Carbon, biodiversity & ecosystem services:
exploring co-benefits

Nigeria

Preliminary Results

UNEP WCMC

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Introduction

Land-use change, primarily through tropical forest loss and degradation, is estimated to contribute 6-17% of all anthropogenic greenhouse gas emissions (van der Werf *et al.* 2009). The UN Framework Convention on Climate Change (UNFCCC) is currently discussing incentives for Reducing Emissions from Deforestation and forest Degradation plus additional activities (REDD+, Figure 1).

Well-planned and carefully implemented REDD+ actions can have positive outcomes that are additional to emissions reductions. Such 'co-benefits' include conservation of biodiversity and maintenance of ecosystem services. Potential co-benefits from REDD+ are highly relevant in Nigeria, where services provided by forests make an important contribution to the livelihoods of local communities (Aruofor 2001).

REDD+

= **Reducing Emissions from Deforestation and forest Degradation**

+

Conservation of forest carbon stocks
Sustainable management of forests
Enhancement of forest carbon stocks

Figure 1: Components of REDD+

Spatial analyses relating potential co-benefits to carbon stocks can support planning and decision-making on REDD+. Simple mapping tools can be used to help identify areas where high carbon, high biodiversity priority, and ecosystem service values overlap, and show how these relate to pressures and management options. This brochure presents results from some initial spatial analyses for Nigeria.

Nigeria

The Federal Republic of Nigeria is located in West Africa and spans nearly 924 000 km^2 (Nigeria National Bureau of Statistics 2008). Nigeria is the most populous country in Africa, being home to over 150 million people (UN Population Division 2009). It is bordered by Cameroon, Chad, Niger, and Benin, and includes 853 km of coastline in the South (Map 1).

Nigeria suffers from high rates of deforestation and forest degradation. Drivers such as conversion for large scale agriculture, uncontrolled logging, unsustainable harvest of fuel wood, overgrazing, incessant bush burning and oil exploration contribute towards the loss and degradation of more than 3 500 km^2 of forest annually (Government of Nigeria 2010).

The Government of Nigeria is taking significant steps towards REDD+ readiness. Nigeria joined the UN-REDD Programme as a partner country and observer to Policy Board meetings in early 2010. The Government launched the National

Map 1: Location of the Federal Republic of Nigeria

Technical Committee on REDD in July 2010. Its Readiness Plan Idea Note (R-PIN) is being developed for submission in November 2010.

Mapping carbon in Nigeria

A new map of Nigeria's terrestrial carbon stocks has been generated, combining estimates of above- and below- ground biomass and soil organic carbon to 1 metre depth (Map 2). The above-ground biomass was derived from a model for tropical Africa, which uses remotely-sensed MODIS NBAR data from 2000-2003 (Baccini *et al.* 2008). Below-ground biomass was derived using ecosystem-specific conversion factors (IPCC 2006) according to FAO ecological zones (FAO 2001). Total biomass carbon stock (Map 3) was estimated as half the total biomass for each cell (Gibbs and Brown 2007). Where no model data existed (i.e. zones with <9 tons of biomass per hectare), values from a global biomass carbon map (Ruesch and Gibbs 2008) were substituted. Soil organic carbon (Map 4) was added from a global soil carbon dataset (Scharlemann *et al.* in prep) based on the Harmonised World Soil Database (FAO *et al.* 2009).

According to this analysis, a total of 7.5 Gt of carbon is stored in the biomass and soils of Nigeria's terrestrial ecosystems. The largest areas of high carbon density are found in the southern parts of the country, mostly along the Niger Delta and in the rainforest regions. The highest carbon density class, which holds 20% of the country's carbon, covers 7% of the country's land area (Figure 2).

