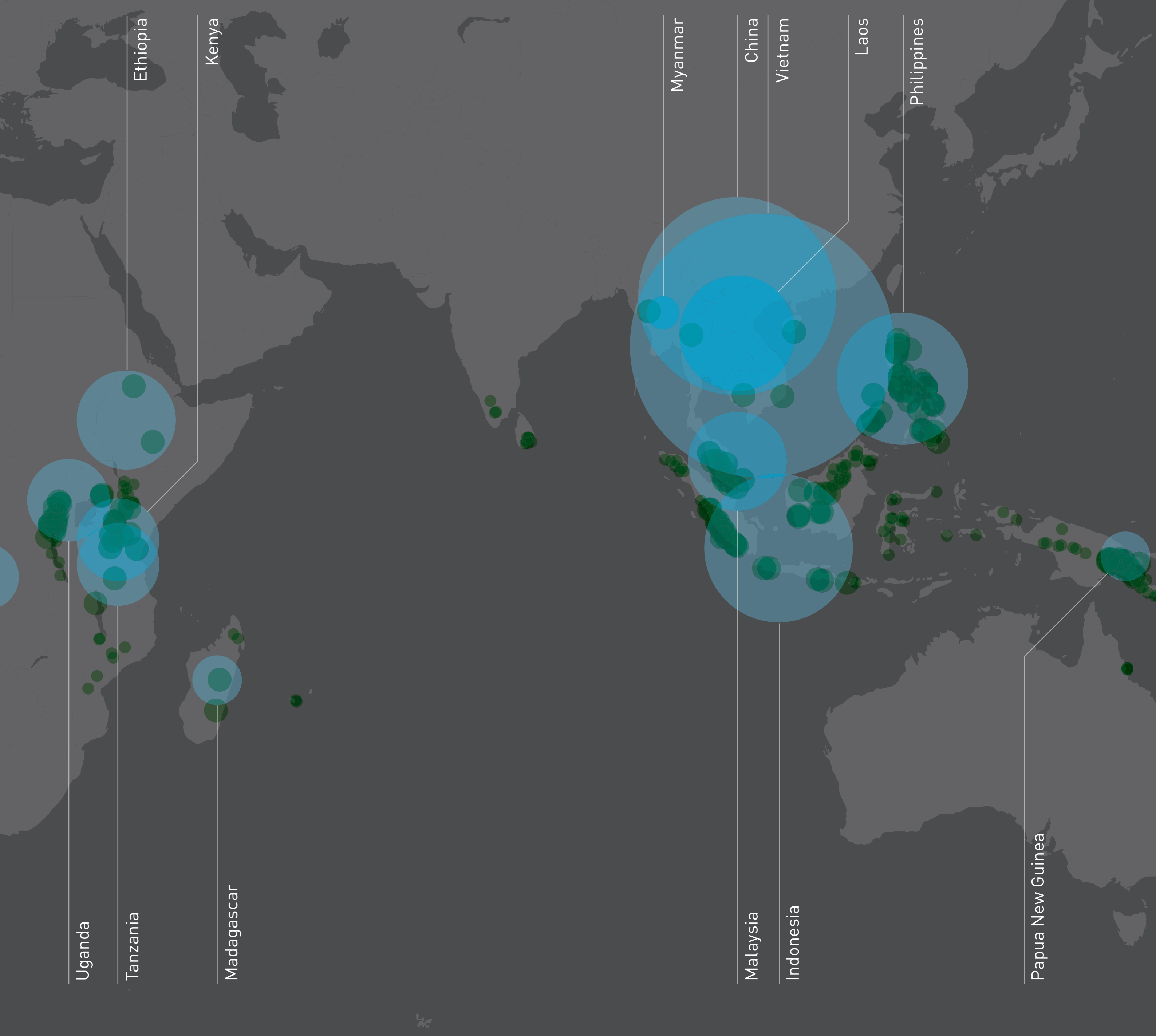
earth security

CLOUD FOREST ASSETS
FINANCING A VALUABLE NATURE-BASED SOLUTION



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Financing a Valuable
Nature-based Solution

Earth Security works with global leaders and organisations to unlock the value of nature-based assets for a sustainable future.

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CLOUD FOREST ASSETS
FINANCING A VALUABLE NATURE-BASED SOLUTION

Monteverde Cloud Forest,
Costa Rica

FOREWORD

My interest in cloud forests was sparked many years ago in Costa Rica, where I learned that by capturing fog from the clouds, these misty mountain ecosystems were increasing the amount of water flowing downstream.

It struck me that this function was so formidable, yet so little known, and that finding a way to finance the value of this water, which is used by hydropower dams, cities and farms, could, in addition to the carbon stored in these forests, provide a key to financing their protection.

We found that most of the world's cloud forests are concentrated in just 25 tropical developing countries, and that of the 979 hydropower dams operating in those countries, more than half are depending on water from cloud forests. This represents billions of dollars of electricity production taking nature's ecosystem services for granted.

And that's not the full story. Hydropower capacity across the tropics is set to double as countries try to expand access to energy with a lower carbon footprint. We identify some 1,084 dams that are already at some stage of planning and investment in these 25 countries. Of these future dams, some 684 – two-thirds – will rely on water from cloud forests.

These forests are not currently protected areas, and they should be, just as countries protect any other type of vital infrastructure. While these investments must conform to rigorous social and environmental impact safeguards, ensuring the protection of these forests upstream should be included as a risk management priority for investors, project developers and policy-makers.

According to the World Bank, almost 60% of the world's poorest countries are in debt distress or at high risk of it, a situation worsened by the Covid-19 pandemic. Many of these countries are the last frontier for standing tropical forests and vibrant biodiversity, but without adequate finance they cannot be expected to meet climate and nature commitments.

The Cloud Forest Bond we are proposing is intended to provide these 25 cloud forest countries and a range of financial actors, including philanthropy, public finance and private investment, with a set of options to capture the economic value of the ecosystem services of these forests. Through this work, I have become convinced that if sovereign finance instruments for nature are to prevent deforestation, they must also help countries create new, long-term income streams from keeping their forests standing.

Our proposals focus on kickstarting immediate action by companies, investors and governments. But they are not just about creating new cashflows. They are also about redesigning relationships. The evidence shows clearly that forest protection is highest where the land ownership rights of indigenous peoples and local communities are fully recognised and exercised. These ownership structures, leading to a fair share of the benefits from forest carbon and water revenues, should form the basis of our approach to financing natural assets.

We also need to pursue these opportunities on a global scale. This is why we propose a Cloud Forest 25 (CF25) Investment Initiative; to establish a collective of all 25 countries sharing this common natural asset, so as to accelerate the international application of market templates, and aggregate the blended finance and data needed to achieve solutions at scale.

My hope for the future is that we can accelerate the paradigm shift that aligns investments with the planet's life-support systems. We are working actively to catalyse these opportunities and welcome an engagement with all stakeholders. This report offers a combination of hard economic data, compelling storytelling and a focus on innovation and impact. We need all three to succeed.

Alejandro Litovsky
Founder and CEO, Earth Security

Cloud forests, found at high altitudes in the tropics, capture fog from clouds and increase the water available downstream

EXECUTIVE SUMMARY

Cloud forests sit on top of tropical mountains and are largely shrouded in mist. They capture moisture from the air, providing fresh and clean water to people and industries far below. This value goes largely unnoticed and unfunded, and losing it would hold back developing countries in their transition to net zero and climate resilience.

Most of the world's cloud forests are concentrated in 25 developing countries. Of the more than 1,000 hydropower dams being planned across these tropical emerging markets in the pursuit of better access to energy, more than 600 will depend on cloud forests for water.

Many of these countries will find it difficult to protect their forests or achieve biodiversity targets in the face of growing economic challenges, including mounting debts in the aftermath of the Covid-19 pandemic and rising food and energy prices. New systems need to be designed for countries to monetise the value of keeping their cloud forests standing.

We estimate that the total value of hydroelectricity that currently depends on cloud-affected forests across these 25 countries is close to $118 billion over 10 years. This increases to $246 billion when the hydropower plants currently being planned in these countries come online.

We therefore propose to mobilise financing for cloud forest protection through payments schemes under which hydropower projects and other industrial water users benefiting from cloud forests pay for this service.

'Payment for ecosystem services' schemes involving water from cloud forests are not new. From Colombia to Tanzania, models documented here and on which we build, range from multi-stakeholder water funds to a pilot-stage 'Cloud Forest Blue Energy Mechanism'. However, these pilots have been very localised and have had mixed results. For this approach to deliver at scale, and provide a new revenue stream for forest protection, a key innovation we propose is to apply the same principles to the design of a model that is compulsory and implemented at national level.

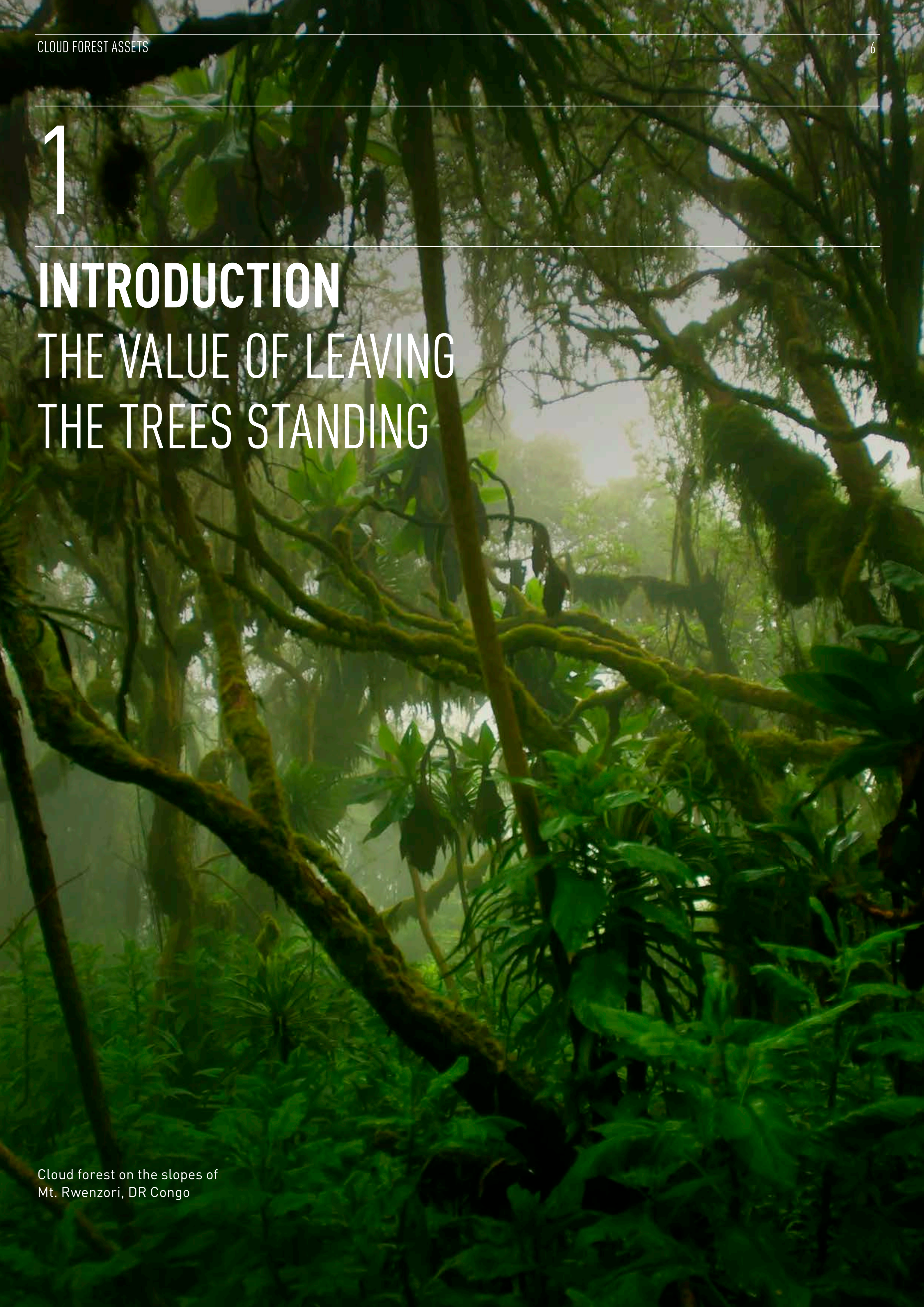
In addition, sovereign carbon finance could add an additional $209 billion across these countries over the next decade. Sovereign carbon, which is being developed through a range of national and other jurisdictional approaches, can offer further revenue streams that also help increase the coherence, security and liquidity of the forest-based carbon pipeline beyond a project-by-project basis. Stacking the value of these forests both in terms of carbon and the water provided to existing hydropower plants amounts to a combined $327 billion for the 25 countries over ten years.

Sovereign finance offers a window to fund these developments. We are proposing **Cloud Forest Bonds** not only as a way to help these countries improve their debt position, but also to fund the creation of new, long-term income streams from services provided by nature. Three design options are proposed for a Cloud Forest Bond: new bond issuances, debt-swaps, and results-based financing instruments, which are matched to the circumstances of each of the 25 countries.

In addition, a **Cloud Forest 25 (CF25) Investment Initiative** is proposed as a way of bringing these countries into a collective group that can accelerate the speed and scale of this transformation. It can do so by streamlining templates for these financing instruments, building the capacity of governments, aggregating the delivery of blended finance, and developing the data needed to get a comparable view of performance across all these countries, which together hold more than 90% of all cloud forests on Earth.

Finally, we recommend that banks, investors, and corporates that operate dams and other water-intensive assets benefiting from cloud forests should recognise the value at risk, and the role that cloud forests play in their resilience to droughts and climate change. Companies can access innovative corporate finance products that reward them for building their resilience with nature, while securing biodiversity and ensuring other ecosystem services for others in society.

The report's proposals are intended for three sets of stakeholders: In cloud forest countries, they include national governments, NGOs, and communities including indigenous peoples' organisations and local experts. Among public finance institutions, they encompass donors, multilateral development banks (MDBs), development finance institutions (DFIs) and global NGOs. In the private sector, they include banks and investors, credit rating agencies and re/insurers, and companies operating water-intensive assets that depend on cloud forests.



