Prosperous Land, Prosperous People: Scaling finance for Nature-based Solutions in Colombia

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The Food and Land Use Coalition

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Foreword & Acknowledgements

This report is one in a series produced by Climate Focus and the Food and Land Use Coalition (FOLU). Since September 2021, Climate Focus and FOLU have been collaborating on a research project looking at financing strategies for land-based Nature-based Solutions (NbS) at a country and global level (see following page). The ultimate objective of the project is to enable public and private financiers to prioritize and deploy activities and investments that will unlock the potential of NbS for climate mitigation, adaptation, resilience, biodiversity and beyond. The 2022 report series includes the publication of country-based assessments in Kenya and Colombia, as well as global analyses focused on the voluntary carbon market. This publication about Nature-based Solutions in Colombia is funded by Norway's International Climate and Forest Initiative (NICFI).

The drafting of this report (and its companion study in Kenya[1]) was led by: Talia Smith, Scarlett Benson, Natasha Mawdsley, Alex Andreoli and Mitch Groves at Systemiq.[i] The 2 companion reports have a similar structure and annexes, adapted to the country context as relevant. Each report is a comprehensive standalone report, whereas the Colombia report will also be translated into Spanish.

FOLU would like to thank the large number of individuals and institutions that have generously contributed time and energy to comment on various drafts of this report. In particular, we would like to thank our partners at Climate Focus – including Charlotte Streck, Juan Pablo Castro, David Landholm, Gabriela Martinez, Felipe Bravo, Sanggeet Manirajah, Manuelita Monsanto and Imogen Long and the Colombian FOLU team. We would also like to thank Stephanie Roe at WWF International for peer review, Claudia Martinez (Director of FOLU Colombia), as well as Morten Rosse and Guido Schmidt Traub at Systemiq for their strategic leadership.

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Elinor Newman-Beckett
Andrew Morrow
Irena Spazzapan
George Darrah

Individuals from other organizations:

Luis Rios, Partnership for Forests
Martin Belcher, Partnership for Forests
Venkat Iyer, World Resources Institute (WRI)
David Burns, WRI
Craig Hanson, WRI
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[i] The contents and opinions expressed herin are those of the authors and do not necassarily reflect the views of the associated and/or supporting institutions, The usual disclaimer applies.

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. The coalition empowers farmers, policymakers, businesses, investors and civil society to unlock collective action at scale.

About this project

There is no pathway to limiting global warming to 1.5°C without the protection and restoration of nature, yet there is a significant financing gap with less than 2% of climate finance currently flowing to Nature-based Solutions (NbS).[2] Investors – both public and private - often lack the information to enable them to invest in land-based mitigation, including which concrete programme and jurisdictional-level investment opportunities exist and how to structure investments in nature and sustainable landscapes (including through access to carbon markets[3,4]). Actors also lack the information needed to assess the economic opportunities provided by a sustainable, nature-and climate-positive economy. When initiating the project there were no studies that set out a comprehensive country-focused assessment of optimal financing strategies for unlocking the potential of NbS.

Through the series of reports, Climate Focus and FOLU will address the following five questions:

1. What is the mitigation potential of NbS at country level? The report looks at a specific set of NbS which deliver climate mitigation through the protection, management and restoration of natural ecosystems and by shifting how food is produced and consumed within the country. The country-level mitigation potential draws from the work of Roe et al (2021).[5]

2. How much does it cost to implement and manage these NbS in specific countries?

3. What is the finance gap between the finance currently flowing into these solutions and the finance that is needed to unlock the full mitigation potential of these solutions?

4. Which funders and financial mechanisms (i.e., carbon markets, private investment, public financing) will be most effective in unlocking the potential of different types of NbS in different country contexts? What is the role of the voluntary carbon market in financing NbS?

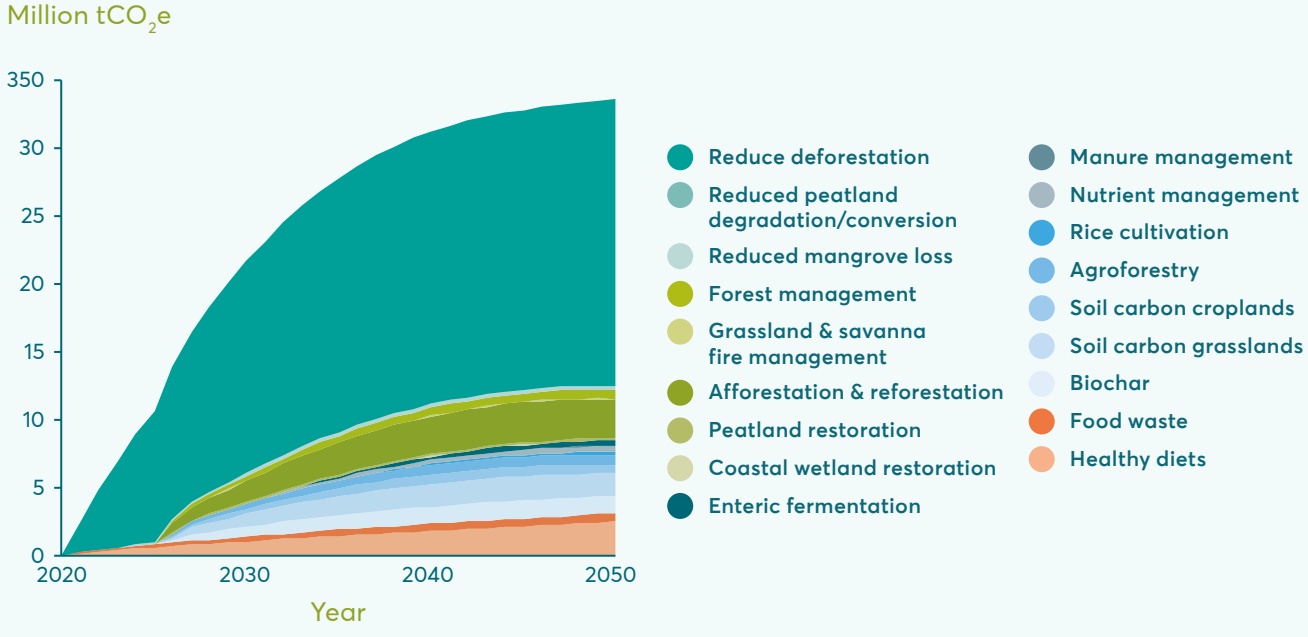
5. What are the features of an enabling environment needed to bridge the finance gap?

Executive summary

Nature-based Solutions (NbS) are a critical part of the transformation agenda for food and land use systems to deliver better prosperity for people and planet. NbS are actions in land-based and marine ecosystems to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.[6] They support the critical transitions, identified by FOLU, to transform the food and land use system, including shifting towards productive and regenerative agriculture, protecting and restoring nature and providing healthy diets.[7] There has also been increasing attention to the role that land-based NbS play in climate change mitigation. Recent evidence suggests that the implementation of 20 different land-based solutions can provide around 30% of global mitigation needed to deliver the 1.5°C temperature target, whilst also securing the climate regulation function of the existing land sink.[8,9]

Colombia is in a strong position to use NbS to accelerate the transition to a 'new food and land use economy' as outlined in FOLU's Roadmap for Colombia.[10] Implementation of a suite of land-based NbS[ii] in Colombia by 2050 has the potential to deliver significant benefits for climate, biodiversity protection, local livelihoods, food and nutrition security. These measures could provide climate mitigation of approximately 340 million tCO_2e per year by 2050, which is four times greater than the annual emissions of Colombia in 2019.[11] Protecting forests has the greatest climate mitigation potential, due to deforestation causing 36% of Colombia's emissions,[12] but reducing and sequestering emissions in agriculture and demand-side interventions should also be prioritised.

Figure 1: Estimated cost-effective mitigation potential per NbS measrue from 2020 to 2050 ($MtCO_2e$ per year) in Colombia[iii]



[ii] This report specifically focuses on the 20 land-based measures defined in Roe et al. (2021), 18 of which are relevant to Colombia.
[iii] Cost-effective mitigation potential is mitigation which can be achieved for less than USD 100 per tonne CO_2e (Roe et al., 2021). The total mitigation per year by 2050 was calculated by applying the mitigation potential scale-up between 2020 and 2050 detailed in Roe at al. (2019) to the average cost-effective mitigation potential for Colombia identified in Roe et al. (2021).

Building a more resilient and prosperous, as well as food- and nutrition-secure economy in Colombia is more important than ever. It was estimated that 54% of the Colombian population were food insecure in 2015. Recent events have exacerbated this issue, such as the COVID-19 pandemic, cost of living crisis and global supply chain disruptions caused by international conflict and climate-related disasters.[13] Studies suggest that NbS can help to build a more climate resilient and food secure Colombia. By increasing the biological diversity on farmland, the agricultural solutions can help drive productivity in both crop and livestock-based systems, alongside producing more nutritionally diverse food.[14] Solutions that plant and protect trees can increase water infiltration, promote soil health and reduce local temperatures, increasing resilience to droughts, erratic rainfall and high temperatures.[15,16] More quantitative studies are needed, however, to ensure these benefits are experienced across all solutions and in all biomes. Conversely, it is also essential to implement NbS with guardrails to mitigate against potential risks such as harm to local communities and unintended impacts on local biodiversity.

The Government of Colombia has already made significant commitments to support NbS and the new President is prioritizing an energetic green growth transition with environmental justice at its centre. It focuses on the human right to food access, with an emphasis on strengthening biodiversity, climate resilience, food security and local livelihoods. Among other targets, Colombia has committed to a 51% reduction in greenhouse gas (GHG) emissions by 2030 through its Nationally Determined Contributions (NDCs) and has pledged to reduce deforestation by 68.5% between 2019 and 2030.[17] The new Government now plans to direct the economy away from resource extraction and towards agricultural and manufacturing industries[18] and is focussing on Rural Reform, through securing land rights for indigenous and rural communities.[19] They also plan to halt deforestation through limiting the expansion of agribusiness into forests and supporting the use of the carbon market for nature protection.[20]

Despite their importance and increasing policy attention, NbS receive limited funding in Colombia, particularly from the private sector. Less than USD 300 million per year is currently spent on land-based NbS in Colombia, or 0.1% of Colombian GDP in 2019. This investment is driven by domestic public finance and international loans, with limited funding coming from the private sector.[iv] There are several reasons for this. For example, private sector investors often lack the information to enable them to invest in land-based mitigation, with a lack of clarity on where concrete programme and jurisdictional-level investment opportunities exist and how to best structure investments in nature and sustainable landscapes across Colombia. Moreover, the rules and dynamics of private carbon markets are complicated and not always easy to navigate. Finally, even once investors understand potential NbS opportunities, additional barriers to investment currently exist in Colombia, such as difficulties in accessing high quality, financially viable initiatives.

There is increasing evidence that NbS are cost-effective solutions that can be deployed today. Solutions which sequester and reduce emissions from agriculture are relatively more costly per tCO_2e than other NbS in Colombia (USD 31 per tCO_2e on average), with the forest and other ecosystem solutions costing far less (USD 6 per tCO_2e on average). Despite higher costs per tCO_2e, agricultural measures tend to be more profitable as they generate higher and faster returns. Some agricultural solutions, such as improved rice cultivation, can generate economic returns immediately, whereas others require more patient capital to yield returns, such as agroforestry which requires time for fruit trees or coffee bushes to mature.

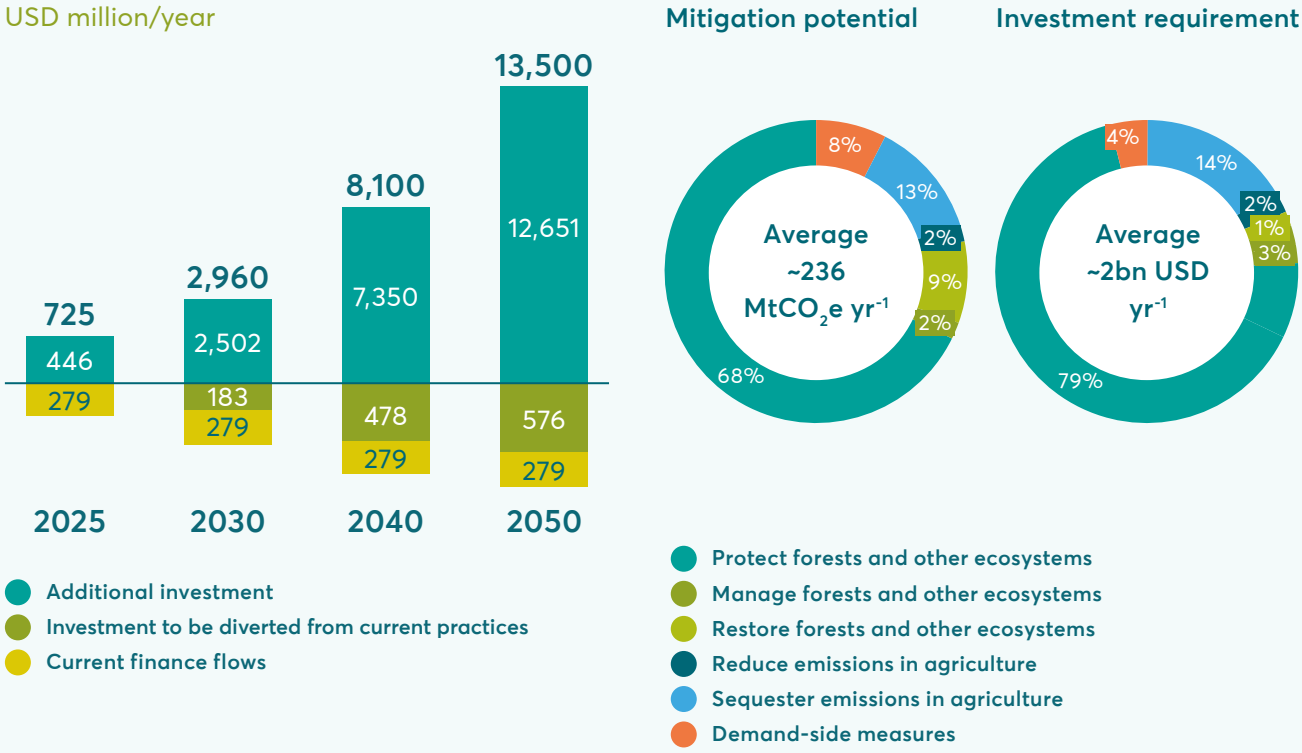
[iv] Due to data availability issues, particularly for private finance, it is likely that USD 300 million is an underestimate of the current finance flows into NbS; however, it still serves as a useful comparator to understand the scale of increase in finance required. This includes payments for protected areas and finance from carbon markets (though is not limited to just carbon markets).
[v] The total investment was calculated using the USD per tonne of carbon dioxide equivalent (USD/tCO_2e) associated with each NbS measure in Colombia as well as the cost-effective mitigation potential summarized in Figure 1 (see methodology document for more information).

This study estimates that Colombia would require USD 13.5 billion of investment per year by 2050 to unlock the potential of NbS (see Figure 2).[v] This represents an almost 50-fold increase in total annual finance for NbS by 2050 compared to 2019 finance flows or just over 1% of projected GDP in Colombia in 2050.[21] On average over the 30 years, USD 5 billion per annum – or nearly 80% of the total investment requirement – is needed to protect forests and other ecosystems, including to reduce deforestation. Agricultural solutions make up 15% of the investment requirement, but most of this investment does not require "new" investment. Over 30% of the finance needed for these solutions could possibly be delivered by re-directing investment that is already going into Colombia's agricultural sector. This is because most of the agricultural solutions require a change in practice (or set of practices) from an existing agricultural model.

Figure 2: Estimated NbS investment needs in Colombia

Left: investment needed per decade split by existing finance that needs to be augmented or redirected (below the line), and additional finance to be sourced (above the line) in USD million per year.

Right: average percentage split of mitigation potential and investment required by NbS category between 2025-2050.



Delivering USD 13.5 billion investment by 2050 requires a number of financial instruments – from grant and direct supply chain-finance to equity and debt-instruments. This study has developed a potential investment pathway for how different financing strategies can be deployed over the next three decades to reach Colombia's total investment requirement. The results highlight how early grant and supply chain finance could enable growth in equity, concessional and market-rate debt which are projected to make up

less than 1% of investments in 2025, but nearly 50% of instruments by 2050. This scale up results from the assumption that NbS business models and revenue streams become more established over time. These could include more innovative business models which create value from standing forests and forest regrowth, such as ecotourism, production of non-timber forest products (NTFPs) or payment for ecosystem services (including biodiversity credits and Habitat Banks).[22]

The analysis also highlights the importance of a diverse set of investor groups collaborating through mechanisms such as blended finance to scale finance for NbS by 2050.

- The Government of Colombia, with the support of international development partners, is an important financier (up to USD 3.3 billion per year by 2050, or less than 1% of projected GDP), as well as enabler of investment, by crowding in private investors. By investing in a supportive enabling environment for international investors, and engaging with businesses around net zero, the Government could crowd in USD 10 billion of private sector investment (a ratio of roughly 1:3).

- Development finance institutions and philanthropy could provide 10% of the total investment in 2025 and 5% in 2050. In the short-term, grant-based investments and concessional financing are projected to be most important whilst the provision of concessional debt becomes increasingly important from 2030 onward. Like the Government, these investors could play a key role in creating the pipeline of initiatives necessary to attract interest from private investors.

- Domestic and international corporates could make up nearly 30% of the investment needed over the course of the transition.

    - Global and domestic Agriculture, Forestry and other Land use (AFOLU)[vi] sector companies who have operations and supply chains in Colombia, could invest USD 3.6 billion per year by 2050 but this could increase to over USD 4.2 billion if the sector pays the full cost of aligning their land value-chains with a net zero future. This represents 16% and 18% respectively of the value add of the AFOLU sector in Colombia today.

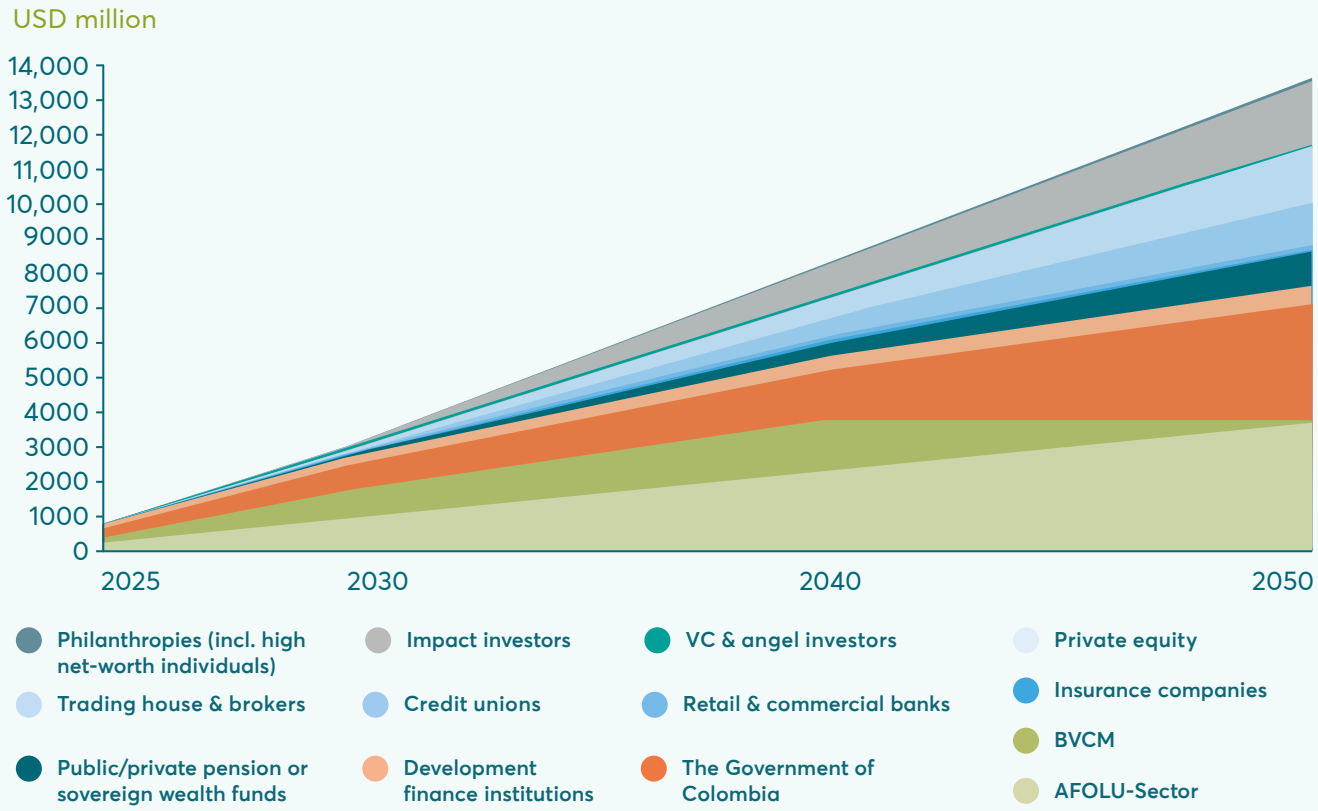
    - 30% of the finance in 2030 could come from corporates investing in "Beyond Value-Chain Mitigation" (BVCM), including through the voluntary carbon market (VCM), representing a 33-fold increase from VCM estimates today. The VCM is a useful mechanism to improve the commercial case of NbS investments; however, if demand for carbon credits is tied to the volume of unabated emissions, then demand for carbon credits would eventually decline as companies transition to net zero.

- Institutional investors including pension and sovereign wealth funds, insurance companies, retail and commercial banks, credit unions, trading houses and brokers, private equity funds, venture capital funds and angel investors, and impact investors could finance nearly 45% of the total investment needed by 2050, compared to a minor contribution today. This reflects the maturation of the business models and revenue streams, as well as increasing ticket sizes, meaning that they are more attractive to investors who require higher returns.

Beyond direct investment, the Government of Colombia is already creating a strong enabling environment for NbS, but more can be done to incentivize investment from the private sector. The Government is making progress to overcome barriers to agricultural transformation around land tenure, insecurity and inequality. Barriers to private investment remain however, including the lack of high quality and profitable

[vi] These companies are referred to as Food, Land use and Agriculture (FLAG) companies in the SBTi guidance for this sector.

