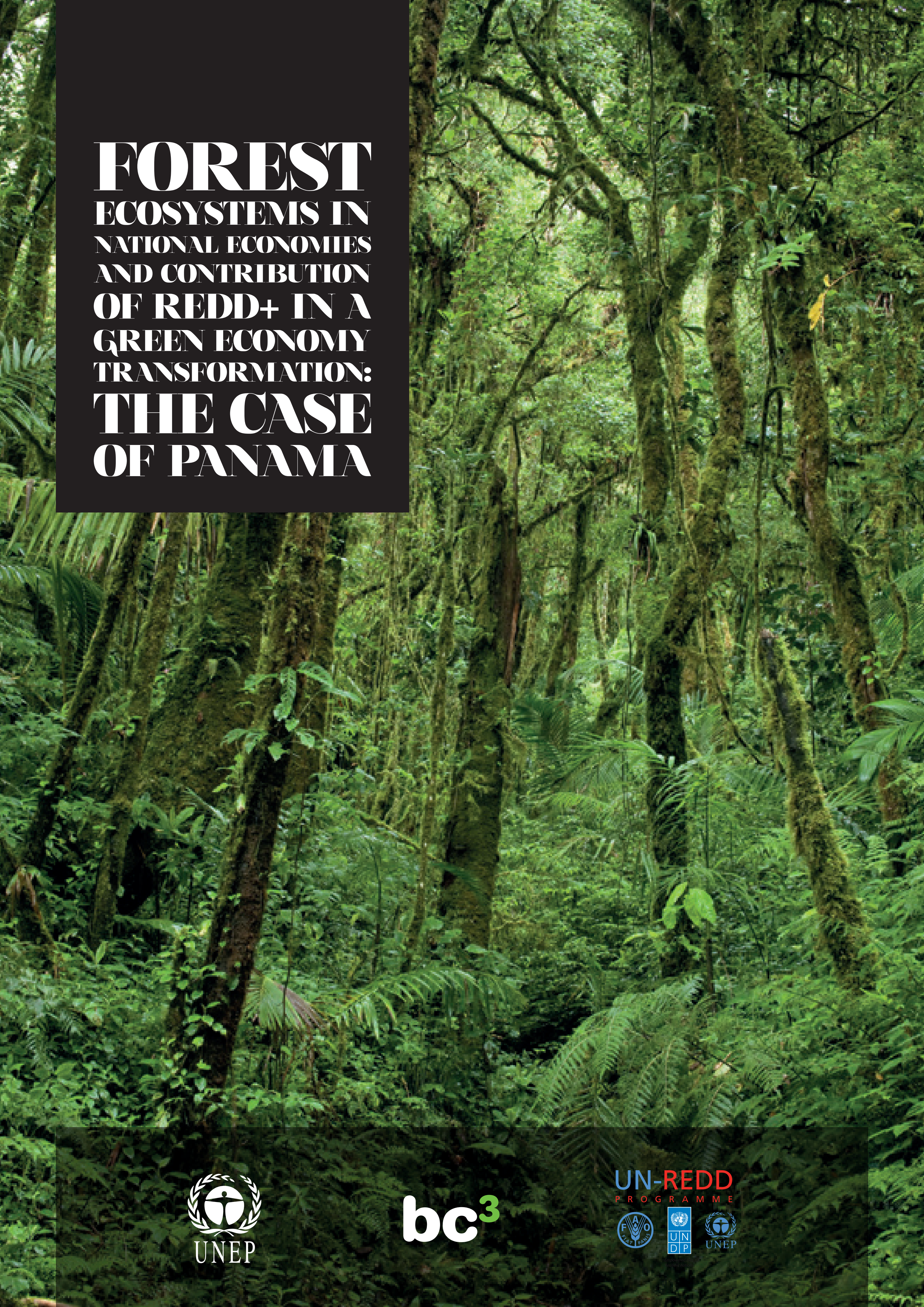
FOREST ECOSYSTEMS IN NATIONAL ECONOMIES AND CONTRIBUTION OF REDD+ IN A GREEN ECONOMY TRANSFORMATION: THE CASE OF PANAMA



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Foreword

As the world works towards defining the post-2015 sustainable development agenda and associated Sustainable Development Goals, it is becoming increasingly clear that integrating conservation of the environment into all decision making and economic planning is essential for long-term growth and human wellbeing. Already, the natural resources that prop up so many economies are under stress, and climate change will only exacerbate the challenge, particularly in developing countries. Integrating efforts in pursuit of more sustainable development—demonstrating higher equity, trans¬parency, and respect for cultural values and biodiversity—is a key task for the global community.

A significant step towards this sustainable future can be taken by integrating the Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+) approach with the efforts to prompt a global Green Economy transition. A recent International Resource Panel report, Building Natural Capital: How REDD+ Can Support a Green Economy, outlines how an investment of $US30 billion per year in REDD+ can ensure green and sustainable growth, as well as mitigate climate change through forest conservation.

Many nations are already demonstrating how the sustainable management of forests, achieved through an integrated approach that considers a wide range of ecosystem services, can contrib¬ute to improved conditions and better health in communities dependent on forests—while generating huge benefits to the rest of society and ensuring the provision of goods and services in the long term. Panama, working through the National Authority of the Environment (ANAM) and with the support of the United Nations and other in¬ternational agencies and local organizations, is one such nation.

This report sheds light on how to develop public policies that also take into account the value of the forests and the benefits they provide as driving forces for a Green Economy. This approach can lead to tangible and sustainable growth, generating a higher equity by benefiting the most marginalized communities in the country. It also provides foundations to stimulate other important sectors of the economy.

This joint effort of the Ecosystem Services Economics Unit of the United Nations Environment Programme, BC3 and the ANAM, within the framework of the UN REDD Panama joint national pro¬gram, can serve as catalyst enabling the mobili¬zation of additional efforts: not just outlining the successes so far, but demonstrating at a country level how REDD+ can contribute to the Green Economy. This report will gener¬ate knowledge and robust tools for a better understanding of the functioning of valuable natural ecosystems, and thus promote efficient and sustainable management of these resources for the benefit of all.

Ing. Silvano Vergara
Minister of the Environment - Panama

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FOREST ECOSYSTEMS IN NATIONAL ECONOMIES AND CONTRIBUTION OF REDD+ IN A GREEN ECONOMY TRANSFORMATION: THE CASE OF PANAMA

Executive summary

Panama is a country of 3.6 million people which has a stable economy, mostly based on the services sector which comprises around 77% of its gross domestic product (GDP). Economic growth is at an average of 8.8% (between 2005 and 2012) in part due to its geographical position which has allowed the country to develop its service sector around transportation and trade associated with the Canal and the Free Trade Zone in Colón.

There are 3,525 million hectares of forest land covering around 47% of Panama, including some of the most biodiverse terrestrial habitats in the world. This natural wealth has been threatened by deforestation in Panama over the last 50 years. From 1992-2008, the forest area declined by 586,000 hectares (roughly 14%), an area bigger than the Coclé province. Forest clearing and associated forest degradation has been driven by a variety of factors in different regions, such as growing demand for timber products, land use change towards more financially lucrative agricultural cash crops and cattle ranching, and the development of roads and infrastructure. As a result, deforestation rates differ between regions, some being more strongly affected than others.

The natural capital of forests contributes to the economy of Panama in several important ways. First, Panamanian forests provide inputs to the economy, including to the agricultural sector, the textile sector, the wood and paper sector, the chemical industry, and the manufacturing and construction sectors, among others. These, together with the forest sector, support up to 0.44% of the GDP of Panama.

Furthermore, forests also directly and indirectly support other portions of the economy, such as the business sector. The forest sector is ranked as the most important sector in terms of forward linkages. It is estimated that an increase in the production of this sector (for instance through an increase of one dollar in capital investment) would increase the production generated in the rest of the economic sectors in Panama by 3.45 dollars. The total annual value added generated by the forestry sector in downstream economic sectors in Panama over the period 2002-2011 reached 80,6 million US$, most notably in the financial, trade and transport sectors.

Panamanian Forests provide significant benefits associated with human well-being both locally and globally, although some of these impacts are not reflected in standard macroeconomic indicators such as GDP. This is because a substantial share of the value of forests is not reflected in markets. These values are known as *ecosystem services* and include important benefits to society such as water regulation and carbon storage, referred to as *regulating ecosystem services.* Forests also provide significant *cultural ecosystem services (such as recreation services)* to society as well as *provisioning ecosystem* services which are often linked to market commodities such as timber and non-timber forest products. While some provisioning services are associated with markets, most other ecosystem services, notably regulating ecosystem services are not traded in markets, and thus their economic value is seldom accounted for. The wedge between the total economic value of forests and the subset of values that are reflected by markets causes a distortion in land use decisions and a socially suboptimal allocation of forest land resources. Acknowledging and estimating the worth of forest ecosystem services, notably provisioning and regulating services, is thus the first step for a transition to a sustainable green economy. This report estimates such values.

The report has identified and assessed the economic value of the following ecosystem services: provision of non timber forest products (NTFP), pharmaceuticals and fuelwood, the benefits of soil protection, water regulation, pollination, carbon storage and recreation (ecotourism). Regulating services (water and soil regulation services, and carbon storage) are the most economically valuable. Of particular importance is that forests store carbon. When they are cleared, this carbon is released into the atmosphere thus contributing to climate change. The value range of one hectare of forest for delivering this carbon storage service, has been estimated between 1,068 -7,784 US$.

Deforestation provides Panama with cash revenue due to timber sales and subsequent agricultural revenues. The clearing of forests between 1992 and 2012 generated revenues of around 335 million US$ to the country in year 2012 only. However, deforestation during this period also generated gross economic losses, due to foregoing the benefits that would have arisen from the delivery of other competing ecosystem services. In contrast, forest conservation would have secured ecosystem services. This economic loss reaches about 606 US$ million in year 2012 only. Hence, the benefit cost ratio suggests that forest conservation during this period would have provided net economic returns to Panama. This report estimates that deforestation in Panama between 1992 and 2012 led to an average net economic loss of about 272 US$ million in the year 2012 only. The total economic losses on this whole period of deforestation (1992-2012) amounts to 3,700 US$ million.

These estimates call for the attention of the Panamanian society. In order to reduce deforestation rates in Panama, a policy intervention is needed. Such an intervention would require additional investments from both the private and the public sectors. In particular, investment by the public sector is necessary to provide forest ecosystem services directly (for example, through creation of protected areas) and to prevent unsustainable forest management (such as controlling illegal logging and compliance with logging permits). Removing existing incentives for deforestation, such as indirect subventions to cattle breeding, is also seen as an essential policy intervention to curb forest land conversion.

Since 2008, an international policy mechanism called REDD+ (Reducing Emissions from Deforestation and Forest Degradation) has been under development to encourage countries, mostly in the tropics, to conserve their forests, manage them sustainably and enhance their forest carbon stocks by means of international economic incentives. The United Nations champions the UN-REDD program, whose main objective is to conserve forests for the purpose of climate change mitigation. However, protecting forests would also secure the provision of the other forest ecosystem services, including those relying on the conservation of biodiversity. With REDD+, the amount of funds available for forests protection are likely to increase substantially. It could therefore help Panama to achieve a transition to a green economy by supporting the implementation of policies which tackle deforestation and therefore enhance one of the country's most important natural capital assets.

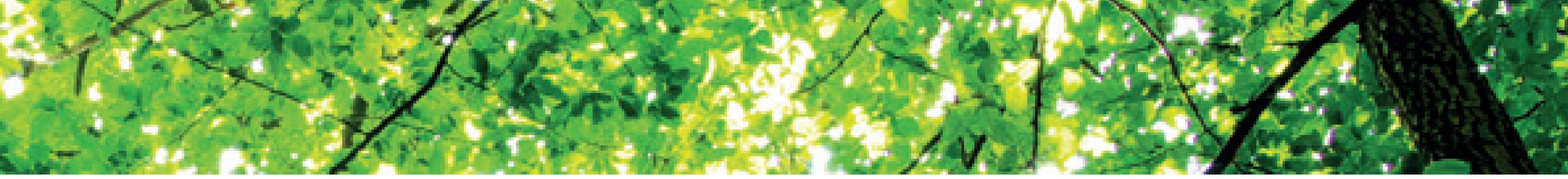
01 Introduction

Sustainable development has been defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (WCED 1987). In other words, economic development today must ensure that future generations are left no worse off than current generations. Because today's economies are biased towards depleting natural capital to secure economic growth in the short term, sustainable development is being jeopardized. A transition to a green economy, that enables economic growth while increasing environmental quality and social inclusiveness, is therefore needed to ensure the well-being of current and future generations (UNEP 2011).

Examples of resource depletion, pollution and energy inefficiencies abound in today's economies. Forest destruction is one of many environmental problems with local, regional, national and global implications. Global deforestation, although showing signs of decline in some regions, is still alarmingly high at 13 million hectares per year, which is about 0.33% of global forest cover (FAO, 2012). In Panama, forest cover losses have increased since the 1990s. Between 2000 and 2008, the annual deforestation rate in the country was around 1.46%. This process of forest clearing and degradation has been driven by a variety of factors including the growing demand for timber products, the competition with more lucrative land uses such as cash crops and cattle ranching and the development of roads and infrastructure (Mariscal, 2012). The benefits of forests to marketed commodities are not limited to timber. Forest ecosystems also provide goods and services that contribute to human well-being, including carbon storage, which contributes to climate change mitigation, water regulation in watersheds, soil erosion control, biodiversity provision, pollination, and provision of non-timber forest products, among others. However, because the maintenance of these ecosystem services is not usually rewarded financially by market forces (unlike timber extraction) there is little economic incentive for (private sector) forest managers to take such benefits into account. This is known as market failure and is one of the key drivers of unsustainable natural resources management worldwide. Understanding and accounting for the full range of services provided by forests is therefore one of the most important tasks for realizing a green economy (UNEP 2011).

Since 2008, an international policy mechanism called REDD+ (Reducing Emissions from Deforestation and Forest Degradation) has been under development to encourage countries, mostly in the tropics, to conserve their forests, manage them sustainably and enhance their forest carbon stocks by means of international economic incentives. The United Nations champions the UN-REDD program whose main objective is to conserve forests for the purpose of climate change mitigation. However, protecting forests does not only reduce carbon emissions from deforestation, it also secures the provision of the other forest ecosystem services including those relying on the conservation of biodiversity. With REDD+, the amount of funds available for forests protection may increase substantially. It could therefore become one of the best opportunities to protect forests and ensure their contribution to a green economy (Pascual et al 2013).

The aim of this report is to assess the value and role of forests in the Panamanian economy. First, the state of the economy (section 2) and the state of the forests (section 3) are presented to contextualize the current situation. Then, the direct contribution of forests to the economy is described by focusing on the impact of the forest sector on the country's gross domestic product (GDP) (section 4). Since the GDP indicator fails to reflect the extent to which production and consumption activities may be drawing down natural capital the second part of the report presents the benefits from forests that are not taken into account within the GDP (section 5). Next, the potential role of REDD+ for achieving the transition to a green economy in Panama is discussed (section 6). Finally, the last section of the report concludes and provides policy recommendations for forest conservation in Panama (section 7).



02

The state of the Panamanian economy

Panama is a country of 3.6 million people with a stable economy that has experienced strong growth despite the 2007-2008 global economic downturn (see Figure 1 below). Panama's GDP expanded by an annual average of 8.8% between 2005 and 2012, slowing to 2.4% in the first half of 2009, due to the global financial crisis and then accelerating to 10.8% in 2011 and 10.7% in 2012.

Panama shows a higher GDP growth rate than other Latin American and Caribbean countries, mainly because of its geographical position which has allowed the country to develop its service sector (approximately 77% of the GDP) around the transportation and trade generated by the Panama Canal traffic and the Free Trade Zone located in Colón, at the northern entrance of the Canal. The Canal alone accounted for about 19% of the GDP in 1999 (Sabonge and Sánchez 2009). The industrial sector is the second-most important in the country, contributing 17% to GDP, followed by agriculture which contributes 6% to GDP (Hornbeck, 2012). As a result, the economy of Panama is heavily dependent on the state of the world economy through international trade.

Panama also benefits from its historical connection with the US. This relation began during the construction of the cross-isthmian railroad in 1855. In 1903, Panama signed the Hay-Buneau-Varilla Treaty, conceding the rights to construct the Canal and to control it "in perpetuity" to the US. The Canal opened in 1914, leading to US dominance over the economy of Panama. It was finally ceded back to Panama in 1977. Today, the US and Panama still have close ties which define some key features of the Panamanian economy. In 2011, the US was Panama's largest export market and import supplier.