1

INTRODUCTION
THE VALUE OF LEAVING THE TREES STANDING

Cloud forest on the slopes of
Mt. Rwenzori, DR Congo

1.0
INTRODUCTION
THE VALUE OF LEAVING THE TREES STANDING

The developing countries that contain most of the world's remaining tropical forests would clearly benefit if the value of those natural assets could be used to mobilise more funding and financial incentives for their protection.

Many emerging market governments are coming out of the Covid-19 pandemic with increased debts and borrowing costs and, if their credit ratings are low, are largely locked out of capital markets. Russia's invasion of Ukraine has made food and energy imports more expensive, and this may impede emerging market governments' capacity to allocate funds towards environmental initiatives without considerable external assistance.

This report aims to show how cloud forests – shrouded in fog and located in tropical mountains in dozens of countries worldwide – have significant economic value that can be unlocked through sovereign funding instruments, generating revenue for governments keen to make best use of their natural assets.

There are no off-the-shelf solutions and the report aims to present ideas that innovatively repurpose some current trends. Cloud Forest Bonds, as proposed here, could not only provide funds for countries' general accounts, but also create new revenue streams for governments to protect these natural assets, already under threat from agriculture, mining and climate change.

Plate-billed Mountain Toucan (Andigena laminisosris), Ecuador

1.1
THE CLOUD FOREST 25 GROUP

Indonesia
Tanzania
DR Congo
Colombia
Peru
Venezuela
Mexico
Papua New Guinea
Brazil
Ethiopia
Ecuador
Cameroon
Bolivia
China
Laos
Kenya
Malaysia
Angola
Uganda
Madagascar
Philippines
Gabon
Vietnam
Republic of Congo
Myanmar

Cloud forests, already environmentally important because of their unique biodiversity, are valuable sources of clean water for existing hydroelectric power, as well as for a significant number of planned hydroelectric power plants.

In addition, they offer the benefits of carbon storage and sequestration and are home to highly endemic and thus at-risk species of — as yet largely unknown — value to humanity. Cloud forests, which occupy a limited area, are under great threat and their hydrological function is of existential value to millions of people living downstream. Over 90% of the world's cloud forests are found in just 25 developing countries across the tropics.

We propose that a group — the Cloud Forest 25 (CF25) — is coordinated to provide a basis for organising sovereign finance at scale. Its members would be connected by their ownership of this natural asset and could share the knowledge and resources needed to link it to finance.

This report focuses on ways in which these countries, companies and investors can design new financial systems that tap into the value of ecosystem services from cloud forests, namely: payments for water from cloud forests that contributes to hydropower generation and benefits other industrial users, and sovereign carbon finance.

The report envisions a Cloud Forest Bond that would incentivise governments to protect their cloud forests and encourage carbon storage, while also providing funding to set up sovereign-level carbon finance schemes and payments for ecosystems services. A Cloud Forest 25 (CF25) Investment Initiative is also proposed to bring these countries into a collective that can step up the pace and scale of this transformation. It can do this by streamlining the templates for income creation, aggregating the delivery of blended finance, and developing the data needed for a comparable view of performance across the countries involved.

1.2
WHY A SOVEREIGN FINANCE PATHWAY?

According to the World Bank, 58% of the world's poorest countries are either in debt distress or at high risk of it, and the danger is spreading to some middle-income countries. High inflation, rising interest rates and slower growth are setting the stage for the type of financial crises that engulfed many developing economies in the early 1980s.[1]

At the height of the Covid-19 pandemic, the Bank's Debt Service Suspension Initiative (DSSI) placed a moratorium on official external debt payments for participating low-income countries, allowing governments to redirect funds to health and social initiatives. But this was only temporary and rescheduled payments will begin to come due in 2024, increasing budgetary pressure for developing economies. This reduced spending flexibility will severely constrain debtor governments' ability to fund climate and nature commitments.

Debt distress also means emerging markets have less money to spend on climate adaptation, or adjusting to the effects of climate change. An increase in climate-related loss and damage undermines development and requires these governments to borrow more money, which is again lost as disasters recur.

This represents a borrowing trap that reflects the speed and severity of climate change. The 20 countries most vulnerable to climate change (known as the Vulnerable 20 or V20) are considering a coordinated halt to repayments of about $685 billion in collective debt.[2] Finance ministers of the V20 are calling for debt-for-nature swaps, in which part of a nation's debt could be forgiven and invested in nature conservation.

New approaches to investing in adaptation could focus more centrally on both the conservation and restoration of nature-based solutions, such as mangroves and forests, which provide a cheaper, more cost-effective and readily available type of green infrastructure in many of these countries. However, while debt-swaps for nature can help relieve the short-term stress, the opportunities created by debt-restructuring will only be effective at curbing future deforestation if they can also help deliver new revenue streams that rely on the value of preserving forests and other nature-based solutions.

Deforestation is not only a primary cause of greenhouse gas emissions for emerging markets that impede their transition to net zero. It also disrupts the water cycle, including rainfall and freshwater and sediment in rivers, with a knock-on loss of hydropower output. Despite their environmental impact, hydroelectric dams are a low-carbon energy source in which many tropical emerging markets are investing aggressively so as to achieve net zero while expanding electricity access for their populations.

The way out of the debt trap, creditors argue, is to ramp up growth and embrace structural reforms. Investing in a country's 'natural capital' as a way of creating more resilient economic development is not yet part of the international consensus among creditors. However, the risk of a domino effect in debt defaults by over-indebted developing countries is an opportunity for creditors and multilateral institutions to consider new ways to use these countries' natural wealth as a form of capital.

Growing pressure on the external debt of emerging markets has provided opportunities for 'debt-for-nature' swaps of the kind that were popular in the 1980s and 1990s, with recent examples in Seychelles, Belize and Barbados. At the same time, a world-first sustainability-linked bond (SLB) sovereign issuance in Chile tied new debt to achieving climate targets. This has been followed in 2022 by Uruguay, with an SLB that for the first time includes a forest protection target.

But these opportunities remain very limited in their ability to value and monetise a country's natural assets. Without new templates that focus on financing natural assets at a sovereign level, the large share of debt restructuring happening across emerging markets will continue to follow the existing path. For example, in September 2022, Ecuador reached a $1.4 billion debt restructuring deal with China, which extended the maturity of loans and reduced interest rates and amortisation. The funds are expected to help the government as it faces protests over food and fuel prices, but the agreement came at the same time as a separate deal between China and the state oil company Petroecuador to release oil reserves.[3]

"As much as we need oxygen, we also need bread."

Eve Bazaiba, Congolese Environment Minister, when asked about DRC's intention to auction oil blocks in environmentally sensitive areas. (October 2022)

1.3
FORWARD DESIGN

This report puts forward three innovative design options for a Cloud Forest Bond and matches these to the circumstances and market access possibilities of each of the CF25 countries. These options include:

1 **Sustainability-Linked Bond**
involving issuances of new money that link the costs of borrowing to achieving environmental targets.

2 **Debt-for-Nature Swap**
as seen since the 1980s and more recently in the cases of Belize and Barbados.

3 **Results-Based Finance**
with funding contingent on agreed results being achieved and verified.

While some members of the CF25 group could already benefit from linking protection of their forests to national-scale funding opportunities for these economically vital natural assets, such as through the UN's REDD+ framework, a **Cloud Forest Bond** is envisioned to provide governments with a template to link forest protection to their general borrowing and access to capital markets.

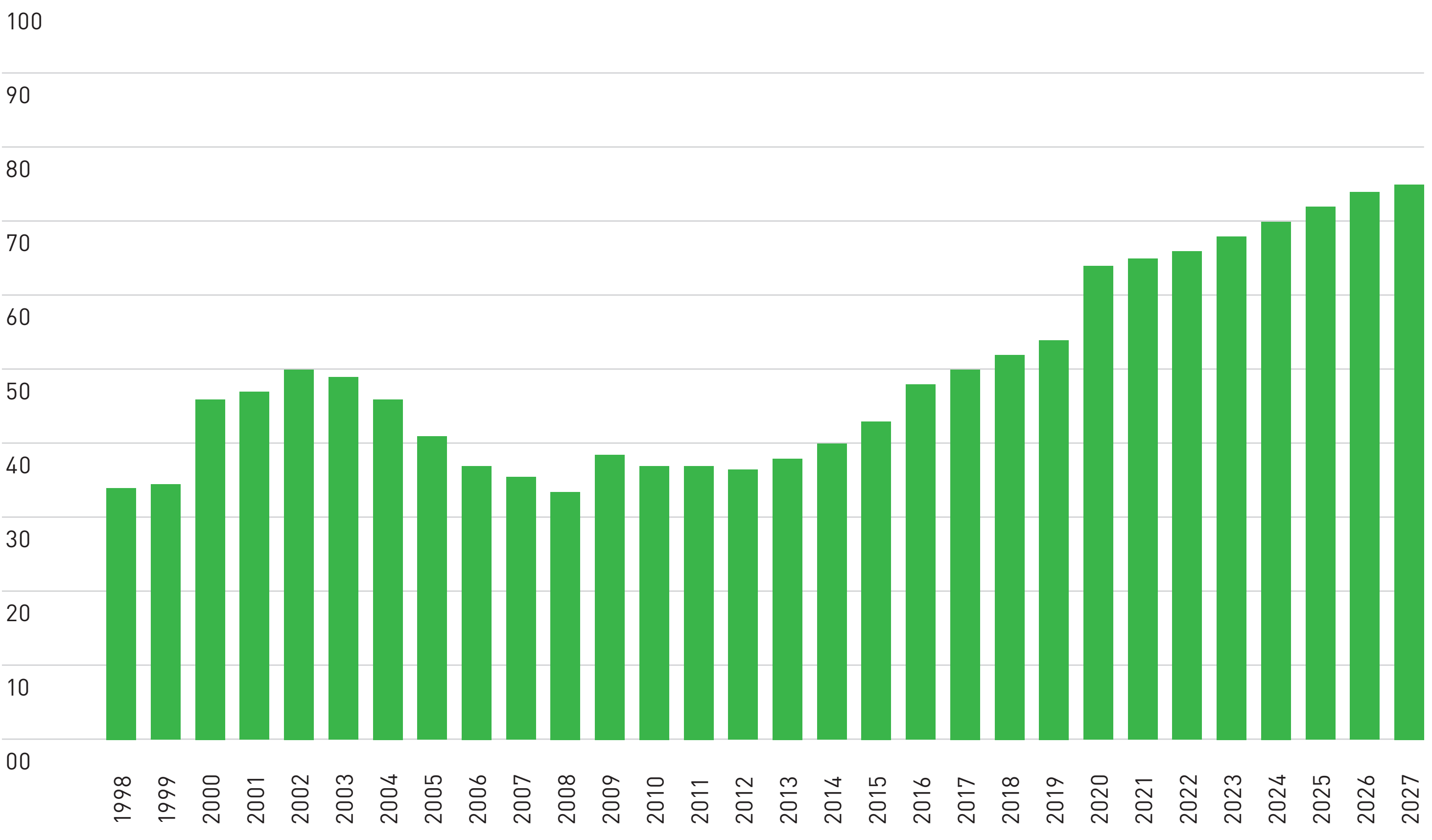
This would be a way to fund general operations while also developing sustainable income streams from carbon and water payments. The range of options makes clear there is no one-size-fits-all, and solutions need to be tailored to countries' individual circumstances through a multi-stakeholder process with the involvement of governments and other interested groups.

Additionally, the report outlines a **CF25 Investment Initiative**, with the goal of accelerating capacity building across the 25 countries, creating templates that can improve common knowledge and reduce transaction costs, developing blended finance windows to aggregate the delivery of risk guarantees and other credit enhancement tools as described, and creating a data platform to enable comparable indicators to be tracked across all these countries.

At the same time, these mechanisms would offer banks, funds, corporates and re/insurers the opportunity to bring biodiversity, nature-based solutions and climate risk mitigation scenarios into their investments and products.

Figure 1
Debt level as % of GDP for emerging market sovereigns 1998–2027 (projected)

Source
International Monetary Fund
WEO Database, April 2022



2

WHY CLOUD FORESTS?
A VITAL GREEN INFRASTRUCTURE

The type of vegetation found in cloud forests helps the capture of fog

2.1
WHY CLOUD FORESTS?
A VITAL GREEN INFRASTRUCTURE

Cloud forests provide tropical emerging markets with a range of ecosystem services, including carbon storage and sequestration as well as a unique 'cloud capture' function that can increase water availability and facilitate the availability of water year-round. This is a crucial ecosystem service for existing and planned hydropower facilities as well as urban and industrial water users downstream of these forests.

The mechanics of cloud capture. Cloud-affected forests (a hydro-climatic definition of the ecosystem) cover an estimated 2.9 million km^2 in 69 countries — with Indonesia, Tanzania, DRC and Colombia the locations with the greatest remaining extent (see Annex 1 for full list).[4] They are generally found at between 1,500 metres and 3,000 metres above sea level. They are cool, wet and persistently shrouded by clouds.
Trees in the upper reaches are almost entirely covered by mosses, ferns and lichens, which soak up liquid water from the air.[5,6] These ecosystems perform a critical function known as 'fog capture', in which the trees and the vegetation growing on them intercept moisture from the clouds, which condenses and drips to the ground. This water would otherwise remain in the atmosphere and re-evaporate or move to other areas.

Increasing the availability of water by 20–60%. In contrast to other types of tropical forest, cloud forests not only regulate the supply of the water cycle, but actively increase the amount of water available in watersheds and flowing down rivers from their headwaters.[7]
They contribute on average an additional 23% of water downstream on top of that provided by rain — with a 50–60% water increase in some forest areas.[8] This water regulation is a critical service to downstream economic activity, including cities, hydroelectric dams, and agricultural and industrial water users, creating a buffer for dry seasons and periods of drought. Intact cloud forests also protect the soil from heavy tropical downpours, reducing erosion and landslides and thus reducing sediment concentrations in rivers that may lead to sedimentation of reservoirs and damage to water supply or hydropower generation infrastructure downstream.

Almost half the world's cloud forests feed river basins that contain hydroelectric dams.[9] Hydropower is a leading source of low-carbon energy for emerging markets and an important area of planned infrastructure investments. The direct water benefits cloud forests provide will on average peak at 166 km downstream from the forests but can still be perceived 350 km away.[10]

Carbon storage. Upland tropical forests are far greater stores of carbon than previously thought, highlighting the need for their conservation and their impact on the emissions profile of cloud forest countries. The United Nations Intergovernmental Panel on Climate Change (IPCC) estimates tropical mountain forest systems in Asia contain the highest levels of above-ground biomass of land forest ecosystems at 204 tC/ha compared to primary tropical rainforests at 194 tC/ha.[11,12] The below-ground carbon storage of tropical upland forests may sometimes exceed above-ground biomass.[13] These values are, however, dwarfed by the fact that lowland tropical forests are of vastly greater extent.

