Policy Briefs 9

Agricultural Expansion and REDD+

An Assessment of Risks and Considerations to Inform REDD+ and Land Use Policy Design

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The Terrestrial Carbon Group Project

1 Key Messages

If the global population stabilizes at about 9 billion people as projected, the next 50 years may be the final episode of rapid global agricultural expansion and land-use change. An understanding of these changes will enable us to focus and prioritise conservation efforts, and facilitate environmental management and planning in the context of a continued pursuit of economic development. This in turn will allow us to avoid further massive and irreversible environmental impacts. Land-use change modelling, therefore, is a crucial tool for scientific analyses and policy planning.

From our analysis of projected land use change due to pressures for agricultural expansion, the following findings are particularly pertinent for the development of effective REDD+ policies:

- In the absence of new strategies such as REDD+, forests will likely continue to fall to provide land to meet agricultural demands.
- Policies based exclusively on past trends are likely to be inadequate. For example, there is a high likelihood of land-use change in vast areas with relatively low current and past deforestation (e.g. the Congo Basin).
- Policies which address land use change in forests only are also likely to be inadequate:
  - Other natural landscapes are also significant stores of terrestrial carbon. These lands are already being rapidly converted, with significant associated emissions.
  - Further, these pressures, and emissions, will significantly increase if REDD+ is implemented only within forest boundaries, without simultaneously reducing the need for the expansion of agricultural land.
  - Even if deforestation is halted (whether through REDD+ or other measures), but agricultural expansion is not curtailed, then the resulting displacement of agricultural expansion from forest land to areas of other natural land cover (including cerrado, grasslands etc) would cancel out a significant proportion of the avoided deforestation emissions: According to our analysis, 50% of the avoided deforestation emissions would be cancelled out by increased emissions from other natural landscapes if agricultural expansion is not curtailed[1].

These results demonstrate that although REDD+ remains a very promising mitigation tool, its effectiveness will be limited without complementary measures to address agriculture as a driver of land use change, both within and beyond the forest.

Based on analysis undertaken for the Terrestrial Carbon Group by the GAEA Institute and partners. Authored by Anna Creed, Bernardo Strassburg and Agnieszka Latawiec, with contributions from Nga Nguyen, Lera Miles, Jorn Scharlemann, Simon Blythe, Andrew Lovett, Gilla Sunnenberg, Lucas Joppa, Felipe Cronemberger, and Alvaro Iribarrem.

This policy brief was undertaken in collaboration with UNEP-WCMC. Collaboration focussed on the protected areas aspect.

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The objective of the Terrestrial Carbon Group is for terrestrial carbon (including trees, soil, and peat) to be effectively included in the international response to climate change.

The Terrestrial Carbon Group Project is publishing a series of Policy Briefs to inform the United Nations negotiations on how to include terrestrial carbon in developing nations in the overall climate change solution. We welcome your comments.

2 Factors Driving Risks

2.1 Carbon distribution across biomes

Forests are a key consideration in any strategy to mitigate climate change. However, other natural landscapes are also significant stores of terrestrial carbon.

- Following decades of extensive deforestation, by the year 2000 forests covered just one fifth of the natural landscape in non-Annex I countries, but due to their relatively high carbon density still accounted for over half of stored volatile terrestrial carbon[2].

- Although other natural landscapes typically have lower carbon densities than forests, in aggregate they covered three-fifths of the natural landscape and accounted for 40% of stored volatile terrestrial carbon in the year 2000[3].

2.2 Legal, Biophysical, and Economic Conditions

Our analysis found that a synthesised combination of legal, biophysical and economic conditions explains patterns of past deforestation. The maps and results presented in the following sections are therefore based on a combination of prevailing legal and biophysical factors and projected economic and demographic conditions – see Section 4 for further information.

Key messages that arise from analysis of these factors in isolation include:

Biophysical suitability: Across non-Annex I countries, 3 billion hectares, or just over one-third of the total land area, is "more suitable" for agriculture from a biophysical perspective[4]. Of this, a quarter was already cultivated in 2000, leaving 2.2 billion hectares for future agricultural expansion – predominantly in Latin America and sub-Saharan Africa[5].

Forests covered slightly more than half of this, leaving 1.1 billion hectares of biophysically "more suitable" land outside of the forests. However, while this may be sufficient to meet agricultural expansion needs, there are carbon emissions impacts from conversion of this land, as noted below.

