficult to grasp. The absence of a clear and consistent understanding of these terms can lead to inconsistency and lack of alignment between different stakeholders (India Blended Finance Collaborative, 2023). Interestingly, we noted how current production practices are rarely questioned on their conceptual clarity because they are simply accepted as the status quo, while transitioning to sustainable alternatives often must be clarified and made very specific.

For example, in the case of regenerative agriculture approaches (of which several NbS form a subset), there exist definitions ranging from specific types of operations that are regenerative to a systemic approach to farming with the objective of enhancing the natural environment (Olsson et al., 2022).

Respondents acknowledged, however, that the multiplicity of definitions and overlaps among approaches might be a short-term problem. As these projects establish and scale, it may eventually become less important how an initiative is labelled or defined, but it would rather be judged on how it contributes to climate, economic, and ecological benefits. ***Therefore, to overcome the confusion surrounding NbS and its overlaps with other sustainable agricultural practices, it is important to uncover the meaning behind the different approaches and to focus on the impact rather than the label (Ewer et al., 2023).***

In addition, demand-side respondents noted that clearer regulatory measures would enable conceptual clarity on investments. Representatives from financial institutions and financial advisories indicated that investments into NbS projects would benefit from the release of a Green Taxonomy for the agricultural sector and a clearer policy horizon to guide investments. Such a unified taxonomy will help in lending clarity and directionality in green financing strategies to commercial lenders as well as reducing the risk of greenwashing (India Blended Finance Collaborative, 2023). This will also ensure that investors are compliant with existing standards and can carry out necessary due diligence. However, policy-side respondents caution that this solution may take time to show impact since these are all long-term measures to support policies that are yet to sufficiently evolve.

Another regulatory input to guide investments would be the release of the sectoral transition plan linked to India’s 2070 net-zero goal and its Long-Term Low-Carbon Development Strategy (LT-LEDS), which includes a plan for the agricultural sector.

This would assume increased significance as the economic and financial aspects of low-carbon development have already been flagged by several stakeholders (Singh and Sidhu, 2021; MoEFCC, 2022), including analysis from a forthcoming report by the FOLU team which reveals significant benefits in relation to costs till 2030 and beyond as NbS are implemented at scale in India (FOLU Coalition, in prep.).

To accelerate investments into NbS projects, a mechanism for facilitating ecosystem partnerships by creating a common platform where government departments, financial intermediaries, as well as civil society organizations could align and partner may also

be useful. Forming sector and sub-sector level cohorts, driven by industry-government interactions and focussed investment practices would also help in bringing energy and direction. An able and established orchestrator, with experience in driving large-scale transformations and with extensive project management experience, would be needed as an anchor to bring diverse stakeholders together, hold the network together and implement NbS interventions at scale.

2. Demand and supply-side integration to go from niche innovation to scaling

Several respondents noted that while there are many positive examples of individual farms or a few farmer collectives in some landscapes implementing NbS projects, for example, the APCNF programme, most of these projects are still too small to be investable for financial institutions looking for (even) less-than-market returns. Currently, several projects fall short in meeting the minimum thresholds needed to qualify for an investment or a loan in terms of scale of operation, expected returns, risk management and borrower credibility, among other factors.

Demand-side respondents also noted that there is a term mismatch between when an NbS project may begin to show results ecologically and financially, and the terms of a typical term loan or the duration of a typical CSR project in India. Conventional lending and assessment practices are limited in the nuance required to factor in the characteristics of the NbS value chain.

In this context, how can NbS projects scale with sustainable and long-term financing? Respondents noted the need for strong price-demand signals and post-harvest hard and soft infrastructure development which can absorb the produce grown by implementing NbS and other alternative practices. Back-end and front-end linkages and infrastructure development would engender predictability in such value chains, reassuring farmers of a ready market for their produce. An example of soft infrastructure noted by a respondent was the formation of producer associations and certification bodies in India which can create a brand value for produce which have incorporated NbS practices. Several examples of such kind exist around the world, for example, Max Havelaar Switzerland for coffee. However, current costs for such certification, traceability, and supply chain monitoring are prohibitive and lacking incentives, necessitating the need for economies of scale.

Among demand-side institutions, respondents note that sourcing companies in particular can drive change by identifying hotspots where favourable socio-political conditions exist, and aim to collectivize and initiate programmes in those landscapes. The standardization of processes and reporting parameters would, in turn, make it

possible to track progress. This would also reduce information asymmetry among stakeholders, improve data visibility and improve financing models, thereby enhancing trust and increase collaboration (India Blended Finance Collaborative, 2023). One risk prevalent with sourcing companies implementing NbS projects is that they may want to focus on one particular crop. For example, companies may provide incentives to grow rice using direct-seeding approaches in the Kharif (monsoon) season and may be willing to pay a premium for the offtake as well. However, in the Rabi (winter) season, farmers grow other crops and may not have an incentive to continue with these approaches, given limited monitoring and lack of continued incentives. Hence, a discontinuity in implementation could prevail.

A gender perspective would also be useful. A demand-side respondent stressed that women often turn out to be better adopters of NbS while being responsible borrowers, and therefore, any NbS investment scaling programme would potentially benefit from a focus on women.

