Carbon, biodiversity & ecosystem services: exploring co-benefits

Ecuador

UNEP WCMC

Ministerio del Ambiente

UNEP World Conservation Monitoring Centre
219 Huntingdon Road
Cambridge, CB3 0DL
United Kingdom
Tel: +44 (0) 1223 277314
Fax: +44 (0) 1223 277136
Email: info@unep-wcmc.org
Website: www.unep-wcmc.org

UNEP promotes environmentally sound practices globally and in its own activities. This publication is printed on wood pulp from sustainably managed forests (i.e. FSC-certified paper). Our printing and distribution policy aims to reduce UNEP's carbon footprint.

UNEP-WCMC

The UNEP World Conservation Monitoring Centre (UNEP-WCMC) is the biodiversity assessment and policy implementation arm of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organisation. The centre has been in operation for nearly 30 years, combining scientific research with practical policy advice.

UNEP-WCMC provides objective, scientifically rigorous products and services to help decision-makers recognise the value of biodiversity and apply this knowledge to all that they do. Its core business is managing data about ecosystems and biodiversity, interpreting and analysing that data to provide assessments and policy analysis, and making the results available to international decision-makers and business.

ACKNOWLEDGEMENTS

UNEP World Conservation Monitoring Centre would like to thank BfN and BMU for financial support. Special thanks to the Ministry of the Environment of Ecuador, especially María Jeaneth Delgado Aguilar, Stephanie Arellano and Guillermo Eduardo Sanchez Riviera; Kelvin Cueva. FAO Ecuador; Tatiana Santander, Aves&Conservación Ecuador; Ian May, BirdLife International; Free de Koning, Conservation International Ecuador; Francisco Cuesta, Iniciativa Regional de Estudios Ambientales Andinos CONDESAN; Carolina Mancheno, Care Ecuador; José Vicente Troya, UNDP Ecuador; Gabriel Jaramillo, Programa para la Conservación y Manejo Sostenible del Patrimonio Natural y Cultural de la Reserva de Biosfera Yasuní; Arianna Granziera, Jörn P.W. Scharlemann and Matea Osti, UNEP-WCMC.

Printed in the UK by Colchester Print Group (an ISO 14001 accredited printing company)

DISCLAIMER

CONTRIBUTORS

Andrea Lucía Araujo Navas
Undersecretary of Natural Heritage
Ministry of the Environment
Quito, Ecuador

Daniela Carrión and Marco Chíu
Undersecretary of Climate Change
Ministry of the Environment
Quito, Ecuador

Monika Bertzky, Corinna Ravilious, Valerie Kapos, Barney Dickson
UNEP World Conservation Monitoring Centre
219 Huntingdon Road, Cambridge, CB3 0DL, UK
E-mail: barney.dickson@unep-wcmc.org

CITATION

Bertzky, M., Ravilious, C., Araujo Navas, A.L., Kapos, V., Carrión, D., Chíu, M., Dickson, B. (2010) *Carbon, biodiversity and ecosystem services: Exploring co-benefits. Ecuador.* UNEP-WCMC, Cambridge, UK.

Available online at:
http://www.unep-wcmc.org/climate/publications.aspx OR www.carbon-biodiversity.net

Introduction

Land-use change, primarily through tropical forest loss and degradation, is estimated to contribute 6–17% of all anthropogenic greenhouse gas (GHG) emissions (van der Werf *et al.* 2009). The maintenance and enhancement of natural carbon stocks are therefore now considered key climate change mitigation measures. An incentive-based mitigation mechanism called 'REDD+', short for '**R**educing **E**missions from **D**eforestation and forest **D**egradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks', is expected to make a large contribution to reducing GHG emissions from land-use change in the future.