Figure 3: A potential investment pathway for investing in NbS in Colombia over the next three decades by investor.



opportunities on offer. Policymakers must therefore act to create a diverse and stable supply of high quality NbS initiatives, attract a greater pool of potential investors and ultimately, lower the burden on the public sector. The recommendations provided in this report identify actions to:

- Increase the incentivises to land managers to implement NbS such as by creating markets for climate-positive products, such as NTFPs, encouraging international responsibility for degradation within Colombian supply chains, tightening net-zero regulation and extending the current carbon tax.

- Increase the attractiveness of NbS investment opportunities to institutional investors, including by promoting profitable business models, de-risking investments using blended finance mechanisms, aggregation of small initiatives into single investments, technical assistance funds and investment into technology to reduce the cost and improve the quality of NbS.

This report concludes that Colombia faces an unprecedented opportunity to build a thriving and resilient nature-positive economy through investment into NbS. Critically, this report demonstrates how the Government can lower the investment burden of the public sector in the long term, by crowding in private sector finance for NbS. It is a report for consultation which describes a potential, yet likely feasible, investment pathway. As such, the ambition is to inform the Government of Colombia's long-term investment and policy strategy for NbS and to inspire the mobilization of wider investors to deploy a range of financial instruments towards NbS in Colombia and globally.

Introduction

In 2019, the Food and Land Use Coalition (FOLU) produced a Global Consultation Report, Growing Better: Ten Critical Transitions to Transform Food and Land Use. The report set out why a global transformation of food and land use systems is needed in the next decade, and it provided a vision for a better future along with a proposed reform agenda to achieve it. This action agenda – anchored around ten critical transitions – is necessary to deliver climate mitigation, safeguard biological diversity, ensure healthier diets for all, improve food and nutritional security and create more inclusive and resilient rural economies.

Nature-based Solutions (NbS) are a critical part of the reform agenda proposed by FOLU. NbS are actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.[25] NbS include critical interventions in both marine and land-based ecosystems which support the 10 Critical Transitions identified by FOLU to transform the food and land use system[24] (see Table 1). In particular, there has been increasing attention to the role that land-based NbS play in mitigating climate change. Roe et al. (2021) suggest that the implementation of twenty different land-based solutions can deliver around 30% of global mitigation needed to deliver the 1.5°C temperature target, whilst also securing the climate regulation function of the existing land sink.[25] This report focuses specifically on these land-based NbS – all of which restore, protect and manage natural ecosystems and shift how food is produced and consumed.[vii]

Table 1: Linkages between FOLU's Critical Transitions, and NbS to transform food and land use systems.[26]

Critical Transition	NbS category		
	Protect, Manage and Restore forests and other ecosystems	Reduce and sequester emissions in agriculture	Demand side solutions (clean cookstoves, food loss and waste and healthy, sustainable diets)
Healthy diets			X
Productive & Regenerative Agriculture		X	
Protecting and Restoring Nature	X		
A Healthy & Productive Ocean	X	X[vii]	
Diversifying Protein Supply		X	X
Reducing Food Loss & Waste			X
Local Loops & Linkages	These transitions are vital to the success of NbS and should be considered in the design of all NbS initiatives. For example, a forest protection initiative should use knowledge from rural communities, ensure benefits to local livelihoods and harness the latest monitoring technology.		
Harnessing the Digital Revolution			
Stronger Rural Livelihoods			
Gender & Demography			

[vii] The authors recognize that the definition of NbS also includes other measures which help humans to respond to societal challenges, including but not limited to those which deliver climate mitigation in land-based, freshwater or marine ecosystems. However, this report specifically focuses on the 20 land-based measures defined in Roe et al. 2021, 18 of which are relevant to Colombia. These measures include solutions such as reducing emissions from enteric fermentation, improved manure management and bioenergy carbon capture and storage (BECCS) which are often not considered as NbS. Going froward, any refernce to NbS is focused specifically on these 18 measures.

[viii] NbS can support Healthy and Productive Oceans, however this study focusses solely on land-based NbS.

Colombia is in a strong position to use NbS to support the transition towards a regenerative and integrated food and land use economy. Building on the FOLU Growing Better report, FOLU Colombia produced a Roadmap for a New Food and Land Use Economy for Colombia,[27] which provides strategies for different actors in the Colombian food system to transition to regenerative and resilient agricultural practices, whilst boosting the economy and ensuring the protection of natural ecosystems. This has been further advanced in the departments of Quindio,[28] Antioquia[29] and more recently Valle del Cauca,[30] with the development of food and land use systems roadmaps, in which enabling sustainable and regenerative territories and aquatic systems though NbS are part of the strategies.

Nature and agriculture are already an important part of Colombia's economy and society. Colombia comprises over 50% forest area and 40% agricultural land (90% of which is pastureland), with the remainder being urban and aquatic environments.[31] Owing largely to its high density of forests, Colombia is home to 10% of the planet's biodiversity,[32] which helps to attract 4 million international tourists per year.[33] The forestry and agriculture sector is also important for the economy, making up 7% of GDP,[34] and employing 16% of the working population[35] However, currently, the productivity of arable land in Colombia is around a third of that of other countries in the Organisation for Economic Co-operation and Development (OECD)[36] and 40% of soils are threatened by erosion.[37] The forestry and agriculture sector also contribute 55% of the greenhouse gas emissions.[38]

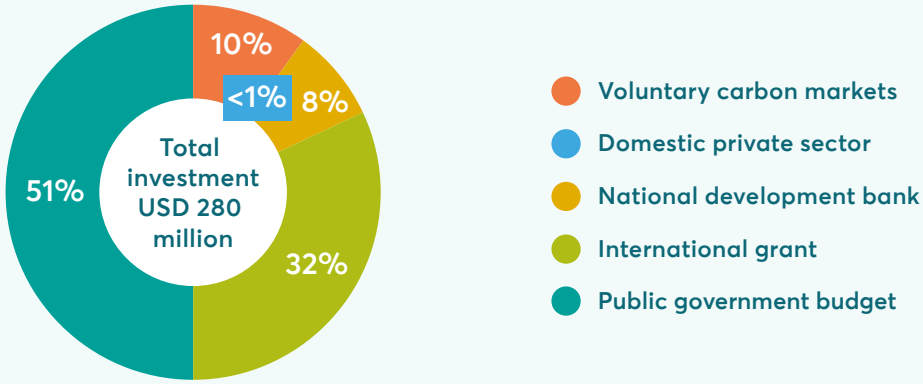
Building a more resilient, prosperous, food- and nutrition-secure economy in Colombia is more important than ever. Recent trends reinforce this need, as evidenced by the COVID-19 pandemic, the cost of living crisis and increasing global supply chain disruptions as a result of global conflict and climate-related disasters. Colombia is particularly vulnerable to climate change impacts, which threaten crop yields in the agriculture sector and could lead to the relocation of over 550,000 smallholder coffee farmers as large areas of land become unproductive.[39] In 2015, 54% of the population was deemed food insecure[40] and as the COVID-19 pandemic was estimated to cause an additional 1.45 million people to fall into poverty,[41] the need to enhance food security and support livelihoods is vital.

The Government of Colombia has already made significant commitments to support NbS. It was one of the first countries to have a Renewable Natural Resources and Environmental Protection Code and a National Restoration Plan was set up in 2015 to provide a framework for biodiversity conservation and adaptation.[42] Through its Nationally Determined Contributions (NDCs), Colombia has committed to a 51% reduction in greenhouse gas (GHG) emissions by 2030 (compared to business as usual). Commodity-driven deforestation is the largest source of emissions and so Colombia has pledged to reduced deforestation by 68.5% between 2019 and 2030 and restore 18,000 hectares of degraded land.[43] In addition, Nationally Appropriate Mitigation Actions (NAMAs) have been set to enhance carbon removals through land restoration and reduce on-farm emissions from livestock,[44] reducing emissions from sugar cane production[45] and promoting forest landscape restoration.[46]

Moreover, the newly elected Government is prioritizing an energetic green growth transition founded in environmental justice, creating a combined agenda on strengthening biodiversity, water, climate resilience , food systems and local livelihoods. The new president, Gustavo Petro, plans to direct the economy away from resource extraction and towards agricultural and manufacturing industries.[47] He is creating an enabling environment for NbS throughout his program, for example securing land rights and redistributing cattle ranch land to indigenous and poor rural communities.[48] He also intends to limit the expansion of agribusiness into forests and to bolster the generation of carbon credits from nature protection as part of his campaign commitment to halt deforestation in the Amazon rainforest.[49]

Despite their importance and increasing policy attention, NbS receive limited funding in Colombia, in particular from the private sector. Less than USD 300 million per year is currently spent on land-based NbS in Colombia, or 0.1% of Colombian GDP in 2019. This investment is primarily driven by domestic public finance as well as international public and donor support, with limited funding from the private sector and voluntary carbon market (VCM)(see Figure 4).[ix] There are several reasons for this. For example, private sector investors often lack the information to enable them to invest in land-based mitigation, with a lack of clarity on where concrete programme and jurisdictional-level investment opportunities exist and how to best structure investments in nature and sustainable landscapes across Colombia. Moreover, the rules and dynamics of private carbon markets are complicated and not always easy to navigate.[50] Finally, even once investors understand potential NbS opportunities, additional barriers to investment currently exist in Colombia, such as difficulties in accessing high quality, financially viable initiatives.

Figure 4: Reported finance flows into NbS in Colombia by source in 2019



Source: Analysis using data from the Government of Colombia and Climate Focus [55,56,57,58,59]

This report therefore seeks to address the knowledge gap that exists around the investment requirement and financing strategies which can be used by public and private investors to unlock the myriad benefits of NbS in Colombia. It considers ways in which the Government of Colombia can crowd in private capital for NbS by using policy reform and public spending activities to create an enabling environment and blended finance to de-risk investments.

The report is structured as follows:

- Chapter 1: Summarizes the NbS opportunity in Colombia – including the mitigation potential and analysis of typical costs and revenues associated with NbS business models.
- Chapter 2: Explores financing requirements and strategies for different NbS in Colombia.
- Chapter 3: Discusses how Colombian policymakers can help to create a positive enabling environment for investment into NbS in Colombia.
- Chapter 4: Concludes with key recommendations and next steps for scaling NbS investment in Colombia and globally.

[ix] Due to data availability issues, particularly for private finance, it likely that USD 300 million is an underestimate of the current finance flows into NbS; however it still serves as a useful comparator to understand the scale of increase in finance required. This includes payments for protected areas and finance from carbon markets. (though is not limited to just carbon markets).

What are Nature-based Solutions?

NbS are actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.[56] NbS include critical interventions in both marine and land-based ecosystems and multiple of the food system Critical Transitions identified by FOLU[57] (see Table 1). This report specifically focuses on the 20 land-based measures defined in Roe et al. (2021) and described below. 18 of these are relevant to Colombia in terms of mitigation potential. The authors recognize that the definition of NbS also includes other measures which help humans to respond to societal challenges, including but not limited to those which deliver climate mitigation in land-based, freshwater or marine ecosystems.

Implementation of these solutions requires finance to pay for either 1) a change in practice or behaviour (e.g. paying farmers to plant trees on-farm or paying governments to increase incentives for forest protection) or 2) the application of a new or existing technology (e.g. paying for on-farm anaerobic digesters to improve manure management or paying for clean cookstoves to reduced deforestation linked to demand for wood fuel).

There are opportunities for generating positive returns on these investments. These business models can broadly be categorized as follows:

1. Cost savings or efficiency gains: e.g. increasing input efficiency can result in less input use, cost savings and increased profitability.[x]

2. Growth of existing markets: e.g. integrating agroforestry into coffee production systems can generate opportunities for price premiums or increased demand associated with the sustainability attributes of commodities.

3. New goods or services: e.g. sale of wild forest honey which was previously not harvested.

4. New revenue streams: e.g. generating payment for ecosystem services through frameworks such as Reducing Emissions from Deforestation and Forest Degradation (REDD+).

There are also business opportunities linked to the enabling environment needed for investment into NbS, for example monitoring technology needed to verify reduced deforestation and the validity of associated carbon credits.

[x] The impact on yields under changing conditions has not been assessed as it is too context-specific.

The table below defines each of the 20 solutions that are considered within this report and gives examples of relevant business models. It draws on FOLU's previous work in Prosperous Forests,[58] a report which demonstrates that innovative forest business models not only exist across the tropical belt, but also hold significant latent potential. It also uses the Blended Finance Taskforce's Better Finance, Better Food report which showcases a broad range of investable land-based NbS opportunities.[59]

NbS name and category		Definition:	Overview of types of business models:
Protecting forests & other ecosystems	**Reduce deforestation** 	This solution seeks to avoid emissions that would have otherwise occurred as a result of deforestation (where tree cover falls below 30% of the area). Commodity-driven agriculture in tropical regions – including the production of soy, palm oil, timber, cattle, rubber and cocoa –is a major driver of deforestation.	Finance for forest protection pays for the opportunity cost associated with not converting forests into other land use types, e.g. agricultural land for growing high value commodities such as palm oil. Finance can be generated through payment for ecosystem services models such as the framework for Reducing Emissions from Deforestation and Forest Degradation (REDD+) where communities, land managers and jurisdictions are compensated for actions that reduce or remove forest carbon emissions[xi] Revenue can then be generated through the sale of carbon credits.[60] Other business models include wild forest production (honey, nuts, pharmaceutical products) and ecotourism.
	Reduce mangrove loss 	This solution seeks to avoid emissions that would otherwise have occurred as a result of degradation of mangroves. Major drivers of mangrove degradation include shrimp farming and deforestation for mangrove poles.	As with reduce deforestation, finance is needed to pay for the opportunity cost associated with an alternative use of that land, e.g. shrimp farming. As above, revenue can be generated through carbon credits or other ecosystem service models. One successful example of a regenerative mangrove business model is Selva Shrimp, a company which raises black tiger prawns naturally in the mangrove forests of south-east Asia. They are sold at a premium as they have been produced without chemicals and in a natural environment. Investors and farmers share in the profits, incentivizing shrimp farmers to maintain the mangrove forests through this proxy payment for the mangrove ecosystem services.[61,62,63]
	Reduce peatland degradation 	This solution involves avoiding greenhouse gas emissions through the protection of intact peatlands.	Similar to the other protection activities, finance is required to cover opportunity costs that come from alternative land uses, such as farming. Finance is also needed for activities that limit degradation, such as community engagement, monitoring of water levels and increased fire management. Revenues can be generated through the sale of carbon credits, eco-tourism or through paludiculture (cultivation on wet peatlands) which can produce valuable materials such as eco-friendly insulation made from endemic peatland crops such as cattails.[64]

NbS name and category		Definition:	Overview of types of business models:
Managing forests & other ecosystems	**Improve forest management** 	Improved forest management involves managing both natural and forest plantations to avoid carbon emissions and to increase carbon sequestration within these forested areas.	Finance is needed for development of new initiatives focused on sustainable management of forest plantations and to help existing initiatives to transition to more sustainable practices such as reduced impact logging, extended harvest rotations and designation of protected areas. Revenue can be generated through the sale of carbon credits, and forest products such as resins, nuts and timber.[65] Producing sustainable timber and then certifying it under the Forest Stewardship Council (FSC) initiative can attract price premiums, further increasing revenues.
	Grassland fire management 	This solution aims to avoid emissions from fires in grasslands. For example, starting early-season fires when there is less organic matter, emits fewer emissions compared to late-season fires.	Finance is needed primarily for training and labour associated with fire management, alongside necessary technologies such as helicopters and remote sensing technologies to monitor and track the extent of the fires.[66,67] The reduced emissions from the landscape can generate revenues through the sale of carbon credits. Farmers also benefit from reduced damage caused by uncontrolled wildfires, and so a reduction in associated cost – fires can destroy pastures, fences, buildings and livestock, all of which need to be repaired or replaced.
Restoring forests & other ecosystems	**Afforestation and reforestation (A/R)** 	This solution enhances carbon sequestration of degraded land by planting trees to shift it from non-forest to forest cover (i.e. above 30% tree cover). A/R which mimics natural ecosystems and uses species suited to specific environmental conditions can stimulate environmental and economic productivity.	The majority of the financing need is required to purchase and plant seedling trees. Revenue can be generated through carbon credits or through models which maximise productivity, using a broad mix of native seeds but focusing on species from which a commercial revenue can be derived, such as sugar palm or rubber. Such near-natural "forests with a cash flow" have yet to be planted on a large scale but may expand rapidly because of the revenue streams and rich ecosystem services they could deliver.[68]
	Mangrove restoration 	This solution increases the carbon sequestration of degraded coastlines by replanting mangroves.	Finance is required to plant mangrove shrubs and to ensure their long-term survival, for example funding the labour and monitoring associated with regulating fishing quotas, restricting certain activities and managing conservation zones.[69] Return on investment can be generated through enhanced fish stocks, medicine and ecotourism.

	NbS name and category	Definition:	Overview of types of business models:
	Peatland restoration 	Peatland restoration involves avoiding emissions by re-wetting degraded peatlands to restore the natural water flow and saturation level.	Finance is needed to re-wet peatlands through the creation of canals, wells and planting of natives species to restore and maintain water table levels.[70] The Sumatra Merang peatland initiative in Indonesia generates revenue through the sale of carbon credits linked to peatland restoration, alongside delivering sustainable livelihoods for local communities through fishing and smallholder cropping of native species.[71]
Reducing emissions in agriculture	**Reduce enteric fermentation** 	This solution seeks to reduce methane emissions resulting from livestock digestion. This could be done through changing feed and grazing strategies.	Helping farmers transition to new feed practices can save costs and drive revenues. Feed strategies such as "balanced feeding", which helps overcome mineral deficiencies in the soil, enhances milk production by improving the nutritional quality of the livestock's diet. Investors could generate returns through profit-sharing mechanisms linked to the increased profit from the milk production.
	Manure management 	This involves the use of technologies such as anaerobic digesters to reduce the CH_4 and N_2O emissions associated with livestock manure.	Costs for manure management are driven by the price of anaerobic digesters, with this being a major upfront investment. However the digesters can be used to extract methane from manure, producing sustainable biogas that can then be used to produce energy and can be a source of revenue or an on-farm cost saving.[73] Alongside the use of digesters, companies such as Newtrient are converting manure into pelletized fertilizer for use on farm or for sale to market. Pelletized fertilizers are not yet cost-competitive with traditional fertilizers, but this may change in the future, potentially enhancing the revenue stream for investors in this solution.[74]
	Nutrient management 	Nutrient management involves changes in fertilizer application and management practices to reduce CH_4 and N_2O emissions associated with fertilizer application.	Finance is required for educating farmers on new practices or for technology that allows for more precise nitrogen application on farms. If implemented effectively these initiatives will result in significant cost savings, increasing farm profitability. This is especially relevant given the significant global rise in fertilizer prices that have been seen recently.
	Improve rice cultivation 	This solution involves sustainably managing rice production to avoid CH_4 and N_2O emissions, such as improved water and fertilizer management.	Finance is required for training farmers on new management techniques such as lower input rice farming or alternate wetting and drying. Rice education programmes in Thailand have been shown to increase farmers' net-income by 26% on average. Profit-sharing mechanisms could help financiers generate returns on their investment.[75]

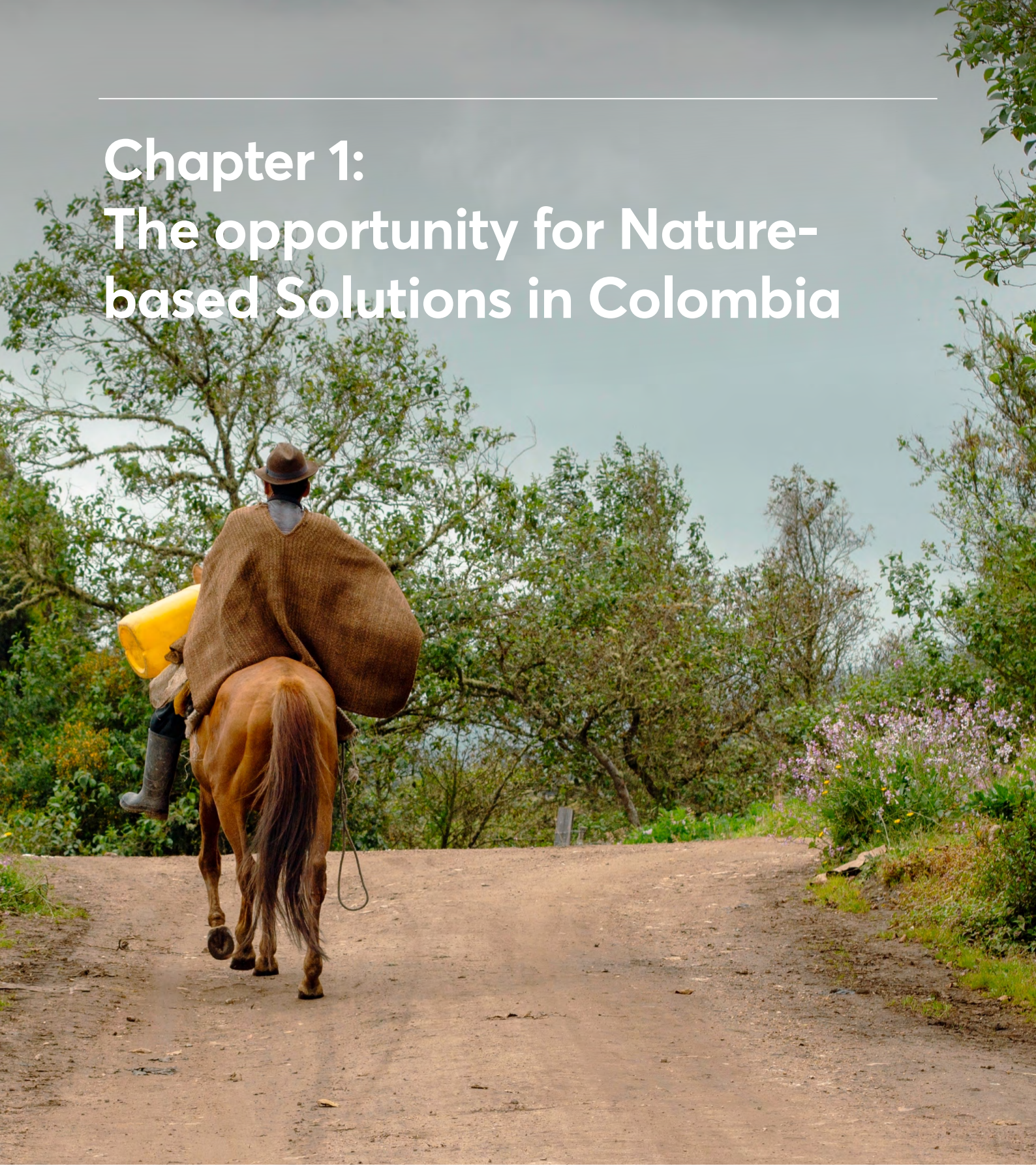
NbS name and category		Definition:	Overview of types of business models:
Soil carbon sequestration in agriculture	**Agroforestry** 	This solution involves increasing the carbon sequestration of farmland by integrating trees into production practices.	Upfront financing is needed to establish trees on farms, but this investment can generate a variety of revenue streams. Additional income streams from agroforestry include from fruit, nuts and timber. These commodities may generate price premiums linked to their sustainability attributes – for example one study showed that coffee integrated with agroforests can command a price premium of 36% more than traditional coffee.[76] The income diversification also drives on-farm resilience making famers and investors less vulnerable to external shocks such as increased temperatures.
	Application of biochar from crop residues 	Biochar is created through the pyrolysis of biomass. It can then be added to farmland to increase the inorganic carbon content in the soil. Inorganic carbon is much more stable than its organic counterpart and persists over longer timescales.	Finance is required to help farmers purchase and apply biochar onto their farm. In most cases this is a one-off cost, however some initiatives support small applications each year.[77] In Belize, carbon investment has helped cacao farmers turn their agricultural waste into biochar; they are paid USD 75 for every tonne of biochar they produce and apply to their soils.[78] Farmers also benefit from the increased yield associated with biochar applications,[79] and this solution may soon generate carbon revenues too.[80]
	Enhance soil organic carbon in croplands[xii] 	This solution involves enhancing soil carbon sequestration in croplands by shifting from current practices to no-till management and cover-cropping.	Implementation of no-tillage farming will require farmer training and investment in new technologies which require upfront financing. These investments can be recouped in the long-term as there is a reduction in fertilizer use, in time spent tilling (freeing up labour hours) and in diesel, repair and equipment costs on larger, more mechanized farms.[81] Case studies show that no-till corn and soybean can be more profitable than conventional practices.[82]
	Enhance soil organic carbon in grasslands 	This solution involves enhancing soil carbon sequestration in pastureland by transitioning to more sustainable management and grazing practices.	Finance will be required to help farmers transition their pastureland management strategies to include rotational grazing, improved feed management and pastureland rehabilitation. Rotational grazing typically has higher establishment costs than conventional grazing (due to the need for fencing and water systems), but offer long-term economic benefits, including healthier herds, which results in fewer veterinary expenses; reduced maintenance and fertilizer costs; and greater pasture productivity. Farmers can generate carbon credits associated with improved sequestration and can increase profits from increased livestock sales.

