FPAN
Forests
Philanthropy
Action
Network

KEY MESSAGES
ABOUT THIS REPORT
CHAPTER 1
CHAPTER 2
CHAPTER 3
CHAPTER 4
CHAPTER 5
CHAPTER 6
CHAPTER 7
CHAPTER 8

Protecting and restoring forest carbon in tropical Africa

A guide for donors and funders
March 2011

Bernard Mercer • Jonathan Finighan
Thomas Sembres • Joshua Schaefer

Pure Climate Foundation
the Wetland Trust
the David & Lucile Packard Foundation

This report was funded by The Pure Climate Foundation, The David & Lucile Packard Foundation, The Linden Trust for Conservation, The Wetland Trust and the Leventis family.

We are very grateful for their generous support throughout the project.

KEY MESSAGES

About the report

Protecting and Restoring Forest Carbon in Tropical Africa: a guide for donors and funders is the first report to be published by **The Forests Philanthropy Action Network (FPAN)**, a UK registered charity formed in 2008 to help coordinate and inform philanthropic support on the whole range of global forest issues.

The report is the culmination of nearly two years of desk and field research, funded by the Pure Climate Foundation, the David & Lucile Packard Foundation, the Leventis family, the Linden Trust for Conservation, and the Wetland Trust.

The aim is to provide an introduction and some initial guidance on a broad and complex topic: which interventions to protect and restore Africa's tropical forest carbon are likely to be successful and under what circumstances; and how donors and funders can engage most effectively.

Conserving and restoring tropical forests are cornerstone actions for climate change mitigation

- Forests will be a cornerstone of global climate change mitigation in the coming decade. McKinsey & Company's greenhouse gas abatement model estimates that annual global emissions need to be reduced by 17$GtCO_2e$ by 2020,[i] to avoid an increase in global temperature above 2°C. Of this total, McKinsey identifies nearly 50 per cent of abatement coming from reductions in emissions from tropical deforestation and degradation. Beyond 2020, a larger share of emissions reduction is expected to be sourced from fossil fuel-related reductions, as technologies such as carbon capture and storage (CCS) come on stream, and more power generation is provided by renewables.

- Intergovernmental Panel on Climate Change (IPCC) reports estimate that deforestation accounts for about 17 per cent of global greenhouse gas emissions. This is conservative – carbon losses from forest degradation are treated as zero, because data is uncertain. If all the world's tropical forests were cleared, around 1,331$GtCO_2e$ would be released – equivalent to 30 years' global emissions at 2005 levels.

Tropical Africa has very significant forest carbon resources, and these are at risk

- Africa's tropical forests are at greater risk than those in Latin America and South -East Asia. They are disappearing three times faster than the world average: an area the size of Finland (30 million hectares) was cleared between 2000–2010, producing the equivalent of 2005 global emissions from aviation and shipping combined.

i. $GtCO_2e$ means gigatonnes (billion tonnes) of carbon dioxide equivalent – see **Chapter 1**.

FPAN
KEY MESSAGES
ABOUT THE REPORT
CHAPTER 1
CHAPTER 2
CHAPTER 3
CHAPTER 4
CHAPTER 5
CHAPTER 6
CHAPTER 7
CHAPTER 8

An historic opportunity now exists to protect the world's tropical forests

Governments, NGOs and the private sector increasingly recognise the importance of reducing emissions from deforestation and degradation. At the December 2009 UN climate meeting in Copenhagen, 190 countries committed to an international mechanism through which developed countries would pay tropical forest countries for REDD (reducing emissions from deforestation and degradation) action, and some governments and international institutions have made REDD funding commitments. Philanthropy can play a crucial role in protecting forest carbon by:

- **Funding early action to protect and restore forests.** Slow progress on agreeing international action on climate change, and challenges in the framing of REDD are constraining widespread early action to protect and restore tropical forests. Charitable trusts and foundations, and individual donors have the option to support on-the-ground projects and other interventions immediately. Such funding is of critical importance, given the time gap of several years (perhaps as much as a decade) that is likely to occur before governmental and institutional funds come fully on stream.
- **Supporting innovation.** Protecting and restoring forests is a formidable challenge, yet little funding is currently available for innovative NGOs seeking to develop new and effective responses. Philanthropic support for entrepreneurial approaches has great catalytic potential.
- **Laying the foundations for effective action to protect tropical forests.** The state of knowledge on how to reduce deforestation and degradation is still very poor, and this is impeding progress (for example, on combating degradation). Donors and funders could make a long-term difference by funding research to improve data and inform action.
- **Supporting and prioritising large-scale action.** Pilot projects are important, but large-scale action now is vital. Philanthropy can be a catalyst, paving the way for governmental donors.
- **Supporting efforts to secure the best REDD-plus agreement for conservation and restoration.** REDD-plus (as currently being negotiated through the UN climate process) risks emphasising *sustainable management of forests* (selective logging) over *conservation* (full protection) and *enhancement of forest carbon stocks* (restoration). More funder support for NGOs working to secure the best possible REDD-plus outcome is an urgent need.
- **Practical conservation and restoration action.** The REDD policy process is critical, but so is on-the-ground action. Funders can make a difference by backing ambitious large-scale conservation and restoration schemes, especially in the early stages.

Sector-specific guidance

The guidance below follows the thematic approach of the report. We found many opportunities for donors and funders to provide valuable support for the conservation and restoration of African tropical forests in the forestry, agriculture, and mining and energy extraction sectors, and also identify a number of priorities relating to the woodfuels challenge, and specific forest protection interventions.

Forestry

Converting logging concessions to forest conservation and restoration areas. Over 120 million hectares of forest across six Central and West African countries could potentially be allocated as concessions to logging companies in the future, equivalent to the size of France, Germany and the UK combined. The rise of payments for REDD means that protecting these forests could potentially become competitive with logging them, in terms of the revenue generated for governments.

Supporting timber plantations for domestic markets. Plantations dedicated to meeting the vast domestic demands in tropical Africa for timber and woodfuels could help ease pressure on forests and free forests for carbon conservation. Our preliminary calculations, using Tanzania and Uganda as case studies, suggest that meeting national timber demand with plantations would require only 5–20 per cent of the equivalent area of natural forest.

Protecting forests delivers a better outcome for forest carbon than 'sustainable use' options. Where logging is being practiced, Sustainable Forest Management (SFM) practices could reduce carbon emissions, compared to conventional logging. However, compared to conserving an intact forest, these practices still result in significant loss of forest carbon.

Agriculture

Ensuring agricultural development in tropical Africa is carbon sensitive. Agricultural development in Africa has shot to the top of the development agenda after many years of neglect. Philanthropic dollars can help ensure that tropical African countries do not replicate the experience of widespread, commercially driven deforestation seen in some other tropical forest regions, such as the Amazon and Indonesia.

Scaling up agricultural systems that sequester more carbon. Farming systems using agroforestry, biochar or conservation agriculture can increase carbon storage in agricultural lands and play an important role in mitigating climate change, while improving food security.

Woodfuels

Promoting efficient cooking stoves. Low-cost stoves that can halve fuel consumption are being promoted by NGOs, development agencies and small businesses in many countries. Taking improved stoves to scale could significantly reduce the total woodfuel harvest: our preliminary calculations suggest that distributing improved stoves to Kenya's 6 million rural households could potentially reduce fuelwood consumption by 50 per cent, saving up to 8.4 million tonnes of carbon a year. Commercialised supply chains have reached millions of households in some countries.

Establishing woodfuel plantations. Woodfuel plantations, especially charcoal plantations near towns and cities, could help reduce deforestation and degradation by diverting woodfuel production away from forests. Producing woodfuel from plantations could drastically reduce the amount of land required to meet demand for energy, and relieve the pressure of woodfuel harvesting on forests. Taking Kinshasa in the Democratic Republic of Congo (DRC) as an example, our preliminary calculations suggest that all of its annual charcoal demand could be met from acacia plantations covering 410,000 hectares – about 25 per cent of the area of natural forest that would be required to grow this volume of wood every year.

Promoting alternatives to woodfuels. While many millions of people across tropical Africa are likely to remain reliant on woodfuels for the foreseeable future, alternative energy sources are viable in many cases: biomass briquettes, biogas, solar cookers and liquid petroleum gas are all examples. Alternatives need to be price competitive, convenient, safe, and readily available if consumers are going to voluntarily switch en masse from woodfuels.

Mining and energy extraction

Fostering a concept of reduced impact mining. The mining industry appears to be responding very slowly to forest carbon conservation and restoration, despite the impact of the industry on forests. 'Sustainable mining' as it currently exists looks primarily at social issues and non-forest environmental issues such as water pollution, rather than carbon impacts. Donors and funders could help to develop and promote mining practices that reduce carbon losses, such as roadless extraction and reforesting of depleted sites.

Improving extractive industries regulation. Philanthropy could also help by funding organisations that are trying to improve regulation in the sector. A clear need is for forest carbon impacts to be included in environmental impact assessments (EIAs).

Conservation and restoration

Supporting conservation and restoration in existing protected areas. Many existing protected areas in tropical Africa are severely under-resourced. As a result, protection is often inadequate, resulting in ongoing logging and woodfuels removals. In the short term, they are unlikely to obtain significant additional finance from governments. Philanthropic support can act as critical 'bridging finance' until more permanent funding mechanisms can be devised.

Funding new large-scale forest conservation and restoration areas. There is an absolutely critical need for new forest conservation and restoration projects in tropical Africa that start now and do not wait for a global deal to be finalised. These should potentially be able to draw on a combination of philanthropic and voluntary market finance, and may also be able to attract support from international institutions and governments. Donors and funders could prioritise the millions of hectares of dormant and already logged forestry concessions that can be found across tropical Africa, which afford huge opportunity to conserve existing forests and restore those that have become degraded.

Supporting civil society and governmental capacity building in tropical African forest protection. Many African countries have woefully underfunded forest protection agencies and civil society organisations. The World Bank and UN agencies are supporting capacity building in a number of African countries, but this is relatively modest and will, in many cases, not reach the full range of organisations that have parts to play. Donors and funders can provide critical help, through a preparedness to fund government departments as well as NGOs.

ABOUT THE REPORT

Aim

The aim of the report is to provide an introduction and some initial guidance on a broad and complex topic: which interventions to protect and restore Africa's tropical forests are likely to be successful and under what circumstances; and how donors and funders can engage most effectively. It is intended as a primer, seeking to summarise the mass of information in a clear, vernacular way that will make it useful to a wide audience, from established charitable trusts, foundations and private donors to funders working within international institutions and governments. The report concentrates on three issues:

- **Interventions**: what is known about the effectiveness of the many forest-related interventions that are already being employed or have been proposed, and how does theory play out in practice in tropical Africa?
- **Success:** what will it take to achieve forest conservation and restoration success in tropical Africa, both in terms of resources and donor and funder commitment?
- **Needs and priorities**: where is the help and support of donors and funders most urgently needed to conserve and restore forests in tropical Africa?

The report is, so far as we can ascertain, the first of its kind Inevitably, given the broad themes and large geographic scope, the research conducted is incomplete. Much further work needs to be done to understand funding options and priorities, particularly at national and sub-national levels.

Scope

This report is first and foremost about forest carbon. This does not mean that its authors or FPAN believe that forests have no value beyond being giant stores of carbon. Forests are vital natural resources that provide many valuable services, including freshwater; a major habitat for terrestrial biodiversity; food, fibre and fuel for hundreds of millions of people; and last but not least, they are valuable as beautiful and awe-inspiring examples of the wonders of nature. Nor does it mean that the non-carbon values of forests (eg, water services, biodiversity, as homes and sources of livelihoods for communities of forest peoples) are not discussed in this report: there are many synergies between protecting carbon and protecting biodiversity and livelihoods, and the report identifies these where relevant.

The report focuses on forest carbon in tropical Africa for two reasons. Firstly, forests play a critical role in the climate change context as sinks (repositories of stored carbon) and as sources (outputs of greenhouse gas emissions when they are deforested or degraded). Secondly, this role appears to have been largely overlooked. Much of the voluminous literature on tropical African forests concentrates on linkages with poverty alleviation, economic development and the rights and livelihoods of forest peoples.

