



GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

A photograph of two young children, a boy and a girl, crouching on a large, moss-covered tree stump in a forest. The boy, on the left, is wearing a green t-shirt and looking directly at the camera. The girl, on the right, is shirtless and looking slightly away. The background is a blurred forest scene.

LAND USE, LAND-USE CHANGE, AND FORESTRY (LULUCF) ACTIVITIES

Chinese farmer works in a rice field. For many farmers rice is the main source of income.

Foreword





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The Global Environment Facility (GEF) provides substantial resources to developing and transition countries to mitigate greenhouse gas (GHG) emissions. One key focus is to promote conservation and enhancement of carbon stocks through sustainable management of land use, land-use change, and forestry—commonly referred to as LULUCF. These GEF interventions cover the spectrum of land-use categories as defined by the Intergovernmental Panel on Climate Change (IPCC), including reducing deforestation and forest degradation, enhancing carbon stocks in non-forest lands and soil, and management of peatlands.

The LULUCF sector is important for climate change mitigation, as it is a significant source of both GHG emissions and carbon storage, with impacts on the global carbon cycle. For instance, land-use change, such as conversion of forests into agricultural lands, emits a large amount of GHG to the atmosphere. The most recent IPCC information (2007) estimated GHG emissions from this sector to comprise roughly 20 percent of total global emissions from human activity, although others have estimated this sector as equivalent to 10-15 percent of total emissions. On the other hand, terrestrial ecosystems such as forests and wetlands store a significant amount of carbon.

The LULUCF issues are intricately linked to how and where people live and sustain themselves, and how ecosystems are managed. The GEF's LULUCF projects support a broad range of activities. These include: increasing afforestation and reforestation; defining conservation areas to secure carbon sinks; and securing and establishing positive incentives for sustainable management of forests. The GEF's projects also support policies and regulations to avoid deforestation; strengthen networks of stakeholders; and build capacity of national and local institutions. Through cross-cutting projects, LULUCF activities work in synergy with sustainable forest management, biodiversity, and land degradation projects to reduce the vulnerability of forest and non-forest lands to climate change. As a result, GEF's LULUCF projects promote multiple environmental, social and economic benefits.

In addition to mitigating GHG emissions, the GEF's LULUCF projects promote development of systems for measuring and monitoring carbon stocks and flux from forest and non-forest lands, and strengthening related policies and institutions. The GEF projects support good management practices with local communities with positive impacts on people's livelihoods, and establish better carbon accounting systems to support future investments and development of financing mechanisms.

To date, the GEF has supported 32 projects that explicitly address the LULUCF objective, and 24 cross-cutting projects with LULUCF components.* A conservative estimate of emission avoidance from 26 of the total 56 projects is approximately 250 million tonnes of carbon dioxide equivalent (CO₂ eq), with an average cost of US\$1.09 per tonne of CO₂ eq.

The GEF is committed to promoting conservation and enhancement of carbon stocks through LULUCF. I hope that the following pages will help readers gain a better understanding of our efforts and will inspire innovation and more successes in LULUCF initiatives to address global climate change challenges with local impacts.

* Cross-cutting projects include LULUCF and SFM/REDD+ projects as well as mixed projects. SFM/REDD+ stands for Sustainable Forest Management/Reducing Emissions from Deforestation and Forest Degradation in developing countries; and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries.

Recently cleared pasture at the edge of the Amazon forest. Expanding cattle ranches are a major cause of deforestation in Brazil.





Land Use, Land-Use Change, and Forestry (LULUCF)—a Challenge for Developing Countries

The Land Use, Land-Use Change, and Forestry (LULUCF) sector is important for climate change mitigation as it has the potential to reduce greenhouse gas (GHG) emissions and sequester carbon. Land use and forestry are intricately linked to how and where people live and sustain themselves, and LULUCF measures can provide global environmental benefits while addressing community benefits. The Global Environmental Facility (GEF) helps developing and transition countries address LULUCF concerns by investing in projects to help conserve, restore, enhance and manage the carbon stocks in forest and non-forest lands.

The purpose of this brochure is to document the GEF's efforts in the LULUCF sector. The brochure presents strategies for reducing GHG emissions and increasing carbon sequestration.¹ The brochure also presents the means of calculating carbon benefits associated with LULUCF projects.

Terrestrial vegetation and soils account for major pools of carbon. These carbon stocks in land-based ecosystems are mostly concentrated in forest ecosystems and wetlands, and are distributed irregularly between tropical and northern latitudes as shown in Figure 1. Tropical forests play a particularly important role in sequestering (fixing into organic matter) 1 Giga tonne (Gt) of carbon every year, or about 40 percent of the total for land-based absorption (Britton et al. 2007). On a global scale, terrestrial ecosystems trap about 2.6 Gt of carbon annually (range of 0.9 to 4.3 Gt). This compares with per capita emissions in Brazil of 2.1 t carbon dioxide equivalent (CO₂ eq) per year (World Bank 2012), and illustrates how important terrestrial carbon sequestration can be.

BOX A LULUCF DEFINITION

Land use, Land-use Change, and Forestry (LULUCF) is defined by the United Nations Framework Convention of Climate Change (UNFCCC) as “A greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land use change and forestry activities”. Activities associated with LULUCF can impact the global carbon cycle by contributing to the addition or removal of GHG to and from the atmosphere (UNFCCC 2012).



Deforestation of the rainforest for soybean fields in Brazil

About half of the earth's ice-free land surface has been directly transformed by humans, and virtually all land has been affected by some sort of human activity through indirect factors such as climate change. Much of the direct change is a consequence of land use, and today about 40 percent of the land surface is in agriculture (crops and pasture).

