SUSTAINABLE MANAGEMENT OF CRITICAL WETLANDS ECOSYSTEMS

Sustainable Management of critical Wetlands ecosystems

Abstract

This report provides the results of an Ex-Ante Carbon-balance Tool (EX-Act) Greenhouse Gas appraisal of the project “sustainable management of critical ecosystems” in Gabon. The project aims at enhanced protection of biodiversity in selected forested wetlands on the Ramsar list (Bas Ogooue, Monts Birougou and Petit Loango/Sette Cama) through knowledge creation and development of conservation measures for sustainable wetlands management. The project is benefiting to 70,000 households and seeks for 30,000 ha of forest area under sustainable forestry management. The GHG appraisal shows high benefits in term of climate change mitigation, i.e. -444,658 tCO2-e per year if the project is successfully implemented.

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Project on sustainable management of critical wetland ecosystems

1) Project description

   a) Project context

   Gabon is a resource-rich country well endowed with an exceptional biodiversity, arable land, forest, mineral (magnesium, iron) and oil resources. The country contains three important terrestrial ecoregions, i.e. the Congolian coastal forest, the Northwestern Congolian lowland forest, the Western Congolian forest savanna and is covered with significant stands of mangrove and swamp forests. Some areas (wetlands and non-wetlands ecosystems) have been classified as National parks and managed by different agencies and government departments. Since 1987 Gabon is also part of the Ramsar convention on wetlands of international importance (WII) and registered about 9 sites representing wide variety of aquatic ecosystems (mangroves, savannas, waterfalls and rapids, lagoons, rivers and lakes) which are representing now about 2.8 million hectares (ha). Gabon’s wetlands are thus rich in biodiversity but are also unprotected. Multiple activities are threatening Gabon’s ecosystems: forestry, mining, oil exploitation, fishing and agriculture. More evidences suggest that biodiversity together with ecosystems services need to be preserved outside national parks. Indeed wetlands provide major ecosystems functions such as recharge of groundwater, water purification, mitigation and adaptation to climate change, and in Gabon they are critical for the provision of drinking water and energy to major urban centers and in sustaining fisheries production and irreplaceable habitat for fish breeding. However despite adhesion to the Ramsar convention, limited action was taken to put in action the convention’s pillars, e.g. maintain the ecological characters of its WII wetlands.

   b) Project objectives and components

   The project “Sustainable Management of critical Wetlands ecosystems” aims at enhance protection of biodiversity in selected forested wetlands on the Ramsar list through knowledge creation and development of conservation measures for sustainable wetlands management, e.g. reduce pressure on land and sustainable forestry management/reducing emissions from deforestation and degradation (REDD+). This will be achieve through different components:

   Component #1 objective (US$ 0.6 million) is to generate knowledge on wetlands in Gabon and to set up a reliable monitoring system that can produce early warning systems on potential alterations of wetlands ecosystems.

   Component #2 (US$ 3.1 million) will provide support for sustainable management of selected critical wetland ecosystems. It will reinforce local capacity (equipment, planning and monitoring) to manage wetlands and improve local livelihood for rural communities (tourism development), and reduce anthropogenic pressures on these wetlands through monitoring and implementation of management plans.

   Component #3 (US$ 3.326 million) will strengthen institutional framework to support wetlands management through cross sectoral consultations on wetlands management issues and priorities.

   Component #4 (US$ 0.485 million) will cover the project management

   The project will benefit to three 3 categorized groups (1) the national institutions, (2) farmers and fishers and (3) the communities in and near the project sites. The direct beneficiaries will be around 70,000 living
within the 3 WII sites. The project will seek for 30,000 ha of forest area under sustainable forestry management and 70 ha of land area where sustainable land management practices will be adopted (Annex 1 PAD607). The number of direct and indirect beneficiaries will be refined with project implementation. The project will span over 5 years with a total cost of US$ 7.521 million.

The project will focus on three of the Gabonese WII sites: (1) Bas Ogooue (2) Monts Birougou and (3) Petit Loango/Sette Cama, table 1. These sites were selected based on the importance of wetland ecosystems services for local population (including climate change adaptation and mitigation), the threats to the wetland ecosystems for competing land uses and the initiatives already undertaken at the sites.