At the same time, the scope of the report is very broad indeed: it aims to provide an overview of the evidence supporting the effectiveness of interventions to reduce deforestation and reverse degradation, across five large themes (forestry, agriculture, woodfuels, mining and energy extraction, and conservation), and across 32 countries.[i]

i These countries are Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Democratic Republic of Congo (DRC), Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Guinea -Bissau, Ivory Coast, Kenya, Liberia, Madagascar, Malawi, Mozambique, Nigeria, Republic of Congo, Rwanda, Senegal, Sierra Leone, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

Given the scale of the research challenge, we elected to concentrate on two goals: offering a clear analysis of the state of Africa's forests, the main causes of deforestation in the region and the likely impact of future trends; and presenting a balanced assessment of the interventions, and providing clear recommendations and guidance for donors and funders. The report does *not* seek to provide:

- an examination of the detail of REDD design, enabling conditions and financing options, as there is already a substantial literature on these topics; or
- an analysis of investment opportunities, as opposed to philanthropic options, although it does indicate where market-based approaches may be effective as a route to tackling a particular problem, such as distributing energy-efficient wood-burning stoves.

The ProForest report

The state of knowledge on what is happening to forest carbon at the ground level appears to be very poor, especially for Africa. At the beginning of this research project, FPAN encountered a dearth of carbon data in a number of essential areas, including:

- the amount of carbon stored per hectare in different forest types in Africa;
- the impact of particular activities (eg, selective logging) on forest carbon; and
- the impact of certain interventions (eg, community forestry) on forest carbon.

In response, FPAN commissioned **ProForest**, a UK-based forest research organisation specialising in natural resource management and practical approaches to sustainability, to conduct a review of primary data on forest carbon in tropical Africa cited in peer-reviewed journals. The findings of this research are summarised in **Chapter 3**.

(The full report, *Terrestrial carbon: emissions, sequestration and storage in tropical Africa: ProForest review of the scientific literature and existing carbon projects for FPAN* can be found in **Annex 1**).

Structure

The case for donor action on tropical forests (Chapter 1) is the introduction to the report. It lays out the case for why philanthropists should focus on forest carbon, and why reducing deforestation and degradation in Africa should be a priority.

Tropical forests and the rise of REDD (Chapter 2) describes the history of tropical forest protection, culminating in the emergence of REDD: reduced emissions from deforestation and degradation. The rise of REDD offers an opportunity that follows decades of delays and reversals that have blighted efforts to protect the world's forests.

REDD and tropical Africa (Chapter 3) takes readers from the story of global efforts to protect the world's tropical forests, and turns towards the state of forests in tropical Africa.

Chapters 4-8 make up the core of the report. These chapters explore in detail the state of play in Africa's tropical forests across five themes: forestry, agriculture, woodfuels, mining and energy extraction, and conservation. The sectors are often closely related – for example, many subsistence farmers make charcoal outside of the growing season – and these chapters therefore refer to each other heavily.

This breakdown has an underlying logic: forests are utilised for a wide range of resources, including timber, agricultural land, energy, and the resources that lie beneath them. The first four thematic chapters explore how the use of each of these resources impacts Africa's tropical forests, and how NGOs, governments and other actors are responding to these impacts. The final thematic chapter looks at activities of a different kind: interventions that seek to conserve and restore forest carbon.

The structure of each of the thematic chapters follows a similar format, with introductory overviews followed by sections on:

- **Introduction:** introduces the topic and sets the scene.
- **The state of [the sector] in tropical Africa:** describes the scale and extent of the sector, the different types of activity, and the patterns of supply and demand.
- **Problems, challenges and future trends:** synthesises evidence on the relative impact of the sector on Africa's tropical forests, the interplay of causes and underlying social and economic factors, and what future trends mean.
- **Interventions and responses:** provides an overview of evidence for the effectiveness of major interventions being employed in response to deforestation, and advises donors and funders on what types of interventions could be funded.
- **Conclusions:** summarises key findings and recommendations.

Genesis of the report: lessons from *Green Philanthropy*

This report has its origins in the donor interviews carried out for New Philanthropy Capital's 2007 report, *Green Philanthropy: Funding charity solutions to environment problems*,[1] which found that a new generation of foundations, individual philanthropists and other funders has recognised the scale and gravity of threats posed by global warming and natural resource depletion, but their support is constrained by poor information and a lack of clear guidance: *'many donors – including younger philanthropists – want to give to environment charities but are held back by uncertainty over the most effective ways to contribute.'*

Green Philanthropy identified a lack of research on the effectiveness of interventions as a major inhibitor of donor action. This gap is particularly apparent on tropical forests, with very little published analysis of the range of approaches and activities available. As well as drawing on *Green Philanthropy* and New Philanthropy Capital's body of work on charitable effectiveness, this report is also a response and contribution to the need for a global approach to protecting tropical forests, as identified by the David & Lucile Packard Foundation in 2008, in *Tropical Forest Carbon Grantmaking Strategy: A Strategy for Collaborative Philanthropic Support for Reducing Emissions from Deforestation and Degradation (REDD)*.[2]

The research process

Following an initial desk-research phase, the FPAN team visited four tropical African countries – Cameroon, Democratic Republic of Congo (DRC), Tanzania, and Uganda – and conducted in-depth consultations with NGOs, government officials, businesses, and experts. Other consultations were carried out in the US, UK, EU and Kenya. For the list of organisations and individuals consulted, see the acknowledgements at the end of the report.

While the genesis of this report lies in the lessons from *Green Philanthropy* and the Packard Foundation's tropical forest grant-making initiative, the research approach and analytical framework also owe a large debt to the pioneering emissions mitigation modelling carried out since 2003 by (amongst others) Robert Socolow and Stephen Pacala, McKinsey & Company, the Stern and Eliasch Reviews, Project Catalyst, Design to Win/Climate Works and the Terrestrial Carbon Group. Their work has provided powerful new tools that are transforming the way in which climate-related philanthropy can be framed and conducted.

About FPAN

The Forests Philanthropy Action Network (FPAN) was founded by Nicholas Josefowitz and Bernard Mercer in early 2008, and became a UK registered charity in 2009. It has three goals:

- to encourage more charitable trusts, foundations and private individuals to engage with the challenge of protecting and enhancing forests;
- to foster informed debate and dialogue on these issues; and
- to produce research-based guidance for donors and funders who are looking to support effective action on forests.

Board of trustees

FPAN is chaired by Nicholas Josefowitz, founder and CEO of Rengen Energy, a business that sources, develops and finances renewable energy, carbon credit, and biomass supply projects. Nicholas has also founded the Pure Climate Foundation as a charitable trust focused on climate change issues.

Other FPAN trustees are: George Leventis, Jason Scott (EKO Asset Management Partners), Lila Preston (Generation Investment Management) and Stephen Rumsey (The Wetland Trust).

Report authors

Bernard Mercer

Bernard co-founded FPAN with Nicholas Josefowitz of the Pure Climate Foundation. In addition, he advises a number of foundations and philanthropists on forests, biodiversity, climate change, and other environmental issues, including the Synchronicity Earth Foundation and The Wetland Trust (a UK-based family trust with a strong commitment to tropical forest conservation and restoration). Bernard is also the chairman of the BBC Wildlife Fund, and of the NHBS Environment Bookstore, which he founded in 1985. His past roles include serving as the first CEO of New Philanthropy Capital (NPC) from 2001–2004. In 2007, he authored NPC's overview of environmental funding and charities, *Green Philanthropy*.

Jonathan Finighan

Jonathan has eight years experience working as a research consultant in the philanthropic sector in Australia and the UK. He has assessed grant applications and conducted research to advise grant-making strategy for the Reichstein Foundation and the Myer Foundation in Melbourne. He worked as a researcher for *Green Philanthropy* for New Philanthropy Capital. Jonathan authored the chapters on agriculture and woodfuels for this report and carried out wide-ranging research throughout the life of the project. Jonathan is now studying for an MSc in Environmental Technology at Imperial College, with a keen interest in the links between agricultural development, food security and the environment.

Thomas Sembres

Thomas holds an MPhil in Environmental Policy from Cambridge University. A French native speaker, having previously worked in Ethiopia at the Economic Commission for Africa, Thomas participated in five country visits in Central and East Africa for this project and provided substantial analytical inputs to this report, particularly for the Forestry and Mining and Energy Extraction chapters. Since then Thomas has delivered training on payments for environmental services, first in Gabon for the Government and civil society and then in France for students of the Master of Public Affairs at Sciences Po. He joined the World Bank in January 2010 to work as a forest specialist within the Forestry Team.

Joshua Schaefer

Joshua has worked in the consultancy and financial services sectors, and is currently carrying out research on forest carbon modelling and analysis for Permian, a forest conservation and restoration company. He holds an MBA from the London Business School, an MSc in finance from Birkbeck College, and an MA and MPhil in History from Cambridge University. Joshua carried out research for the Forestry and Mining and Energy Extraction chapters, and contributed to a number of drafts of the report, particularly Chapters 1–3.

References

1. Mercer, B., *Green Philanthropy: Funding charity solutions to environment problems.* A guide for donors and funders. 2007, New Philanthropy Capital: London. Available from: www.philanthropycapital.org.
2. David & Lucile Packard Foundation, *Tropical Forest Carbon Grantmaking Strategy: A Strategy for Collaborative Philanthropic Support for Reducing Emissions from Deforestation and Degradation (REDD).* 2008. Available from: http://www.packard.org/assets/files/conservation%20and%20science/Tropical_Forest_Carbon_Grantmaking_Strategy_-_June_2008.pdf.

CHAPTER 1: THE CASE FOR DONOR ACTION ON TROPICAL FORESTS

- **A call for donor action**
- **Tropical forests and climate change**
- **Africa's tropical forests and climate change**
- **What can philanthropy do for Africa's tropical forests?**

Chambura Gorge, Uganda
©iStockphoto/Prill Mediendesign and Fotografie

CHAPTER 1: THE CASE FOR DONOR ACTION ON TROPICAL FORESTS

Chapter summary

- **A call for donor action** looks at the background to the challenge of conserving and restoring tropical forests, asking why so little has been achieved despite widespread consensus on their importance, before going on to outline the rise of REDD and the current and potential contribution of philanthropy.
- **Forests and climate change** sets out the compelling case for very large-scale action to reduce greenhouse gas emissions from tropical deforestation and degradation, and how this global imperative will not be acted upon unless wealthy nations shoulder the costs and provide unstinting support and commitment.
- **Africa's tropical forests and climate change** focuses on the case for immediate action across the 500 million hectares of tropical forest on the continent, underlining why the threats to forest carbon in Africa are as critical in the global context as forest loss in the Amazon and Indonesia.
- **What can philanthropy do for Africa's tropical forests?** This section summarises the wide range of opportunities that exist for charitable trusts, foundations and individual donors to provide invaluable support, both in relation to generic needs (eg, capacity building of in-country NGOs) and for each of the thematic areas that are covered in detail later in the report – forestry, agriculture, woodfuels, mining and energy extraction, and conservation.

1. A call for donor action

1.1 We want to save tropical forests, but do too little to protect them

Building consensus to tackle some environmental threats is a formidable task, because of fundamental disagreements within society. On some issues, the disagreements centre on whether a particular problem really exists; on others, disputes are a function of priorities: does the problem matter? While there are many who passionately believe that animals such as pandas, whales, gorillas and orang-utans should not be pushed to extinction, some regard their preservation as of marginal significance or even of no consequence, arguing that other global problems are far more important. And on climate change, the ranks of those who reject claims that human-induced greenhouse gas emissions are the cause of global warming have swelled over the last few years.