	NbS name and category	Definition:	Overview of types of business models:
Energy	**Bioenergy with carbon capture and storage (BECCS)[a]** 	BECCS involves capturing and storing the carbon that is generated through the combustion of biomass for electricity generation.	BECCS is a nascent technology and therefore current investment is required to establish and operate trial BECCS-based power plants. There is a direct revenue stream from the sale of electricity or products and possibly additionally through carbon payments.[84] For example, a plant currently operating in Illinois captures the emissions released from fermenting corn to ethanol and geologically stores it in the underlying sandstone formation.[85]
Demand side	**Increase use of clean cookstoves** 	This solution involves avoiding emissions through the introduction of more efficient cookstoves which require less fuelwood, leading to less pressure on forests for wood for cooking and heating.	Investment is required to purchase and distribute cookstoves. These stoves are proving to be a cost-saving solution for households as efficient stoves reduce the need to purchase fuel, as well as reducing the health risks associated with indoor air pollution.[86] Additional revenue could come from the sale of the stoves or from carbon credits, global sales of which generated USD 11 million in 2020.[87]
	Reduce food loss and waste 	This solution avoids emissions from the production of food that is wasted (i.e. not consumed) and emissions from decomposition through the implementation of measures such as improved storage and those which change consumer awareness.	Investment in this solution could be targeted across the value chain, from educational campaigns to limit household waste to refrigeration technologies at a farm-level to reduce food loss. Tackling food waste in consumption drives cost savings for households and businesses,[88] whilst addressing food lost in production increases the volume of food sold, improving incomes.[89,90] Other potential business models include obtaining value from the food, such as through the production of bioenergy,[91] and the global cold-storage market is expected to reach over USD 330bn in value by 2030.[92]
	Shift to healthy and sustainable diets 	This solution involves reducing emissions from diverted agricultural production by adopting sustainable healthy diets (not including emissions from land use change).	Investment into this solution could help fund public policy campaigns that encourage dietary shifts, improving meals in public procurement or developing animal protein alternatives. Health related cost savings can be large and revenues can come from sale of meat alternatives – which by some estimates could become a market worth over USD 250bn by 2030 (from USD 3bn in 2020).[93]

[xii] The authors acknowledge the impact of agricultural practices on soil carbon sequestration potential is highly context specific, varying with for example, climate conditions, soil type/ management, crop species and management intensity. It is important to also consider the spatial and temporal limitations of assuming soil carbon sequestration can lead to climate change mitigation because a) there remains questions around the permanence of soil carbon sequestration, b) leakage can occur, for example where agricultural practices increasing soil carbon sequestration in one place may result in lower yields leading to agricultural expansion and carbon losses off-farm or c) where practices increasing soil carbon sequestration may increase at the same time increase other damaging GHG emissions such as CH4 or N2O.

[a] NbS not considered in the Colombia case, due to lack of mitigation potential identified by Roe et al. (2021)

Chapter 1: The opportunity for Nature-based Solutions in Colombia

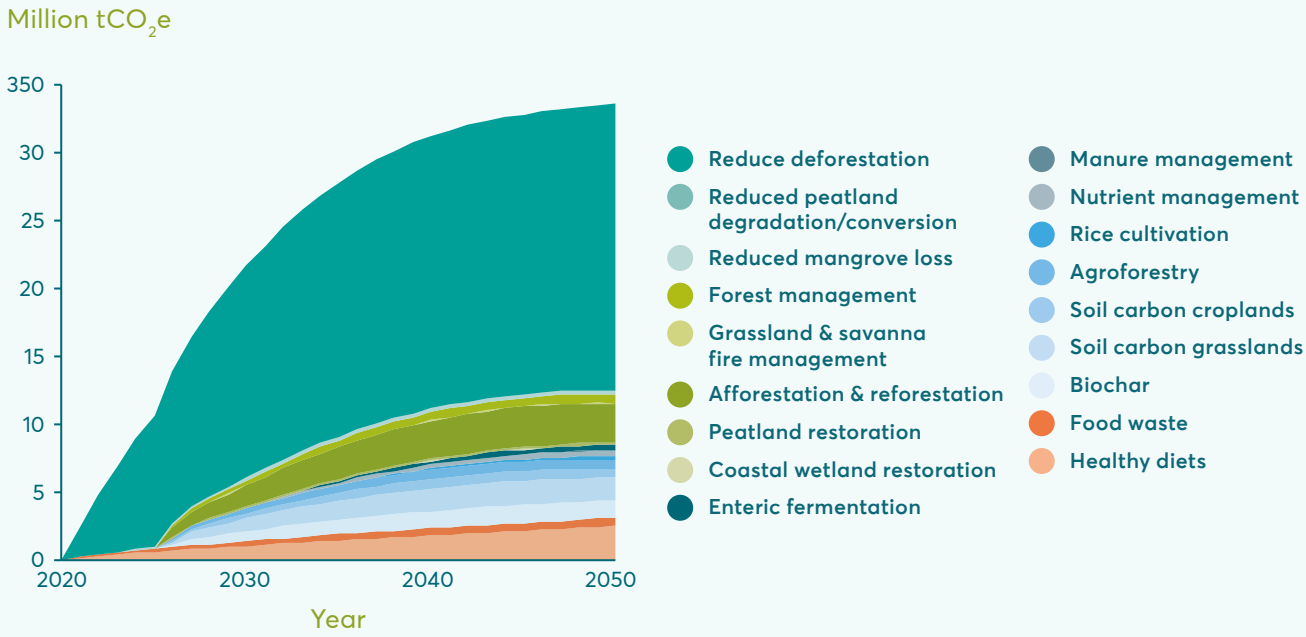


This chapter provides a summary of the mitigation potential of different NbS in Colombia and presents some emerging evidence as to the other benefits they provide in terms of food and nutrition security, health, biodiversity and resilience. It also summarizes the cost and revenue profiles associated with different NbS business models.

NbS provide an important path to a low-carbon, prosperous, food secure, healthy and resilient future in Colombia. For instance, estimates have shown that Colombia can cost-effectively mitigate 340 million tonnes of carbon dioxide equivalent ($MtCO_2e$) per year by 2050 through implementing a suite of NbS to 2050.[xiii] This is important for both Colombia and for global progress towards the Paris Agreement, as Colombia's climate mitigation potential thereby amounts to nearly 2% of the total global potential from these solutions.

Protecting forests has the greatest climate mitigation potential, but reducing and sequestering emissions in agriculture and demand-side interventions should also be prioritised in Colombia. Forests and other ecosystem-based solutions account for nearly 80% of Colombia's climate mitigation potential, with efforts to reduced deforestation accounting for 65% alone. Figure 5 shows the growth of annual cost-effective mitigation potential for 17 of the 18 NbS over the next three decades in Colombia. Roe et al. (2021) find that of the 20 land-based solutions, in Colombia there is no cost-effective mitigation potential for BECCS and reducing peatland degradation, and although there is mitigation potential for increased use of clean cookstoves and it is included in the investment requirements, it has been excluded from this graph to avoid double counting with reduced deforestation. Roe et al. (2019) assume that agricultural solutions are implemented at scale after 2025, reaching 14% of the total by 2050, whilst demand-side solutions account for 8% of the mitigation potential.[94]

Figure 5: Estimated cost-effective mitigation potential per NbS solution from 2020 to 2050 ($MtCO_2eq$ per year) in Colombia[xiii]



NbS can unlock a plethora of core benefits, but if they are poorly implemented they can cause harm – mitigating these risks is vital. For instance, afforestation and reforestation initiatives that involve non-native species can harm local biodiversity, degrade soils and can use too much water, putting pressure on local communities.[95] Further, NbS implemented without active consultation from the Indigenous

[xiii] Cost-effective mitigation potential is mitigation which can be achieved for less than USD 100 per tonne CO_2e (Roe et al., 2021). 340 million tCO_2e per year by 2050 was calculated by applying the mitigation potential scale-up between 2020 and 2050 detailed in Roe at al. (2019) to the average cost-effective mitigation potential for Colombia identified in Roe at al. (2021).

Peoples and Local Communities (IPLCs) may exacerbate inequality or harm economic opportunities by restricting access to what was once common pool resources.[96] Application of guardrails ensures that NbS are implemented to the highest standard, maximizing core benefits whilst mitigating risks of unintended consequences. As such, they should be considered throughout the planning, designing, managing and implementing stages of NbS. The International Union for Conservation of Nature (IUCN), the NbS guidelines and the World Resources Institute (WRI), a FOLU partner, have all identified guardrails to consider in the implementation of NbS.[97,98] Those most important in this context include:

1. Provide a net-gain to biodiversity by considering local ecology – NbS should support and/or enhance biodiversity in an ecosystem, using native species that complement the local ecology. Supporting these areas to deliver vital ecosystem services in both the short and long-term.

2. Inclusive and empowering governance and implementation process – NbS should be designed, implemented, managed and monitored with indigenous and local communities. Through a process that respects local circumstances, facilitates local benefits and considers the diversity and pre-existing challenges that exist in an area.

3. Mainstreamed within an appropriate jurisdictional context – NbS interventions should be designed to take account of, work with and align with sectoral, national and other policy frameworks. Helping to create an environment where government and non-government players are aligned, and actors throughout the system are helping to enhance and facilitate a policy environment that is conducive to effective NbS implementation.

4. Do not substitute action to phase out fossil fuels – NbS should be implemented alongside a suite of other mitigation efforts, understanding that a rapid phase-out of fossil fuels is required and climate change will negatively affect the carbon balance of many ecosystems, potentially reducing their carbon sequestration ability and turning carbon sinks into carbon sources.

These four guidelines do not constitute an exhaustive list but serve to give an indication of the considerations stakeholders need to bear in mind when designing and implementing NbS.[xiv] Certain solutions and actors will have to take the guidelines into varying degrees of consideration. For instance, REDD+ reduced deforestation initiatives will have to consider guideline 3 more, due to the significant advantages of jurisdictional approaches.[xv]

Beyond climate mitigation, there is increasing evidence – globally and in Colombia – that these same solutions can deliver benefits for food and nutrition security, health, climate resilience and biodiversity. For example, improving agricultural grazing practices (e.g. through rotational grazing) in the Orinoquía region of Colombia has been shown to increase the quality and richness of cattle forage which has resulted in increased milk production per cow by seven times.[99] Research in Colombia also demonstrates that leaving forests standing is a cost-effective mechanism to minimize damage from landslides, with one study showing that protecting forests reduced the costs associated with repairing infrastructure following a landslide by 16 times.[100] Additional evidence related to the benefits NbS can provide for health, biodiversity, resilience and food and nutrition security can be found on the following pages. More research needs to be undertaken to quantify and verify the benefits of NbS in different Colombian biomes as many of the wider benefits have still only been assessed qualitatively or in other local contexts.

[xiv] For further information on NbS guardrails see work by WRI (https://www.wri.org/insights/guidance-voluntary-use-nature-based-solution-carbon-credits-through-2040), IUCN (https://www.iucn.org/resources/issues-brief/ensuring-effective-nature-based-solutions) and Nature-based Solutions Initiative (https://nbsguidelines.info/)
[xv] For more information on the benefits of jurisdictional REDD+ approaches, see WRI paper on this topic (https://ww.wri.org/insights/insider-4-reasons-why-jurisdictional-approach-redd-crediting-superior-project-based)

Examples of NbS benefits in Colombia

Food Security

Food security is the ability to have consistent physical and economic access to nutritious and healthy foods.[101] Research has demonstrated that agricultural practices which integrate NbS have positive impacts on food security, in some cases increasing productivity for both livestock and crop-based products as well as producing more nutritionally diverse food.[102] These solutions can also increase resilience to external shocks, helping to maintain food security during crisis. For instance, increased farmland biodiversity can reduce harm from pests.[103] Avoiding deforestation also supports agricultural productivity and thus food security due to the ecosystem services provided by forests, e.g. by supporting the water cycle, reducing soil erosion and flooding.[104,105]

Examples of NbS benefits to food security

A conservation program in Ecuador which has protected 15,000 hectares of mangroves sustains populations of mangrove oysters which support nutrition and income security for families living in Punta de Miguel near Ecuador's border with Colombia.[106]

In the Orinoquía region in Colombia, milk production has grown from around one litre per cow in 2016 to seven litres per cow in 2019, through the use of rotational grazing practices and using manure as natural fertilizer, which increase the quality and richness of the forage for the cattle.[107]

In South-West Colombia, cocoa agroforestry farms have been shown to provide local farmers with a higher diversity of food crops than cocoa monocrops,[108] helping to drive long-term nutritional security amongst communities.

Livelihoods

Livelihoods are defined as the capability for generating incomes and securing a means of living.[109] Many of the agricultural NbS, when implemented effectively, have been shown to increase farm profitability whilst enhancing economic resilience, helping to drive long-term sustainable incomes.[110,111] This can occur due to the lower costs associated with decreased inputs.[112] However, in some instances farmers and land-managers may have to overcome a period of lower profitability while their businesses adjust to the new conditions, such as in the establishment phase of an agroforestry initiative or while soil fertility recovers when reducing nutrient inputs. Initiatives vary significantly based upon location, and neighbouring initiatives often show widely different results. More research is required to further understand these differences and to identify ways in which all agricultural solutions can be implemented In a way that drives long-term and sustainable livelihoods for all farmers. In Colombia, more research is required to understand the impact on livelihoods of the protection and restoration solutions, especially outside the context of REDD+ where the majority of analysis is focused.

Examples of NbS benefits to livelihoods

In the Cauca state in Colombia, climate smart coffee farms have 20% lower external costs than traditional farms. These external costs are related to insufficient income, lack of social security, occupational hazards, alongside environmental factors such as water and air pollution.[113]

Converting cattle farming to silvopasture systems has been shown to increase milk productivity by an average of 36.2% in Colombia, due to diversified on farm vegetation providing higher quality feed for cattle.[114]

Food loss and waste in Colombia equates to about USD 5.4 billion in economic losses per year. A significant amount of this occurs at the farm level, significantly reducing on farm profitability.[115]

Resilience

Climate resilience is the ability of a system to effectively anticipate, absorb, accommodate and recover from hazardous events.[116] Examples of NbS delivering greater climate resilience include agroforestry systems which can reduce temperatures through tree shade and increase water infiltration and soil health through tree roots.[117] The diversity of crops on these farms also helps to limit the risk that may come from one crop failing.[118] Reducing large-scale deforestation can help maintain regional climate integrity and help maintain the stability of the water cycle and can reduce risk of pandemics as a result of zoonotic spill over due to increased contact between wildlife, humans and livestock.[119,120]

Examples of NbS benefits to resilience

Studies show that in Colombia, restoring forests as a preventative mechanism is 16 times more cost-effective than repairing damaged infrastructure after landslides.[121]

Silvopasture cattle farming systems in Quindío district have been shown to have 45% less annual soil erosion occur on them in comparison to traditional pastureland.[122]

In the district of Tolima in Colombia, climate smart practices for rice farming has been shown to lower water demand, helping to reduce yield loss during dry seasons.[123]

Health

Certain solutions have clear and quantified direct health benefits. An example of this is the reduction in indoor air pollution for households when they transition to clean cookstoves.[124] Reducing meat consumption as part of a more sustainable, healthy diet could help reduce the impact that obesity is having in Colombia. More needs to be done to quantify this in the Colombian context.[125]

Examples of NbS benefits to health

Rates of malnutrition and obesity cost the Colombian state at least USD 1.5 billion per year due to lost economic activity.[126] Increasing consumption of fruit vegetables, whilst diversifying proteins sources could help partially alleviate this cost.

The Government of Colombia's push to replace traditional wood-burning cookstoves with 1 million more efficient cookstoves, is likely to avoid health costs of more than USD 120 million due to a reduction in indoor pollutants.[127]

A study of indigenous communities in Putumayo, Colombia, shows that agroforestry systems can yield 128 different plant species, providing services related to food and natural medicines.[128]

Biodiversity

Biodiversity is the variability of all living organisms from all sources.[129] Solutions that protect ecosystems have clear and well understood biodiversity benefits as they are conserving high biodiversity-value intact ecosystems and the species that rely on them.[130] This is especially true in Colombia, which is regarded as one of the most biodiverse countries in the world.[131] The biodiversity impact of the restoration of ecosystems through solutions such as afforestation and reforestation, and coastal wetland restoration is highly dependent on whether the initiatives are implemented with native species and if they consider the local ecology of an area.[132] Agricultural solutions can have significant effect on farmland biodiversity by helping to create, maintain and strengthen ecological niches for a variety of species.[133] The majority of research around biodiversity in Colombia in relation to NbS has been around protecting and restoring tropical forests. Future research is required to investigate the biodiversity impacts of other solutions such as coastal wetland restoration, enhanced soil organic in carbon croplands and grasslands in a Colombian context. Finally, the controversies around BECCS and biodiversity still need to be clarified. This debate has not been touched upon here due to the lack of mitigation potential for BECCS in Colombia, according to Roe et al (2021).

Examples of NbS benefits to livelihoods

Mangrove conservation in the Caribbean region provides a refuge habitat for corals, by reducing environmental stress, helping to maintain their diversity.[134]

Silvopastures in Colombia contain a greater number of native plant species (72) compared to traditional pastures (62). The unique mix of flora and fauna may serve to reduce pests, with traditional ranches having 95% more hemipterans (tree bugs) than the silvopastures, indicating that increased biodiversity may serve as a natural pest control.

The Pacific Region of Colombia alone provides a home to 831 bird species, 195 amphibians, 167 mammals, 210 reptiles and 5,124 plant species. REDD+ initiatives such as the Chocó-Darién Conservation Corridor have protected at least 15 endangered plant species and 142 endangered animal species.

Methods summary to select NbS costs in Colombia

Cost and revenues (in USD per tCO_2e) of NbS initiatives were estimated for the case of Colombia through literature review and collection of financial data from implemented initiatives, as well as from the investment business cases of initiatives yet to be implemented.

Cost information came in multiple forms, however to get a complete, yet comparable understanding of project financials across the diverse spectrum of NbS, the following principles were applied:

1. Costs have been adjusted to 2020 values and comprise: transaction, establishment, enabling, operational and opportunity costs.

2. Revenue data was also collected when it was available. In some cases, proxy data has been used, e.g. to estimate revenue from carbon credits.

3. Initiatives and costs are specific to Colombia where possible, but in a number of instances initiatives and data from other countries have been used as a proxy. This is a limitation of the study and an area for future work.

4. Costs reflect the forest or farm-level costs incurred when setting up an initiative and omit additional costs related to a certain form of investment, such as Measurement, Reporting and Verification (MRV) costs for carbon finance.

5. Opportunity costs have been calculated by considering the profits generated through production of the key commodity driver of habitat destruction in Colombia. For example, the loss in profits from choosing to protect forests rather than using the land for cattle farming has been used for the opportunity cost for reducing deforestation.

6. For the agricultural solutions, costs of NbS practices have been compared to typical business as usual (BAU) agriculture or forestry, in order to understand what the additional cost or cost savings are over and above the costs being paid today.