Depending on where and how REDD+ is implemented, its actions may generate other benefits in addition to maintaining and enhancing carbon stocks. These co-benefits can include ecosystem and social benefits such as biodiversity conservation, maintenance of ecosystem services and improvement of local people's livelihoods. Planning for co-benefits provides an opportunity for countries to achieve more than GHG savings when implementing REDD+.

Analyses of the spatial relationships between carbon, co-benefits and socio-economic context can support planning and decision-making at national and sub-national scales. When such spatial analyses are based on data developed at an appropriate scale, done in consultation with a wide range of stakeholders, they can help to prioritise among the different benefits and services under consideration and the actions that might best deliver them.

Ecuador is a country with high forest cover and very high biodiversity. However, Ecuadorian forests are under pressure from deforestation and resource exploitation. The government is addressing the issue by planning for a high quality REDD+ mechanism that maximises benefits for the climate, the environment and people. This report presents the result of spatial analyses to support this planning process. More detail on the methods applied, results and data sources are compiled in a separate technical report (UNEP-WCMC and MAE in prep.).

Forests and REDD+ in Ecuador

The Republic of Ecuador, its name derived from its location astride the equator, is located in the Northwest of South America (Map 1). It is bordered by Colombia to its North, by Peru to its East and South and by the Pacific Ocean to the West. It also includes the Galapagos Islands, ca. 1 000 km from the mainland. In total, Ecuador spans an area of 255 234 km^2 (SENPLADES 2009).

There are three mainland geographic regions: the coast, the highlands, and the Amazon rainforest. A number of active volcanoes can be found in the highlands, several of which exceed 5 000 m altitude. Chimborazo, at 6 310 m, is the highest mountain of the country.

The climate across Ecuador is greatly influenced by altitude. In the Andean highlands it is temperate, whereas in the Pacific coastal area and in the Amazon rainforest region the climate is tropical.

As of May 2010, the population of the Republic of Ecuador was estimated to be 14 285 288 (INEC 2010), more than 90% of whom are living in the coastal and Andean regions. Much of the population is poor; in 2009, 46% of the population lived in poverty and 20% in extreme poverty.

Map 1: Location of the Republic of Ecuador

Around 50% of the area of the country is covered by forest (Sierra 1999), mostly evergreen forests of the Amazon, the Andean foothills, and the Andes. More than 6.8 million hectares of forest are owned by ancestral peoples, indigenous communities and Afro-Ecuadorian communities. Most of this land is located in the Amazon region of the country and in the province of Esmeraldas.

Ecuador is among the countries with the highest deforestation rates in Latin America. According to FAO (2009), annual deforestation was 1.5% between 1990 and 2000, and increased to 1.7% between 2000 and 2005, totalling 1 980 km^2 of forest loss per year. However, there is a strong political will to change this trend. The Ministry of the Environment is developing a New Forestry Governance model, which aims to manage forests in a sustainable manner. One of the specific objectives of the model is to reduce the country's deforestation rate, thereby accomplishing one of the goals of the National Development Plan 2009-2013 (SENPLADES 2009).

The implementation of a REDD+ mechanism will contribute to both the new Forestry Governance Model and the National Climate Change Strategy. Moreover, REDD+ has the potential to contribute to mobilising technical and financial resources for the forestry sector and help accomplish social and environmental goals in addition to reduced deforestation. Consequently, the country is taking firm steps to prepare for the implementation of REDD+.

Ecuador's National REDD+ Strategy, which is currently under development, aims at simultaneously contributing to climate change mitigation and to managing Ecuador's forests in a sustainable manner. This goal will be accomplished through the implementation of policies, measures and activities at national level to reduce deforestation and its associated GHG emissions. The elements of the strategy are in line with the Forestry Governance Model, and include incentive-based policies, forestry control, reforestation and afforestation activities, a forestry information system, sustainable forest management, and land tenure regularization. Further cross-cutting elements pertain to legal, financial and institutional frameworks, financial sustainability, multiple benefits, cross-sectoral planning, management of timber demand, and key stakeholder engagement.