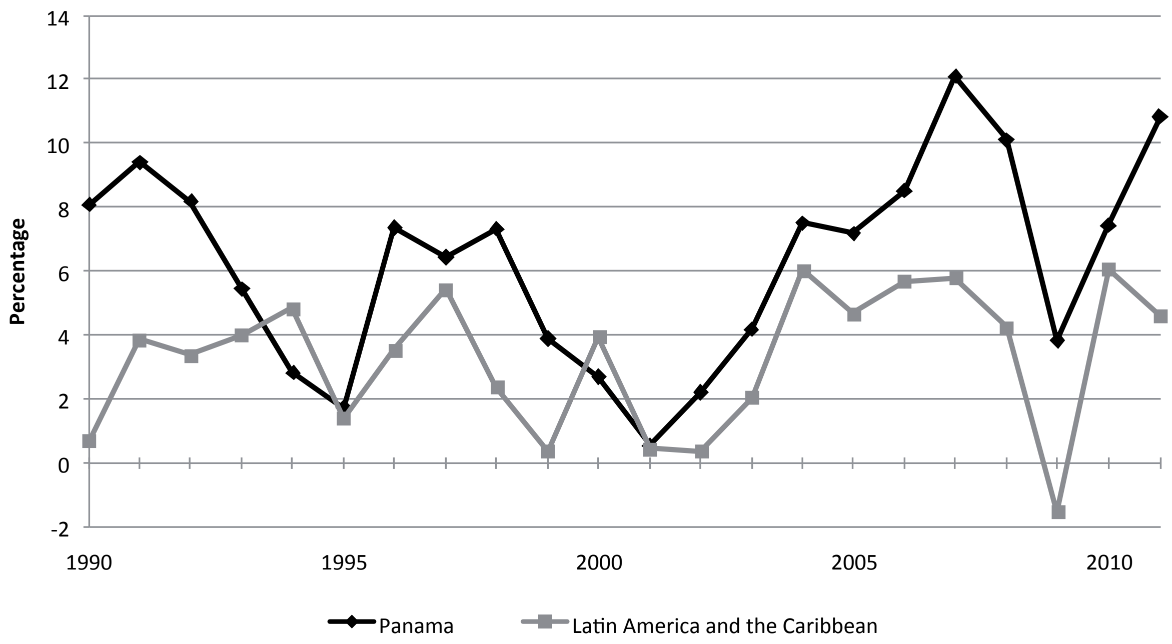


Figure 1: Evolution of GDP growth (%), in constant prices (1996), from 1990 to 2012. *Source: IMF, World Economic Outlook Database, April 2013*

03
The state of the Panamanian forests

The territory of Panama is divided into 9 provinces and 5 *comarcas* (see the map in the appendix). The *comarcas* may be defined as administrative divisions or special territories whose organization is managed by indigenous communities. In 2008, forests covered 47% (or 3,525 million hectares) of the national territory of Panama, 35% of which were located in indigenous *comarcas*.

The Panamanian forests are some of the most biodiverse in the world with 1,298 endemic species. Among these, 1,176 are plants, 56 are freshwater fish, 18 are reptiles, 17 are mammals, 15 are amphibians, 10 are birds and four are marine fish. According to Holdridge's classification system, Panama contains 12 out of the 30 life zones that exist in the world (ANAM, 2010). The terrestrial biodiversity is mainly present in the forests which can be classified according to five main types: dry forest (rainfall is less than 1500 mm/yr), moist forest (rainfall between 1500 mm and 3000 mm/yr), wet forest (rainfall is more than 3000 mm/yr), lower mountain forest (between 800 and 1500 m of altitude) and upper mountain forest (more than 1500 meters of altitude) (Condit et al., 2010). Regarding the state of the forests, in 2008, 76% of these forests were mature forest, 20% were intervened forest, 3% were secondary to mature forest and 1% was floodable forest[1] (data from UN-REDD & CATIE).

[1] Forests are called mature when more than 80% of the land is covered by trees or undergrowth. In mature forests, predominant species are those specific to the final stage of ecological succession. In secondary forests, the vegetation is in a state of secondary succession, resulting from the complete or partial removal of the primary vegetation due to anthropogenic or natural causes. For this reason, these forests include different stages of plant succession. Intervened forests refer to forest area where more than 60% of the coverage has been altered or operated by human intervention or other causes (FAO, 2010).

In spite of providing habitat for a highly diverse species and ecosystems, Panamanian forests have been cleared intensively for more than 50 years. The forest area decreased by 586,000 hectares between 1992 and 2008 (an area bigger than the Coclé province), which represents a loss of more than 14% of the previously existing forest cover. Figure 2 provides information about the total forest area in Panama, and the change in forest cover between 1992 and 2008.

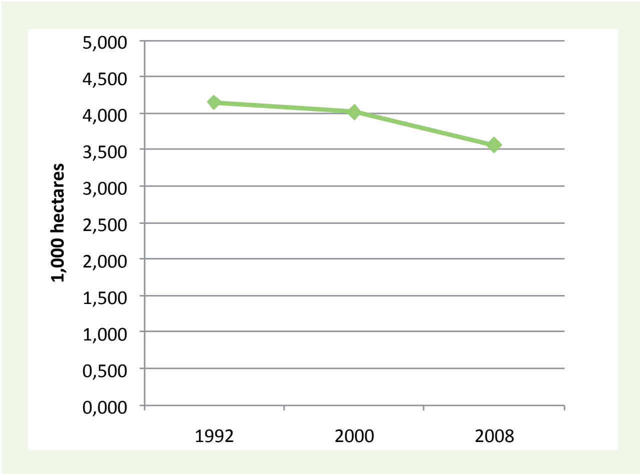


Figure 2: Total forest area in Panama in 1992, 2000 and 2008 (1,000 ha). *Source: UN-REDD and CATIE*

Annual deforestation rates in Panama increased from 0.43% between 1992-2000 to 1.46% between 2000 and 2008 [2].

Figure 3: Deforested land in the east of Panama (Mamoní river basin). *Source: Emilio Mariscal*

[2] According to the FAO, which uses a different classification of forests, taking plantations into account but not intervened forests, forest cover losses have been decreasing over the same period.

Figure 4: Map of forest cover change in Panama between 1992 and 2000. *Own elaboration. Data Source: UN-REDD and CATIE*

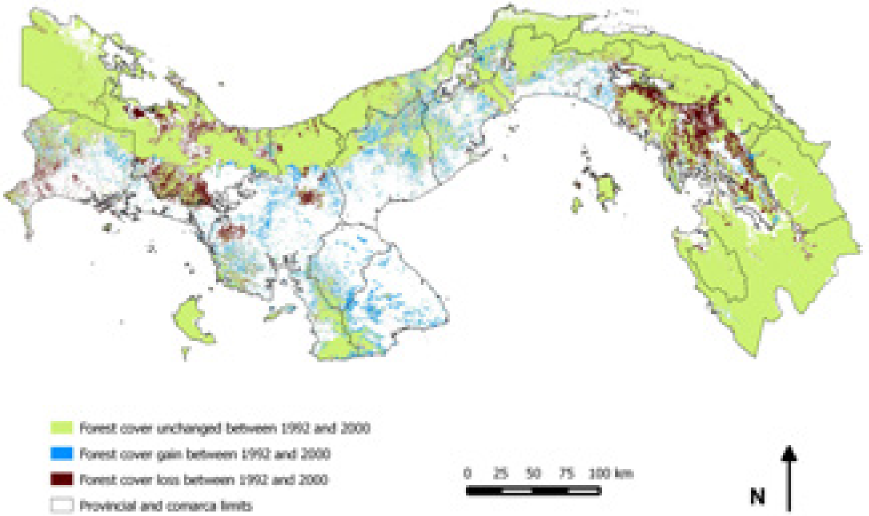
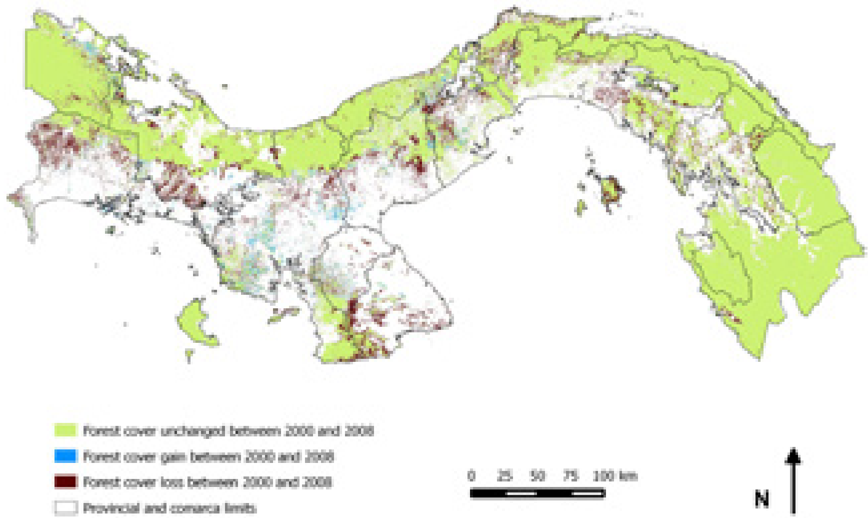


Figure 5: Map of forest cover change in Panama between 2000 and 2008. Own elaboration. *Data Source: UN-REDD and CATIE.*



It is worth mentioning that such deforestation rates, on average, are relatively low compared to other Central American countries (FAO, 2010) because Panama's economy relies less on agriculture than the economies of its neighboring countries. This loss of forest cover also differs between regions, some being more strongly affected than others. The following maps illustrate the evolution of the forest cover in Panama between 1992-2000 and 2000-2008.

As can be seen in the map in figure 4, deforestation was mainly concentrated in the Darien's province (in the East), the comarca Ngöbe-Buglé (in the West) and the Province of Panama during 1992-2000. These three regions alone accounted for 87% of the total deforestation in Panama although they contain only 53 % of the country's forests.

Between 2000 and 2008, deforestation slowed down in the Darién and in the comarca Ngöbe-Buglé, but increased in the provinces of Herrera, Coclé and Los Santos (see Figure 5).

Scientists have long drawn attention to the potential negative effect of deforestation on sedimentation and therefore on water availability in the Canal watershed. As the Canal traffic is generating up to 19% of the Panamanian GDP, it led the authorities of Panama to provide incentives for reforestation (Law 24 on reforestation and afforestation, 1992). This law provides tax breaks for forest plantations. The government also created Protected Areas (PAs) throughout the country and in particular in the Canal watershed. Between 1992 and 2000 due to government policies, reforestation took place in the Canal watershed. This reforestation declined between 2000 and 2008, while deforestation increased strongly. Figure 6 shows the evolution of the forest cover in the Canal watershed between 1992-2000 and 2000-2008.

According to a report from Chemonics International Inc. (2004), the most important threats to tropical forests in Panama are land use conversion for agriculture and cattle ranching, road construction and enlargement and extraction of timber. These direct drivers differ strongly between different areas of the country. For instance, while the main cause of deforestation in the Bocas del Toro province and in the Ngöbé-Buglé comarca is land conversion to subsistence agriculture and cattle ranching, in the Darién, logging is the predominant threat.

While forest land tenure in Panama varies between public, private and indigenous territories (*comarcas*), 98% is owned by the state (FAO, 2010). In order to control deforestation the national authorities implemented the forest law of 1994. It states that all activities related to forests should be subject to a management plan approved by the Authority of the Environment (ANAM), (ANAM, article 11 of the law). For example since 2006 in the province of Darien, only communities can get logging permits and under strict legal conditions, including the proposal for a sustainable management plan for 25 years. Once approved by the authorities, the permission to extract a determined volume of wood in a specific area each year may be granted. In general, communities then agree with a firm which will be in charge of timber extraction and sales. Part of the task of the ANAM is to train communities so that they can manage the extraction of forest products in a sustainable way. In practice, illegal logging and non-compliance with legal rules is widespread (personal communication with UN-REDD and ANAM representatives). This suggests that, in Panamá, deforestation is exacerbated by government failure as public institutions fail to enforce permit compliance and control illegal logging. Other types of permits also exist in the rest of the country including subsistence permits (for individual use only) or logging permits on private lands.

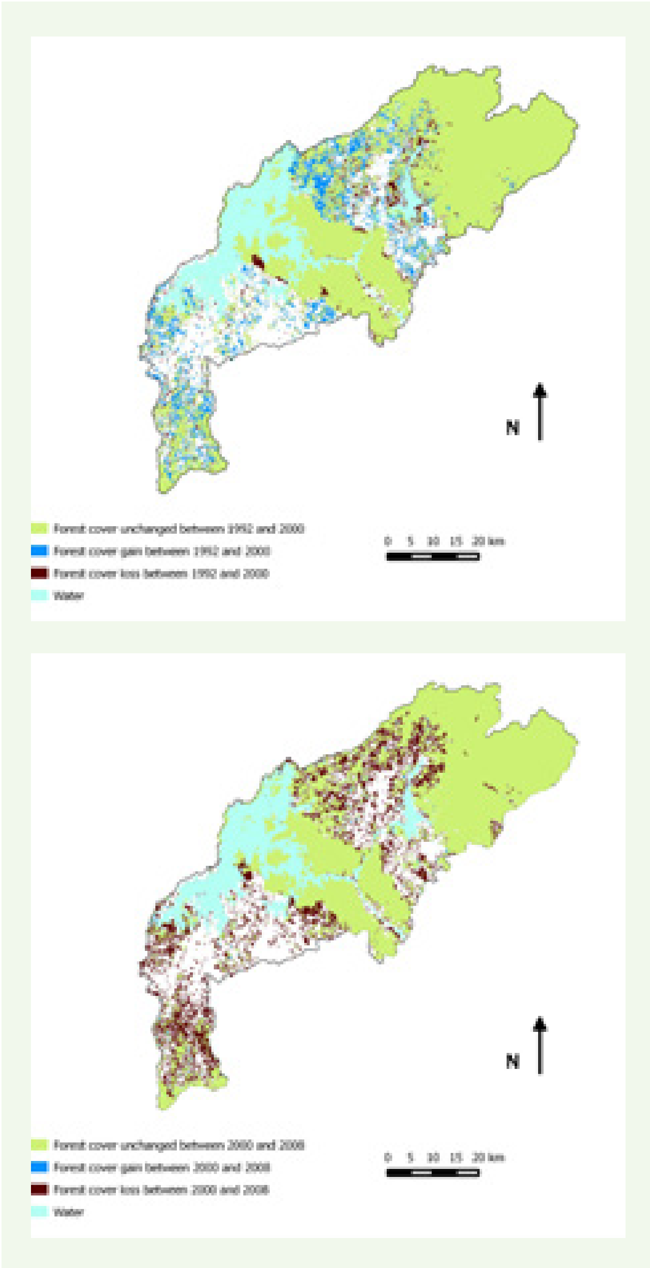
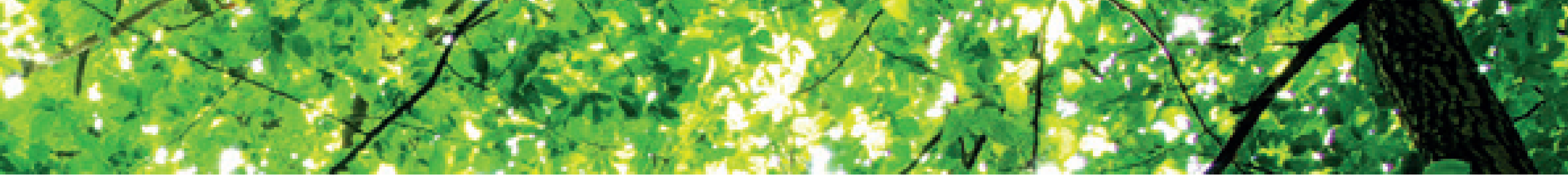


Figure 6 : Forest cover in the canal watershed between 1992 -2000 (left) and 2000-2008 (right). *Own elaboration. Data Source: UN-REDD and CATIE*



04 The contribution of the forestry sector to the Panamanian economy

4.1 Direct contribution

Some of the benefits from the Panamanian forests are accounted for in the GDP, especially those related to timber extraction and commercialization, which are the main contributions of the forestry sector to the GDP. The forestry sector includes silviculture and wood extraction activities, and contributes to the value added of the agricultural sector into the Panamanian economy. In addition, wood extracted from the forest is used as an input in different manufacturing and transformation industries[3] such as wood products, paper and paper products and furniture manufactures. All these provide financially tangible contributions to the economy of Panama and are summarized in table 1.

