# USING MODELS TO INFORM POLICIES THAT MEET MULTIPLE OBJECTIVES

## ASSESSING THE CONTRIBUTION OF BRAZIL'S FOREST CODE TO BIODIVERSITY CONSERVATION


### SUMMARY

- Land-use change models can help to develop a holistic understanding of the range of potential impacts of different land-use related policy options, and so can strengthen development and implementation of policies to meet a range of objectives, including biodiversity conservation, climate change mitigation, sustainable development and food security.
- Brazil's Native Vegetation Protection Act, commonly known as the Forest Code (FC), is one example of a policy that can be used to achieve several objectives. Using land-use modelling to inform ongoing decisions on how the provisions of the FC are put into practice can help to increase its effectiveness in meeting multiple objectives and commitments.
- Model projections show that the full implementation of the provisions of the FC will both reduce emissions of greenhouse gases and contribute to conserving biodiversity in Brazil. They further highlight the importance for biodiversity conservation of implementing the Environmental Reserve Tradable Certificate (CRA[i] in Portuguese) mechanism quickly and effectively.
- Model results also show the need to put in place additional measures to protect areas, such as the Caatinga forests and grassy savanna in the Cerrado, which may suffer increased land-use pressures as a result of the FC.





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## BACKGROUND

Brazil harbours more than 20% of all living species on Earth, is the world's most megadiverse country and encompasses the Cerrado and Mata Atlantica biodiversity hotspots, as well as the Amazon forest. Threats to biodiversity in Brazil, mirroring those reported globally, include habitat loss and degradation due to land-use change. For example, less than 22% of the historic extent of Atlantic Forest remains and 40% of the natural vegetation within the Cerrado has been lost.[ii]

Brazil is committed to conserving its biodiversity, to reducing deforestation as part of climate change mitigation, and to sustainable development more broadly. It has established national targets aligned to the CBD[iii] Aichi Biodiversity Targets (Box 1). Furthermore, in its Intended Nationally Determined Contributions (INDCs) to the UNFCCC[iv], the Brazilian government has pledged to: (1) strengthen policies and measures to reach zero illegal deforestation in Amazonia by 2030 and (2) restore or reforest 12 million hectares of forests nationally in the same timeframe.[v]

To help meet these commitments, Brazil has developed policies and laws addressing the use of both public and private lands. In recent years, the country has increased the extent of its network of protected areas, helping to prevent loss of natural areas within public lands. The 2012 Native Vegetation Protection Act, commonly known as the Forest Code (FC), and related action plans are the main tools available for regulating changes to native vegetation on private lands, which encompass about 53% of all native vegetation in Brazil.[vi]

**Box 1: Land-use related biodiversity targets**

Brazil's national biodiversity targets align with the international Aichi Biodiversity Targets and include that by 2020:

(5) the rate of loss of native habitats is reduced by at least 50% compared to 2009

(12) the risk of extinction is lowered and the conservation status of threatened species is improved

(15) the contribution of biodiversity to climate change mitigation and adaptation is enhanced by preserving and restoring terrestrial biomes.[vii]

## MODELLING POLICY IMPACT

To support Brazil in meeting its national land-use related commitments, including biodiversity conservation, an economic land-use change model (GLOBIOM-Brazil; Box 2), was used to assess the potential impacts of options for implementing the provisions of the FC. The model has been validated by comparing the 2000-2010 model projections with official land-use and crop-production statistics for 2010, and was used in the development of Brazil's INDC. This assessment was carried out at the national level to identify potential trade-offs in the effects of the FC on Brazil's six terrestrial biogeographical regions (referred to as "biomes" in Brazilian law). The assessment also enabled comparison of land-cover change within and outside biodiversity priority areas in each biome, and how individual species ranges and habitats could be affected by the FC.

### Box 2: GLOBIOM-Brazil

The model simulates the production and trade patterns of 18 crops, and 5 forestry and 6 livestock products. It provides projections on the change in extent between 2000 and 2050 of 6 land-use classes: "Mature Forest", "Managed Forest" and "Forest Regrowth", other natural land, cropland and pasture (spatial resolution ≈ 50 km²). For detailed information on the model, the model validation results and the methods used for the biodiversity assessment please refer to Câmara et al. (2015) available at: www.redd-pac.org

Specifically, the model enabled exploration of the impact of different measures being considered by the Brazilian Ministry of Environment as part of the implementation of the FC, through the simulation of three scenarios:

- A counterfactual "Business as Usual" (BAU) scenario against which to measure the overall impact of the FC. It represents a continuation of 2000 land-use trends: illegal deforestation takes place in all biomes except Mata Atlantica and forest restoration is not compulsory.
- Full implementation of the Forest Code. Under this scenario (FC), illegal deforestation is zero in all biomes after 2010, the Small Farms Amnesty and the Environmental Reserve Tradable Certificates (CRA[i] in Portuguese) are established, and forest restoration to meet legal thresholds of forest cover is compulsory beyond 2020.
- A scenario (FCnoCRA) in which no CRA mechanism is introduced, but which includes all the other provisions within the FC scenario.

