Modelling future land use changes in the Republic of Congo

2000–2030

A Report by the REDD-PAC project

COMIFAC

IIASA

UNEP WCMC

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Land use is a crucial factor in both economic development and the environment. Land dedicated to agriculture allows regular production which benefits nearby populations, meeting their food needs, and potentially benefits the economy as a whole. On the other hand, agricultural land has a much lower carbon content than forest land and is generally poorer in biodiversity. Land can be used in different ways to achieve different goals and it may be difficult to achieve all goals at the same time, which means making difficult choices when designing policies.

Congo is 65 % covered by forests including 21 million hectares of dense humid forests. Currently, three quarters of dense humid forests are occupied by forest concessions. With a low population density and a large urban population, only a small share of land is cultivated. The Congolese economy relies on oil and timber while imports meet 90% of the cereal needs of the country. The country has been undertaking readiness activities for reducing emissions from deforestation and forest degradation plus the conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks (REDD+).

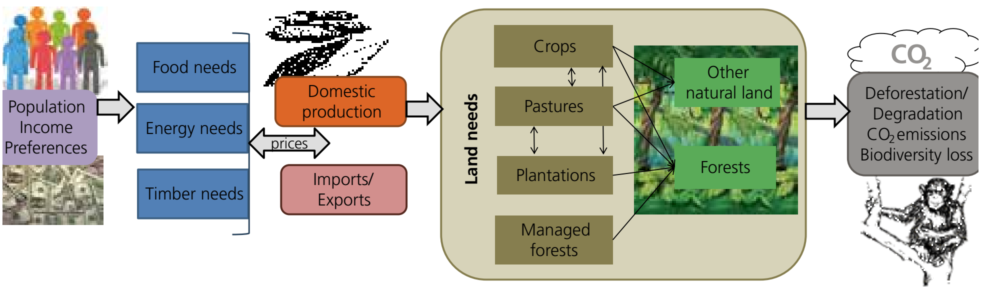
This study is intended to assist institutions involved in REDD+ and the planning of National Strategies and Action plans for Biodiversity in the Republic of Congo by attempting to identify the areas under the greatest conversion pressures in the future and the consequences in terms of agricultural production, greenhouse gas emissions and biodiversity loss.

FOTOS: ALINE SOTERRONI

A modelling approach

Models make it possible to explore the consequences of future changes in a simplified context. The REDD-PAC project adapted the GLOBIOM (www.globiom.org) model to the Congo Basin context. The GLOBIOM model is a global economic model which represents land use competition between the agricultural sector, the forestry sector and the bioenergy sector. The simulation period is 2000–2030, the first 2000–2010 period enables testing of the model's capacity to reproduce past trends.

Deforestation is modelled on the basis of changes in production and consumption for all countries at the same time. Thus, we can more easily verify the validity and consistency of estimates and avoid an artificial increase in future deforestation unrelated to changes in demand. The spatial resolution of the results allows for consistency in deforestation calculated at sub-national level with deforestation calculated at national level, as well as enabling heterogeneity of carbon and biodiversity to be taken into account.

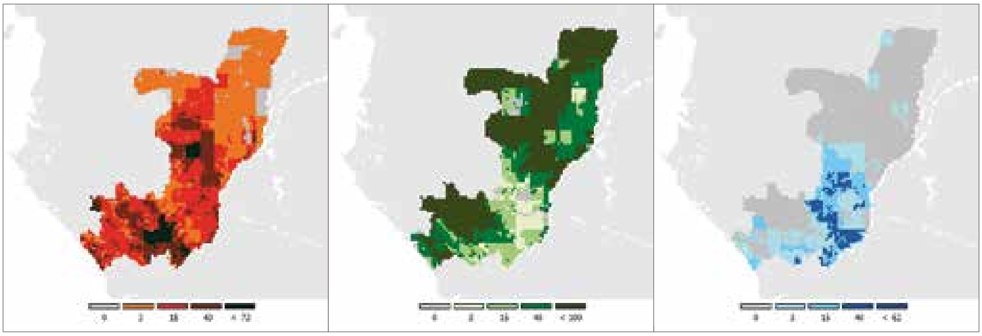


Overview of the GLOBIOM model

Adaption of the GLOBIOM model to the Republic of Congo

The Republic of Congo forms part of the COMIFAC region in the model. Congo can trade with other COMIFAC countries and with other regions of the world. Agricultural production and changes in land uses are represented in 218 spatial units.