The terrible paradox of tropical forests is that there seems to be strong consensus on the urgent need to protect them (including support from climate sceptics, on the basis that they are irreplaceable natural resources) – yet official estimates indicate that 300 million hectares, or about one third of the size of the continental United States, have been lost since 1980. The loss of mature forest cover is higher, because an unknown amount of forest has naturally regenerated in some areas.[i]

Why has the desire to protect tropical forests led to so little effective action? As we explore in **Chapter 2**, efforts to negotiate international agreement have had a troubled history, in part because there are many different perspectives on why they need protection. Are tropical forests valuable because of the carbon they store, or because of the products and services they provide, such as fruits, nuts and other foods, freshwater, rainfall generation, timber, and fuelwood for heating and cooking? Or are they primarily in need of protection because many millions of people and an extraordinary abundance of wild plant and animal species live within them and are reliant on forest resources? Perhaps other reasons for protecting tropical forests – aesthetic, cultural, religious, ecological, and biological – are also at the heart of a definition of tropical forest value?

For donors and funders, these are key questions that surface within every grant application. Because there is a lack of consensus on the 'hierarchy of forest values', definitions of success vary widely, and often conflict. A scheme to help cocoa farmers in West Africa might improve incomes but reduce forest carbon, by incentivising more forest clearance. A proposal for a new protected area that keeps forest carbon intact might lead to the loss of land rights and livelihoods for forest communities.

This report does not seek to comprehensively assess the claims for each of the values of tropical forests, or to weigh or grade them in relation to each other. Instead, it comes at the challenges from the assumption that conserving existing tropical forests and restoring those that are degraded is an absolute need – for all of humanity, and the peoples of the tropics in particular – not an optional extra. The environmental reasons are straightforward: we cannot afford the climate cost of emissions from deforestation and degradation; we need restoration to draw down significant quantities of CO_2 from the atmosphere; and we need all of the ecosystem services that healthy forests provide (especially freshwater, rainfall generation, and biodiversity).

But in practice – and despite rising global concern since the 1970s – the utilisation of forest resources for food, biofuels, bushmeat, fibres and other materials, timber, woodfuels, and the extraction of metals, oil and gas has won out over conservation and restoration in many (but not all) tropical forests. The bias toward utilisation has often

i Re-based FAO data, see Grainger, A. *Difficulties in tracking the long-term global trend in tropical forest area*,[1] which also provides an invaluable commentary on the challenges of calculating accurate and reliable forest cover estimates.

been reflected in the priorities of governments in tropical regions, and the international institutions and donors who have supported them, with economic and infrastructure development and revenue generation usually taking precedence.

Tropical forests have also been used as bargaining chips, in pursuit of other goals. The most egregious example is the position taken by some NGOs and civil society groups in the 1990s during the Kyoto Protocol negotiations. Arguing that tropical forest protection should be made conditional on developed countries implementing deep cuts in their own emissions, some NGOs advocated for the exclusion of forest carbon credits (for avoided deforestation and degradation) from the Protocol's provisions, on fears that cheap credits would flood the market, lower the price of carbon and thus disincentivise fossil fuel mitigation. The argument is sound in the context of global emissions equity, but this opposition has indirectly contributed to further inaction on combating deforestation and degradation over the last decade. Since Kyoto, some NGOs have continued to oppose regulated markets in forest carbon, and it can be argued that the dispute remains a block on rapid and widespread action to implement tropical forest conservation and restoration.

Another example of the bargaining chip approach is the desire of many to tie forest conservation finance to democracy and governance goals and conditions. Should funding be withheld from Burma, Sudan and other undemocratic regimes? To what extent should securing land rights for forest peoples be a precondition? As with the arguments over forest carbon credits, the view that finance should be withheld is entirely defendable relative to global goals on rights, social equity and transparency, but has not triggered new action to protect and restore tropical forests.

1.2 Setting goals for forest conservation and restoration success

Tropical forest conservation and restoration is unquestionably a formidable challenge: the danger is that the negatives tend to occupy centre stage, leading to paralysis and a loss of belief in a better future for tropical forests. Donors and funders immersing themselves in the voluminous literature on reducing emissions from deforestation and degradation, or REDD (see Box 1), may conclude that the principal goal of many experts and participants is to explain – with great clarity – why we cannot conserve and restore tropical forests. The systems for monitoring and verifying carbon gains are not robust and will not work. Land tenure will take decades to resolve. Forest credits will flood the carbon markets and the price of carbon will be too low. Investors will decline to enter the market because the risks are too high and the financial returns inadequate. Before we can save forests we must first eradicate poverty in the tropics…stop the excessive consumption in wealthy countries that is one of the main drivers of tropical deforestation…ensure that the rights and livelihoods of all indigenous and local peoples are fully protected…

Many scientists and commentators seem fixated on explaining how things will get worse if we continue along the 'business as usual' path. Where are the scenarios and models that show how we can triumph over these obstacles? Rights-led NGOs tell us that wrongly framed tropical forest conservation and restoration will marginalise forest peoples and strip them of their land. Where are the visions of how forest protection can lead to a better future for tropical forest inhabitants? Economists insist that the drive for economic growth in developing countries must always take precedence over environmental protection. Where are the projections that show how the huge carbon assets of tropical economies can be leveraged to usher in a new era of prosperity? Instead of chronicling decline, we need to concentrate on envisaging success.

Box 1: The meaning and evolution of REDD

The term **REDD** emerged at the end of 2005, when a coalition of rainforest nations put a proposal for **reducing emissions from deforestation in developing countries** to a meeting of the UN Framework Convention on Climate Change (UNFCCC) in Montreal. Since then, REDD has been developed from an idea to a framework for action, and with the strong endorsement of REDD in the Copenhagen Accord, agreed at the UNFCCC meeting in Copenhagen at the end of 2010, the stage is set for tropical forest conservation and restoration at a scale that has never previously been attempted.

The concept has shape-changed several times. The second 'D' has morphed into **forest degradation** ('developing countries' remains implicit). This development is in recognition of the fact that significant carbon emissions arise from changes to forest structure that do not necessarily count as deforestation – selective logging, woodfuel production, and even slash and burn farming are some examples. Degradation has also been interpreted by some stakeholders to capture negative impacts to forests beyond carbon, such as the loss of biodiversity, or water services.

The next development, during 2009, was to **'REDD-plus'**: *'Reduced Emissions from Deforestation, forest Degradation, conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries.'* The expanded definition reflects rising awareness that, besides avoiding the deforestation and degradation in threatened forests, we also need to protect valuable forests that are not immediately in danger ('conservation'), restore lost forests ('enhancement of forest stocks') and manage forests on sustainable lines.

The future may see the scope of REDD expanding further, beyond forests altogether. Some organisations are advocating for REDD to include emissions reductions from Agriculture, Forestry and Other Land Uses (**AFOLU**), such as grasslands, wetlands and other non-forest ecosystems. This is in recognition of the fact that agricultural land can be a significant source of greenhouse gas emissions.

What might success look like? A first goal could be to restore 300 million hectares of tropical forest, replacing the losses that have occurred over the last thirty years, while at the same time ensuring that none of the remaining tropical forests are deforested or degraded. This is a long way ahead of current ambitions to halve deforestation rates by 2020, and the EU goal of eliminating tropical forest loss by 2030.[2-5] Longer-term objectives could aim to bring tropical forest cover back to where it was before Europe and America's hunger for sugar, coffee and tea began the depredations of empire.[6, 7]

It is easy to dismiss such thinking as hopelessly unrealistic and dangerously utopian. But the same could be said for other global challenges where ambitious targets have been set, such as the eradications of poverty, malaria and tuberculosis that are firmly established within international social policy. Goals that set the bar as high as we can imagine are a critical driver of collective action – as much for forests as for poverty and infectious diseases.

But goals alone are insufficient: plotting a course toward a target is essential. While much of the debate around REDD is heavily process-oriented, some organisations have provided a starting point for this

kind of strategic thinking. Separate estimates from the **International Tropical Timber Organization (ITTO) and the Global Partnership on Forest Landscape Restoration (GPFLR)** put the global area of degraded forestland, which could be restored with some level of forest and tree cover, at 850 million to 1 billion hectares. The ITTO focuses solely on the tropics, but the GPFLR also identifies substantial areas of land suitable for forest restoration in Europe, North-East Asia and Australia.[8, 9]

Perhaps counter-intuitively, addressing deforestation and degradation in the principal countries that provide finance for tropical forest protection could be an ingredient of success. Tropical nations that are asked to protect their forests for the global good can rightly point to the extensive deforestation of much of Europe and parts of North America as evidence of double standards.

The UK, for example, has lost perhaps as much as 90 per cent of its post-Ice Age forest cover,[10] while Europe as a whole has lost around 50 per cent.[11] Forest cover in many developed countries, in Europe and beyond, is increasing, but if plantations are excluded the picture is less rosy: the US had the seventh highest rate of primary[ii] forest loss in the world at the beginning of the 21st century, losing over 200,000 hectares every year in 2000–2005. Russia lost over 500,000 hectares a year over the same period.[12]

At the same time, realism on the art of the possible is essential. Some tropical forest areas will be deforested because forest conservation and restoration cannot compete economically with alternative land uses. For example, the mining of metals and oil and gas extraction can produce per hectare revenues far above any supportable valuation of carbon and ecosystem services. The same is often the case for agriculture. Because supply and demand factors are not uniform, conservation and restoration opportunities will vary widely over time and space. Assessing the options at the local level is the most reliable and efficient means for donors and funders to provide effective support, rather than employing a formulaic approach.

ii Defined as intact natural forest that is largely untouched by human activity.

1.3 REDD – a new dawn for conservation and restoration?

As we explore further in **Chapter 2**, prospects for conserving and restoring tropical forests received a massive boost in 2005 when the Coalition for Rainforest Nations (CfRN), a collaborative group of over 30 tropical forest countries, put a proposal for 'reducing deforestation in developing countries' to a UNFCCC climate meeting in Montreal. Since then, REDD has been developed from an idea into a framework for action, with a clear commitment included within the Copenhagen Accord (see below).[13, 14]

The core REDD idea arose out of the recognition that the conventional economic development model has been disastrous for tropical forests. In country after country (Brazil, Nigeria, Ghana, Malaysia, Indonesia), booming economies and new prosperity have been built on a surge of deforestation, with logging generating valuable cash in the first phase, followed by conversion of forests to cropland. Once cleared, deforested lands have then produced commodities – cocoa, beef, sugarcane, soybean, rubber, palm oil – for which there is strong and rising global demand. The revenues have underpinned the next phase of development – increasing urbanisation, higher per capita incomes, and improved health and education provision.

This poses a dilemma for countries that still have significant forests but are in an early stage of economic development, such as the DRC and Papua New Guinea. Do they sacrifice up to 90 per cent of their forests, as other developed and developing countries have, in order to bring their peoples out of poverty? Is this in their best long-term interests, when large-scale deforestation will intensify global warming?

REDD is a proposition for how this dilemma could be resolved. Instead of deforesting, countries would be paid to keep their forests standing, based on a valuation of forest carbon assets. Because carbon can be measured and unitised in tonnes of physical carbon (and the carbon dioxide equivalent), the valuation can be based on a price of carbon per tonne. The original 2005 REDD proposition

(see **Chapter 2**) argued that this favours an approach where the finance can be earned by trading forest carbon credits in regulated markets as the most equitable and effective mechanism. Countries that adopt wise forest management will earn higher revenues if their carbon assets rise (or reduce at a lower or slower rate). The revenues gained will offset the 'lost revenues' that could have been obtained from timber and agricultural commodity sales on deforested land. From the viewpoint of developed countries, buying forest carbon from tropical countries can be seen as a component of their mitigation commitments, and a means to fulfil the responsibility to help tropical countries achieve greater prosperity that was enshrined in the Millennium Development Goals.

The REDD story since 2005 is mixed. On some fronts, significant progress has been made in developing the concept to a point where it can go operational. But on others, major challenges remain. Some of the outstanding issues (covered in more detail in **Chapter 2**) include: the potential for logging to be an allowable REDD activity (under the *'sustainable management of forests'* heading); the absence of a methodology for rewarding reductions in forest degradation; and the many ongoing difficulties in achieving a workable REDD rulebook, particularly on aspects of carbon measurement, reporting, and verification.