3. An enabling policy environment to cater to risk management, incentive and signalling mechanisms

Several respondents stressed that an enabling policy environment is key to channelling sustainable public and private finance to NbS projects. Such an enabling environment can take various forms – including, but not limited to, regulatory frameworks, policy instruments, and the provision of hard and soft infrastructures directed at both financial and non-financial actors to promote sustainable land use finance. It may involve direct policy actions in the form of creation of new markets or alterations in the practices of existing markets. It may also be in the form of indirect incentives and signals that aim to encourage market participants to invest in sustainable land use activities. It may also take the form of transparency measures like encouraging voluntary disclosures or mandating obligatory disclosures. Respondents from financial institutions indicated that this particular process has already started among the investors and lenders they interact with, and may soon become a norm in the industry.

In practice, an enabling environment can be structured across three aspects.

One, the development of a risk framework to manage existing and emerging risks in NbS interventions. Demand and supply-side respondents noted the need for technically-suitable and locally-contextualised guidelines, metrics, and methodologies to assess and monitor risks and track progress in NbS projects. One innovation here may be to develop alternative lending models, for example, scorecard-based frameworks, that are adapted to the borrower and sector profile (India Blended Finance Collaborative, 2023).

Two, setting up an effective and efficient incentive framework, or adjusting existing ones, to generate and re-direct flows of capital to NbS interventions. Respondents suggested that this could include efficient market signals for crop diversification, intensifying support for upstream and downstream infrastructure falling under the umbrella of alternative agricultural practices (for example, the bio-inputs economy), and generating higher financial flows through new and innovative financial instruments which offer great potential to support the transition (The Economic Times, 2024). The recent Union Budget announcement of establishing 10,000 need-based bio-resource centres across the country is a useful step to establish climate resilience-related agricultural infrastructure (Ministry of Finance, 2024b).

When asked about the potential for green bonds in particular, demand-side stakeholders indicated challenges around meeting strict criteria and reporting requirements. These requirements are currently only being met by large-scale projects (for example, utility-scale solar energy projects) which are financially de-risked through stringent long-term purchase agreements. A similar source of demand for green bonds could emerge from FLAG companies which source directly from thousands of farmers and have committed to implementing NbS in their supply chains. In these cases as well, high compliance and transaction costs remain significant hurdles.

Three, the need to set up effective and efficient signalling mechanisms to inform and influence behaviour of market participants around NbS. Here as well, the importance of NbS-sensitive green taxonomies was mentioned as a way to signal markets about sustainable activities and investment areas, and attract financial capital. Additionally, disclosure requirements as part of larger climate and sustainability commitments of the public and private sector would promote transparency and help direct the flow of private capital. Movement on this aspect has already been initiated by financial authorities in India. A foremost example of this movement is the recently-released Draft Disclosure framework on Climate-related Financial Risks by the Reserve Bank of India (RBI), which mandates a better, consistent and comparable disclosure framework for regulated entities in India (Reserve Bank of India, 2024).

4. Need for early-stage risk capital which is adaptive in nature

Respondents on the demand-side and supply-side noted that there are slowly some commercial projects and business models emerging around NbS projects, led by factors like mandatory sustainability commitments and voluntary carbon markets, but the bankable pipeline remains small.

Larger capital pools (institutional investors and large corporates and value chains) seem to be predominantly offering mature-stage capital, which is suitable for proven business models and bankable projects already under implementation. Respondents note that what might be required instead is early-stage risk capital, to cover the upfront costs of the design and piloting of NbS. This will allow the demonstration of commercial viability and expected cash flows and provide a scope for environmental markets and product premiums to operate in the future. At the moment, providing such kinds of capital is beyond the current interest of larger investors.

Among smallholder farmers and smaller farmer collectives, upfront costs for adopting some NbS are substantial. Meanwhile, limited access to finance and weak incentives can be a deterrent even for established businesses, including FLAG company value chains, looking to integrate sustainable practices when the conditions are right. In this context, lack of access to the right kind of financing at the right time can raise opportunity costs, which may prevent NbS adoption from taking place at the scale and speed that is necessary (World Bank, 2024).

Over time, NbS implementation at scale may require a continuum of capital providers - from public agricultural budgets and early-stage grants to private equity and debt providers - to match evolving financing needs of the project and of actors in the value chain. Each of these financing entities have potentially different contributions to make (Table 5). Currently, investments into NbS interventions by the private sector are often seen as start-up investments and less as real asset investments, given that few such mature projects exist and many more still need to be discovered in India. Regardless of the stage and financing source, the financial solution needs to remain adaptive. Here, capital stacking may help. The types of capital needed include (in that order):

- Government support to provide early impetus to alternative agricultural practices (Singh et al., 2024b).
- Early-stage funding through grants for technical assistance and skilling.
- Impact funds to build capacity for accessing capital markets.
- Development finance institutions for providing infrastructure to access direct and indirect revenue sources.
- Growth finance for scaling up and scaling out.

Table 5: Potential contributions of financing entities in investments into NbS projects

Funders	Nature of Finance	Investment Horizon	Example interventions	Expected Impact
Central and state governments	Farmer income support, crop insurance	Short and Medium Term	Upfront incentives; repurposing subsidies.	Improved nutrient management; support for alternative agricultural practices & crop diversification
NGOs, Foundations	Technical Assistance	Short, Medium and Long Term	Post-harvest Centres of Excellence.	Provision of catalytic capital to connect farmers with alternative markets; Grading, separation, certification, packaging and market access for NbS adopters.
Impact Funds	Incubation/ Early-stage Funds	Short and Medium Term	Skilling, FPO-level processing facilities for NbS-based produce.	Better realisation, ability to 'store & sell' to conscious buyers; ability to accept modern capital; listing on the Social Stock Exchange (SSE).
Development Finance Institutions	Social Finance Instruments	Short, Medium and Long Term	Bridge with government machinery to create Social Impact Bond (SIB)/ Development Impact Bond (DIB) structures; providing credit guarantees.	Infrastructure for NbS implementation and capacity building; providing credit guarantees for banks and NBFCs to initiate lending to farmers for transitioning to NbS.
Conventional Investors/ Funds	Capital market instruments	Medium and Long Term	Scaling up and scaling out the social enterprise into a modern business.	Conventional investments for growth.