Table 1: Contribution of the forest sector to the GDP (2001-2010) in 2010 constant prices (billions of US$[4]). *Source: INEC Instituto Nacional de Estadisticas y Censo*

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGRICULTURE, LIVESTOCK, HUNTING AND SILVICULTURE	482	474	503	530	589	652	745	836	849	925
Silviculture, wood extraction, services and related activities and share of the agricultural GDP (%)	22	24	23	27	29	31	35	39	40	45
	(4,56)	(5,05)	(4,53)	(5,13)	(5,01)	(4,70)	(4,67)	(4,66)	(4,76)	(4,82)
MANUFACTURING INDUSTRIES	828	793	799	860	917	993	1102	1345	1364	1440
Total contribution of the forest manufacture and share of the manufacturing GDP (%), including:	50	64	61	56	64	69	76	88	80	72
	(6,09)	(8,02)	(7,64)	(6,51)	(7,03)	(6,94)	(6,92)	(6,58)	(5,84)	(5,03)
- Sawing and planing of wood (%)	(0,33)	(0,01)	(0,01)	(0,01)	(0,01)	(0,01)	(0,01)	(0,01)	(0,01)	(0,01)
- Wood, cork, straw and plaited products manufacture (%)	(0,60)	(0,60)	(0,56)	(0,60)	(0,57)	(0,56)	(0,52)	(0,45)	(0,45)	(0,44)
- Paper and paper product manufacture (%)	(3,37)	(3,81)	(3,66)	(3,39)	(3,38)	(3,61)	(3,76)	(3,62)	(2,56)	(2,18)
- Furniture and mattresses manufacture (%)	(1,80)	(3,61)	(3,41)	(2,51)	(3,07)	(2,75)	(2,63)	(2,50)	(2,82)	(2,40)
GDP	9,461	9,998	10,655	11,911	13,218	14,956	17,797	21,825	23,110	26,589
Contribution share of the forest sector to the GDP (%)	(0,77)	(0,88)	(0,79)	(0,70)	(0,71)	(0,67)	(0,62)	(0,58)	(0,52)	(0,44)
- Contribution share of silviculture, wood extraction and services activities to the GDP (%)	(0,23)	(0,24)	(0,21)	(0,23)	(0,22)	(0,20)	(0,20)	(0,18)	(0,17)	(0,17)
- Contribution share of wood manufacturing industries to the GDP (%)	(0,53)	(0,64)	(0,57)	(0,47)	(0,49)	(0,46)	(0,43)	(0,41)	(0,34)	(0,27)

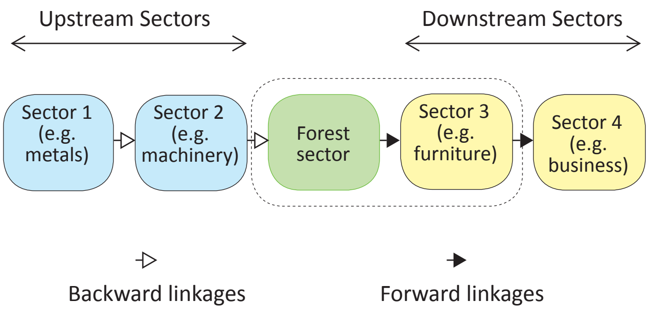
[3] Manufacturing industries refer here to industrial production, in which raw materials are transformed into finished goods on a large scale.

[4] The Panamanian currency is the Balboa, it is indexed on the dollar, so that 1 B/.=1 US$.

As seen in Table 1, the added value generated by silviculture in Panama has been increasing between 2000 and 2010 but its contribution to the agricultural GDP has remained generally constant. Regarding the manufacture of wood products, while the added value has also increased, its share in the value added of the manufacturing GDP has decreased during the last years. On aggregate, the contribution of the forestry sector and wood manufacturing industries has increased, but at a lower rate than the growth in GDP. This explains that the contribution share of the forestry sector to the Panamanian GDP has decreased (halved) over the 2001-2010 period (from 0.88% to 0.44%). This is mainly due to a strong growth of the service sector and not to a weakening of the forestry sector. Despite this relatively low marketed added value to the GDP, it is important to highlight that this sector plays a key role in the economy as its outputs enter into the productive structure of other industries. Therefore, in assessing the total added value of the forest sector to the GDP it is also necessary to look at the indirect relationship of the forestry sector with other sectors of the economy, that is the intersectoral linkages between the forestry and other productive sectors.

Table 2 shows the direct contribution of the forestry sector to these six other industries. Additionally, the forest sector impacts the production in other sectors because forestry is part of a chain of production in which each sector is a link. Figure 7 below illustrates this chain.

Figure 7: The forest sector, downstream sectors and upstream sectors in the economy



The direct contribution of the forest sector to downstream industries, measured in table 1, is shown in the dotted box: some sectors (e.g. construction) use products from the forest sector. Subsequently, products from these sectors enter the productive process of other downstream sectors, such as the business sector for instance. The forest sector therefore has an indirect effect on the production and the value added created in these sectors. These so-called forward linkages can be assessed by posing the question: how much does an increase in the production of the forestry sector impact the production and the value added in downstream sectors? Similarly, backward linkages exist when a sector uses the outputs from several other sectors (upstream sectors) for its own production, therefore creating value added in those input supplying sectors. However, since the forestry sector is a primary sector, it is mainly associated to others through forward linkages and has relatively few backward linkages.

4.2
Intersectoral linkages

Six types of industries employ inputs that are supplied by the forestry sector. These include: the agricultural sector, the textile sector, the wood and paper sector (including the publishing industry), the chemical industry, and the manufacturing and construction sectors. The information about the share of their inputs that are directly supplied by the forestry sector appears in table 2. As can be seen for instance, wood inputs play a major role in the forestry sector itself[5] and of course in the wood and paper sector.

Table 2: Percentage share of inputs from the forestry sector into intermediate demand of other industries (2001, 2006 and 2011). *Source: INEC-Eora MRIO database*

Sector	2001	2006	2011
Forestry	29,49	29,59	34,67
Wood and Paper (including edition)	6,68	6,70	8,31
Construction	0,45	0,17	0,56
Agriculture	0,19	0,19	0,24
Petroleum, chemicals and non metallic mineral products	0,16	0,16	0,21
Other Manufacturing (including furnitures)	0,16	0,16	0,20
Textiles and Wearing Apparel	0,07	0,07	0,09

[5] In this table, the forestry sector includes industries such as sawmill industries.

Unfortunately, only limited data is available from the Panamanian institute of Statistics (INEC) regarding national accounts, in particular, input-output matrices do not exist. Therefore, input-output tables from the Eora multi-region input-output (MRIO) database (Lenzen et al. 2012, Lenzen et al., 2013) have been used to evaluate the intersectoral linkages mentioned above. The Eora MRIO database provides a time series of high resolution input-output tables for 187 countries. These tables have been constructed using data from the UN program for Sustainable Development Solutions Network (UNSDSN). They have then been modified in order to disaggregate data on the agricultural and forest sectors using tables for neighboring Colombia as a second best proxy and data on the GVA (Gross Value Added) provided by the Panamanian institute of Statistics. In particular, data on the sales and the input structure of the forest sector in Colombia have been used. This has yielded the data in Figure 8 which provides quantitative estimates of the forward linkages between the forestry and other productive sectors of Panama for the period 2002-2011. A de-

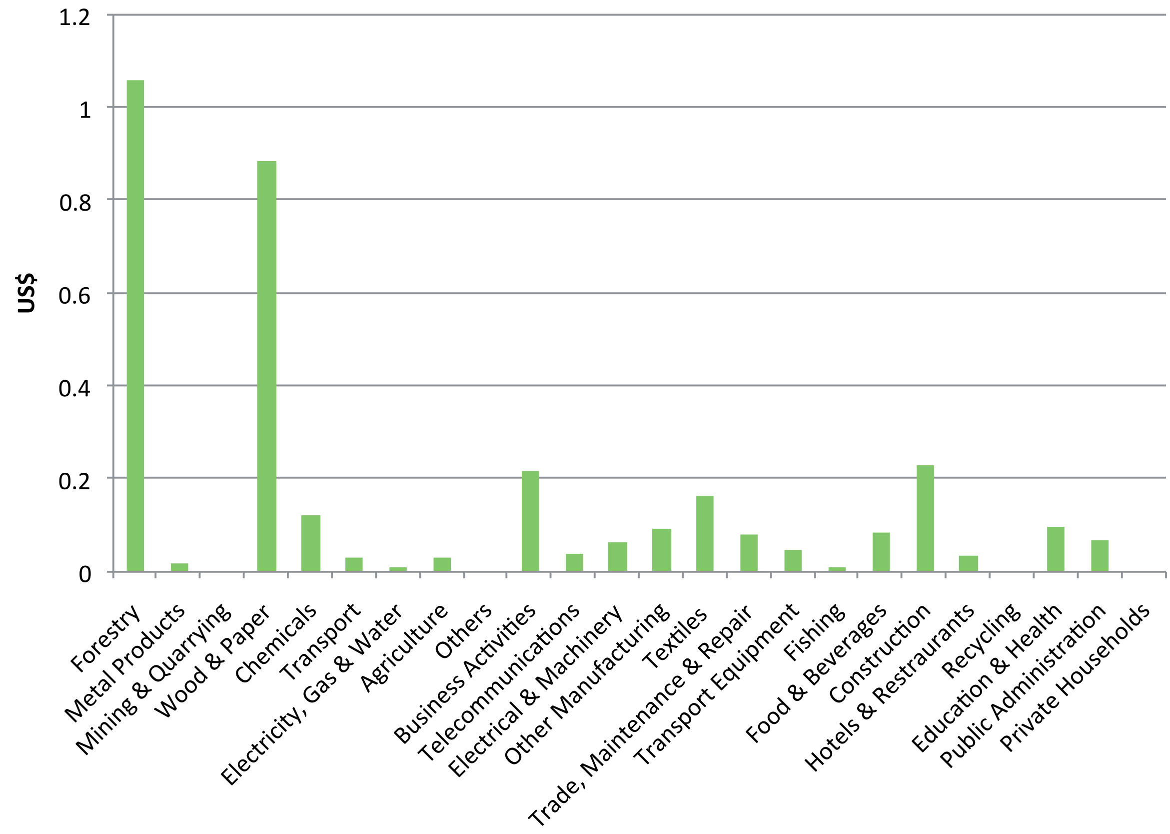


Figure 8: Forward linkages of the forestry sector in average between 2002 and 2011. *Source: INEC-Eora MRIO database*

tailed explanation of the figure is given below.

If the primary inputs used by the forestry sector increase (e.g. additional labor cost), the production of this sector will increase and, consequently, the production in downstream sector will increase as well. This is what is shown in Figure 8. It indicates by how much the production of the downstream sectors increase when the primary inputs used in the forestry sector increase by one dollar. For instance, a one dollar increase in the use of primary inputs by the forestry sector would increase the value of production of the wood and paper sector by 0.88 dollars. In total, it would increase the production of other sectors by 3.45 US$[6].

[6] These estimations do not take into account the impact of prices on the linkages between sectors. When the price of timber is changing, the demand for timber products from other sectors might also change. In other words, it is assumed that forest products cannot be substituted by other products.

The same analysis was done for each sector of the economy. The order of the sectors in Figure 8 provides the ranking of each economic sector in terms of forward linkages. The ranking of each sector corresponds to its most frequent ranking between 2002 and 2011. The forestry sector (first on the left), whose position stayed the same between 2002 and 2011, is the sector ranked 1st implying that it is the sector with more forward linkages in the Panamanian economy. It confirms that the forest sector is key in terms of providing valuable inputs to other areas of the economy in Panama.

To summarize the position of the forestry sector in the Panamanian economy, and using a typology of the 24 sectors of the Panamanian economy, the backward and forward linkage measures are shown in Figure 9. The horizontal axis tells how much any given sector is dependent on total inter-industry demand, that is, it reflects to what extent it supports the production of downstream industries. The higher the value on this axis the stronger the forward linkages are. The ordinate tells how much any given sector is dependent on inter-industry supply. That is, it measures how much a given sector employs outputs from other industries as inputs in its own productive processes (the higher the value,

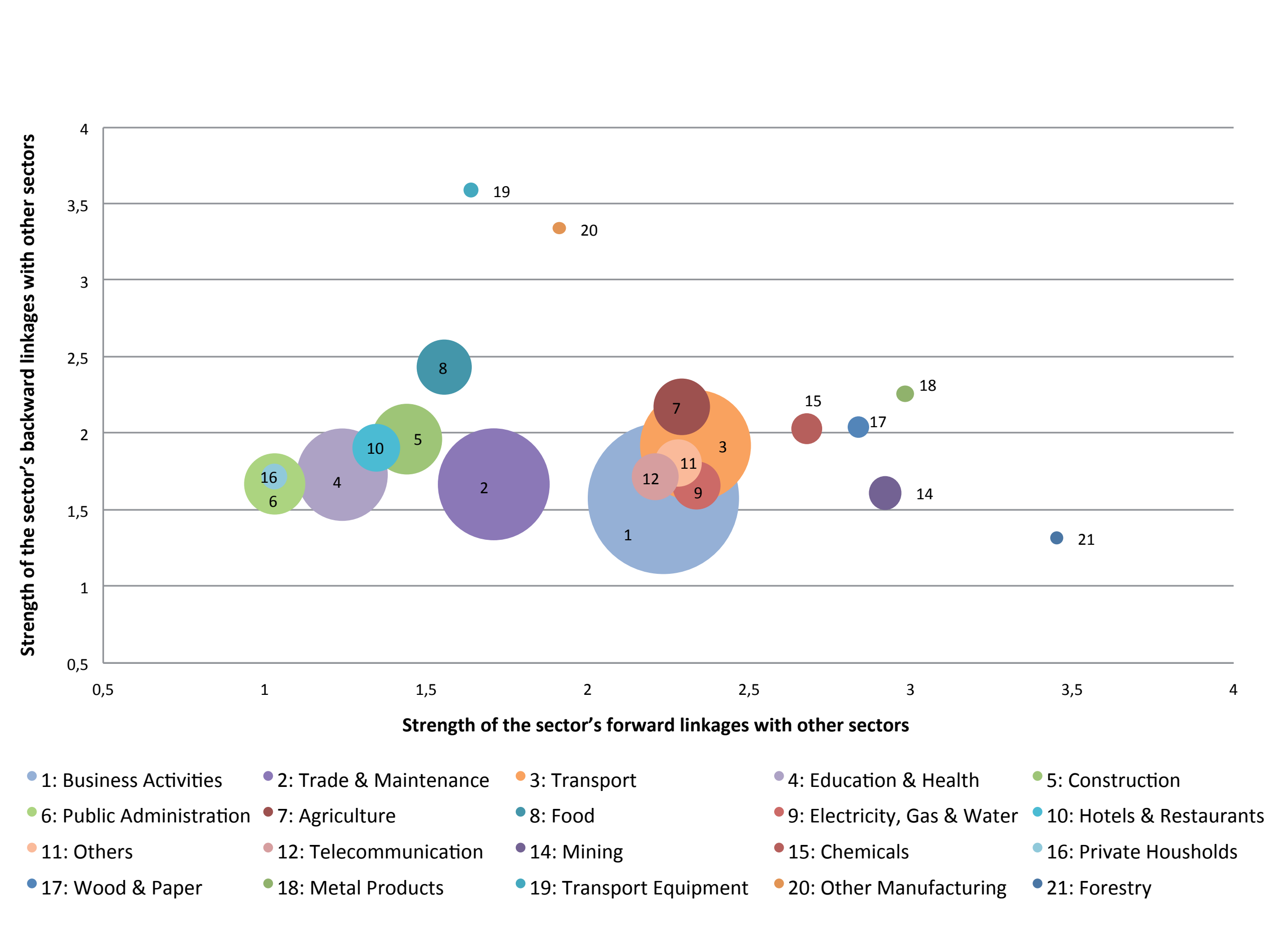


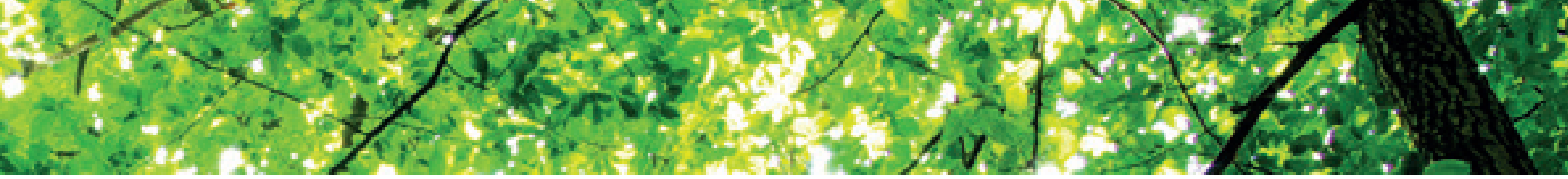
Figure 9: Typology of sectors of the Panamanian economy in average between 2002 and 2011.
Source: INEC-Eora MRIO database

the stronger the backward linkage is). The size of the circle corresponds to the gross value added created in any given sector and as such it indicates the direct contribution of the sector to the Panamanian GDP.