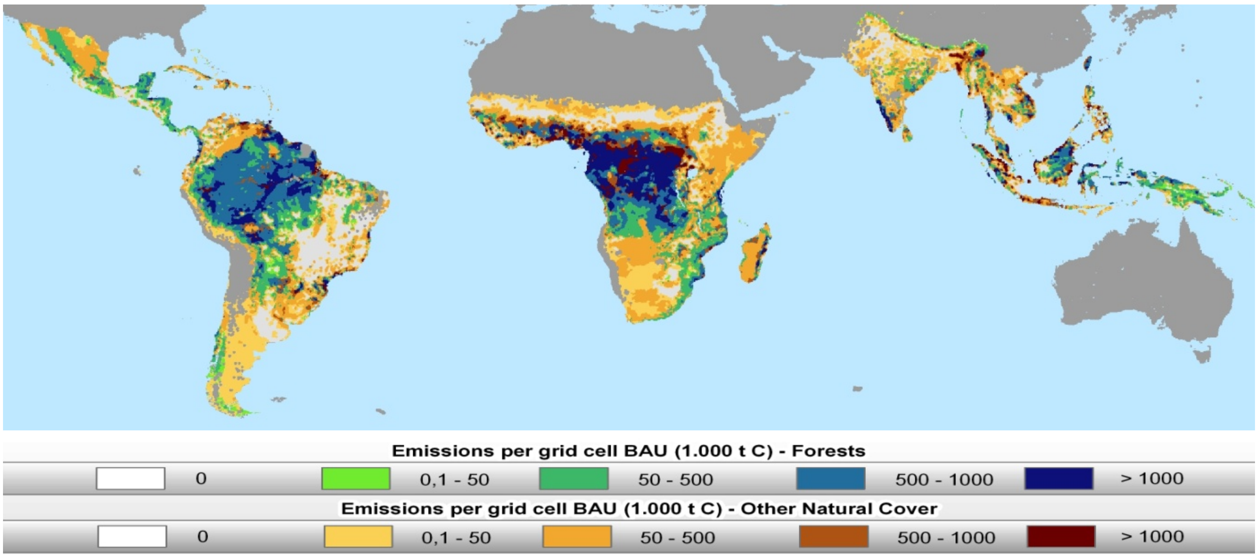
Economic pressure: A growing population and changing diets, particularly in developing countries, are projected to put increasing pressure on the agricultural sector over the coming decades. In terms of increases in total calorie demand (total population x per capita calorie consumption), a 260% increase is forecast in sub-Saharan Africa between the years 2000 and 2050. In both Asia and Latin America, a 60% increase is forecast.

This increased demand gives rise to high pressure for conversion for agricultural purposes across nearly all natural landscapes in all regions – with relatively lower pressure for the more remote areas of the Amazon forest.

Legal protection: Only 6% of forested land and 3% of other natural land cover is effectively legally protected. Therefore, although protected areas greatly reduce deforestation inside their borders, they are unlikely to have a major impact in aggregate on reducing deforestation without an increase in their area and improved effectiveness.

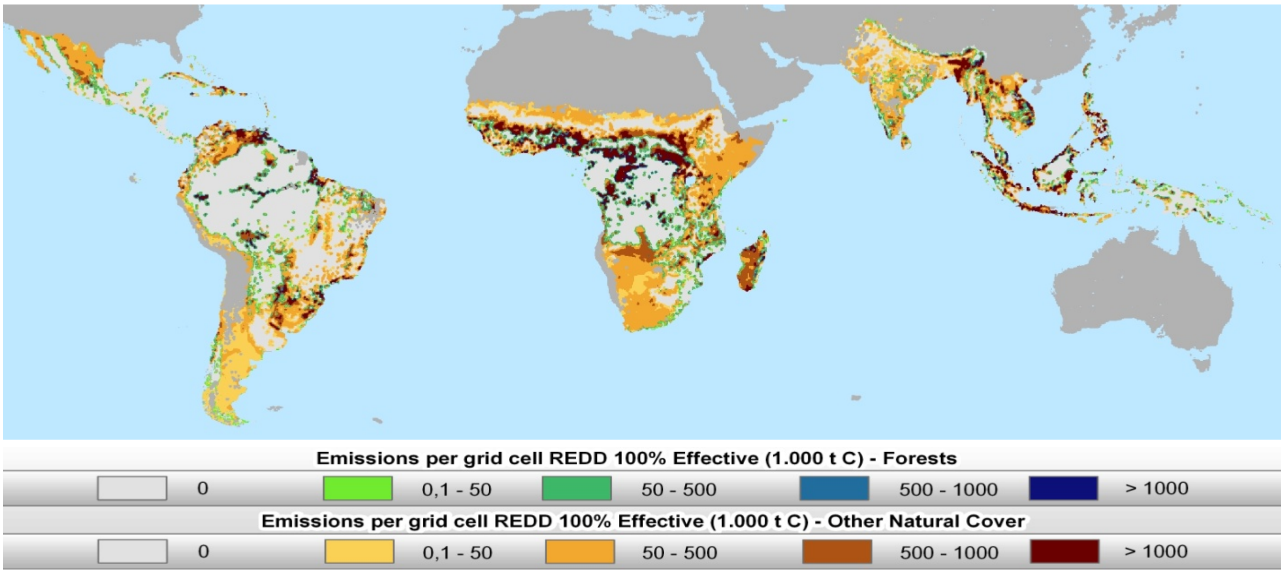
Projected Emissions from Conversion of Natural Lands for Agricultural Purposes