Blended finance has emerged as a novel alternative to financing the agricultural sector. While some examples exist, investors and financiers are yet to consider blending as a preferred mechanism for catalytic funding of NbS projects. While local banks are hesitant to embrace blended finance due to procedural restrictions, the implementing agency may find the incentive structure unappealing and overloaded due to frequent monitoring requirements.

However, designing the model such that role complementarities and physical proximity is harnessed can encourage and enable diverse actors to collaborate in managing blended finance instruments (Dey and Mishra, 2022). One demand-side respondent suggests that combining such instruments with loans and small grants, complemented by custom repayment schedules based on understanding farmer needs, context and geographies can further encourage NbS adoption. If implemented well, evidence suggests that concessionary capital can have several roles to play in kickstarting NbS financing at scale (Havemann et al., 2020) (Table 6).

Table 6: The role of concessionary capital like blended finance instruments in scaling NbS investments (adapted from (Havemann et al., 2020))

Role of concessionary finance	Use in NbS interventions
Identify and enable new financing structures	Research & Development of new financial structures.
Anchor new structures by offering capital	Conducting due diligence, acting as reference to other investments, testing intermediation mechanisms.
Risk mitigation	Changing the risk-return perception of private investors.
Technical support	Providing assistance to meet demand- and supply-side monitoring and verification criteria.
Reward for providing co-benefits	Assigning a financial value to an additional co-benefit (agro-biodiversity conservation, livelihood development).
Market development	Supporting the development of market and policy incentives; monitoring and communicating financial and development impacts.

5. Clarity on the role and impact potential of nature markets

Respondents note that nature markets, for example, the generation of carbon credits in voluntary and compliance carbon markets, remain a viable way to channel indirect economic benefits into NbS projects – especially as these projects mature. While livelihood, biodiversity, and water co-benefits make carbon credit projects ecologically-beneficial and well-rounded (and hence, much more attractive to buyers on international registries), some respondents expect that biodiversity and water credits would start to be generated and traded on their own in the near future. Currently in a nascent stage (Ministry of Agriculture & Farmers Welfare, 2024), carbon credits may become a significant source of financing NbS a decade or so down the line, as carbon credit markets for the agricultural sector mature in India (Khurana et al., 2024).

Typically, carbon credit project developers follow one of two strategies regarding the generation of credits from NbS interventions. One strategy focusses on reduction credits – reducing emissions from agricultural activities – and the other strategy focusses on removal credits – generating sequestration benefits through increasing and preserving carbon on farms through, for example, agroforestry initiatives. There is a growing demand for both these types of carbon credits from national and international entities looking for credits generated in India.

While voluntary carbon markets are critical for mobilizing resources for the pursuit of global climate and nature goals, carbon markets currently remain fragmented and complex. *Because of the recent scrutiny around some the workings of the carbon markets globally (West et al., 2023), project developers in India are doubling down on creating robust MRV capabilities to ensure transparency and compliance. Meanwhile, off-takers of carbon credits (entities with sustainability and net-zero commitments, financiers, brokers, and financial institutions) generated from NbS interventions are also looking out for high-integrity and high-quality carbon credits with co-benefits for biodiversity and local communities.* Such a focus also follows apparent economic and environmental risks from a unidimensional focus on carbon, including the impacts on local groundwater tables in India (Srivathsa et al., 2023).

Respondents from nature credit enterprises indicated the high potential of NbS-based approaches to generate carbon credits. In current voluntary markets, these approaches can fetch a price ranging from less than USD 20/tCO₂e for agroforestry to about USD 100/tCO₂e for biochar generated from crop residues. These prices may also fluctuate, creating an additional layer of uncertainty for project developers. In addition, carbon credits are currently able to monetize only some of the benefits of adopting NbS at the farm level. Their price, whatever it might be, is unlikely to reflect the full range and

extent of the gains accrued to provisioning and regulating ecosystem services (Koh et al., 2021).

However, there exist significant land thresholds for projects to be considered investable because of the significant transaction costs involved in setting up projects and generating credits. Several supply-side respondents noted average minimum land thresholds to be hundreds of hectares, curtailing the emergence of carbon credit-focussed NbS interventions in India. With the further development of nature markets, clearer incentive mechanisms, and robust policy support, these land thresholds may come down.

From a farmer income perspective, some respondents expressed concerns about the amount of additional income that nature credit markets could generate at the level of a typical smallholder farmer in India. They noted that there is a need to understand the limitations and impact potential of these markets to contribute to increased farmer incomes - such indirect incomes could supplement direct incomes from reduced input costs and potential price premiums, but are not designed for being, and may not become, the predominant income sources or incentive mechanisms for smallholder farmers to adopt NbS.

Nevertheless, these markets can fill in crucial funding gaps in some cases, which may fall beyond the scope of philanthropic or CSR funding in India. Respondents noted that philanthropic funding often cannot support behaviour change and opportunity costs over the longer-term. CSR funding for agricultural projects, on the other hand, has a major focus on capacity building, value chain development, and encouraging alternative activities, with a strong ‘soft’ component, i.e., achieving convergence with existing government schemes, without an explicit focus on additional revenue generation.

