POLICY DIALOGUES

Urgent Actions Needed to Reduce CO_2 Emissions from Deforestation and Fires in Bolivia

March 2026 – No. 86

PITCH

Bolivia, a country with nearly half of its territory covered by forests, faces significant deforestation and vegetation degradation from fires. According to updated estimations, the country experienced an average annual deforestation of 360.000 hectares and an annual average of 3,7 million hectares affected by fire between 2010 and 2023.

The climate implications are significant: cumulated net emissions from deforestation over this period reached about 974 million tons of CO_2, while gross emissions from fire-induced vegetation degradation contributed an additional 1,6 billion tons.

These findings align with previous reports and studies, revealing that the country ranks among the highest per capita emitters from land-use change worldwide. It highlights the urgent need to design specific and effective policies to reverse this trend.

CONTEXT AND ISSUES

Bolivian forests and natural ecosystems are not only essential for biodiversity and the provision of ecosystem services, but also function as globally significant carbon sinks.

In recent years, the policy framework has favored fire-based deforestation for agricultural expansion. Although burns are intended to remain controlled, weak oversight and limited enforcement have allowed them to escalate into uncontrolled large-scale wildfires, driving deforestation and significantly increasing carbon emissions. Land-use change is the main source of CO_2 emissions in the country. According to the last Biennial Report of the country, the "Agriculture, Forestry and Other Land Use" (AFOLU) sector represents 50% of total national greenhouse gas emissions (in CO_2eq) [1]. As a result, Bolivia ranks among the top 20 countries for land-use change emissions between 2010 and 2022 [2].

Land-use change and fire dynamics in Bolivia are complex and continuously evolving. While fire has traditionally been used to manage natural grasslands, it is increasingly impacting forested areas. In 2019, 40% of the total burned area — amounting to 2 million hectares — was forest. Since then, forests have consistently accounted for more than 20% of the area affected by fire each year, often leading to significant emissions from fire-induced forest degradation.

However, assessing carbon emissions from deforestation and fires is a challenging task due to the multiple processes involved. In particular, deforested or burned areas may recover and recapture part of previously released carbon, while the estimation of fire emissions remains fraught with technical and methodological challenges.

Our new research [3] advances previous work [4] and provides up-to-date comprehensive estimates of net carbon emissions resulting from deforestation, as well as preliminary gross estimations of emissions from vegetation degradation by fires, between 2010 and 2023. We further analyze the spatial distribution of these emissions and their underlying drivers, offering evidence to inform climate and land-use policy.

METHODS

Emissions from land-use change

CO_2 emissions from land-use change were estimated using a high-resolution carbon bookkeeping model that tracks changes among different carbon pools (aboveground biomass, belowground biomass, and soil carbon) across 30×30-meter pixels throughout the country. Some key inputs to the model include:

Authors Lykke E. ANDERSEN (SDSN Bolivia), Fabiana ARGANDOÑA (SDSN), Carla OLMOS (SDSN), Diego CALDERON (SDSN), Sebastián MIRANDA (SDSN), Alvaro MUÑOZ (SDSN), Sergio CHOQUE (SDSN)

Keywords Deforestation, fires, carbon emissions, Bolivia.

Themes Climate Change

Geography Bolivia, South America

- The **annual land cover maps** from 1985 to 2023 provided by MapBiomas Bolivia [5] (Fig.1), to track changes from forest to non-forest or forest regrowth;
- The **map of forest types** [6] (Fig.1) and **biomass density** data [7], to assess spatial variability.

The estimated emissions from deforestation reflect ***net*** emissions, as they account for both gross emissions from forest cover loss and gross carbon removals from forest regrowth, considering both clearly anthropogenic and not clearly anthropogenic forest loss.

Emissions from fire-induced vegetation degradation

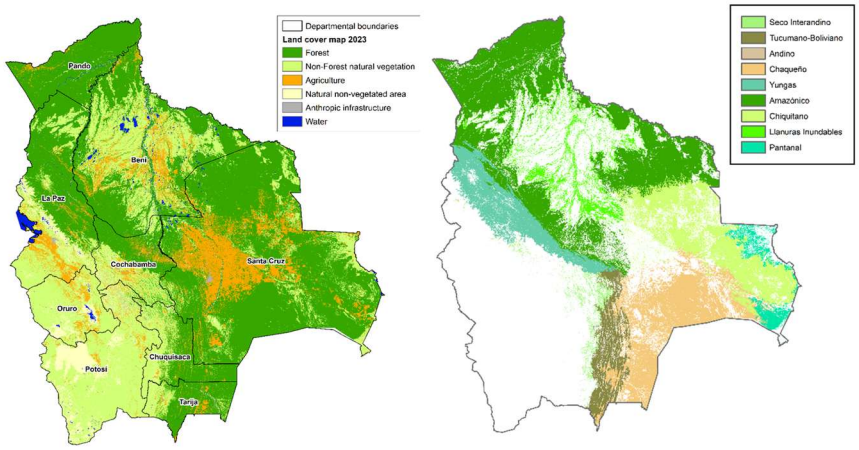
The assessment relies on two key datasets:

- **Burned areas** from satellite data (MODIS, 2010-2023), to assess the location and extent of land cover affected by fires and to provide other spatial analyses;
- **Fire emissions**, from the Global Fire Emissions Database [8], at 500×500 meters of spatial resolution. These emissions stem from both fire-induced deforestation and forest and non-forest vegetation degradation by fire. Note that we do not distinguish between human-caused fires from natural ones.

To avoid double counting of deforestation emissions — which may or may not be caused by fires — those occurring within burned areas were excluded from fire degradation estimates. As a result, emissions from forests that were fully cleared and turned into other land cover types — within burned areas — are not included in the fire-related emissions.

Importantly, this approach does not distinguish between emissions from forest degradation and those from non-forest vegetation degradation. In addition, the estimates represent only ***gross*** emissions, as post-fire vegetation regrowth — a complex phenomenon that does not always occur after fire events — is not accounted for.

Figure 1 - Land cover map (right) and forest types (left) of Bolivia.



Source: Andersen et al. (2025)[3], based on the data from MapBiomas Bolivia (2024) and MMAyA (2022).

RESULTS

Massive carbon emissions from both deforestation and fires

Figure 2 summarizes the average annual carbon flows between different reservoirs during the 2010–2023 period. The largest carbon flow, estimated at 126 million tCO_2 per year, comes from fires that degrade forest without completely eliminating forest cover, and from the degradation of natural non-forest vegetation. Emissions from degradation are particularly concerning, as they are not associated with land cover change and often lack any identifiable benefits.

The second largest emission flow —62 million tCO_2 per year — results from the conversion of forest to agricultural land. The third most significant flow, at 31 million tCO_2 per year, corresponds to the transition from forest to natural non-forest vegetation, which means there is no productive economic activity driving these changes. This situation should be further explored, as it may present an opportunity to reduce forest loss or reveal another underlying problem.

Nonetheless, transitions indicating forest regrowth from natural non-forest vegetation were also observed, highlighting the dynamic and, in some cases, reversible nature of land-cover change. This environmental fluidity adds complexity to the estimation of carbon emissions and removals. Net CO_2 emissions from deforestation in Bolivia average 70 million tCO_2 per year over 2010-2023.

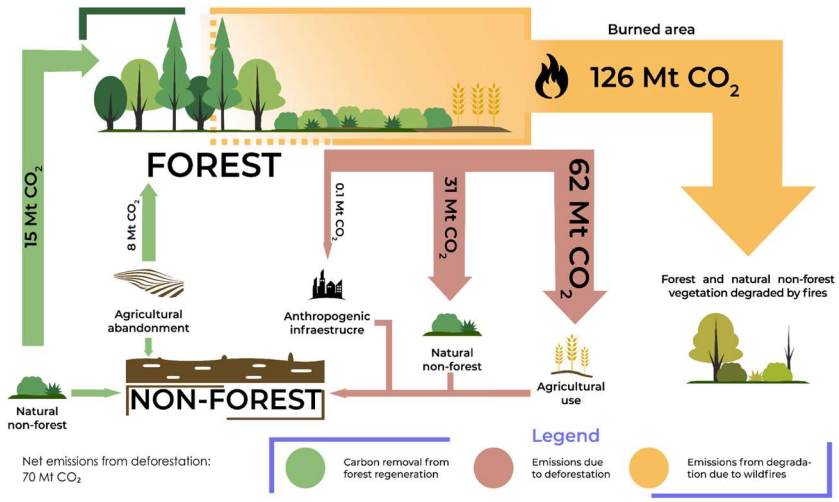
Highest emission levels in the Chiquitano and Amazon forests

Among the forest types analyzed, the Chiquitano forest recorded the highest net emissions from deforestation with 350 million tCO_2 over the study period and the highest gross emissions from fire-induced degradation, at 529 million tCO_2. The Amazon forest ranked second, with 330 million tCO_2 in net deforestation emissions, despite exhibiting the largest gross deforestation emissions (516 million tCO_2), due to its comparatively higher levels of forest regrowth. Together, these two forest types are critical to Bolivia's emissions profile, accounting for approximately 70% of the country's net deforestation emissions and more than 50% of fire emissions.

Bolivia among the highest per capita emitters from deforestation and fires

On a per capita basis, Bolivia emitted an average of 18.9 tCO_2 per person and per year over the study period with 6.6 tCO_2 from deforestation and 12.3 tCO_2 from fire degradation.