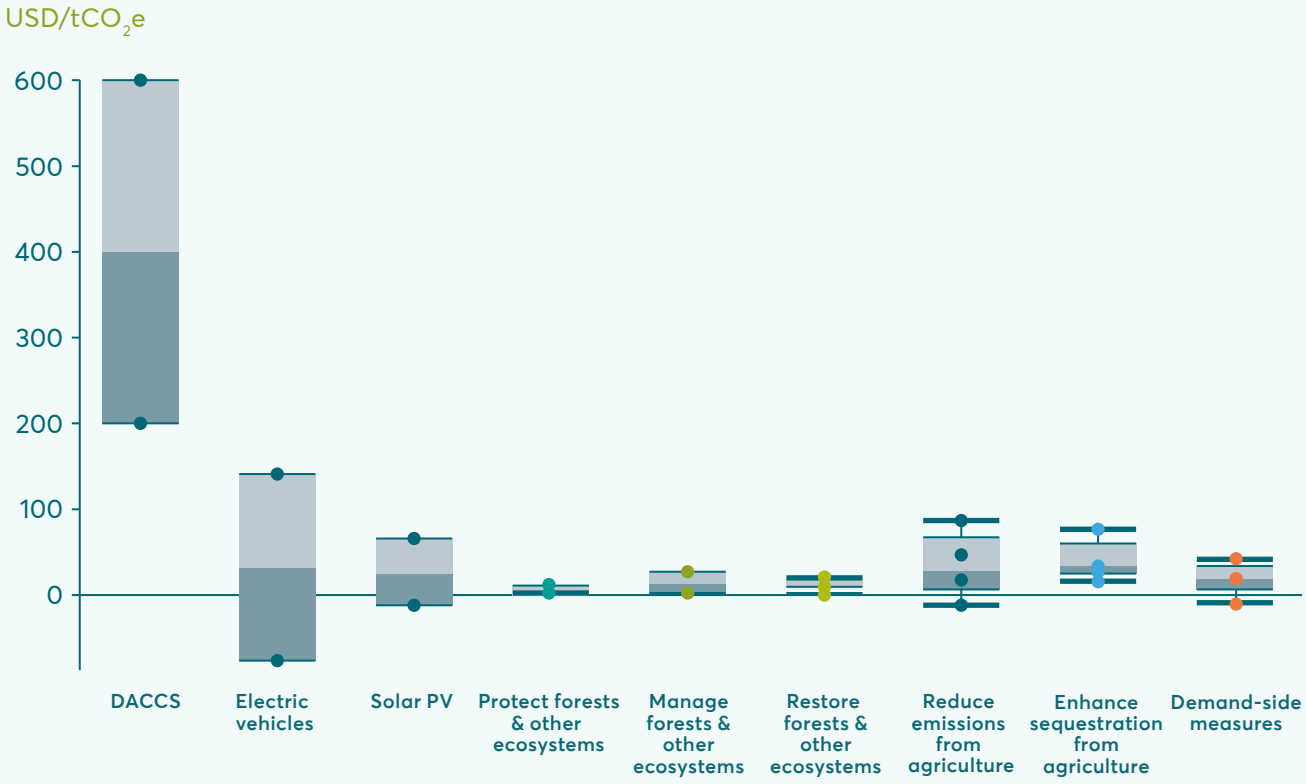
7. The analysis considered the evolution of NbS costs and revenues over time, as a way of portraying the changes likely to occur as typically seen when new sectors grow, expand and strengthen over time. This generally results in an annual decline in costs, increase in opportunity costs and revenues.

8. Of the 20 NbS only 18 are pertinent in the case of our analysis in Colombia, as both reducing peatland degradation and conversion and BECCS have no cost-effective mitigation potential identified by Roe et al. (2021).

For more detail on this methodology and the costs selected for use in this analysis, please refer to the methodology document.

NbS are cost-effective solutions that can be deployed today. Implementing these solutions will cost less than USD 40 per tonne of CO_2e on average across all solutions, based on the underlying analysis of NbS costs in Colombia. While non-nature related mitigation solutions can attract a lot of attention, NbS can achieve significant emissions reductions and removals, often for a lower cost per tonne of CO_2e. As seen in Figure 6, compared to direct air carbon capture and storage (DACCS)[137], electric vehicles[138] and solar photovoltaic (PV) energy,[139] which can cost up to USD 600, USD 110 and USD 50 per tCO_2e respectively, NbS are typically more cost-effective and a highly competitive means of deploying climate mitigation technologies.[xvi] In this pivotal decade in which we need to halve emissions[140], actions that can tackle emissions immediately are essential.

Figure 6: Range of reported annual carbon abatement costs per NbS category compared to global opportunities in other sectors (USD per tCO_2e).[xvii]



Source: Various sources compiled as part of this analysis. Please refer to the annex for all sources.

Agricultural solutions tend to be more costly per tCO_2e than other NbS. Manure management could cost as much as USD 71 per tCO_2e due to the high establishment cost of purchasing a manure digester. Forest and other ecosystem solutions are comparatively low cost, such as peatland restoration. Reduced deforestation appears to be low cost at under USD 33 per tCO_2e however, this cost must be paid for the cumulative area of forest protected each year to ensure ongoing protection and therefore becomes much greater in reality (please see the accompanying Methodology document for more information). Some solutions, such as nutrient management can deliver cost savings compared to conventional practices.

[xvi] These examples are included as illustrative cases for comparison and do not necessarily reflect Colombian policy decisions or research priorities.

Despite a wide range of costs per tCO_2e, agricultural solutions in this analysis tend to be more profitable as they generate higher and faster returns. Some agricultural solutions, such as improved rice cultivation, can generate economic returns immediately, whereas others require more patient capital to yield returns, such as agroforestry which requires time for fruit trees or coffee bushes to mature. Some solutions in forest and other ecosystems don't yield traditional returns in markets today, and so may need to look to solutions such as carbon markets to attract investment from a wider range of investors. More innovative business models are also emerging, such as those which create value from standing forests and forest regrowth described on page 17 for reducing deforestation as well as in FOLU's 2019 paper, Prosperous Forests.[142] Ecotourism, production of NTFPs or payment for ecosystem services, such as through biodiversity credits and Habitat Banks could all increase the profitability of such initiatives.[143] This distinction is important to understand the profitability and overall business model associated with each NbS. This is particularly relevant for traditional institutional investors, i.e. those that require more immediate financial returns and who have thus far struggled to identify their role in this transition.

Reduced deforestation and enhanced soil carbon sequestration in grasslands are two of the most important mitigation activities in Colombia. Their business models are very different and thus require distinct financing strategies. Case studies on the initiative-level economics can be found below.

Case study 1:
One initiative to reduce deforestation in Colombia

This case study of an effort to reduce deforestation located in central Colombia. In this region, agricultural expansion of livestock is one of the largest drivers of deforestation. This case study is based on a real-life initiative currently in implementation. Partners in Colombia developed a biodiversity conservation site of 5,000 hectares to be protected for a minimum of 30 years. The initiative seeks to achieve forests protection in partnership with land managers and farmers, who receive incentives in exchange for forest protection. These financial incentives are in the form of performance-based payment for ecosystem services (PES). These resources provide important revenue sources for farmers and land managers.

This serves an archetypal example of a reduce deforestation effort in Colombia, although it is not the only model that exists (see more information in the Methodology document on how archetypes are used in this analysis). Typical cost profiles of initiatives and the revenue sources needed to incentivize forest protection are discussed below. This is based on a real initiative but is supplemented with additional data and assumptions where necessary.

Cost drivers:

- Establishment, transaction and enabling costs are low (<USD 1 per tCO_2e). The most important cost driver is the opportunity cost for land managers and farmers; these costs have been calculated as the profits associated with agricultural expansion of livestock in Colombia.[144] This is estimated to be USD 800 per hectare.

- A large proportion of the establishment, transaction and enabling costs come from labour costs. This includes costs of full time staff who develop the business plans, alongside contracted staff such as lawyers and carbon market specialists.

Revenue sources:

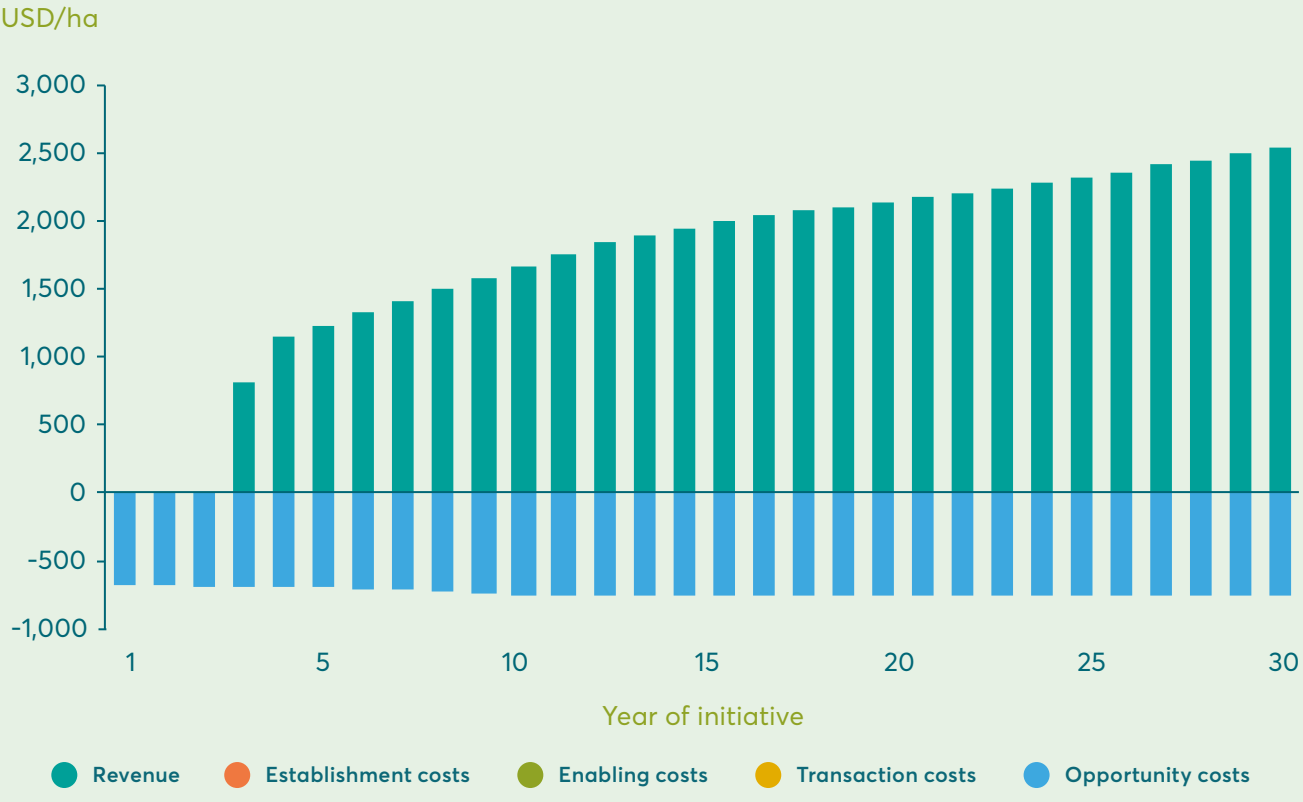
- It could be possible for the initiative to secure revenue from both carbon credits as well as PES. However, source data from the initiative did not quantify the revenue directly associated with any sort of PES credits, so these have been excluded. This study has estimated the potential revenue from carbon credits based on average carbon prices for reduce deforestation credits in Colombia in 2019 (analysis of Ecosystem Marketplace data) combined with carbon price projections (based data from Climate Focus, 2022).[145]

- Revenue data has been converted from USD/tCO_2e to USD/ha based upon the carbon mitigation density associated with reduce deforestation in Colombia (from Roe et al., 2021).

- There are other opportunities for generating revenue from standing forests, e.g. wild forest production (honey, nuts, pharmaceutical products) and ecotourism which have not been integrated into this example as more data is needed to understand the economics of these business models.

[xviii] Specific details about the initiative have been deliberately omitted from this case study due to the commercially sensitive nature of some of the data. This has been agreed with partners.

Figure 7: Estimated cashflow over 30 years associated with reduced deforestation initiative (USD per hectare)



Case study 2:
One initiative to enhance soil carbon in grasslands in Colombia (using cost data from Brazil as a proxy)

Enhancing soil carbon sequestration in grasslands requires changes to cattle rearing in Colombia, which is home to over 28 million cattle.[146] A World Bank silvopastoral cattle initiative helped plant more than 2.6 million trees on 32,000 hectares of land, sequestering 1.2 million tCO_2 in the process.[147] This initiative was based upon grants providing finance to famers to improve ranching productivity, to protect biodiversity and conserve forests. Although this initiative didn't generate returns for investors, profit-sharing mechanisms could have been developed given that famers' incomes increased by up to USD 523 per hectare due to increased farmland productivity.

Unfortunately, the Colombian example did not provide sufficient financial data and therefore costs from an initiative in Brazil were used to fill the data gaps. Naturally, the context and circumstances surrounding the rearing of cattle in Brazil differ from Colombia. Nonetheless, given the importance of cattle rearing in both countries, this case study is able to provide an archetypal example of a business model to enhance soil carbon in grasslands from improved cattle rearing.

The initiative in Brazil sought to restore designated areas of pastureland through improved cattle production and simultaneous forest restoration. In this example, ana investment partnership between farmers and a developer was formed where the developer took on partial management of the ranch, including bringing in investment required to shift practices. The developer invested capital to pay for improved cattle management across the ranch, including reforming rotational grazing, investing in infrastructure such as fencing to support grazing and also forest restoration activities for areas freed up from grazing.[148] Opportunity costs were not available for the initiative, so this study estimated these by considering the difference in profitability compared to traditional cattle ranching in Colombia.[149] Typical cost profiles of initiatives like this one and revenue sources needed to incentivize forest protection are discussed below. This is based on a real initiative but is supplemented with additional data and assumptions where necessary.

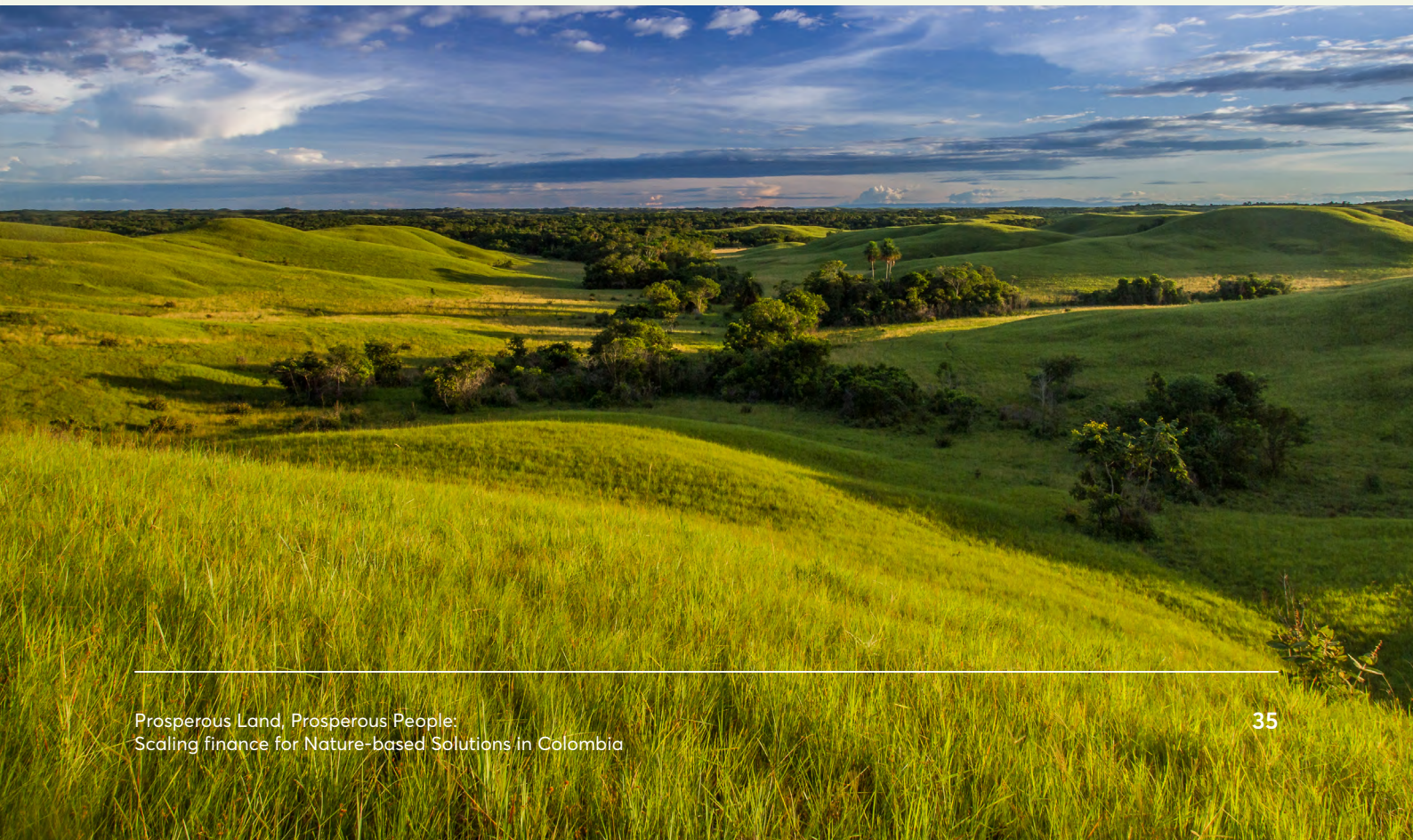
Summary of costs and revenues:

- Start-up cost are high in years 1 and 2 and include business planning and verification costs. By year 3, the costs are primarily operations and maintenance (O&M) and opportunity costs.

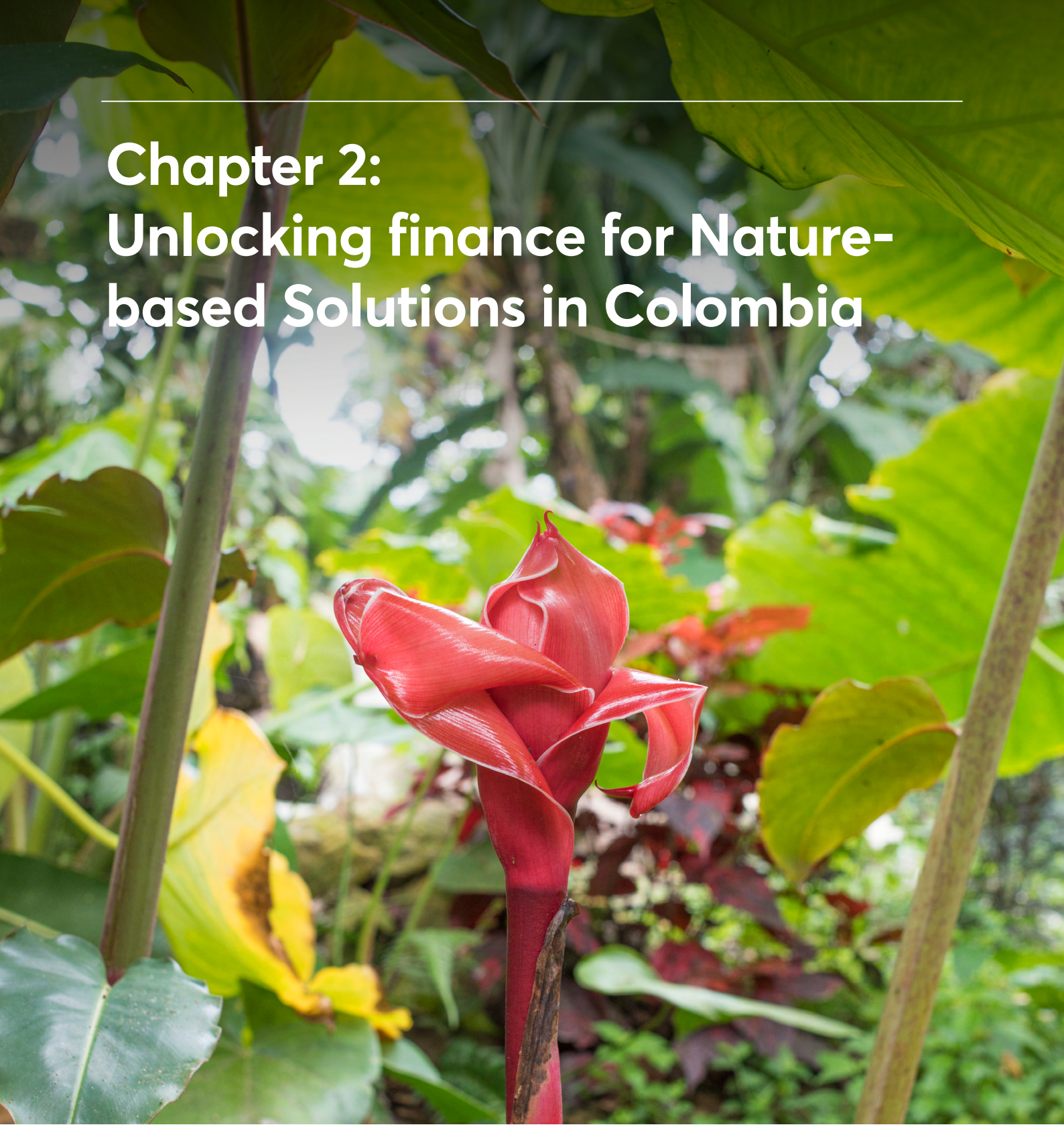
- Revenue begins being generated from year 2 as cattle raised through the improved practices are sold. Long-term economic benefits include healthier herds, which results in fewer veterinary expenses; reduced maintenance and fertilizer costs; and greater pasture productivity.[150]

- Although there is a revenue stream from the sale of cattle, the high initial costs (establishment, enabling and transaction) would be prohibitive to some investors. This is an example where initial public and/or donor finance could fund the initiative and allow for private investment to take over once returns start to be generated.