Biodiversity hot spots. Cloud forests represent biodiversity hot spots of unique global value. They are rich in plants and animals, with species that may occur only in a single cloud forest, and would face extinction if the forest were lost.[14,15] In Mexico, cloud forests make up 1% of all forests but contain 12% of all plant species.[16] This biodiversity value of cloud forests translates tangibly into economic value for host countries in the form of ecotourism, while other benefits of their unique biodiversity, such as medicinal uses, are yet to be fully understood and explored.

What is a cloud forest?

Cloud forests can be classified in different ways according to forest cover and cloud presence. To aggregate cloud forests across regions, this report uses the hydro-climatic definition of 'cloud-affected forest', which means areas with forest cover greater than 10% and fog present greater than 70% of the time, while ecologically-defined cloud forests cover a smaller extent.[17]

Found mostly at between 1,500 and 3,000 above sea level. This varies according to location — in inland mountains such as the Andes cloud forests can be found at up to 3,500–4,000 metres, while on small islands in the Pacific they are as low as 400 metres above sea level.[18]

Cooler and wetter than other forests. Their high altitude and the persistent presence of clouds mean cloud forests have average temperatures of 17.7°C and receive on average 2,000–2,600 mm of rain per year — making them 4.2°C cooler and 184 mm wetter than other upland forests in the tropics.[19]

Shorter trees covered in mosses and ferns. In the upper reaches, trees are short compared with lowland forests (2–20m against 25–45m) and are crooked and gnarled.[20] Vegetation such as mosses and liverworts cover up to 70% of trees in the higher reaches of cloud forests and support fog capture.[21]

Blanketed in dense ground-level clouds. Their most distinctive feature is the high frequency of cloud, or fog, at ground level, allowing vegetation to strip water from these clouds and perform the unique fog-capture function that makes cloud forests so vital to the hydrological cycle.

Figure 2
Regional overview

Region	Current cloud-affected forest area (km^2) [A]	Unprotected cloud-affected forest area (km^2) [B]	Estimated loss of cloud-affected forests in last 20 years (km^2) [C]
Americas	1,111,499	691,802	46,820
Africa	988,527	746,191	76,049
Asia	689,278	505,973	44,251
Oceania	140,019	134,868	2,840
Global	2,929,322	2,078,834	169,960

Sources and Notes

[A] Estimated area of cloud-affected forests from an updated version of the data described in Mulligan (2011).[22]

[B] The area of cloud-affected forest not under protection is estimated by the difference between the area of current cloud-affected forest and the area of cloud-affected forest under protection. Estimates of area of cloud-affected forests under protection are from an overlay of cloud-affected forest extent and the World Database on Protected Areas.[23]

[C] Loss of cloud-affected forest over the last 20 years is based on an overlay of cloud-affected forest extent and the Global Forest Change (GFC) dataset described in Hansen et al. (2013).[24]

2.2
THE CLOUD FOREST 25 (CF25)

Figure 3
The Cloud Forest 25

Country	Current cloud-affected forest area (km^2) [A]	Protected cloud-affected forest area (km^2) [B]	Estimated loss of cloud-affected forests in last 20 years (km^2) [C]
Indonesia	343,077	107,946	11,161
Tanzania	204,208	96,163	12,721
DR Congo	202,782	44,008	18,555
Colombia	202,235	58,298	10,241
Peru	189,699	55,198	7,762
Venezuela	163,114	137,579	2,014
Mexico	162,474	34,098	4,826
Papua New Guinea	138,582	5,119	2,817
Brazil	108,450	39,350	8,361
Ethiopia	108,441	15,438	2,561
Ecuador	91,438	25,106	3,116
Cameroon	90,651	13,819	4,622
Bolivia	70,962	29,669	1,763
China	66,094	1,656	4,217
Laos	65,067	15,350	12,013
Kenya	56,615	14,435	2,489
Malaysia	55,216	15,311	5,154
Angola	54,893	0	6,191
Uganda	50,735	13,150	7,096
Madagascar	47,385	10,639	11,856
Philippines	46,431	13,549	1,701
Gabon	44,713	6,922	484
Vietnam	37,656	8,268	3,299
Republic of Congo	35,058	4,161	1,060
Myanmar	33,518	1,840	4,597

Sources and Notes

[A] Estimated area of cloud-affected forests from an updated version of the data described in Mulligan (2011).[25]

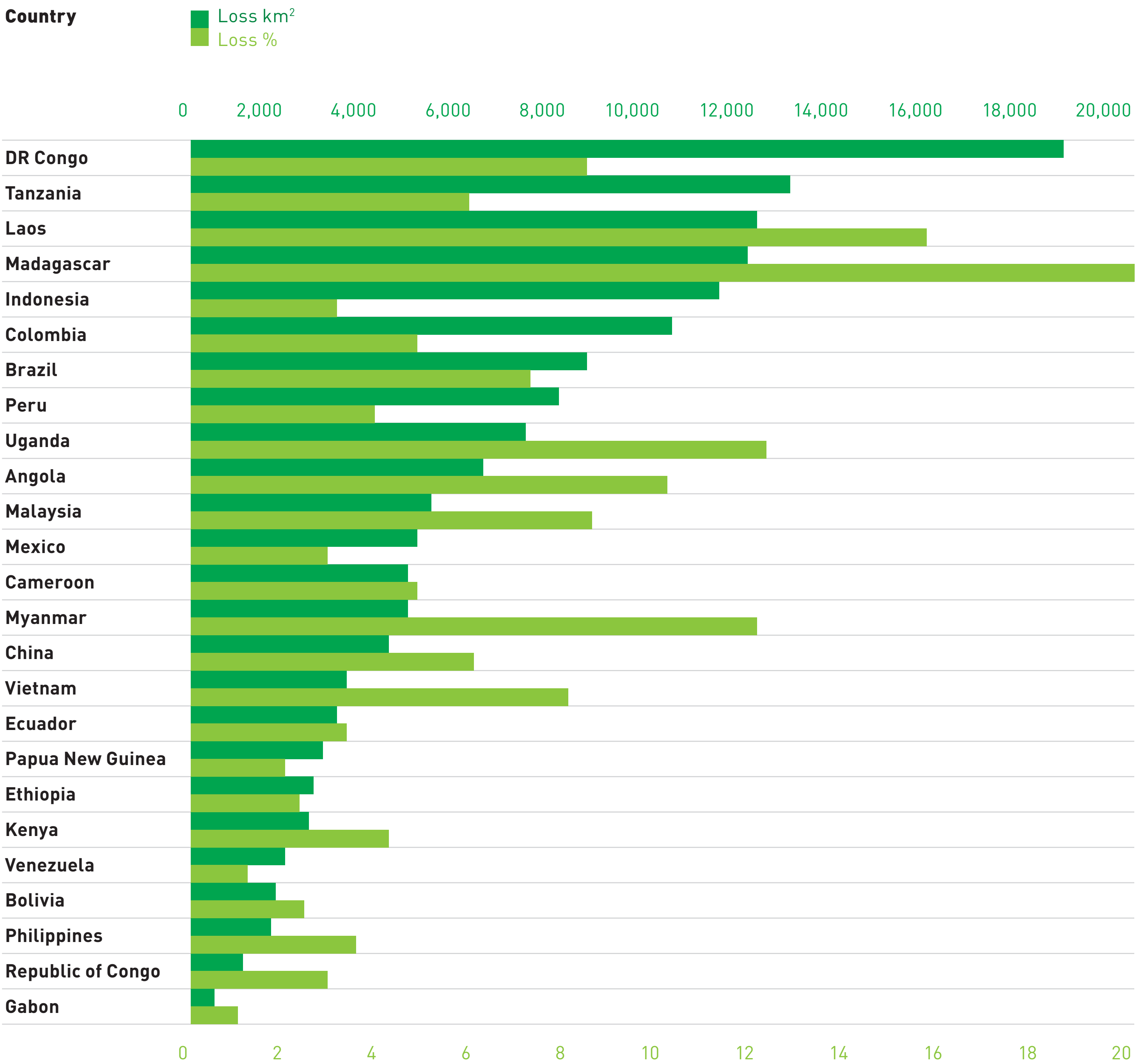
[B] Estimates of area of cloud-affected forests under protection are from the World Database on Protected Areas.[26]

[C] Loss of cloud-affected forest over the last 20 years is based on the Global Forest Change (GFC) dataset described in Hansen et al. (2013).[27]

More than 90% of all cloud forests are found in 25 emerging markets across the tropics. We refer to these as the 'Cloud Forest 25' (CF25), a collective of countries that can coordinate the deployment of sovereign-scale financing opportunities and finance for nature-based solutions covering the majority of this global ecosystem.

2.3
DEFORESTATION: LOSING NATURAL CAPITAL

Figure 4
Biggest losses of cloud-affected forests over the last 20 years in the CF25



Sources and Notes
An updated version of the data described in Mulligan (2011)[28] and Global Forest Change (GFC) data described in Hansen et al. (2013).[29]

Deforestation drivers
While the causes of cloud forest loss vary from region to region, three main drivers are clear:

Global commodities

Commercial agriculture is an important cause of cloud forest loss. Coffee cultivation is particularly to blame, as climate change affects the crop, forcing farmers to move to higher altitudes to find lower temperatures. Cardamom has also led to cloud forest loss in Tanzania and Sri Lanka.[30] Tea cultivation and grazing are also important drivers in some regions. Mining, while having a smaller land footprint globally compared with agriculture, is a threat to cloud forests in DR Congo, Rwanda, Bolivia, Ecuador and Venezuela, as well as in Indonesia, Malaysia, Papua New Guinea, Sri Lanka and the Philippines.[31]

Local livelihoods

Commercial logging is not generally viable in cloud forests due to the inaccessible terrain.[32] However, cloud forests are cleared and burned to make way for subsistence farming, hunting and grazing, sometimes because of the lack of alternative livelihoods for indigenous and migrant communities. In Guatemala's Central Highlands, population growth and lack of resources are forcing Q'eqchi' Maya communities to clear cloud forests to grow subsistence crops.[33] Timber extraction is a threat in Asia, mostly for local building, fuel and charcoal.

Climate change

A changing climate poses a threat to the biodiversity of cloud forests as well as their viability as an ecosystem.[34,35] This is made worse by the loss and degradation of lowland forests surrounding cloud forests. The loss of these adjacent forests at lower altitudes reduces moisture evaporation and cloud formation at higher altitudes, in turn affecting the level of the cloud base and thus the ground-level cloud available to sustain a cloud-affected forest.[36] Deforestation in the Caribbean lowlands upwind of the Monteverde cloud forest in Costa Rica has contributed to reduced cloud cover in the forest.[37] The conservation of cloud forests requires halting and even reversing deforestation in nearby lowland forests.

Coffee: alternative investments and nature-positive value chains

In Honduras — the world's fifth-largest coffee producer — cloud forests are being cleared at a rate of 6,500 hectares per year to make way for plantations and to fuel industrial coffee dryers.

Nearly four square metres of cloud forest are lost per 100 kilograms of roasted coffee beans produced.[38,39] Coffee growing has also been a major cause of cloud forest loss in Ecuador, Vietnam's Central Highlands and the Mexican state of Veracruz.[40,41]

Rising temperatures because of climate change are reducing the areas suitable for growing Arabica coffee, forcing farmers to move up at least 400 metres in altitude. In Guatemala, Mexico, Honduras and Costa Rica, coffee cultivation is moving to between 2,000 and 2,500 metres above sea level, into areas currently occupied by cloud forest.[42] With global demand for coffee rising, and lower-altitude coffee areas in Mexico, Nicaragua and El Salvador becoming unsuitable, cultivation is expected to cause further loss of cloud forests and the ecosystem services they provide.

A potential solution for coffee-exporting countries, investors and global companies is to promote more 'shade-grown' coffee. This is grown within the forest, reducing temperatures and the need to migrate upwards. Farmers receive additional benefits such as natural forms of pest control. Extensive trials show shade growing could maintain 75% of the area suitable for coffee production globally if deployed at scale, benefiting coffee yields, smallholder farmers and cloud forests.[43] These methods would only sustain the hydrological and ecological integrity of cloud forests if carefully managed and with minimal use of artificial pesticides.

2.4
PROTECTING CLOUD FORESTS

Despite their importance, cloud forests are not adequately protected. An analysis of forest governance and government commitments to protect cloud forests compared with actual forest losses reveals important failings which must be rectified if these ecosystems are to be preserved.

Protection trumps restoration
Due to their biological complexity, cloud forests have among the slowest rates of recovery of all tropical forests. In cases of deforestation where the entire root mat is removed, forests could take 200–300 years to fully recover.[44] This means the protection of remaining cloud forests should be the highest priority for governments.[45 46] From a carbon finance perspective, the density of mosses, ferns and lichens growing on the trees of a cloud forest is key to their carbon sequestration capability. Old-growth forests are better at sequestering carbon than secondary or restored forests.[47 48] Hydrologically, old-growth cloud forests have a much greater surface area for the interception of fog.