The Government is already implementing a number of activities as part the preparation for REDD+, such as (1) determining the current deforestation rate to establish a Deforestation Baseline; (2) characterizing Ecuador's forests and determining carbon quantities per forest type through a National Forest Inventory, (3) implementing an incentive-based policy for the conservation of native forests called the 'Socio Bosque' Programme, (4) developing the financial structure needed for the uptake and channelling of financial resources coming from the implementation of a REDD+ mechanism, (5) ensuring social and environmental co-benefits, (6) defining a legal and institutional framework for environmental services in Ecuador, (7) designing an Engagement Programme for civil society and indigenous people on REDD+, and (8) designing an incentive-based policy for sustainable forests management complementing the Socio Bosque Programme.

The work presented here supports Ecuador's aim to maximise benefits from REDD+ that are additional to maintaining and enhancing carbon stocks.

Mapping carbon in Ecuador

In 2008, the country's first forest carbon map was generated for integration into the prioritization system of the Ecuadorian Programa Socio Bosque (MAE 2010b, and see separate section). For this map, the forest cover classes from Sierra (1999) were merged into 4 broad forest cover classes for which average IPCC aboveground biomass carbon estimates are available.

Here, we present an updated national biomass carbon map for the mainland of the country. It is based on an updated vegetation stratification (MAE 2009, updated) and on above-ground biomass estimates compiled from national sources, where possible[1], and includes below-ground as well as above-ground carbon. In the Amazon region, the detail within the forest types was further increased by using spatially explicit biomass estimates from Saatchi *et al.* (2007). Below-ground biomass was calculated by applying IPCC root-to-shoot ratios (IPCC 2006) by ecoregion (FAO 2001; Cárdenas *et al.* 2009; Josse *et al.* 2009). A factor of 0.5 was used to convert from biomass into carbon stocks in tonnes per hectare (Brown 2002). According to the resulting map, a total of 1.63 gigatonnes (Gt) of carbon is stored in biomass in Ecuador. More than 1 Gt of this biomass carbon is stored in areas that were classified as of very high or high carbon density (Figure 1), mainly in the Amazon region or the foothills of the Andes (Map 2).

Results of the updated National Forest Inventory that is planned for late 2010/2011 (MAE 2010b), will be of great importance in further improving knowledge of carbon stocks in Ecuador's different vegetation types.