Figure 8: Estimated cashflow over 30 years associated with the enhanced soil organic carbon initiative (USD per hectare)



Chapter 2: Unlocking finance for Nature-based Solutions in Colombia



This chapter presents an estimate of the total investment required in Colombia by 2050 for each NbS solution. It also presents a pathway for how this total investment can be financed. These results are discussed, outlining implications for the role of different investors and the suitability of different financing strategies to invest in NbS. A summary of the modelling used for this analysis is also provided; more detailed information can be found in the Methodology document.

[xix] Risk/return profile measures the number of standard deviations from the mean revenue in any given year may be.
[xx] Here and henceforth in this table, "any" refers to a non-restricted boundary, i.e. for any level of investment risk from low to high, the instrument can be adopted.

Methods summary for estimating investment requirements and pathways for NbS in Colombia

The analysis for developing an investment pathway for NbS in Colombia has been split into 2 key components:

a. Estimation of the total investment requirements in Colombia

b. Model of a feasible investment pathway for delivering the total investment requirement

Total investment requirement

This study estimated the total investment required per year across the 20 NbS (or in Colombia, the 18 solutions that apply, see Chapter 1) for 4 snapshot years: 2025, 2030, 2040 and 2050. The cost and revenue (in USD per tCO_2e) per year of implementing each solution were taken from the database described on page 28 and combined with assumptions around how these costs might change over time as result of decreasing technology costs and increasing costs of land and commodity prices. These costs were then combined with the mitigation potential per year calculated from Roe et al. (2019 and 2021) to yield the total cost of implementing each solution in Colombia to achieve the cost-effective mitigation potential.

Feasible investment pathway

This study built archetypal NbS profiles based on a literature review across all NbS solutions and information from real business models. A literature review, interviews and a survey were also used to understand the investment approaches of different investor groups to build structured investor and instrument profiles. The model then compares the instrument and NbS profiles to determine their alignment in different years of the initiative's lifetime and at the different stages during the transition, before then factoring in which instruments investors can adopt and how well they themselves are aligned with each NbS profile. The breakdown of investment is thus allocated through this exercise, considering both investor and instrument alignment with each NbS. For some investor groups (corporates, philanthropies, Development Finance Institutions (DFIs) and the Government of Colombia), the model also takes into account a maximum limit for potential investment where budgets may be particularly constrained. More detailed methods have also been developed for estimating feasible investment from corporates, which also relies on a recently published report by Climate Focus estimating the feasible supply of carbon credits in Colombia.[151] For more detail on the methodology, please refer to the Methodology document.

Instrument	Investment risk	Risk/return profile[xix]	Return expectations
Grant – finance that does not seek a financial return on investment. Supply-chain finance is a subset of this instrument, where AFOLU sector corporates are disbursing grant finance to their supply-chain	Any[xx]	Any	None
Equity – finance that purchases a stake in the initiative, with high return expectations and a high appetite for risk	Any	High	High
Concessional Debt (CD) – debt finance that has return expectations below the market rate, and so is a comparatively "cheap" form of finance for initiatives. Can be used to de-risk investments	Medium	Medium	Low
Market-Rate Debt (MRD) – traditional debt finance at market rates, i.e. non-concessional	Medium	Low	Medium
Beyond Value-Chain Mitigation (BVCM) – finance from corporates outside of the AFOLU sector seeking mitigation outcomes, not a financial return on investment	Any	Any	None

Investor category	Size of investment (USD amount)	Length of investment	Return expectations	Requirements on maturity of investment	Importance of other 'core' benefits	Instruments				
						Grants	Equity	CD	NCD	BVCM
Government of Colombia	Any	Less than 10 years	Low	None	High	✓		✓	✓	
Domestic and international corporates	Any	Any	Low	None	High	✓	✓	✓	✓	✓
Development finance institutions	Any	Any	Low	Up to, but not including, maturity	High	✓		✓	✓	
Pension and sovereign wealth funds	> USD 5 million	Any	Medium low	Growth and mature stages	High		✓	✓	✓	
Insurance companies	> USD 5 million	>5 years	Medium	Growth and mature stages	Low			✓	✓	
Retail and commercial banks	< USD 30 million	>5 years	Medium	None	Low			✓	✓	
Credit unions	< USD 20million	<10 years	Medium low	Up to, but not including, maturity	Medium			✓	✓	
Trading houses and brokers	> USD 1 million	< 5 years	Medium	Growth and mature stages	Low		✓		✓	
Private equity funds	> USD 5 million	<10 years	High	From pre-seed to mature	Low		✓			
Venture capital and angel investors	<USD 30 million	< 5 years	High	Start-up and pre-seed	Low		✓			
Impact investors	< USD 30 million	< 10 years	Medium low	From pre-seed to mature	High		✓	✓	✓	
Philanthropies (incl. high net-worth individuals)	< USD 10 million	All time horizons	Low	Start-up and pre-seed	High	✓		✓	✓	

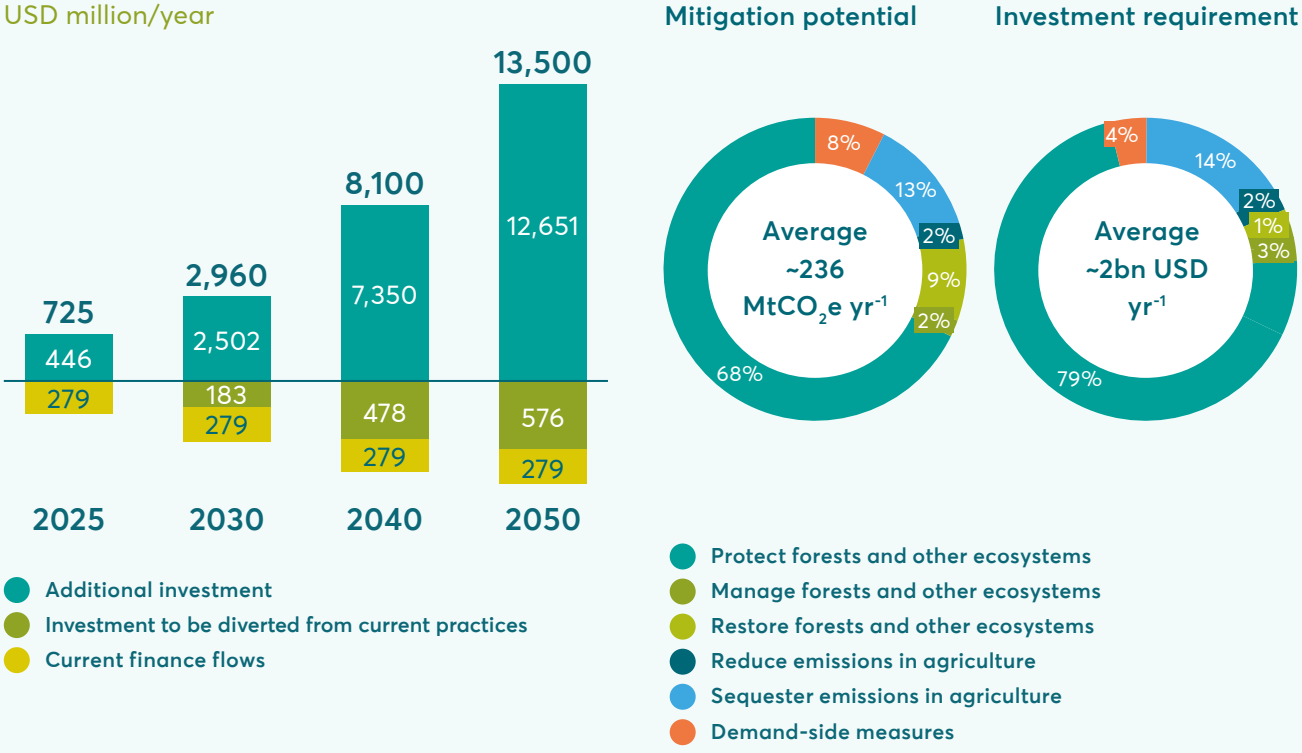
2.1 Estimating the total investment required in Colombia for NbS per year by 2050

This study estimates USD 13.5 billion of investment would be required per year by 2050 to achieve Colombia's cost-effective mitigation potential for NbS (see Figure 9).[xxi] Although this represents a nearly 50-fold increase in total annual finance from 2019, this total amounts to just over 1% of projected GDP in Colombia in 2050.[152,153] Investing this amount would deliver a suite of benefits for people and planet – including: climate mitigation, biodiversity protection, food and nutritional security, enhanced human health and resilience. By 2030, these initiatives could lead to an emissions reduction of nearly 220 million tCO_2e yr^{-1} – surpassing Colombia's NDC target of a 51% emissions reduction by 2030, even before taking other sectors into account.[154,155]

Figure 9: Estimated NbS investment needs in Colombia

Left: investment needed per decade split by existing finance that needs to be augmented or redirected (below the line), and additional finance to be sourced (above the line) in USD million per year.

Right: average percentage split of mitigation potential and investment required by NbS category between 2025-2050.



[xxi] The total investment was calculated using the USD per tonne of carbon dioxide equivalent (USD/tCO_2e) associated with each NbS measure in Colombia as well as the cost-effective mitigation potential summarised in Figure 1 (see methods summary above and Methodology document for more information).

On average over the 30 years, USD 5 billion per annum – or nearly 80% of the total investment requirement – is needed to protect forests and other ecosystems, including to reduce deforestation. This investment would unlock nearly 70% of the average annual cost-effective mitigation potential of NbS (160 $MtCO_2e$) but represents a major investment compared to the estimated USD 100 million going into these solutions today. This is because protecting forests and other ecosystems through paying for the opportunity cost of the land is expensive, as you must protect that land year on year. By comparison, the solutions that unlock the most potential for each dollar spent are afforestation and reforestation, shifting to sustainable and healthy diets and application of biochar from crop residues. Together these account for 17% of the average annual mitigation potential for just USD 80 million per annum, 1% of the average annual finance required. For a breakdown of investment required per solution, please refer to section 2 of the annex.

Over 30% of the investment required in 2050 for agricultural solutions could be met by redirecting investment that is already going into Colombia's agricultural sector (or 5% of the total investment). This is because most of the agricultural solutions require a change in practice (or set of practices) from an existing agricultural business. Moving from a "business as usual" (BAU) agricultural production system to models which integrate NbS may mean doing less of one practice and a substitution with a more sustainable practice. New or additional sources of finance are only required when the incremental costs of the change in practice exceed the cost of the BAU production system or significantly affect cash flow.

2.2 A potential pathway for financing the total investment required

This study has developed a potential investment pathway to meet the USD 13.5 billion total investment requirement for NbS in Colombia. This includes an analysis of different funders, financiers and financial mechanisms and how aligned they are to finance the implementation and ongoing management of different NbS initiatives. The results of the analysis highlight the importance of a diverse set of instruments and investor groups in scaling finance. This collaboration, through mechanisms such as blended finance, can be used to relieve the pressure on Government funding and increase private sector investment into nature.

2.2.1 Summary of key results

A range of instruments – from grant and direct supply-chain finance to equity and debt instruments – are needed to finance NbS in Colombia. The pathway highlights how early grant and supply-chain finance could enable growth in the use of all instruments – debt and equity based – to 2050. Equity, concessional and market-rate debt (non-concessional debt) are shown to make up less than 1% of finance in 2025 but grow to nearly 50% in 2050, whilst market-rate debt becomes the most widely used instrument by 2050.

- **Grant and supply-chain finance** are key to unlocking the potential of NbS, particularly when NbS initiatives are in early stages and have not yet been able to demonstrate the viability of their business models to investors. In 2025, grant and supply-chain finance make up 85% of the total finance for NbS. By 2050 this drops to 50%, as the share of investment increases through beyond value chain mitigation and instruments that seek a market-based financial return on their investment.

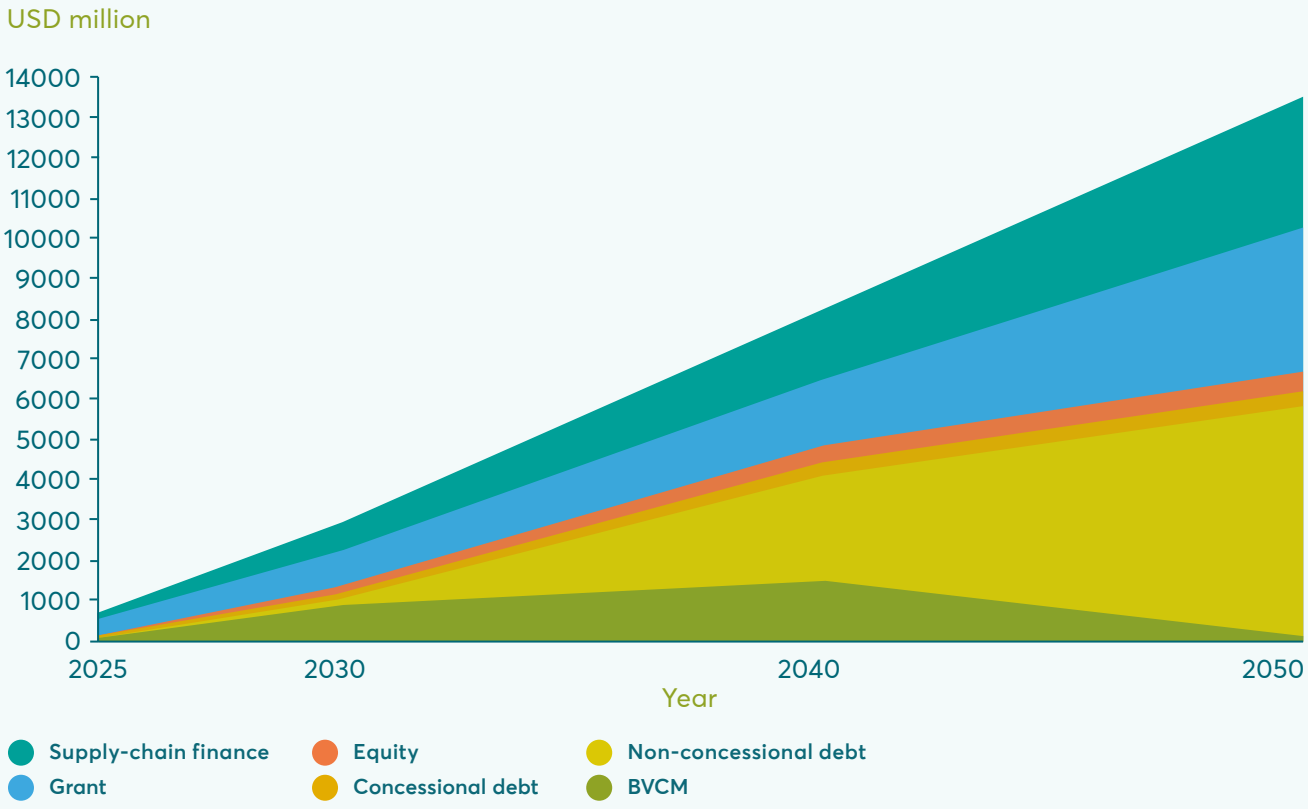
- **Market-rate debt** will be an important source of finance for initiatives which are at more mature stages, meaning they are no longer in early establishment or "proof of concept" stages and have demonstrated profitability over time, enabling them to access debt capital. This analysis identified that NbS most suited to access debt capital include enhancing soil organic carbon sequestration in grasslands and improved forest management initiatives, as well as reduced deforestation in the latter stages of the transition when initiatives become commercially viable. Collateral, such as land, is necessary for NbS initiatives to access market-rate debt, but due to limitations of the existing dataset this has not been integrated into the model.

- **Concessional debt** can help finance initiatives in need of upfront investment to grow and therefore helps to de-risk in the early stages of development. These initiatives include: agroforestry, improved soil organic carbon sequestration and improved forest management.

- **Equity investments** are better suited to initiatives with high potential returns but which also have a higher associated risk. Agroforestry and enhanced soil organic carbon sequestration in crop and grasslands are the main recipients of equity investments, but initiatives in improved rice cultivation and manure management also feature in the latter stages of the transition. This analysis assumes some initiative aggregation over the transition period, which allows traditional equity investors, such as private equity funds to overcome the issue of prohibitively small investment sizes.

- **Beyond Value-Chain Mitigation (BVCM) payments** assumed as including, but not only limited to, purchases of carbon credits through the Voluntary Carbon Market (VCM) are important enablers of the transition in the early stages, financing reduce deforestation initiatives in particular. In 2030, they could be particularly important, alone making up 31% of the total investment needed in this year. By 2050, BVCM payments make up only 1% of total finance. Recent evidence suggests that the demand for BVCM could be met almost entirely by the carbon markets in Colombia (see Section 2.2.2c). Biodiversity credits are also on the rise in Colombia and may form part of BVCM investment in addition to carbon credits.

Figure 10: A potential investment pathway for investing in NbS in Colombia over the next three decades by investment instrument



This analysis suggests all stakeholders will have an important role to play in this transition – from the Government of Colombia to corporates contributing to societal net zero and investing in BVCM. In the early years prior to 2030, investment is dominated by public sector actors and corporates engaged in mitigating their supply chains. These investors will then enable the contribution from institutional investors to grow to 45% of the total investment required by 2050.

- **In 2025, over 45% of finance for NbS could come from the Government of Colombia,** almost all of which would need to be disbursed in the form of grants to support initiatives in the initial stages of their development. This equates to 0.4% of the approved Government budget for 2023.[156] This may also require bilateral partnership in the form of Overseas Development Assistance (ODA), although this study has not evaluated what proportion of the Government of Colombia's contribution would be supported by ODA. By 2050, even though the total investment from the Government could grow ten-fold to over USD 3.3 billion, finance from the Government of Colombia would represent just a quarter of total investment as the contribution of other investors grows. The ratio of government to non-government finance (including development assistance) could shift from 1:1 in 2025 to 1:3 in 2050.

- **Development finance institutions (DFIs) and philanthropies could grow their investment six-fold by 2050.** In 2025, DFIs and philanthropies are projected to make up an estimated 10% of total investment but by 2050, could finance less than 5% of the investment needed for the transition. In 2050, this would make up an estimated 40% of DFI funding[157] and 20% of philanthropic finance[158] in Colombia.[xxii] While grants would be the primary instruments used by these two stakeholders throughout, by 2050 over 10% of investment may be delivered through concessional and market-rate debt. Historically, DFIs play a more significant role in disbursing grants, managing technical assistance and offering concessional loans.[xxiii] Philanthropies (including high-net worth individuals) do not always operate in this way, but globally there is evidence to suggest philanthropic investments are seeking to use catalytic and innovative forms of finance, including different types of grant, equity and debt-based instruments.[159]

- **Domestic and international corporates could make up nearly 30% of the investment needed over the course of the transition.** This group involves two distinct stakeholder buckets, which have been considered separately. Firstly, corporates whose operations, supply chains and customers form part of the agriculture, forest and other land use (AFOLU) sector – for example, companies who work in the coffee and dairy value chains. Reducing emissions and sequestering carbon in their land footprints (scopes 1–3) is necessary to limit global warming to 1.5°C. Secondly, corporates from any sector which are committed to net zero and may be incentivized to go beyond their "fair share" of climate mitigation as defined by the Science Based Targets initiative (SBTi), to also invest in BVCM so as to support global efforts to limit global warming to 1.5°C.

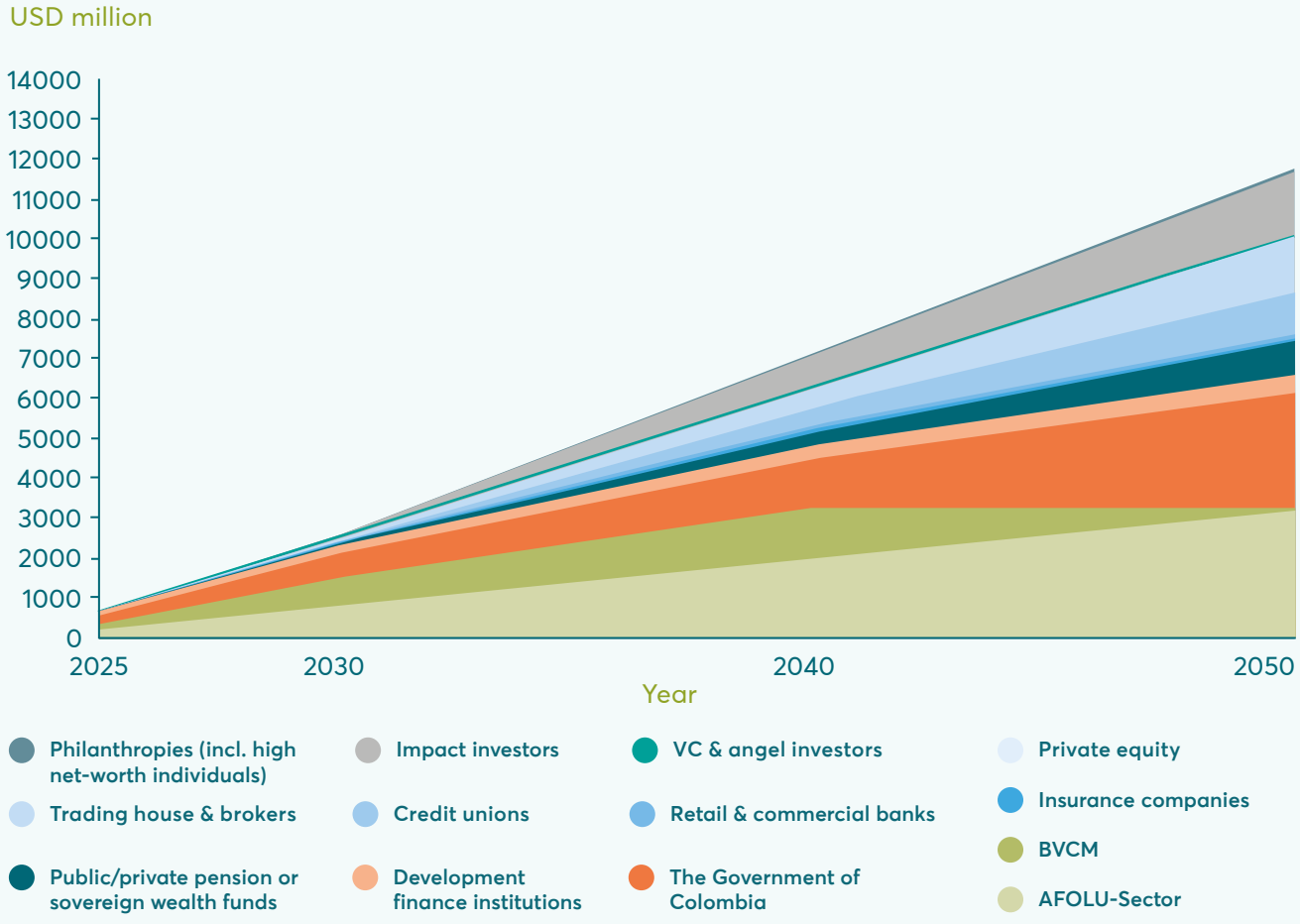
    - **AFOLU sector corporates** could finance a significant proportion of the investment needed over the course of the transition, using the full spectrum of instruments. In 2025, these corporates could finance over 25% of the investment using only direct supply-chain finance (i.e. does not seek a financial return on investment). By 2050, AFOLU sector corporates could still be responsible for financing over 25% of the transition, but with some contribution from a broader range of instruments. Supply-chain financing still makes up 90% of total finance; equity, market-rate debt and concessional debt accounts for the remaining 10%. The 2025 finance estimate equates to 0.8% of the value add of the AFOLU sector in 2021, whilst this increases to 16% in 2050.[160]

[xxii] These estimates assume a 3% growth rate per year from current figures to 2050.
[xxiii] DFI can also extend budgetary support to governments through bilateral partnerships, but this source of finance is considered under the Government of Colombia's contribution.

