AR/03

BIOSERF

Sustainability of tropical forest biodiversity and services under climate and human pressure

DURATION OF THE PROJECT
01/04/2011 – 31/03/2015

BUDGET
798.888 €

KEYWORDS
Biodiversity, ecosystem services, Congo Basin forests, climate change, social change, modelling

CONTEXT

Nowadays, this is established that tropical forests are disappearing or become degraded at worrying rates. The main threat for these forests is deforestation. Yet, more than wood,, forest ecosystems provide many other resources of prime importance to human populations (the so-called ecosystem services or ES). Agroforestry, hunting, collection of plant products, living places, pure water and clean air contribute a lot to human well-being and livelihood. The excessive consumption of ES represents however an additional major threat to forest survival owing to shifts in traditional practices. Indeed, socio-economical conditions are changing as a result of population increase, demand for forest products by cities (bushmeat, ivory, medicinal plants, etc.), road constructions to facilitate trade, etc. These changes induce an increased pressure on the forest. Canopy cover becomes fragmented; soils lose their fertility; animal and plant density and diversity decrease. These conditions might ultimately lead to the disappearance of some ES and to the rarefaction of others beyond a threshold under which they can no longer regenerate. The threads associated with climate changes also have to be considered.

The question arises to know whether it is possible to build predictions on the optimal evolution of a forest system under human pressure to preserve biodiversity and human well-being. To answer such a question, one has to consider, on the one hand forest growth and its regeneration and, on the other hand, the use of the forest by man. Both these aspects will be investigated in the project field studies. Data collected will be used to feed mathematical models.

The project will focus on the lowest latitude zone of the Congo Basin, on the WWF Lake Tele – Lake Tumba Landscape, the largest area of swamp and flooded forest in Africa, and more specifically on the DR Congo part of the Landscape, spreading over ca.78,972 km² in the Equateur Province. The huge biological value of the Lake Tumba Landscape is widely recognized. WWF Belgium, WWF Congo, the Belgian Development Agency, and CARPE (Central African Regional Program for the Environment) supported by USAID (United States Agency for International Development), finance and manage biodiversity conservation, community-based development and environmental research programs in the region. The DRC's authorities are collaborating with the international NGOs and Development Agencies on land use planning. This has so far resulted in the delimitation of protection areas, community-based natural resource management areas, and extractive resource zones.

The Landscape contains various habitats ranging from terra firme and swamp forests to grasslands, savannahs and prairies along the Congo River and its numerous tributaries. Partial biodiversity surveys have taken place in the last few years but much remains to do especially at the vegetation/plant use level. Among the large mammals, the presence of many primate species has been reported (among which the bonobo), but also of the forest elephant, the African forest buffalo, the bushpig and the leopard. Huge and increasing human pressure is threatening the sustainability of the ecosystems through ill-adapted practices, including slash-and-burn or shifting cultivation, forest product harvesting and commercial fishing and hunting (primate, crocodile, bushpig, elephant for ivory).

PROJECT DESCRIPTION

Objectives

The general objectives of the project are to explore the evolution of the socio-ecological system, with a focus on ecosystem services and to assess their sustainability in an area of evergreen tropical forest under increasing human pressure and climate change.

The specific objectives of the project are as follows:

- Study the physical and biological processes that govern the natural regeneration of the forest ecosystem, especially the dispersal pattern of selected tree species, which (partially) depends on the animal community (frugivore vertebrates and particularly primates). This dispersal capacity becomes limited if hunting increases (thus reducing natural disperser numbers), if the habitats of the dispersers are/become fragmented or if the collection of diaspores is too intensive.
- Identify and evaluate quantitatively some ecosystem services currently provided by the forest to the local human communities, under the present socio-economic context. The selection of ES to be studied will be made on the basis of cartography including participatory GIS and socio-economic survey among stakeholders.
- Explore, with the use of the coupled DVM-ABM model, possible scenarios for the future evolution of the forest ES over the whole area covered by the WWF Lake Tele – Lake Tumba Landscape, under different climate, demographic and socio-economic scenarios of change, specifically developed for this area. A sustainability assessment will be conducted for each of these scenarios.