A Stylized Dichotomy of NbS Investments

At a systemic level, respondents noted that encouraging farmers and institutionalising NbS adoption at scale in India is especially difficult because of the diversity of stakeholders and levers. Respondents noted how NbS adoption, and the land use transition that is needed concurrently, often depends on the political economy of the given landscape.

Agriculture is a sector where one cannot directly implement interventions, but rather has to encourage farmers to change practices. The behaviour changes and sustained motivation that this requires is often hard to implement. Agriculture being under the State List in India (giving state governments in India the power to enact laws), there are

often tensions between new farming initiatives, regional and national, and the input and post-harvest ecosystem, including suppliers, food processors, retailers, financiers, and banks. Some barriers must be resolved at the national level, while some at the state level or below.

This calls for a differentiated approach which is area-oriented and nature-inclusive. For example, consider the following stylized archetypes:

On the one hand, for staples and commodity crops in major high-yielding agrarian regions (for example, the Indo-Gangetic Plains or Peninsular India), the focus may be on on-farm direct and indirect financing approaches. Here, the large land areas under cultivation, declining soil health, water scarcity, and climate change are major reasons for farmers to be open to the idea of adapting farming practices, which is increasingly being supported by central and state governments in India (Sharma, 2024). With the easing of credit access, provision of concessions based on adopting NbS, enabling incentives and stable procurement prices for crop diversification, creation of new market linkages, onboarding of tenant farmers, and the development of safety nets to compensate for potential yield losses in the short-term upon adoption (Singh et al., 2024a), a strong investment case can be made which delivers climate as well as economic benefits.

On the other hand, NbS approaches can be promoted and supported in minor agrarian regions with speciality crops (for example, the Himalayan states) by focussing on post-harvest investment opportunities. Here, the focus may instead be on post-harvest value chain development solutions like sorting, processing, logistics, and retail of sustainably-grown produce, so that it reaches more customers and demand is built to respond to existing supply potential.

Table 7 describes the stylised characteristics of these two archetypes across a set of different attributes. These stylized characteristics are only illustrative and agrarian contexts in India and complex and multi-faceted; but they provide indicative implications for financing pathways, strategies, and adoption possibilities.

In sum, there is a need to consider implementing NbS approaches at a landscape-level. Under landscape-level transitions, multiple farmers within a geographical area transition to NbS practices, thereby generating an expansive set of benefits (carbon, water, soil health, biodiversity, livelihoods). Participating farmers can then share those benefits amongst multiple parties. Landscape transitions can result in economies of scale and enhanced climate resilience due to shared knowledge, resources, and collective

impact of practices. Further, it can attract more support from public and private-sector stakeholders. Lastly, it may help empower communities as such approaches encourage collective action and foster social cohesion.

Table 7: Stylized characteristics of two archetype landscapes and indicative implications for NbS investments in India

	Agrarian region with speciality crops	Agrarian region with staples and commodity crops
Sector of intervention	Post-harvest	On-farm
Current agricultural approach	May already be largely organic/low on chemical inputs.	NbS largely a niche innovation executed at a small scale. Some regions may be performing better than others because of local factors (inspirational leaders, local movements, personal motivation). Currently, few studies exist that accurately value NbS-incorporated produce, in terms of ecological benefits and livelihood outcomes.