Table 1: Ramsar sites and associated characteristics undergoing project implementation

<table>
<thead>
<tr>
<th>Sites</th>
<th>Characteristics</th>
<th>ha</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bas Ogooue</td>
<td>Alluvial Plain</td>
<td>862,700</td>
<td>Dense population, Fishing, hunting, tourism, competing land uses with slash and burn agriculture, forestry</td>
</tr>
<tr>
<td>Monts Birougou</td>
<td>Heavily forested high interiors (swamps and savanna)</td>
<td>536,800</td>
<td>Forestry and mining activities, destructives fishing practices</td>
</tr>
<tr>
<td>Petit Loango &amp; Sette Cama</td>
<td>Coastal plain wetlands</td>
<td>480,000 &amp; 220,000</td>
<td>Oil exploitation</td>
</tr>
</tbody>
</table>

2) Data used for EX-ACT analysis

In the absence of project, i.e. with the absence of strengthened institutional framework, of monitoring and local capacity to manage forested wetlands, the risk is high that land use competition by resources industries (petroleum, forestry, and mining) will create major pressures on the integrity of those wetland ecosystems. Urban development and unfettered exploitation (deforestation, mining and petroleum exploitation) could compromise the medium to long term capacity of these ecosystems to deliver goods and services needed for e.g. biodiversity protection, climate change adaptation and mitigation, in particular in Monts Birougou and Petit Loango which are poorly managed wetlands sites.

The with-project situation would provide resources with the above components to extend the coverage of management activities in Gabon’s wetlands and ensure their sustainable use and conservation.

In EX-ACT these two scenario are translated in term of degradation level on forest ecosystems in the “forest and management” module.

Support for the sustainable management (component #2) is given in priority to mangrove ecosystems (p.10 of PAD607), for the WII in Sette-Cama and Petit Loango. As reported by Ajonina et al 2014, Gabon’s mangrove surface area decreased by 19% over the period 2000-2014 with deforestation hotspot (over 90% in some places) in the peri-urban areas around Libreville, Port Gentil and Sette-Cama. Major drivers of mangroves loss are due to over-exploitation of wood, land reclamation for urban development and infrastructures, degradation from pesticides and eutrophication and hydrocarbon and gas exploitation, Ajonina et al 2014.

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1 Ajonina et al 2014. Carbon pools and multiple benefits of mangroves in Central Africa: Assessment for REDD+. 72pp
a) Agro-ecological variables

The project area is characterized by a tropical climate with a wet moisture regime. The dominant soil type was specified as LAC soils according to the IPCC classification. While the project will be implemented about a period of 5 years, EX-ACT will account in addition for a 15 year period of capitalization, which is needed in order to capture the full impact of management and conservation strategies on biomass and soil carbon stocks.

b) Forest degradation and management module

i) Petit Loango & Sette Cama mangrove

We use carbon stock data in undisturbed mangrove in Gabon from Ajonina et al 2014, as a Tier 2 level information, screenshot 1. Aboveground and deadwood biomass are corrected in tC ha by multiplying by 0.451, i.e. carbon fraction of above ground biomass from IPCC 2014². For belowground biomass we use the root carbon concentration of 0.36, Kauffman & Donato 2012³. We assume an initial degradation state of the mangrove to be 19%, going toward a moderate degradation level (40%) in the absence of project, while the project implementation through monitoring and sustainable management of the mangrove will allow to recover to a very low degradation level (10%).

EX-ACT screenshot 1: Tier 2 approach for mangrove, data from Ajonina et al 2014 for undisturbed mangroves.

ii) Monts Birougou Foret & Bas Ogooue

We consider the forest of these two wetlands sites as being tropical rain forest. We assume the same degradation level than the one of mangrove at the start of the project, in the without and with-project situation. Main threats in these areas are overexploitation of forest for timber and other food products, and mining.

c) Information gap and assumptions

Under component#2 of the project, 30,000 ha of forest area are under sustainable forestry management. We assume an even partition of the surface area between the three WII, although the project mentions that priority of component#2 is given to mangrove ecosystems. Given the high productivity of these

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ecosystems and their ability to store and sequester on a long term carbon within the soil, gross carbon flux from management activities in mangrove could be enhanced if we have to consider a bigger surface area. More information would be needed here.

We used data from Ajonina et al. 2014 for mangrove and corrected them according to each pool compartments, see above. Data from Ajonina et al. 2014 are reported for undisturbed mangrove, whereas mangrove within region of Sette Cama are disturbed by industrial operations (see annex 1 here). The authors also precise that more on field sampling and analysis would be require to refine their estimation. We also consider here that the soil carbon stock is unexpectedly high. More information would be needed here.