In order to develop a high quality models it is important to have a good representation of the starting situation. Whilst agriculture is the main reason for deforestation, there is considerable uncertainty as to the current location of agricultural land among existing land cover maps for Congo and agricultural statistics are almost non-existent. A hybrid map has been created using the best existing land cover maps after consulting with local experts. Sub-national production in the base year has been computed using assumptions on local consumption and trade to the main cities.

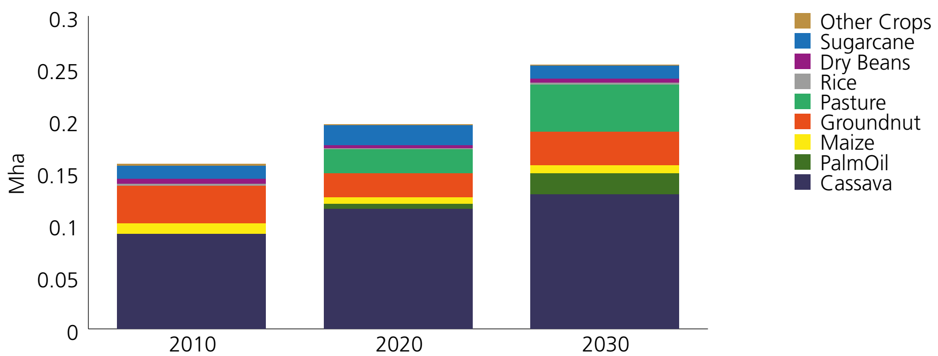


Hybrid vegetation map: share in % of units occupied by cultivated land (on the left), dense forests excluding flooded forests (in the centre) and dry forests (to the right)

Future deforestation

According to conservative projections, 6 million people will be living in Congo in 2030, of which 72 % will live in cities and average per capita GDP will be multiplied by 2.3 compared to 2010. A larger and richer population generates an increase in local consumption of agricultural products which is translated into an increase in cultivated areas.

