Modelling future land use changes in Central Africa

2000–2030

A Report by the REDD-PAC project

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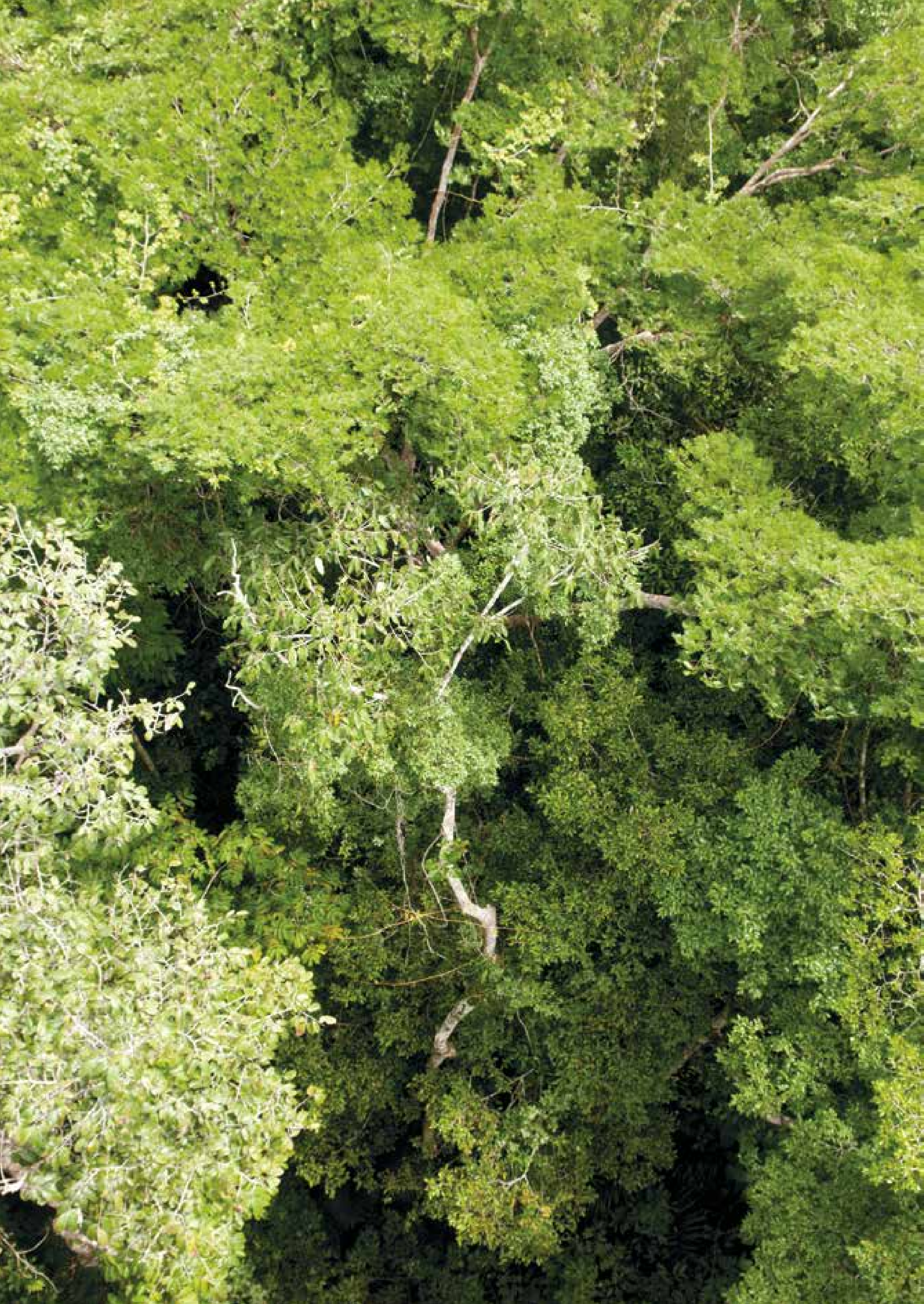


Land use is a crucial factor in both economic development and the environment. Land dedicated to agriculture allows regular production which benefits nearby populations, meeting their food needs, and potentially benefits the economy as a whole. On the other hand, agricultural land has a much lower carbon 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.