An enforcement gap The absence of effective law enforcement means protected areas are not always the best way to prevent forest loss. Madagascar, for example, has the highest percentage of 'protected' cloud forests among the top 25 cloud forest countries, but it also has a high rate of cloud forest loss, with 10% of the total lost over the past 20 years. Much of this was in currently protected areas. Cloud forest loss in protected areas is also high in the DR Congo, Indonesia and Venezuela, generally as a result of human encroachment combined with weak enforcement of protection. In the DR Congo, this is made worse as people are displaced by conflict.[49]

IPLC management is a good proxy for forest protection There is a strong correlation between low deforestation and areas under the management of indigenous peoples and local communities (IPLC). In fact, IPLC management, including the full recognition of their land rights and ownership, has emerged as a good indicator, in fact a proxy, for good forest management and protection.[50] There is ample evidence that securing indigenous peoples' forest tenure is a cost-effective way to protect forests and IPLC-managed forests have much lower rates of loss or damage than others.[51 52 53 54] For example, IPLC land (owned or governed by indigenous peoples, with or without legal recognition) has been found to be in good ecological condition even though only 13% of it overlaps with officially protected areas.[55] By contrast, government ownership and management of forests have often led to forest degradation as local users' traditional stewardship arrangements are overlooked.[56]

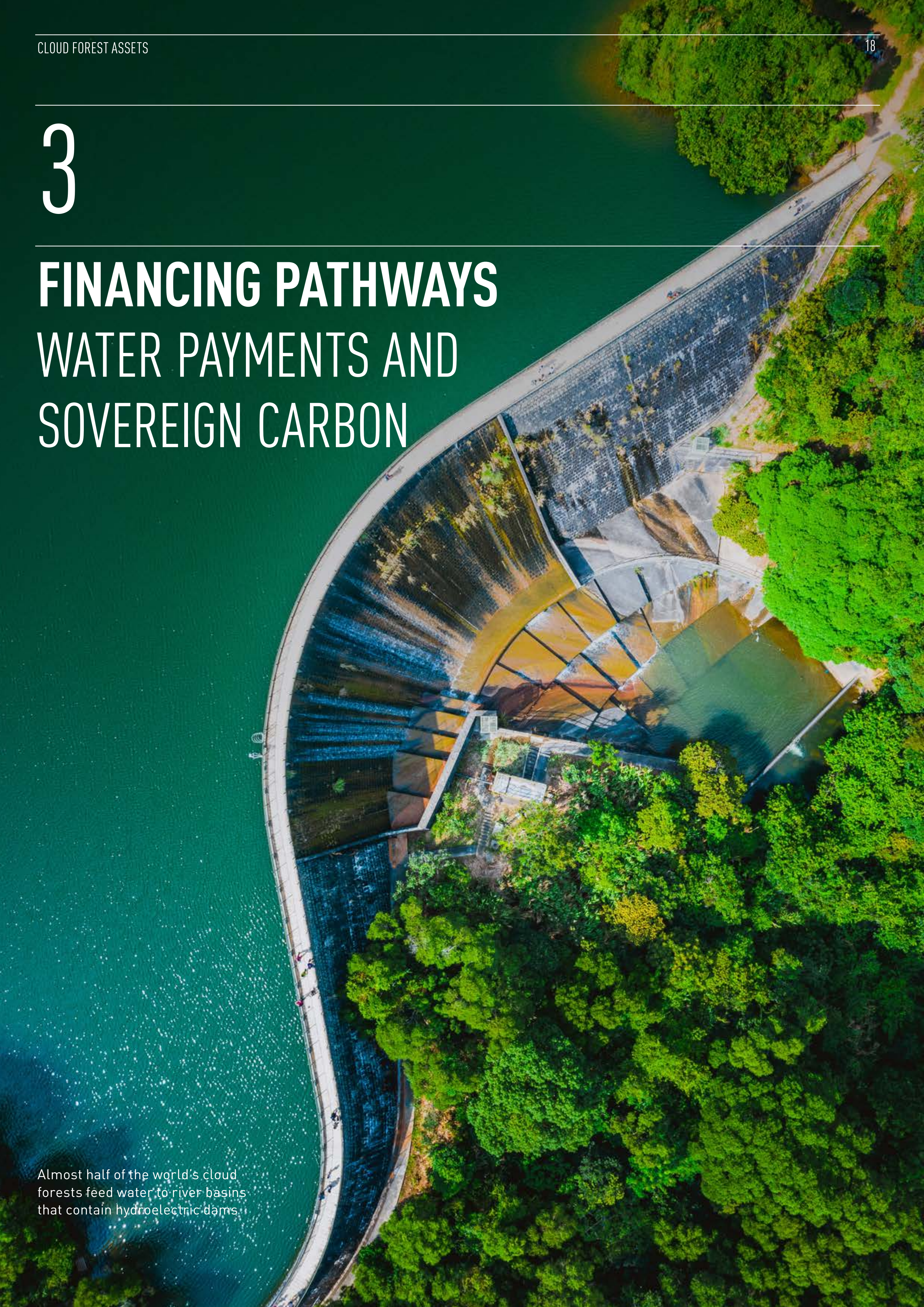
Forest commitments rely on external finance Roughly half of all cloud forest countries have defined targets for forest protection or restoration in their Nationally Determined Contributions (NDCs) for cutting emissions and adapting to climate change under the Paris Agreement. None of these countries, however, has recognised the value of their cloud forests specifically nor refers to cloud forests in their NDCs. As for making financial resources available to achieve their targets, only nine out of 25 have made concrete commitments to fund these through domestic spending without needing additional funding from international sources.

Ecuador has committed to reducing emissions from deforestation by up to 20% by 2025 — but domestic spending will only pay for measures needed to reduce emissions by 4%. The remaining 16% will require international finance. So, while many top cloud-forest emerging markets see value in protecting and restoring their forests, the financial resources currently earmarked for this are nowhere near enough to fund their stated commitments. The debt burden exacerbated by Covid-19, and rising food and energy import costs, further undermine the ability of these governments to maintain financial commitments in the face of other existential pressures.

3

FINANCING PATHWAYS

WATER PAYMENTS AND SOVEREIGN CARBON



Almost half of the world's cloud forests feed water to river basins that contain hydroelectric dams.

3
FINANCING PATHWAYS
WATER PAYMENTS AND SOVEREIGN CARBON

Protecting cloud forests at scale will require funding the value of those forests as assets in their own right. We identify two key areas of opportunity for developing countries in the Cloud Forest 25 group to generate revenues from the ecosystem services provided by their standing forests. New flows of fiscal revenues at a national level will need to be created to incentivise countries to increase the area of cloud forest under effective protection and to finance that protection and its opportunity costs.

These opportunities are, firstly, to create a mechanism for payments for ecosystem services from water users such as hydropower dams which works on a national scale and is subject to compliance norms. Secondly, the financing of forest carbon at sovereign and sub-sovereign jurisdictional scales as part of an approach to wider areas of lowland tropical rainforests. To realise these opportunities, the section below provides governments and stakeholders with elements for engaging in a design process that considers new financing mechanisms, policies, fiscal revenue structures, and law enforcement models.

The economic benefits that would derive from implementing such systems, and the mechanisms that governments can put in place to realise these revenue streams, are explored below for the top 25 developing countries representing more than 90% of global cloud forest cover. Additional economic values derived from cloud forests, such as ecotourism, water for agriculture, urban water utilities or other industries, are not included in this analysis, but are also clear benefits.

Of the 1,084 dams at some stage of planning in these emerging markets, 684 are expected to rely on water from cloud forests.

63%

3.1
PATHWAY 1
WATER & ELECTRICITY

Over the next 30 years, the International Energy Agency estimates a doubling of hydropower capacity may be required to support the net-zero transition.[57] **Some developing countries are already making large investments in hydro as a low-carbon model to drive economic growth and provide access to energy for their populations.**

How cloud forests matter to hydropower investments

Cloud forests are vitally important to present and future hydropower capacity in key emerging markets for a number of reasons:

Increasing water flow to dams and reducing sedimentation. Cloud forests can increase availability of water by up to 60% and almost half of all cloud forests feed river basins that contain hydroelectric dams.[58,59] Hydropower is a leading source of low-carbon energy for emerging markets and its importance is set to grow as new dams come onstream. Of the 979 hydropower dams currently in operation in the 25 countries, 528 depend on water from cloud forests. Looking into the future, of the 1,084 dams that will be built, or are at some stage of planning, 684 are expected to rely on water from cloud forests.

Cloud forests reduce sedimentation in the water compared with other land uses, cutting treatment costs for dams and other water users and reducing the potential for dam infilling and turbine damage.[60] A study modelling the Calima watershed in Colombia found that deforestation in certain cloud forest hot spots could reduce fog capture by up to 70%, causing annual water flows to the reservoir to fall by 2.2% and sediment inputs to increase by as much as 400%, in turn leading profits to fall by 12.3% due to a decline in production and higher costs of dredging.[61]

Meanwhile, a study of 27 water utility companies in the United States found that for every 10% increase in forest cover in their source areas, their water treatment costs fell by 20%.[62]

Reducing risks of seasonal drought, including under climate change scenarios. Cloud forests can gather water from the clouds even during the lowland dry season – indeed, fog capture contributes a greater proportion to the overall water balance in cloud forests in the dry season than during the rainier months. In the Sierra de las Minas in Guatemala, cloud water accounted for 19% of water input in the dry season, against 1% in the rainy season.[63,64] A study of another cloud forest in Guatemala found that fog capture could exceed rainfall by 147 mm during the dry season.

As a result, cloud forests and their fog capture function are key to reducing drought risks, particularly as climate change affects rainfall patterns. This is shown by the fact that where cloud forests have been lost, drought risks have increased. For example, more than 70% of forest cover in Brazil's Cantareira watershed – which supplies the city of Sao Paulo with water – has been lost, and today no more than 5% of the watershed is covered with cloud forest. The drought that hit the region in 2014-5 left the city with barely a month's water supply while also seriously disrupting electricity provision due to its reliance on hydropower.[65]

Figure 5
Current and future hydropower plants dependent on cloud-affected in the top 25 cloud forest countries

Country	**Present**			**Future**			**Present + Future**	
	Hydropower plants in operation [A]	Hydropower plants dependent on cloud-affected forests [A]	Capacity of electricity dependent on cloud-affected forests (MW) [A C]	Hydropower plants currently in the pipeline [B]	Hydropower plants that will depend on cloud-affected forests [B]	Capacity of electricity dependent on cloud-affected forests (MW) [B C]	Hydropower plants dependent on cloud-affected forests	Capacity of electricity dependent on cloud-affected forests (MW) [C]
Indonesia	40	22	1,261	7	6	459	28	1,720
Tanzania	6	5	307	7	5	407	10	714
DR Congo	10	5	131	6	6	208	11	339
Colombia	12	11	1,207	10	10	1,189	21	2,396
Peru	14	10	191	46	42	1,605	52	1,796
Venezuela	9	6	724	3	3	422	9	1,146
Mexico	59	45	1,924	6	5	403	50	2,327
PNG	6	5	100	2	1	8	6	108
Brazil	470	171	2,232	701	338	1,675	509	3,907
Ethiopia	11	9	364	16	15	1,100	24	1,464
Ecuador	10	7	648	66	66	3,529	73	4,177
Cameroon	3	2	29	9	7	561	9	590
Bolivia	14	11	230	10	7	761	18	991
China	46	36	2,095	5	5	485	41	2,580
Laos	19	14	618	81	73	4,283	87	4,901
Kenya	8	5	314	6	6	730	11	1,044
Malaysia	9	6	515	6	4	398	10	913
Angola	6	3	22	4	1	0	4	22
Uganda	6	6	304	16	16	424	22	728
Madagascar	5	4	63	0	0	0	4	63
Philippines	17	9	888	7	6	146	15	1,034
Gabon	3	3	214	1	0	0	3	214
Vietnam	173	128	4,580	52	49	1,329	177	5,909
Rep. Congo	6	4	208	2	2	121	6	329
Myanmar	17	1	38	15	11	590	12	628
Total	979	528	19,207	1084	684	20,832	1212	40,039