Map 1: Business as Usual Scenario



Total land use change area = 600 million hectares: 304m from forested land, 294m from other natural landscapes
Total emissions = 56Gt carbon: 38Gt from forested land, 18Gt from other natural landscapes

Map 2: Assuming REDD+ is 100% Successful leading to No Further Deforestation



Total land use change area = 600 million hectares: 0 from forested land, 600m ha from other natural landscapes
Total emissions = 36Gt carbon: 0Gt from forested land, 36Gt from other natural landscapes

Notes on scenarios: Two scenarios were run to estimate the total volume and spatial distribution of emissions arising from future conversion of the natural landscape for the purposes of agricultural expansion, over the period from 2000 to 2050.

- BAU scenario: The 'business-as-usual' scenario assumes an average of 12 million hectares of additional land are required each year for the purposes of agricultural expansion. This equates to 600 million hectares over the 50-year period from 2000 to 2050. This estimate is consistent with a mid-range of assumptions in the IPCC scenarios and the literature range as reported in a study of the Netherlands Environmental Assessment Agency[6].
- REDD+ scenario: The 'REDD+ is 100% successful' scenario is a hypothetical case where it is assumed that agricultural expansion is continued at the same rate as under business-as-usual, but expansion that would have occurred on forest land is displaced onto non-forest land. The purpose of this extreme scenario is to investigate the net mitigation impact of a REDD+ scenario that does not take a landscape view of risks and does not address underlying drivers of land use change.

Note, we do not include in these emission estimates neither the potential sequestration potential nor further emissions from subsequent agricultural practices.

3 Results

3.1 The Need to Look Forward

Future patterns and geographical distribution of land-use are expected to be significantly different from those experienced in the past and currently observed. Therefore, there is a need to also focus on regions with little history of land-use change to date, but with high likelihood of change in the future (such as most of Sub-Saharan Africa).

By region, sub-Saharan Africa contains the greatest absolute area of forest and other natural land cover at highest probability (risk) of conversion. This is due to the combination of higher biophysical suitability, medium to high economic pressure and low effective legal protection in sub-Saharan Africa. Latin America has high effective protection, high biophysical suitability but lower economic pressure, and S, E & SE Asia has high economic pressure, but the remaining natural lands have lower biophysical suitability.

3.2 The Need for a Landscape View

Addressing deforestation is key to climate change mitigation, and agriculture demand will continue to threaten forests. However, there is a need to take a landscape view when designing incentives mechanisms or other policies to effect climate change mitigation through (any part of) the terrestrial system.

A narrowly focused REDD+ mechanism by itself will have its effectiveness significantly compromised. Although sufficient potential agricultural land may be available outside of forested land, the high likelihood of leakage of emissions from forests to non-forested areas implies that it will not be possible to achieve the desired and necessary mitigation impact through REDD+ without also addressing agriculture as a driver of deforestation.

- A quarter of all natural land cover in non-Annex I countries is estimated to have a high or very high probability (risk) of additional conversion for agricultural purposes[7].
- Proportionally, forested areas are at a much greater risk: 38% of forested land is calculated to be at high or very high risk, compared to 22% other natural landscapes, and our BAU scenario suggests that forests will have three times higher conversion rates than other natural landscapes.
- However, in absolute terms, the areas of forested and other natural landscapes at high or very high risk are roughly equivalent (at 0.75 billion and 1billion respectively), and our BAU scenario suggests that half of future agricultural expansion will be at the expense of forest land, and half at the expense of non-forest land.
- On the assumption that no measures to reduce demand for agricultural land (such as increasing cattle productivity in extensive systems) are put in place, our REDD+ scenario where no land-use change takes place inside forests shows a net mitigation impact of just 50% of BAU emissions, due to the leakage of emissions from forests to other natural landscapes.