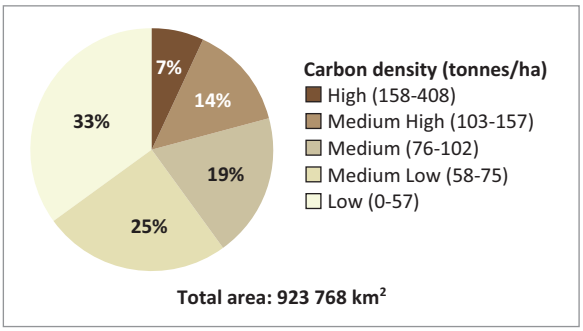
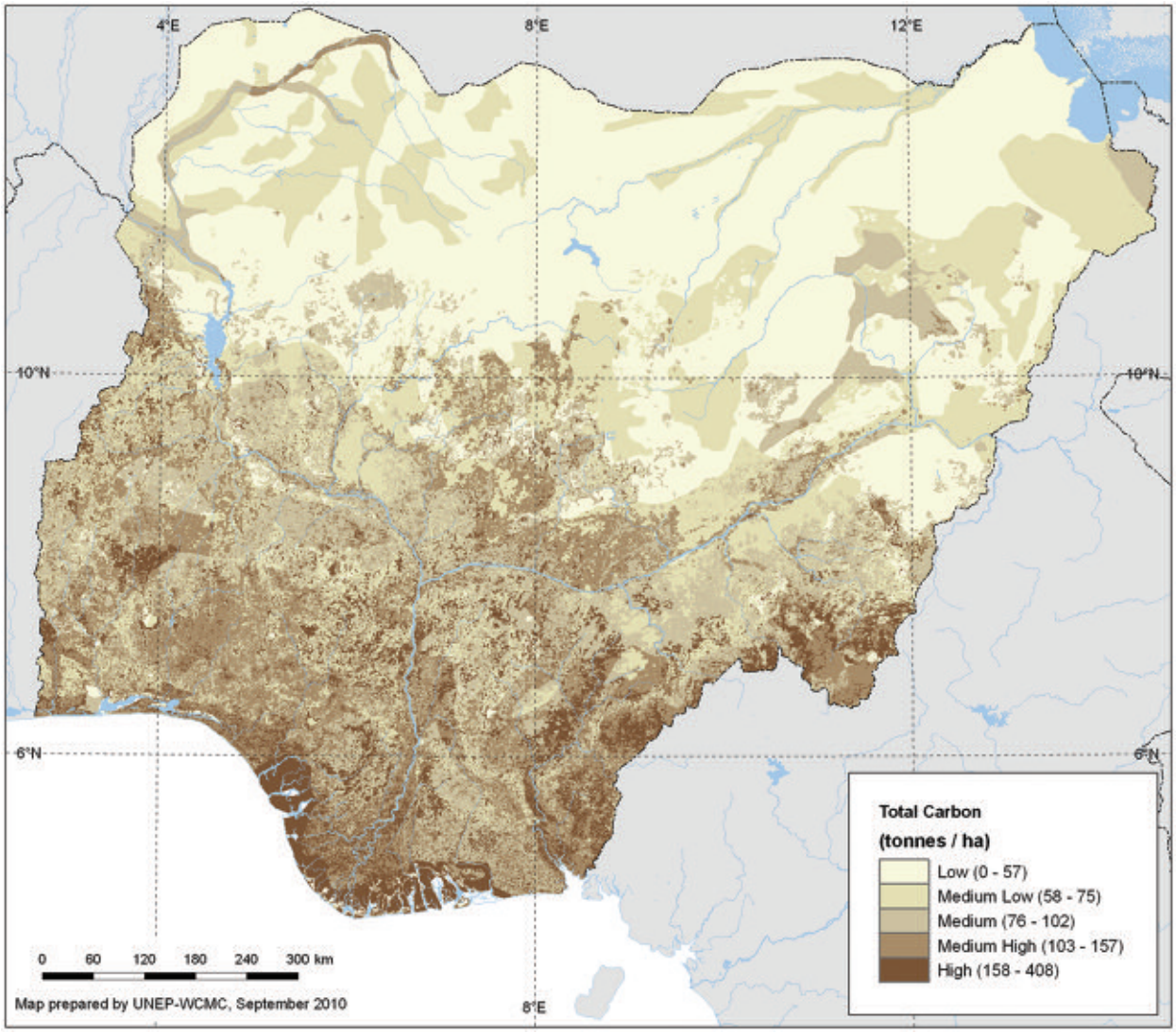
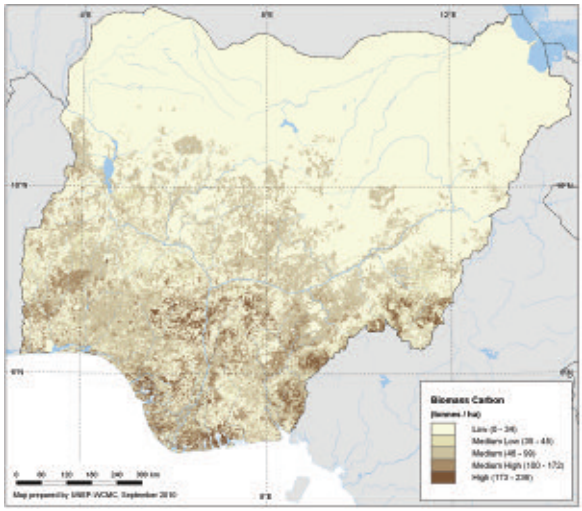