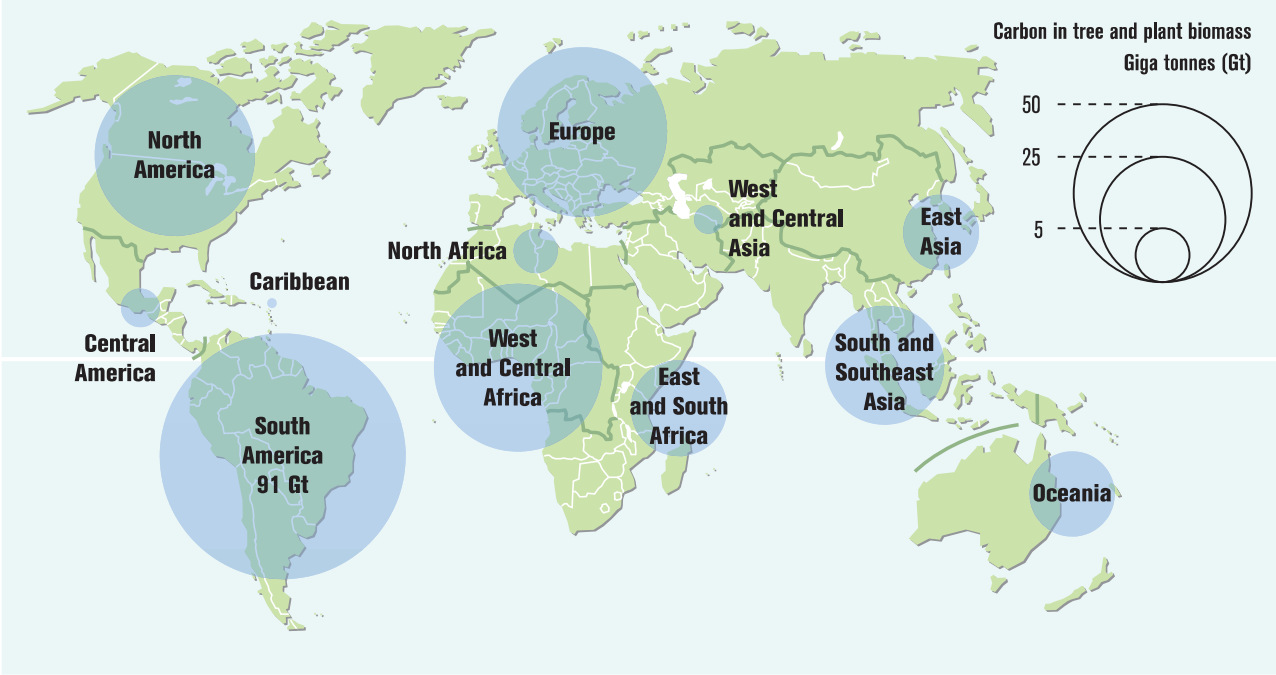
Since the 1850s the world has seen a shift in the locations where major carbon flux² from the land takes place, as shown in Figure 2. The location of major flux was the United States until 1910, then China until 1960. Now the locations of major flux includes Central and South America, South and Southeast Asia, and tropical Africa, where a very large flux of carbon to the atmosphere continues. This current flux from the land is attributed to emissions from deforestation and other land-use change activities in the tropics. The IPCC (2007) estimated these emissions at about 6 Gt CO₂ eq per year, or the equivalent of roughly 20 percent of the total global emissions from human activity. However, others more recently estimated CO₂ emissions from

land-use change and forestry to be roughly equal to 10 to 15 percent of total human induced emissions (Denman et al. 2007, Friedlingstein and Prentice 2010, Peters et al. 2012).

Emissions of GHG can be avoided by sequestering carbon on the land through converting non-forest land to forest land and by encouraging native reforestation; planting trees; restoring peatlands; or converting cropland to permanent pastures. Estimates of carbon sequestration when cropland or pasture is converted to forest or plantation range from 5.7 to 7.5 t CO₂ eq per hectare (ha) per year.

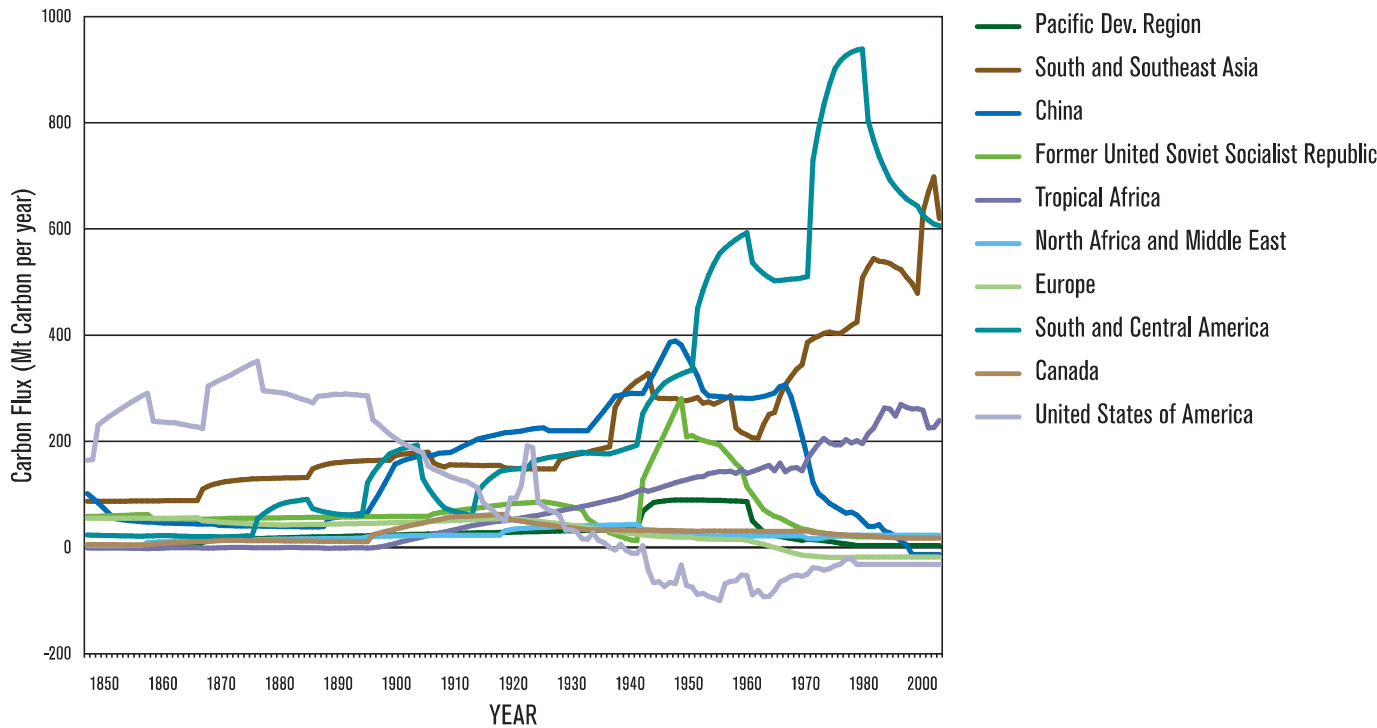
Growing trees in an agroforestry or silvopasture system can be compatible with agriculture and ranching and also are effective at sequestering carbon (Braimoh 2012). As a result, the LULUCF objective is synergistic with that of Sustainable Forest Management (SFM) and is closely linked to the GEF biodiversity and land degradation focal areas in generating multiple global environmental, social and economic benefits.