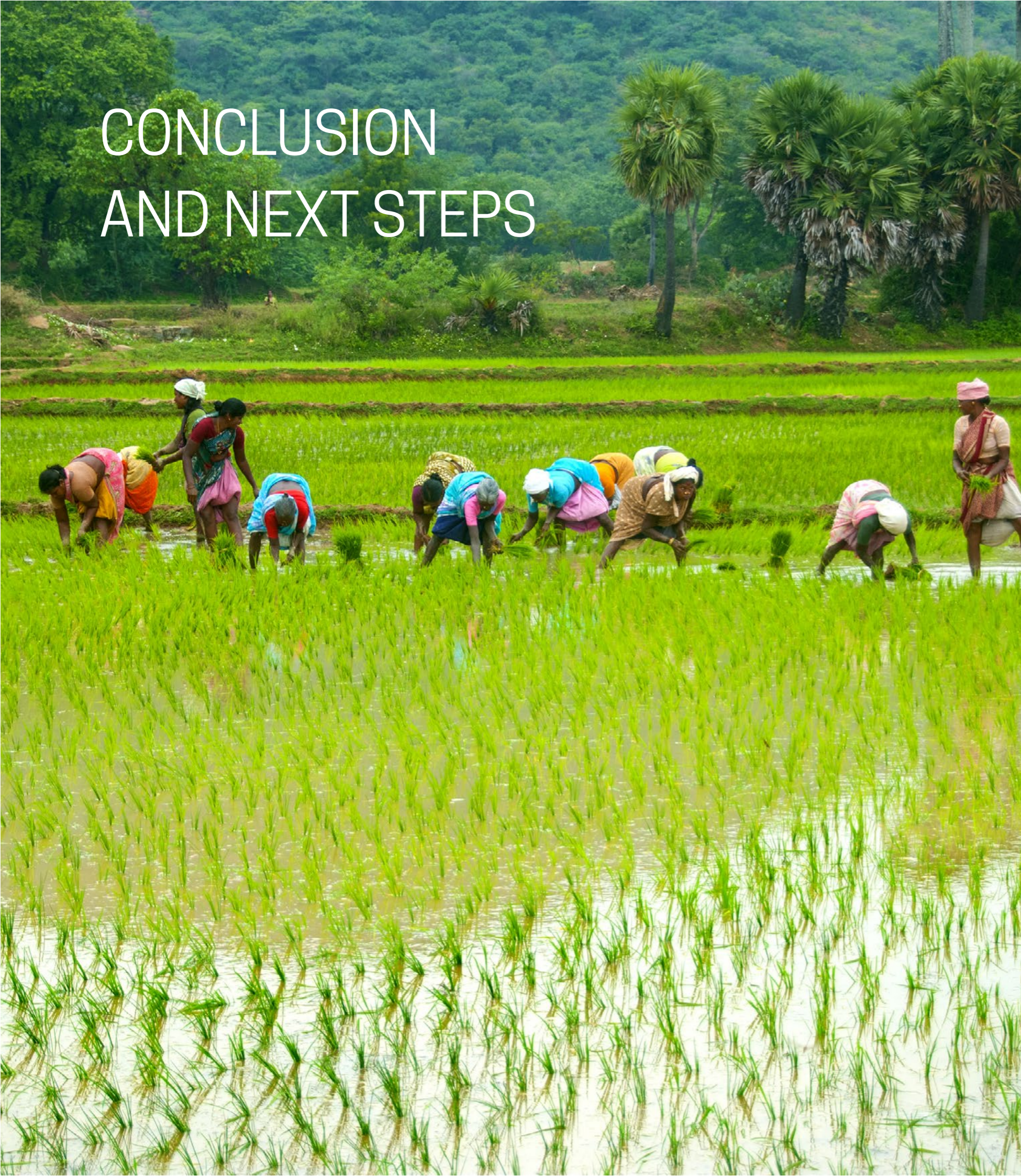
Incentives for staples and commodity crops	Not conducive; 1. Difficult biophysical conditions. 2. Slow percolation of national policies. 3. Low participation rates.	Conducive; 1. Incentives for decreasing water and chemical uses as part of state and national schemes, policies, and programmes. 2. Concessional credit access based on farming practice. 3. Nature credit markets. 4. Potential for premiums for produce grown using alternative agricultural practices.
Types of activities to be encouraged	1. Climate-resilient post-harvest infrastructure development. 2. Improved access to finance. 3. Capacity building and technical assistance to value chain actors.	1. Climate-resilient pre- and post-harvest infrastructure development 2. Improved agricultural production. 3. Technical assistance to state and national-level policy makers. 4. Improved access to finance.
Potential time-horizon for transition	Faster; 1-2 years to be initiated	Slower; medium to long-term. Respondents give a time outlay of 5-20 years, combining inputs, advisory and infrastructure, which needs patient capital.
Farmer types	Small and marginal farmers, FPOs.	Small, marginal and medium-sized farmers, FPOs, FLAG companies.
Immediate potential loss to farmer	Unlikely.	Potential yield losses in the short-term; increased labour input.

Alternative farmer-linked income streams	Not explored.	Dairy farming, livestock rearing.
Role of regulation	Facilitating, for better market access.	Enabling, for ecosystem building and policy coherence.
Barriers to accessing direct investments	Very High, because limited infrastructure may currently exist.	Very High, because current funding terms are often not favourable to farmers and implementers.
Transaction costs	Low for farmers; to be borne by post-harvest value chain agents.	High for farmers; but innovations exist towards collectivization.
Costs of farmer participation	Likely low.	Medium to High, in the form of: 1. Foregone revenues from short-term yield decreases, offset by decrease in input costs (this may be context-specific). 2. Transaction costs for nature credit programmes.
Revenue sharing	May be divided between farmers, FPOs, and other value chain agents.	May be divided between farmers, FPOs and farmer-facing organizations. In case of nature credit projects, there exist different models based on who puts in initial investment (can be farmer-led or investor-led).

Quantification of co-benefits	Currently unexplored.	In case of nature credit projects, adaptation and resilience benefits (in terms of livelihood, gender, health, and education benefits) are often quantified, which also informs project selection. A social return of investment may also be done periodically.
Scaling opportunities	<ol style="list-style-type: none"> 1. Untapped opportunities and first mover advantages. 2. Existing supply channels if demand can be sustainably increased. 3. Existing socio-political leverage points and market creation opportunities. 	<ol style="list-style-type: none"> 1. Vast area under cultivation if solid business cases and robust monitoring approaches can be developed. 2. Emerging digital tools for monitoring with economies of scale. 3. Decreasing reputational, transitional and operational risks for FLAG companies. 4. Ambitious sustainability commitments of several actors in the value chain.

Barriers to be overcome	<ol style="list-style-type: none"> 1. Lack of infrastructure. 2. Limited local stakeholder engagement. 3. Lack of dedicated credit lines. 4. High up-front investment needed. 5. Site-specific implementation challenges (partnerships, social relationships, compliance). 6. Difficulty in finding investable projects/ FPOs. 	<ol style="list-style-type: none"> 1. Lack of bankability of projects. 2. High transaction costs for investors. 3. Lack of data and tools (limited monitoring, reporting, and verification capacity). 4. High upfront costs. 5. Lack of standard metrics to measure impact. 6. Site-specific implementation challenges (partnerships, social relationships, compliance). 7. Hard to find investable projects/ FPOs.
Enabling conditions to be formed	<ol style="list-style-type: none"> 1. Early-stage risk capital. 2. A fund that aggregates multiple small value chains to decrease transaction costs. 	<ol style="list-style-type: none"> 1. Adaptive financing. 2. Collaborations between private capital, public capital, and philanthropy. 3. Early-stage risk capital.