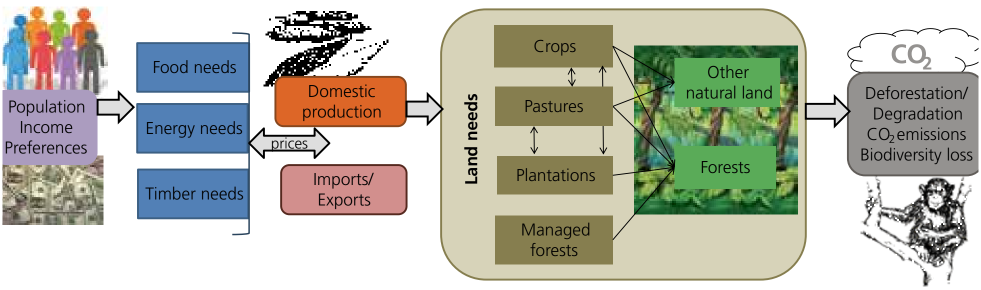
Countries members of the Central Africa Forest Commission (COMIFAC) identified reducing emissions from deforestation and forest degradation plus the conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks (REDD+) as a major challenge in the last review of the Convergence Plan for Sustainable Forest Management, along with the conservation and sustainable use of biological diversity and reducing the impacts of climate change. This study is intended to assist institutions involved in REDD+ and the planning of National Strategies and Action plans for Biodiversity in COMIFAC countries 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.

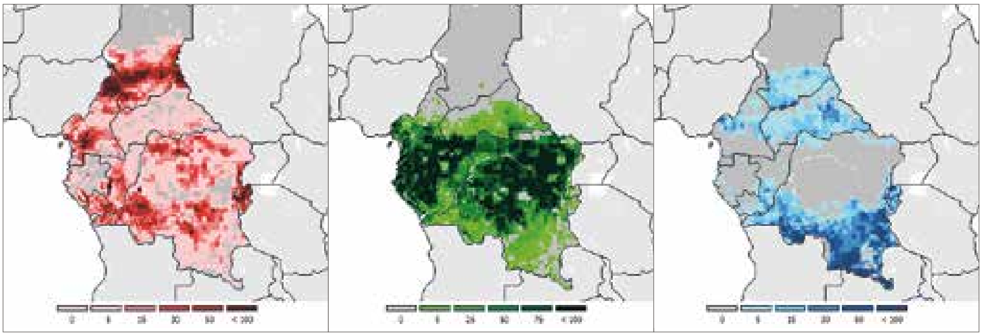


General overview of the GLOBIOM model

Adaption of the GLOBIOM model to COMIFAC countries

The sub-regional model covers all COMIFAC countries. In the model, the COMIFAC region is linked to the other regions of the world. The COMIFAC sub-regions - Cameroon, DRC, the West that includes Gabon and Equatorial Guinea, the North that includes Chad and the Central African Republic, and the East that includes Rwanda and Burundi - can also trade between each other. Agricultural production and the changes in land uses are represented in 2211 spatial units.

In order to develop 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 in the sub-region. A hybrid map has been created using the best existing data after consulting with local experts and available agricultural statistics.

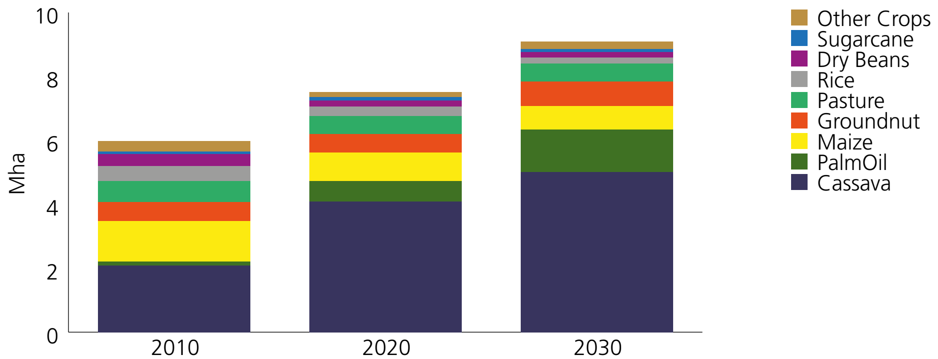


Hybrid vegetation map: share in % of units occupied by cultivated land (on the left), dense forests excluding flooded forests (in the centre) and dry forests (to the right)