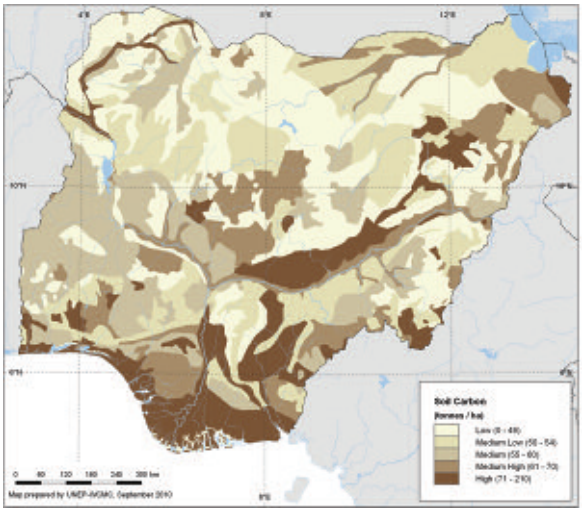
Figure 2: Distribution of land area in Nigeria according to carbon density classes



Map 2: Terrestrial carbon stocks (in biomass and soil) of Nigeria (underlying data from Baccini *et al.* 2008; Ruesch and Gibbs 2008 and Scharlemann *et al.* in prep.)



Map 3: Biomass carbon stocks of Nigeria (underlying data from Baccini *et al.* 2008; Ruesch and Gibbs 2008)



Map 4: Soil organic carbon stocks of Nigeria (underlying data from Scharlemann *et al.* in prep.)