CONCLUSION AND NEXT STEPS



Adopting NbS at scale in the agricultural sector in India has the potential to provide climate change adaptation and mitigation opportunities at scale, while also providing significant environmental, social, and economic co-benefits. It can also offer attractive financial returns on investments made by the public and the private sectors. There is tremendous enthusiasm for actors in the agricultural sector for operationalising these NbS, but determining the means to finance them has been a major challenge. This report describes the current status of investments and stakeholder perceptions, to scope what possibilities exist, and to explore how future challenges can be dealt with.

We find that NbS investments in the agricultural sector remain a relatively blind spot for private sector financing in India. Public sector budgets are predominantly focussed on climate adaptation and resilience building initiatives. Meanwhile, the quantum of mitigation-focussed climate finance remains well below its potential and primarily channelled to projects in other sectors like energy and the built environment.

NbS promise to be cost-effective climate change adaptation and mitigation instruments in India, with the potential to realise financial as well as climate returns with significant socio-ecological co-benefits. Effective investment pathways are needed to realise their promise.

Current innovations in financing are taking shape in India. They have taken the form of environmental impact bonds, collaborations between commercial banks and NBFCs to service debt instruments, the rise of agri-tech companies providing data-driven solutions to supply-side stakeholders and the use of blended financing to de-risk investments. Despite these innovations, conversations with demand-, supply- and policy-side stakeholders reveal a few challenges in scaling investments. These include tackling the inertia in production systems where specific incentives and

disincentives are locked in, several implementation and financing risks, and concerns around designing risk management mechanisms tailored for the agricultural sector in India.

Insights from these conversations also point towards sectoral needs and future prospects. These include the need for the creation of hard and soft infrastructure, a stable and coherent regulatory environment around NbS implementation and financing, the need for early-stage capital to get NbS projects off the ground, and effectively integrating indirect revenue sources (like nature credits) into farm revenues. There are opportunities to address these systemic barriers and utilise the evolving conditions for scaling NbS investments. This will ensure that the private sector also emerges as a key partner in the People (farmers) – Public – Private Partnership and integration necessary for the adoption of NbS in India.

In the short-term, it may be necessary to determine possible entry points that will engage the organized private sector to build climate resilience as part of their existing value chain activities. Long-term actions may require deeper, multi-stakeholder consultations and consensus building, including actions that will address the vulnerabilities of smallholder farmers, while simultaneously providing incentives to the organized private sector to engage and invest.

How can this momentum be built? Public resources as well as grants, philanthropic and early-stage capital can play a role in de-risking investment in agricultural development, thereby catalysing funding from the private sector. However, relevant data on private sector and public domestic climate finance flows in the sector is inadequate, thus preventing an accurate assessment of current and future needs. Having more comprehensive information on climate finance that focuses on small-scale producers is crucial because information on trends, investment gaps, and opportunities would shed light on practical actions that governments, development finance institutions, climate funds, private investors, and businesses can take.

Given the diversity of implementation contexts that the agricultural sector in India offers, we find that investment strategies may need to be tailored to maximise direct and indirect investments into the sector. These differing strategies may well be based on the geographic, agronomic, political, and economic context of the given state or region in India.

Where do we go from here? This analysis is a first step in unlocking the multitude of benefits India could receive through implementing NbS; however, more needs to be done to support the transition. Insights from this report can therefore be followed by financial and regulatory structures that mainstream NbS adoption into investment and policymaking processes. In doing so, each sector of society can contribute towards building a financial ecosystem, where each institution and actor understands their distinct roles, and commits to them to ensure consistent funding for NbS projects.

This can take several forms. Additional research, data collection, and engagement can help in bringing more nuance and evidence into investment strategies. Additional data collection on costs and benefits of NbS could improve financing strategies and support investment selection. Further engagement with private investors would help in better understanding their net-zero strategies, sustainability commitments, and the mechanisms they can use to invest in NbS. The demonstration of different business models on a pilot basis through a few 'model investment projects' would also help to inform specific finance strategies and allow investors to explore realistic project-level economics. Finally, empirical evidence of how costs and revenues may vary over space and time would increase investor confidence including, for example, the quantification of opportunity costs, which are often context-specific. Further engagements with demand-, supply- and policy-stakeholders can ensure that each one proactively engages with NbS investment opportunities, takes steps to address the barriers outlined in this report, builds on the enabling conditions for scaling these investments, and designs robust pathways to ensure the realisation of the abundant prospects for NbS implementation at scale in India.

ANNEXURE 1

Technical Steering Committee (TSC) of the NCMA Initiative

S.No.	Name	Designation	Organisation
1.	Ms. Anita Arjundas	Executive Director	ATREE
2.	Dr. Shalini Dhyani	Senior Scientist	CSIR NEERI
3.	Mr. Nikhil Goveas	Lead Advisor, India	EDF
4.	Mr. T Nanda Kumar	FOLU Senior Fellow, Retd. IAS	FOLU India
5.	Mr. S Vijay Kumar	FOLU India Lead, Retd. IAS	FOLU India; TERI
6.	Mr. Abhishek Jain	Director, Powering Livelihoods	CEEW
7.	Dr. Manish Anand	Senior Fellow	TERI
8.	Dr. Ruchika Singh	Director, SLR	WRI India
9.	Dr. S Nedumaran	Senior Scientist - Economics	ICRISAT
10.	Mr. Swapan Mehra	Founder and CEO	IORA Ecological Solutions
11.	Dr. Sudarshan Dutta	Lead, NbS Agriculture	Kosher Climate
12.	Dr. VM Chowdary	Senior Scientist	NRSC
13.	Dr. AK Nayak	Director	NRRI
14.	Ms. Vidvatta Sharma	Programme Manager	Shakti Foundation
15.	Mr. Sushil Saigal	Director of Programmes	TNC
16.	Mr. Manoj Singh	Lead - Regenerative Agriculture	TNC
17.	Ms. Prachi Patil	Project Coordinator	WASSAN
18.	Dr. PS Roy	Senior Fellow	WRI India
19.	Ms. Priya Narayanan	Senior Programme Manager	WRI India

ANNEXURE 2

Promising NbS in India

Twenty NbS have been identified for implementation globally and with a demonstrable climate action potential in the land sector (Roe et al., 2021). These NbS are focussed on both demand and supply-side measures and cut across ecosystems (**Figure A2.1**). At their full potential, these NbS can deliver about 700 Mt CO₂e of mitigation potential per year on average in India in a cost-effective manner i.e., at less than USD 100/tCO₂e, in addition to significant climate change adaptation benefits.