## POTENTIAL IMPACTS OF THE FOREST CODE ON BIODIVERSITY

### *Protection of forests*

The GLOBIOM-Brazil projections suggest that the full implementation of the FC will both reduce emissions of greenhouse gases and support the protection of forest-dependent biodiversity in most parts of Brazil, by reducing the levels of deforestation relative to the counterfactual (BAU) scenario (Figure 1). Implementing the FC stabilizes the total forest area towards 2050 if both restoration and the loss of Mature Forest are taken into account. However, some loss of Mature Forest continues, with potentially important biodiversity impacts that are not easily reversed. Regenerating forests usually support different species and biological communities than Mature Forest do, and it could take up to 300 years for their biological composition to recover. The loss of Mature Forest is greater in the absence of CRA, especially in the Amazon and Cerrado biomes (Figure 2), suggesting that rapid and effective implementation of the CRA mechanism has the potential to support the protection of these ecosystems and conserve their rich biodiversity over the long term.



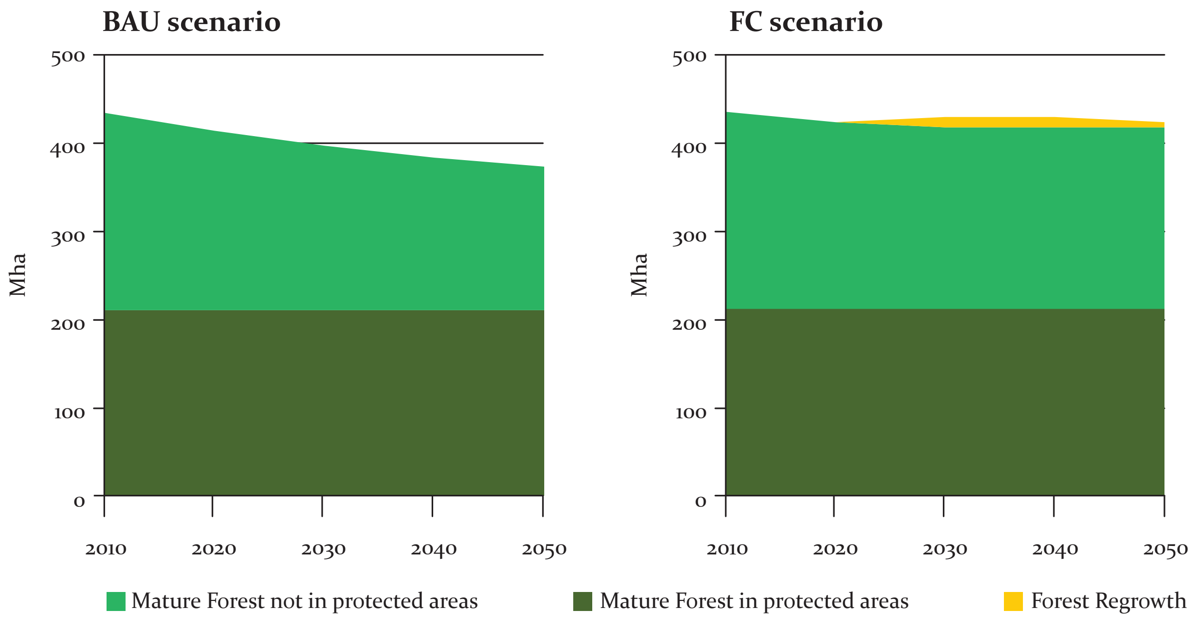


**Fig. 1:** Projected change in Brazil's forest cover within and outside protected areas under two scenarios. In the Forest Code (FC) scenario less Mature Forest (forest standing in 2010) is lost than in the counterfactual (BAU) scenario, and Forest Regrowth increases in importance due to the requirements of the FC.

## *Other ecosystem impacts*

Despite the overall positive impact of the FC, the model results show the potential for negative side effects in some ecosystems (Figure 2). Specifically, the dry-forest ecosystems of the Caatinga and non-forest vegetation in the Cerrado may be at risk; both of these biomes have lost natural vegetation in the past three decades, and the model suggests that such pressure will continue.

The case of the Caatinga is particularly worrisome; in the FC scenarios losses surpass those under the BAU scenario. Little conservation action has so far targeted biodiversity in the Caatinga, and despite some recognition of the need to increase legal protection in this biome, the proportion included in protected areas remains low.[vii] Despite climate change impacts already felt in the Caatinga as increased climate variability and drought, the introduction of irrigation techniques and new agricultural technologies could foster agricultural expansion within this region. Special provisions are thus needed to protect the Caatinga and the endemic biodiversity it supports.