Carbon and biodiversity

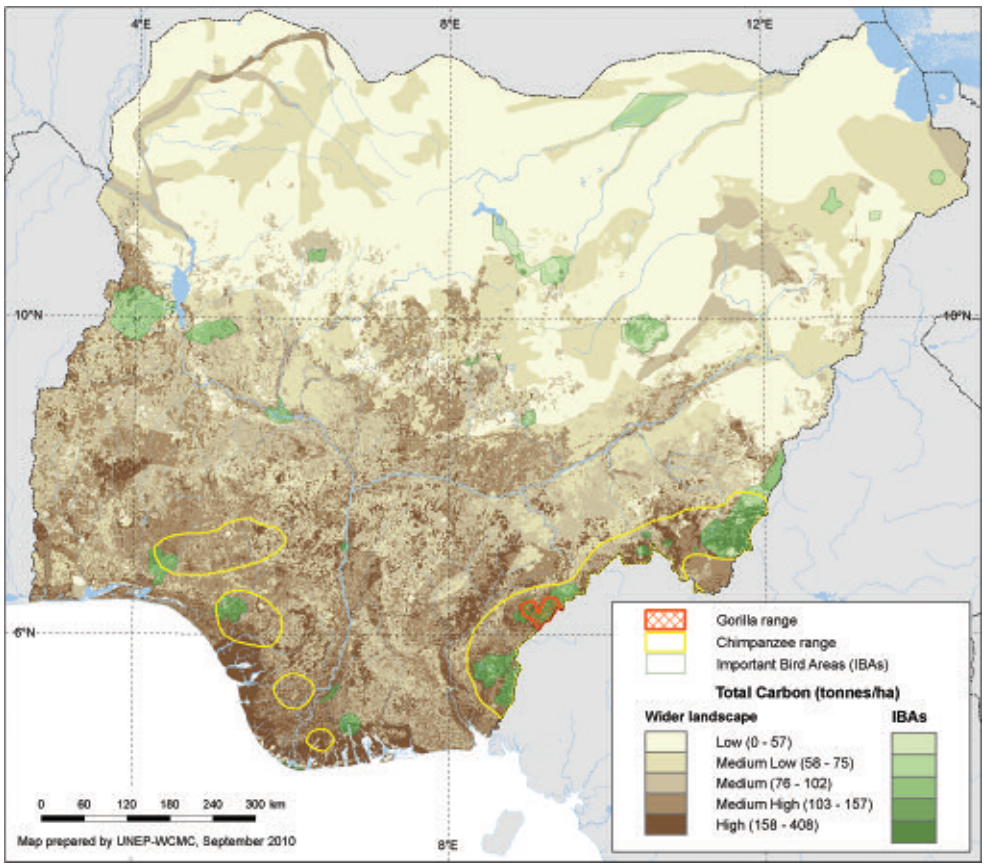
Nigeria is considered one of the most biodiverse countries in Africa. It is home to 889 species of birds, 109 amphibians, and 648 fish (FEPA 1992), and is a global hotspot for primate species (CBD National Focal Point Nigeria 2010). The Niger Delta also contains the most extensive area of mangrove in all of Africa (WWF 2001).

The relationship between carbon distribution and areas of importance for biodiversity in Nigeria was investigated using datasets on areas of importance for bird species, Important Bird Areas (IBAs; BirdLife International 2010), and on the distribution of two important species of Great Apes: the Nigeria-Cameroon chimpanzee and the Cross River gorilla (updated from Caldecott and Miles 2005).

In Nigeria, there are a total of 27 IBAs covering some 31 269 km^2 (3.4% of the country's area).

Overlaying the IBAs with the carbon data (Map 5) shows that nearly a fifth (18.4%) of their area is of high carbon density. Overall, IBAs contain just over 4% (0.34 Gt) of Nigeria's terrestrial carbon stock.

Nigeria-Cameroon chimpanzee and Cross River gorilla distribution areas cover 45 403 km^2 (5% of the country's area) and 1 253 km^2 (0.1% of the country's area) respectively (Map 5) and hold important carbon stocks. Nigeria-Cameroon chimpanzee areas contain 0.63 Gt of carbon (8.4% of total carbon), and the Cross River gorilla distribution area holds 0.02 Gt (0.3% of total carbon). Most (70%) of the area where IBAs, Cross River gorilla distribution and Nigeria-Cameroon chimpanzee distribution all overlap is high in carbon density and in total contain about 0.02 Gt of carbon.