Forests and other ecosystems	Protect	1) reduced deforestation; 2) reduced mangrove loss; 3) reduced peatland conversion
	Manage	4) improved forest management; 5) improved grassland fire management
	Restore	6) afforestation and reforestation; 7) mangrove restoration; 8) peatland restoration
Agriculture	Reduce	9) enteric fermentation, 10) manure management, 11) nutrient management; 12) rice cultivation
	Sequester	13) agroforestry; 14) biochar from crop residues; 15) soil organic carbon in croplands; 16) soil organic carbon in grasslands
Energy	BECCS	17) bioenergy with carbon capture and storage
Demand-side measures		18) clean cookstoves; 19) reduced food loss and waste; 20) a shift to healthy and sustainable diets

Figure A2.1: 20 aggregate NbS identified for land-based mitigation in India (adapted from Roe et. al 2021 and FOLU Coalition India.

A total of 13 out of these 20 NbS were chosen in a prioritization exercise, based on discussions within the TSC. A number of criteria were considered for the prioritisation – including their mitigation potential, adaptation benefits, livelihood benefits, land availability, ease of implementation, national government interest, implementation context, data availability at a reasonable resolution, and data sourcing ability from within the TSC. This was reflected in the score given to each NbS. The NbS which were excluded were food waste reduction, grassland and savanna fire management, among others.

Out of these 13 NbS, cost data was collected for 6 NbS. The remaining 7 NbS were not costed because of their limited impact potential and lack of data available on their economic costs and returns in an Indian context. Data on the cost of implementation of these 6 NbS were then evaluated by TSC members (**Table A2.1**).

Table A2.1: Results of prioritization exercise of 13 selected NbS in the Indian context.

NbS for which cost data collected ¹	Score	NbS for which cost data not collected	Score
Soil Organic Carbon in croplands	8.6	Reducing deforestation	6.9
Agroforestry adoption	8.2	Reducing mangrove loss	6.4
Improved rice cultivation	6.6	Improved forest management	4.9
Biochar from crop residues	6.3	Soil carbon in grasslands	3.3
Afforestation and reforestation	5.3	Enteric fermentation	2.6
Improved nutrient management	4.9	Mangrove restoration	4.4
		Manure management	1.8

¹ The NbS in bold were found to generate 90% of the total mitigation potential.

Just 6 NbS could generate 90% of the mitigation potential and are relevant from an adaptation perspective as well (Roe et al., 2021; FOLU Coalition, in prep.). These 6 solutions are well-known, locally-relevant and already under implementation in some parts of the country. These 6 solutions appear to be profit-making in the long-term, according to a review and analysis of current data sources (FOLU Coalition, in prep.). The profits may accrue from Year 0, or may accrue a few years into implementation.

Eventually, the focus was narrowed down to 4 NbS which showed the maximum incremental revenue potential and demonstrated potential to be implemented at scale in agricultural landscapes in India (FOLU Coalition, in prep.):

1. **Soil Organic Carbon in croplands,**
2. **Improved nutrient management,**
3. **Agroforestry adoption, and**
4. **Biochar from crop residues.**

Summary information on these 4 NbS is given below and their potential is explored further in a forthcoming report (FOLU Coalition, in prep.). The 2 dropped NbS were (a) Improved rice cultivation and (b) Afforestation and reforestation because of the constraints around large-scale feasibility and non-uniform application in the Indian context.

Soil Organic Carbon in croplands

Increasing Soil Organic Carbon (SOC) in croplands refers to the use of land management practices, including the addition of organic manures, cover cropping, mulching, no-tillage, and rotational grazing to sequester carbon in agricultural soils. Agricultural soils can act as both sources and sinks of carbon, and the use of improved land management practices (like the ones mentioned above) has the potential to stimulate the carbon sequestration capacity of agricultural soils. SOC sequestration in croplands potentially has immediate, significantly improved returns with no extra costs (upto INR 21,000/acre) (FOLU Coalition, in prep.).

Case study: A global review of SOC sequestration in agricultural soils indicates that if SOC% content in agricultural soils were to be doubled (from 0.27% to 0.54%) through improved land management practices, an annual sequestration potential from 0.56 to 1.15 tC/ha/yr (or 2.0 to 4.1 tCO₂e/ha/yr) could be unlocked (Zomer et al., 2017). For South Asia specifically, the range of achievable SOC sequestration potentials are between 0.62 and 1.28 tC/ha/yr (or 2.2 to 4.6 tCO₂e/ha/yr) for at least 20 years, because of the relatively low soil organic carbon levels on croplands currently (Zomer et al., 2017). India-based studies indicate a carbon sequestration potential of 0.16-0.33 tC/ha/yr (or 0.57-1.18 tCO₂e/ha/yr) across different land management scenarios over a long-term period spanning more than 15 years (Pathak et al., 2011).