4 Further Information

4.1 The Model

This Policy Brief presents the results of spatially explicit analysis across 133 non-Annex I countries assessing where future agricultural pressures may lead to further conversion of natural landscapes, both forested and non-forested, using 2050 as a case study. This assessment is based on a combination of prevailing and projected legal, biophysical and projected economic and demographic factors. Other drivers of land use change (such as timber) are not addressed, and neither is forest degradation nor sequestration.

This policy brief builds on that of Policy Brief 6, utilising new analysis and data. Full information on the methodology, assumptions and data used, and limitations of the tool, are available in an accompanying technical brief available at www.terrestrialcarbon.org/publications - see under Policy Brief 9.

All maps generated are displayed on the Planetary Skin carbon mapping and monitoring tool at www.planetaryskin.org/home

4.2 Wider Applications

Our analysis can inform the design of policies to deliver land based mitigation (including REDD+) in the context of future land use change.

The methodology used is replicable in different contexts and scales, and can be repeated with alternative data sets. This gives rise to a number of further uses and applications, including:

- Setting of reference emissions levels.
- Estimation of the significance of alternative forest definitions to an assessment of the likely impact of REDD+.
- Regional or national level risk analysis, that incorporate additional information regarding other factors, both driving and constraining land conversion in the local context.

Further, the risk maps and scenarios can be used as base data (layers), which can be overlaid with further information (such as biodiversity hotspots) to further investigate impacts of BAU and REDD+.

To discuss these or any other applications of interest, please contact us.

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[1] In the BAU scenario, deforestation emissions to 2050 are projected to be 38 Gt C. In the REDD+ scenario, there are no deforestation emissions, but emissions from the offsetting conversion of additional other natural landscapes are 18Gt. Therefore, despite halting deforestation, the net mitigation impact would be only 18GtC: 50% of the BAU deforestation emissions.

[2] We define "volatile terrestrial carbon" as the carbon that would be emitted in the event of land use change (deforestation or equivalent).

[3] The remaining one fifth of land and 8% of volatile carbon is attributable to already cultivated land.

[4] Here defined as having "very high", "high", "good" or "medium" suitability (ie, suitability index score >=40%).

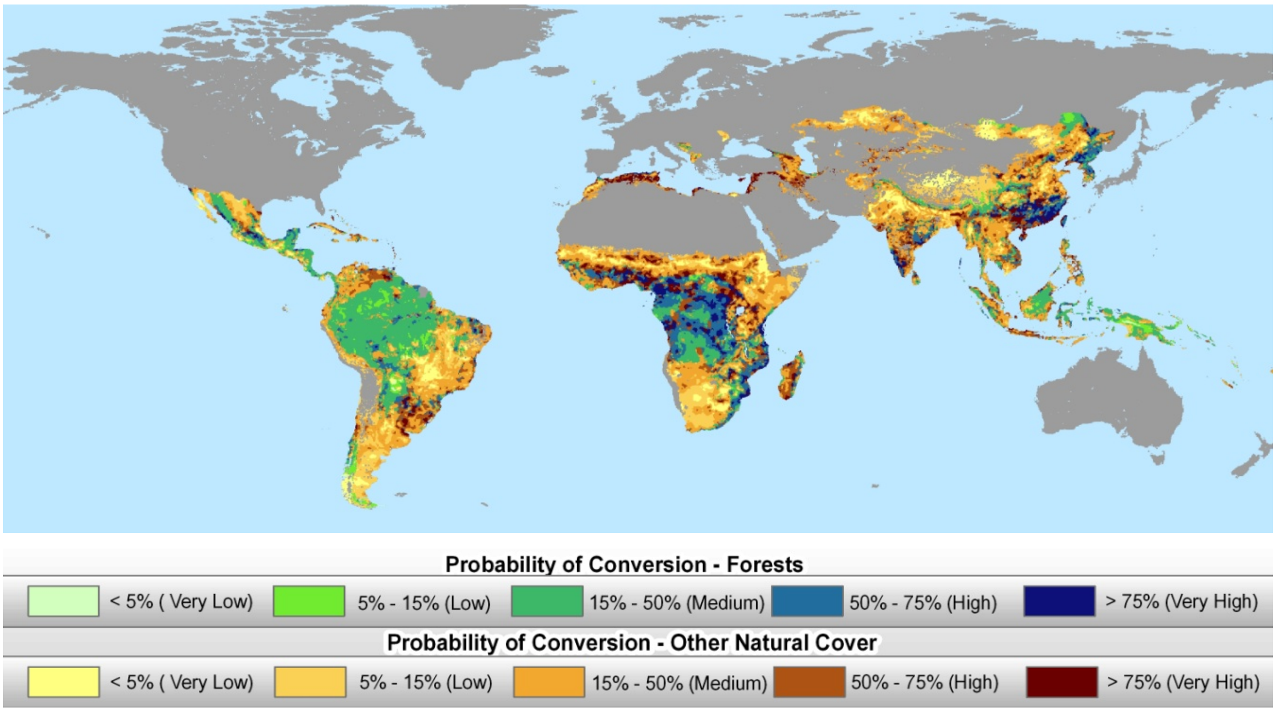
[5] Of course, agricultural expansion is not restricted to areas of high suitability. Indeed, 40% of agricultural land in 2000 is classified as having "low suitability". However, it is reasonable to suppose that where higher suitability land is available, this will be converted in preference to lower suitability land, all other things being equal.