It should be noted that the fishing and the textile sector are not represented in Figure 5 as they have extremely high values for backward linkages. They would be located in the upper-left corner. As illustrated by figure 5, forestry in Panama is a relatively small sector but it strongly supports downstream economic sectors, more than all other sectors, including all other primary sectors. On the contrary, forestry is not dependent on other sectors' production.

4.3 Value added induced by the forestry sector

As a further indicator of the key economic significance of the forestry sector, it is worth noting the extent to which it contributes to the value added of other sectors. Figure 10 provides an overview of the value added induced annually in each downstream sector (other than the forestry sector) between 2002 and 2011. This value added may be generated directly or indirectly. For instance, the forestry sector contributes directly to the value added created in the wood and paper sector. It also contributes indirectly to the value added created in the fishing sector because the latter uses boats which are produced using timber from the wood and paper sector. It also shows the evolution of the total value added induced in other sectors. On average over the period 2002-2011, the total annual value added induced in downstream sectors by forestry reaches 80,590,000 US$.



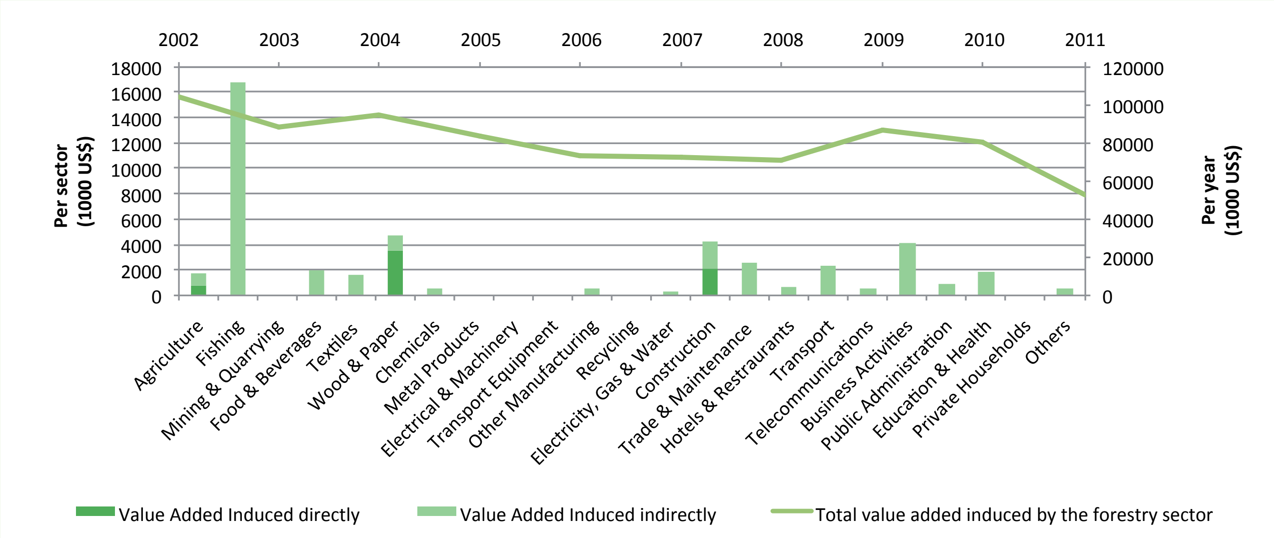


Figure 10: Value added induced annually in downstream sectors between 2002 and 2011. *Source: INEC-Eora MRIO database*

The forest sector, in addition to those already mentioned, has strong indirect forward linkages with the three most important sectors of the economy of Panama in terms of their share in the total GDP of the country: the financial sector, the trade sector and the transportation sector. It is also worth noting that the total value added induced in all other sectors has been decreasing consistently since 2002. This loss of induced value-added of the Panamanian forestry sector may be due to an increase of the share of imported wood products by these sectors. As shown in figure 11, imports of wood products have more than tripled between 2002 and 2011.

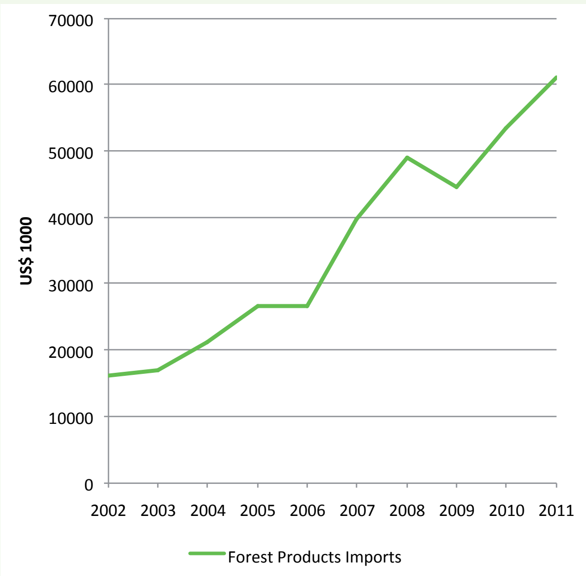


Figure 11: Imports of forest products in Panama between 2002 and 2011. *Source: INEC-Eora MRIO database*

In summary, although the forestry sector supports many other sectors, its impact on GDP in the context of an open economy such as the Panamanian one may be rather small. It is also decreasing as imports of wood products are increasingly used by other sectors.

However, this result would be grossly biased if only the contribution to the GDP was acknowledged. A country may have a high GDP growth but exhaust its natural resources and damage its environment and biodiversity, therefore jeopardizing the wellbeing of current and future generations. Importantly, forests provide significant benefits that are associated with human well-being both locally and globally but these are not taken into account by standard macroeconomic indicators such as the GDP. For instance, people living in rural areas benefit from an easy access to forests and can collect non-wood forest products such as food, raw material and medicines. They can also collect firewood and use it as an energy source for cooking. Since the majority of poor people are located in rural areas (according to the UN, in 2008, 18% of people were leaving below the poverty line in urban areas and 60 % in rural areas), forests can contribute to poverty alleviation. In addition, forests provide many other services including regulation services such as water regulation services that make life possible and support social and economic structures. The recent TEEB Assessment (The Economics of Ecosystems and Biodiversity) suggest that the values of forest ecosystem services are in fact dominated by regulatory functions (Kumar, 2010). However, these positive externalities in the form of regulation services are seldom reflected in market transaction and thus are not included in financial value added figures that make up its share of GDP. The green economy is concerned with acknowledging such external benefit flows from natural capital. The next sections focus on estimating the economic value of some of these key services to provide a more robust view of the role of forests to the Panamanian economy.

05 The value of Panamanian forests

5.1 Forest ecosystem services and human well-being

Forest ecosystems provide considerable benefits to human well-being, beyond their more tangible role in supporting economic activities as shown previously. These benefits are known as ecosystem goods and services which include goods that can easily be marketed as well as ecosystem processes such as water regulation or carbon storage. Three main categories of forest ecosystem services exist: (i) provisioning services, (ii) regulating services and (iii) cultural services (MEA 2005 and Kumar 2010). This categorization is summarized in the following figure.

Provisioning services cover the provision of forest goods such as wood (timber and firewood), non timber forest products (NTFP) and pharmaceuticals. Regulating services

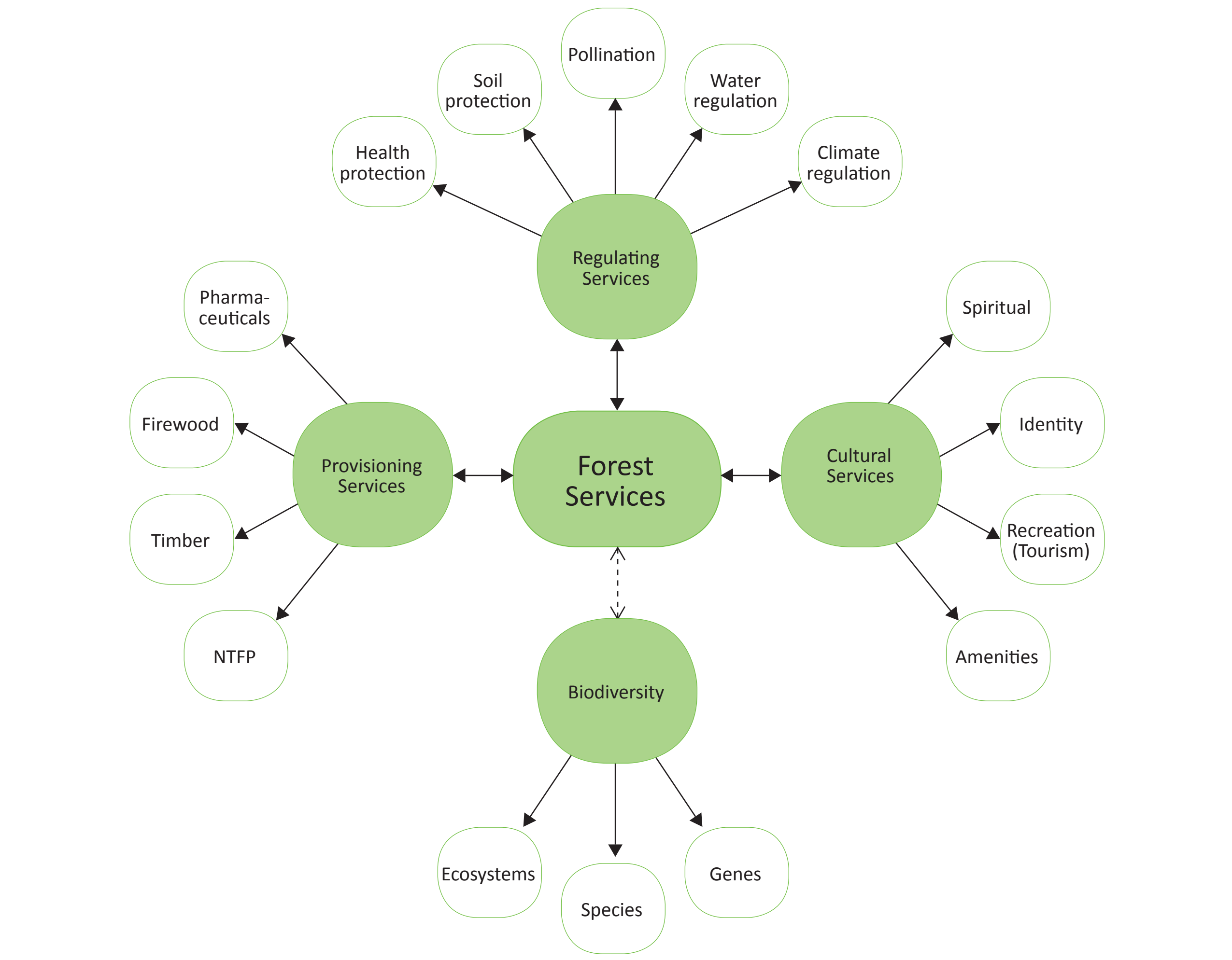


Figure 12: Typology of forests ecosystem services

are services that determine the functioning capacity of ecosystems and their ability to regulate the impact of external shocks and to respond to changes in environmental conditions without losing functionality. Cultural services capture many of the more intangible non-use values of forests, for instance existence, spiritual and inspirational values associated with well-being. Finally, biodiversity is not a service per se, but it supports the ecosystem functioning and therefore the provision of other services, in particular regulation services. Like provisioning services, regulating services can be quantified, though not without difficulty.

Table 3 below provides a detailed description of the regulating services provided by forests.

Regulating services	Description
Climate Regulation	Forest ecosystems can affect the climate both locally (temperature and precipitations) and globally (role in the carbon cycle).
Water regulation	The timing and magnitude of runoff, drought and flooding can be affected by changes in forest land-use cover. In particular, they impact the water storage potential. Also forest ecosystems can help to filter out wastes into waters.
Erosion regulation/ soil protection	Forest land cover change can impact soil erosion, soil fertility, and, sedimentation in watersheds.
Disease regulation	Changes in forest ecosystems can change the abundance of disease vectors such as mosquitos.

Table 3: Regulating services produced in forests. *Source: adapted from the MEA (2005)*

While some of these services are linked to markets (for instance timber provision), most of them are not, so they do not have a financial value (a price) attached to them and thus do not appear in standard economic accounts and macroeconomic indexes such as GDP. Lacking a price tag in the marketplace does not imply lack of value, however, it can cause a suboptimal allocation of resources in the forest sector and economically biased forest land use decisions. Figure 13 illustrates the linkages that exist between forests, ecosystem services and human well-being.

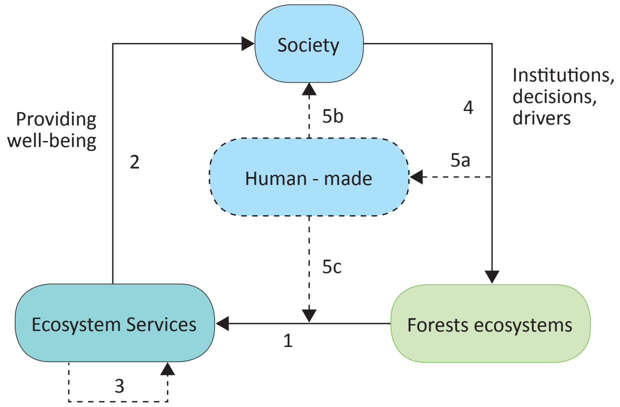


Figure 13: Linkages between forest ecosystems, services and human well-being. *Source: adapted from the UNEP (2013)*

The forest stock determines the amount of ecosystem services available (arrow 1), that is, the amount of benefits contributing to human-well-being (arrow 2). For instance, the higher the forest stock the larger the carbon storage capacity. Some ecosystem services may also impact the provision of other services (arrow 3). In particular, biodiversity may enhance the ecological functions of the forest and its resilience, leading to changes in the provision of other regulating services. These ecosystem services then contribute to human well-being. Ecosystems supply bundles of ecosystem services within which tradeoffs and synergies occur. A typical tradeoff between forest ecosystem services occurs when provisioning services (defined by timber production) are prioritized at the cost of reducing the carbon storage capacity of forests through deforestation for commercial purposes. In this context, sustainable policies are needed to find the optimal land use that balances the supply of ecosystem services in order to maximize human well-being now as well as in the future by providing bundles of services (food, non timber products, fresh water, etc). Furthermore, through institutional land use decisions (such as land tenure, policies or markets), humans impact forest ecosystems (arrow 4). It should also be noted that, at times, forest ecosystem services may not come directly from natural capital stocks in the forest. Of course natural capital, though necessary for human well-being, is not the only asset that delivers benefits to humans (arrow 5a and 5b). Finally, it is often the case that human assets in terms of physical capital (technology) or human capital (education and traditional knowledge) are necessary to turn changes in forests into beneficial ecosystem services, such as timber production (arrow 5c). However, those links (5a, 5b, 5c) are not the focus of this report.

The previous part of this report (section 4) estimated the contribution of the forestry sector to the Panamanian GDP therefore focusing mostly on marketed provisioning goods and services, such as timber provision (grey box in figure 12). As already noted, all the benefits from forest ecosystem services cannot be maximized simultaneously. Figure 14 below illustrates the tradeoffs which may result from different land-use management decisions. It goes from full timber extraction on the left to full conservation on the right.

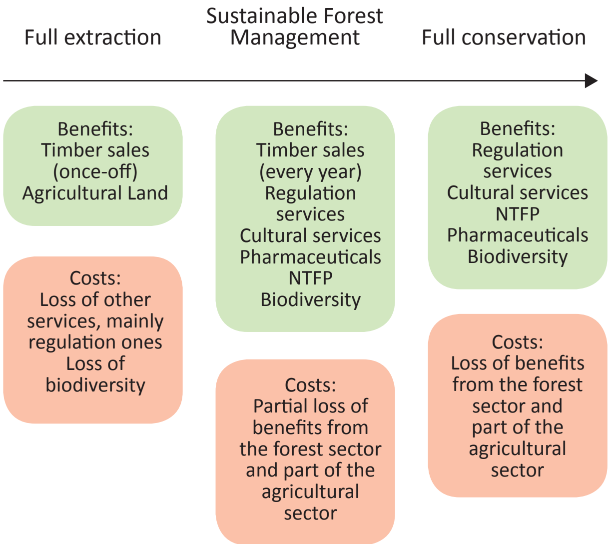


Figure 14: Benefits and costs from different level of forest extraction

The aim of this section (section 5) is to report the value of these non-marketed services, keeping in mind that as they are often bundled, they may be competing with other marketed (provisioning) ones. The focus is thus on assessing such potential tradeoffs as well as what the impact of a successful REDD+ implementation strategy would be in Panama. The following services have been identified and evaluated in the sections below: provision of non timber forest products (NTFP), soil protection, water protection, bioprospection, pollination services, and carbon storage services. Other ecosystem services provided by forests are discussed briefly in a more qualitative manner.