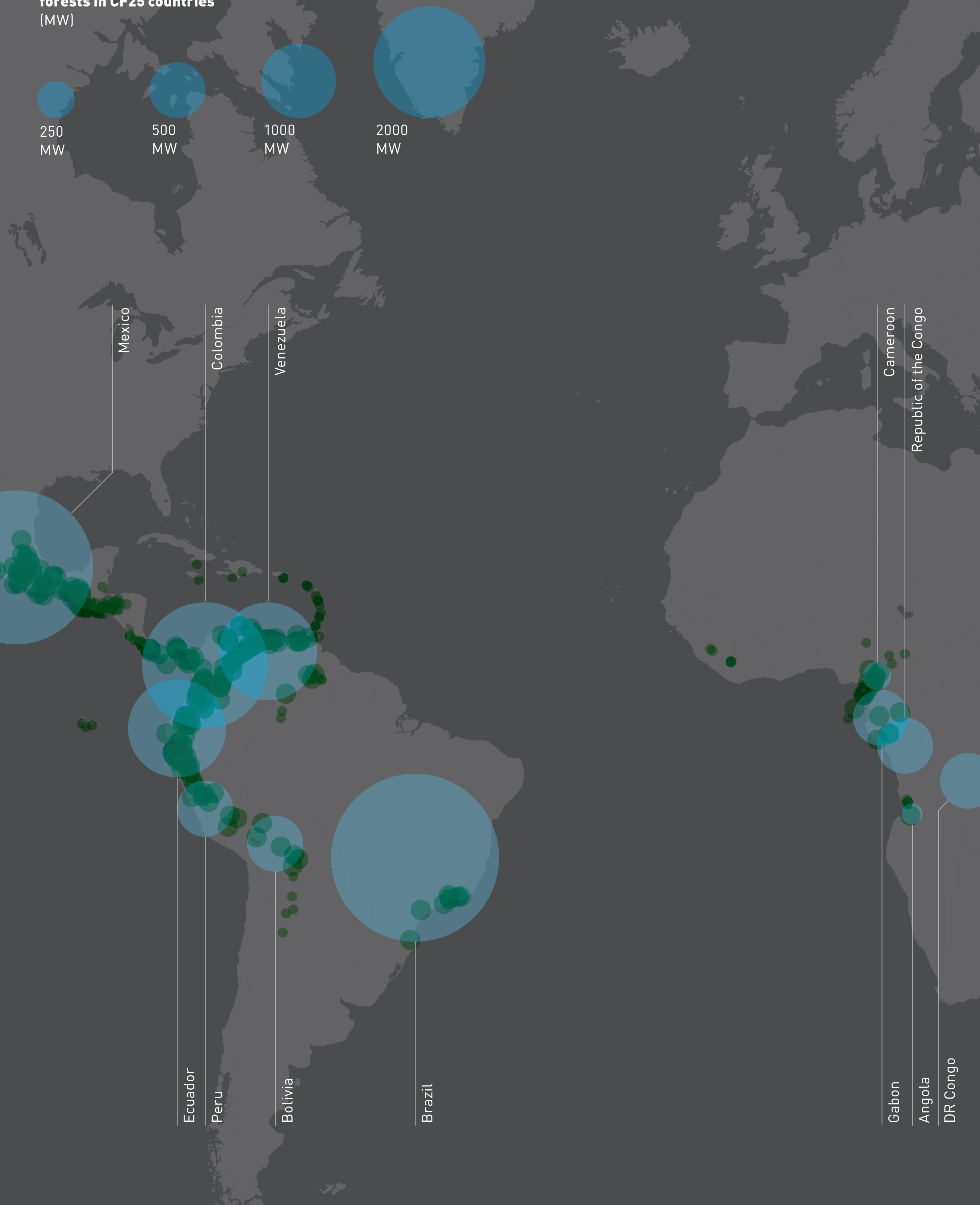
Sources and Notes

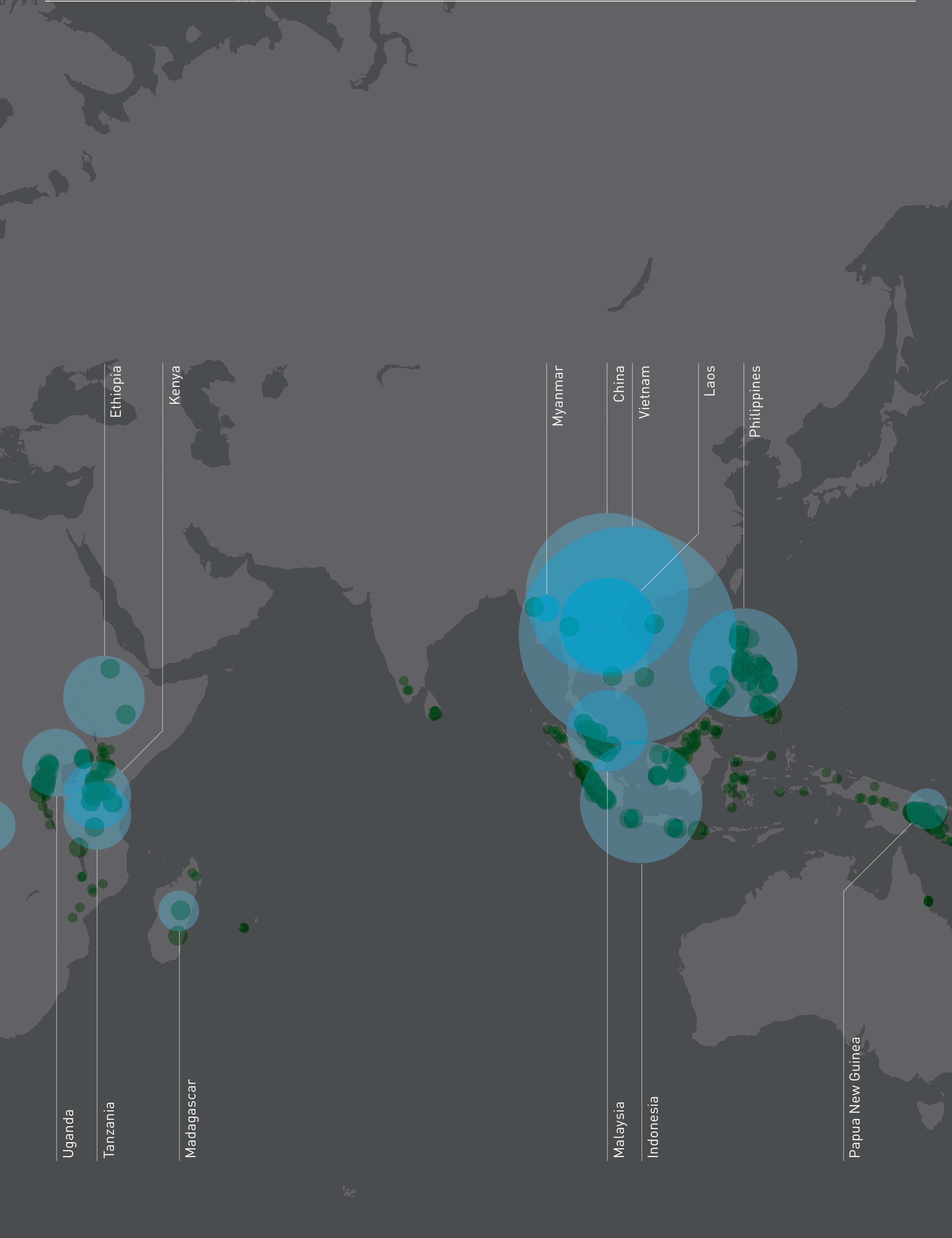
A Based on current hydropower plants in the Global Power Plant Database by the World Resources institute.[66] This does not include more comprehensive datasets that go beyond hydropower-only dams, such as GOODD.[67] Cloud-affected forest cover and water supply estimates are from the updated versions of the data described in Mulligan (2011) and Mulligan (2013).[68 69 70]

B Based on Future Hydropower Reservoirs and Dams dataset (2015).[71] This dataset does not cover the entire universe of future hydropower plants at some planning stage and should be approached accordingly. Cloud-affected forest cover and water supply estimates are from the updated versions (August 2022) of the data used in Mulligan (2011) and Mulligan (2013).

C Instantaneous power capacity of hydropower plants in megawatts.

Figure 6
Current hydroelectric capacity from dams dependent on water from cloud-affected forests in CF25 countries
(MW)




Ethiopia
Kenya
Myanmar
China
Vietnam
Laos
Philippines
Uganda
Tanzania
Madagascar
Malaysia
Indonesia
Papua New Guinea

Creating sovereign-level payments for ecosystem services

Just as carbon credits are finding a route to evolve from a project-by-project basis to a sovereign level, and offer a potential cashflow for governments, so Payment for Ecosystem Services (PES) schemes, in particular for water provided by forests to users such as hydropower, water utilities and industry, could enable sovereigns to develop new fiscal revenue streams and markets to maintain the services of their natural assets as well as finance their economies.

What are Payments for Ecosystems Services (PES) models? These are financing models where economic actors that benefit from ecosystem services (clean water, coastal protection etc.) pay for their conservation instead of taking that benefit for granted – and can sometimes reduce other costs, such as water treatment, that they would face if those ecosystems were not there. This includes 'water funds' where downstream users such as water utilities or other industries that need to spend money on treating water will pay into an independently governed fund that in turn pays for conservation measures upstream, including paying farmers to use fertilisers more efficiently. This saves downstream companies money by reducing water treatment costs, cuts overall water pollution, and maintains healthy ecosystems such as forests and land use upstream.

A design opportunity: taking PES systems to a sovereign level. PES systems are often local, struggle to get users to pay or to deal with free-riders, and have barriers to scale because they lack policy frameworks that can be applied across entire river basins. PES models could be taken to scale through nationwide regulatory frameworks that establish these systems at river basin level; the redirection of existing provincial or land taxes, or the creation of new PES taxes and fees that can be widely applied within a basin, benefiting from existing government oversight and tax enforcement.

Several examples of PES systems in cloud forest countries used to pay for water provided by cloud forests provide insights to inform the design of sovereign-level interventions:

Mexico
Establishing the right level of payments

In Coatepec in the Mexican state of Veracruz, land-use change due to agriculture had reduced primary forest cover (including cloud forests vital to the water supply) by 90%. In response, the municipality set up Mexico's first payments for hydrological services programme, in the form of a trust fund known as FIDECOAGUA. The scheme receives funds from the national government as well as a tax on municipal water users, with the money used to pay farmers to protect cloud forests and to conduct reforestation.[72] In 2020, 700 ha of cloud forests were covered by the programme, out of a total of 2,000 ha within the municipality.[73] As a result of the programme, deforestation rates in cloud forest covered by the programme were lower than in other areas, suggesting that the scheme had a positive impact on the conservation of Coatepec's upland cloud forests.[74]

However, interviews with participants in the scheme indicated that the payments were too small to make much difference to their incomes, with 30-40% saying they would have preserved the forests even without payments from the scheme. Participants reported receiving PES payments equal to less than 3% of their total income, and in some cases less than 1%. While cloud forest conservation in this region has been comparatively successful, it is less clear to what extent this is a direct result of the PES scheme. If PES schemes are to deliver long-term success in forest conservation in the face of competing incentives to clear forests,[75] monetary benefits need to be big enough to provide a compelling financial incentive.

Bolivia

Creating tri-sector agreements

In the department of Santa Cruz in eastern Bolivia, another scheme launched in 2002 has had success in incentivising the preservation of cloud-forest habitat in the buffer zone bordering the Amboro National Park. A total of 1,140 families in 35,000 ha of watershed containing a threatened cloud-forest habitat are compensated for protecting those forests, including with in-kind payments in the form of beehives, beekeeping training and barbed wire. The scheme is a tripartite agreement between the downstream water provider, municipal authorities, and local NGO Fundacion Natura. Donor funds and revenues from a tariff levied on downstream water users are channelled into a separate bank account by the downstream water provider. The money is then used by the municipal authorities to buy items to be provided to upstream farmers as in-kind payments.[76] Five years on, compliance with the scheme was said to be good and the impact on conservation of cloud forests was generally positive.[77]

It is estimated that a hectare of land covered with cloud forest in this part of Bolivia can contribute 1,500 more cubic metres of water to the aquifer per year than a hectare that has been deforested, reflecting the importance of cloud forests to the regional water balance. Bundling of ecosystem services provided by cloud forests, including biodiversity payments, enabled early-stage funding for the project. This in turn allowed the benefits of the project to be demonstrated, paving the way for local water service users to begin paying into the scheme.[78]

Tanzania

Developing a binding legal framework

A rare example of a PES scheme outside Latin America focused on cloud forest water services is in Tanzania's main city, Dar es Salaam, which is home to 6.7 million people and is one of the fastest-growing cities in Africa. It relies for most of its water on the Ruvu River, which has its headwaters in the cloud forests of the Uluguru Mountains.[79] [80] As part of the scheme, the city's water utility (DAWASCO) and Coca-Cola Kwanza Ltd – which both rely heavily on water from the Ruvu River – agreed to pay into a fund managed by the NGO CARE Tanzania. Funds would be passed on to authorities in four villages in the Uluguru Mountains, which would pay farmers to implement land conservation measures. A Memorandum of Understanding (MoU) was signed in 2008, stipulating the roles and obligations of the parties and committing DAWASCO and Coca-Cola Kwanza to pay $100,000 and $200,000 respectively over the next four years.[81]

However, only DAWASCO ever paid into the fund, and total payments amounted to $1,600 shared between 144 farmers. As a result, their participation in the scheme was limited, as was its impact on cloud forest conservation in the Uluguru catchment. A major reason for the project's failure was the absence of a legal framework compelling service users to compensate service providers according to the terms of the MoU.[82] Failure to monitor water quality also made it hard to demonstrate the impact of changed land management practices, prove the effectiveness of interventions, or establish a threshold for payments to service providers.[83]

Colombia

Moving companies towards compliance

A pilot developed by the NGOs Conservation International and The Nature Conservancy sought to develop a pay-for-success model for hydroelectric dams to support the water services of cloud forests.[84] This model, called a 'Cloud Forest Blue Energy Mechanism', aimed to mobilise debt and equity from domestic commercial investors into a Special Purpose Vehicle (SPV), which would pay implementation partners to restore and conserve cloud forest ecosystems. Then, once restoration measures provided tangible economic benefits of value to hydropower operators (reduced sedimentation, increased water flow and improved water regulation), these companies would pay the SPV for those results, and the funds would be used to repay investors. A study modelling the Calima watershed in Colombia found that deforestation in certain cloud forest 'hot spots' could reduce fog capture by up to 70%, causing annual water flows into the reservoir to fall by 2.2% and sediment inputs to increase by as much as 400%, leading profits to fall by 12.3% due to a decline in production and higher costs of dredging.[85] Another study modelled the benefit of restoring cloud forest cover in the watershed from its current level of 54% to 90% (implying restoration of 18,000 ha). This would increase fog capture by 25% and water flow by 6%, increasing power generation by 4% and net revenue by 5%. Restoring cloud forests would also reduce sedimentation by more than 60%, leading to much lower dredging costs. In total, the study estimated that this ambitious cloud forest restoration scenario could generate an additional $300/ha/year in revenues.[86]

This innovative financial model has not yet reached full proof of concept. Despite the compelling business case for hydropower dams, engaging hydropower companies in cloud forest conservation has faced challenges stemming, among other things, from complexities in modelling timeframes for the hydrological impacts of restoration and companies' tendency to view familiar grey infrastructure as more reliable and less risky for investors.

3.2
PATHWAY 2
SOVEREIGN CARBON

Investors and governments are anticipating the development and trading of carbon finance for forests more widely at sovereign and sub-sovereign jurisdictional levels. While still at a nascent stage, this approach will facilitate the transition to achieving greater scale, coherence and effectiveness of nature-based carbon projects, while also enabling sovereigns to meet their climate commitments.

From the vantage point of the tropical developing countries where most cloud forests are concentrated, a problem with today's voluntary carbon market, according to the US-based Coalition for Rainforest Nations, is the offshoring of proceeds. This means that most of the money from the sale of forest carbon credits ends up with developers and brokers, and very little in national treasuries or in the pockets of people living in the forest.

This is turning the governments of rainforest nations against the voluntary carbon market. Both Indonesia and Papua New Guinea – countries in the Cloud Forest 25 – and Honduras (ranked 26th in total cloud forest cover) have chosen to put voluntary carbon project development on hold. Sovereign- and jurisdictional-level carbon credits, via the REDD+ mechanism, could help developing countries address this problem and capture a larger part of the benefits.[87]

What is REDD+?

The United Nations Framework Convention on Climate Change (UNFCCC), in Article 5 of the Paris Agreement has created the REDD+ framework, providing the basis for countries to engage in Reducing Emissions from Deforestation and Forest Degradation (REDD). The plus sign enlarged its scope to include sustainable management of forests and conservation of forest carbon stocks.

The REDD+ framework helps establish international funding flows from a variety of sources, for example from donors and multilaterals backing results-based forest programmes, but it cannot be used for carbon-offsetting purposes. However, REDD is now also used as shorthand to describe a category of projects in the voluntary carbon market that are related to avoided deforestation.[88] The issuance of carbon offset credits that result from REDD+ activities must be subject to and regulated by specialised standards, which offer additional safeguards with regard to environmental impacts, as well as ensuring adequate baselines and the use of some of the credits as a buffer pool, among other criteria.

Current options

Countries currently have two ways to create sovereign-level financial flows for forest carbon. The different aspects of the two approaches are explored in the next section:

Option 1
Issuing large-scale, jurisdictional forest carbon credits

Sovereigns and large sub-sovereigns (such as states, provinces or regions) in cloud forest countries can issue credits using a specialised independent carbon standard (ART/TREES) and a market intermediation platform (LEAF Coalition) that have been set up for that purpose.