FIGURE 1 CARBON STOCKS IN TREE AND PLANT BIOMASS BY REGION



Source: FAO 2006a.
Map produced by Emmanuelle Bournay

FIGURE 2 ANNUAL NET FLUX OF CARBON TO THE ATMOSPHERE FROM LAND USE CHANGE



Note: from Houghton 2008.



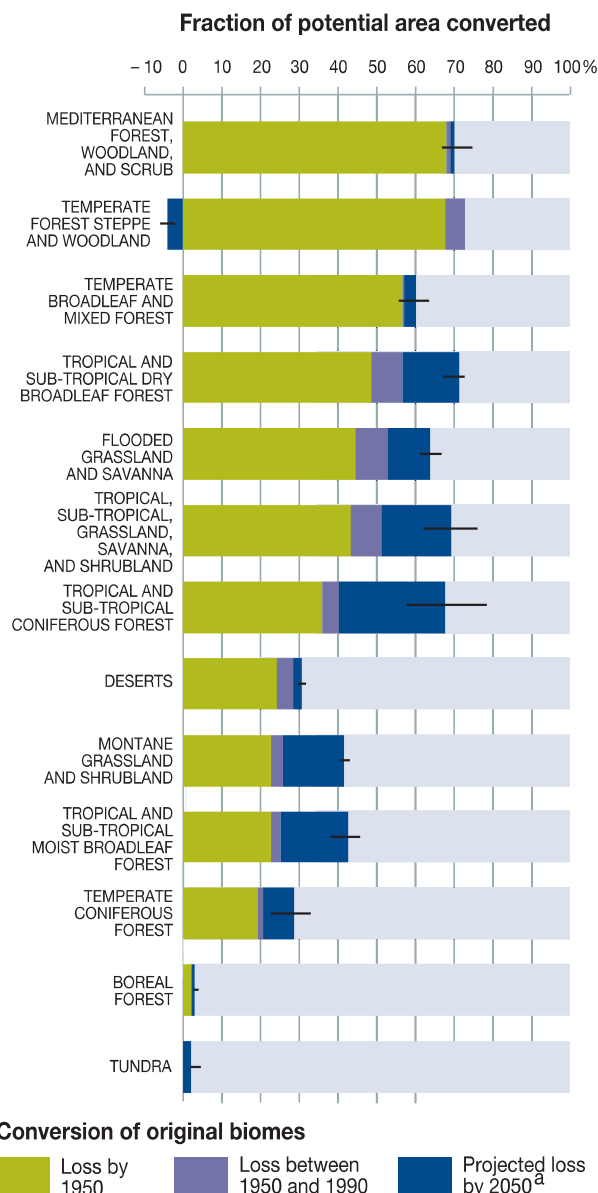
Illegal logging contributes to deforestation and GHG emissions in many parts of the tropics, such as this forest in Indonesia.

Past, present, and projected land-use change estimates for terrestrial biomes³ illustrate the difference among major vegetation types over history, and their vulnerability in the future as shown in Figure 3. The changes, termed conversions, are primarily human-induced. For example, conversions in the temperate and Mediterranean vegetation were high in the past and have slowed recently. A net gain in deciduous forests occurred in the recent past despite significant logging in North America and Siberia. In the humid tropical forests about 5.4 million ha per year were lost between 2000 and 2010. During the same decade, the Amazon Basin suffered the largest net loss of forests, about 3.6 million ha per year, followed by Southeast Asia, which lost 1.0 million ha annually. Loss in the Congo Basin during that time was 0.23 percent per annum or 700,000 ha per year. This was less than the rates in the Amazon and Southeast Asia, where loss in each was just over 0.4 percent per annum.

Fortunately, the rate of forest loss has slowed in some areas. For example, the loss of humid tropical forests has declined from 7.1 million ha per year to 5.4 million ha per year over the last two decades. In Southeast Asia, the rate of loss was reduced 50 percent during that period between the 1990s and the following decade (Achard et al. 2009). However, much of the projected loss of forests by 2050 is in tropical ecosystems as shown in Figure 3.

A major driver of land use change and deforestation is food production. In 2000, the global estimate for cropland was 15 million km² and pasture was 28 million km². Currently conversions of tropical forests to agriculture represent a significant alteration to global carbon cycles, and contribute around 20 percent of contemporary global carbon emissions (Parry et al. 2007).

FIGURE 3 PAST, PRESENT AND PROJECTED PROPORTIONAL LOSS OF BIOMES DUE TO LAND USE CHANGE



^a According to four scenarios. For 2050 projections, the average value of the projections under the four scenarios is plotted and the error bars (black lines) represent the range of values from the different scenarios.

Source: Achard et al. 2009

Other land-use changes contribute to increased carbon flux from land to the atmosphere. For example, urban development limits terrestrial carbon storage yet urban expansion is estimated to consume 10,000 to 20,000 km² per year of cropland in the developing world, much of it prime agricultural land (Turner et al. 2007). Loss of permanent pasture and peatlands also represents a net terrestrial carbon loss.



Mature and recently logged areas of the boreal forest in Siberia, Russia

Sustainable forest management is a challenge when communities rely on these forests for fuel. A woman carries firewood in Nepal.





The GEF's Strategy for Land Use, Land-Use Change, and Forestry (LULUCF)

Since its inception, the GEF has recognized the importance of forests for their role in producing global environmental benefits, sustaining livelihoods, and for their potential contribution to developing countries' sustainable development plans. The LULUCF strategy explicitly recognizes that interventions on all land uses and land-use changes may affect carbon stocks and GHG benefits. The objective of the GEF-5 strategy in LULUCF is to promote conservation and enhancement of carbon stocks through sustainable land use (Global Environmental Facility 2011). Successful outcomes of this objective include:

- Best management practices in LULUCF adopted both within the forest land and in the wider landscape;
- Restoration and enhancement of carbon stocks in forests and non-forest lands, including peatlands; and
- GHG emissions avoided and carbon sequestered.

Outcome indicators include:

- Number of countries adopting good management practices in LULUCF;
- Hectares of forests and non-forest lands restored and enhanced; and
- Tonnes of CO₂ equivalent emissions avoided.