5.2 Data and methods

As data were not always available for Panama, or only for some areas of Panama, the report applies a benefit transfer approach to evaluate the value of forest ecosystem services across the country. This approach involves using information from existing primary studies to inform current decisions regarding impacts on ecosystems. The principle of this approach is to estimate the value of a given ecosystem service in a policy site (Panama) by adjusting an existing valuation estimate from a similar ecosystem elsewhere. This method is used more specifically to estimate the value of non timber forest product provision, pollination services, and soil protection services. Values are computed using data from other Latin American countries including Costa Rica, Honduras and Brazil. For the other services, data extracted from various studies on ecosystems services provision in Panama were used. Additionally, when necessary, values are translated into Purchasing Power Parity (PPP) dollars in 2012. The PPP dollar takes into account the differences in purchasing power of a "basket of goods" across countries, so that it readily allows a comparison between values for different ecosystem services found in different areas, and, at different points in time. Additional information on the methods used is given in the appendix.

5.3 Values of selected forest ecosystem services

5.3.1 Provision of timber

First, forests provide multiple subsistence goods to local people as well as to Panamanian industries such as commercial wood and fuelwood. According to the FAO (FAO, 2010), the volume of wood contained in one hectare of Panamanian forest is around 184 m^3. However, all this volume cannot be translated into marketable timber. In a study from BCEOM (Bureau Central des Etudes de l'Outre-Mer) and ANAM (BCEOM-TERRAM, 2005), the volume of commercial timber per hectare of forest in the province of Darién was estimated to range between 10-44 m^3/ha with an average value around 22 m^3/ha. Yet, according to the ANAM, the commercial volume per hectare is likely to be lower in other regions of the country as it depends on the type of ecosystem. For these areas, an average commercial volume of 10 m^3/ha was chosen. Then, a national average was estimated around 13 m^3/ha using data on the forest area inside and outside the Darién province. When forests are managed following a sustainable management plan (SMP), where timber extraction is based on the natural growth rate of the particular tree species, the maximum extraction is around 10 m^3/ha/yr for teak in Central America (Khatun, 2011). In permits assigned to communities in the Darién, the authorized level of extraction corresponds to the level set as being sustainable and is around 7.92 m^3/ha/yr on average for all forest concessions.

Regarding the price of timber in Panama, the study reports an average price between 95 US$/$m^3$ and 153 US$/$m^3$ on average and exploitation costs between 74 US$/$m^3$ and 109 US$/$m^3$ suggesting a net margin[7] between 20 and 44 US$/$m^3$.

The net income value from full timber extraction in one hectare of forest should therefore range between 266 and 572 US$/ha, with an average value around 419 US$/ha. If timber extraction is not managed sustainably, other services provided by forests are likely to be degraded or lost. However, if timber extraction is managed sustainably (following a Sus-

[7] Costs are assumed to be equivalent for sustainable and full timber extraction.

tainable Management Plan as it is required in the community permits in the Darién), the value of commercial timber in one hectare of forest is between 162 and 348 US$/ha/yr, with an average value around 255 US$/ha/yr, and other ecosystem services will be conserved. It should also be noted that one hectare of forest managed sustainably will provide cash benefit every year since it enables forest regeneration, while full extraction only has a once-off market value. Table 4 summarizes the results.

Ecosystem Service	Minimum value – Average value – Maximum value
Timber provision without SMP(2012 US$/ha)	266 – 419 – 572
Timber provision under a SMP(2012 US$/ha/yr)	162 – 255 – 348

Table 4: Value of forests for timber provision

5.3.2

Provision of firewood

Forests also provide a source of energy, especially for cooking by local people who live in or nearby the forests. According to Morell (2012), in 2010, 433,615 people in Panama used firewood to cook, and the vast majority of those (89%) lived in rural areas with the rest residing in urban areas. Here, it is assumed that people collect dead wood so that the provision of fuelwood does not tradeoff with other services such as regulating ones.

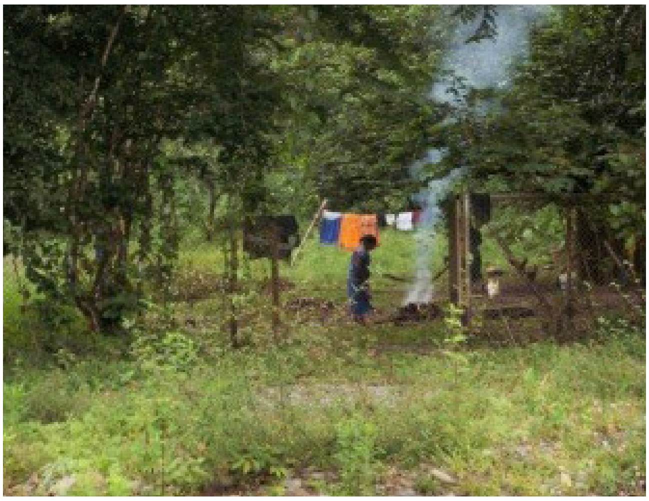


Figure 15: Woodfuel use by indigenous people. *Source: Emilio Mariscal*

The method generally used to estimate the value of fuelwood is to calculate what it would cost to replace this source of energy by another equivalent one (see the appendix for more details on the methodology). In Panama, fuelwood would most probably be replaced with liquefied petroleum gas (LPG). Based on the data from FAOSTAT, it is possible to estimate the fuelwood production around 0.3 m^3/ha and to calculate the amount of LPG that would be necessary to replace firewood. In average, it would represent 76 kg of LPG. Given the price of LPG being 1.46 US$/kg in 2012, the estimated value of one hectare of forest used for the provision of firewood is estimated around 111 US$ in 2012 prices in average. However, the value of one hectare of forest for fuelwood provision is highly spatial. Forests that are remote are less likely to be used for fuelwood provision and should therefore have a small or even null value whereas forests close to villages are more likely to have a high value. This average value should therefore be taken with caution. Also, since this value does not take into account the cost of harvesting wood, in particular labour time, it might be overestimated.

Ecosystem Service	Average value
Fuelwood provision	111

Table 5: Value of forests for fuelwood provision in 2012 US$/ha/yr

5.3.3

Provision of NTFP

Together with timber and firewood, forests also provide a variety of non timber forest products (NTFP) that are widely used by local people and indigenous communities such as food, medicine, handcraft material, and many others. Godoy et al (2002) estimated the gross value of these NTFP in two distinct forests of Latin America: one in Honduras and one in Bolivia. They showed that the value of one hectare of forest depends heavily on its proximity to the market. In a remote area, the value of one hectare of forest with regard to the provision of NTFP varied from 10.2 US$ in Honduras to 6.1 US$ in Bolivia. In accessible ones, the value of one hectare of forest varied from 41.7 US$ in Honduras to 11.2 US$ in Bolivia. Therefore the gross value of NTFP provision of one hectare of Panamanian forests for the provision of NTFP is estimated between 6 and 42 US$, with an average value around 16 US$/ha/yr. Once again it is assumed that labor costs are negligible.

Ecosystem Service	Minimum value – Average value – Maximum value
NTFP provision	6 – 16 – 42

Table 6: Value of forests for NTFP provision in 2012 US$/ha/yr

5.3.4

Provision of pharmaceuticals

Forests provide plants used in the development of modern medicines and other commercial products. Firms may therefore pay for the right to search and use genetic resources from a particular area through bioprospecting. This kind of contract, generally between a pharmaceutical firm and a government body, is known as Material Transfer Agreement. The first, and most famous case, was signed by Merck & Co, the largest US pharmaceutical producer, and the Costa Rica Biodiversity Institute in 1991. Since them, several studies have focused on the potential value of forest for bioprospecting using actual data on the contribution of forests relating to plant-based pharmaceutical products (Simpson et al. 1996, Rausser & Small 2000, Costello & Ward 2006). Panama sits astride two hotspots of biodiversity (CI 2013), the Meso-America hotspot in the north and the Tumbes Choco Magdalena hotspot in the South. Conservation International (2013) evaluated the number of endemic plants per hectare of forests in each of these two hotspots. Based on these evaluations, Narloch (2012) estimated the value of one ha of forest for bioprospecting in Panama to be between 0.1 US$ and 16 US$ with an average value around 5 US$ per year per hectare. These values can vary significantly across regions of Panama. Also, it is worth mentioning that bioprospecting contracts are highly controversial. If one were to be signed between the government of Panama and a pharmaceutical firm, strict protections for indigenous or local rights and knowledge would have to be enacted.

Ecosystem Service	Minimum value – Average value – Maximum value
Pharmaceuticals provision	0.1 – 5 – 16

Table 7: Value of forests for pharmaceuticals in 2012 US$/ha/yr

5.3.5

Water regulation

Water availability in Panama is affected by the seasonal pattern of precipitation. During the wet season, generally from May to November, water supply is far above the anthropogenic and ecological demand. During the dry season, water scarcity does not represent an issue in “normal” rainfall years either. However, climatic events such as those linked to El Niño, that are associated with droughts, and La Niña, that are associated with flooding, do affect the precipitation patterns. This causes major problems to the main economic sectors across the country, including impacts on water resources, energy, farming, livestock, forestry and fishery sectors.

In Panama, the value attached to water-related ecosystem services provided by forests is mostly represented by their impact on water regulation, especially during those years affected by climatic anomalies. The services of water flow regulation not only include the mitigation of floods and droughts, but also the moderation of the variability in more continuous processes. It has implications for a wide range of ecosystem processes and functions, many of which affect human wellbeing. For these reasons, water regulation is frequently described as the most valuable of the services delivered by watersheds. In many regions of the world, the value of water regulation alone by forests outweighs the value of all other forest provisioning services combined, including timber and non-timber forest products, food, genetic information, pharmaceuticals (TEEB, 2009; Kumar, 2010).

Panama is divided into 52 watersheds (ANAM, 2010). The vegetation in each of these watersheds affects surface runoff, infiltration and evapotranspiration. Compared with grasslands, forests and plantations have greater leaf area and more developed root systems. Greater leaf area leads to more evapotranspiration (as transpiration of vegetation increases). At the same time, the root systems of trees affect soil porosity increasing water infiltration in the wet season and therefore increasing groundwater recharge. As a result, there is a reduced risk of wet-season flooding, as well as the potential for more water availability during the dry season due to water stored below ground in the water table. Water flows during the year will therefore be the result of the balance between these two competing effects. Hence, the choice of land use and of forest tree species impacts the availability of water in both seasons, and consequently deforestation or reforestation may change water flows.

The evidence on the effect of vegetation change on water flow variability in the tropics is generally mixed. Annual water flows have generally been shown to be a decreasing function of forest cover (Bruijnzeel, 1990) but the effect on dry season flows has been shown to be positive in some cases (Hamilton & King, 1983) and negative in others (Sun et al., 2006). In Panama, the forest-water controversy has played out with particular force among scientists studying the potential impact of reforestation in the Panama Canal watershed, in part because of the geopolitical significance of the Canal.

The Panama Canal currently carries approximately five per cent of global marine traffic, representing 19% of the GDP of Panama (Sabonge and Sánchez, 2009). Thus a reduction in water flows that disrupts operation of the Canal not only has an impact on the local economy, but also potentially affects the economy of Panama as a whole. Given the seasonal rainfall pattern of the region, the capacity of the Canal is limited by the dry season water available for operating the locks and depends on flows from the watershed. Flows in the dry season have been low enough to restrict the Canal operations one out of fifteen years. In the recent past, during the 1997-98 El Niño event, rainfall far below the seasonal average led the Panama Canal Authority to impose draft[8] restrictions on Canal users for over four and a half months, with significant implications for Canal revenues (an estimated loss of 12 US$ million), forgone energy sales from the Gatun hydroelectric plant (5-8 US$ million), and additional dredging and water-saving costs (10 US$ million), in addition to considerable economic damages suffered by carriers (Donoso et al., 2001).

Figure 16: Dredging work in the Canal. *Source: Emilio Mariscal*

Based on the proposition that reforestation in the watershed would increase the water flows in the dry season, the Panamanian government implemented public policies (law 21) to promote reforestation in the area of the Canal. However, the impact of reforestation on dry season flows in the Panama Canal watershed is still under debate. Ibañez et al. (2002) showed that wet season flows were higher in a deforested catchment while dry season flows was higher in a forested one. Calder (2002) reached a different result estimating a reduction in annual runoff ranging from 18% to 29% following conversion of full pasture to full forest in two sub-basins in the Panama Canal watershed, even though no dominant effect has been found related to dry season flows. More recently, based on a spatially-explicit hydrological model, Simonit and Perrings (2012) tested the potential effect of reforestation on dry season flows. They found that if all existing grasslands were allowed to regenerate as natural forest, there would be a reduction in dry-season flows across the watershed of 8.4 % compared to 11.1 % if reforestation took the form of teak plantations. However, Simonit and Perrings (2012) have also showed that the potential impact of land cover change on dry season risks to Canal operations and other uses varies significantly across the watershed, with the hydrological impact of forest ranging from 3,787 m^3/ha to -1,496 m^3/ha during the dry season (average -39m^3/ha). They estimate that 37% of the area currently under natural forest has a positive impact on dry-season flows, providing an average of 37.2 million m^3 of seasonal flow, equivalent to 16.37 US$ million in revenue to the Panama Canal Authority. Using a marginal value of 0.44 $/$m^3$ for dry-season flows supporting Canal navigation (Simonit & Perrings, 2013) and a value of 0.21 $/$m^3$ for human consumption according to the current water price applied by the municipality of Panama City, the water regulation value of forests in the watershed ranges from 2,462 US$/ha/yr to -972 US$/ha/yr (average -25 US$/ha/yr). In parts of the watershed not currently under forest, they found that reforestation of areas with high precipitation rates, flat terrain, and soil types with high potential infiltration would enhance dry-season flows. However, they note that these conditions exist in less than 5 percent of the watershed not currently under forest, potentially yielding an additional 3.54 million m^3 to Canal navigation (roughly 1.56 US$ million) during the dry season.

When compared to alternative land cover and land uses (i.e. grassland for pasture), the impact of forest cover on dry season flows depends on site-specific variables such as the hydraulic characteristics of the soil, amount of precipitation during both dry and wet seasons, and slope. Simonit and Perrings (2012) found that in soils with high to moderate water infiltration potential forest has a positive effect on dry-season hydrological flows, while in soils with very low infiltration potential the effect is negative. For soils with low infiltration potential, a positive effect of forest is likely only for areas where precipitation rates are above 325mm and 2,010mm for the dry and wet seasons, respectively. Applying these criteria to the spatial distribution of soil and precipitation attributes across the country, it is possible to identify the areas where forest has the potential for increasing dry-season flows (Figure 17).

Most of these areas are already forested. Others are under agricultural use or represent degraded woodland (Figure 18).

From figure 18, it is possible to deduce which land should be reforested (yellow and orange) and which forests should be protected (green) to improve water availability. This is particularly relevant in watersheds where water shortage is likely to occur during the dry season. To identify these watersheds, the ANAM is currently working on a project to estimate water availability in the 52 watersheds of the country. So far, estimations have been calculated for 10 watersheds from the Pacific side of the country, using data on the water entering and exiting the system, and data on different water uses. Watersheds are then classified into four catego-

[8] The draft refers to the height of the submerged portion of a ship and depends on the load carried by the ship. As the toll is proportional to the total weight of the boat, draft restrictions impacts the canal revenues.