Future deforestation

According to conservative projections, close to 200 million people will be living in COMIFAC countries in 2030, with a strong increase in urban populations and average per capita GDP. A larger and richer population generates an increase in local consumption of agricultural products which is translated into an increase in cultivated areas.

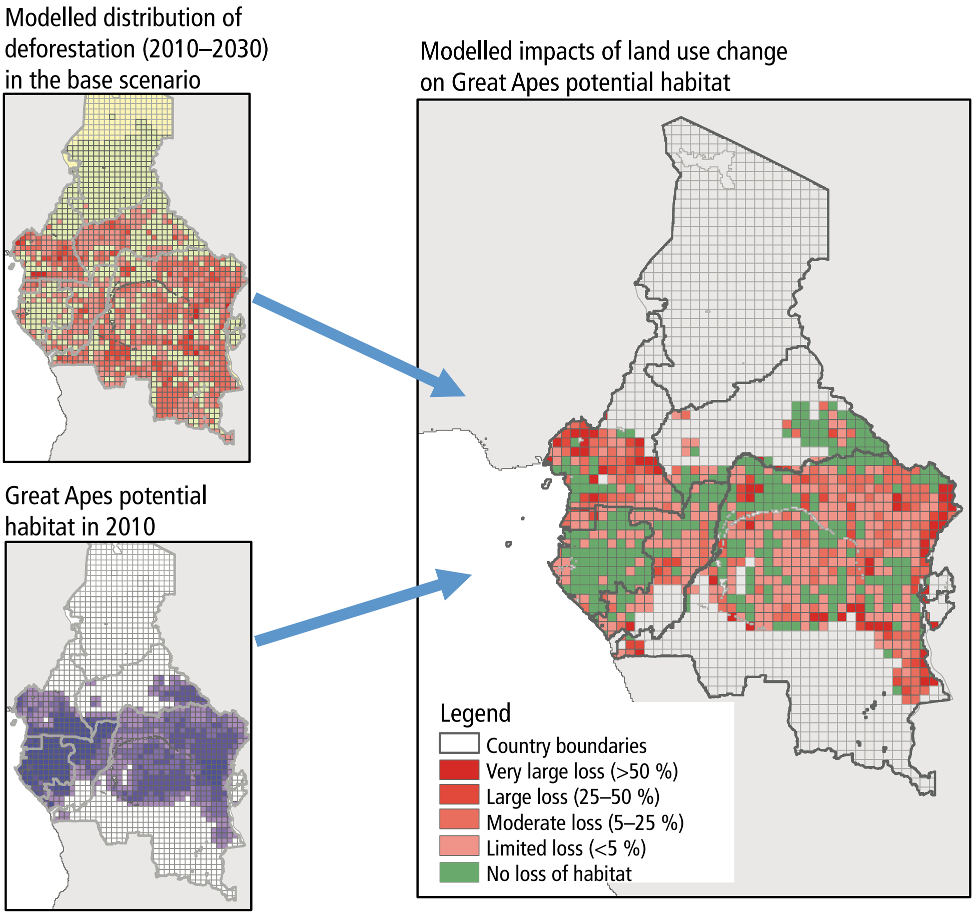
Our results show increasing deforestation from 610 000 hectares per annum over 2000–2010 to 920 000 hectares per annum over 2020–2030. This leads to the emission of 10 billion tCO_2 over 2010–2030. The two thirds of the calculated deforestation are explained by the expansion of cassava, maize and groundnuts and the fallow land associated with these crops. Oil palm explains 15 % of total deforestation. 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.