Setting design problems to one side, the massive positive of REDD is that it has provided a framework within which – for the first time – the world has begun to concentrate and focus on the how of tropical forest conservation and restoration. Largely behind the scenes, a quiet revolution is taking place. Teams of scientists, economists and other academics are working with business consultants and policy-makers to piece the REDD infrastructure together: the rules, mechanisms, institutions and processes that will be needed in the operational phase. This is a major cross-sectoral effort, involving the UN, governments, research institutes, carbon finance companies, international institutions, charitable foundations, and NGOs and civil society groups.

The negative is that little has been done thus far to identify strategic priorities and effective interventions. Which forests in which countries are most urgently in need of conservation and restoration? Which activities will produce the best reductions in deforestation and degradation, and the biggest increases in new sequestration (forest re-growth) for the lowest cost?

The overall message for donors and funders is that REDD provides an incredible opportunity to usher in a new era of wise tropical forest stewardship. Their support is critical on many fronts, from the policy arena to direct financing of on-the-ground projects. The billions of dollars of REDD commitments made so far do not remove the need for philanthropy. There are two main reasons for this. First, these sums seem large but are small in the context of the hundreds of millions of hectares of tropical forest where conservation and restoration is an urgent imperative. Second, philanthropic support for efforts to get REDD priorities right is absolutely critical, especially during the formative 2010–2020 period, as we explore below.

1.4 Donor support is vital, but currently limited

New Philanthropy Capital's *Green Philanthropy* report[15] and the *Where the Green Grants Went* publications[16] of the UK Environmental Funders Network (EFN) show that the overall level of philanthropic funding (especially from UK trusts and foundations) for environment-related NGOs and other civil society organisations is low, both in absolute terms and relative to support for other charitable sectors. Analysis in the EFN study of the 97 UK trusts that are active environment funders shows that the total grant distribution in 2006/2007 was £53.9 million ($80 million); this represents close to only 3 per cent of all grants made for that period. This is dwarfed by the environment funding of the US philanthropic sector: £1.34 billion ($2 billion), or 19 times greater than the UK total. On a per capita basis, US foundation giving on the environment is nearly four times that of UK trusts and foundations; moreover, the gap is still growing. In absolute terms, UK environment funding is 3 per cent of total trust giving. The US proportion is higher at 7 per cent.[16]

Within the spectrum of environment activity, tropical forests are only one of several major areas in need of support, including climate change at the overall level and mitigation of fossil fuel emissions; marine and other non-forest ecosystem and biodiversity conservation; and a raft of other issues, from pollution and waste to sustainable development approaches. The result is that NGOs and other civil society groups working on tropical forests are reliant on a relatively small number of funders, who have relatively small sums available for disbursement. In simple terms, tropical forest conservation and restoration is chronically underfunded from a philanthropic perspective.

But, as we explore in **Chapter 2**, the handful of philanthropic funders who are active and ongoing supporters of tropical forest work have been highly influential in the development of REDD. For example, Terrestrial Carbon Group, the Coalition for Rainforest Nations and the Ecosystem Climate Alliance have all made important contributions, which would not have been possible without philanthropic support. Governmental and intergovernmental funding for NGOs is quite limited (especially for the critical areas of policy advocacy, research, and REDD design). This increases the need for philanthropic 'seed capital' at a time when there is a premium on new ideas and innovation that can drive effective action as REDD moves into an operational phase.

The most pressing need is for more philanthropic funders that commit to ongoing grant-making programmes over the next 5–10 years. The current group of such funders could almost be counted on the fingers of two hands. This is very unhealthy, because NGO activity can become too reliant on one or two funders. If, for example, either the David & Lucile Packard Foundation or the Gordon and Betty Moore Foundation were to cease support for tropical forest work, the repercussions for a wide range of key NGOs would be severe.

There are some encouraging signs that the funder base is beginning to expand (see **Chapter 2**), but this needs to be accelerated, particularly in the UK, which has a disproportionately smaller number of philanthropic forest funders relative to the NGO base than the US. The consequence is that UK NGOs probably draw more of their finance from public donations and supporter and membership income than their US counterparts, although such assertions are difficult to substantiate because of the lack of analysis of funding flows. If this is the case, it can be argued that the weakness of UK forests philanthropy may be contributing to two negative trends: the lack of serious scrutiny of forest NGO objectives and performance (foundations normally require stronger accountability than public givers); and a lack of funding for research and innovation. As we see throughout this report, claims of the efficacy of particular interventions are frequently based on scant and disputed evidence, and this in turn reflects on the underfunding of research, particularly secondary and comparative analysis.

Where is the support of philanthropic funders most needed? In the overall tropical forest context, there is a strong need for funding that continues and redoubles support for NGO efforts to secure the best possible REDD framework. This includes vital lobbying and campaigning to ensure the inclusion of effective approaches as allowable activities (for example, natural restoration as a sequestration category), and the obverse – working to exclude some activities that may be harmful to forests, especially forestry practices that are being advocated by some for inclusion under the 'sustainable management of forests' umbrella. There is also an opportunity for philanthropy to contribute at the strategic level through funding that aims to improve our understanding of which forests are most at risk and most in need of conservation and restoration action.

As we see in the concluding section of this chapter, the priorities look very different when attention is focused on a geographic region, rather than tropical forests as a whole. For tropical Africa, the philanthropic priorities identified through research for this report overwhelmingly point to the need for practical action rather than policy-related activity.

2. Tropical forests and climate change

Forests perform a dual role in the climate change context, increasing global air temperature when they act as *sources* of emissions (through deforestation and forest degradation), and reducing global air temperature when they act as *sinks* (through removal of greenhouse gases from the atmosphere and subsequent storage in biomass and soils).

Quantifying and communicating these negative and positive climate impacts has proven highly problematic. Unlike censuses of human populations, or assessments of oil consumption based on sales of barrels, data on changes in forest carbon is largely based on predictive modelling – the extrapolation of results from a combination of remote sensing and information collected from sample sites. Modelling of this type will always be vulnerable to significant margins of error (as we explore below). The alternative (physically counting or bar coding every tree on the planet) is far beyond reach.

In broad terms, current global data on forests underestimates actual emissions, because forest degradation is not accounted for. The UN's Food and Agriculture Organization (FAO) designates forests as 'deforested' when 10 per cent or less of the original tree cover is left. As a result, emissions released from up to 90 per cent of forest loss are not officially counted.[iii] In addition, forest data almost certainly underestimates the sink function – both current and potential – although uncertainties and the paucity of data on carbon sequestration mean that published estimates provide wide rather than narrow ranges.

iii As we went to press, a new paper by Sasaki and others, *Approaches to Classifying and Restoring Degraded Tropical Forests for the Anticipated REDD-plus Climate Change Mitigation Mechanism* (in press, Biogeosciences and Forestry) notes that emissions due to forest degradation suggest that they double the 1.5-2.2 PgC yr^{-1} released by deforestation.

The overall conclusion is that forests are far more important in the climate change context than is generally understood, because actual carbon losses and potential carbon gains are significantly undercounted. See Box 2 for a summary of data challenges and uncertainties relating to tropical forests.

2.1 Tropical forests as sources of emissions

Land use activity (including agriculture) is a major driver of climate change, producing between 30–35 per cent of global anthropogenic (human-induced) greenhouse gas emissions.[17-19] Deforestation accounts for c 50 per cent of this total, with estimates ranging from 12–17 per cent of global emissions (mostly in the tropics).[17, 20, 21] The underlying contribution of land use to global warming is higher than this data indicates, because emissions from forest degradation are not currently counted. Emissions from forest soil degradation and loss are also incompletely quantified.

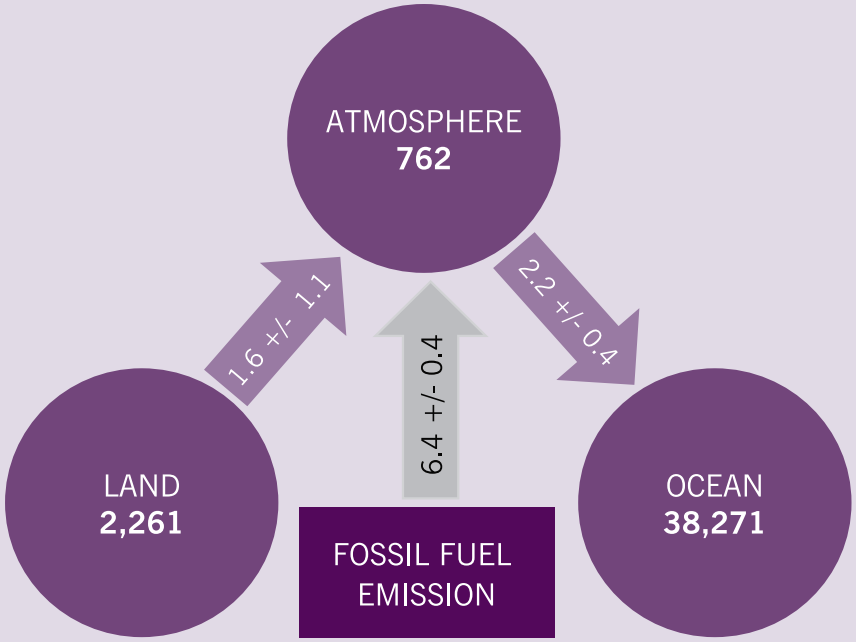
2.2 Tropical forests as carbon sinks

There are an estimated 1.6 billion hectares of tropical forest (see Table 1). These forests are estimated to store 512GtC, which if deforested would emit 1,877GtCO_2; for comparison, global greenhouse gas emissions for the year 2005 were estimated to be about 45GtCO_2e.[22]

2.3 Forests are central to the global carbon cycle

Forests are central to the global carbon cycle (see Figure 1). As trees grow, they absorb carbon from atmospheric carbon dioxide (CO_2), the most common anthropogenic greenhouse gas, and use it as a building block to grow. In exchange, trees give out oxygen; this is a process that was begun by algae in primordial pools at the earliest phase of biological life on Earth. When plants die and decompose, or burn, much of the carbon they stored is returned to the atmosphere, and again becomes CO_2 (methane and nitrous oxide are also released through decomposition).

Figure 1: The global carbon cycle: carbon stored in, and annual net exchanges between, the land, oceans and atmosphere (billion tonnes of carbon)*



Source: IPCC, Climate Change 2007: *The Physical Science Basis. Contribution of Working Group to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.*[23]
* Negative figures mean a net reduction of carbon from the atmosphere. Carbon stores and all cumulative fluxes since 1750 are as of the end of 1994.

Courtesy of Rainforest Foundation UK

Some of the plant matter is buried and compressed by geological forces over time to become coal, crude oil, or natural gas. These fossil fuels can be thought of as a legacy product, bequeathed by millions of years of plant life that has made the Earth habitable for humans and other animals, by removing vast volumes of CO_2 from the atmosphere.

While humans have used some fossil fuels and forest carbon for thousands of years, utilisation accelerated sharply with the advent of the industrial revolution 250 years ago, leading to significant alterations in the global carbon cycle. Large-scale conversion of fossil fuels by burning them to generate energy has released carbon into the atmosphere that was previously safely stored underground; and large-scale clearing and burning of forests (and other land ecosystems, such as wetlands and grasslands) has increased the exchange of carbon between land, atmosphere and oceans (also called the carbon flux).

2.4 Why is deforestation higher in the tropics?

Current rates of deforestation are much higher in the tropics than in temperate regions, in part because many developed countries have already been heavily deforested over the last few centuries. And in Europe and North America agricultural land has declined over the last 200 years as crop yields increased through the industrialisation of agriculture, and as globalisation allowed developed countries to outsource some of their agricultural production to other parts of the world – often the tropics.