- **Corporates engaged in BVCM** could make up 15% of the investment required in 2025 and over 30% of the investment in 2030. This equates to a four-fold increase in 2025 and 33-fold increase in 2030 from current voluntary carbon market finance estimates. Much of this finance is directed towards reducing deforestation. By 2050, however, this contribution is expected to drop to just 1% because of the assumption that society delivers deep decarbonization across all sectors and because BVCM investment will need to shift towards investing in carbon removal to ensure that any residual emissions are neutralized in line with efforts to limit warming to 1.5°C.

- **Institutional investors could provide a quarter of the investment needed over the course of the transition.** These investors include pension and sovereign wealth funds, insurance companies, retail and commercial banks, credit unions, trading houses and brokers, private equity funds, venture capital funds, angel investors, and impact investors. Due to the financial constraints of the Government, their role in the transition is essential. Their role in 2025 is projected to be limited due to the fact that initiatives will require grant funding, but by 2050 they could contribute nearly 45% of the total finance required through a mix of debt and equity. Impact investors (14%), trading houses and brokers (12%), and credit unions (9%) could be the most significant institutional investors at this point.

Figure 11: A potential investment pathway for investing in NbS in Colombia over the next three decades by investor



2.2.2 Discussion and implications for key stakeholders

2.2.2a Government of Colombia

The Government of Colombia, with the support of development partners, has an important role to play, both as a disburser of finance and as a key enabler to incentivize investment from the private sector. The results show the fundamental role the Government of Colombia will need to play in helping initiatives get to the stage of maturity where they can generate returns and attract private sector investment. This means that in the short-term, the Government may need to deploy finance with minimal to low return (e.g. grants) to these immature business models. This is due largely to the fact that the investment requirement is dominated by initiatives which struggle to generate non-carbon financial returns today, such as reducing deforestation. The Government will also be key to financing the implementation of food loss and waste initiatives, particularly those relating to the Law 1990 of 2019.[161] This policy was enacted to ensure access to more healthy and sustainable diets and seeks to incentivize actions to enable more productive and regenerative production systems, support more local trade and markets, increasing the supply of edible food and reduce the public health burden. The Government of Colombia is already acting on several of these aspects, but is yet to establish an integrated vision of food systems. In this way, the Government will be key to also financing agricultural solutions, as well as the shift to healthy and sustainable diets.

However, this financial burden need not rest solely on Colombian taxpayers. Still, now being an upper middle income country and an OECD member, will limit the opportunities for the Government of Colombia to source payment from high-income countries to support a just transition. Blended finance solutions could attract private sector actors willing to invest in regenerative and sustainable value chains, or pursuing more jurisdictional REDD+ opportunities for reducing deforestation, or bilateral and multilateral agreements. Moreover, the Government, on top of its role as a disburser of finance, can consider policy as a means of increasing private sector investment, for example, through supporting the aggregation of initiatives and shaping the dialogue with the AFOLU sector. This role will be explored further in Chapter 3. In particular, as the investment requirement for reducing deforestation is so great, considering alternative levers to paying landowners to protect forests could decrease this burden considerably. This could include disincentivizing practices leading to deforestation or increasing the value attributed to keeping forests standing, through developing markets for sustainably produced NTFPs and placing a value on ecosystem services.

2.2.2b Agriculture Forestry and other Land use (AFOLU) corporates

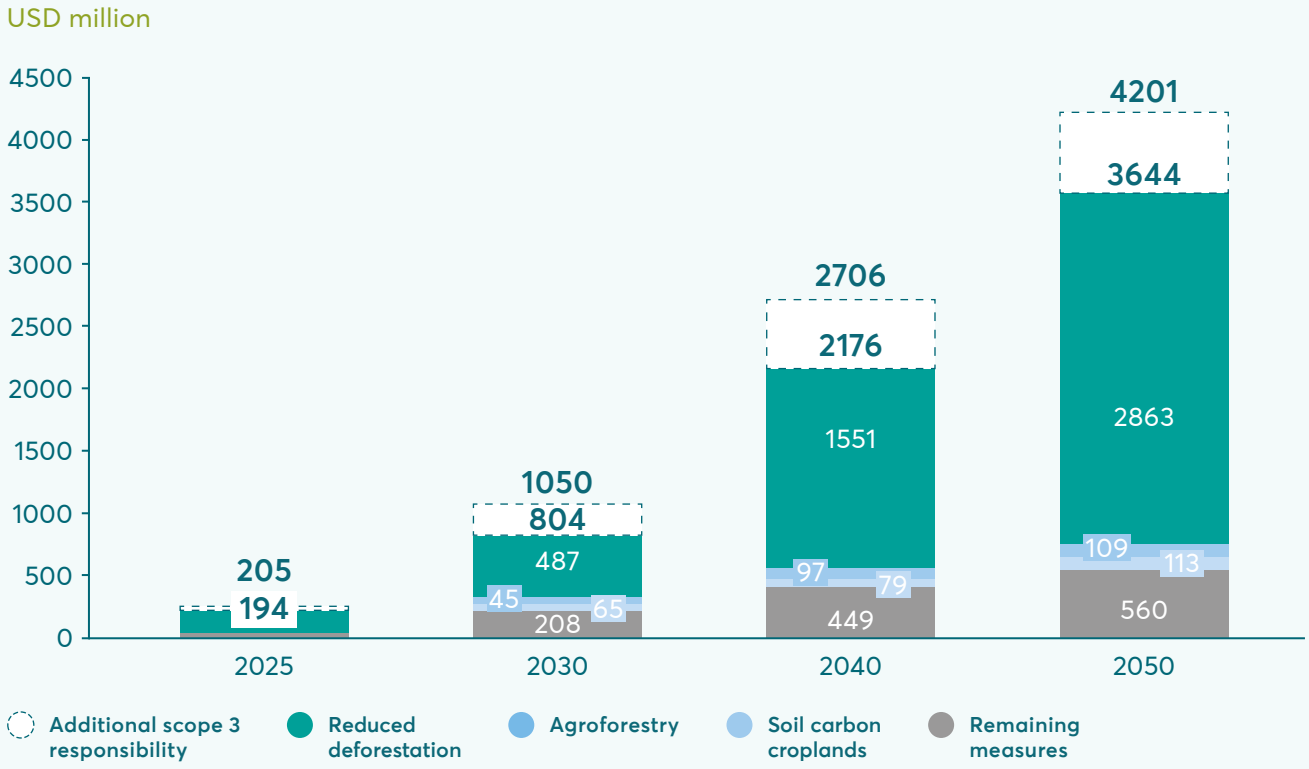
If AFOLU sector companies (both domestic and international) paid 100% of the estimated costs associated with reducing emissions and sequestering carbon in their land footprints in Colombia (scopes 1–3) to support global efforts to limit global warming to 1.5°C, they would on average deliver nearly a third of the total NbS investment requirement to 2050 (USD 2.2 billion annual average over the period). Over 60% of this investment would be channelled into reducing deforestation, nearly 20% into enhanced soil organic carbon sequestration in grasslands and a further 6% into agroforestry. This calculation is based on the proportion of mitigation potential which sits within the value chains of companies and modelling based on the Science Based Targets initiative (SBTi) Food, Land use and Agriculture (FLAG) sector guidance[xxiv] which requires AFOLU companies to deliver emissions reductions and removals totalling 72% of their land-based emissions footprint by 2050. (Note these corporates will also need to pay for the permanent storage and removal of any residual emissions to achieve net zero). Given that a large proportion of key commodities produced in Colombia are consumed within country, it is critical that Colombian AFOLU sector corporates set net-zero targets and invest within their value chains to reach their goals. Despite the fact that Latin

[xxiv] The SBTi guidance refers to companies in the AFOLU sector as Food, Land use and Agriculture (FLAG) sector companies

America is a growing region for the adoption of SBTs, there is still significant potential for improvement. At the end of 2021, only 4% of high impact companies committed to set SBTs were located in Latin America. This deficit is especially apparent in Colombia where only 8 companies have committed to SBT, scaling up this number will be an important part of unlocking the USD 2.2 billion investment amount.

While it is not unreasonable to expect these companies to pay to deliver their own share of climate mitigation responsibility (emissions reductions and carbon sequestration), it is foreseeable that some companies will lag behind in taking responsibility for their climate impact. Other companies – for example domestic small- and medium-sized enterprises (SMEs) – might have financial constraints preventing them from covering the full investment. Where AFOLU sector corporates are unable to pay the full cost of mitigation, they can engage with other financiers to invest within their supply chain, including in the form of carbon credits. However, in this case, only one party will be able to claim the emissions reductions or removals against its own SBTi target.[xxv] This analysis suggests that a further USD 800 million per annum could be unlocked from private investors in this way. This reduces the corporate spend by nearly 20% to an average USD 1.9 billion per year.

Figure 12: Estimates of required versus aligned annual investment in mitigation in AFOLU company value chains in Colombia



[xxv] Double claiming can only occur where the emission reduction or removal is in one company's scope 1 or 2 and a separate company's scope 3, for example where an agribusiness reduces emissions from enteric fermentation and claims that as a scope 1 emissions reduction and a retailer who sources from that farm claims it as a scope 3 emission reduction.

2.2.2c All sector corporates contributing to "beyond value chain mitigation"

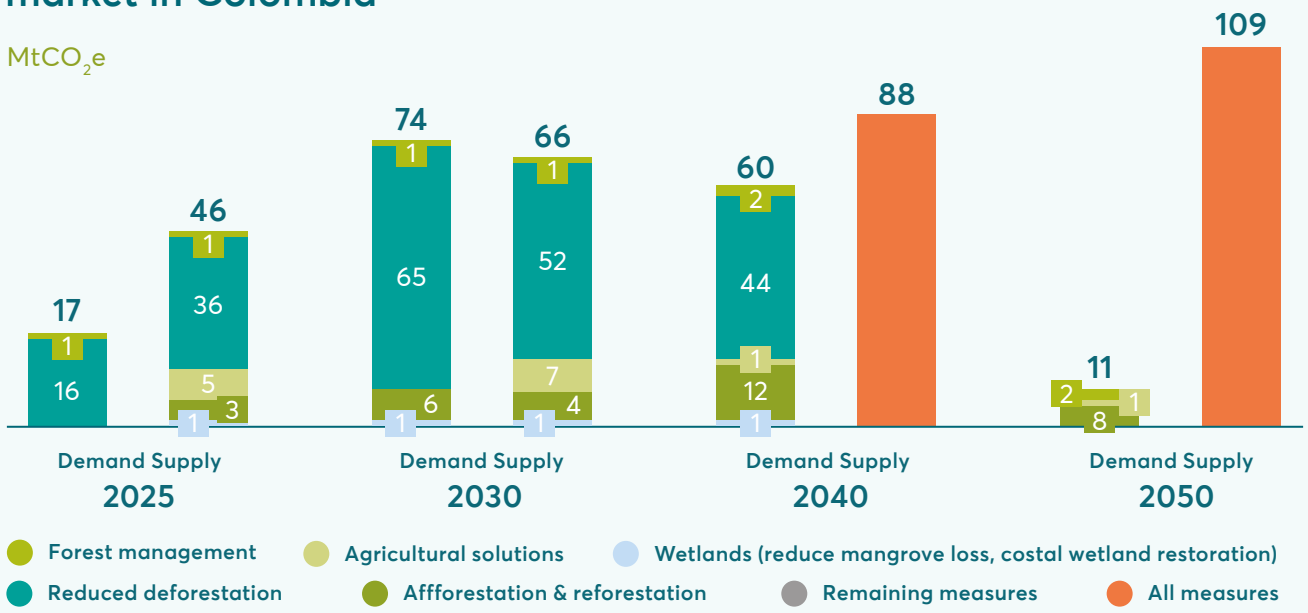
Colombia could attract nearly USD 780 million per year in carbon finance from companies investing in beyond value chain mitigation (BVCM) including, but not limited to, the purchase of carbon credits on the voluntary carbon market (VCM). All corporate sectors (including AFOLU), are recommended by the SBTi to invest in BVCM to support delivery of global net zero targets. The BVCM financing is calculated by modelling the science-based emissions reduction trajectories of all corporates and making assumptions about the proportion of remaining emissions in a given year compensated for by BVCM investments, starting at 20% and increasing over time (see the methodology document for more information). Reduce deforestation, afforestation and reforestation and improved forest management are due to receive the highest amount of investment from the BVCM investments over the 30-year period. Some of this BVCM investment could come from carbon finance through the VCM.

Recent evidence suggests that the demand for BVCM could be met almost entirely by the carbon markets in Colombia. A recent study by Climate Focus estimates the mitigation which could be achieved through developing initiatives for the carbon markets.[162] Their estimates are based upon the cost-effective mitigation potential identified by Roe et al. (2021), potential carbon price scenarios (low, medium and high) and feasibility barriers related to business, land and political factors. Figure 13 shows a comparison between the supply estimate and the BVCM demand estimated by this study. The supply estimate sourced from Climate Focus is only disaggregated until 2035. Total supply outstrips demand for all snapshot years in the high carbon price scenario and all years except for 2030 in the low carbon price scenario, driven by increased demand for reduce deforestation, afforestation and reforestation, reduce mangrove loss and coastal wetland restoration. In particular, the demand for afforestation and reforestation is undersupplied from 2025-2035 with the gap marginally increasing over this time period. This implies that in some years, finance for BVCM may have to come from beyond the carbon market. The picture for reduce deforestation is more nuanced, with the potential supply and demand being similar until the mid to late 2030s, when supply remains high and demand for BVCM from reduction solutions falls. As the need to finance reduce deforestation remains high post 2040, it will be important to ensure that there are business models established to ensure that other investors, beyond BVCM, can fill the investment gap.

By setting the right conditions, the Government of Colombia could leverage BVCM payments to make up a greater proportion of investment than the results of the pathway display. The current scenario hinges upon the proportion of global mitigation potential found in Colombia (2%).[164] This could be strongly influenced by the extent to which the Government of Colombia engages with corporates outside the AFOLU sector to create the environment that they need to invest in BVCM in Colombia – both increasing the supply of available initiatives for corporates to invest in and increasing the demand from corporates for these initiatives. This could be through, but is not limited to, the growth of the carbon market in Colombia (this is explored more in Chapter 3). Growing the BVCM finance for reduce deforestation which do not rely solely on carbon payments linked to offsets, will be particularly important for the Government, as otherwise by 2050 the Government may be left to pay for this solution through grant finance.

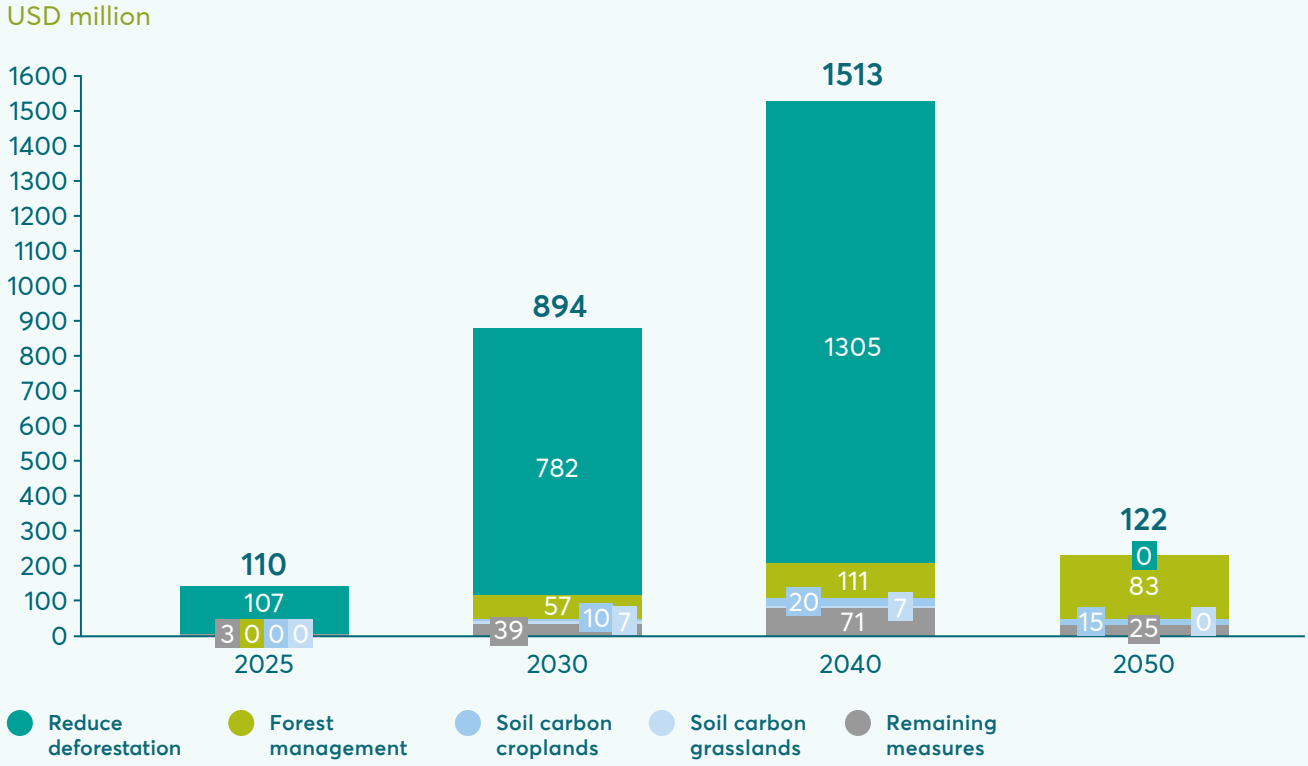
[xxvi] In this instance, DFIs should be understood as those financing initiatives directly and does not preclude their role as financiers of the Government of Colombia. Also, even if they have similar investment profiles, DFIs and philanthropies are significantly different in their investment capacity, in that philanthropies have limited budget in Colombia.

Figure 13: Estimated demand for BVCM in Colombia compared to mitigation potential which could be supplied through the carbon market in Colombia



Source: Demand from this analysis. Supply estimates based on Climate Focus study using a low carbon price scenario.[163]

Figure 14: Estimated aggregate investment flows into climate mitigation in Colombia outside of their value chains to 2050



2.2.2d Development finance institutions and philanthropies[xxvi]

DFIs and philanthropies should seek initiatives that can demonstrate a path to commercial viability at some point in the future, as well as deploy capital to tackle deforestation today. In a role similar to the Government of Colombia, as stakeholders capable of disbursing finance which does not require a return, DFIs and philanthropies are key actors in creating the pipeline of initiatives necessary to attract interest from institutional investors. With their long-term perspective and interest in benefits beyond climate mitigation and financial returns, DFIs and philanthropies should invest in initiatives that are high-risk but have an outsized climate and societal impact – such as those that reduce deforestation. To enable the transition away from grant finance, these initiatives should have a clear business proposition where possible, even if it may take some time to become commercially viable. This will allow the solution to move away from a reliance on grant finance and to instead leverage debt and equity finance, where there is a broader spectrum of investors available to engage with.