In the Cerrado (and to a lesser extent in the Amazon), the loss of non-forest vegetation is higher under the FC scenarios than the counterfactual (BAU) scenario. This relates to wider concerns that, despite important progress on conserving forest ecosystems in Brazil, the conservation of non-forest ecosystems has been neglected. Although the FC in fact includes a requirement to protect natural vegetation more broadly, discussion of the law has especially focused on forests and the need to reduce greenhouse gas emissions from land-use change. The scenarios therefore assume that the FC will be used to protect "forests" (including woody savannas), and the results highlight the threat this may cause to natural non-forest areas, with implications for the wider implementation of the law. The Cerrado biome has the richest flora among the world's savannas (>7000 species) and high levels of endemism.[viii] Increasing landscape conversion and resulting threats to numerous Cerrado species have heightened interest in conservation within this biome. The modelling results show that attention to less-forested Cerrado ecosystems may be warranted, and highlight the need for holistic assessments of policy impacts.

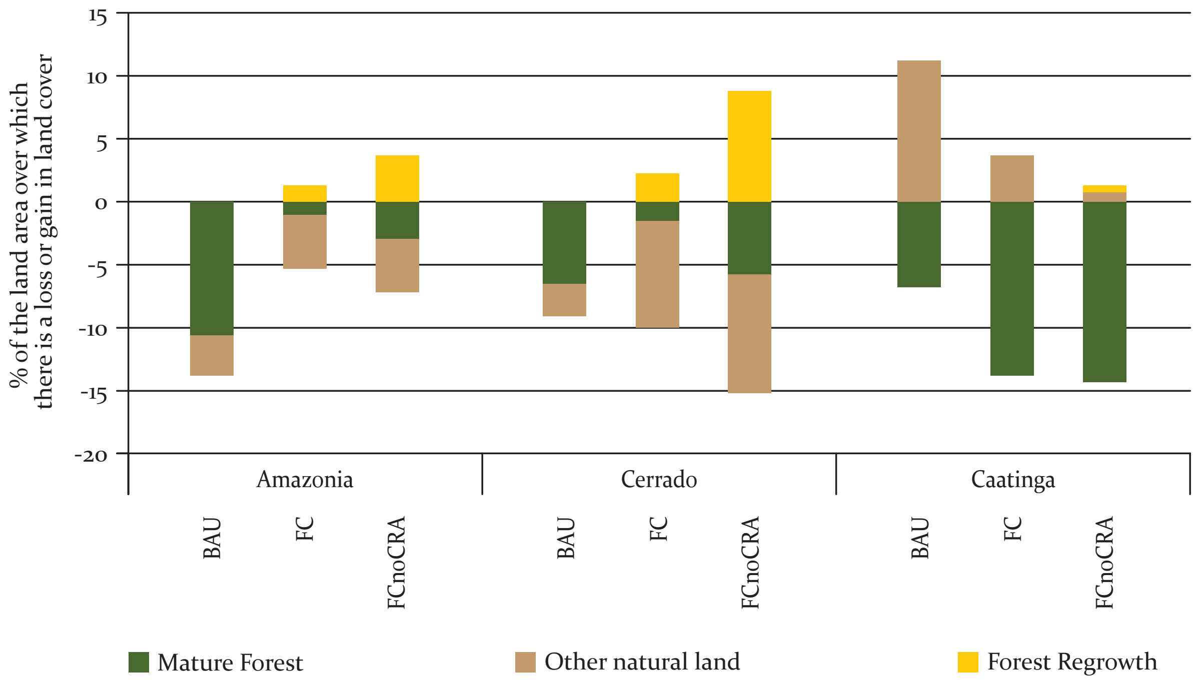


**Fig. 2:** Modelled land-use change 2010 to 2050 within different biomes. The bars show the proportion of the total land area over which there is net loss of Mature Forest (dark green), loss or gain in other natural land (light brown) and gain in Forest Regrowth (yellow) under different scenarios: counterfactual scenario (BAU), full implementation of the Forest Code (FC), Forest Code without the tradable environmental certificates (FCnoCRA).

## *Impacts on species*

The impact of the FC on individual species was evaluated for the 311 terrestrial vertebrates (mammals, amphibians and birds) categorized as threatened by the Brazilian government, and for which the IUCN[ix] Red List database holds species-range and habitat data. The information on habitat requirements and range of each threatened species was linked to the GLOBIOM-Brazil results to assess species-specific impacts of projected changes in land cover. Overall, the full implementation of the FC reduces the number of species projected to suffer habitat loss (Table 1). The species projected to lose habitat differ between the scenarios, with some Cerrado and Caatinga species facing increased pressure under the FC scenario (Figure 3).

| Scenario | Number of species projected to lose: | |
|---|---|---|
| | over 5% of their habitat | over 25% of their habitat |
| BAU (counterfactual) | 128 | 20 |
| Forest Code | 76 | 6 |

**Table 1:** Modelled land-use change impacts on threatened terrestrial vertebrate species (of 311 species assessed) under a counterfactual (BAU) scenario and full implementation of the Forest Code (FC).