Map 5: Distribution of terrestrial carbon, IBAs and great apes in Nigeria (data from Birdlife International 2010; updated from Caldecott and Miles 2005)

Carbon, biodiversity and Protected Areas

Protected Areas are nationally, and in some cases, internationally recognised areas that are managed to achieve long-term conservation of nature (Dudley 2008). According to the World Database on Protected Areas (WDPA; IUCN and UNEP-WCMC 2010), Nigeria has 972 nationally designated Protected Areas, consisting of a mix of National Parks, Strict Nature Reserves, Forest Reserves, Game Reserves, Wildlife Sanctuaries, and Community Forests. They cover 127 537 km^2, approximately 14% of the country's total land area.

Overlaying the WDPA data with the carbon density map (Map 6) shows that about 15% of Nigeria's total carbon stock (1.11 Gt) and 17.9% of its high carbon density area falls within its Protected Areas. Analysis of the protection status of carbon stocks within IBAs shows that almost 0.28 Gt (or 86%) of carbon within IBAs is in a Protected Area (Figure 3).

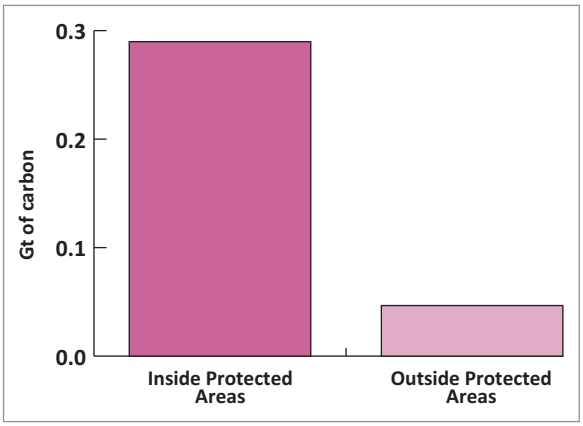
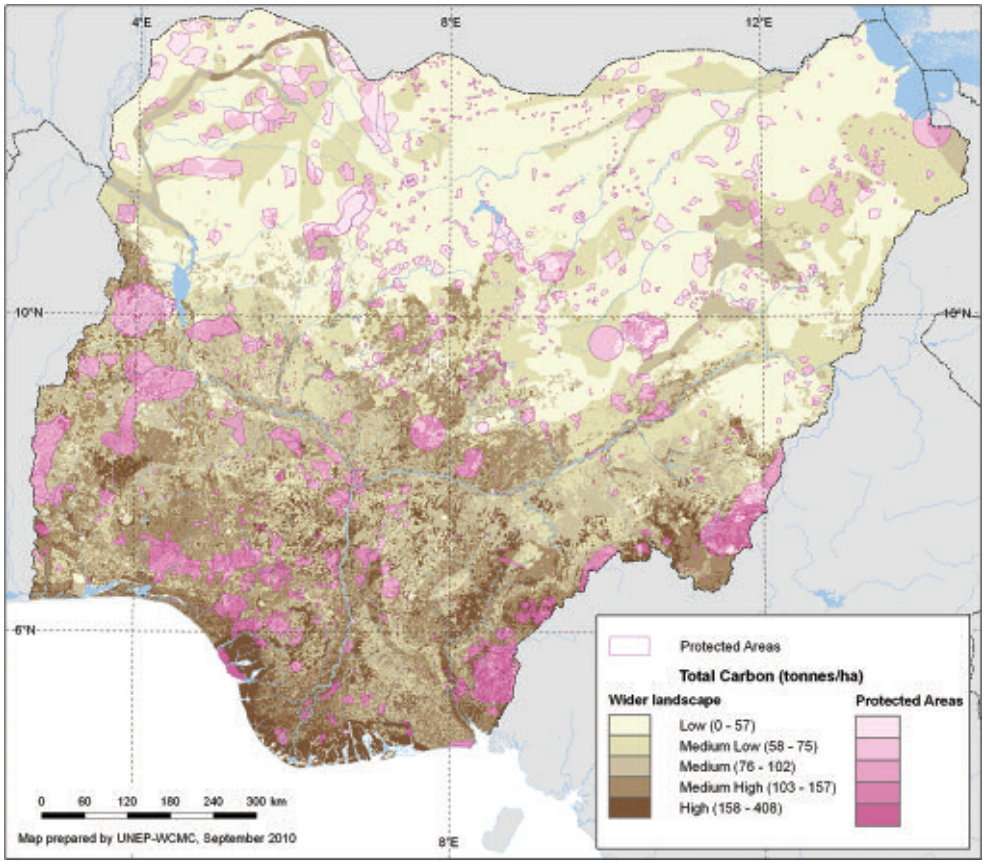