Figure 17: Estimated areas of potential dry-season water flow increase from current forest cover and/or reforestation. *Source: own calculations*

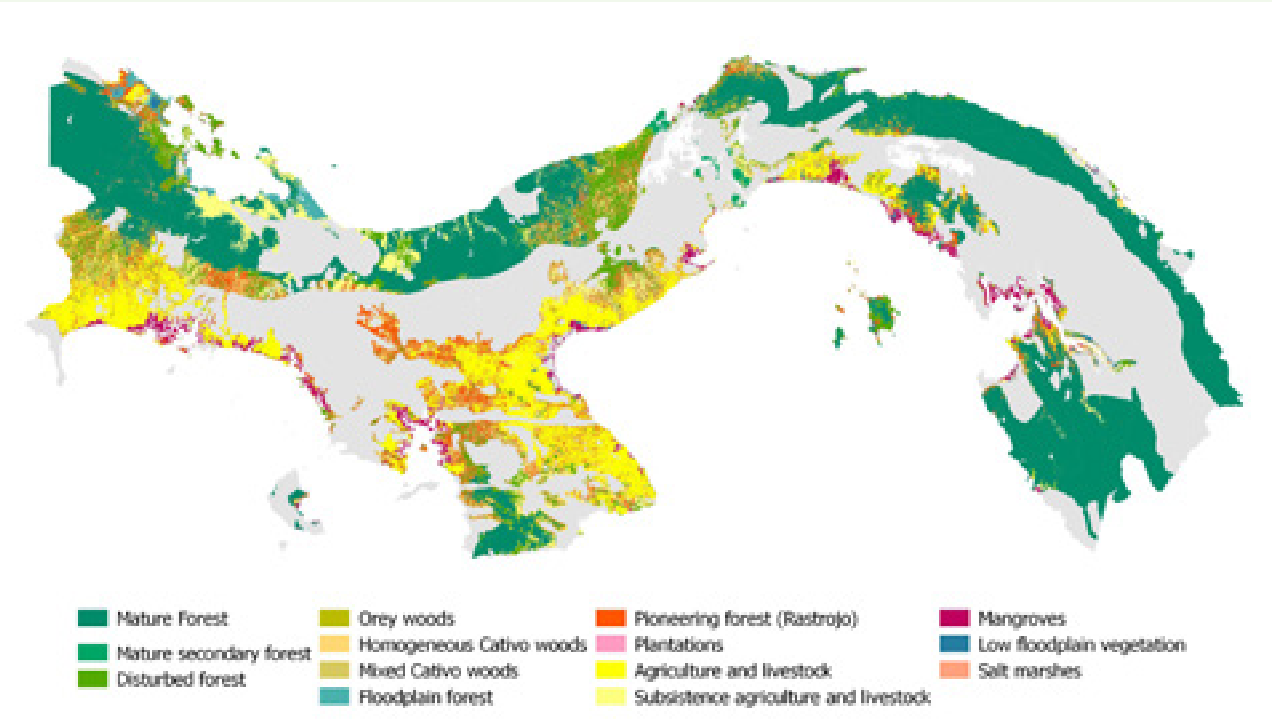


Figure 18: Current land use cover in areas with estimated positive conditions for dry-season flow increase from existing forest and reforestation. *Source: own calculations*

ries: those that are in water deficit, those that are water balanced, those with available water and those with abundant water. The results show that, among the ten watersheds studied so far, seven are water deficit during the dry season (the Antón river basin, the Chico river basin, the Guararé river basin, the la Villa river basin, the Santa María river basin, the Grande river basin and the Pacora river basin). The other three are either in a balanced state (the Chiriquí and the Chiriquí Viejo river basin) or in a state of water availability (the Bayano river basin). Figure 19 builds on figure 18 to represent the land that should be reforested and the forests that should be protected in order to secure water availability during the dry season in these ten watersheds. The seven watersheds that are in deficit of water in the dry season are circled in red. As can be seen, in these watersheds, the reforestation of large areas of agricultural land would improve dry season water flows.

The forest land and other potential areas for reforestation represent a potential added value under a REDD+ scheme in terms of the water regulating services that would be additionally provided and which would benefit the country at large, especially under uncertain and extreme climatic conditions. The economic valuation of this service, however, remains extremely challenging. As shown for the Panama Canal watershed, the impact of land cover on dry season flows varies significantly across space, ranging from positive to negative values. Out of the Panama Canal watershed this value is mostly represented by human consumption (0.18 $\$/m^3$ from latest IDAAN data, except Panama City and Colon). Assuming that climatic and soil characteristics in the Canal watershed reflects the average conditions for the entire country, then following Simonit & Perrings (2013) the forest water regulation value to human consumption in Panama would range from 682 US$/ha/yr to -269 US$/ha/yr (average -41 US$/ha/yr). These estimates however are highly uncertain. The following table summarizes the value of forest for water regulation inside and outside the Canal watershed.

Ecosystem Service	Minimum value – Average value – Maximum value
Water regulation in the Canal watershed	(-972) – (-25) – 2,462
Water regulation outside of the Canal watershed	(-269) – (-41) – 682

Table 8: Value of forests for dry-season water availability in 2012 US$/ha/yr

A correct estimate of the value of forest providing water regulating services in Panama would require the development of a spatially explicit hydrological model for the entire country, taking into account the complete set of beneficiaries at all scales.

An important project conducted by the Smithonian Tropical Research Institute, the Agua Salud Project, may provide interesting insights regarding the effect of land-use on water

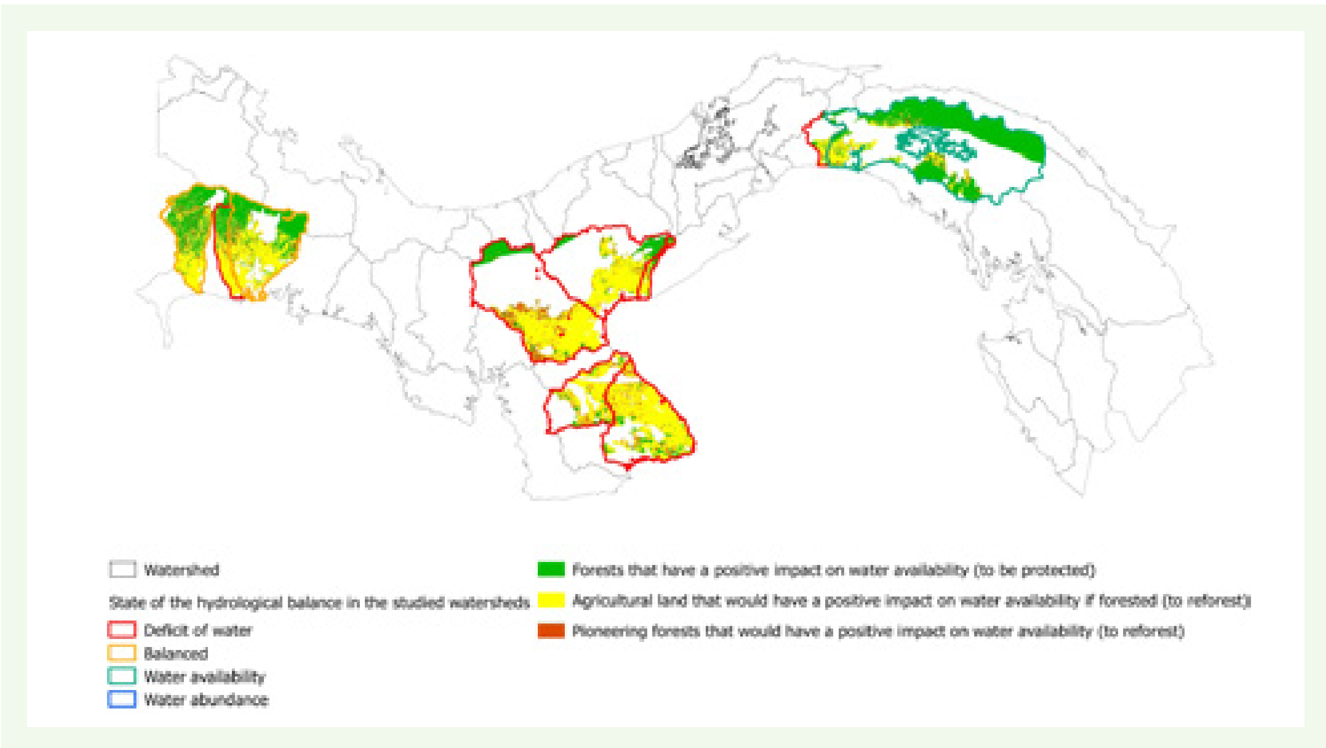


Figure 19: Areas where forests should be protected (green) or planted (yellow and orange) to secure water availability during the dry season in 10 watersheds. *Source: own calculations based on data from the ANAM*

flows and water quality. It is aimed at testing the assumption that reforestation does not always have a positive impact on water availability. However it would also be helpful if they could provide information on the effects of avoiding deforestation. These two effects might differ as second growth forests are different from mature forests.

Finally, additional investigation on the hydrological processes outside of the Canal watershed would also be useful, as results obtained for this area might not be relevant for the whole country.

5.3.6

Soil protection

Deforestation also causes soil erosion, which, in turn, causes a loss of soil fertility, and, soil sedimentation in downstream rivers and water reservoirs. It can therefore significantly impact agricultural productivity, hydropower generation and transport capacity in rivers and the Canal.

Impact of forests on soil fertility

First, topsoil erosion can lead to a loss of nutrients and therefore soil fertility. This loss can be compensated for by using more fertilizer on agricultural land. According to Torras (2000), who used a benefit transfer analysis with data on soil attributes from Brazil, the value of soil erosion control in Brazil is estimated at about 490 US$ per hectare of forest, which represents the cost of using fertilizers if soil fertility is lost due to erosion. This value constitutes the best available estimation for Panamá. Yet, it should be taken with due caution as Brazil's soils may differ from Panamanian ones.

Ecosystem Service	Average value
Soil fertility	490

Table 9: Value of forests for soil fertility in 2012 US$/ha/yr

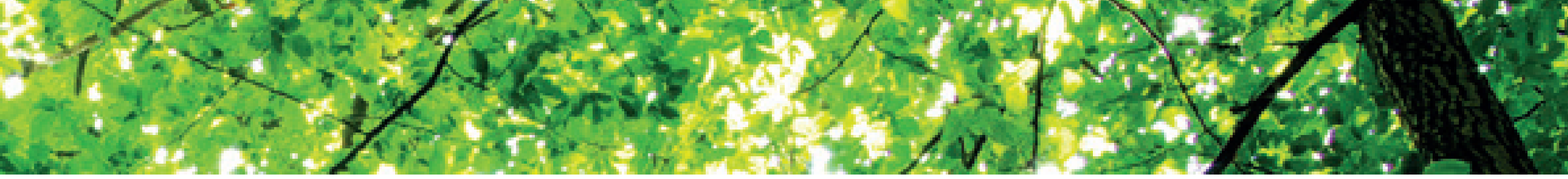
Impact of forests on sedimentation

When eroded soils are washed away, they cause soil sedimentation in rivers and reservoirs, decreasing the potential volume of water storage. This decrease means that less water can be stored and transferred from the wet to the dry season. Nuñez and Shirota (2011) estimated that the conversion of one hectare of forest increases sedimentation by 14.33 m^3. This estimation was carried out in the Canal area but can be considered as an acceptable proxy for the sedimentation in the other watersheds of Panama (personal communication with Nuñez). This also impacts hydropower generation in all watersheds and fluvial transportation through the functioning of the Canal. According to Nuñez, the corresponding economic value is around US$198/ha/yr. However, for this estimation, it was assumed that each cubic meter of water was used to maintain the functioning of the canal, the loss of one cubic meter thereby reducing the toll revenues. In reality, water may become scarce in the Canal watershed only by the end of the dry season (and only in some years). That is, the decrease in available water will threaten the functioning of the canal, only if the total volume of water available reaches a minimal threshold. Taking this into account, Simonit and Perrings (2012) estimated an average value for securing the functioning of the Canal of 0.44 $/$m^3$ considering the mean water level at Gatun during the dry season which also accounts for the storage capacity of the system. As the volume of water available for operating the locks decreases with sedimentation, the conversion of one hectare of forest leads to an average loss of income of 6 US$/yr.

Additionally, Porras et al. (2001), estimated the gross income from hydropower generation in the Canal to be between 2.79 US$/$m^3$/yr (Gatun Plant) and 6.97 US$/$m^3$/yr (Alajuela Plant). According to Aylward (2002), these values are good proxies for net income gains and can be extrapolated to other watersheds in the center and the North-West of Panama. The sedimentation increase of 14.33 m^3 due to the conversion of one hectare of forest would therefore cost between 40 US$ and 100 US$, with an average value around 70 US$/ha/yr. Here again, investigation for other regions than the Canal watershed would provide more rigorous results.

Ecosystem Service	Minimum value – Average value – Maximum value
Sedimentation control in the Canal watershed	46 – 76 – 106
Sedimentation control outside of the Canal watershed	40 – 70 – 100

Table 10: Value of forests for sedimentation control in 2012 US$/ha/yr



5.3.7

Pollination

Tropical forests provide habitats for wild insects such as native bees that pollinate two-thirds of the world's crop species. In particular coffee production, one of the top five most valuable export crops, is increased by 15-50% with bees' visitation (Roubik, 2002). Coffee is an important crop for Panama with a harvest area of about 28,000 ha in 2011, and a total production of 13,000 tonnes (data from FAOSTAT). In 2011, the price of coffee was 1,750 US$ per tonne so that the total value of the Panamanian coffee production was 22.8 million US$.

Based on research in Costa Rica, Ricketts et al. (2004) studied the value of tropical forest in supplying pollination services to agriculture and in particular to coffee production. Their estimates showed that in plots within 1,000 meters of forests, coffee yields increased by 20% and the quality of the beans also improved (the frequency of small misshapen seeds decrease by 27%). As Panama is similar to Costa Rica as regards soil properties, climate and coffee yields, the impact of the pollination service on these yields may be similar. Based on prices and yields from Panama since 2000 (FAOSTAT), the pollination service in Panama is estimated to be between 84 and 151 US$ per hectare of agricultural land close to the forest and per year, with an average around 116 US$ per year per hectare.

These values only relate to coffee plots within 1,000 meters from a natural forest. Using geographical data provided by UN-REDD, the total area of agricultural land within 1,000 meters from a natural forest in Panama in year 2008 has been calculated. Knowing the coffee harvest area, the area of coffee production within 1,000 meters from forest in 2008 can also be calculated. Those estimates are minimum values because they are based on the assumption that coffee plantations are homogeneously distributed over the agricultural space while, in reality, they are probably close to forests due to the fact that they require the same conditions as forests to grow. The total value of forests regarding the pollination services in 2008 is calculated to be between 747,000 US$ and 1,334,000 US$, with an average value around 1,027,000 US$.

It is worth noting that the pollination value of one hectare of forest highly depends on its location. Indeed, this value exists only if agricultural lands (here coffee) are close to the forest. Areas of forest confined inside larger forested areas have no pollination value (0 US$) whereas one hectare of forest near a hectare of coffee plantation can generate up to 151 US$/yr. The average value, which should be considered cautiously, would be close to zero, because only a small share of total forests are close to agricultural land.

Ecosystem Service	Minimum value – Average value – Maximum value
Pollination	0 – 0.3 – 151

Table 11: Value of forests for pollination in 2012 US$/ha/yr

5.3.8

Carbon storage

Importantly, forests play a key role in climate regulation by storing carbon. When forests are cleared, carbon stored above and below ground in leaves, branches, stems and roots is released into the atmosphere.[9] As a result, forest clearing becomes a major source of CO_2 emissions and contributes to climate change. Climate change is expected to have serious impacts on nature and human well-being globally, including more frequent and more severe droughts and flood episodes, significant biodiversity loss through species extinction, changes in the structure of ecosystems and landscapes, changes in water availability which will impact consumption, changes in agriculture, changes in energy generation and increases in heat related illnesses (IPCC, 2007). All these impacts will have economic consequences, and will force countries to adapt, at a potentially high cost.

UN-REDD, based on previous work from Baccini et al. (2012), Saatchi et al. (2011) and the ASB (Partnership for the Tropical Forests Margins), estimated the above-ground forest carbon stock density to be between 71 and 122 tC per hectare in Panama, with an average value around 111 tC/ha. According to Gibbs et al. (2007), root biomass is typically estimated to be 20% of the above-ground biomass. Below soil forest carbon stock in Panamá is then between 14 and 24 tC/ha of forests, with an average around 22 tC/ha. The total amount of carbon above and below-ground in tropical forest is therefore between 85 and 146 tC/ha, with an average value around 133 tC/ha. Converting these value in tones of CO_2 equivalent, it corresponds to 313 to 537 tCO_2e/ha with an average around 489 tCO_2e/ha. These results correspond to the gross avoided emissions from deforestation, meaning the quantity of greenhouse gases that would be released into the atmosphere if forests were to be cleared. However, as underlined by Baccini et al. (2012), vegetation replacement could partially offset some emissions from deforestation. This is important to note as REDD+ mechanisms are likely to compensate for avoided emissions. It is therefore more relevant to look at net rather than gross avoided emissions. UN-REDD Panama also estimated the carbon stock density in agricultural land and pasture to be between 18 and 99 tCO_2e per hectare, with an average around 53 tCO_2e/ha[10]. Using these values, the net avoided emissions from forest conservation are calculated to be between 214 and 519 tCO_2e/ha, with an average around 436 tCO_2e/ha. Values are summarized in Table 12. [11]

[9] Above ground carbon might be released instantaneously if forest is burnt. It might take more time otherwise. As for below ground carbon, it is likely to take time to convert into greenhouse gas emissions.