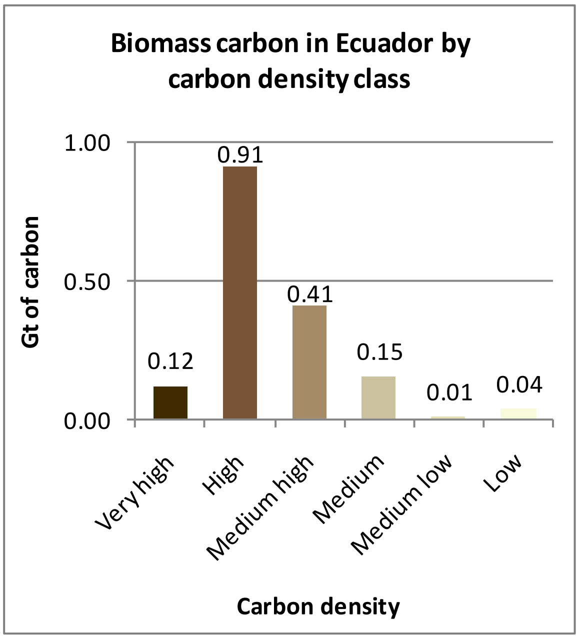
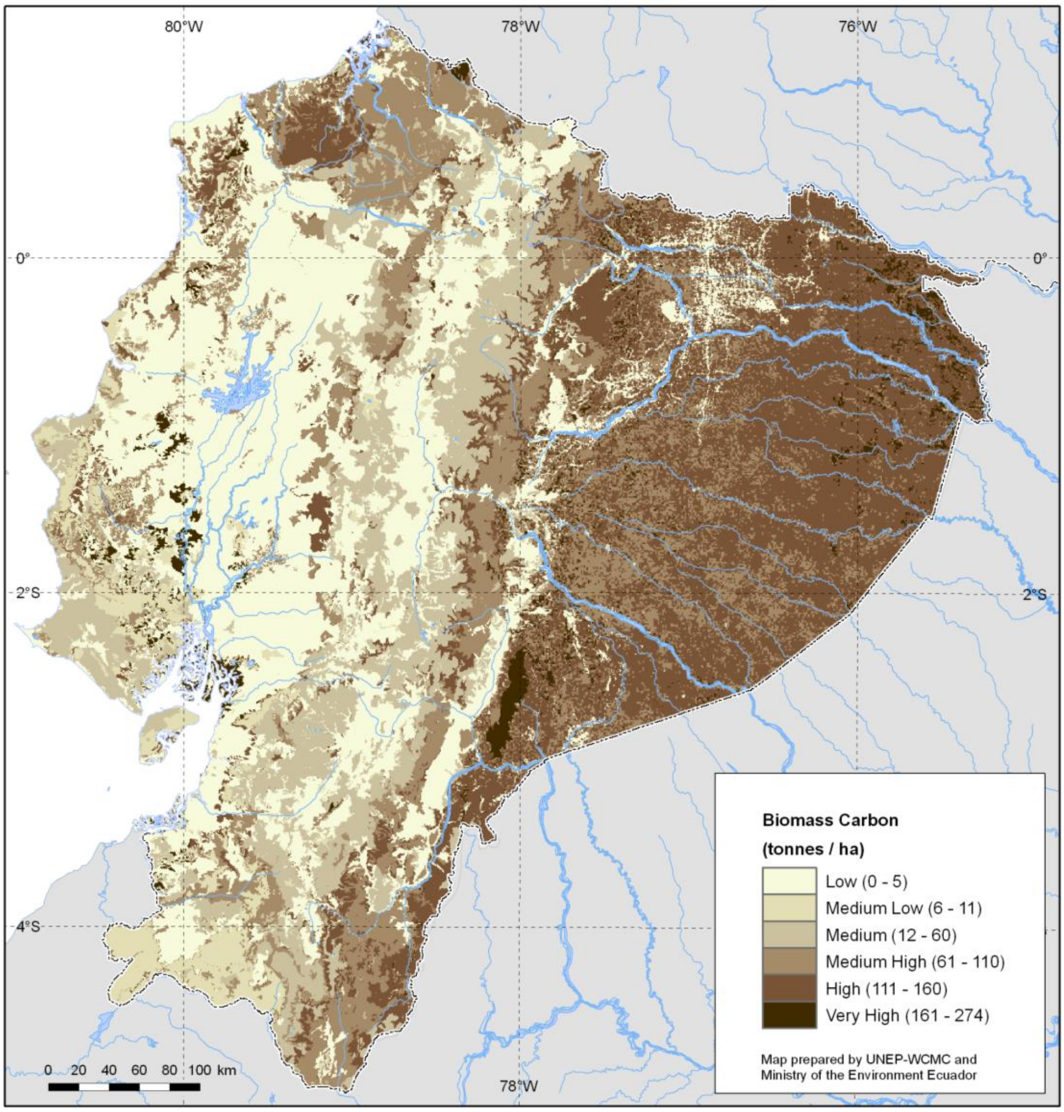


Figure 1: Distribution of biomass carbon stocks in Ecuador among areas of different biomass carbon density.

[1]Where no national estimates were available relevant regional or global average estimates were used (for more detail, see UNEP-WCMC and MAE in prep.)