Figure 3: Protection status of carbon in IBAs



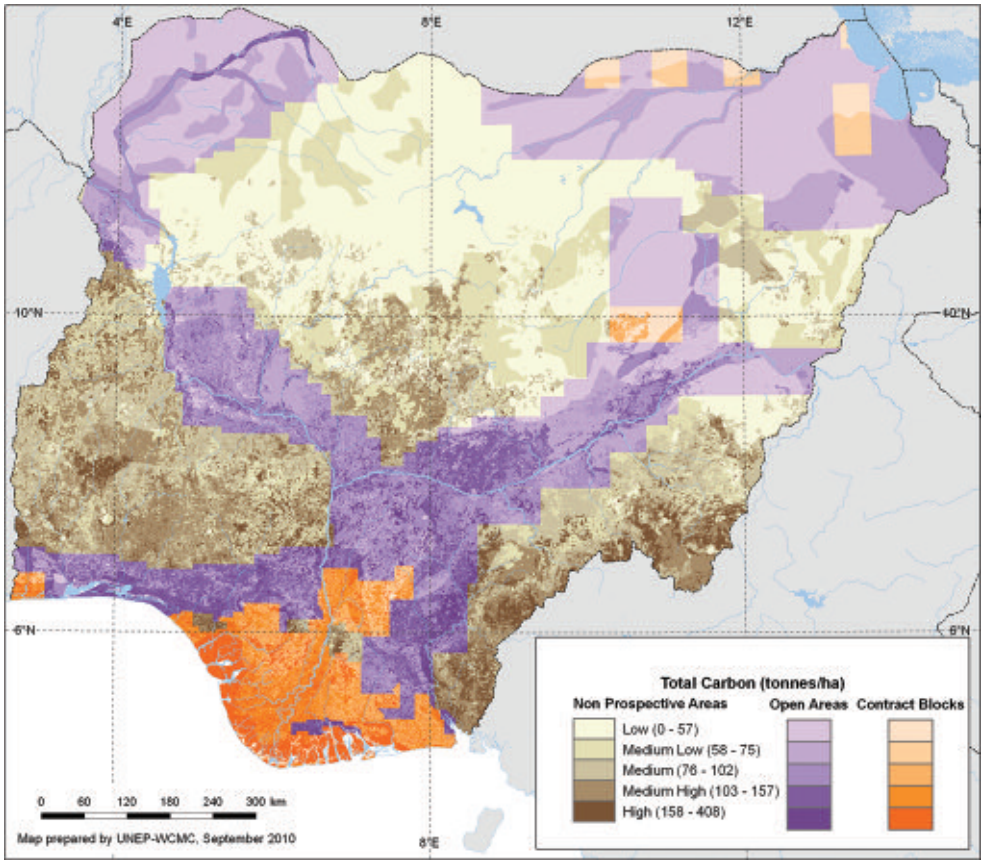
Map 6: Distribution of terrestrial carbon and Protected Areas (data on Protected Areas from IUCN and UNEP-WCMC 2010)

Pressures on carbon: oil and gas development

Nigeria holds the second largest oil reserves in Africa, and is currently the region's primary oil producer (EIA 2010). Land allocated to present or future oil and gas exploration and development covers a considerable amount of the country (Map 7). Understanding how this land is distributed relative to the country's terrestrial carbon can help to identify where carbon stocks may come under pressure from oil and gas development in the future.