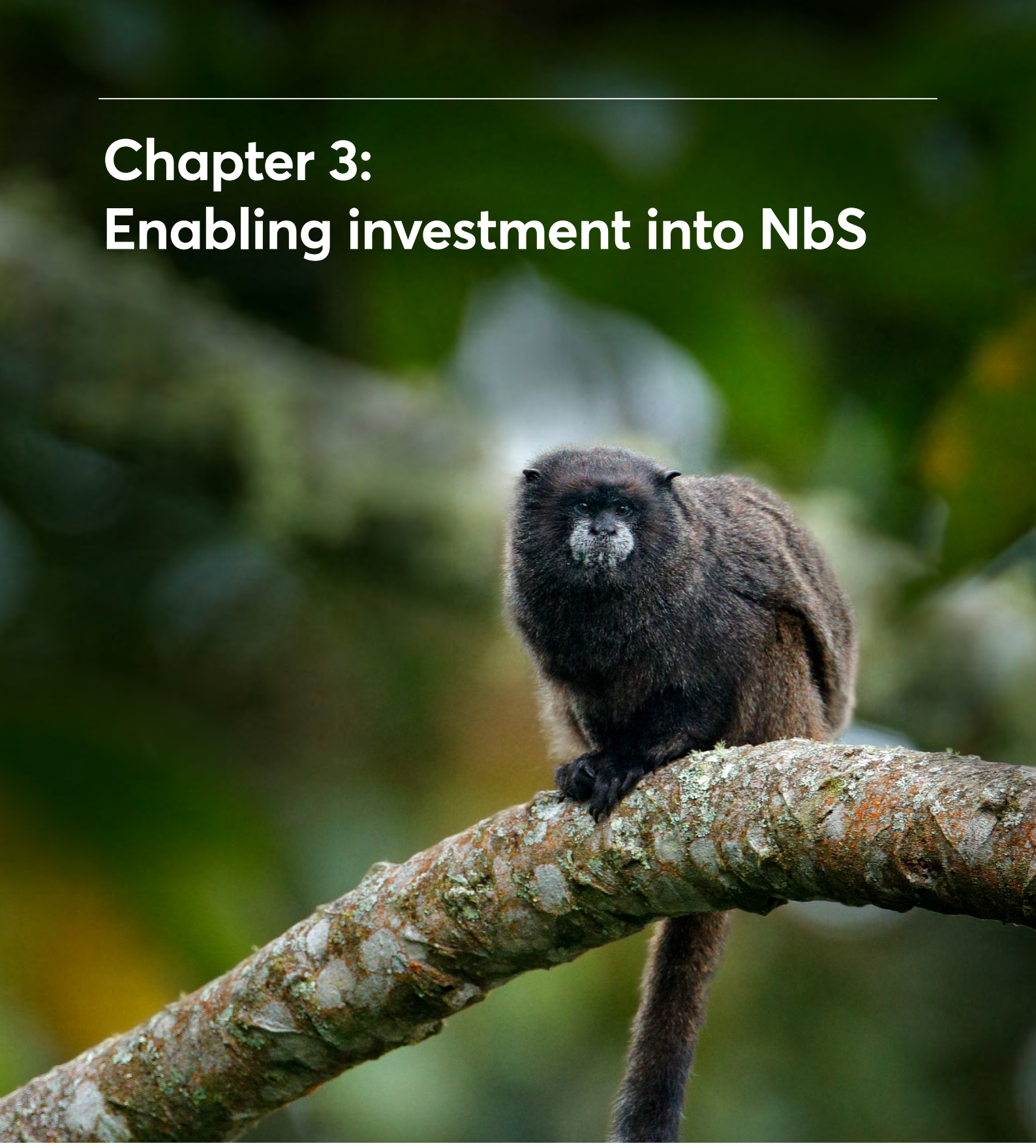
2.2.2e Institutional investors

While their contribution to the transition is limited today, institutional investors are projected to finance nearly 45% of the pathway to scaling NbS by 2050 and are essential. This growth represents a nearly 23-fold increase in investment from 2030 to 2050. Two assumptions drive this evolution in the feasible investment pathway: a) the increase in ticket sizes over the three preceding decades through aggregators and b) the extent to which NbS business models become more mature, more commercially viable and therefore less risky investments later in the transition. The combination of these two factors will allow institutional investors to increase their share of finance for initiatives that generate competitive returns and which would otherwise fall below their minimum investment size. Both of these factors could be accelerated by the Government of Colombia, through supporting aggregation and capacity building mechanisms. The latter can also be improved through the use of blended finance instruments, whereby an investor such as the Government of Colombia can deploy finance in the establishment stage, and reduce the risk for institutional investors to invest in the latter stages.

Institutional investors could play an even more significant role in Colombia's pathway to scaling NbS if investors adopt "true value accounting" principles of nature. This approach assesses the true costs and benefits of agricultural production and consumption by considering the adverse impacts to the environment, human health and communities. Currently only impact investors, pension or sovereign wealth funds and credit unions are considered to take benefits to society and the environment into account, and as such they make up the largest proportion of investment from institutional investors – together making up 70% of this group's total investment in 2050. Trading houses and brokers also make up a significant proportion of investment in 2050 (27%), bucking the trend that investors need to consider environmental and social benefits of investments; they don't, however, contribute significantly until after 2040. This is because citizen and shareholder pressure, and domestic and international regulation will be key to shifting institutional investors towards the use of true value accounting of nature.

[xxvi] In this instance, DFIs should be understood as those financing initiatives directly and does not preclude their role as financiers of the Government of Colombia. Also, even if they have similar invest profiles. DFIs and philanthropies are significantly different in their investment capacity, in that philanthropies have a limited budget in Colombia.

Chapter 3:
Enabling investment into NbS



This chapter highlights some of the barriers which Colombia currently faces to scale investment into NbS and the challenges which farmers experience when trying to access finance. It then provides recommendations as to how Colombian policymakers can act to increase investment in NbS from the private sector.

Colombia has a conducive investment climate for NbS, however barriers to investment still exist. Colombia combines a high mitigation potential for NbS, with strong political support for protecting and restoring biodiversity through a transition towards more regenerative agricultural models. Colombia's legal and regulatory frameworks align with and support international investment opportunities and it has a proven track record for NbS investments, such as through the carbon market.[166] However, the scale of finance required for NbS still hasn't been met. This is due to a number of barriers to investment, some which are specific to Colombia, whilst others exist for investments into NbS across geographies.

Aside from directly funding NbS initiatives, the Government of Colombia can play a critical role in overcoming a number barriers to NbS implementation and investment. This study focusses on the actions that Colombian policymakers can take to increase total investment into NbS. Due to constrained finances, it is in the interest of the Government to deploy catalytic finance i.e. which will incentivize further investment from other financiers, namely the private sector. It is therefore focussed on actions which can boost investment from corporates and institutional investors. A key factor inhibiting corporate and institutional investment into NbS is due to a lack of high quality and profitable opportunities on offer. Policymakers can therefore act to create a diverse and stable supply of high quality NbS initiatives, attract a greater pool of potential investors and ultimately, lower the burden on the public sector.

The following recommendations are split into two groups:

1. actions to incentivize land managers to implement NbS, and,

2. actions to increase the attractiveness (quality, risk and profitability) of NbS investment opportunities to investors.

They consider current progress by the Government of Colombia to tackle barriers to investment in NbS and suggest where further action can be taken to support an enabling environment for private sector investment.

Incentivising land managers to implement NbS

1

Barrier: There are currently limited financial incentives for landowners to implement NbS in Colombia. In fact, in some cases, harmful practices are incentivized.

This is particularly true for cattle ranching, which is supported through current land tax and price guarantees and is one of the key drivers of deforestation in the country. Farmers and landowners are therefore not encouraged to protect their land or transition away from harmful agricultural practices. Addressing perverse incentives can be a double-positive for NbS by both removing the support to damaging BAU practices as well as providing support to NbS.

Current progress: Rural reform has been occurring since the 2016 Peace Agreement and has been accelerated by the Petro Government. Its activities are aimed at improving land equality, land use planning and boosting productivity and security in rural economies.[167] Other policies and incentives which support sustainable development in rural areas include:

- Colombia has established 64 agricultural zones (ZRC) to prevent the expansion of the agricultural frontier by securing land tenure for smallholders and promoting rural economies.[168]
- The Rural and Agricultural Planning unit (UPRA) is supporting agricultural reform through efficient land use planning, market tracking and regulation around the use of appropriate production methods.[169]
- The law 99 of 1993, has established several economic and financial incentives to motivate NbS, including the transfer of income resources from the municipalities to protect watersheds, the potential to develop payment for ecosystem services and transfers from the energy sector to the environmental sector.

Recommendations: The Rural Reform encapsulates much of the needed policy action needed to create incentives for positive or disincentives for negative practices. However, the new Petro's government is yet to reveal the full extent of its plans. Therefore, for now recommendations based on existing activities could include:

1. Ensuring that land being distributed as part of the Reform is well used to support the vision for a nature-based and regenerative economy. This may require additional regulation or incentives.
2. This could be juxtaposed with a reform of the Price Stabilization Fund (PSF)[170] for beef and milk to disincentivize landowners from setting up unsustainable cattle ranches and promote improved solutions such as silvopastoral systems.

2

Barrier: There are currently limited markets for sustainably produced forest and agricultural products in Colombia and globally. This low demand provides little incentive for land managers to transition their business models or improve their production through NbS.

Current progress:

- Colombia's world leading and innovative regulation on supporting NTFPs, covers several commodities such as fruits, resins and barks and aims to protect these renewable resources and promote a culture where the sustainable use of these products is aligned with Indigenous community. The regulation allows businesses involved in this NbS space to work within a well-defined legal framework.[171]
- Colombia also has the program "Colombia Compra Eficiente" that has started limited efforts to support "sustainable" procurement. Improved data collection and monitoring has also increased transparency and reduced corruption in the tendering process.[172]

Recommendations:

1. The current NTFP regulation could serve as a framework to help support other NbS, beyond the forest sector in an attempt to grow the market for a broader suite of climate-positive commodities. This could be supported by certification opportunities for these commodities, which ensures traceability of the product and may allow them to be priced at a premium. Alternatively, price guarantees, similar to those already existing for products like beef, could be applied to these products as a way of smoothing out unstable demand.
2. Building on its progress so far, the Government could lead the way on sourcing responsibly through strengthening its criteria for public procurement. This can send a demand signal to other value chain actors (from farmers to retailers) for healthier and plant-based alternatives as well as sustainably sourced commodities. First and foremost, food procurement must focus on delivering nutritious food in suitable quantities as to support a healthy lifestyle. A similar approach could be used for procurement of other products which rely on natural materials. This could include clothing, furniture or timber building materials.

3

Barrier: The demand from other countries for commodities is driving deforestation in countries like Colombia.[173] Therefore the responsibility of acting on environmental issues in Colombia such as reducing deforestation should be a collective effort and not rest solely with the Government of Colombia. However, importing countries are often still not taking responsibility for the negative environmental impacts embodied within their imports – although there is increased calls for deforestation free value chains.

Current progress:

- Gustavo Petro is voicing this argument on international stages in an attempt to drive collective action on ecosystem protection in Colombia. He has highlighted coca farming as a particular practice which cannot be solved in producing countries alone, but requires demand shifts too.[174]
- Colombia has recently enlisted international collaboration through the EU-Colombia Joint Declaration on Environment, Climate Action and Sustainable Development.[175]
- The Government are also working to build a fund to promote a Forest Economy and prevent the expansion of the agricultural frontier. As part of this, Norway, Germany and the UK also made pledges at COP27 to support Colombia's efforts to work with indigenous peoples and local communities to reduce deforestation in the Amazon.[176]

Recommendations:

1. The Government has a role to play in monitoring international value chains in Colombia to understand current agricultural practices and to identify organisations or countries who are driving negative impacts on ecosystems and communities.
2. Policymakers should then attempt to engage with foreign governments and corporates, to get them to understand how their international trade and business policies help drive environmental degradation within countries like Colombia. This could lead to further strategic environmental partnerships like the agreement with the EU and crowd in additional support for NbS from those responsible.

4

Barrier: There are currently limited financial or regulatory incentives for businesses with value chains in Colombia to decarbonize their supply chains. This means that these businesses will not be educating and encouraging farmers within their supply chain to implement NbS. Colombian policymakers' ability to change this is limited by many international corporates having a supply chain footprint in Colombia.

Current progress:

- Colombia implemented a carbon price in 2016 of USD 5 per tCO_2e on fossil fuels, with the proceeds directed into the "Sustainable Colombia Fund."[177] Companies can receive tax breaks for investing in climate mitigation which has increased the demand for Colombian carbon credits and emissions reduction projects.[178]
- According to the new tax reform in December 2022, 80% of the tax on carbon will be directed to the creation of a new fund, namely "Fund for the sustainability and climate Resilience" FONSUREC. This fund may also receive funds from other sources and will be managed by the Ministry of the Environment and Sustainable Development. The fund will mostly support NbS and provides a unique opportunity to develop innovative projects to protect and conserve unique ecosystems in Colombia, including through PES.[179]
- Progress has also been made towards supporting corporate climate action through the 2021 Climate Action Law[180] and is piloting carbon accounting requirements for the private sector through the National Registry for GHG Emissions Reductions (RENARE).[181]

Recommendations:

1. The Government of Colombia can benefit from engaging with both Colombian and international AFOLU sector companies and financial institutions. In the first instance, regulation on climate risk assessment and disclosure such as mandating the Taskforce on Climate-related Financial Disclosures (TCFD) in Colombia would require companies to identify their climate risk hotspots and would encourage action – such as transitioning to and investing in more resilient NbS practices.
2. Secondly, if AFOLU sector companies plan to reach net zero emissions across the full value chain by 2050, or are required to do so by law, then they will have to invest into NbS in their supply chains in Colombia. By promoting the uptake of net zero commitments and enhancing due diligence regulation, alongside creating a strong investment environment, the Government of Colombia can increase the responsibility of the AFOLU sector in the transition and decrease its own burden.
3. Policymakers can consider how to engage more companies in BVCM, such as through the carbon market. The current climate mitigation tax break associated with the carbon tax has already boosted the VCM in Colombia, but extending this tax to capture more high emitting sectors, could increase this market further. Petro has already highlighted his support for the carbon market and the role Indigenous Peoples and Local Communities (IPLCs) could play, however only if their land rights are secured.

Increasing the attractiveness (risk level, size and profitability) of NbS initiatives to investors

1

Barrier: International investors often perceive the food, nature and land sector in emerging markets like Colombia as high risk, including the perception that political, regulatory and currency risk is particularly high, compounded by weaker local capital markets in comparison to markets in high income countries.[184] There are also concerns more generally that NbS initiatives will not achieve the impact that they originally state, such as emission reductions not proving additional or carbon sequestration not being permanent.

Current progress:

- The Peace Agreement and Rural Reform are paving the way to reduce conflict and increase security in Colombia, boosting its reputation in the eyes of international investors.
- To ensure the quality level, many of the projects generating credits for the carbon market are being registered and certified through standards such as Cercarbono for domestic markets and VCS for international markets.

Recommendations:

1. The Government should develop guidelines to assess the quality of NbS initiatives, which can be adopted by other financiers. This should include indicators to support the selection of initiatives and guidance on how to monitor and assess the impact once programmes are established. This could be supported by certification standards, like those used within the carbon market, which will ensure the quality of NbS activities.
2. Policymakers can reduce the risk to institutional investors, through co-financing initiatives using blended finance instruments such as guarantees and risk insurance. The use of results-based finance can also help to build investors' confidence that the initiative will achieve the desired outcome.[185] They can also support mechanisms for aggregating multiple small initiatives into a single investment, which allows the private sector to diversify its investments and reduce risk.
3. The Government can further ensure the quality of initiatives through investing in development of better monitoring techniques, such as technology to monitor soil carbon sequestration in agricultural lands.

2

Barrier: Some solutions do not currently have business models with well-established revenue streams. This makes it difficult for them to access finance from investors who require a return, such as institutional investors. There is therefore not enough public or philanthropic finance available to support these solutions and enable them to scale to the point at which they could become more financially viable.

Current progress:

- Initiatives such as Partnership for Forests (P4F) are already catalysing investment in forests and sustainable land use through uniting communities, private companies and the public sector to bring together solutions, capital and technical assistance.
- The new El FONSUREC fund will channel carbon tax funds into NbS initiatives including reducing deforestation, reforestation and restoration.[186]
- A number of programs already exist which bring together both public and private sector on NbS. This includes REDD+ projects such as the Visión Amazonía, a results-based program, working to protect forests in Amazon[187] and the Orinoquía Sustainable Integrated Landscape Program with the support of the World Bank-administered BioCarbon Fund Initiative for Sustainable Forest Landscapes (ISFL).[188]

Recommendations:

1. Capacity building in the rural economy will be key to both building the pipeline of initiatives by ensuring their effectiveness and in building the political will and public support necessary to sustain the transition in the long term. Knowledge sharing on the best business models for specific solutions in specific biomes for generating returns for farmers and investors will also be needed to scale private finance. In Colombia, this knowledge should be drawn from IPLCs who have a unique understanding of how to create value from forests and ecosystems.
2. Where business models can augment revenues with carbon credits, rural communities can enhance the financial case for their initiatives and make their returns more competitive, further increasing demand for NbS from private financiers who seek an economic return. Policymakers can shape the extent to which Colombia realizes the opportunity of the VCM which, as explored in Chapter 2, is currently underutilized. This could include considering additional options for jurisdictional REDD+ projects or developing similar schemes beyond forest protection, as these projects can achieve mitigation on a large scale.

3

Barrier: Smallholder farming is dominant in Colombia, with 81% of farms making up 5% of agricultural land and occupying on average two hectares of land.[189] Therefore, many NbS initiatives, are currently too small to attract international and large scale finance.

Current progress:

- FINAGRO, the Colombian agricultural development bank provides small-scale loans to farmers, of which, 80% were less than USD 2,700 and include loans for silvopasture.[190]

Recommendations:

1. Local and national government could play a key role in fostering initiatives that work with smallholders and small enterprises to aggregate their initiatives into a package of solutions which can be financed through a sole investment. This increases the overall ticket size, reduces the transaction costs of investments and can reduce risk to investors, allowing larger financial institutions such as pension funds or insurance companies to invest. Increasing smallholder and indigenous access to markets for sustainable commodities will be essential to guarantee the transition. Aggregators could come in many forms; for example this research has highlighted cooperatives, landscape-level carbon initiatives and supply chain investments that all achieve a level of aggregation. For example, Producers Direct has developed "Centres of Excellence" which provide smallholders with access to loans, training and support market access.

4

Barrier: Solutions which require a change in practice and therefore the purchase of new resources such as machinery or seeds, can come with high establishment and maintenance costs. These high upfront costs increase the risk of investment and can prove prohibitive to private investors.

Current progress:

- The Climate Finance Accelerator (CFA) is a technical assistance programme funded by the UK government which supports Colombia and other countries to achieve their NDCs. It brings together project developers, financiers and policymakers to overcome barriers to investment and develop a steady stream of climate initiatives, including in the AFOLU sector. It uses blended finance solutions to de-risk investments for private sector participation in climate finance.[191]
- Banco$_2$ is a public-private partnership which brings together communities who are working to protect their local ecosystems and companies seeking to invest in mitigation.[192]

Recommendations:

1. Policymakers should continue to develop blended finance instruments for the AFOLU sector, building upon the knowledge from the CFA. This should involve strong engagement and an open mindset to new and innovative approaches. This could include engagement with other governments to share learnings, as well as with the private sector or start-ups who may already have solutions which could be scaled.
2. Additional investments into cross-cutting activities such as technology development will improve the ease of implementation of NbS opportunities in Colombia. In particular, improved forest governance, spatial planning and monitoring systems will be needed to address cross-border challenges such as creating deforestation-free supply chains for multinational corporations. Research and development into the understanding and use of endemic tree and plant species would increase the efficacy of restoration activities. Investment into monitoring technology would accelerate the reduction in transaction and O&M costs for many solutions, such as reducing deforestation and monitoring soil organic carbon and open them up to more investors. This is paramount for carbon finance programmes which can currently face high MRV costs, which can be brought down significantly with the use of latest technologies.

Chapter 4 : Conclusions

There is a strong investment case for NbS to support a food systems transformation in Colombia. The 18 solutions presented here could mitigate 340 $MtCO_2e$ per year by 2050. NbS would provide additional benefits in terms of supporting biodiversity, food security, resilience and improving livelihoods and health outcomes (although not quantified here). Colombia also has a conducive political and regulatory environment to support the protection of nature and encourage international investment. Most solutions can be achieved at low cost (USD 40 per tCO_2e on average), with agricultural solutions demonstrating strong return on investment today. There are also promising new business models which should be adopted in coming years to unlock higher returns for currently unprofitable solutions and support the development of a sustainable land and forest economy in Colombia.

In order to unlock the full benefits of these solutions in Colombia, annual investment will need to grow to USD 13.5 billion by 2050, and cannot rely on Government finance alone. This equates to a 50-fold increase in annual investment into NbS in Colombia from current finance flows, or just over 1% of projected GDP. The proposed public budget for 2023 for the environmental and agriculture sector are approximately USD 300 million[193] and 850 million[194] respectively. Therefore, the investment potential of the Government into NbS is limited. Closing the funding gap for agricultural solutions can be partially (34%) achieved by diverting pre-existing finance in agricultural production systems towards the more regenerative NbS practices, such as transitioning from traditional livestock farming to rotational grazing systems.

A combined public-private strategy is required to unlock the finance required for NbS by 2050. Government, DFI and philanthropic finance is critical in the near-term to scaling business models which can provide profitable investment opportunities. The focus should be on deploying their scarce finances catalytically, through blended finance instruments to de-risk investments and crowd in private capital in the medium to long term. In this way, the results show that by 2050, the majority of NbS could be supported through a spectrum of traditional institutional investors. This study also demonstrates the important role which AFOLU sector corporates engaged in decarbonising their value chains in Colombia could play and how this would increase as more net zero commitments are made in the sector.

Beyond direct investment, the Government of Colombia is already creating a strong enabling environment for NbS, but more can be done to incentivize investment from the private sector. The Government is making progress to overcome barriers to agricultural transformation around land tenure, insecurity and inequality. Barriers to private investment still remain however, including the lack of high quality and profitable opportunities on offer. Policymakers must therefore act to create a diverse and stable supply of high quality NbS initiatives, attract a greater pool of potential investors and ultimately, lower the burden on the public sector. The recommendations provided in this report identify actions to increase the supply of initiatives through incentivising land managers to implement NbS such as by creating markets for climate-positive products, encouraging international responsibility for degradation within Colombian supply chains, tightening net-zero regulation and extending the current carbon tax. Additional actions are also considered which increase the attractiveness of NbS investment opportunities to institutional investors, including by de-risking investments using blended finance mechanisms, aggregation of small initiatives into single investments, technical assistance funds and investment into technology to reduce the cost and improve the quality of NbS.

Annex

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1. NbS data selection

This annex provides an overview of the sources, assumptions and cost categories used while determining the cost of financing Nature-based Solutions for Colombia. Initiatives were selected based on the quality of the data. If no quality data was available in Colombia, initiatives from countries in the same region with better quality data were selected. If this was not available, data was selected from countries on a similar development trajectory. Specific details about some of the initiatives have been deliberately omitted from this case study due to the commercially sensitive nature of the data. This has been agreed with partners. Additionally, in certain instance data has been adapted to maintain consistency throughout all solutions.