Map 2: Updated biomass carbon map of the Republic of Ecuador based on vegetation cover data and biomass estimates from national and international sources

When soil carbon counts

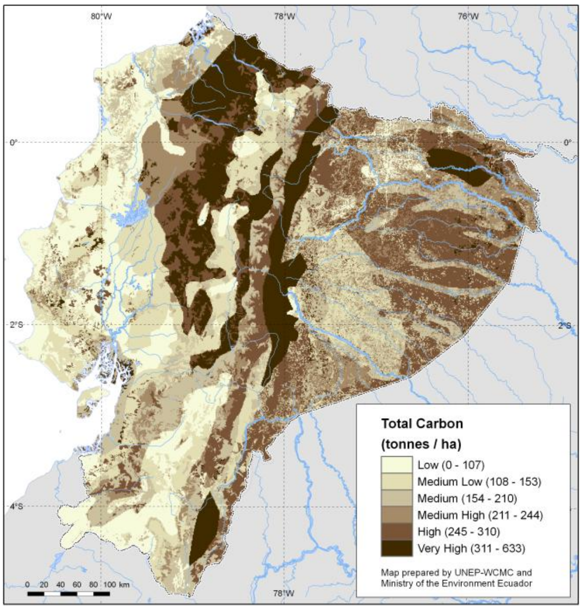
Globally, it is estimated that larger amounts of carbon are stored as soil organic matter than as biomass (IPCC 2000; Feller and Bernoux 2008), and these reserves may be distributed very differently from biomass carbon stocks. However, current knowledge on amounts of carbon stored in different soil types is limited.

It was not possible to obtain a national level dataset on soil characteristics for Ecuador that included sufficient detail to allow for conversion into a national soil carbon map. Consequently, data for Ecuador were clipped from a global map of soil carbon to 1 m depth (Scharlemann *et al.* in prep.), which is based on the Harmonised World Soil Database (FAO *et al.* 2009). According to these data, almost 3.6 Gt of carbon is stored in the soils of Ecuador. Combined with the figures for biomass carbon this gives an estimated total national carbon stock for Ecuador of 5.2 Gt (Map 3).

Overall, the Amazon region of Ecuador, covering about one third of the country's mainland area, stores about 58% of the country's total biomass carbon, whereas the Andean and Coastal regions hold 28 and 13% respectively (Table 1). However, inclusion of soil carbon changes the relative contributions of the regional carbon stocks; the percentage of the total carbon stored in the Amazon region is much lower than that stored in the Andean region.

Including soil carbon also affects the distribution of carbon stocks among land cover types. Almost half of Ecuador's biomass carbon (46%) is stored in the Amazonian lowland evergreen forest, but this vegetation, which occupies 25% of the land area, contains only 27% of the total national carbon storage when soil carbon is taken into account. The evergreen forest of the Andean foothills stores about 11% of the country's biomass carbon and 7% of its total carbon; and the Moretales (palm-rich forests) and evergreen Andean mountain forest store 9 and 8% of the biomass carbon and 10 and 5% of its total carbon stock, respectively (Figure 2). It is notable that cultivated land, which covers about 29% of the mainland, only stores about 2% of its biomass carbon (Figure 2), but houses sufficient soil carbon to account for 20% of the total carbon stock.

These data show the large contribution that soil carbon can make to a country's total carbon stocks and highlight the importance of wise management of soil carbon for climate change mitigation. Options for managing soil carbon stocks include the use of agricultural practices that reduce the release of carbon from soil in cultivated areas.