ART stands for 'Architecture for REDD+ Transactions', and serves as a global quality standard for jurisdictional REDD+. It provides the confidence in the integrity of emission reductions and removals from forest protection and restoration needed to unlock finance at scale for ambitious climate action, and to incentivise governments to achieve those results.[89]

ART's standard, known as TREES (The REDD+ Environmental Excellence Standard), provides a high-integrity basis for creating forest carbon offset credits at large, jurisdictional levels. This enables national governments and large sub-national jurisdictions to achieve results at scale, regulating land-use, enforcing laws and recognizing the land rights of indigenous peoples. Working at a jurisdictional level also helps to mitigate some of the key risks inherent in project-based approaches to REDD, such as reversals – the release of stored CO_2 back into the atmosphere – and leakage, or the displacement of activities that cause emissions.

The LEAF Coalition was launched in 2022 by governments and global companies to facilitate the marketplace for jurisdictional forest carbon credits, using the ART/TREES standard. The coalition aims to mobilize at least $1 billion in finance to support tropical and subtropical forest jurisdictions in making substantial reductions in their emissions from deforestation, and provide a pathway for cloud forest countries to consider this approach.[90] All eligible national and subnational jurisdictions (authorised by national governments) in tropical and subtropical regions, which meet ART/TREES requirements, are invited by the LEAF Coalition to submit proposals.

Option 2
Issuing sovereign REDD+ Results Units (RRUs) for performance-based finance

Countries can receive results-based payments at a sovereign level through REDD+ programmes, financed by a range of sources, including donors and multilateral climate funds. The resulting REDD+ Results Units (RRUs) are based on activities to preserve and protect forests at the national level, where emissions reductions are measured and reported through the REDD+ mechanism. While these are not currently favoured in carbon markets as tradable carbon credits for offsetting purposes, they provide the basis for other types of liquidity with investors, for example through their use as a measure of a government's commitments in sovereign finance transactions.

Gabon, a 'Cloud Forest 25' country, was the first African state to receive funding through this mechanism for its efforts to reduce deforestation. In 2021, it obtained $17 million from the Central African Forest Initiative (CAFI), a Norway-backed funding platform, which will disburse a total of $150 million over the next 10 years. Gabon is using the REDD+ framework to create 187 million RRUs.[91]

Gabon is currently aiming to sell half of those units on the voluntary carbon market, via REDD.plus, a platform that will facilitate the trading of RRUs issued by a sovereign government, making them available to voluntary buyers. REDD.plus is led by the Coalition for Rainforest Nations, a non-profit based in New York with more than 50 member countries.

However, there is a debate about how RRUs should be commercialised. The carbon market consensus currently favours the notion that RRUs should not be treated as carbon credits, nor used for offsetting purposes.[92] [93] [94] The UNFCCC REDD+ framework, it is argued, was designed to guide countries in measuring REDD+ results and accessing results-based payments, not in issuing carbon credits, and the framework lacks some essential aspects to qualify as a carbon standard. Concerns include the possible inflation of baselines, poor quantification, the lack of credit buffer pools to ensure risk management, and the lack of safeguards of the permanence of these emissions reductions, among other aspects that carbon standards generally address to provide buyers with a measure of the quality of credits. On the opportunity side, RRUs could offer a quantified way for countries to measure the performance of forest commitments in sovereign finance instruments.

In both cases, in order to attract investment, countries need to have clear and consistent regulations that can uphold a programme as large as REDD+, including accountability for how they will use invested money through various financial instruments. They should also harmonize land-use management and law enforcement across levels of government; recognise the rights of indigenous peoples and local communities (IPLCs) and demonstrate transparency in the distribution of funding, especially to local communities; and create adequately resourced Measurement, Reporting, and Verification (MRV) systems.[95]

Figure 8
Carbon sequestration of the top 25 cloud-affected forest countries by area

In order to target the additionality of carbon sequestration, analysis of potential carbon revenues is applied only to cloud forest areas that are not currently within protected areas, and would be legally protected as a result of sovereign carbon efforts.

Country	**Current cloud-affected forest area** (km^2) [A]	**Unprotected cloud-affected forest area** (km^2) [B]	**Annual carbon sequestration from unprotected cloud-affected forests** ($MtCO_2$) [C]	**Estimated revenue from carbon sequestration by unprotected cloud-affected forests over 10 years** ($ Billion) [D]
Indonesia	343,077	235,130	227	22.67
Tanzania	204,208	108,045	117	11.69
DR Congo	202,782	158,773	172	17.17
Colombia	202,235	143,938	179	17.94
Peru	189,699	134,500	168	16.77
Venezuela	163,114	25,535	32	3.18
Mexico	162,474	128,376	160	16.00
Papua New Guinea	138,582	133,463	129	12.87
Brazil	108,450	69,099	86	8.61
Ethiopia	108,441	93,002	101	10.06
Ecuador	91,438	66,332	83	8.27
Cameroon	90,651	76,832	83	8.31
Bolivia	70,962	41,293	51	5.15
China	66,094	64,437	62	6.21
Laos	65,067	49,716	48	4.79
Kenya	56,615	42,180	46	4.56
Malaysia	55,216	39,906	38	3.85
Angola	54,893	54,893	59	5.94
Uganda	50,735	37,587	41	4.07
Madagascar	47,385	36,745	40	3.97
Philippines	46,431	32,881	32	3.17
Gabon	44,713	37,791	41	4.09
Vietnam	37,656	29,389	28	2.83
Republic of Congo	35,058	30,897	33	3.34
Myanmar	33,518	31,677	31	3.05
Total	2,669,492	1,902,418	2,086	208.59

Sources and Notes

A Estimated area of cloud forests from an updated version of the data described in Mulligan (2011).[96]

B Estimated by the difference between the area of current cloud forest and the area of cloud forest under protection, from the World Database on Protected Areas.[97]

C Indicative based on regional estimates of mean above-ground rate of carbon sequestration for tropical mountain forests, of which cloud forests are a subset, as provided in Cook-Patton et al. (2020).[98] These do not include below-ground biomass, sequestration from pastures or from deforested land being left to recover.

D Uses a conservative estimate of $10/$tCO_2$ applied only to unprotected cloud forests for the additionality that could be provided by efforts to protect these areas.

Future design concepts

With finance for nature providing a rapidly developing space for innovation, we identify two areas of potential design for governments to explore monetising the value of protecting tropical ecosystems such as cloud forests:

Concept 1
Bilateral sovereign carbon agreements

The international transfer of carbon offsets between nations envisioned by Article 6 of the Paris Agreement is still being negotiated. Credits issued by this mechanism will be used by sovereign nations to reach their climate goals, and possibly by the private sector to meet its voluntary carbon reduction targets.

Some sovereign first-movers are demonstrating how these models can work in practice: In 2020, Switzerland signed a bilateral carbon offsetting deal with Peru – a 'Cloud Forest 25' country – followed by a number of other developing countries, in anticipation of the development of Article 6.[99] Their agreement includes provisions to avoid 'double counting' as well as funding local projects that support Peru's sustainable development. Nature-based solutions such as forests are not yet included in the framework agreement but, as the REDD+ framework is likely to be included in the further implementation of Article 6, mechanisms such as REDD+ Results Units (RRUs) described above could support cloud-forest countries in trading carbon mitigation outcomes with other countries.

Concept 2
A tax on the export of carbon credits

While carbon is increasingly viewed as a global commodity, the developing and least-developed countries (LDCs) selling forest carbon credits internationally do not yet view themselves as carbon commodity exporters. However, we argue, they could consider taxing carbon credits as they do other primary export commodities on which they depend. In fact, these revenues may be key to unlocking sovereign action at scale. Sovereign tax systems are no longer ignoring the life cycle of carbon credits and their effects on income or carbon taxes. In Colombia and Mexico – both cloud forest countries – and in South Africa, tax systems allow carbon credits to be used to offset a proportion of an entity's carbon taxes.[100]

The market for carbon credits could be worth upward of $50 billion in 2030.[101] Indonesia has in the past imposed export taxes on palm oil, while Madagascar has done so on vanilla, coffee and pepper. These cloud forest countries could in future apply the same principles to carbon offsets.[102] Also, taxing carbon credits may be an additional incentive for governments to forgo agricultural commodities that provide them with export tax income, in favour of keeping forests standing without having to renounce a stream of fiscal revenue.

Figure 9
The jump in greenhouse gas emissions from deforestation of cloud-affected forests

Calculating carbon storage services

In order to appreciate the carbon sequestration provided by cloud forests, the carbon they are already storing, and the deforestation emissions to be avoided by each country, consider how the hypothetical loss of all cloud forests would affect the emissions profile of each of the 25 top cloud forest countries.

The carbon contained in cloud forests can be considered 'irrecoverable' in the 30-year timescale up to mid-century. Their loss would not only jeopardise these countries' prospects of achieving a net-zero transition, but also global climate stability.[103]

Country	Annual total CO_2 emissions in 2018 ($MtCO_2e$) [A]	Emissions of CO_2 from complete removal of cloud-affected forests ($MtCO_2$) [B]	Years of annual CO_2 emissions equivalent to complete removal of cloud-affected forests (Years) [C]
Indonesia	1,704	17,045	10.0
Tanzania	176	10,146	57.8
DR Congo	682	10,075	14.8
Colombia	268	10,048	37.5
Peru	186	9,425	50.6
Venezuela	277	8,104	29.2
Mexico	695	8,072	11.6
Papua New Guinea	64	6,885	107.4
Brazil	1,421	5,388	3.8
Ethiopia	205	5,388	26.3
Ecuador	92	4,543	49.5
Cameroon	123	4,504	36.5
Bolivia	126	3,526	27.9
China	11,706	3,284	0.3
Laos	39	3,233	83.7
Kenya	71	2,813	39.5
Malaysia	388	2,743	7.1
Angola	125	2,727	21.9
Uganda	71	2,521	35.6
Madagascar	41	2,354	57.0
Philippines	235	2,307	9.8
Gabon	14	2,221	159.0
Vietnam	364	1,871	5.1
Republic of Congo	20	1,742	85.8
Myanmar	232	1,665	7.2
Total	19,324	132,629	39.0

Sources and Notes

[A] Climate Analysis Indicators Tool (CAIT).[104]

[B] Estimated cloud-affected forest area was converted to above-ground biomass (AGB) by multiplying by Spracklen and Righelato's (2014) mean estimate for AGB of tropical montane forests. This was multiplied by factor 0.5 to calculate carbon, and converted to CO_2 by multiplying by the stoichiometric ratio between CO_2 and carbon (44/12).[105 106] Calculations do not account for emissions of non-CO_2 gases, such as CH_4 & N_2O released during burning, or carbon that is stored by agricultural crops or pastures immediately after land conversion.

[C] The amount of CO_2 emissions as a result of fully clearing cloud-affected forests is divided by the amount of total CO_2e emissions in a year (based on emissions in 2018). This assumes all CO_2e emissions are CO_2.

Figure 10
Total estimated value linked to sovereign carbon and hydropower

Country	Value of electricity dependent on cloud-affected forests from current hydro-power plants over 10 years ($ Billion) [A]	Value of electricity from future hydro-power that will be dependent on cloud forests over 10 years ($ Billion) [B]	Revenue from carbon sequestration in unprotected cloud-affected forests over 10 years ($ Billion) [C]	Combined value of present water and carbon from cloud-affected forests over 10 years (excludes future hydro) ($ Billion) [C]
Indonesia	5.08	1.85	22.67	27.76
Tanzania	1.59	2.11	11.69	13.28
DR Congo	0.54	0.86	17.17	17.71
Colombia	11.36	11.19	17.94	29.31
Peru	1.76	14.81	16.77	18.53
Venezuela	6.95	4.05	3.18	10.14
Mexico	15.47	3.24	16.00	31.48
Papua New Guinea	0.81	0.06	12.87	13.68
Brazil	17.74	13.31	8.61	26.35
Ethiopia	0.54	1.63	10.06	10.60
Ecuador	3.65	19.87	8.27	11.92
Cameroon	0.20	3.92	8.31	8.51
Bolivia	1.90	6.30	5.15	7.05
China	10.10	2.34	6.21	16.31
Laos	3.07	21.30	4.79	7.87
Kenya	2.81	6.52	4.56	7.37
Malaysia	2.33	1.80	3.85	6.18
Angola	0.03	0.00	5.94	5.97
Uganda	2.12	2.95	4.07	6.18
Madagascar	0.29	0.00	3.97	4.27
Philippines	6.05	0.99	3.17	9.23
Gabon	1.68	0.00	4.09	5.77
Vietnam	21.56	6.26	2.83	24.40
Republic of Congo	0.69	0.41	3.34	4.04
Myanmar	0.12	1.80	3.05	3.17
Total	118.47	127.56	208.59	327.06

Sources and Notes

[A] Uses data described in Mulligan (2011), Sáenz and Mulligan (2013), and Byers et al. (2018). Capacities of hydropower plants were used to calculate the perfect generation over the period.[107 108 109] The average capacity factors reported by the IPPC (2011) for each region were used to estimate the actual power generated. Electricity value was calculated using the 2019 price for the region.[110 111]

[B] Uses the Global Future Hydropower Reservoirs and Dams dataset (2015).[112]

[C] Estimated carbon sequestered/period (converted to CO_2) uses mean predicted above-ground rate of carbon sequestration for tropical mountain forests [113] for areas currently unprotected, multiplied by \$10 t/CO_2.

[D] Excludes the value of electricity from future hydropower plants, carbon sequestration in protected areas, and any potential direct revenues from water services such as PES-related taxes on hydropower. Additional values of cloud forests, including ecotourism, ecosystem services, water provided to agriculture or water utilities in cities are acknowledged but have not been included in this analysis.

4

DESIGNING CLOUD FOREST BONDS

Bundling the water and carbon values of cloud forests enhance the opportunities for finance

4

DESIGNING CLOUD FOREST BONDS

Our research into the financing needs and opportunities associated with cloud forest protection has led us to three key conclusions:

With these conclusions in mind, we have developed three potential design options for a Cloud Forest Bond in order to meet the market possibilities and debt conditions of all Cloud Forest 25 countries.

1
Emerging markets in the tropics need new financing solutions.

Emerging market sovereigns, particularly at the lower end of the credit spectrum, must deal with increasingly tough social and economic challenges at home. At the same time, they face significant obstacles when it comes to accessing international finance and capital markets. This in turn undermines their ability to finance ambitious climate solutions and set themselves on a net-zero low-carbon development path. More integrated financial solutions are needed if emerging market issuers are to make meaningful progress towards conservation and climate adaptation whilst also meeting the social and economic needs of their populations.