Reduce deforestation

	Forest Protection initiative using a Habitat bank
Source	Fontanilla-Diaz et al., 2021[195] Silva et al., 2019[196] P4F
Description	Habitat banks are private biodiversity conservation and restoration initiatives that generate biodiversity credits which can be sold to project developers needing to offset their biodiversity impacts. This habitat bank in Colombia sells biodiversity credits through the protection of standing forests. Opportunity costs were calculated from a study that estimated the shadow price of reducing deforestation based upon agricultural income foregone in the Brazilian Amazon.
Cost category	• Enabling, Transaction and Establishments costs are identified for the setting up of the initiative. This includes labor and other early-stage input costs. • O&M costs are available for the continued management of the initiative. • Revenue comes from the selling of the ecosystem services to third parties. • Opportunity costs come from a study that looks at the cost of protecting the Brazilian Amazon from agriculture.
Key assumptions	Selling of biodiversity credits is a widely replicable way to protect forests.

Reduce mangrove loss

	Carbon initiative to support mangrove protection
Source	Engle et al., 2017[197]
Description	Verified carbon initiative from Indonesia that sells carbon credits from the protection of mangrove forests, alongside sustainably managing the area for other land-use options, such as timber production. Opportunity costs were calculated from a study on intensive shrimp farming coastal Vietnam associated with loss profit from not engaging in shrimp farming, which is a major driver of mangrove loss.
Cost category	• Establishment costs come from the setting up of the carbon and sustainable management initiative. • O&M costs from the management of the associated activities, this includes labor and staff costs. • Revenues come from the sale of carbon credits. • Opportunity costs come from shrimp farming profits.
Key assumptions	Indonesia and Vietnam can be used as a proxy for Colombia. Mangrove destruction is the mainly driven by of shrimp farming.

Improve forest management

	Timber and carbon offset forest management initiative
Source	Ramirez et al., 2020[198] Olchewski et al., 2010[199]
Description	A combined timber/carbon initiative in Ecuador demonstrating how forests can be better managed in Latin America and demonstrates the costs and revenues associated with improved forest management. This was compared to a conventional timber initiative in Colombia to determine opportunity costs.
Cost category	• O&M costs come from day-to-day management of the timber/carbon initiative in Ecuador. • Revenues come from the production of carbon credits and timber. • Opportunity costs come from the profits associated with BAU timber production in Colombia.
Key assumptions	That Ecuador can be used as a proxy for Colombia.

Grassland fire management

	Improving fire management in savanna grassland
Source	WALFA fire management report[200]
Description	Reducing early season grassland fires by improving fire management and control. Costs covered and revenue generated by sales of carbon credits.
Cost category	• Establishment costs come from the setting up of this initiative, this includes the early-stage labor costs and mapping of the area. • O&M costs come from the starting of early-season fires that take place to limit the overall impact of fire on the landscape. • Revenue comes from the selling of carbon credits.
Key assumptions	Australia can be used as a proxy for Colombia. Opportunity costs from BAU activities are not required due to the land being unproductive prior to fire management.

Afforestation and reforestation

	Timber and carbon offset forest management initiative
Source	Ramirez et al., 2020[201] Olchewski et al., 2010[202]
Description	A combined timber/carbon initiative in Ecuador that demonstrates how afforestation can occur sustainably in Latin America whilst producing revenue, it also shows the costs and revenues associated with afforestation. This was compared to a conventional timber initiative in Colombia to determine opportunity costs.
Cost category	• O&M costs come from day-to-day management of the timber/carbon initiative in Ecuador. • Carbon and timber revenues also come from this initiative. • Opportunity costs come from the profits associated with BAU timber production in Colombia.
Key assumptions	Ecuador can be used as a proxy for Colombia.

Mangrove restoration

	Intensive shrimp farming compared to mangrove restoration in Vietnam.
Source	Tuan and Tin, 2013[203] Engle et al., 2017[204]
Description	Study carries out a cost-benefit analysis on restoring mangroves in Vietnam based upon 'willingness to pay' estimates and market-based pricing methods. This was compared to a study on intensive shrimp farming to estimate the opportunity cost.
Cost category	• Establishment and O&M costs come from the potential cost of setting the mangrove protection initiative. • Opportunity costs come from the profitability associated with BAU shrimp farming in Vietnam.
Key assumptions	Vietnam can be used as a proxy for Colombia. 'Willingness to pay' is a good way to estimate how much the cost of mangrove restoration would be.

Enteric fermentation

	Feeding strategies and manure management for cost-effective mitigation of greenhouse gas emissions from dairy farms in Wisconsin
Source	Dutreuil et al., 2014[205]
Description	An integrated farm system model was used to simulate the economic and environmental impact of changing feed management strategies to more sustainable practices that reduce enteric fermentation in dairy farms in Wisconsin.
Cost category	• O&M costs are calculated based upon the cost of the changing the feed strategies.
Key assumptions	USA can be used as a proxy for Colombia.

Manure management

	Implementation of small-scale bio digesters in Kenya
Source	Khatri-Chhetri, 2020[206]
Description	Economic assessment of purchasing a small digester for managing manure in Cambodia.
Cost category	• Economic assessment of biogas plants in various locations in Kenya, looking at small-scale digesters with a capacity of manure from 4-5 cows.
Key assumptions	The use of manure for the biodigester does not result in increased need for fertilizers and the investment (establishment costs) are written off over a 10 year period. Kenya can be used as a proxy for Colombia.

Nutrient management

	Improving nutrient management in Mexico
Source	Systemiq analysis
Description	Using the calculated country average cost of fertilizer from FAO data in Mexico and then assuming a 20% reduction in nitrogen inputs to calculate the incremental change in costs.
Cost category	• A negative incremental change in cost due to the reduced fertilizer inputs.
Key assumptions	Limited data could be found on the isolated impact of nutrient management. Therefore, a top-down analysis was conducted to determine the changes in costs. Reducing nitrogen fertilizer will not have a negative impact on crop revenues. Mexico can be used as a proxy for Colombia.

Rice cultivation

	Balancing Economic and Environmental Performance for Small-Scale Rice Farmers in Peru
Source	White et al., 2020[207]
Description	Study that estimated the environmental and economic performance factors of 65 rice farmers in Peru, demonstrating that more sustainable rice cultivators (lower inputs) are the most profitable.
Cost category	• Revenue data from the rice sales was provided. • O&M costs come from the day-to-day management of the more sustainable rice farms. • Analysis of the dataset allowed for the calculation of the incremental changes in costs and revenues associated with the lower input rice farming.
Key assumptions	Peru can be used as a proxy for Colombia.

Agroforestry

	Long-term effects of shade and input levels on coffee yields in the Pacific region of Nicaragua
Source	Lopez-Sampson et al., 2020[208] Baker and Bauman 2017[209]
Description	An agroforestry-based carbon offset initiative was used to approximate the establishment cost of setting up an agroforestry initiative. The Lopez-Sampson paper studied the profitability of various types of coffee production in Nicaragua, including agroforestry and non-agroforestry farms and allowed for a comparison between costs and revenue across different types of coffee production.
Cost category	• Establishment costs come from the cost of setting up a carbon-offset initiative. • O&M costs come from the cost associated with producing agroforestry based coffee. • Revenues were from the selling of the coffee. • Opportunity costs come from the production of BAU coffee production.
Key assumptions	Nicaragua can be used as a proxy for Colombia and the establishment costs of setting up a carbon offset initiative is indicative of agroforestry initiatives.

Biochar from crop residue

	Biochar as carbon removal strategy
Source	Samaniego et al., 2021[210]
Description	Theoretical study that reviewed the understanding of carbon dioxide removal within Latin America with a focus on biochar in Colombia.
Cost category	• Establishment cost of Biochar based upon t/CO_2 sequestered by this measure.
Key assumptions	The theoretical top-down approach by the authors of this paper is relevant to the on the ground circumstances and can be used as a proxy for this bottom up approach.

Soil organic carbon grassland

	Improved cattle farming in Brazil
Source	Fontanilla-Diaz et al., 2021[211] P4F
Description	P4F study contains costs and revenue information on an improved cattle farming initiative in Brazil through sustainable intensification and grassland recovery. Conventional beef production in Colombia provides the opportunity costs.
Cost category	• Establishment costs from the starting of the initiative. • Enabling and transaction costs come from staffing costs of the experts at the early stage of the initiative. • O&M costs come from the management of the initiative. • Revenue sources are from the selling of the cattle. • Opportunity costs come from BAU beef production.
Key assumptions	That Brazil can be used as a proxy for Colombia.

Soil organic carbon in cropland

	No-Till farming in Brazil
Source	Battisti et al., 2020[212] Faleiros et al., 2018[213]
Description	Study analyzed the profitability of a no-tillage soybean monoculture that had corn as an off-season crop in Brazil. The opportunity costs came from comparing to traditional till soy and maize farming systems in Western Brazil.
Cost category	• Establishment costs come from the buying of the machinery required to make no-till farming more functional. • O&M costs come from the management of no-tillage farming. • Revenue is identified from the selling of the soy and maize produced by this no-till farming. • Opportunity costs come from the profit from no-till soy and maize farming.
Key assumptions	That Brazil can be used as a proxy for Colombia.

Increase clean cookstoves

	Clean cookstoves in Colombia
Source	Admire Initiative Clean Cookstoves[214] Fuso-nerini et al., 2017[215]
Description	Initiative in Colombia that looked at the barriers for increased uptake of clean cookstoves and took a market-based approach to understand ways to overcome this, providing establishment costs for implementing clean cookstoves in Colombia. The initiative in Kenya provides opportunity costs associated with reduced fuelwood input.
Cost category	• Establishment costs includes purchasing of cookstoves in Colombia. • A negative opportunity costs was calculated by determining the reduced charcoal input (due to improved efficiency).
Key assumptions	The theoretical top-down approach is representative to the on the ground circumstances. Kenya can serve as a proxy for Colombia.

Reduce food loss and waste

	Top-down analysis on additional cost and revenue (value) of food loss and waste in Colombia
Source	Systemiq analysis
Description	Using national value of food system (expressed in GDP) to assess to value of FLW along the supply chain (Lipinski, 2020). Using targets as set by Roe et al. 2021of FLW reduction of 50% by 2050 as the potential value that can be captured (assuming linear trajectories with 2021 as base). Cost of measures determined using ReFed data from the United States. See methodology document for more information.
Cost category	No BAU cost or revenues are considered. Analysis focused on additional cost/ revenue instead.
Key assumptions	• There will be a linear FLW decrease from 2021 to 2050. • The value of food system as percentage of GDP as proxy for value of food loss and waste reduction. • Mitigation measures will be implemented with cost <USD100 or mitigation potential >2MT per year (86% of ReFed proposed measures). • Incremental cost as weighted average of measures per phase of the supply chain.

Shift towards sustainable healthy diets

	Top down approach on additional cost and revenue for shifting to a healthier diet in Colombia
Source	Systemiq analysis
Description	Calculating the transition towards a healthy diet using public health campaigns, diversified protein supplies and reduced meat consumption as proxies. Using data from the United Kingdom as a proxy, corrected for price of food, population, number of inhabitants, number of people in public sector and GDP. See methodology document for more information.
Cost category	• No BAU cost or revenues are considered. Analysis focused on additional cost/revenue instead. • No carbon credits creation or revenue from carbon credit sales.
Key assumptions	The UK can be used as a proxy for Colombia.

Reduce peatland degradation

	No mitigation potential
Source	<no mitigation potential> as determined by Roe et al. 2021
Description	-
Cost category	-
Key assumptions	There is no USD/tCO_2 cost effective mitigation potential for reduced peatland degradation in Colombia between 2020-2050.

BECCS

	No mitigation potential
Source	<no mitigation potential> as determined by Roe et al. 2021
Description	-
Cost category	-
Key assumptions	There is no USD/tCO_2 cost effective mitigation potential for BECCS in Colombia between 2020-2050

Peatland restoration

	Reducing peatland fires in Indonesia
Source	Systemiq analysis
Description	Replanting and restoring peatlands via canals, wells and planting. Costs include community engagement to reduce intentional fires in peatlands.
Cost category	• Establishment, enabling and transactional costs were all used to calculate the start up costs associated with this initiative. • Revenue was calculated based upon the sales of carbon credits. • Opportunity costs were based upon loss of profit from average smallholder farm in Indonesia, using FAO data.
Key assumptions	Indonesia was used as a proxy for Colombia given the relatively similar development trajectories that the countries are on and the fact that there was a lack of high quality data available from Latin America.

2. NbS results comparison

NbS	Cost-effective mitigation potential (million tCO_2eg)		Cost (million USD)	
	Average annual	Cumulative	Average annual	Cumulative
Reduce deforestation	159	4761	5337	160113
Reduce peatland degradation	0	0	0	0
Reduce mangrove loss	2	68	146	4371
Forest management	4	122	199	5970
Grassland and savanna fire management	0	6	0	0
Afforestation and reforestation	20	589	36	1072
Peatland restoration	1	29	14	429
Coastal wetland (mangrove) restoration	0	5	2	61
Enteric fermentation	1	18	8	254
Manure management	0	1	1	38
Nutrient management	2	49	56	1682
Rice cultivation	1	22	24	734
Agroforestry	5	146	193	5784
Soil carbon croplands	5	141	193	5784
Soil carbon grasslands	12	346	634	4783
Biochar	9	263	0	11
BECCS	0	0	0	0
Food waste	4	125	51	1529
Sustainable diets	13	396	44	1314
Clean cookstoves	1	16	0	0

Average $/tCO$_2$eq	Three most significant investors	Most significant instruments
33.63	FLAG sector corporates, Government of Colombia, impact investors	Market-rate debt, grants, supply-chain finance
N/A	N/A	N/A
64.64	FLAG sector corporates, DFIs, Government of Colombia	Market-rate debt
48.97	Corporates engaged in BVCM, Government of Colombia, DFIs	BVCM, grants, market-rate debt
0.00	Government of Colombia, corporates engaged in BVCM, DFIs and philanthropies	Grants, BVCM
1.82	Corporates engaged in BVCM, Government of Colombia, DFIs	BVCM, grants, market-rate debt
15.02	Government of Colombia, corporates engaged in BVCM, DFIs	Grants, BVCM
13.38	Corporates engaged in BVCM, Government of Colombia, DFIs	Grants, BVCM, market-rate debt
14.09	FLAG sector corporates, DFIs, Government of Colombia	Grants, supply-chain finance
27.44	FLAG sector corporates, VC & angel investors, DFIs	Equity, grants, supply-chain finance
34.05	FLAG sector corporates, DFIs, Government of Colombia	Grants, supply-chain finance
34.05	FLAG sector corporates, Government of Colombia, impact investors	Equity, supply-chain finance, grants
39.71	FLAG sector corporates, Government of Colombia, impact investors	Equity, concessional debt, market-rate debt
33.89	FLAG sector corporates, Government of Colombia, impact investors	Equity, supply-chain finance, grants
54.95	FLAG sector corporates, Government of Colombia, impact investors	Equity, concessional debt, market-rate debt
0.04	FLAG sector corporates, DFIs and philanthropies, Government of Colombia	Grants, supply-chain finance
N/A	N/A	N/A
12.23	FLAG sector corporates, DFIs, Government of Colombia	Grants, supply-chain finance
3.32	FLAG sector corporates, Government of Colombia, impact investors	Supply-chain finance, concessional debt, equity
0.00	Corporates engaged in BVCM, Government of Colombia, DFIs and philanthropies	BVCM, grants

3. Possible NbS business models

Source used by project example Other potential sources

Measure	Cost saving or efficiency gain	Growth of existing market	New goods or services	New revenue streams	Examples
Reduce deforestation			Other potential sources	Source used by project example	Carbon credits, PES, forest products e.g. wild honey, sale of monitoring data
Reduce mangrove loss			Other potential sources	Source used by project example	Carbon credits, PES, sale of monitoring data
Reduce peatland degradation and conversion			Other potential sources	Other potential sources	Carbon credits, PES, sale of monitoring data
Forest management		Source used by project example	Other potential sources	Source used by project example	Carbon credits, sustainably sourced products e.g. palm oil, carbon credits, sale of monitoring data
Grassland and savana fire mgmt				Source used by project example	Carbon credits, payment for ecosystem services (PES)
Afforestation and reforestation		Source used by project example	Other potential sources	Source used by project example	Carbon credits, sale of new forest e.g. coffee, 'Dragons blood' and data
Coastal wetland (mangrove) restoration			Other potential sources	Other potential sources	Carbon credits, PES, sale of monitoring data
Peatland restoration			Other potential sources	Source used by project example	Carbon credits, PES, sale of monitoring data
Enteric fermentation	Other potential sources		Other potential sources	Source used by project example	Carbon credits, PES, cost savings from higher productivity, sale of new products which reduce methane
Manure management			Other potential sources	Other potential sources	Carbon credits, revenue from sale of new anaerobic digesters
Rice cultivation	Source used by project example			Source used by project example	Carbon credits, potential increased yields, premium for sustainably sourced products
Nutrient management	Other potential sources	Other potential sources		Source used by project example	Carbon credits, reduced cost of fertiliser inputs, sale of biofertilisers
Agroforestry		Source used by project example	Other potential sources	Source used by project example	Carbon credits, potential increased yields, premium for sustainably sourced products, sale of additional products
Biochar		Other potential sources		Other potential sources	Carbon credits, PES, sale of biochar or pyrolyser technology
Soil carbon croplands	Source used by project example			Source used by project example	Carbon credits, potential increased yields
Soil carbon grasslands	Source used by project example			Source used by project example	Carbon credits, potential increased yields
BECCS		Other potential sources		Other potential sources	Carbon credits, electricity generation
Food waste	Source used by project example	Other potential sources	Other potential sources		Cost savings through less wastage, sale of new data and solutions for reducing waste
Healthy diets	Source used by project example	Other potential sources	Other potential sources		Health cost savings, sales of existing and new protein alternatives
Clean cookstoves	Source used by project example	Other potential sources		Other potential sources	Carbon credits, sale of cookstoves, fuel cost savings

4. Investor profiles

National, local and municipal governments

- **Return on investment:** full range, from below 5% to above 10%
- **Ticket size:** no limits, from USD 0 to above USD 30 million
- **Project maturity:** all stages, from start up to mature projects
- **Investment time horizon:** less than 10 years
- **Do non-fictional benefits influence decisions and if so, what are they?** Yes. Poverty alleviation, climate adaptation and resilience, biodiversity, health and food security
- **Investor's overall risk appetite:** high

Private/listed business (corporations)

- **Return on investment:** full range, from below 5% to above 10%
- **Ticket size:** no limits, from USD 0 to above USD 30 million
- **Project maturity:** all stages, from start up to mature projects
- **Investment time horizon:** over any timeframe
- **Do non-fictional benefits influence decisions and if so, what are they?** Yes. Poverty, alleviation, climate adaptation and resilience, biodiversity, health and food security
- **Investor's overall risk appetite:** high

Development finance institutions

- **Return on investment:** below 10%
- **Ticket size:** no limits, from USD 0 to above USD 30 million
- **Project maturity:** all stages up to, but not including, maturity
- **Investment time horizon:** over any timeframe
- **Do non-fictional benefits influence decisions and if so, what are they?** Yes. Poverty, alleviation, climate adaptation and resilience, biodiversity, health and food security
- **Investor's overall risk appetite:** high

Venture capital and angel investors

- **Return on investment:** above 10%
- **Ticket size:** below USD 30 million
- **Project maturity:** start up and pre-seed projects
- **Investment time horizon:** less than 5 years
- **Do non-fictional benefits influence decisions and if so, what are they?** No
- **Investor's overall risk appetite:** high

Philanthropies (including high net-worth individuals)

- **Return on investment:** below 5%
- **Ticket size:** below USD 10 million
- **Project maturity:** start up and pre-seed
- **Investment time horizon:** over any timeframe
- **Do non-fictional benefits influence decisions and if so, what are they?** Yes. Poverty, alleviation, climate adaptation and resilience, biodiversity, health and food security
- **Investor's overall risk appetite:** high

Impact investors

- **Return on investment:** full range, from below 5% to above 10%
- **Ticket size:** below USD 30 million
- **Project maturity:** from pre-seed through to mature projects
- **Investment time horizon:** less than 10 years
- **Do non-fictional benefits influence decisions and if so, what are they?** Yes. Poverty, alleviation, climate adaptation and resilience, biodiversity, health and food security
- **Investor's overall risk appetite:** high

Public/private pension or sovereign wealth funds

- **Return on investment:** below 10%
- **Ticket size:** above USD 5 millions
- **Project maturity:** from pre seed through to maturity
- **Investment time horizon:** over any timeframe
- **Do non-fictional benefits influence decisions and if so, what are they?** Yes. Poverty, alleviation, climate adaptation and resilience, biodiversity, health and food security
- **Investor's overall risk appetite:** medium

Credit unions

- **Return on investment:** below 5%
- **Ticket size:** below USD 20 million
- **Project maturity:** all stages up to, but not including, maturity
- **Investment time horizon:** less than 10 years
- **Do non-fictional benefits influence decisions and if so, what are they?** Yes, food security
- **Investor's overall risk appetite:** high

Insurance companies

- **Return on investment:** 5% to 10%
- **Ticket size:** above USD 5 million
- **Project maturity:** growth and mature projects
- **Investment time horizon:** 5 years or more
- **Do non-fictional benefits influence decisions and if so, what are they?** No
- **Investor's overall risk appetite:** medium

Trading house and brokers

- **Return on investment:** from 0% - 10%
- **Ticket size:** over USD 1 million
- **Project maturity:** growth and mature projects
- **Investment time horizon:** less than 5 years
- **Do non-fictional benefits influence decisions and if so, what are they?** No
- **Investor's overall risk appetite:** medium

Retail and commercial banks

- **Return on investment:** 5% - 10%
- **Ticket size:** below USD 30 million
- **Project maturity:** all stages, from start up to mature projects
- **Investment time horizon:** 5 years or more
- **Do non-fictional benefits influence decisions and if so, what are they?** No
- **Investor's overall risk appetite:** medium

Private equity funds

- **Return on investment:** above 10%
- **Ticket size:** above USD 5 million
- **Project maturity:** from pre-seed through to mature projects
- **Investment time horizon:** less than 10 years
- **Do non-fictional benefits influence decisions and if so, what are they?** No
- **Investor's overall risk appetite:** high

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