The GEF's LULUCF strategy covers the spectrum of land use and land-use change categories, including forests and non-forest lands, as well as production and conservation landscapes. This strategy enables synergies with the GEF's Sustainable Forest Management/Reducing Emissions from Deforestation and Forest Degradation (SFM/REDD+) mechanism (Box B), which strengthens GEF investments in forests to take advantage of that incentive.

Although essential to sustainability and human welfare, the agriculture sector is responsible for about 14 percent of global GHG emissions and is a key driver of deforestation and land degradation, which accounts for an additional 17 percent of emissions. However, agriculture can be an important part of the solution to climate change by capturing synergies among activities to develop more productive food systems and to improve natural resource management. For these reasons, the GEF invests in projects addressing sustainable agriculture. The GEF is open to supporting Climate Smart Agricultural projects (Box C) ensuring concrete global environmental benefits.

BOX B SUSTAINABLE FOREST MANAGEMENT/REDUCING EMISSIONS FROM DEFORESTATION AND FOREST DEGRADATION (SFM/REDD+)

The objectives for LULUCF are to conserve, restore, enhance, and manage the carbon stocks in forest and non-forest lands, and to prevent emissions of the carbon stocks to the atmosphere through the reduction of the pressure on these lands. The SFM/REDD+ mechanism of the GEF has two objectives that are closely aligned with the LULUCF objectives, and as a result these objectives provide synergy in climate change mitigation activities. The SFM/REDD+ objectives are:

- Reduce pressure on forest resources and generate sustainable flows of forest ecosystem services, and
- Strengthen the enabling environment to reduce GHG emissions from deforestation and forest degradation and enhance carbon sinks from the LULUCF activities.

The GEF has supported efforts to avoid forest loss and degradation since its beginning in 1991, in such places as the Amazon, through protection of rainforest there. Although initially focused on setting aside land to conserve biodiversity resources, these efforts were highly effective at avoiding considerably larger amounts of CO₂ eq emissions. The GEF's efforts were stepped up in 2007, when it launched the Tropical Forest Account, a pilot incentive scheme promoting country investments in multiple focal area projects that yield benefits in REDD+. This initiative focused on the three regions of large mainly intact tropical forests (Amazonia, the Congo Basin, and Papua New Guinea/Borneo). Building on this success, in 2010 a separate funding envelope was established for SFM/REDD+, where GEF recipient countries willing to invest portions of their STAR (System for the Transparent Allocation of Resources) allocation from two out of the three focal areas of biodiversity, climate change mitigation, and land degradation, could receive additional incentive funding for higher impact SFM/REDD+ projects.

The overall goal of the current SFM/REDD+ strategy is to achieve multiple environmental benefits, including GHG emissions avoidance, from improved management of all types of forests. The SFM/REDD+ mechanism works to ensure that the goods and services derived from the forest meet present-day needs while at the same time securing their continued availability and contribution to long-term development. The REDD+ is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. It goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks.

The SFM/REDD+ includes supporting activities that will: develop national systems to measure and monitor carbon stocks and change from forest and non-forest lands; strengthen related policies and institutions; undertake good management practices; and establish financing mechanisms and investment opportunities. The LULUCF also includes non-forest lands, which allows for lands to be converted to forest land and also for good practices to be applied to non-forest lands for GHG benefits.



Uncut tropical forest in Uganda, Africa



An example of climate smart agriculture is the use of perennial crops such as tea in India. These agroforestry systems help to build carbon sinks on the land.

BOX C CLIMATE SMART AGRICULTURE

Agricultural practices that mitigate GHG emissions may be eligible for the GEF financing. Agriculture (including raising livestock) accounts for 52 and 84 percent of global anthropogenic methane (CH_4) and nitrous oxide (N_2O) emissions, respectively (Smith et al. 2008). This is significant because both CH_4 and N_2O have much higher global warming potentials compared to CO_2 . The CO_2 eq of CH_4 and N_2O are 25 and 298 respectively. Agricultural soils may also act as either a sink or a source for carbon.

Agricultural practices that can mitigate GHG emissions are classified into three broad categories, based on their underlying practices:

- **Reduce emissions:** The fluxes of CO_2 , CH_4 , and N_2O can be reduced by managing the flows of carbon and nitrogen. For example, by properly timing fertilization and taking care not to apply more nitrogen than can be taken up by crops will minimize the emission of N_2O . Also, efficient management of feed can suppress the amount of CH_4 produced by livestock.
- **Enhance sequestration:** Atmospheric carbon can be sequestered in vegetation and soils through the use of perennials and low-till or no-till practices. Agroforestry systems build sinks on agricultural lands while allowing food production.
- **Avoid or displace emissions:** Crop residues can be used as fuels in place of fossil fuels. Also, practices that sustain fertility in soils can forestall the cultivation of new lands currently under forest or other non-agricultural vegetation.

Many of these agricultural mitigation practices have co-benefits, such as improved efficiency, reduced cost, and environmental benefits, as well as trade-offs. For successful implementation, co-benefits and potential adverse effects must be balanced, while communication and capacity building are also necessary. The LULUCF objective has as a key expected outcome the adoption of good management practices in the wider landscape. Climate smart agriculture practices also can have adaptation benefits.

The use of the perennial crop coffee in Costa Rica is another example of climate smart agriculture.