Map 3: Total carbon density in Ecuador

Table 1: Distribution of Ecuadorean terrestrial carbon stocks among the mainland regions

Region	% of total area	% of total biomass carbon	% of total carbon
Amazon	33	58	36
Andean	41	28	46
Coastal	26	13	18

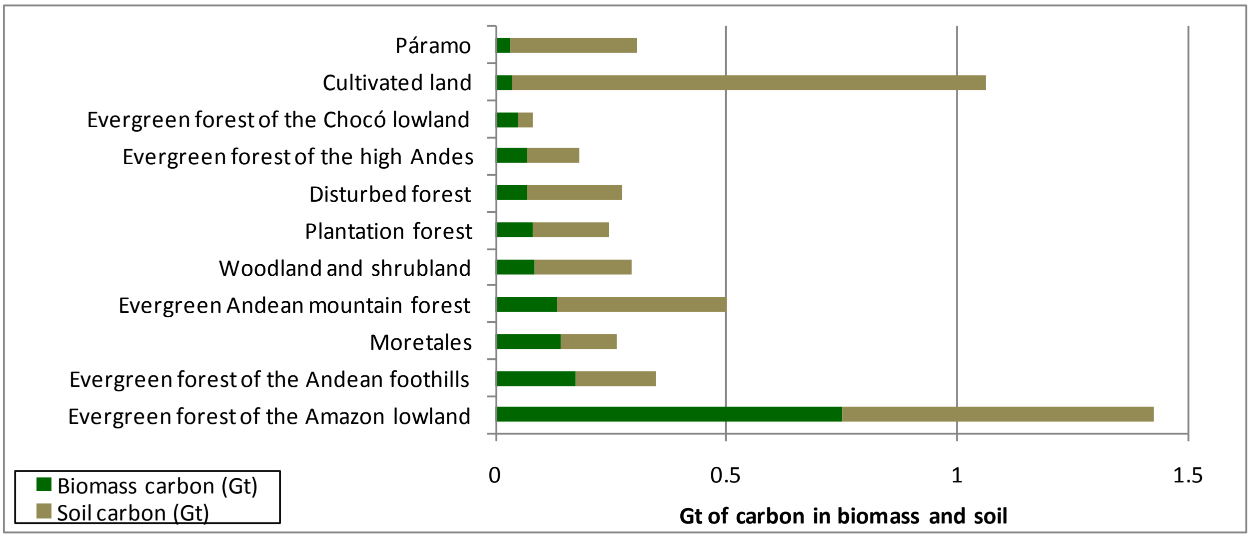


Figure 2: Biomass and soil carbon in Ecuadorian land cover types (land cover types with < 0.08 Gt of total carbon not shown)

However, our knowledge of soil carbon stocks is as yet incomplete. Due to the coarseness of the soil data currently available for Ecuador, the maps in this report show only biomass carbon (apart from Map 3). Equally, calculations are based on biomass carbon only. When a more detailed national soil carbon dataset has been generated as the required data become available, maps and calculations can be modified to include the new data.

Exploring co-benefits in Ecuador

There is a huge potential to gain co-benefits from REDD+ in Ecuador. Despite its small size, the country is among the 17 most biodiverse countries in the world (Mittermeier *et al.* 1999); however, many of its species are threatened by different pressures (see Table 2). At the same time, improvements in human well-being are prioritised by national policy. Consequently, the country is seeking to maximise both environmental and social co-benefits from REDD+.

Table 2: Numbers of known and threatened species in Ecuador (IUCN 2010; MAE 2010a)

Taxon	Known species	Threatened species (%)
Vascular plants	17 058	1 716 (10%)
Mammals	382	42 (11%)
Birds	1 655	71 (4%)
Amphibians	464	171 (37%)
Reptiles	404	11 (3%)
Fish	1 539	18 (1%)

Biodiversity

There are different approaches to identifying areas of importance for biodiversity. Among these approaches is the identification of Key Biodiversity Areas (KBAs) (Eken *et al.* 2004; Langhammer *et al.* 2007), sites of importance for different species according to internationally agreed criteria. Most of the globally identified KBAs are Important Bird Areas (IBAs), key sites for conservation of threatened, restricted range and/or migratory or congregatory bird species. these areas amounts to 0.85 Gt, or 52% of the country's total. KBAs include more than 50% of Ecuador's very high carbon density land and almost 60% of the high carbon density land (Figure 3).