2
A template for replicable and scalable sovereign finance is needed.

There have been some important climate innovations in financial markets. These relate to financing opportunities for emerging market governments linked to natural capital, debt restructurings, and public and private capital flows, as well as the future of climate finance instruments and transaction structures. We see the potential for certain innovative aspects of these transactions to be repeated and scaled across larger groups of countries sharing similar natural assets — such as the top 25 Cloud Forest countries — to help provide more substantial climate funding and/or support for emerging market governments to capitalise on their natural assets and to ensure that ecosystems are protected at scale.

3
Ecosystem services can be used to create new financial instruments to fund conservation.

We envision the creation of a Cloud Forest Bond, a financial instrument that can incentivise governments to commit to cloud forest protection. However, the aim of such an instrument should also be to fund the development of new revenue streams from ecosystem services: sovereign carbon credit issuances using the REDD+ framework for cloud forests not currently located within legally protected areas, and to establish new domestic fiscal revenues for forest protection from sovereign-level payments for ecosystem services infrastructure. These payments would be initially linked to current and planned hydropower projects that directly benefit from their water services. This is especially important as a climate adaptation strategy to safeguard a natural asset linked to water and low-carbon energy production, as well as other important uses for cloud forest water services not explored in this research, such as food and farming.

4.1
CLOUD FOREST BONDS: THREE OPTIONS

Option 1
A Sustainability-Linked Bond

SLB

SLBs allow sovereigns to raise new money from capital markets, linking the costs of borrowing to the achievement of environmental targets. SLBs do not restrict the use of proceeds and allow the issuer to raise money as usual for general budgetary purposes.

However, the issuer must achieve a detailed list of ambitious environmental milestones before a certain date in order to stop the bond's legal documentation from triggering an unfavourable change in the payment structure. These goals are supported by comprehensive reporting by external auditors, who not only validate the ambition and potential impact of the initiatives, but also write legally binding second-party opinions (SPOs) to determine whether the targets have been reached. In this way, SLBs present a transparent and impactful alternative that gives more confidence to investors and more flexibility to borrowers.

While there are numerous examples in the corporate debt markets, a sovereign issuer had never come to the USD markets with an SLB structure until Chile in February 2022. Chile's SLB is directly linked to the evaluation of two key performance indicators (KPIs) related to the country's greenhouse gas emissions and renewable energy generation. Chile's SLB has a contingent 'step up' coupon if the KPIs are missed. In October 2022, Uruguay followed in Chile's footsteps with a new sovereign SLB that for the first time includes a forest policy target as part of its climate commitments.

Uruguay's SLB framework links its sovereign bond financing strategy to its climate and nature targets as established under the Paris Agreement, with one of its KPIs being the "maintenance of native forest area (in hectares) with respect to reference year (in %)". A coupon step-up will be triggered if the government fails to enforce legislation to avoid deforestation, relying on historical values and underlying data from 1990 to 2019.[114] Market reception of Uruguay's bond was very strong and it was 3.75x over-subscribed. This allowed the government to both reduce the cost of the debt as well as increase the amount to $1 billion.

A possible limitation of using an SLB for nature conservation, critics have argued, is that the timeframes for long-term environmental policies go well beyond the 5- to 10-year maturity span of SLBs that aim to incentivize those policies. Will future governments maintain environmental commitments once an SLB has been repaid? An alternative option some analysts have suggested is the use of perpetual bonds. A perpetual bond has no maturity date and pays a steady stream of interest forever. It is often considered a type of equity, rather than debt, and is not redeemable, with the issuer not required to repay the principal amount. Linking perpetual bonds to sustainability outcomes should be further explored as an option in sovereign green finance.[115]

An SLB for cloud forest countries

— Includes KPIs for the protection of cloud forests, such as percentage increase of legally protected cloud forest area and percentage increase of cloud forest area under IPLC management.

— Builds in credit enhancement options for governments of countries whose access to markets is weak or at prohibitively expensive rates, including "pay for performance" subsidies and grants from multilaterals.

— Requires data transparency and third-party oversight including the provision of satellite-based assurance would help benefit unsecured credit spreads and build credibility for investors.

Option 2
A debt-for-nature swap

DFNS

In contrast to sustainability-linked sovereign bonds, which are a new concept, debt-for-nature swaps date back several decades. They were popular in the 1980s and 1990s, before declining in the 2000s and re-emerging in response to the debt distress facing many countries as a result of the Covid-19 pandemic.

The first such transaction was carried out in 1987, when Bolivia attempted to alleviate its debt crisis by negotiating a deal with Conservation International under which $650,000 of its debt was forgiven in exchange for the government agreeing to establish three conservation areas in the Bolivian Amazon basin. In total, 39 countries have benefited from debt-for-nature swaps, around half of them in Latin America and the Caribbean. The total value of global debt-for-nature swaps is $2.6 billion, resulting in transfers of $1.2 billion to conservation projects.[116]

Belize closed a new debt-for-nature swap in November 2021, breathing fresh life into the DFNS framework and demonstrating the utility of a debt buyback transaction in sovereign debt markets. In addition to the benefits of buying debt at a discount and cancelling it, the Belize transaction included commitments from the government to significant marine conservation, including the protection of up to 30% of the country's ocean. A tourism-based economy with a significant "blue" component, Belize found itself in debt distress over several years, which was exacerbated by a delay in interest payments due to the Covid-19 pandemic. Against this backdrop, the government decided on a DFNS, which allowed it to reduce debts considerably by buying back bonds from creditors at a 45% discount and retiring those bonds.

This transaction reduced debt by $189 million immediately and reduced further debt service over the 20-year tenor of the country's so-called Superbond by an additional $200 million. As part of the conditions for the transaction, the Belize government guaranteed up to $4.2 million per year over 20 years for funding outcome-based marine conservation via money disbursed from an independent Conservation Trust Fund, plus an endowment fund of $23.5 million available after the 20-year period. If conservation milestones, such as achieving a marine spatial plan by 2025 and an increase in Marine Protected Areas to 30% by 2030, are not achieved then funds will be withheld or reduced.

The Nature Conservancy (TNC), a global NGO, played a key role in this transaction, both as a provider of financial capital and as a credibility stamp for private and public investors. In addition, the transaction added several new innovative aspects to the DFNS playbook and, importantly in the current market environment, demonstrated how it can be used effectively as a restructuring tool for commercial bond debt that has tangible benefits in terms of overall debt reduction and the conversion of a portion of debt service payments into local currency.

Additionally, this transaction introduced a fairly new type of credit enhancement, a Political Risk Insurance (PRI) enhancement, which was the first use of Arbitral Award Default and Denial of Justice policies from the US Development Finance Corporation (DFC). This credit enhancement allowed for a 12-notch credit rating upgrade which permitted the issuance of an Aa2-rated (Moody's) "blue bond" to fund the buyback of Superbonds as well as fund a portion of the conservation efforts.

A DFNS for cloud forest countries

— Offers a way for highly indebted countries in debt distress to link commitments to protect their cloud forests to debt restructuring, making funds available for revenue-generating initiatives such as sovereign carbon or sovereign PES systems.

— Sets up independent governance and oversight of conservation funding based on the achievement of previously agreed milestones, creating credibility and assurance with stakeholders as well as credit enhancement/blended finance options.

— Involves working with external stakeholders (such as conservation NGOs) who have the necessary technical capabilities and provide the transaction with credibility in the eyes of other key stakeholders.

Option 3
A results-based finance instrument

RBF

Results-based financing refers to any programme or intervention that provides funding contingent on agreed results being achieved and verified. RBF interventions have been used to incentivize performance in social sectors such as health and education and are now starting to be applied to environmental agendas.

Given concerns that many of the low- and middle-income countries where biodiversity protection is most needed also have the least fiscal space available to invest in nature-positive outcomes, the World Bank, via the International Bank for Reconstruction and Development (IBRD), has designed a structure that used its own balance sheet to provide fiscal support to the South African government for wildlife conservation at two of its largest national parks. The financial concept of the instrument, dubbed the "Rhino Bond", is a bond debt instrument issued by the IBRD (rated AAA/Aaa) with proceeds used to fund efforts to increase rhino populations in the two parks by more than 4% over the term of the bond.

In addition to the unique off-balance-sheet nature of the transaction, the IBRD enlisted a financial partner, the Global Environment Facility (GEF), to contribute a "pay for performance" enhancement to the financial returns of the instrument to investors. The $150 million bond has been structured to offer a Conservation Success Payment from the GEF to bondholders of up to $13.8 million, depending on observed growth in rhino numbers. Thus, private investors would see significantly better financial returns if conservation efforts are successful.

The IBRD issued the bond as a debt instrument with no coupon and a final maturity of March 2027, at a discount to its par value of 94.84%. Given the creative structure and its use of proceeds, the World Bank hoped to use public sector support to "crowd in" private sector investors into backing global public goods like wildlife conservation. Private investors thus have a chance to make a safe impact investment due to the WB AAA rating that ensures the principal is repaid with the potential bonus of a success payment if rhino numbers increase. It also allowed the GEF to increase the effectiveness of its grant funding by paying for results.

The appetite for experimentation with results-based financing instrument is increasing, creating the potential for a range of new instruments or hybrid financial models to come to market where multilateral development banks play a catalytic role. Moving beyond wildlife, an instrument focusing on cloud forests would enable payments for an ecosystem service that is vital to the climate adaptation of developing countries. The concept would include leveraging the balance sheet of a global or regional multilateral bank to raise funds with specific nature-based targets and include an environmental NGO to provide additional financial incentives to investors via pay-for-performance.

An RBF instrument for cloud forest countries

- Creates an off-balance sheet transaction that is ideal for countries with restricted access to capital markets or unsustainable debt levels where traditional on-balance sheet debt instruments are not well-suited.
- Provides an opportunity for a government to fund jurisdictional carbon and/or issue REDD+ Results Units (RRUs), enabling multilateral banks, foundations and private investors to support the liquidity of these carbon reductions in innovative ways.
- Offers a way to attract private investors and capital markets to invest in the country's development that would not happen otherwise and, if successful, enhance the country's market reputation for positive performance.

Figure 11
Suggested Cloud Forest Bond model for CF25 countries

Country	Region	Cloud-affected forest cover Km²	Ratings Average	Tier 1–4	Suggested transactions
Indonesia	Asia	343,077	BBB	1	SLB
Tanzania	Africa	204,208	N/A	3	RBF
DR Congo	Africa	202,782	N/A	3	DFNS-Bi
Colombia	Americas	202,235	BBB	1	SLB
Peru	Americas	189,699	BBB	1	SLB
Venezuela	Americas	163,114	≤ CCC	4	None
Mexico	Americas	162,474	BBB	1	SLB
Papua New Guinea	Oceania	138,582	N/A	3	DFNS-Bi
Brazil	Americas	108,450	BB	1	SLB
Ethiopia	Africa	108,441	≤ CCC	3	DFNS-Bi, DFNS-Com
Ecuador	Americas	91,438	B	2	DFNS-Com
Cameroon	Africa	90,651	B	3	DFNS-Bi
Bolivia	Americas	70,962	B	2	DFNS-Com, SLB+
China	Asia	66,094	A	1	SLB
Laos	Asia	65,067	B	3	DFNS-Bi, RBF
Kenya	Africa	56,615	B	2	DFNS-Com, RBF, SLB+
Malaysia	Asia	55,216	A	1	SLB
Angola	Africa	54,893	B	2	DFNS-Com, RBF, SLB+
Uganda	Africa	50,735	N/A	3	RBF
Madagascar	Africa	47,385	N/A	3	DFNS-Bi, RBF
Philippines	Asia	46,431	BBB	1	SLB
Gabon	Africa	44,713	B	2	DFNS-Com, RBF, SLB+
Vietnam	Asia	37,656	BB	1	SLB+
Republic of Congo	Africa	35,058	≤ CCC	1	DFNS-Com, RBF
Myanmar	Asia	33,518	N/A	4	None

Notes and Sources
Market data 31/10/2022.
≤ CCC means a rating of CCC and lower.

Tier Definition
The suggested transactions in our cloud forest country dataset evaluate relevance of bond options for each country based on a tiered system:
1 Highly-rated (>BB) with market access and a well-established USD/EUR curve.
2 Low-credit rating with historical market access but currently with bonds at discount.
3 No rating, no market access, low-income, IDA-eligible/Blend countries with limited debt capacity.
4 No rating, no market access, and/or on sanctions list of US Office of Foreign Assets Control (OFAC).

Suggested Transactions
The suitability of transaction options for each country tier is based on a range of criteria, including the degree of market access (10-year bond spreads), debt sustainability and gross external financing needs, among others:
DFNS-Bi Debt-for-nature swap using bilateral debt at a negotiated discount.
DFNS-Com Debt-for-nature swap using commercial debt at a market price.
RBF Off-balance sheet KPI-linked instrument with Results-Based Finance.
SLB Sustainability-Linked Bond: a 'new money' solution.
SLB+ Sustainability-Linked Bond Plus: a 'new money' solution issued with blended finance/credit enhancement.

4.2
SETTING KEY PERFORMANCE INDICATORS (KPIS)

Establishing the right KPIs to measure the environmental outcomes of these financing options is vital to their credibility with investors.[117] To be reliable, credible and effective, these KPIs should be:

Few and simple. During the Chilean SLB roadshow and advanced marketing process, investors requested only a few straightforward KPIs. The final instrument included just two: absolute greenhouse gas (GHG) emissions and the share of renewable energy in the national electricity system.[118] Uruguay's SLB framework is similarly simple, incorporating a forest protection KPI alongside GHG emissions.

Measurable, verifiable and data-driven. Metrics should be linked to measurable actions that a government can take, such as increasing the number of hectares of forest protected or restored.[119] KPIs should be able to be independently assessed, and the data underpinning them should be as near real-time as possible.

Ambitious. The credibility of these financial instruments rests on setting ambitious KPIs. In the case of the Chilean SLB, the selected KPIs were widely criticised because the government would most likely have achieved them anyway.

Aligned with government commitments. In order to ensure cross-government alignment, KPIs should be based on and support a government's defined environmental and climate goals, for example as set out in its Nationally Defined Contributions (NDCs).

The table below provides an overview of the types of KPIs that can be used in the design of cloud forest-related transactions.