This assessment provides a partial view of the potential threats to biodiversity in Brazil, dealing only with the impacts of agriculture and forestry related land-cover change, but not explicitly addressing threats such as infrastructure development, degradation and disturbance, poaching or the effects of climate change. Nonetheless, it can help to inform the development and implementation of policies that support effective biodiversity conservation. In addition to supporting implementation of the FC, such analyses can, for example, make a significant contribution to Brazil's National Program for the Conservation of Threatened Species (Pro-Species).[vii] They can help in the assessment of species' status and contribute to development of the species' Action Plans, which guide future activities to promote recovery and long-term protection of particular species, including by highlighting where additional provisions may be needed.

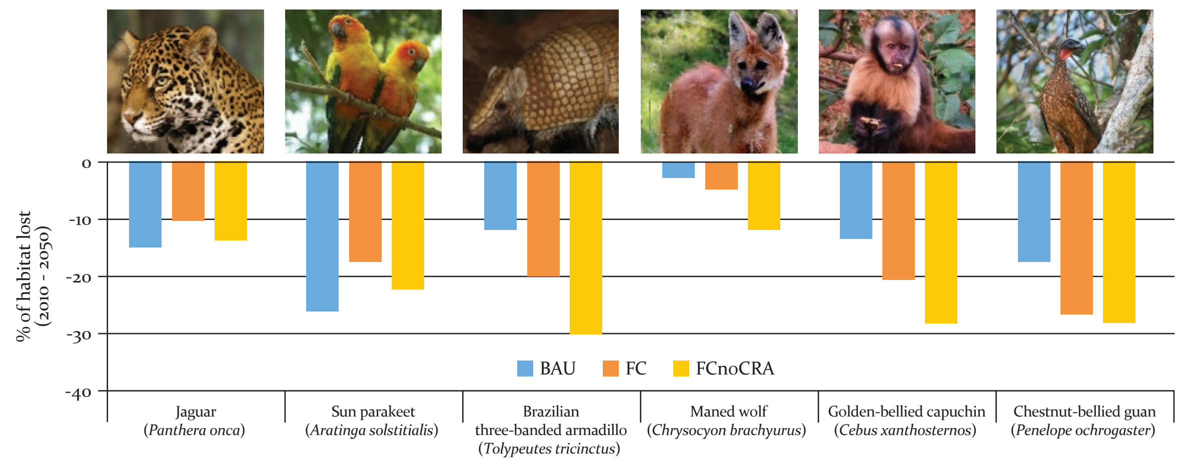


**Fig. 3:** Example results showing variation among species in the impacts caused by changes in land use under different scenarios: counterfactual (BAU), full implementation of the Forest Code (FC) and Forest Code without the tradable environmental reserves (FCnoCRA) (note the selected species are included to show the variation rather than a general trend across species).

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## NEXT STEPS

Key actions for supporting the achievement of Brazil's biodiversity conservation commitments may include:

- Continued use of holistic assessments to evaluate potential impacts of new policies and options for their implementation, including those addressing the full (natural vegetation, including non-forest ecosystems) scope of the FC.
- Rapid and effective implementation of the CRA mechanism, which favours the conservation of priority biodiversity areas within forest ecosystems and supports the protection of non-forest vegetation across biomes.
- Development and implementation of specific actions to protect dry forests across the Caatinga and non-forest vegetation within the Cerrado.
- Consideration within conservation planning for individual threatened species of the full range of potential impacts, both positive and negative, of the FC. Development of specific measures to address potential impacts on the most vulnerable species.

### *Endnotes*

[i] Cota de Reserva Ambiental.

[ii] Ministerio du Ambiente, Mata Atlantica (2016) and 1st National report to CBD.

[iii] Convention on Biological Diversity.

[iv] United Nations Framework Convention on Climate Change.

[v] INDC submitted by Brazil, available from http://www4.unfccc.int/submissions/INDC

[vi] Soares-Filho et al. (2014).

[vii] 5th National report to CBD.

[viii] Klink and Machado (2005).

[ix] International Union for the Conservation of Nature.

The **United Nations Environment Programme World Conservation Monitoring Centre** (UNEP-WCMC) is the specialist biodiversity assessment centre of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organisation. The Centre has been in operation for over 30 years, combining scientific research with practical policy advice.

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## Disclaimer



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