Datasets on oil and gas contract blocks and open areas (IHS 2010) were overlaid with the national carbon map. Oil and gas contract blocks are areas of land designated by the state and leased to third parties (concessionaires) for the purposes of oil and gas exploration or development. Open areas have been similarly designated for exploration but are not currently leased to third parties (companies can apply for rights to explore or develop there).

The carbon overlay shows that 0.97 Gt of carbon is stored within oil and gas contract blocks (orange areas in Map 7), representing almost 13% of total carbon within Nigeria. Almost 30% of the area of oil and gas contract blocks is of high carbon density (the darkest orange in Map 7). A further 2.78 Gt is stored in open areas (37% of Nigeria's total carbon stock; purple areas in Map 7); 4.8% of the area of open areas is high carbon density.



Map 7: Distribution of terrestrial carbon, oil and gas contract blocks and open areas (data from IHS 2010)

Conclusions

Carbon and co-benefits

As a first step towards informing decision-making about carbon management, these preliminary results show that, in many cases, high carbon density areas and areas of importance for biodiversity do coincide. Significantly, much of the area that is of high biodiversity priority is also high in carbon density. Actions to secure more of these areas and their carbon and to improve their management are likely to achieve considerable biodiversity related co-benefits. However, a large amount of Nigeria's carbon is outside the areas of biodiversity importance considered here (but may be important for other aspects of biodiversity); if carbon management prioritises these areas, the benefits to biodiversity are less certain. In areas of high biodiversity importance and low carbon storage, resources for conservation and management will need to come from sources other than REDD+ programmes.

Planning for forest carbon management, including under REDD+, will also need to take into account existing land management plans and designations, such as areas designated for resource exploitation and development. An understanding of the carbon stocks of these areas may help stakeholders work together to help mitigate future pressures.

Outlook

These results are useful as a preliminary basis for assessing the relationship between carbon and potential co-benefits of REDD+ action. In future, the analyses will be improved and extended in close collaboration with relevant Nigerian Government Agencies and Institutions. The improvements anticipated include: development of an improved carbon map based on recent national land cover developed by the National Space Research and Development Agency (NASRDA) and on forest inventory data; incorporation of additional aspects of biodiversity; inclusion of other ecosystem services, such as soil conservation and hydrological regulation; and analyses of the relationship between all of these parameters and the distribution of human populations and measures of poverty or wellbeing. Further, an effort will be made to place these extended analyses in the context of existing land use plans and prioritisation schemes. These detailed assessments can also help to identify monitoring needs in relation to co-benefits from REDD+ activities.

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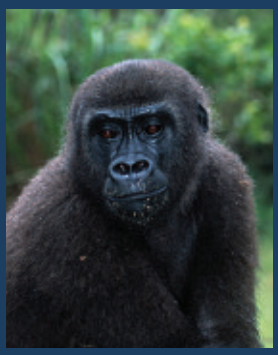

Benefits of actions to maintain and enhance carbon stocks for climate change mitigation can be increased by taking into account areas important for biodiversity and ecosystem goods and services. Here, we present initial analyses of the spatial relationship of carbon stocks to areas of importance for biodiversity and protected areas in Nigeria, based on a preliminary carbon map for the country. The relationship between carbon stocks and potential pressures from oil and gas exploration is also presented. Future work will improve the carbon map based on up-to-date landcover data and will address other aspects of their importance for biodiversity and ecosystem services to provide a basis for discussion and planning for co-benefits from carbon management in Nigeria.

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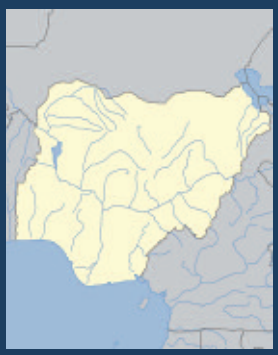

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