Figure 12
Examples of Key Performance Indicators for cloud forests

KPI	Indicator Metric	Temporal Coverage
Cloud forest area annual net change	%	Annual
Cloud forest area annual net change in protected areas	%	Annual
Increase of legally protected cloud forest area	%	Annual
Increase of cloud forest area under IPLC management	%	Annual
Cloud forest influence on hydropower dams	%	Annual

Notes and Sources
Given there are different ways of defining the ecological boundaries cloud forests and that KPIs are to be used to geo-spatially measure performance, further refining the development of KPIs would require a clear definition of cloud forests that will be used and uniformly applied across countries.

Further selecting KPIs should be also based on the monitoring methods that will be used. For example, net change in forest cover needs to take account of remote sensing challenges due to cloud cover.

4.3
USING CARBON AS COLLATERAL IN A SOVEREIGN TRANSACTION

Below we outline how governments and financial stakeholders can explore the potential to use forest carbon as collateral that can de-risk financial transactions, in much the same way as gold is currently used.

For least-developed cloud-forest countries with low credit ratings, forest carbon could provide a novel way to collateralise and de-risk sovereign finance transactions that incentivise environmental protection as proposed in this report. Developing such a concept could help cloud forest countries to rely on their own natural assets to provide de-risking capital and guarantees, and unlock their access to international capital markets.

Design criteria

Advancing the concept of carbon as collateral would require:

Additionality
A government should commit to placing carbon credits generated by forests into a designated account that will be used as collateral for a sovereign financial transaction. This would ideally apply to expanding forest protected areas in places not currently protected, and where formal protection would afford the necessary additionality, which would most readily be done in publicly owned lands.

Liquidity
Ensuring the liquidity of carbon collateral for investors would require governments to assure them that they can get hold of those carbon credits in the case of a default, and have a transparent price discovery mechanism, for example by issuing the credits via jurisdictional carbon frameworks that provide the appropriate standards and are based on REDD+.

Good governance
The credits are created and placed in a trust fund that is independently governed to be used as collateral in the case of default and/or for coupon payment on the transactions. Periodic independent audits, supported by real-time satellite monitoring, provide scrutiny of the account to ensure permanence. The country's Central Bank would provide a policy framework that enables those credits to be used as collateral, enhancing its existing 'eligible collateral' policy that currently defines what can be used for collateral in the country, and defining carbon credits as an investable financial instrument.

Blended finance
Risk guarantees by MDBs and public financial institutions can be provided to bridge the liquidity gap until voluntary carbon credit markets are large enough to support the size of these types of transactions. In addition, political risk insurance can cover initial gap years until verified carbon credits are deposited in the trust fund account, potentially throughout the maturity of the transaction to assure investors of the permanence of those credits.

5

RECOMMENDATIONS

A cloud forest is grown under a glass dome in Gardens by the Bay, Singapore

5.1
RECOMMENDATION 1
SHAPING A CLOUD FOREST BOND

Most CF25 countries have the opportunity to link the protection of cloud forests, and locking in carbon stored in these forests, to improved terms of sovereign finance through a range of alternative financial models depending on those countries' levels of access to capital markets and their debt sustainability.

A well-structured instrument could help countries to achieve lower costs of capital in international markets; broaden the sovereign issuer's investor base; establish a mechanism for NGO and DFI subsidies and cashflows based on successfully meeting KPIs; and design new mechanisms that will allow governments to create a positive fiscal cashflow from the protection of forests. Such an innovation would have three important aspects:

An innovative design process at country level that brings together multi-stakeholder partnerships to enable government agencies, including treasuries and environment ministries, as well as financial institutions and country experts in academia and civil society, to define the parameters, data, and financial incentive structures that are best suited to each country's condition.

Designing new fiscal income streams. Sovereign finance for nature should also be about creating systems that can generate new financial returns for governments committing to forest protection. Proposals include the establishment of sovereign carbon finance models, either as jurisdictional carbon credit issuances or as performance-based REDD+ Results Units (RRUs). Governments could also fund the establishment of water payment systems for cloud forest services at national level. These would be based on a model of fees or taxes applied to current hydropower projects that directly benefit from their water services, and would in future apply to those at the planning stage.

Linking sovereign finance and climate adaptation. Developing and least-developed countries (LDCs) must find new ways of financing their resilience to climate change. Sovereign finance instruments that focus on maintaining healthy upstream forests and the hydrological services they provide to downstream users could offer a practical way to involve capital markets in financing country adaptation outcomes. These are vital not just to power generation but also to other water-dependent sectors such as agriculture, urban water utilities and industrial development within river basins that are fed by cloud forests.

5.2
RECOMMENDATION 2
DEVELOPING A CLOUD FOREST 25 (CF25) INVESTMENT INITIATIVE

This report has identified the 25 developing countries that hold most of the Earth's cloud forests, and the viable options for each of them to develop Cloud Forest Bonds that fit their debt situation and access to markets. Multilateral and regional development banks, global investors and global NGOs can work together to provide a global support network to help all these countries benefit from economies of scale in resources, knowledge and replication.

To enable collective action at scale, a Cloud Forest 25 (CF25) Investment Initiative would work on the following outputs to develop the enabling infrastructure:

Templates for sovereign carbon, PES and Cloud Forest Bonds. Successfully designing and negotiating sovereign nature financial transactions, such as debt-for-nature swaps and results-based impact bonds, involves developing entirely new systems. This in turn requires lengthy negotiations, often lasting many years, with a wide range of stakeholders. For decision-makers in developing and least-developed countries this poses a difficult task. The development of templates and frameworks that are widely understood by creditors and debtors is key to creating solutions that can easily be replicated and scaled up. A CF25 Investment Initiative must bring together the full range of technical expertise to create templates and guidance on Cloud Forest Bonds, sovereign carbon finance models and, importantly, payment for ecosystem services schemes that could be adopted on a sovereign scale, creating new fiscal income streams that governments can use to plan economic development that works in greater balance with nature.

Global window for blended finance for forest outcomes. Blended finance instruments – such as risk guarantees and political risk insurance, project preparation grants, and first-loss investments provided by multilateral development banks (MDBs), donors and philanthropists – have lowered the risk perception of sovereign nature financial transactions so as to attract private investors. Such 'credit enhancements' are essential to the success of most nature-based finance models, but will be difficult to scale without coordination and innovation. A CF25 Investment Initiative is an opportunity to design options for scaling the delivery of blended finance across these 25 countries, with specific natural assets and nature-based outcomes in mind. The resulting model could involve a financing facility hosted by an MDB, or a blended finance window within an investment fund targeting tropical forests. Greater economies of scale are needed if donors and public finance institutions are to deploy blended finance for nature effectively across more transactions and geographies.

Data platform to scale performance tracking – a Cloud Forest Value Index. Globally comparable data is essential for enabling scale in the design of new financial mechanisms and tracking evidence of Key Performance Indicators (KPIs). In addition, identifying 'critical resilience scenarios', such as when a country's high hydropower dependency on cloud forests coincides with high rates of deforestation upstream of dams, is also necessary for investors and companies in infrastructure sectors, as well as credit rating agencies. This would help establish stringent requirements for those investments to consider how nature-based solutions will affect their long-term performance. A CF25 Investment Initiative would anchor the design of a platform that measures the multi-dimensional data indicators explored in this report. A 'Cloud Forest Resilience Index' would help countries, MDBs and investors to benchmark performance on natural assets, anticipate resilience scenarios and climate exposure, inform policy and financial priorities, and align infrastructure investments and net-zero plans on a common basis of natural assets.

Such a platform would also offer the private sector – global investors and corporates operating water-intensive assets that are linked to cloud forests – a common platform with which to engage stakeholders and financing opportunities, including through sectoral approaches such as infrastructure and hydropower.

5.3
RECOMMENDATION 3
DELIVERING PRIVATE SECTOR LEADERSHIP

Opportunities for immediate action by the private sector are relevant to three types of companies: corporate operators of assets that benefit from cloud forests and can improve their business strategies and obtain lower costs of capital; banks and investors financing these assets to improve risk management, due diligence and disclosure frameworks in line with emerging climate and nature regulations; and companies offering risk solutions, including credit rating agencies and re/insurers, to develop and price their products more effectively and support corporate clients in the transition to climate resilience and net zero.

Corporate assets and green finance products. Power companies and utilities operating dams and other water-dependent infrastructure in areas influenced by cloud forests can link corporate commitments to their protection to green finance products. This can be in the form of corporate green bonds or Sustainability-Linked Loans (SLL), where nature and biodiversity targets are becoming increasingly relevant to investors, as well as corporate bonds utilising some of the same principles and KPIs presented in this report. For example, in 2020, investors and foundations partnered to support the world's first corporate green bond from a water utility to focus on protecting upstream forests. The bond – issued by Central Arkansas Water (CAW) – will enable the company to protect 46% of the forest land in the Lake Maumelle watershed and secure clean water for half a million residents of greater Little Rock, Arkansas. Such models provide a blueprint for companies either operating or planning to develop infrastructure in cloud forest areas.[120] Where companies take a direct interest in preserving cloud forests for their hydrological services, proving additionality may also enable them to benefit from carbon credits as part of their net-zero strategies.

Investment risk management and disclosure. The investment risk frameworks used in hydropower infrastructure investments rarely include nature dependencies and ecosystem services. Based on the analysis in this report, financial institutions and companies involved in hydropower projects across CF25 countries should review how dependent these dams are on cloud forests, including those currently at the planning stage. They should reflect this in an upgraded risk register, and request that projects take appropriate measures to build resilience. The Task Force on Nature-related Financial Disclosures (TNFD), to which many financial institutions are being asked to sign up, aims to incorporate nature risks in financial disclosures.

The hydrological ecosystem services provided by cloud forests to water-dependent infrastructure projects fall squarely into this definition, whereas the loss of cloud forests would compromise the water available to these projects, undermining their economic viability. In line with the emerging requirements of TNFD, financial institutions should consider cloud forests where relevant to the area of influence of any type of water-dependent infrastructure investment. A range of quantification tools and methods under development will facilitate the measurement of cloud forest footprints on hydropower and create the data needed to improve disclosure.

Underwriting and reinsurance products. Swiss Re, the reinsurance company, has identified forestry insurance as a largely untapped tool to help close the forest protection gap with viable forest management solutions.[121] The hydrological services of cloud forests make them an important asset in mitigating risks associated with droughts and floods, creating three types of opportunities for reinsurers. First, companies underwriting hydropower dams in areas of cloud forest dependence must immediately update risk registers to recognise these dependencies and require conservation measures upstream of the assets they underwrite. Secondly, in cases where downstream users such as dams, water utilities and others benefiting from cloud forests are willing to pay for their conservation as part of payment for ecosystem services schemes, the design of innovative insurance models based on these cashflows may offer an opportunity for innovation. Thirdly, regional and sovereign insurance facilities set up by donors and private insurance companies to deal with climate risks in underserved markets (e.g. Africa Risk Capacity) must consider nature-based solutions as risk mitigation investments, making nature an asset in sovereign climate insurance models.

ANNEX 1

Figure 13
Global distribution of cloud-affected forests across 69 countries

The following table provides an overview of all countries with cloud-affected forests in the tropics with information on the current cloud-affected forest area, protected cloud-affected forest area and recent cloud-affected forest loss.

Country	Current cloud-affected forest area (km^2) [A]	Protected cloud-affected forest area (km^2) [B]	Loss of cloud-affected forests in last 20 years (km^2) [C]
Indonesia	343,077	107,946	11,161
Tanzania	204,208	96,163	12,721
DR Congo	202,782	44,008	18,555
Colombia	202,235	58,298	10,241
Peru	189,699	55,198	7,762
Venezuela	163,114	137,579	2,014
Mexico	162,474	34,098	4,826
Papua New Guinea	138,582	5,119	2,817
Brazil	108,450	39,350	8,361
Ethiopia	108,441	15,438	2,561
Ecuador	91,438	25,106	3,116
Cameroon	90,651	13,819	4,622
Bolivia	70,962	29,669	1,763
China	66,094	1,656	4,217
Laos	65,067	15,350	12,013
Kenya	56,615	14,435	2,489
Malaysia	55,216	15,311	5,154
Angola	54,893	0	6,191
Uganda	50,735	13,150	7,096
Madagascar	47,385	10,639	11,856
Philippines	46,431	13,549	1,701
Gabon	44,713	6,922	484
Vietnam	37,656	8,268	3,299
Republic of Congo	35,058	4,161	1,060
Myanmar	33,518	1,840	4,597
Honduras	31,754	8,531	3,986
Guatemala	30,481	5,144	2,359
Zambia	27,004	3,189	2,574
Thailand	16,797	10,312	1,150
Mozambique	16,693	8,093	2,046
Guyana	15,179	650	155
Costa Rica	14,872	7,182	532
Panama	12,877	7,579	443
Malawi	11,868	4,863	1,520
India	10,420	2,406	691

Country	Current cloud-affected forest area (km²) A	Protected cloud-affected forest area (km²) B	Loss of cloud-affected forests in last 20 years (km²) C
Zimbabwe	9,313	1,102	936
Burundi	8,542	910	441
Rwanda	7,833	1,673	475
Dominican Republic	6,919	4,424	661
Taiwan	5,935	2,852	117
Equatorial Guinea	5,800	1,972	146
Nicaragua	4,825	1,906	419
Sri Lanka	3,502	1,012	76
Argentina	3,283	3,266	8
South Sudan	2,673	1,168	91
Cambodia	2,408	2,407	57
Yemen	2,138	0	0
Solomon Islands	1,014	0	22
Eritrea	963	0	0
Haiti	956	309	101
El Salvador	881	638	43
Liberia	768	3	94
Cuba	616	339	18
Timor-Leste	611	166	17
Nigeria	459	175	34
Somalia	420	0	0
Vanuatu	382	0	2
Jamaica	314	260	11
Saudi Arabia	298	140	0
Central African Rep.	190	41	2
Guinea	179	87	47
Belize	172	172	1
São Tomé + Príncipe	161	149	0
Comoros	157	155	4
Brunei	110	89	1
New Caledonia	31	31	0
Côte d'Ivoire	25	21	5
Fiji	9	0	0
Chile	1	0	0
Global	2,929,322	850,488	169,960

Sources and Notes

A Estimated area of cloud forests from an updated version of the data described in Mulligan (2011).[122]

B Estimates of area of cloud-affected forests under protection are from the World Database on Protected Areas.[123]

C Loss of cloud-affected forest over the last 20 years is based on the Global Forest Change (GFC) dataset described in Hansen et al. (2013).[124]

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