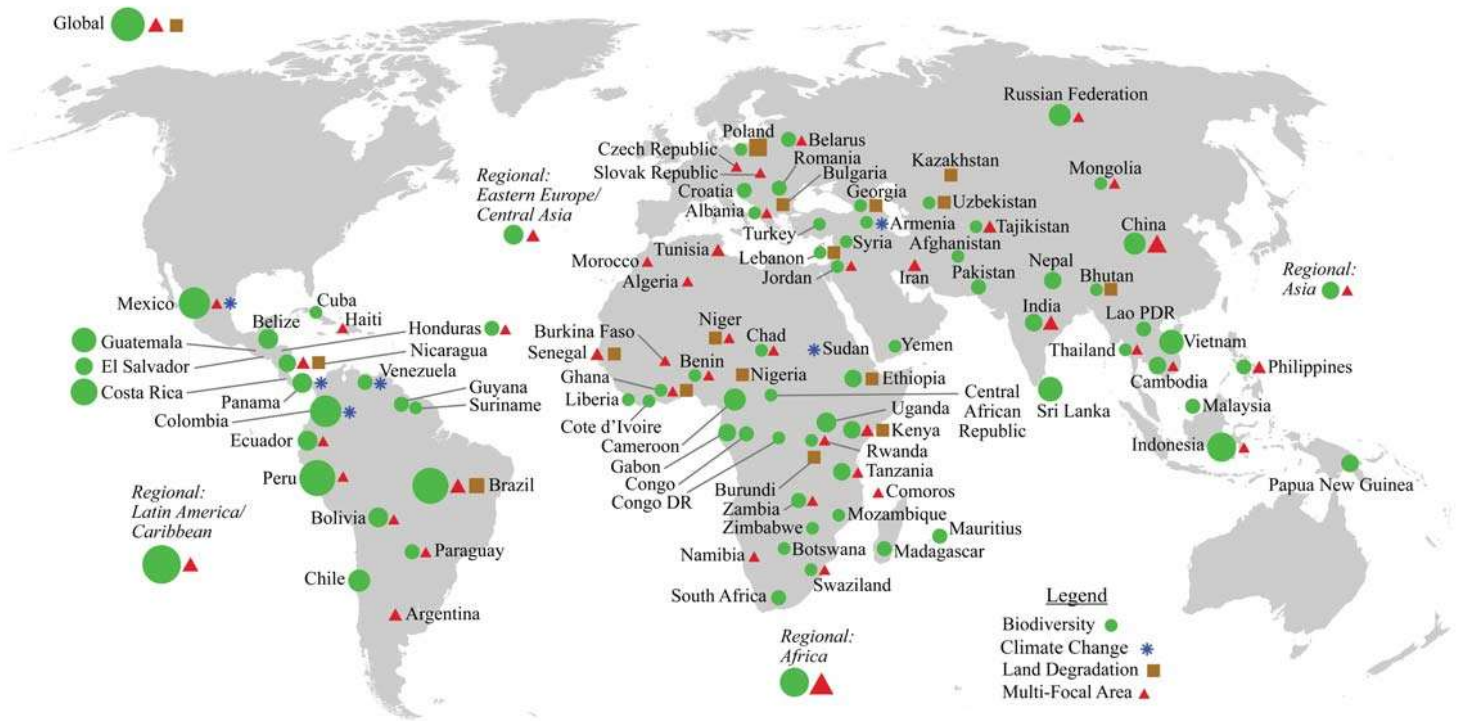
Overview of the GEF Portfolio

Over the last 20 years, many countries and partnering agencies have implemented—and continue to implement—LULUCF projects through GEF investments as shown in Figure 4. Some projects are focused regionally or globally and involve more than one country. Many are multi-focal projects, addressing biodiversity, climate change, and/or land degradation. The overall goal of the GEF climate change mitigation strategy is to support developing countries and economies in transition toward a low-carbon development path to slow growth in GHG emissions and thus contribute to the stabilization of GHG concentrations in the atmosphere. A key indicator for successful investments is the number of t of CO₂ eq avoided (both direct and indirect) over the investment or impact period of the projects.

In 1991, US\$4.1 million in pilot projects were initiated in LULUCF-related projects, and these were 100 percent funded by the GEF as shown in Figure 5. By GEF-2 (1998–2002), the investment made by the GEF received a 100 percent match in co-financing and by GEF-4 (2006–2010) and the first half of the GEF-5 period (2010 to 2012) close to \$1 billion in financing was provided to LULUCF. About half (48 percent) of the LULUCF-related projects have provided support to Latin American countries followed by Eastern Europe and the Caribbean (18 percent) and Global (18 percent), followed by Asia (11 percent) and Africa (5 percent) as shown in Figure 6.

The GEF has supported 32 projects that explicitly contained the climate change mitigation LULUCF objective (CCM-5), and additional 24 that are LULUCF and SFM/REDD+ projects and mixed projects. Almost all from the latter category also include GEF financing from focal areas other than climate change mitigation (land degradation and biodiversity focal areas). Furthermore, three projects are multi-trust fund (MTF) projects, which are financed from Least Developed Country Fund (LDCF) and Special Climate Change Fund (SCCF) as well as the GEF Trust Fund. The projects are distributed over nine GEF Agencies: United Nations Development Programme (UNDP), The World Bank, United Nations Industrial Development Organization (UNIDO), United Nations Environmental Programme (UNEP), the Food and Agricultural Organization (FAO), International Fund for Agricultural Development (IFAD), Asian Development Bank (ADB), African Development Bank (AfDB) and Inter-American Development Bank (IDB).

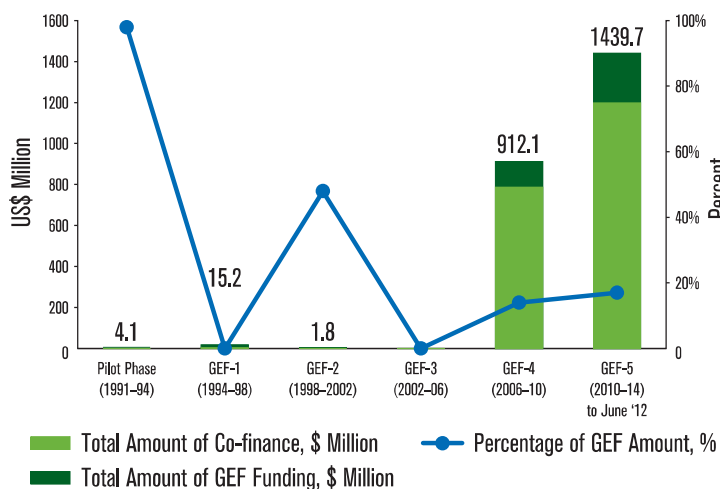
FIGURE 4 THE GEF FORESTRY PROJECTS BY FOCAL AREA AND COUNTRY, 1991–2010



Source: GEF Project Tracking and Management Information System, August 2012

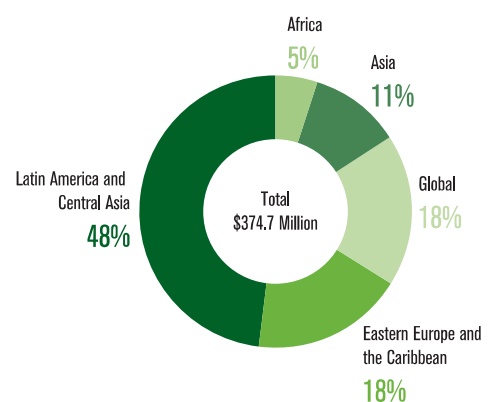
Note: The size of the symbol corresponds to the relative number of projects within a country.