Box 2: Gaps in knowledge on forests and carbon emissions

Are global estimates of emissions from deforestation accurate? The IPCC's *Fourth Assessment Report* of 2007 notes that studies over the past decade have consistently reported annual emissions from deforestation and degradation around a mean of 1.6GtCO_2e per year for the 1990s.[23-28] This figure is also supported by the findings of a 2008 study.[29] However, the IPCC notes that these estimates are subject to very large error margins, of around 1GtCO_2e – implying a range from 0.5 to 2.7GtCO_2e.

Are global estimates of forest cover and composition accurate? Serious concerns have been raised over the accuracy of surveys performed by the UN Food and Agricultural Organisation (FAO).[1, 30] Emissions estimates based on deforestation data from such surveys may be flawed.

How much carbon do different types of forest sequester and store? Data on how much carbon different types of tropical forest actually store, sequester, and emit (when cut down and burnt), is poor, especially in tropical Africa, as explored in the **ProForest** report.[iv] This could undermine the accuracy of macro-level estimates for global net emissions.

iv See **Chapter 3** for a summary of the **ProForest** report. (The full report, *Terrestrial carbon: emissions, sequestration and storage in tropical Africa: ProForest review of the scientific literature and existing carbon projects for FPAN* can be found in **Annex 1**).

Are emissions from degradation being measured? A hectare of forest could lose most of its carbon stocks, through activities like small-scale logging or even some agriculture, before being registered as deforested. By failing to account for emissions from degradation, estimates are grossly underestimating how much carbon tropical forests are releasing to the atmosphere every year.

Are old-growth tropical forests still sequestering carbon? Research in the past few years has found mature forests in the tropics do still sequester carbon, not in a 'steady state' as previously thought.[31-34] These forests cover huge areas of land in Africa and South America in particular – perhaps they could be off-setting a proportion of emissions from deforestation and degradation elsewhere. This would make the loss of mature forests even more damaging in climate terms.

Are forests sequestering more carbon as a response to higher concentrations of CO_2? Trees absorb CO_2 as they grow – once absorbed, carbon becomes trunks, branches and leaves. Higher concentrations of CO_2 in the atmosphere could therefore stimulate trees to grow faster and bigger, which could compensate for the increase in carbon emissions caused by humans. However, some research suggests that this may be offset by changes to carbon sequestration in tree roots, meaning that the overall effect on carbon sequestration is negative. Research is ongoing.[35]

2.5 Tropical deforestation and emissions mitigation targets

The mainstream consensus is that annual global greenhouse gas emissions need to be reduced by 17GtCO_2e[v] by 2020 to hold the increase in global temperature to no more than 2°C. This correlates to a ceiling of 450 ppm (parts per million of CO_2e) in the atmosphere (See Figure 2 and Figure 3).[vi] Holding the temperature increase at this level is the target agreed in the Copenhagen Accord.[13] Calculations by McKinsey and Project Catalyst argue that about **50 per cent** (9GtCO_2) of this total reduction in annual emissions have to be obtained from reducing tropical deforestation and degradation. This projection is based on the assumption that obtaining equivalent mitigation from fossil fuel sources is not possible in the time frame (due to current unavailability of appropriate technologies, such as carbon capture and storage (CCS) in power generation) (Figures 3–5).[19, 38, 39]

The implications are staggering. Many of the poorest nations in the world are expected to deliver half the global emissions reductions required by 2020. To achieve this goal, they must carry out effective forest conservation and restoration across vast areas of many millions of hectares. Wealthy countries are helping, through the World Bank, the United Nations, and bilateral aid, but the undertaking is huge. A few countries (notably Brazil) may have the forest protection infrastructure in place, but many are equipped with weak and inadequate capacity. This is particularly true for tropical Africa, where the collective manpower and budgets of all of the forest protection agencies across the region would probably be considered insufficient to manage more than one or two national parks in the US or the UK. Looked at from this perspective, the early funding provided by the FCPF (Forest Carbon Partnership Facility) and UN-REDD for REDD capacity building is a drop in the ocean (see **Chapter 2**).

Why is so much being expected of tropical countries? The answer is that the reductions that are needed over the next ten years are deemed to be unobtainable by other means. The technologies required to lower emissions in the energy and transport sectors will not be deployable at significant scales for years to come. For example, no full-scale CCS power station has yet been built or refitted, and large solar or geothermal power grids are far from implementation. When the construction cycle is factored in to the equation, significant mitigation contributions from new power generation are not expected to materialise until the 2020-2050 period. Cost is also a factor: CCS and other technologies are expensive per tonne of carbon mitigated (see **Figure 4**).

By contrast, McKinsey argues, reducing emissions from deforestation and forest degradation can be achieved sooner and more cheaply, with fewer technological constraints to overcome. Logging and forest clearance can be halted by political and economic decisions; degraded forests can be allowed to regenerate; demand for timber can be met from tree plantations, rather than forests; charcoal production from forests can be significantly reduced through marketing highly efficient cooking stoves and alternative fuels, such as briquettes and biogas. The challenges facing efforts to reduce deforestation are not so much technological as political and social: building the political will to conserve forest carbon, in the face of lucrative agricultural expansion, and setting up the institutions required to effectively finance forest carbon protection, for example.

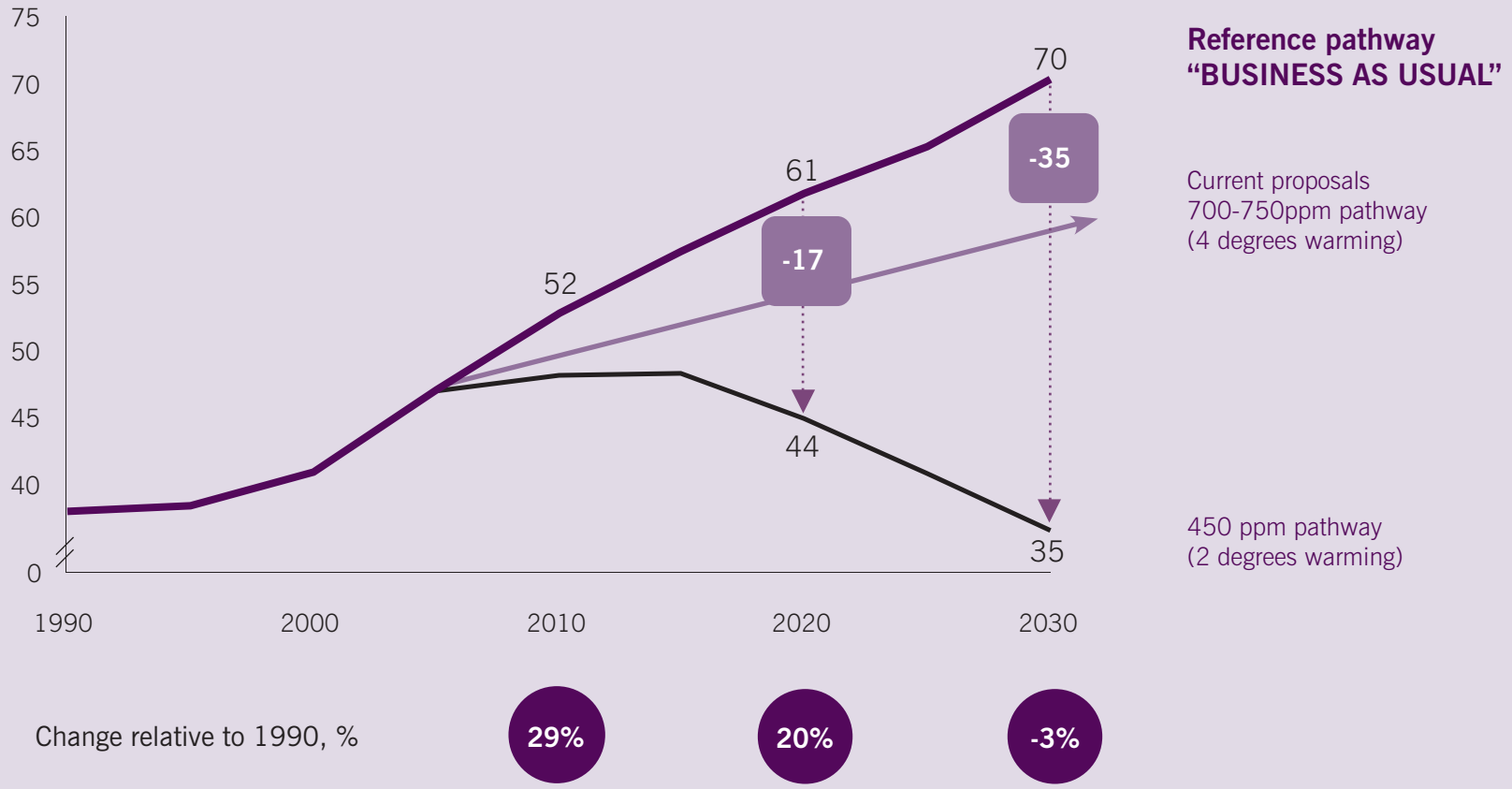
Political and social problems are not necessarily less challenging than technical barriers, and it should also be noted that many questions remain around how interventions such as timber plantations and improved woodfuel stoves can be most effectively implemented. Nevertheless, it is arguable that these kinds of problems can be overcome sooner than the technological constraints preventing large-scale emissions reductions in the energy and transport sectors. Any hope of beginning significant mitigation of global emissions therefore begins with reducing emissions from deforestation and degradation. Failure to do this in the next decade will lead to higher greenhouse gas concentrations in the atmosphere by 2020 and make the challenges of climate change almost impossible to overcome.

v Gigatonnes of 'carbon dioxide equivalent' ($GtCO_2e$). This is used to represent the aggregate global warming potential of all greenhouse gasses for a particular source or timescale. Greenhouse gasses such as methane and nitrous oxide are far less concentrated in the atmosphere than carbon dioxide, but their potential to trap heat, and therefore impact global warming is much higher: methane is estimated to have 25 times the global warming potential of carbon dioxide, and nitrous oxide almost 300 times (over a 100 year timescale).

vi More recent analysis from Project Catalyst estimates that the global recession and lower estimates for emissions from deforestation and land-use have reduced projected business as usual (BAU) emissions in the year 2020 by 61 $GtCO_2e$ to 58 $GtCO_2e$, narrowing the gap between BAU emissions and climate safety from 17$GtCO_2e$ to 14 $GtCO_2e$.