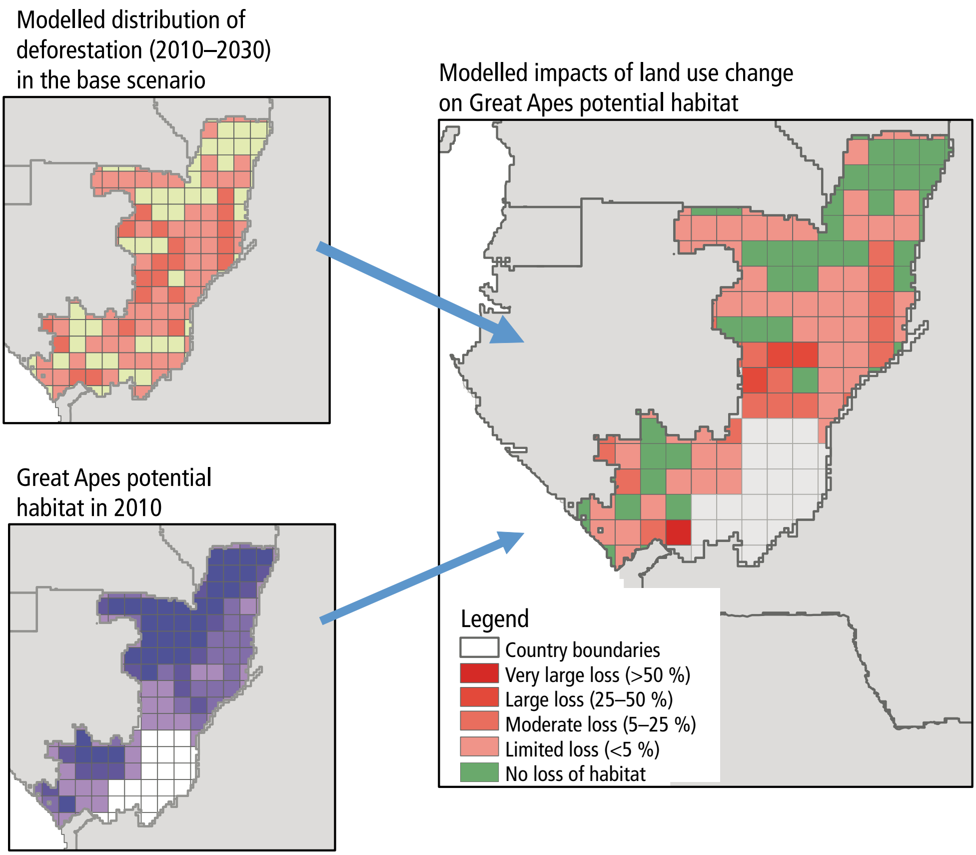
Our results show increasing deforestation from 15 000 hectares per annum over 2000–2010 to 25 000 hectares per annum over 2020–2030. This leads to the emission of 238 million tons CO_2 over 2010–2030. Two thirds of the calculated deforestation is explained by the expansion of cassava and groundnuts and the fallow land associated. In the base scenario, oil palm explains 6 % of total deforestation. The model also predicts increasing deforestation due to livestock. Increase in imports and expansion of agricultural land in non-forest types of vegetation reduce the impact on forests of increased local demand but could create other problems.



Trend in deforestation by cause in Congo between 2010 and 2030 in the base scenario.

Impacts on biodiversity

Congo is home to two species of Great Apes, the chimpanzee and the lowland gorilla, which are very dependent on the presence of natural forests for their habitat. They are also species that are potentially a great attraction for the development of eco-tourism. The model forecasts a particularly substantial loss of habitat for Great Apes in the Cuvette and in Bouenza. In addition to the direct loss of habitat, the expansion of agricultural areas will lead to an increase in contacts between wildlife and human thus increasing poaching risks.



Modelling of the impact of deforestation on the potential habitat for Great Apes

What factors can reduce or increase future deforestation?

Cumulated deforestation over 2010–2030 varies between 425 000 and 697 000 hectares in the scenarios retained versus 449 0000 hectares in the base scenario. Improved crops yields, an increase in protected areas and reduced growth in population and GDP could reduce deforestation, whereas expansion of oil palm plantations, expansion of uncontrolled agriculture in protected areas or forestry concessions, and a stronger increase in population and GDP increase deforestation in relation to the base scenario. Uncontrolled expansion of agriculture into forest concessions causes the largest increase in future deforestation compared to the base scenario.

Base Scenario	Other Scenarios: Socio-economic context in Congo	Other Scenarios: Permanent forest domain	Other Scenarios: Agricultural Development
Macro ▮ 6.2 million inhabitants in 2030 ▮ GDP: $ 26.5 billions in 2030	**Macro +** + 646 million inhabitants in 2030 + $ 2 billions of GDP in 2030	**NoPA** Expansion of agriculture into protected areas possible	**Yields +** Increase of future agricultural yields
Permanent forest domain ▮ No expansion of agriculture into protected areas ▮ No expansion of agriculture into forest concessions	**Macro –** – 452 million inhabitants – $ 4.6 billions of GDP in 2030	**NoFC** Expansion of agriculture into forest concessions possible	**Palm +** Objective of 250,000 ha of oil palm in Congo-Brazzaville and 300,000 ha in Cameroon in 2030
Agriculture ▮ No increase of agricultural yields		**PA +** Protection and expansion of protected areas to 17 % of territory	

The main hypotheses within the Base scenario are described on the left and changes made to these assumptions in each scenario are presented on the right (one scenario by white box).