FIGURE 5 GEF INVESTMENT IN CLIMATE CHANGE MITIGATION LULUCF-RELATED PROJECTS INCLUDING SFM/REDD+



Source: GEF Project Tracking and Management Information System, August 2012

FIGURE 6 REGIONAL DISTRIBUTION OF THE GEF PORTFOLIO IN LULUCF-RELATED PROJECTS, INCLUDING SFM/REDD+



Note: These figures do not include values for Small Grant Programmes for LULUCF. Approximately \$20.6 million additional was invested in these LULUCF projects.

Source: GEF Project Tracking and Management Information System, August 2012



A rubber tree plantation in Thailand next to a cassava field. Plantations can help reduce GHG emissions from agricultural soils.

Through the LULUCF objective, the GEF climate change mitigation portfolio contributes to a diverse and innovative set of initiatives focusing on strategies that deliver multiple environmental benefits, including carbon benefits, while addressing multiple Conventions. The objective also supports developing new carbon monitoring systems, or upgrading existing monitoring systems, which are necessary for improving the ability to account for carbon. This is a flexible approach, allowing for project design to explicitly choose activities to improve carbon benefit production.

The LULUCF projects supported by the GEF have resulted in approximately 250 million t CO₂ eq emissions avoided, although this is a conservative estimate because only projects from GEF-4 and GEF-5 replenishment periods (26 of the 56 projects) provided estimates of emissions avoided. The average cost of CO₂ eq emissions avoidance for the 26 projects that reported estimates was \$1.09 per t CO₂ eq.

The LULUCF objectives are closely linked with those of LDCF and SCCF, also managed by the GEF, whose priority is climate change adaptation. In promoting conservation and enhancement of carbon stocks through sustainable land management, LULUCF related activities may also contribute towards increased production from agricultural and forest lands, and may enhance

their resilience of natural resources against the expected impacts of climate change. For example, in Rwanda, the GEF has invested in a project through resources from LDCF and SFM, to conserve and restore critical landscapes. The project is expected to provide mitigation benefits and reduce climate change vulnerabilities of associated communities by promoting food, water and fuel wood security.

CASE STUDIES

To illustrate the types of LULUCF-related projects in which the GEF has invested, two case studies are described in the following pages. Both are projects that are currently under implementation.

CASE STUDY

ENHANCING INSTITUTIONAL CAPACITIES ON REDD+ ISSUES FOR SUSTAINABLE FOREST MANAGEMENT IN THE CONGO BASIN

GEF Agency:	World Bank
GEF Funding:	\$13 million
Co-financing:	\$60.3 million
Planned dates of implementation:	2011 to 2016

Introduction

The Congo Basin forest is the world's second largest contiguous block of tropical forest, harboring an extraordinary biodiversity and a high level of endemism. It forms an integrated ecological unit, encompassing the territories of Cameroon, Central Africa Republic, Democratic Republic of Congo, Equatorial Guinea, Gabon and the Republic of Congo. It is home to more than 24 million people, most of whom rely on forests for their livelihoods. The Congo Basin forest also performs valuable ecological services, such as flood control, climate regulation at the local and regional levels, and buffer against global climate change with a huge amount of carbon stored in its abundant vegetation and its soil. The forests of the Congo Basin are estimated to be a carbon reservoir of 24—39 Gt of carbon.

Project overview

The GEF/World Bank Regional REDD+ Project aims to strengthen the capacities of the Congo Basin countries on REDD+ issues by:

- Reinforcing the regional political and technical dialogue on REDD+, promoting inclusive participation and representation of key stakeholder groups, and responding to incremental capacity building needs to maintain regional cohesion;
- Improving the science-based knowledge to measure and monitor carbon stocks in the Congo Basin forests; and
- Mainstreaming REDD+ concepts in SFM projects.

The GEF resources provides incremental funding to work on environment and social issues related to REDD+, and aims to reinforce the participation of civil society organizations (CSOs) and non-governmental organizations (NGOs), local stakeholders, and notably forest communities. This part of the work is to be developed in collaboration with active partners on this issue, such as World Resources Institute (WRI) and International Union for the Conservation of Nature (IUCN). Also, the GEF will serve as a regional catalyst to provide technical and political guidance on key issues related to REDD+, including land tenure reforms, customary rights, and benefit-sharing mechanisms.

The Project will also reinforce the capacity of Congo Basin countries to work collaboratively and to collectively interact with donors and technical partners, and to achieve economies of scale on common needs such as the establishment of species-specific allometric equations for the Congo Basin.



More than 24 million people live in the Congo Basin and most rely on the forests for their livelihood. This small farm is in the rainforest of Cameroon in the Congo Basin.



The Congo Basin is the largest contiguous block of tropical forest on the planet and the forest performs valuable ecological services, such as flood control and a buffer against climate change due to the large amount of carbon stored in its vegetation and soil.

CASE STUDY

LANDSCAPE APPROACH TO MANAGEMENT OF PEATLANDS AIMING AT MULTIPLE ECOLOGICAL BENEFITS

GEF Agency:	UNDP
GEF Funding:	\$2.7 million
Co-financing:	\$9.4 million
Planned dates of implementation:	2012 to 2017

Introduction

Natural peatlands once covered a considerable area of Belarus (2,939,000 ha), but the extent of natural peatlands in the country today is much diminished. Fifty-four percent of what used to be peatlands have been drained for agriculture, forestry, and mining, in a land-use conversion process that commenced in the 1950s.

Peatlands are globally recognized as one of the most valuable and, at the same time, most threatened natural habitats. In addition to their biodiversity significance, natural peatlands are a large carbon stock, being the most carbon-dense ecosystems in the terrestrial biosphere. However, peatland drainage leads to fast mineralization of the carbon and nitrogen stocks in the soil, which transforms the peatland from a carbon and nitrogen sink to a potentially very strong carbon and nitrogen source. As such, the drained peatlands of temperate Europe (especially Germany, Poland, Belarus, Ukraine, and Russia) constitute an important source of GHG emissions and are—after Southeast Asia—the second most important global hotspot in this respect. In Belarus’

Poozerie region alone, peatlands sequester 0.4 Mt of carbon per year, which is just under 30 percent of the total national sequestration potential of 1.39 Mt of carbon per year.