[10] In this estimation, the root biomass in agricultural land is considered as negligible.

[11] As said, vegetation replacement will partially offset some emissions from deforestation. However this process is likely to take many years. Technically, it would therefore be better to measure the full emissions from deforestation and then

Carbon stocks	Minimum value	Average value	Maximum value
Above ground forest carbon stocks in tC/ha	71	111	122
Below ground forest carbon stocks in tC/ha	14	22	24
Total forest carbon stocks in tC/ha	85	133	146
Gross emissions from deforestation tCO_2/ha	313	489	537
Carbon stock in agricultural land tC/ha	5	15	27
Net emissions from deforestation tCO_2/ha	214	436	519

Table 12: Carbon stocks in forests and croplands in tC/ha. *Source: data from UNREDD*

In 2012, the carbon price on the market for REDD projects was around 7.4 US$/$tCO_2$e (Peters-Stanley and Yin, 2013). Globally, the carbon price has been decreasing in the last years. For this reason, it is relevant to use a minimum and maximum price to calculate the value of the carbon storage service. According to UN-REDD and the Partnership for Tropical Forests Margins, values are between 5 and 15 US$/$tCO_2$e. The corresponding value of forests for carbon storage is therefore between 1,068 and 7,784 US$ per hectare. The average value is 3,224 US$/ha. It is worth noting that these values are not annual values because the carbon is released once in the atmosphere. This explains the high values found in comparison with other services.

Ecosystem Service	Minimum value – Average value – Maximum value
Carbon storage	1,068 – 3,224 – 7,784

Table 13: Value of forests for carbon storage in 2012 US$/ha (not per year)

It should also be noted that the price of the carbon on the market may not reflect the real value of the carbon storage capacity of the forest. For more than a decade, studies have been focusing on the social cost of CO_2 emissions. This cost represents the damage imposed by emitting one tonne of CO_2 into the atmosphere. Following the Stern review (2007) this cost would be between 19 and 65 US$/$tCO_2$e now, depending on global mitigation effort scenarios. With these estimations, the value of forests for carbon storage in Panama would be between 4,058 and 33,730 US$/ha. Deforesting one hectare of land now could therefore have a cost of almost 34,000 US$ in the future. If a REDD program is implemented, however, it will not compensate countries on the basis of this social cost, but rather based on the price of carbon on the market.

	Minimum value – Maximum value
Social cost of one hectare of deforestation	4,058 –33,730

Table 14: Social Cost of carbon emissions from deforestation in 2012 US$/ha (not per year)

5.3.9

Ecotourism

Panamanian forests located in protected areas (approximately 58 % of Panamanian forests in 2008) provide recreational benefits to local people and national and international tourists who come to visit them. Tourism is an important source of income for Panama and is predicted to grow from 4% of the GDP in 2008 to 10% in 2020 (T&L 2008, Narloch 2012). Ecotourism alone would generate a net revenue of 144 million US$ per year during this period. Based on these predictions, Narloch (2012) found an average potential ecotourism value of 53.2 US$ per hectare of protected areas and per year in Panama. This value could vary between 26 and 106 US$ per hectare of protected area per year across different regions, as some areas attract more tourists than others. However, it is based on the projected benefits from ecotourism. It does not quantify the true value of protected forests for tourists which may be better determined through exercises that reveal the preferences of tourists for Panamanian forests. These preferences are likely to depend on the state of the forests as well as its size or its location. BCEOM-TERRAM (2005) used two different methodologies to estimate the value of one particular protected area, the International Park La Amistad. This protected area is located in the west of Panama and is shared with Costa Rica. Its Panamanian area is 207,000 hectares. Both methods estimate people´s willingness to pay to visit the park, meaning how much they are ready to pay to benefit from its touristic services. Based on a contingent valuation method, the value of the park is estimated between 3,125,000 US$ and 3,327,000 US$ per year. This amounts to an average per hectare value between 15 and 16 US$/ha/yr. If instead a travel cost method is used, the value of the park is estimated around 57,551 US$ per year, which corresponds to 0.3 US$/ha/yr. However, this method cannot capture non-use (existence) values. For this reason, contingent valuation values are better estimates for the value of forests for ecotourism in protected areas.

While these figures may offer a proximate value of forests in protected areas for tourism, they should be taken with due caution for several reasons. First, they were estimated for one particular park and may not be representative of other protected areas' value. Second, these values depend

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allow for the benefits of sequestration over time. In the same way, it would be more accurate to take into account the carbon sequestrated each year in each land use. Growing forests, for instance, are capturing carbon from the atmosphere each year. However, given the uncertainties, it is not taken into account in this report.

strongly on thresholds. Deforestation in protected areas could have no impact on ecotourism, as long as a minimum amount of forest is conserved. In other words, marginal losses of forests may not induce economic losses in ecotourism. Finally, these values cannot be extrapolated to forested areas that are not part of a reserve or a park.

Ecosystem Service	Minimum value – Maximum value
Ecotourism in protected areas	15 – 16

Table 15: Value of forests for ecotourism in protected areas in 2012 US$/ha/yr

5.3.10
Other services

Other services cannot be quantified but they deserve to be taken into account when making land cover management decisions:

- There is a clear consensus in the scientific community that forests in tropical country watersheds have a positive impact on water quality directly, and through reducing sedimentation. However this impact has not been quantified yet so that it is not possible to calculate the associated potential economic losses caused by deforestation.

- As pointed out by Gottdenker et al. (2011), deforestation may have an impact on the propagation of vector-borne disease such as Malaria, Dengue or the Chagas Disease which in turns have economic impacts such as the cost of treatment and of sick leaves (Sachs & Malaney, 2002). For instance, in 2011, 3,884 cases of dengue were observed in Panama. Moreover, deforestation, through its impact on water quality may influence the incidence of waterborne diseases such as yellow fever.

- By reducing water availability in some watersheds, deforestation may have an impact on the productivity of fisheries. Inland fisheries may be affected by a decrease in water availability and quality. Marine fisheries may also be impacted as most of the species used in commercial fishing spend their juvenile stage in mangrove forests.

- By decreasing the amount of water available for irrigation, deforestation would probably cause economic losses in the value of agricultural production.

- Last but not least, forests are of great value to indigenous people. This value is not only an economic one but also a spiritual and cultural one. Therefore it would be inappropriate to estimate it solely in monetary terms. As 35% of the forest area of Panama is located in indigenous *comarcas*, it is important to take both these economic and non-economic values into account and protect the rights of indigenous communities when designing REDD+ policies in Panama.

5.4
Summary of the benefits provided by forests

Based on the estimates provided above, table 16 summarizes a disaggregated picture of the economic benefits provided by Panamanian forests on a per hectare basis. Values that are provided in US$/ha/yr are marked with a star in the table, while values in US$/ha are marked with two stars. Given the heterogeneity of forests, when possible a range is provided with the central figure indicating estimated average values. The method used and the main references are also shown. Finally, colors are used to represent the uncertainty of each estimation. Green refers to low uncertainty, yellow to medium uncertainty and red to high uncertainty.

This table confirms that forests provide multiple benefits in addition to timber provision. In particular services linked to water regulation, soil protection and carbon storage have great values. It demonstrates the economic benefits that could be secured through REDD+ options that focus on forest protection on lands that would otherwise be converted.

Service	Minimum value	Average value	Maximum value	Methodology	References
Timber provision without SFM ** (not per year)	266	419	572	Direct Market Pricing	BCEOM-TERRAM (2005)
Timber provision with SFM *	162	255	348		
Fuelwood provision *	-	111	-	Replacement Cost	FAOSTAT data
NTFP provision *	6	16	42	Benefit Transfer	Godoy et al. (2012)
Pharmaceuticals provision *	0,1	5	16	Benefit Transfer	Narloch (2012)
Water regulation in the Canal watershed *	-972	-25	2462	Avoided cost	Simonit & Perrings (2012)
Water regulation outside of the Canal watershed *	-269	-41	682		
Soil fertility *	-	490	-	Benefit Transfer	Torras et al. (2000)
Sedimentation control in the Canal watershed *	46	76	106	Avoided cost	Simonit & Perrings (2012), Nuñez & Shirota (2011), Porras et al. (2001)
Sedimentation control outside of the Canal watershed *	40	70	100		
Pollination *	0	0,3	151	Benefit Transfer	Ricketts et al (2004)
Carbon Storage ** (not per year)	1,068	3,224	7,784	Direct Market Pricing	UN-REDD data, Baccini et al (2012)
Ecotourism in protected areas *	15	-	16	Contingent Valuation	Narloch (2012)
Disease regulation	Unknown				
Inland fisheries	Unknown				
Irrigated agriculture	Unknown				
Cultural and spiritual value	Incommensurable				

Table 16: Benefits from forest ecosystem services in US$/ha/yr or US$/ha

* in US$/ha/yr, ** in US$/ha

Nevertheless, non-marketed services' valuation faces several problems of uncertainty. Uncertainty can come from the fundamental lack of knowledge about how forest ecosystems support the service, as in the case of water regulation and soil protection services (Kumar, 2010). It may also reflect ignorance about the way people value such ecosystems. This is true, in particular, for cultural services such as the value of forests for ecotourism. Finally, uncertainty may also come from the methodology used. For instance, the value of forests for soil fertility is shown in red as this result was obtained primarily for Brazil and not for Panama. When possible, the table provides a range of values, from minimum values to maximums, to capture part of this uncertainty. This range also reflects, in some cases, the spatial differences of value which may exist. It is the case for provision of NTFP, fuelwood and pharmaceuticals, water regulation, and pollination. A spatial analysis and estimation of these values would provide additional and useful information for land use management decisions.

Finally, it is important to underline that non-marketed services´ valuation faces other problems in addition to uncertainty issues (Ludwig 2000). Most of the evaluation methods rely on simplifying assumptions which lead to a lack of robustness of the results. Also, some ecosystem services, for which values are highly subjective and cannot be properly estimated in monetary terms, might be left aside from the decision making process, even though their values are of higher order than economic values (social and personal values). For all these reasons, the economic values calculated in this table (and in the following section) should be taken with due caution. Policy makers should keep in mind that they are estimations of ecosystem services' values rather than exact values.

06

The potential benefits of REDD+ in transition to a green economy in Panama

This section aims at quantifying the economic losses caused by deforestation so far, and this way, give an idea of the potential benefits that could arise from a successful REDD+ implementation in Panama.

6.1

Economic losses from annual deforestation

While timber sales and carbon emissions has a once-off value, the consequences of deforestation on other services continue to be felt in the economy in every subsequent year. Using data from UN-REDD on annual deforestation between 1992 and 2008 and estimations for the period 2008-2012, economic gains and losses that arise in year j from deforestation in year i are estimated[12]. Economic benefits include the benefits arising from timber sales, and deforestation also provides land for agriculture. These benefits can be estimated through the average agricultural profit margin that one hectare of land can produce. According to UN-REDD, farmers earn an average of 454 US$/ha/yr in Panamá. This value varies with the area considered, for instance revenues are lower in *comarcas*. They also depend on the type of agricultural use and the technology. All in all, farmers earn between 89 and 1,399 US$/ha/yr. These benefits, contrary to those from timber sales, arise annually. When one hectare of forest is cleared, growing crops or breeding cattle on this hectare is possible in all subsequent years. Economic losses represent the losses of other ecosystem services due to forest clearing for all years between 1992 and 2012. These losses would have been avoided if forests have been conserved during this period. Therefore, it is possible to answer two questions: how much are the net economic losses that arise from deforestation since the year 1992 (i) in each subsequent year until 2012? and (ii) in total regarding the whole period 1992-2012? The average values are shown in 2012 US$ million in the following figure.

[12] These estimations were calculated using values found in table 17. It was assumed that deforestation was negligible in protected areas.

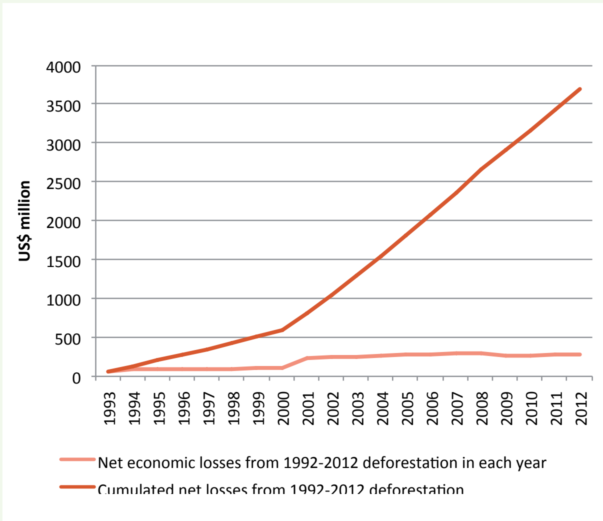


Figure 20: Yearly and accumulated economic losses from 1992-2012

The values for the year 2012 and the total losses induced between 1992 and 2012 are shown in the table below.

	2012	1992-2012
Gains from deforestation	334.6	2,927.7
Losses from deforestation	606.4	6,628.3
Net losses from deforestation	271.8	3,700.6

Table 17: Gains and losses caused between 1992-2012 due to deforestation in US$ million

This quick analysis is not a cost benefit analysis of deforestation but it already provides a picture of how much deforestation cost in this period. Indeed, deforestation in the 1992-2012 period will also impact following years. A cost benefit analysis would have also taken into account discounted future benefits and losses. It also means that if deforestation was to stop in Panama, the deforestation that occurred before this date would still imply annual economic losses, unless the land was reforested.

In 2012, deforestation provided cash revenue for Panama due to timber sales and agricultural revenues of around 335 million US$. Nevertheless, the deforestation that happened between 1992 and 2012 generated an economic loss in this year, due to foregoing the benefits from other ecosystem services that tradeoff with such provisioning service from forests. In contrast, forest conservation would have secured ecosystem services. This economic loss reaches about 606 US$ million in year 2012. As a result, deforestation in Panama between 1992 and 2012 led to an average net economic loss of about 272 US$ million in the year 2012 only, which represents 0.42% of the GDP. If one looks at the total economic impact between 1992 and 2012, the net economic losses from deforestation amount about 3,700 US$ million.

This analysis provides a comparison of the benefits arising under forest conservation or under commercial extraction. Sustainable forest management might be an intermediary solution as it would provide economic benefits from timber sales without causing such losses of other ecosystem services. However, further work is needed to evaluate the potential impact of sustainable forest management on ecosystem services. In particular, in the context of REDD+, it will affect the carbon storage value of the forest.

If deforestation continues, some of the ecosystem services will become scarcer and might be lost in an irreversible way if the resilience of the forest ecosystems is jeopardized. This implies potential increased economic losses for each hectare deforested in the country. Lastly, the loss of other forest ecosystem services also has a multiplier effect on the economy as there are sectors in the economy that depend on the regulating services provided by forests. For instance, the hydropower generation sector supplies inputs to other downstream sectors. An increase in soil erosion and sedimentation would therefore have a direct effect, for instance a decrease in the quantity of electricity generated through hydropower plants, but also an indirect impact on the economic productivity of downstream sectors. The costs shown in this report are therefore likely to be underestimates of the true cost of deforestation in Panama.

6.2 Policy options for a sustainable management of forests

A portfolio of policies is available for greening the forest sector while fighting deforestation, but some will require additional investments from both the private and the public sector (UNEP 2011). Some can be identified including:

- Developing Ecotourism: as shown previously the potential for ecotourism development in Panama is significant. It could certainly bring substantial additional revenues to finance the flow of forest ecosystem services and biodiversity.

- Implementing national payment for ecosystem services (PES) programmes: PES schemes are incentives offered to landowners in exchange for managing their land to provide a particular ecosystem service. The ACP (Authority of the Canal) begun to implement such a scheme in the watershed for the provision of water and soil regulation services. This scheme is still in its pilot phase. It should be noted that experiences in other countries have found that forest land under protection contracts corresponds mainly to forest that may not be in direct danger of being converted because of its remoteness and difficult access (see Sierra and Russman 2006, Robalino et al. 2008 for examples in Costa Rica). Targeting the areas that should benefit from these programs is therefore crucial to ensure their economic efficiency (additionality).

- Improving the enforcement of existing protected areas: In Panama, already 30% of the forest area belongs to land which has a legal status as protected area. According to Oestreicher et al. (2009) an increase in the available funding and stronger governance are necessary to improve surveillance in protected areas in Panama. Also, community participation and equitable benefit-sharing are most likely to improve forest conservation efficiency in protected areas.