What factors can reconcile several objectives?

Increased agricultural productivity could reconcile agricultural development, climate change mitigation and biodiversity conservation. On the contrary, the combination of stronger economic growth and stronger population growth leads to deterioration of all of our indicators. For the other scenarios which are tested, we observe trade-offs. They either lead to a gain in agricultural development but losses for the environment such as the scenario on oil palm expansion, or gains for climate and biodiversity but losses for agricultural development such as the expansion of protected areas.

Comparison of scenarios in respect to their contribution to several objectives (the green colour indicates progress towards the achievement of an objective whilst the red indicates a greater distance from the objective).

	Economic Development and Food Security		Climate Change mitigation		Conservation and sustainable use of biodiversity	
	Calories produced by inhab.[a]	Net agricultural imports[b]	Total emissions[c]	Emissions from deforestation[d]	Loss of habitat of large primates[e]	Number of species losing >10 % of their habitat[f]
Base Scenario	2303	–171	404	282,0	1,5 %	465
MACRO+	–3,3%	12,3 %	8,1 %	8,9 %	8,1 %	2,6 %
MACRO–	1.1 %	–18.5 %	–5.3 %	–10.4 %	–11.9 %	–3.0 %
No PA	0.0 %	1.4 %	17.4 %	17.2 %	14.9 %	5.6 %
No FC	2.0 %	–10.7 %	70.3 %	129.6 %	50.0 %	6.9 %
PA+	–6.8 %	11.7 %	3.5 %	–10.3 %	–17.3 %	–35.5 %
Yields+	14.9 %	–32.0 %	–8.0 %	–13.8 %	–12.5 %	–2.4 %
Palm+	96.3 %	0.5 %	25.6 %	21.9 %	31.4 %	13.5 %

a) production of calories in kcal per inhabitant per annum in 2030 on the basis of the crops represented in the model, b) value of imports of agricultural products in 1000 USD in 2030 on the basis of the crops represented in the model, c) total emissions from the agricultural sector and changes in land uses in Megatons CO_2 between 2010 and 2030, d) total emissions from deforestation in Megatons CO_2 between 2010 and 2030, e) proportion of the area of the potential habitat of large primates converted to other uses between 2010 and 2030, f) number of species considered that lose more than 2 % of their potential habitat within the country between 2010 and 2030

Conclusion

The results of this study show that over the 2010–2030 period, future deforestation could lead to the emission of 282 million tons of CO_2 and 465 species to lose more than 2 % of their potential habitat within the region.

By comparing the results of several scenarios, we observe that a lower population growth and higher agricultural yields could reconcile agricultural development, climate change mitigation and sustainable use of biodiversity. For agricultural yields, the weakness of statistics in the agricultural sector in Congo makes the implementation of effective policies difficult. It is important to invest in a system to collect and regularly update statistics on population and agriculture in order to allow a careful diagnosis on current obstacles for agricultural intensification.

Our results show that achieving the objective of 250 000 hectares of oil palm plantations could translate into an increase of deforestation of 140 000 hectares between 2010 and 2030. In order to minimize impacts of oil palm expansion on forests and ensure their long term profitability, the state should identify the most suitable area for plantations.

Finally, the results of this study show the importance of forest concessions to prevent deforestation. Many efforts have been undertaken in the last decade to switch to low impact logging in Congo. These efforts should be pursued and go hand in hand with efforts to increase the added value of timber products to ensure long-term profitability. Preventing illegal poaching inside forest concessions can increase their contribution to reducing species' extinction, which is one of the objectives of the Convention on Biological Diversities' Strategic Plan for Biodiversity 2011–2020.

REDD pac www.redd-pac.org

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