Project overview

The Belarus Project takes a landscape-level approach to the management of peatlands and peatland forests to conserve biodiversity, enhance carbon stocks, and secure the flow of ecosystem services. The project will result in the development of a National Peatland Strategy and Action Plan as a framework for managing peatlands, through which management plans, zoning arrangements, and public engagement mechanisms will be implemented. Key outcomes from the project will include: development of a landscape approach to peatlands; conservation and management in the Poozerie area (the lake area situated in northern part of Belarus) covering 500,000 ha; creation of 20,000 ha of new protected areas within underrepresented bogs and mesotrophic mire; improved management effectiveness of 93,588 ha of existing protected areas; and creation of 45,000 ha of buffer zones and corridors managed to minimize impact on core areas. The project seeks to restore 2,000 ha of degraded peatlands and 3,000 ha of degraded black alder (*Alnus glutinosa*) forest. The project will result in the saving of 1 Mt CO₂ eq over a 10-year period with a unit cost of \$2.7 per t CO₂ eq.



Drained peatlands of temperate Europe are an important source of greenhouse gas emissions second only to the peatlands of Southeast Asia in their contribution. Restoration of peatlands involves restoring the poorly drained conditions. These images are of Grichino peatlands in Belarus, Europe, before and one year after restoration.

Dry tropical forest in Kenya.





Counting Carbon: towards Monitoring, Reporting, and Verification

Investments in GEF projects contribute to development of countries' national monitoring, reporting, and verification (MRV) systems through capacity building (e.g., forest assessments, monitoring forest cover change, and information management systems). These MRV systems account for the amount of forest carbon and the changes in carbon stored or emissions avoided over time. These monitoring systems are needed for eventual accounting of carbon credits for each country as a whole, and are used for reporting to the UNFCCC.

Land use, land-use change, and forestry activities that encourage reforestation or discourage deforestation are especially important to carbon accounting efforts, and the level of success of LULUCF activities can be quantified using the amount of carbon stored on the land. The reasoning is that the carbon in above-ground and below-ground vegetation may be stored for decades or centuries, so these activities may buy time to transform energy systems to lower-GHG-emitting systems and to reduce the intensity of climate change related to atmospheric GHGs.

Monitoring systems can be used to measure the effectiveness of land use planning, policies, and regulations in storing carbon. Recently, technical methods have been developed for measuring both carbon in vegetation and changes in stocks due to land use changes, since data and these methods are highly transferable. Currently, few countries monitor carbon stocks associated with land use changes, because data and technology are limited in many countries. However, rapid improvements in the capacity to measure changes in these countries are expected (Box D).

The GEF promotes projects that conserve and enhance carbon stocks through sustainable management of LULUCF, and funds the establishment of carbon stock monitoring systems. Simple assumptions are applied about the impact of land-use changes on carbon stocks and about the biological response to a given land use. In Box E, two examples are given for how carbon can be counted and used to estimate global environmental benefits in the GEF LULUCF and SFM/REDD+ projects supported by the GEF.



Participants in a workshop held in Nairobi, Africa, on estimating and tracking the impact land management projects have on carbon stock changes and greenhouse gas emissions.



The Carbon Benefits Project developed an online system.

Guidance for estimating benefits from LULUCF activities has been provided by the IPCC (Penman et al. 2003). The basis of the methodology is that

- Flux of CO₂ to or from the atmosphere is assumed to be equivalent to changes in carbon stocks in existing biomass and soils; and
- Changes in carbon stocks can be estimated by first establishing rates of change in land use and then the practice used to bring about the change.

New LULUCF-related projects are expected to cover the spectrum of land-use categories, as defined by the IPCC, including reducing deforestation and forest degradation, enhancing carbon stocks in non-forest lands, and management of peatlands. The GEF supports activities that will develop national systems to measure and monitor carbon stocks and fluxes from forest and non-forest lands; strengthen related policies and institutions; undertake good management practices with local

communities; and establish financing mechanisms and investment opportunities.

The GEF support involves a combination of: technical assistance for policy formulation; building institutional and technical capacity to implement strategies and policies; monitoring and measurement of carbon stocks and emissions; developing and testing policy frameworks to slow the drivers of undesirable land-use changes; and working with local communities to develop alternative livelihood methods to reduce emissions and sequester carbon. Where appropriate, pilot investment projects designed to reduce net emissions from LULUCF and to enhance carbon stocks may be supported. Synergy with SFM, biodiversity, and land degradation, as well as reduction of the vulnerability of forest and non-forest lands to climate change, may be explored so as to generate multiple global environmental benefits as well as social and economic benefits.



Slash and burn agriculture is prevalent in the tropical forests, such as in this Peruvian Amazon forest that has been planted with maize seedlings.

BOX D THE CARBON BENEFITS PROJECT: TOWARD A STANDARDIZED SYSTEM FOR MODELING, MEASUREMENT, AND MONITORING IN PRODUCTION LANDSCAPES

There is a growing consensus that improved management of terrestrial carbon must be a significant component of international approaches to mitigating climate change. It is also widely accepted that large-scale and increased carbon storage achieved through strategic land management is both a possible and desirable goal. However, with no standardized way of measuring changes in carbon stocks, it has been difficult to compare the carbon benefits of different land management projects. Accurate accounting through monitoring, reporting, and verification is the cornerstone to reduce GHG emissions and to meet other important opportunities associated with the management of carbon stocks.

To resolve this need, GEF funded the Carbon Benefits Project (CBP) in 2007 to develop a standardized system for measuring, monitoring, and modeling carbon stock changes and GHG emissions from forest and agro-ecosystems. With UNEP as lead Agency and a host of universities and research institutions as partners, the CBP has delivered a set of tools and protocols for assessing changes in total system carbon. The web-based system was designed to be specifically applicable to all projects focusing on natural resource management, including forestry, agroforestry, agriculture, and pasture management in all climate zones, soils types, and land uses.

The measurement system provides the means to directly measure carbon stocks and stock changes using a combination of remote sensing observations, ground calibration, and web made geographic information systems. The system also provides estimates of CH₄ and N₂O from direct field and remote sensing measurements. This approach allows for large area landscape assessments of carbon at very high spatial resolution.

The modeling system provides project-scale estimates of all major sources and sinks of GHGs related to land use, including soil and biomass carbon stocks, soil N₂O, and CH₄ emissions, enteric CH₄ and emissions from manure and biomass burning. The system consists of a set of linked modules which allow the user to collate, store, analyze, project and report carbon stock changes and GHG emissions for baseline and project scenarios in natural resource management interventions in a standard way.

This user-friendly carbon-accounting protocol can be used to create maps that show the carbon storage associated with different land types, and to monitor and verify carbon benefits from sustainable land management. The ability to easily and inexpensively generate these data and information will enable decision-making at many levels—within governments, nongovernmental organizations, the private sector, and carbon financial markets—to better leverage investments in land management activities, improve the prospects for mitigating and adapting to climate change, and enhance livelihoods.