Methodology

To reach these objectives, we will use mathematical models. The project will integrate two spatial-dynamic models, the CARAIB dynamic vegetation model and a spatial agent-based model The models will be adapted to the particularities of the tropical forest ecosystem (main traits, plant autoecology and functional ecology) and to the local human community's situation (demography, land use, ecosystem services, ethnobotany). The upgraded models will be fed with locally gathered data on plant-animal interactions, on human-nature interaction and on human behaviours related to land use. The originality of the research will be the combination of social, environmental and economical information for a synthetic/holistic and anthropocentric approach towards a sustainable use of ecosystem services.

INTERACTION BETWEEN THE DIFFERENT PARTNERS

Interactions between partners are summarized in Fig. 1. The team coordinating each work package is the principal investigator; the researches are closely integrated by the directly interacting teams.

EXPECTED RESULTS AND/OR PRODUCTS

- Annotated lists of useful species; Priority ranking of useful species; List of ecosystem services and their socio-economic evaluation; stakeholder typology and demographic data including population dynamics; current (and expected future) status of forest/ES
- Seed production, growth and density data for five selected tree species; improved dynamic vegetation model
- Dispersal speeds and distances (dispersal kernel) of the five tree species , improved DVM
- Units for ES valuation; ES maps for the present, coupling of DVM and ABM
- Maps of land use; biophysical parameters; pressure on biodiversity and ES for selected future time slices (2020, 2030, 2040, 2050)
- Report with the conclusions of the workshop to be distributed to local NGOs, local administrations, and Belgian development cooperation services, etc.

PARTNERS

Activities

ULg-ENV: Department of environmental science – Behavioural biology unit of the University of Liège

This unit focuses on behavioral ecology of vertebrates in natural and experimental systems. Studies aim to define the adaptative value of behaviour, at individual, population and species scales, this theme being considered in the framework of evolution and biodiversity theories. The unit is composed of three laboratories (Fish and amphibian ethology, Fish demography and hydroecology, Animal and human evolution) and of the Primatology research group (PRG). At first, dealing mostly with mechanisms implied in habitat selection, (feeding ecology, home range variation), PRG researches are now concentrated on primate behaviour and conservation in human disturbed environment and to the contribution of the non-human primates to forest regeneration.

FUNDP : Department of Geography of the University of Namur

This laboratory is mainly implicated in the development of multi-agent models for land use applications. These models are combined with building scenario exploring the responses of individuals and society to processes inducing future environmental changes. The participatory approach is used with direct involvement since the early stages of the projects. Then it becomes possible to evaluate the effects of changes at landscape level on ecosystem services and to propose quantified solutions of sustainable development.

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ULg-UMCCB : Climate and biogeochemical cycle modelling unit of the University of Liège.

Besides collaborating to international campaigns for atmospheric CO2 monitoring, the unit develops models simulating rock weathering, carbon cycle with emphasis on vegetation dynamics and paleoclimates. The models are applied to problems concerning the past (paleo-vegetation reconstruction, influence of vegetation on climate) or to problems of the present (influence of future climates on vegetation distribution, on primary production, on fire, etc.).

Ugent : Laboratory for tropical and subtropical agronomy and ethnobotany of the University of Gent

The research interests of the team cover a wide range of agronomic and socio-economic topics in tropical and subtropical regions: agro-ecophysiology of plants in (semi-)arid areas, agrobiodiversity, ethnobotany, domestication and new crop development, sustainable agricultural systems, water managements, market integration of small-scale farmers in developing countries - value chain analysis. They focus on applied research that bridges the gap between academic research and its application by governments, NGOs, and other actors in rural development in tropical and subtropical countries.

RBINS : Conservation biology unit of the Royal Belgian institute of natural sciences

The unit conducts researches of population biology, ecology, ethology, and conservation biology. The studies have generated methodologies suitable to the analysis and the mitigation of biological extinction risks, according to schemes combining detection and reversal of degradation, highlighting of simplification, regression or fragmentation of plant or animal communities.

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Follow-up Committee
For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting http://www.belspo.be/fedra

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