Deforestation dynamics by cause in COMIFAC countries between 2010 and 2030 in the base scenario.

Impacts on biodiversity

COMIFAC countries are home to four species of Great Apes, the chimpanzee, bonobo, mountain gorilla 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 ecotourism. The model forecasts a particularly substantial loss of habitat for Great Apes in the centre of Cameroon and the eastern region of the DRC. 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 the 2010–2030 period varies between 12 and 18 million hectares in the scenarios retained versus 16 million hectares in the base scenario. Improved crops yields, an increase in protected areas and reduced growth in population and GDP could reduce deforestation, whereas the objectives of increased oil palm areas, 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.

BAU	Other Scenarios		
Macro ▮ 197 million inhabitants ▮ PIB: $ 203 billions in 2030 **Permanent forest domain** ▮ No expansion of agriculture into protected areas ▮ No expansion of agriculture into forest concessions **Agriculture** ▮ No increase of agricultural yields	**Socio-economic context in COMIFAC countries**	**Permanent forest domain**	**Agricultural Development**
	Macro + + 16 million inhabitants + $ 10 billions of PIB in 2030	**NoPA** Expansion of agriculture into protected areas possible	**Yields +** Increase of future agricultural yields
	Macro – – 15 million inhabitants – $ 36 billions of PIB in 2030	**NoFC** Expansion of agriculture into forest concessions possible	**Palm +** Objectif of 250,000 ha of oil palm in Congo-Brazzaville and 300,000 ha in Cameroon in 2030
		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. Failure to respect protected areas leads to little economic gain compared to the negative impacts on emissions and biodiversity loss and forest concessions can also help prevent deforestation in the future. For the expansion of protected areas, although there are significant gains for biodiversity and deforestation reduction, we observe negative impacts both for agricultural development and emissions, illustrating the potential for trade-offs between different objectives.

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]
BAU	2303	-8009	11893	10095.0	4.8 %	371
+MACRO	–2.7 %	14.9 %	12.8 %	13.8 %	13.1 %	9.4 %
–MACRO	–0.5 %	–23.9 %	–14.8 %	–14.6 %	–13.3 %	–8.6 %
No PA	0.2 %	–0.8 %	4.3 %	2.9 %	10.5 %	13.5 %
No FC	0.1 %	–0.2 %	12.3 %	14.0 %	11.7 %	3.5 %
+ PA	–3.2 %	4.9 %	9.4 %	8.9 %	–3.0 %	–71.2 %
+ Yields	19.6 %	–25.8 %	–30.6 %	–32.1 %	–26.1 %	–15.1 %
+ Palm	2.6 %	0.3 %	1.9 %	0.9 %	2.1 %	1.6 %

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 among 2115 species considered that lose more than 10 % of their potential habitat within the region between 2010 and 2030.

Conclusion

Unlike in other tropical countries, deforestation is rising in the Congo Basin countries. The results of this study show that over the 2010–2030 period, future deforestation could lead to the emission of 10 gigatons of CO_2 and 371 species to lose more than 10 % of their potential habitat within the region, including 51 threatened species.

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 most of the COMIFAC countries makes the diagnosis of current trends difficult. However, a good knowledge of the barriers to agricultural intensification is a prerequisite to the design and implementation of efficient policies. Part of investments in the context of REDD+ should support these efforts, while ensuring minimum impacts on the forest cover.

Our results show that strong economic growth could have negative impacts on the environment through increased demand for agricultural and forest products. In actual fact, everything depends on how the fruits of economic growth are used. Stronger economic growth may also create jobs outside the agricultural sector and be favourable to the dissemination of innovative technologies for increasing land productivity.

Finally, the results of this study show the importance of effective management of protected areas for the protection of species and so the prevention of species' extinction which is one of the objectives of the Convention on Biological Diversities' strategic plan for 2011–2020. While most of the COMIFAC countries lack the resources for efficiently protecting existing protected areas, these results confirm the importance of financial and technical support to existing protected areas.

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CREDITS

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