- Investing in improving forest management and certification: the economy of Panama would benefit from a sustainable management of forests. However the recourse to SMP has proven to be costly. A way to finance it would be the development of certification schemes which would provide additional revenues by optimizing this market niche both internally and in export markets.

- Improving the control of illegal logging and the compliance with community permits: Community permits are granted to indigenous people if they provide a sustainable management plan for timber extraction. In general, they then go into partnership with a buyer which will cut and sell the timber in exchange for financial remuneration. Indigenous people are in charge of managing and controlling the wood extraction, but they do not always have the means necessary to perform this task. More training of indigenous people about forest management might therefore have a positive impact on compliance and thus on the value of their forests to the Panamanian economy.

- Revising reforestation and afforestation incentives: The Panamanian law 24 provides incentives for reforestation and afforestation projects. However these incentives focus mainly on commercial plantations. Reforestation, in the sense of regrowth of secondary forests, is done only to compensate or restore ecological damages elsewhere. Extending the existing incentives for commercial plantations to reforestation would generate economic benefits as native tree forests on average are more valuable (given the bundle of ecosystem services they support) than monoculture plantations, and especially with regard to the supply of regulating ecosystem services.

- Favoring alternative land uses: sylvopastoral systems and agroforestry are alternative land uses that have potential to be both beneficial to farmers and to provide offsite-benefits in the form of carbon sequestration, reduced sedimentation in surface water, and maintenance of a wider basis of biodiversity than agriculture. Yet, the economic evidence (Current et al. 1995) shows that farmers need both financial and technical assistance in making the transition to modern and profitable forms of agroforestry. These incentives already exist for sylvopastoral system. Indeed, the law 25 (2001, revised in 2012) from the Ministry of Agricultural Development provides subsidies to livestock farmers who incorporate silvopastoral systems (up to 50% of their investment). It also aims at providing technical support, helping farmers managing risk and promoting technological innovation.

- Removing policy measures which favor competing activities, in particular cattle ranching which is favored through advantageous loans.

- Improving the quantity and quality of information regarding forest assets, in particular in areas outside of the Canal watershed.

All of these policy interventions necessitate social safeguards to reserve the rights and livelihoods of forest-dependant people, including indigenous communities, in order to balance economic efficiency with social equity aspects. To this end, the UN-REDD program in Panama is studying how REDD policies would induce opportunity costs for local communities, and therefore how to maximize public benefits from REDD+ while reducing costs for local people. The analysis focuses on four interconnected factors: the benefits and costs from different land use, the associated changes in carbon stocks and flows, the land area that could be part of the REDD+ program and the future value of carbon credits.

Finally, these policies should also take into account the risks of deforestation leakage, that is, when deforestation seems to stop in one area due to government intervention, while, in reality, it was moved to another area. The forest law already intends to reduce regional leakage, in particular by requesting sustainable management plan for timber extraction. New policy interventions will therefore need to comply with this law article. A full analysis of these policy options is still needed.

6.3

The role of REDD+ for achieving the transition to a green economy

The aim of the REDD+ scheme is to incentivize (i) the reduction of emissions from deforestation and the degradation of forests, (ii) the sustainable management of forests and (iii) the enhancement of forest carbon stocks. With REDD+, the amount of funds available for forests protection may increase substantially (Pascual et al., 2013). To date, a vast majority of these resources represent new, additional and increased foreign aid, and encompass a major financial scaling-up for the forestry sector (Phelps et al. 2011). The official development assistance into the forestry sector increased by an average of 125 percent between the period 2002-04 and 2008-2010, mostly attributed to REDD+ related financing (CPF 2012). In 2009, the Copenhagen Accord committed developed countries to contributing 3.5 US$ billion in fast-start climate finance between the 2010-12 period, especially for REDD+. Since then commitments have increased to more than 7 US$ billion. Financial support for REDD+ has mainly been channeled through new bilateral agreements (4.8 US$ billion since 2008), multilateral agreements through various partnerships (2.6 US$ billion) and smaller donors. The UNFCCC Green Climate Fund, currently under negotiation, plans to provide 100 US$ billion per year for climate change mitigation and adaptation, including REDD+ actions (Pascual et al., 2013). National REDD+ implementation is likely to be done through a variety of instruments. In particular, in Panama, REDD+ funds could finance PES implementation, reforestation and afforestation policies, sustainable forest management plans, increasing the control of illegal logging and permits compliance, agroforestry promotion and acquisition of new information. This last input would be provided in particular through the measurement, reporting and verification (MRV) mechanism of the REDD+ which aims at supporting countries to develop cost-effective and robust monitoring of carbon emissions and other benefits. If protected areas are included in the scope of REDD+, it could also finance instruments to increase their surveillance and control.

REDD+ would therefore help Panama to achieve a successful transition to a green economy by supporting the implementation of policies which reduce forest destruction and therefore enhance the country's national capital. In this way, it could participate to change the forest sector into a sustainable one and strengthen its role in the economy of the country.

07

Conclusions and Policy recommendations

As reported in the first part of this report, the contribution of the forestry sector to the Panamanian economy in terms of its role in supporting the country's GDP is relatively small, even if it supports other downstream sectors. This is because the country's economy is mainly based on the service sector, including the transport, trade and the financial sectors. However, the GDP indicator does not take into account the depletion of natural capital and therefore the loss of benefits provided by forests and other ecosystems.

According to data from ANAM, deforestation in Panama has been increasing since the last decade. This has strong economic consequences as it implies on average a cumulated loss of more than 3,700 US$ million in total on the 1992-2012 period. These losses are likely to increase in the future, with an increase in the scarcity of forest land if deforestation rates continue to be positive. In this context, the REDD+ programme may be one of the best opportunities the country could use to leverage additional funds to finance a shift to a green economy and a sustainable forestry sector.

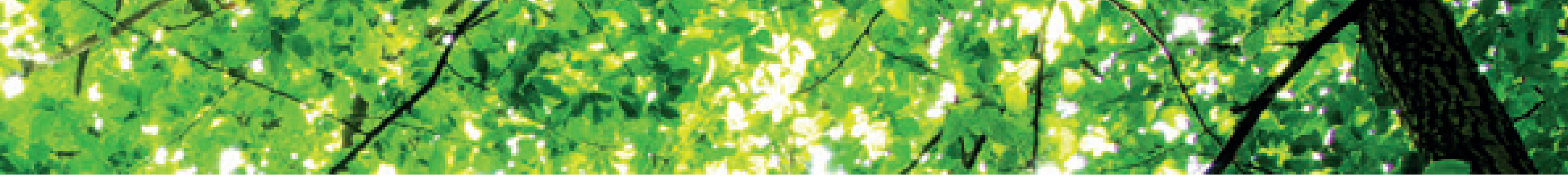
Some policy recommendations for reducing deforestation and greening the forest sector follow are identified:

- A key task in greening the forest sector is to invest in assessing the value of the forest ecosystems services produced in Panama in a way that the spatial heterogeneity of forests is explicitly accounted for, as most of the data available is limited to the Canal area. More research is needed on the other forested areas of the country.

- One of the main challenges to be addressed includes how to align incentives to deforest (incomes one can get from clearing forests) and public benefits in the quest for sustainable forest conservation and use by the different economic actors of the country. Removing existing incentives for deforestation, such as indirect subventions to cattle breeding, is therefore essential to curb land conversion. Additionally, investment by the public sector is therefore needed to provide forest ecosystem services directly (e.g., through PAs) and to prevent unsustainable forest management, i.e. by controlling illegal logging. This need for additional investment could be partially leveraged by REDD+ financing.

- Developing a green accounting framework in Panama is required to fully internalize the contribution of ecosystem services to the economy. Beyond the need for more national account data such as input-output tables, indicators of economic performance, such as growth in Gross Domestic Product (GDP) need to be adjusted to account for pollution, resource depletion, declining ecosystem services, and the distributional consequences of natural capital loss to the poor. This is being pursued in the ongoing development of the System of Environmental and Economic Accounting (SEEA) by the UN Statistical Division which could be developed in Panama.

- Designing differentiated policies to take into account the location and status of the forests is key. Drivers of deforestation differ according to the area considered. This should be taken into account when designing policies. In particular, these drivers are different in the north-west (Province of Bocas del Toro and comarca Ngöbé-Buglé), in the Canal area and in the Darién. Rompré et al (2008) argued that most future habitat loss in the Panama Canal region is likely to arise from urbanization as Panama City expands and population grows along the highway system. Decision-makers will therefore need to emphasize preservation of forests on the edge of such infrastructure developments, where risk of deforestation is highest. In the north-west, where subsistence farming combined with low soil fertility has already resulted in significant forest cover losses, promoting the access to new green technologies for crop and cattle ranching intensification (so-called ecological intensification by means of optimizing ecological process and ecosystem services) can reduce the deforestation rates. In the Darién, illegal logging continues to be the main driver of deforestation and may be tackled through the implementation of sustainable management plans and increased control of illegal logging. Moreover, some forested areas are under a comarca regime and others in protected areas. This also calls for differentiated instruments that account for differences in land tenure institutions and the social fabric that supports them. In the *comarcas*, increased training and participation of indigenous communities may improve compliance to community permits and alleviate poverty. Last but not least, it is important to stress that policy interventions should not leave any area aside because of the risks of spatial leakage.



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Appendix:

1. Map of administrative divisions in Panama.

Own elaboration. Data
Source: UN-REDD and CATIE

2. Methodology

The general method used is the benefit transfer analysis.

Actualization of values:

The values found in a number of studies from different countries and undertaken at different points in time need to be standardized to a common metric. Here standardization approach is followed as described in van der Ploeg et al. (2010) based on data from the World Bank's World Development Indictors (WDI) database. Most country-specific values (V) found in the literature are actually expressed in US$ for a specific year, t. If not the specific year of data collection is known, the publication year of the study is taken.

First, these values are converted into the local currency units (LCU) using the official exchange rate E (LCU per USD, period average in WDI) at time t. Secondly, these values are transferred into 2011 values using the GDP deflators (D) for the respective years. Finally, these 2012 local currency value are converted into international dollars by dividing by the purchasing power parity conversion factor ('local currency per international $' series of WDI), F. The formula to calculate values in 2012 international dollars is:

V$ 2012 = VUS$ t * E LCU/US$ t * D2012/Dt * 1 / F LCU/$ 2012

Provision of firewood:

The method used to estimate the value of fuelwood is to calculate what it would cost to replace this source of energy by another one. In Panama, fuelwood would most probably be replaced with liquefied petroleum gas (LPG). Based on the data from FAOSTAT, the fuelwood production in Panama in 2012 is 1096036 m^3 which corresponds to p=782882.9 tonnes of wood. The energy content € of this quantity of fuelwood is calculated in kilo barrel of oil equivalent using the following formula:

e=p (tonnes)*0.0028=2174.67 KBOE

This formula summarizes the facts that the energy content of fuelwood is 15GJ/tonne and that 1 KBOE=5400 GJ.

Then it is translated into tonnes of LPG with the conversion factor 1KBOE= 118.23 tonnes of LPG. Since the price of LPG was 1.46 US$ per kilogram in 2012, the total value of forests for fuelwood provision is around 375.383.196 US$. Following data from the ANAM and the CATIE, and assuming that the deforestation rate is constant around 55500 ha/yr between 2008 and 2012, the projected area of forest in 2012 would be around 3 372 000 hectares. So the value of one hectare of forest for fuelwood provision is around 111 US$ in 2012.

Gains and losses from annual deforestation:

To estimate the gains and losses from annual deforestation, the following data were used:

- The forest land cover of the country in 1992, 2000 and 2008, and projections for 2012. They were used to estimate the average annual deforestation rate in the country.

- The forest land cover in protected areas in 1992, 2000 and 2008 and the area of protected area. Only protected areas implemented before 1992 were taken into account.

- These data were provided by UN-REDD and CATIE. Then, using table 16, the gains and losses from annual deforestation (in hectares) were calculated.

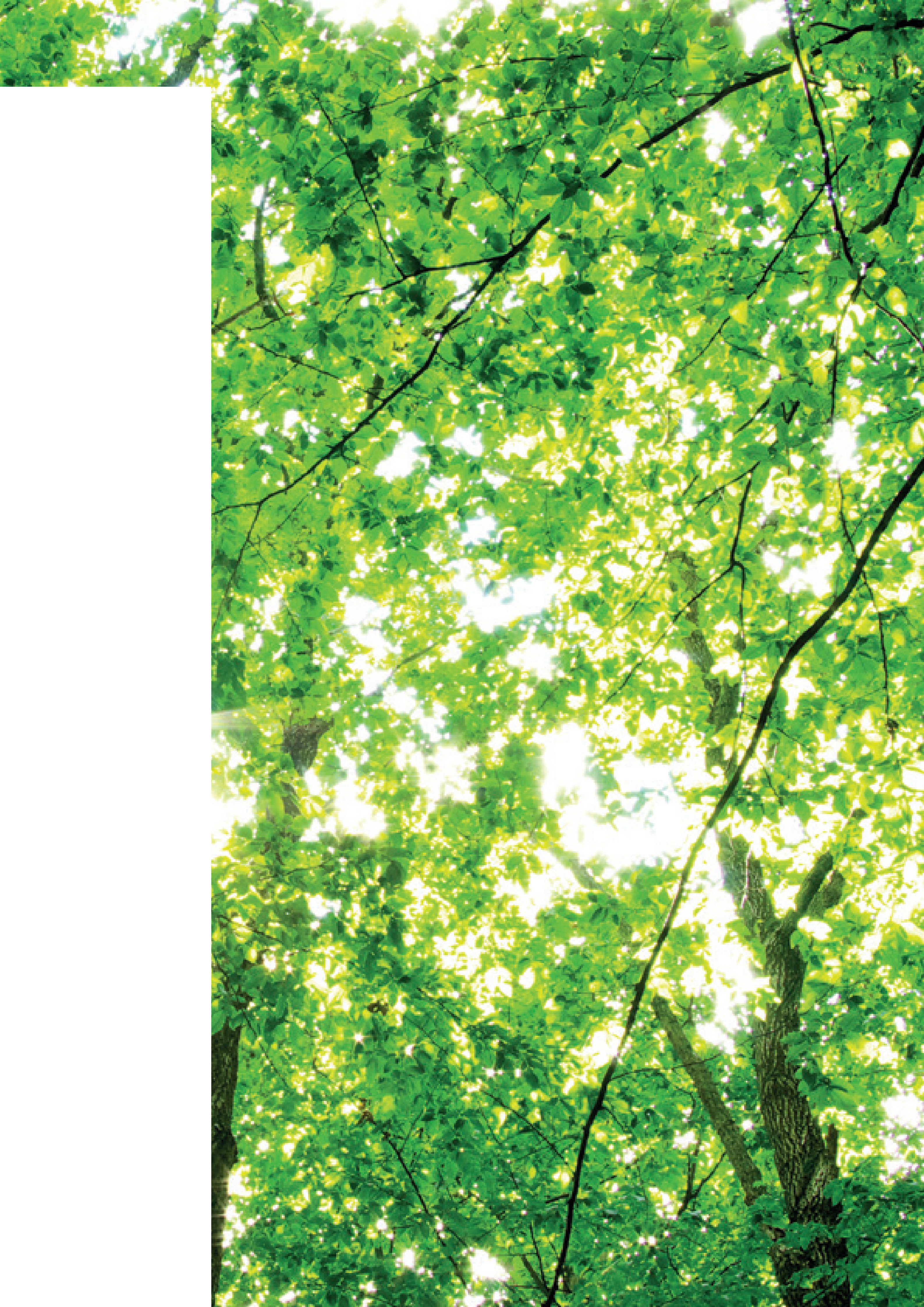
It is worth noting that these values do not take into account the pollination service. Indeed, when deforestation occurs in an area, it is unlikely to impact negatively the provision of this service (unless the area of forests decreases below an ecological threshold and pollinating insects cannot survive anymore). The figure below provides an explanation. In the first year, forests which are close to agricultural land (light green) provide a pollination service to coffee plots which are within 1000 meters (yellow). When deforestation occurs, this area of forest is cleared (as it is the more accessible) and replaced by agricultural land (year 2). As a result, some forests which initially were far from coffee plots (green) become close to them and now provide the service. The area of forest providing the pollination service, and the area of coffee plots benefiting from it did not decrease with deforestation. The service provided by the whole forest remains the same.

Year 1

Area of coffee far from forest	Area of coffee within 1000 m from forest	Area of forests providing the pollination service	Area of forests which do not provide the pollination service

Year 2

	Area of coffee within 1000 m from forest	Area of forests providing the pollination service	



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