Figure 2: Current proposals put us on a 700–750 ppm pathway and a 4 degree future

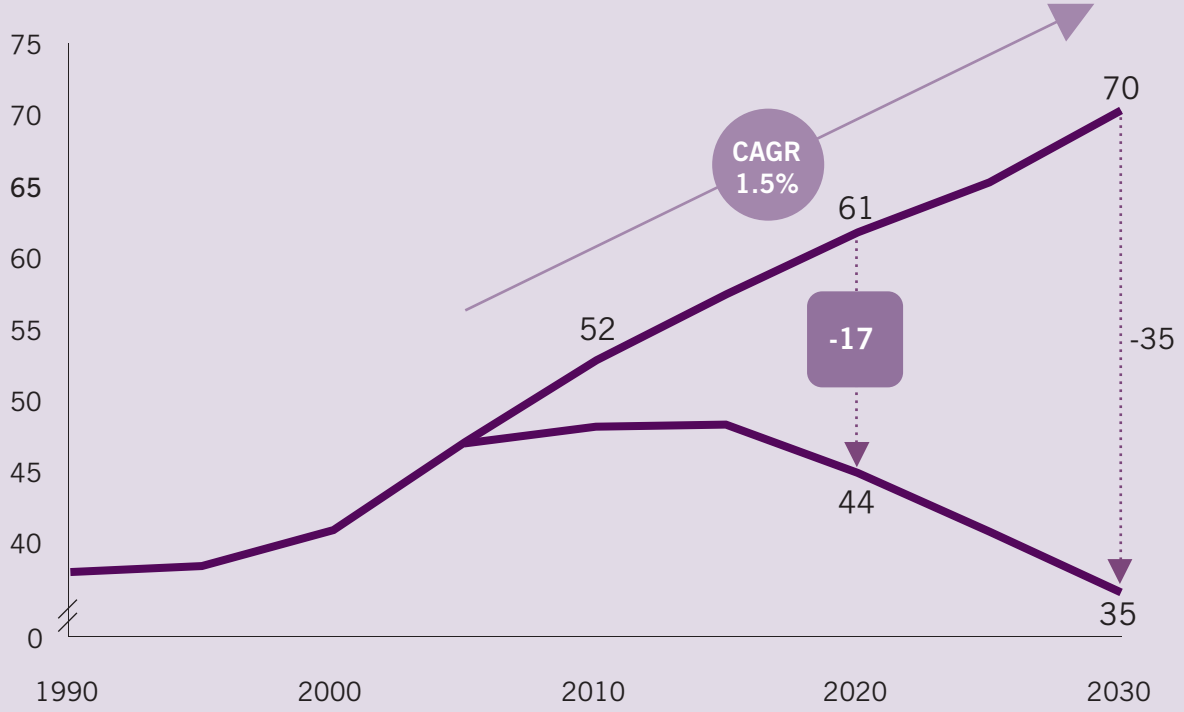
Global GHG emissions, $GTCO_2e$ per year



Source: Adapted from Project Catalyst, *Towards a Global Climate Agreement: Synthesis Briefing Paper, June 2009.*[36]

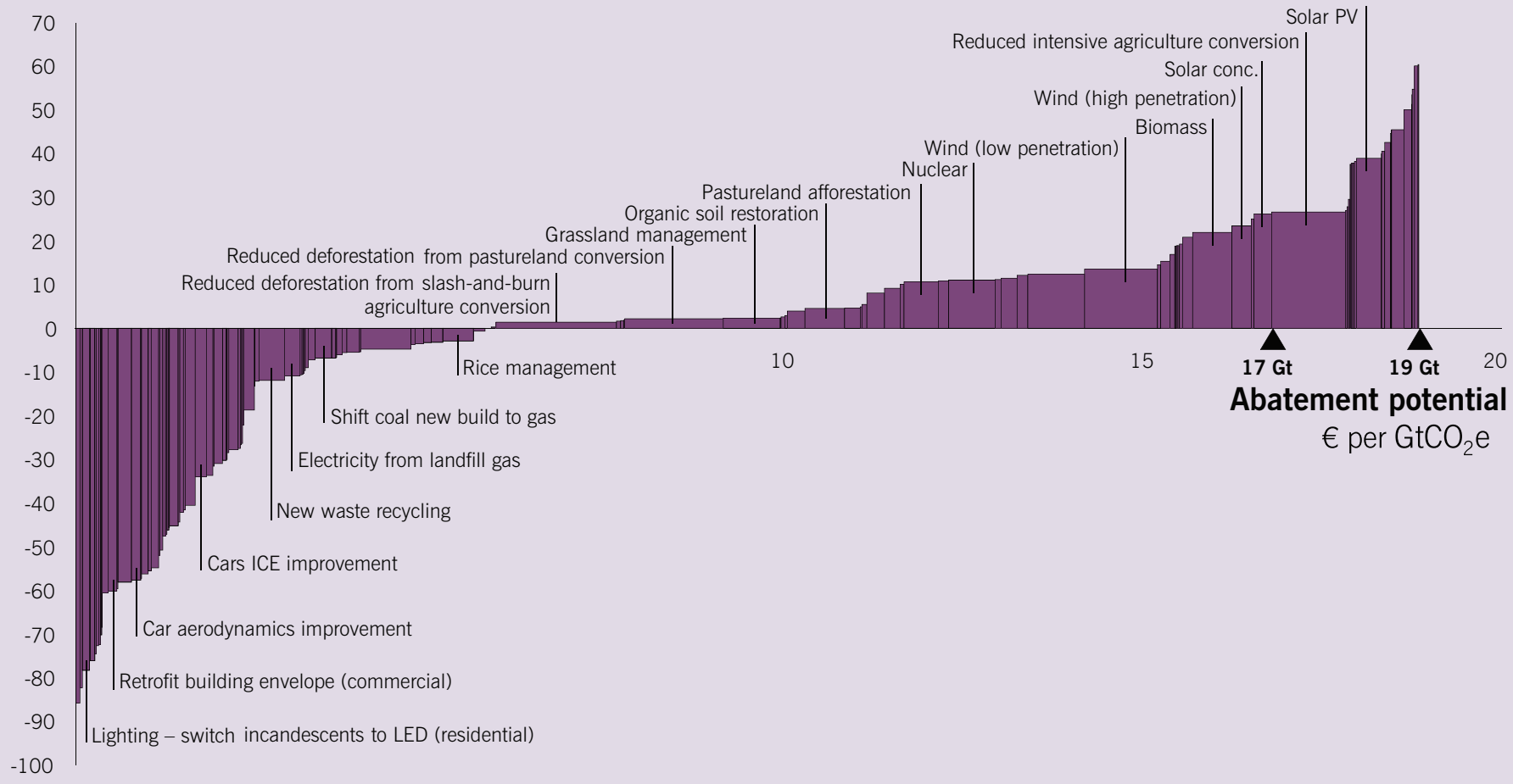
Figure 3: Emissions reductions required versus business-as-usual

Global GHG emissions, $GtCO_2e$ per year



Source: Adapted from Project Catalyst, *Towards a Global Climate Agreement: Synthesis Briefing Paper, June 2009*.[36]

Figure 4: McKinsey global greenhouse gas abatement cost curve, 2020*



Source: McKinsey & Company, Pathways to a Low Carbon Economy: Version 2 of the Global Greenhouse Gas Cost Abatement Curve. 2009.[19]
* Up to costs of €60 ($74) per tonne abated.

2.6 Commitments

Scientists, NGOs and tropical forest countries have made significant progress in raising the profile of reducing deforestation as a climate change mitigation strategy. A strong commitment to include REDD in a future international climate change treaty was one of the few points of clarity to come out of the COP15 meeting in Copenhagen in December 2009. Some REDD finance has already been provided by governments and international institutions to support capacity building and pilot projects in tropical forest countries in preparation for a future REDD scheme.

2.6.1 The Copenhagen Accord

The December 2009 Copenhagen Accord[13] was an important step toward averting catastrophic global warming. For the first time in history, 190 countries committed to a financing and implementation framework that will aim to hold the global temperature increase at no more than 2°C by 2050. The commitment of $100 billion a year of new funding for developing countries from 2020 is also a first, and is roughly equivalent to the entire existing global overseas development aid (ODA) flows. The Accord is also the first time that both developed (Annex 1) and developing (non-Annex 1) countries have agreed to put forward their own quantified emissions reduction targets and national mitigation plans.

In financial terms, REDD can expect to receive a substantial (but undefined) amount from the $30 billion of climate mitigation commitments for the 2010–2012 period announced in the Accord, and a proportion of the targeted $100 billion a year envisaged by 2020. These are very large amounts of money relative to the historical annual spend by governments on tropical forests. For comparison, the world's biggest environmental donor (the World Bank's Global Environment Facility) has an annual budget of around $700 million, but this covers the whole range of marine and terrestrial ecosystems, not just tropical forests.[38]

The Accord has been widely criticised for what it does not include or do: it is not legally binding; it is based around the 2°C target rather than the 1.5°C demanded by many developing countries, especially vulnerable small island states; it does not mandate an international body to have oversight of the transparency of measurement, assessment, reporting and verification monitoring issues (MARV); it does not specify the sources and composition of the $100 billion of finance; and it does not commit countries to mandatory emissions reductions targets. Nevertheless, the ambitions and commitments embodied in the Accord are higher than all previous iterations of the UNFCCC (United Nations Framework Convention for Climate Change) process. If countries live up to their promises then the Accord may come to be seen as a historic milestone.

From a tropical forests perspective, the Accord is very significant. Almost two decades after the first attempt to embed forest protection within international agreements (the failed *'Forest Principles' drawn up at the Earth Summit in Rio in 1992), the Accord unequivocally recognises 'the crucial role of reducing emissions from deforestation and degradation and the need to enhance removals of greenhouse gas emission by forests.'* It also endorses REDD-plus (see Box 1) as the optimal forest protection and enhancement model to achieve these aims. The Accord goes on to outline measures to provide the investment that REDD-plus will require, through multilateral, bilateral, public, private and alternative sources of finance, with a significant portion of the funding flowing through a new Copenhagen Green Climate Fund.

2.6.2 Government and multilateral funding for forests

Government and multilateral funding to reduce emissions from deforestation and degradation (REDD) in tropical forest countries is now substantial (see **Chapter 2**). The United Nations, through its UN-REDD programme, and the World Bank, through its FCPF, are together committing over $200 million to REDD capacity building and pilot projects.[39, 40] The World Bank Group as a whole spent over $500 million on forest conservation and sustainable management in 2009,[41] while other development banks (such as the African Development Bank) have together committed around $100 million in total. REDD funding from donor governments is also significant. $4.5 billion was pledged for REDD (for 2010–2012) during the Copenhagen meeting by Norway, Japan, the US, Britain, France and Australia.[42, 43]

3. Africa's tropical forests and climate change

Africa's tropical forests constitute the second largest reservoir of tropical forest carbon in the world. Its forests are being lost at an alarming rate and, due to a multitude of causes (including agricultural suitability, poor protection and lack of alternative energy sources), they could be at greater risk of deforestation than forests in other parts of the tropics.

3.1 Sub-Saharan Africa has the second largest tropical forest area in the world after Latin America

Sub-Saharan Africa has an estimated half a billion hectares of forest (see Table 1). These forests are estimated to store **171GtC**, 35 per cent more than Asia and only a quarter less than Latin America. This translates into potential carbon dioxide emissions of 627GtCO_2; for comparison, global greenhouse gas emissions for the year 2005 were estimated to be about 45GtCO_2e.[22]

Table 1: Forests and forest carbon data in the three major tropical forest regions

Region	Total forest carbon (GtC)	Total forest area, 2005 (million ha)	Annual (%)deforestation 2000–2005 (million ha)	Annual deforestation (%)
Latin America	215	853.9	4.33	0.5%
Africa	171	504.1	3.06	0.6%
Asia	126	283.1	2.85	1.0%

Source: Strassburg, B., A. Creed, and R. Ashton, *Policy Briefs 1: Distribution of Terrestrial Carbon Across Developing Countries.*[44] Food and Agricultural Organization (FAO), *Global Forest Resources Assessment 2005.*[12]

Africa's tropical forest carbon is distributed across many countries. The DRC holds around a third of tropical Africa's forest carbon[44] but 16 other countries are estimated to have forest carbon stocks of more than 1GtC each (see **Chapter 3**).

3.2 Africa's tropical forests are being lost at an alarming rate due to a multitude of causes

Sub-Saharan Africa lost an estimated **thirty million hectares** of forest (equivalent to the size of Finland) in the first decade of the 21st century.[45] This is nearly **30 per cent** of global tropical forest loss in the period. Only Latin America lost more over this period, with 4.3 million hectares being cleared every year. The annual rate of loss is particularly alarming: 0.6 per cent, **three times the global average**. Emissions from this forest loss are significant, estimated at up to 900MtCO_2 (megatonnes, or million tonnes, of CO_2) a year in 2005 – roughly equal to the global emissions from shipping and aviation in the same year.[22, 29]

Deforestation and forest degradation in tropical Africa is the product of a set of proximate causes (eg, logging, woodfuels and agricultural expansion) and underlying drivers (infrastructure, migration, commodity prices).[vii] The interplay between the various causes and drivers is explored more fully in **Chapter 3** and the subsequent thematic chapters. The key messages are:

- **Forestry is often at the front line of deforestation.** This is especially true in forests with high value timber trees (Central Africa), where logging causes significant degradation and can open up forests to new causes of deforestation.

vii For one of the most comprehensive and widely cited accounts of the interplay of proximate causes and underlying drivers of deforestation, see Geist & Lambin, *Proximate Causes and Underlying Driving Forces of Tropical Deforestation*.[46]

- **Agricultural expansion is the greatest cause of deforestation in tropical Africa.** Some estimates attribute agriculture as a cause in over 80 per cent of deforestation.
- **Demand for woodfuels has severely affected Africa's forests.** Demand for basic energy – in the form of raw fuelwood or charcoal – accounts for over 80 per cent of all wood that is harvested from Africa's forests.
- **Mining and energy extraction have cleared large areas of forest.** The 'forest footprint' of mining and oil drilling can extend far beyond the site of extraction itself, because of transport infrastructure and settlements.
- **Infrastructure development can be a major driver of deforestation.** New roads, railways and ports lower transport costs and thus increase the profitable frontier of Africa's forests.