Improved nutrient management

Improved nutrient management refers to avoided N₂O emissions and/or production-linked CO₂ emissions by reducing total fertilizer application through the use of best practices and improved technologies. By reducing the over-application of fertilizers (for example, improving the timing, placement, and form of fertilizer application and making greater use of manure), significant improvements in efficiency can be made without negatively impacting crop yields. Improved nutrient management potentially has immediate returns at no added costs, as compared to business as usual (upto INR 4,000/acre) (FOLU Coalition, in prep.). The co-benefits associated with it are reduced externalities, including improved drinking water quality, increased opportunities for recreation, and health benefits.

Case study: Site-specific nutrient management (SSNM) for rice and wheat in the Indo-Gangetic Plains revealed a significant decrease in fertilizer application, leading to reduced carbon-equivalent emissions, in combination with increased yields and farmer incomes. If implemented across rice and wheat agricultural systems in India, this would translate into 13.92 Mt more rice and wheat production with 1.44 Mt less Nitrogen fertilizer use, translating to mitigation of 5.34 Mt CO₂e/yr (Sapkota et al., 2021).

Agroforestry adoption

The adoption of agroforestry refers to the practice of planting and maintaining trees and other vegetation in agricultural lands to increase carbon sequestration in above- and below-ground biomass as well as soil carbon. This includes windbreaks and shelterbelts, alley cropping, and farmer-managed natural regeneration. Globally, its mitigation potential is averaged to be 0.37 tCO₂e/ha/yr. Agroforestry systems are also habitat for species and support connectivity, control soil erosion, enhance groundwater recharge, and improve air quality.

Practising agroforestry on 1-acre potentially breaks even financially in the 4th year of operation and generates returns thereafter (upto INR 8,500/acre from Year 4) (FOLU Coalition, in prep.).

Case study: Analysis of current agroforestry systems in 26 districts across 10 states in India revealed a carbon sequestration potential ranging from 0.05 to 1.03 tC/ha/yr (or 0.18 to 3.7 tCO₂e/ha/yr), with an average of 0.21 tC/ha/yr (or 0.76 tCO₂e/ha/yr) (Ajit et al., 2017).

Biochar from crop residues

Biochar is a carbon-rich, fine-grained, highly-porous type of charcoal made from biomass. The production process converts rapid-mineralizing carbon (like biomass) to persistent and stable carbon (charcoal) through pyrolysis (i.e. heating biomass in a low-oxygen environment) that can persist in soil for hundreds to thousands of years. Biochar can be produced using crop residues, woody residues, manure, and other sources of biomass. Globally, biochar production is known to help in carbon sequestration as it is a stable form of carbon itself, while biochar also contributes to decreasing carbon losses from agricultural soils. Biochar potentially has higher establishment and fixed costs, which are recovered through increasing profits from improved farm returns as compared to business as usual (upto INR 1,500/acre) (FOLU Coalition, in prep.). As co-benefits, biochar production can also lead to an enhancement of soil quality and fertility.

Case study: Analysis of irrigated paddy systems in Cambodia demonstrated yield increases of up to 33% from the addition of approx. 41.5t of rice husk char (RHC) per hectare of paddy. The carbon sequestration from the biochar addition is approx. 0.42 tCO₂e per tonne of RHC. If energy generation from gasification is included, this figure jumps to approx. 0.86 tCO₂e per tonne of RHC (Shackley et al., 2012).

ANNEXURE 3

List of stakeholder respondents

S.No.	Name	Organization	Stakeholder Type
1.	Mr. Ashok Methil	Ex-CGM, NABARD	Policy
2.	Mr. S Vijay Kumar	FOLU Coalition India	Policy
3.	Agriculture Business Unit (ABU) Department and Environmental, Social and Governance (ESG) Department	State Bank of India (SBI)	Demand
4.	Himanshu Vaghela, SS Bhat, Kuldip Dixit and Sumit Soni	Friends of Women's World Banking (FWWB) India	Demand
5.	Ms. Smitha Hari & Mr. Sourajit Aiyer	Auctus ESG	Demand
6.	Mr. Venky Ramachandran	Agribusiness Matters	Demand
7.	Mr. Swagatam Patnaik & Mr. Sachin Chauhan	ImpactDash	Demand
8.	Ms. Mona Kachhwaha	UC Impower	Demand
9.	Mr. Sandeep Bhattacharya	GIZ India	Demand
10.	Mr. Varad Pande & Mr. Rajvardhan Singh	Boston Consulting Group (BCG)	Demand
11.	Mr. Shailesh Dagar	Intellicap	Supply
12.	Ms. Maitri Patel	Kosher Climate	Supply
13.	Mr. Nikhil Goveas	Environmental Defense Fund (EDF) India	Supply
14.	Mr. Ashis Mondal	Action for Social Advancement (ASA), Bhopal	Supply
15.	Mr. Ravi Trivedi & Mr. Ankur Sanghai	The Nudge Foundation	Supply
16.	Mr. KN Kumar	Meghalaya Farmers Empowerment Commission (MFEC)	Supply
17.	Mr. Kamlesh Saxena	Rallis India	Supply
18.	Mr. Sai Kishore Nellore	Olam Agriculture India	Supply
19.	Mr. Sandeep Roy Choudhury	VNV Advisory	Supply
20.	Mr. Kaushal Bisht	Varaha	Supply
21.	Ms. Krutika Ravishankar	Farmers for Forests	Supply
22.	Ms. Priya MP	Organic Mandya Farmers Federation	Supply

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