[6] IPCC Special Report on Emissions Scenarios, and Netherlands Environmental Assessment Agency (2010) 'Rethinking Global Biodiversity Strategies: Exploring Structural Changes in Production and Consumption to Reduce Biodiversity Loss'.

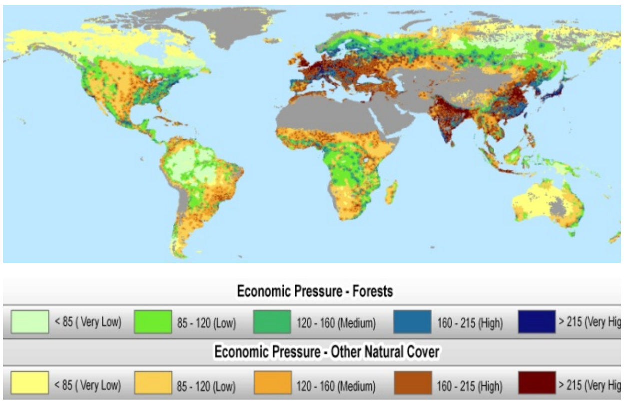
[7] A high or very high risk of additional conversion for agricultural purposes means a probability of 50% or higher that at least an additional 10% of the land area will be converted by 2050.

Annex: Maps of Likelihood of Additional Conversion for Agricultural Purposes

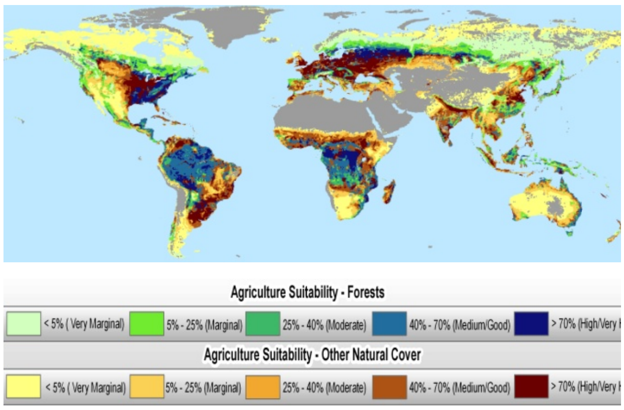
Map 3: Probability (Risk) Map



Map 4: Economic Pressure Map



Map 5: Biophysical Suitability Map



Future patterns and geographical distribution of land-use are expected to be significantly different from those experienced in the past and currently observed. For successful REDD+ and land use policy design, there is therefore a need to also focus on regions with little history of land-use change to date, but with high likelihood of change in the future - such as most of Sub-Saharan Africa. By region, Sub-Saharan Africa contains the greatest absolute area of forest and other natural land cover at highest probability (risk) of conversion.

Although REDD+ remains a very promising mitigation tool, its effectiveness will be limited without complementary measures to address agriculture as a driver of land use change, both within and beyond the forest. According to our analysis, 50% of the avoided deforestation emissions would be cancelled out by increased emissions from other natural landscapes if agricultural expansion is not curtailed.