3.3 Africa's tropical forests are poorly protected and face a high risk of conversion

Research from Terrestrial Carbon Group (TCG) concludes that 67 per cent, or almost 300 million hectares, of Africa's tropical forest area is at risk of being cleared in the future. TCG estimates that only 38.3 million hectares, under 8 per cent, of Africa's tropical forests are 'effectively protected by law' (many areas are nominally protected but effectively unprotected). Forests outside of effectively protected areas face a high risk of conversion: TCG assessed the agricultural suitability of forested land across the tropics, as a means of modelling which forests are likely to undergo agricultural conversion in the future. TCG concluded that a high proportion of Africa's forests are suitable for agriculture: 85 per cent, compared to 70 per cent in South-East Asia, and 90 per cent in Latin America.[12, 47]

In addition to protecting vast stores of carbon, reducing deforestation in tropical Africa could help reduce the negative impacts of climate change, and preserve vital ecosystem services, such as rainfall generation.
Courtesy of Rainforest Foundation UK

3.4 Reducing deforestation in Africa could also bring multiple benefits in terms of development and economic growth

The case for focusing on Africa is also compelling for other reasons that are not related to forest carbon and deforestation rates. The need for philanthropic support is arguably greater in Africa than other regions because of relatively poor institutional capacity and resources, and smaller financial flows towards forest protection projects. Furthermore, the important ecosystem services that standing forests provide to agriculture, such as rainfall generation, soil conservation and cooling local temperatures, means that conserving forests could be absolutely vital in helping tropical African countries adapt to climate change. This is especially pertinent given predictions on the negative impact of climate change on crop yields in Africa (which are already the lowest in the world).[48-50]

4. What can philanthropy do for Africa's tropical forests?

Tackling African tropical deforestation faces many challenges, but there are also many opportunities. As in other sectors (for example, health, education or development), philanthropic funding can catalyse and lever action on a much larger scale. It can fill gaps in the support and investment provided by governments, international institutions and the private sector, often for projects and initiatives that are experimental and innovative. Philanthropy can also play a role in building the foundations of global efforts to protect forest carbon, by funding research to fill the significant gaps that remain in forest carbon data; requiring grant recipients to evaluate, and make publicly available, the carbon impact of their projects; and funding in-country governmental and civil society forestry capacity.

4.1 Overall priorities and opportunities

4.1.1 More philanthropy

More philanthropy is needed to conserve and restore Africa's tropical forests. At present there are too few charitable foundations and other donors and funders with ongoing grant-making programmes for the region. This constrains activity (too little money available), and is unhealthy (NGOs are too reliant on one or two annual grants, and funder commitments to existing grantees can stifle innovation).

4.1.2 Philanthropy's catalytic role

Philanthropic funders might conclude that because of the billions of dollars committed to REDD in Copenhagen, their support will not be needed. This is far from the case. Much of the funding will pass from governments to governments, and through market channels, and many NGOs with new ideas and entrepreneurial energy will continue to find it difficult to access adequate finance, as they do at present. Philanthropic funders have the freedom to provide start-up capital for new organisations and projects in ways that intergovernmental and governmental donors often cannot.

This is particularly true for in-country NGOs across tropical Africa, where capacity is often severely constrained by lack of funding. In Angola, for example, there is almost no NGO or civil society infrastructure devoted to the forest carbon challenge, despite Angola having the second largest stores of forest carbon in Africa, behind the DRC.[51]

Another area where philanthropy can play a catalytic role relates to the need for a vision of success in the region. A first goal in tropical Africa could be to restore the millions of hectares of forest that have been lost over the last thirty years, while at the same time ensuring that none of the remaining forests are deforested or degraded. A longer-term objective could be to bring Africa's tropical forest cover back to where it was before the colonial era. Philanthropy can help by encouraging all participants to work more strategically, setting priorities, targets and objectives.

4.1.3 The need for better evidence on effectiveness

The **ProForest** report (see **Annex 1**) exposes the paucity of the current evidence base on which key decisions on Africa's tropical forests are based. Unless the evidence is improved, poorly substantiated theories will continue to drive activity, and this could have disastrous consequences. Philanthropic funders can play an absolutely key role here, by insisting that grantees monitor and evaluate their forest carbon impacts, and by funding secondary research that compares the results of different practices (for example, different approaches to restoration).

4.1.4 Small-scale and bottom-up approaches need to be integrated within large-scale thinking

The last two decades have seen a shift toward bottom-up approaches to managing forests in the tropics, based on granting ownership or management rights to people living around those forests. Interventions like community forestry are strongly supported, both within development agencies (especially the Scandinavian and UK bilateral funders) and the rights-based NGO community. But community-based approaches have their weaknesses: they can be very difficult to scale up, and can often involve trade-offs between improving livelihoods and conserving carbon. They can also bring with them very high transaction and management costs, and lack of economies of scale.

Forest carbon conservation and restoration in tropical Africa must take place at very large scales if the necessary emissions reductions from deforestation and degradation are to be achieved. The implication is that national and regional initiatives are integral to the overall effort: relying solely on small community-based projects will be a recipe for failure. Donors and funders can help to resolve these difficulties by providing support on pragmatic rather than ideological lines. There is no inherent virtue in top-down or bottom-up: both are needed, and are not mutually exclusive.

4.1.5 Forest carbon and development goals

One of the great ironies of the history of tropical forest protection is that when 'offsets' were first proposed (in the early 1990s), one of the attractions was their presumed ability to deliver 'win-wins' – improvements in livelihoods and jobs (co-benefits) as well as protection and enhancement of carbon and ecosystem values. Subsequent disenchantment with forest offsets was due in part to growing recognition that delivering win-wins was in fact challenging.

At the heart of the problem of co-benefits lies the reality that different participants have different goals. Many international institutions, governments and NGOs have development remits alongside their forest protection responsibilities. But core development priorities – alleviation of poverty, the protection of the rights and livelihoods of forest peoples, and the drive to improve economic prosperity – can lead to tensions with forest carbon objectives: it is dangerous to assume that both sets of priorities will be mutually supportive. From a donor perspective, the key is to understand which co-benefits are being sought alongside carbon, and to scrutinise the evidence (and any trade-offs) on dual gains.

4.1.6 Tropical Africa and the global REDD deal

REDD is an evolving concept: exactly how it will operate and who will be rewarded for reducing deforestation (and for which activities) is still being negotiated between world governments, NGOs and international institutions. Small changes to the wording of policies or treaties relating to REDD may set precedents for how forest carbon conservation and restoration will be approached for years to come, and have huge consequences for the world's tropical forests. For example, the failure to exclude monoculture plantations from the definition of 'forest' could mean that replacing degraded forest with palm oil plantations is counted as a conservation success. Philanthropists can help ensure that the final shape of REDD puts an emphasis on the conservation and restoration of natural forests, by funding negotiating parties (whether NGOs, governments or businesses) that are working within the UNFCCC process to secure the best possible framing of allowable and non-allowable activities.

4.1.7 Practical action is being neglected because of the focus on policy

The UNFCCC process has been vital as the centre of attention on the development of the REDD framework. But an unintended consequence is that actual forest conservation and restoration is being neglected. Many REDD schemes are on hold while efforts continue to be made to reach a global climate agreement. Philanthropy can help by providing seed funding and other support to catalyse immediate practical action.

4.2 Thematic priorities and opportunities

The recommendations below show that there are many effective interventions that donors and funders can support immediately, all of which are ingredients in overall forest conservation and restoration success.

4.2.1 Forestry

Converting logging concessions to forest conservation and restoration areas. Over 120 million hectares of forest across six Central and West African countries could potentially be zoned to allow logging in the future. This is about the size of France, Germany and the UK combined. The rise of REDD means that protecting these forests could potentially become competitive with logging them, in terms of the revenue generated for governments.

Supporting timber plantations for domestic markets. Plantations dedicated to meeting the vast domestic demands in tropical Africa for timber and woodfuels could help ease pressure on forests and free forests for carbon conservation. Our preliminary calculations, using Tanzania and Uganda as case studies, suggest that meeting national timber demand with plantations would require only 5–20 per cent of the area of forest needed to meet demand.

Conserving forests delivers a better outcome for forest carbon than 'sustainable use' options. Where logging is being practised, Sustainable Forest Management (SFM) practices could reduce carbon emissions, compared to conventional logging. However, compared to conserving an intact forest, these practices still result in significant loss of forest carbon, estimated at up to 40 per cent in some studies. Donors and funders should not lose sight of this baseline when making funding decisions around forest carbon protection. If the opportunity exists to fully protect a natural forest, then it should be protected.

4.2.2 Agriculture

Ensuring agricultural development in tropical Africa is sustainable. Agricultural development in Africa has shot to the top of the development agenda after many years of neglect. Philanthropic dollars can help ensure that tropical African countries do not replicate the experience of widespread, commercially driven deforestation seen in some other tropical forest regions.

Scaling up agricultural systems that sequester more carbon. Farming systems using agroforestry, biochar or conservation agriculture could increase carbon storage in agricultural lands and play an important role in mitigating climate change, while improving food security – if scaled up to reach millions of farmers.

4.2.3 Woodfuels

Promoting efficient cooking stoves. Low-cost stoves that can halve fuel consumption are being promoted by NGOs, development agencies and small businesses in many countries. Taking improved stoves to scale could significantly reduce the total woodfuel harvest: our preliminary calculations suggest that distributing improved stoves to Kenya's 6 million rural households could potentially reduce fuelwood consumption by 50 per cent, saving up to 8.4 million tonnes of carbon a year. Commercialised supply chains have reached millions of households in some countries. Donors should be open to supporting businesses, not just NGOs, to expand their stove operations.

Establishing woodfuel plantations. Woodfuel plantations, especially charcoal plantations near towns and cities, could help reduce deforestation and degradation by diverting woodfuel production away from forests. Producing woodfuels from plantations could drastically reduce the amount of land required to meet demand for energy, and relieve the pressure of woodfuel harvesting on forests. Our preliminary calculations suggest that all of Kinshasa's annual charcoal demand could be met from plantations covering only 200,000 hectares – about 12 per cent of the area of natural forest that would be required

to grow this volume of wood every year. Donors with strong business expertise and the stamina to contemplate multi-year involvement could make a significant difference.

Promoting alternatives to woodfuels. While many millions of people across tropical Africa are likely to remain reliant on woodfuels for the foreseeable future, alternative energy sources are viable in many cases: biomass briquettes, biogas, solar cookers and liquid petroleum gas are all examples. Alternatives need to be price competitive, convenient, safe, and readily available if consumers are going to voluntarily switch en masse from woodfuels. Poor consumer awareness is a barrier for many alternatives. Donors could help by supporting NGOs and businesses manufacturing and distributing alternative energy technologies, as well as funding public education programmes.

4.2.4 Mining and energy extraction

Fostering a concept of reduced impact mining. The mining industry appears to be responding very slowly to REDD and protecting forest carbon, despite the impact of the industry on forests. 'Sustainable mining' as it currently exists looks primarily at social issues and non-forest environmental issues such as water pollution. Donors and funders could help to develop and promote mining practices that inflict less damage to forests, such as roadless extraction and reforesting depleted sites.