The project mentions about 10 hectare of land area where sustainable management practices will be applied. This is not taken into the following computations as not enough data are available.

EX-ACT Results

The following tables (screenshots 2) summarize the GHGs sequestration and the share of the balance per GHG from above scenario. Results are given in tonne CO$_2$ equivalent (tCO$_2$-e). Positive numbers represent sources of CO$_2$-e emission while negative numbers represent sinks. The left table section summarizes estimated CO$_2$-e emissions and sinks from the scenario without-project (left column), from the scenario with-project (middle column) and the total balance (right column). The middle table details the Carbon Balance under project implementation, showing the CO$_2$ fluxes from biomass and soil carbon fluxes. The right table details annual CO$_2$-e fluxes for the forest management activities without and with-project implementation.

EX-ACT screenshot 2: EX-ACT results, gross fluxes and balance of greenhouse gases (GHG) of the without- and with-project scenario, share of GHG of the balance and annual CO$_2$-e emissions

- The **without-project scenario** is expected to generate about **6.2 million tCO$_2$-e** over the entire period of analysis of 20 years because of forest Degradation (i.e. deforestation, degradation, thinning, and disturbance from urban and industrial activities...).
- The **with-project scenario** sequesters about **2.7 million tCO$_2$-e** from forest management activities allowing for a decrease of the degradation level of wetlands forests.
In order to overall evaluate the impacts of the project for GHG mitigation, it is necessary to consider the difference between the gross fluxes of the with- and without-project scenario, which is given by the **Carbon Balance**. The project’s implementation leads to an overall carbon balance of around **-8.9 million tCO$_2$-e** over the full analysis duration of 20 years, or about **296 tCO$_2$-e per hectare** and **14.8 tCO$_2$-e per hectare per year**.

With this impact the project can be characterized as having high benefits for climate change mitigation. When translating the qualitative uncertainty assessments by the IPCC into a quantitative estimation as done by EX-ACT, the here indicated carbon balance is associated to an uncertainty of about 20%.

**Discussion and recommendations**

The project through components #1 to 3 seeks at the sustainable management of wetland ecosystems through among other activities reducing anthropogenic pressures, enhanced local capacity management, knowledge and monitoring and strengthen institutional framework. These should have a leverage effect on anthropogenic pressures and associated degradation on these crucial ecosystems, and benefit to the biodiversity, reduce land and water degradation through appropriate agricultural practices and reduce pollution (from mining extraction, oil exploitation, eutrophication) and improve local livelihood.

The present analyze also highlights that enhancing protection of forested wetlands through conservation measures for **sustainable wetland management brings high benefits in term of climate change mitigation**, i.e. **-444,658 tCO$_2$-e yr$^{-1}$**. Tropical rain forest and mangrove are highly productive ecosystems and mangrove are among the most carbon-rich ecosystems from their ability to store and sequester carbon in the soil compartment, as shown in screenshot 1 and in Donato et al 2011$^4$ and Murray et al 2011$^5$ for global comparison. From our scenario, forest management practices in tropical rain forest mitigate about **12.6 tCO$_2$-e ha$^{-1}$ yr$^{-1}$** while in mangrove **19.2 tCO$_2$-e ha$^{-1}$ yr$^{-1}$**.

Ramsar sites in Gabon account for 2.8 million hectare, and about 82% of this critical wetland ecosystems does not benefit yet from any kind of protective activity. Capacity of Gabon to implement Wetlands monitoring systems, identify site specific threats, evaluate those threats and prioritize them, and based on the diagnostic identify potential protective interventions (pollution control fishery management and community forestry) will benefit and add value to their ecosystems services.

Mangroves declining in West Africa is associated to urbanization and coastal infrastructure development, and overexploitation of mangrove product. Mangrove deforestation causes carbon emissions with other greenhouse gases (CH$_4$ and N$_2$O). The conservation of mangrove forest and other forest from WII can help to reduce carbon emissions, such as REDD+ programme. Environmental sustainable practices such as alternative technology to reduce the use of mangrove wood for energy use, sustainable forestry and increase capacity to enhance protected areas could reduce threats to wetland associated forest, an in particular mangrove, contribute to local livelihoods (fisheries, tourism) and on a long term contribute in climate change adaptation (mangrove landward migration to cope with sea level rise) and mitigation.

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$^4$ Donato et al 2011. Mangroves among the most carbon-rich forests in the tropics. Nature Geoscience, 4, 293-297