BOX E EXAMPLES OF CARBON BENEFITS CALCULATIONS

Example 1. Estimating global environmental benefits from reduced deforestation A project is focused on an area in which 500 ha are currently being deforested per year, and the project intends to reduce the deforestation to 100 ha for each of three years. One estimate of average forest carbon stock per ha in a country can be obtained from FAO in its 2010 Global Forest Resource Assessment (FAO 2010). As an example, the country of Ghana is listed as having 77 t carbon per ha in 2010. Assuming deforestation removes all living forest carbon mass, then the direct carbon benefit of not deforesting 400 ha per year for three years is:

$$3 \text{ years} \times 400 \text{ ha per year} \times 77 \text{ t carbon per ha} = 92,400 \text{ t carbon benefits}$$

or

$$92,400 \text{ t carbon} \times 3.67 = 338,800 \text{ t CO}_2 \text{ eq benefits}$$

where 3.67 is the conversion factor for changing carbon benefits to CO₂ eq benefits.

To calculate indirect carbon benefits, one may assume that the project will continue to reduce the deforestation rate by 400 ha per year for an additional 17 years after the project ends. The indirect benefits are:

$$400 \text{ ha per year} \times 17 \text{ years} \times 77 \text{ t carbon per ha} = 523,600 \text{ t carbon benefit}$$

or

$$523,600 \text{ t carbon} \times 3.67 = 1,921,612 \text{ t CO}_2 \text{ eq benefit}$$

Total direct and indirect CO₂ eq benefits are then

$$338,800 + 1,921,612 = 2,226,041 \text{ t CO}_2 \text{ eq.}$$

If GEF funding of \$3 million was needed for the project, the cost-effectiveness of this project is

$$\text{\$3 million} / 2,226,041 \text{ t CO}_2 \text{ eq.} = \$1.35 \text{ per t CO}_2 \text{ eq.}$$

If there is additional information known about the project forests, for example, if the forests are primary forests and scientific literature can be cited with estimates of carbon stocks in primary forests in the country or area of interest, then using that information would be more appropriate for the calculation. This information should be documented and submitted to the GEF, written similarly to the above paragraph, with citation of the references.

Example 2. Estimating global environmental benefits from reforestation A project is focused on reforestation of 1000 ha in an area of tropical dry forest in Africa. Assuming that the growth rate for the forest is 2.4 t dry matter per ha per year for forests under 20 years (Engleston et al. 2006), and that it took 2 years for the restoration to occur, direct benefits of restoration would be:

$$1,000 \text{ ha} \times 1.2 \text{ t carbon per ha per year} \times 2 \text{ years} = 2,400 \text{ t carbon benefits}$$

or

$$2,400 \text{ t carbon} \times 3.67 = 8,800 \text{ t CO}_2 \text{ eq direct benefits.}$$

If the trees are expected to grow at the same rate for an additional 16 years after the end of the project, indirect benefits would be:

$$1,000 \text{ ha} \times 1.2 \text{ t carbon per ha per year} \times 16 \text{ years} = 19,200 \text{ t carbon benefits}$$

or

$$19,200 \text{ t carbon} \times 3.67 = 70,400 \text{ t CO}_2 \text{ eq benefits.}$$

Total benefits (direct and indirect) are:

$$8,800 \text{ t CO}_2 \text{ eq} + 70,400 \text{ t CO}_2 \text{ eq} = 79,200 \text{ t CO}_2 \text{ eq.}$$

In this example, we assume no growth rate (0 t carbon per ha per year) without the GEF intervention (baseline). If \$1 million of the GEF grant funding was needed for the project, the cost-effectiveness can be estimated as

$$\text{\$1 million} / 79,200 \text{ t CO}_2 \text{ eq.} = \$12.62 \text{ per t CO}_2 \text{ eq.}$$

Palm oil plantations contribute to loss of tropical forest in Malaysia



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ENDNOTES

- 1 Removal from the atmosphere and storage on land
- 2 Carbon flux is the movement of carbon between reservoirs of carbon. In this case, the flux is between organic matter in terrestrial systems and the atmosphere.
- 3 Biomes are the world's major communities, classified according to the predominant vegetation.

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AfDB	African Development Bank
CBP	Carbon Benefits Project
CCM	Climate Change Mitigation
CH₄	Methane
CO₂	Carbon dioxide
CO₂ eq	Carbon dioxide equivalent (a reference measure of how much global warming a given type and amount of greenhouse gas may cause using the functional equivalent of CO ₂ as a reference)
CSO	Civil Society Organizations
FAO	Food and Agricultural Organization
GEb	Global Environmental Benefits
GEF	Global Environment Facility
GHG	Greenhouse Gases
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development
IPCC	International Panel on Climate Change
IUCN	International Union for the Conservation of Nature
LDCF	Least Developed Countries Fund
LULUCF	Land Use, Land-Use Change, and Forestry
MTF	Multi-trust fund
MRV	Monitoring, reporting, and verifying
NGO	Non-governmental organizations
N₂O	Nitrous Oxide
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SCCF	Special Climate Change Fund
SFM	Sustainable Forest Management
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WRI	World Resources Institute

UNITS OF MEASURE

Gt	Giga tonne (one billion metric tonnes)
ha	hectare
Mt	Million tonnes/Megatonne
t	metric tonne

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Cover: Nomadic Penan children examine a tree stump in the Sungai Nyakit area of the Limbang District, Sarawak, Malaysia. The Penan have been blockading a logging road in order to stop the destruction of their rainforest home.

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ABOUT THE GEF

The GEF unites 182 countries in partnership with international institutions, civil society organizations (CSOs), and the private sector to address global environmental issues while supporting national sustainable development initiatives. Today the GEF is the largest public funder of projects to improve the global environment. An independently operating financial organization, the GEF provides grants for projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants.

Since 1991, the GEF has achieved a strong track record with developing countries and countries with economies in transition, providing \$10.5 billion in grants and leveraging \$51 billion in co-financing for over 2,700 projects in over 165 countries. Through its Small Grants Programme (SGP), the GEF has also made more than 14,000 small grants directly to civil society and community based organizations, totaling \$634 million.

The GEF partnership includes 10 Agencies: the UN Development Programme, the UN Environment Programme, the World Bank, the UN Food and Agriculture Organization, the UN Industrial Development Organization, the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development, the Inter-American Development Bank, and the International Fund for Agricultural Development. The Scientific and Technical Advisory Panel provides technical and scientific advice on the GEF's policies and projects. The GEF partnership also includes other accredited agencies at the National and Global level.

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