Improving extractive industries regulation. Philanthropy could also help by funding organisations that are trying to improve regulation in the sector. For example, requiring mining companies to reforest areas of land as compensation for deforestation on their sites could produce significant mitigation. Another positive intervention would be to include forest carbon assessments within environmental impact assessments (EIAs). Pursuing these reforms through existing regulatory initiatives such as the Extractive Industries Transparency Initiative (EITI) might be an option.

4.2.5 Conservation and restoration

Supporting conservation and restoration in existing protected areas. Many existing protected areas in tropical Africa are severely under-resourced. As a result, protection is often inadequate, resulting in ongoing logging and woodfuels removals. In the short term, they are unlikely to obtain significant additional finance from governments. Philanthropic support can act as critical 'bridging finance' until more permanent funding mechanisms can be devised.

Funding new large-scale forest conservation and restoration areas. There is an absolutely critical need for new forest conservation and restoration projects in tropical Africa that start now and do not wait for a global deal to be finalised. These should potentially be able to draw on a combination of philanthropic and voluntary market finance, and may also be able to attract support from international institutions and governments. Donors and funders could prioritise the millions of hectares of dormant and already logged forestry concessions that can be found across tropical Africa, which afford huge opportunity to conserve existing forests and restore those that have become degraded.

Supporting capacity building in tropical African forest protection. Many African countries have woefully underfunded forest protection agencies and civil society organisations. They do not have the resources to protect their forests properly. The World Bank and UN agencies are supporting capacity building in a number of African countries, but this is relatively modest and will, in many cases, not reach the full range of organisations that have parts to play. Donors and funders can make a big contribution by filling this gap, especially on NGO capacity building.

5. References

1. Grainger, A., *Difficulties in tracking long-term global trends in tropical forest area.* PNAS, 2007. 105(2): p. 818-823.
2. AFPNews. *People's climate summit seeks to halve emissions by 2020.* 26 May 2010]; Available from: http://www.google.com/hostednews/afp/article/ALeqM5jAZKcwJAE6Z33Ysu8-ExCL-eTFyw.
3. European Commission. *Environment: Forests*. 22 April 2010 26 May 2010]; Available from: http://ec.europa.eu/environment/forests/deforestation.htm.
4. Pro Natura (Friends of the Earth Switzerland), et al., *Submission to the CBD SBSTTA 14.* 2010. Available from: http://www.wetlands.org/LinkClick.aspx?fileticket=OAu9%2BHiuztM%3D&tabid=56.
5. Amazon Environmental Research Institute (IPAM), et al, *Financing Options for REDD+.* 2010. Available from: http://www.conservation.org/Documents/Joint_Climate_Policy_Positions/Financing_Options_for_REDDplus_English.pdf.
6. Ferguson, N., *Empire: the Rise and Demise of the British World Order and the Lessons from Global Power.* 2003, London: Penguin.
7. Tucker, R.P., *Insatiable Appetite: The United States and the Ecological Degradation of the Tropical World.* 2000, London: University of California Press.
8. Global Partnership on Forest Landscape Restoration. [cited 2009 17 November]; Available from: http://www.ideastransformlandscapes.org/.
9. International Tropical Timber Organization (ITTO), *ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests.* 2002. Available from: http://www.itto.int/en/policypapers_guidelines/.
10. UK Clearing House Mechanism for Biodiversity, *Nature and extent of UK forest cover*. Available from: http://uk.chm-cbd.net/default.aspx?page=7637.
11. UNEP-WCMC, *European Forests and Protected Areas: Gap Analysis*. 2000, UNEP-WCMC & WWF. Available from: http://www.unep-wcmc.org/forest/eu_gap/Technical%20Report.pdf.
12. Food and Agricultural Organization (FAO), *Global Forest Resources Assessment 2005*. 2006, FAO: Rome, Italy. Available from: ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E00.pdf.
13. United Nations Framework Convention on Climate Change (UNFCCC), *Draft decision -/CP.15. Proposal by the President. Copenhagen Accord*. 2009. Available from: http://unfccc.int/resource/docs/2009/cop15/eng/l07.pdf.
14. Coalition for Rainforest Nations (CfRN). *United Nations Climate Change Conference: Montreal, Canada.* 2005 9 December 2005 26 May 2010]; Available from: http://www.rainforestcoalition.org/eng/MontrealUNFCCC.php.
15. Mercer, B., *Green Philanthropy: funding charity solutions to environment problems. A guide for donors and funders.* 2007, New Philanthropy Capital: London. Available from: www.philanthropycapital.org.
16. Environmental Funders Network (EFN), *Where the Green Grants Went: Patterns of UK Funding for Environmental and Conservation Work.* 2009. Available from: http://www.greenfunders.org/wp-content/uploads/WTGGW4-Final.pdf.
17. IPCC, *Working Group III: Climate Change Mitigation, in IPCC Fourth Assessment Report,* B. Metz, et al., Editors. 2007, Cambridge University Press: Cambridge, UK, and New York, NY, USA. Available from: http://www.ipcc.ch/ipccreports/ar4-wg3.htm.
18. Terrestrial Carbon Group, *How to Include Terrestrial Carbon in Developing Nations in the Overall Climate Change Solution*. 2008. Available from: http://www.terrestrialcarbon.org/site/DefaultSite/filesystem/documents/Terrestrial%20Carbon%20Group%20080808.pdf.
19. McKinsey & Company, *Pathways to a Low Carbon Economy: Version 2 of the Global Greenhouse Gas Cost Abatement Curve.* 2009. Available from: http://www.mckinsey.com/clientservice/ccsi/pathways_low_carbon_economy.asp. Version 1 was published in 2007. Other valuable McKinsey materials can be found at their Climate Change Special Initiative website, http://www.mckinsey.com/clientservice/ccsi/. It is noteworthy, however, that the principal focus is on fossil-fuel related mitigation, with only one paper relating to land use (by Richard Elman, on agriculture and water).
20. Carbon Positive. *Deforestation accounts for 12% of emissions.* 09 November 2009 08 June 2010]; Available from: http://www.carbonpositive.net/viewarticle.aspx?articleID=1722.

References continued

21. Mongabay.com. *Emissions from deforestation overestimated; 12% rather than 17%*. 04 November 2009 08 June 2010]; Available from: http://news.mongabay.com/2009/1103-redd_emissions.html.
22. World Resources Institute, *Climate Analysis Indicators Tool (CAIT)*. 2008. Available from: http://cait.wri.org/.
23. IPCC, *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, S. Solomon, et al., Editors. 2007, Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA. Available from: http://www.ipcc.ch/.
24. Houghton, R.A., *Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management 1850-1950.* Tellus, 2003. 55B: p. 378-390.
25. Achard, F., et al,, *Improved estimates of net carbon emissions from land cover change in the tropics for the 1990s*. Global Biogeochemical Cycles, 2004. 18.
26. DeFries, R., et al, *Carbon emissions from tropical deforestation and regrowth based on satellite observations for the 1980s and 90s*. Proceedings of the National Academy of Sciences of the United States of America, 2002. 99(22): p. 14256-14261.
27. Fearnside, P. and W. Laurance, *Comment on "Determination of Deforestation Rates of the World's Humid Tropical Forests"*. Science, 2003. 299: p. 1015a.
28. Achard, F., et al,, *Determination of Deforestation Rates of the World's Humid Tropical Forests*. Science, 2002. 297.
29. Houghton, R.A., *Carbon Flux to the Atmosphere from Land-Use Changes: 1850-2005, in TRENDS: A Compendium of Data on Global Change.* 2008, Woods Hole Research Centre: Falmouth, M.A., USA. Available from: http://cdiac.ornl.gov/trends/landuse/houghton/houghton.html.
30. Grainger, A., *An evalution of the FAO tropical Forest Resrouce Assessment,* 1990. The Geographical Journal, 1996. 162.
31. Lewis, S.L., et al, *Increasing carbon storage in intact African tropical forests.* Nature (London), 2009. 457(7232): p. 1003-1006.
32. Luyssaert, S., et al., *Old-growth forests as global carbon sinks*. Nature, 2008. 455: p. 213-215.
33. Grace, J., *Understanding and managing the global carbon cycle. Journal of Ecology,* 2004. 92(2): p. 189-202.
34. Baker, T.R., et al, *Increasing biomass in Amazonian forest plots.* Philosophical Transactions of the Royal Society London, 2004. B (359): p. 353-365.
35. Heath, J., et al., *Rising atmospheric CO_2 reduces sequestration of root-derived soil carbon.* Science, 2005. 309(5741): p. 1711-1713.
36. Project Catalyst, *Towards a Global Climate Agreement: Synthesis Briefing Paper*, June 2009. 2009. Available from: http://www.project-catalyst.info/images/publications/towards%20a%20global%20climate%20agreement_july3_v.pdf. Briefing paper accompanying the Project Catalyst presentation made at UNFCCC side event, Bonn.
37. McKinsey & Company, *Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?* 2007. Available from: http://www.mckinsey.com/clientservice/ccsi/pdf/US_ghg_final_report.pdf. McKinsey & Company have produced similar nation-based reports on greenhouse gas mitigation options for Australia, Belgium, Brazil, China, Czech Republic, Germany, Sweden, and the UK, all downloadable from http://www.mckinsey.com/clientservice/ccsi/Costcurves.asp.
38. Global Environment Facility (GEF). 26 April 2010]; Available from: http://www.thegef.org/gef/.
39. World Bank. *Forests Issue Brief*. June 2010 18 June 2010]; Available from: http://go.worldbank.org/TZB54EA2T0.
40. United Nations Collaborative Programme on Reducing Emissions for Deforestation and Degradation in Developing Countries (UN-REDD). 16 October 2009]; Available from: http://www.un-redd.org.
41. World Bank. *Forests and Forestry.* 18 June 2010]; Available from: http://go.worldbank.org/VIQE69YFZ0.
42. REDD-plus, *'About that $3.5 billion...'*. 2010. Available from: http://redd-plus.com/drupal/thematic-group/redd-and-finance/US$3.5-billion-redd-commitment-at-copenhagen.

References continued

43. Carbon Positive, *REDD may yet survive Copenhagen failures.* 2009. Available from: http://www.carbonpositive.net/viewarticle.aspx?articleID=1786.

44. Strassburg, B., A. Creed, and R. Ashton, *Policy Briefs 1: Distribution of Terrestrial Carbon Across Developing Countries*. 2009, Terrestrial Carbon Group (TCG). Available from: http://www.terrestrialcarbon.org/TCG%20Policy%20Brief%201%20Distribution%20of%20TC%20090606.pdf.

45. Food and Agricultural Organization (FAO), *Global Forest Resources Assessment 2010: Key Findings*. 2010, FAO: Rome, Italy. Available from: http://foris.fao.org/static/data/fra2010/KeyFindings-en.pdf.

46. Geist, H.J. and E.F. Lambin, *Proximate Causes and Underlying Driving Forces of Tropical Deforestation*. BioScience, 2002. 52(2): p. 143-150.

47. Terrestrial Carbon Group, *Estimating Tropical Forest Carbon at Risk of Emission from Deforestation Globally: Applying the Terrestrial Carbon Group Reference Emission Level Approach*. 2009. Available from: www.terrestrialcarbon.org. Policy Briefs 3.

48. World Bank, *Agriculture for Development, in World Development Report 2008*. 2007, The World Bank: Washington, D.C., USA. Available from: http://go.worldbank.org/LBJZD6HWZ0.

49. allAfrica.com. *Climate change threatens food security* 2009 19 January 2009 21 January 2009]; Available from: http://allafrica.com/stories/200901190949.html.

50. Conway, G., *The science of climate change in Africa: impacts and adaptation, in Grantham Institute for Climate Change Discussion papers.* 2009. Available from: https://www8.imperial.ac.uk/content/dav/ad/workspaces/climatechange/pdfs/discussion_papers/Grantham_Institue_-_The_science_of_climate_change_in_Africa.pdf.

51. Terrestrial Carbon Group, *Distribution of Terrestrial Carbon Across Developing Countries*. 2009. Available from: http://www.terrestrialcarbon.org/.