Figure 2 | Average annual carbon fluxes from land-use change and degradation by fires, in million tons of CO_2 (2010–2023).



Source: Andersen et al. (2025) [3]

Taking into account the average emissions per hectare during the study period, along with recently released data on fire extent and forest loss for 2024, preliminary estimations suggest that per capita

emissions soared to 50 tCO_2 in 2024. When combined with 2 tCO_2 from fossil fuels and industry, this amount ranks Bolivia among the world's highest per capita emitters — note, however, that this ranking includes *gross* emissions from fires.

High interannual variability and increasing trend over the past decade

Figure 3 shows significant year-to-year variation in emissions, especially those caused by fires, as these are strongly influenced by natural climate variability, including changes in precipitation patterns and wind dynamics.

Within the study period (2010–2023), the year 2010 stands out as an extreme year in terms of fires, and recent years since 2019 have shown exceptionally high emissions from both deforestation and fire-induced degradation, highlighting that fires are increasingly affecting forested areas. These peaks can be partly attributed to drought conditions and to policies that encourage agricultural expansion and authorize burning for longer periods than previous laws.

Due to limitations in the data used for our study, fire emissions for 2023 and emissions from both deforestation and fires for 2024 are presented as preliminary estimates. According to available sources, 2024 saw record-breaking figures for both forest loss and burned area, concentrated in the departments of Santa Cruz and Beni. This unprecedented surge in fires, causing record-high carbon emissions, was most likely driven in part by the extended drought, which intensified fire severity and spread, escalating the crisis to catastrophic proportions.

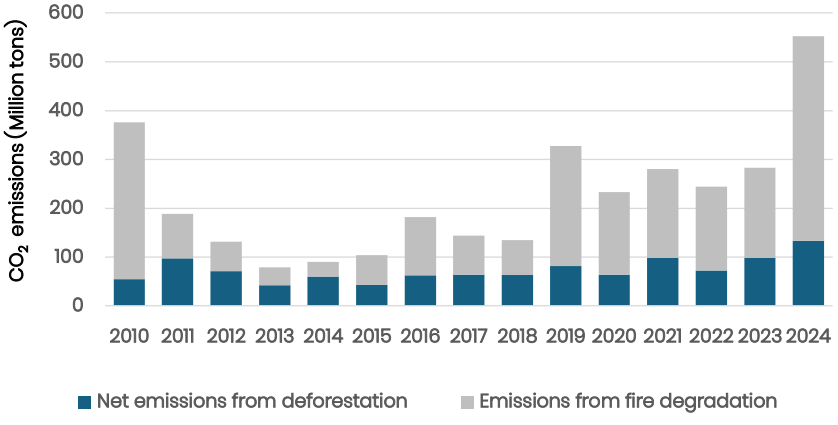
Between 2010 and 2023, 44% of the burned area experienced fire only once, while the remaining 56% burned two or more times, indicating a high recurrence of fire events. This pattern of high recurrence further reinforces the vulnerability of Bolivia's forests to ongoing degradation and long-term carbon losses.

While natural climate variability will continue to cause fluctuations in forest loss and fires, the institutionalization of fire use in agriculture, combined with prolonged droughts in recent years, has intensified fire dynamics. Bolivia's forests are now more fragmented and burn more frequently than ever before. As a result, they have become increasingly vulnerable to external threats, making them more susceptible to future degradation and carbon losses compared to the past.

Most of the emissions come from the department of Santa Cruz

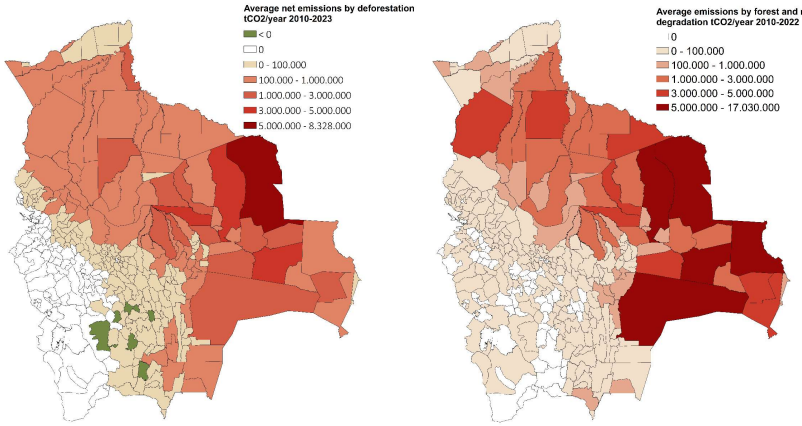
Figure 4 presents average annual net emissions from deforestation and gross emissions from fire degradation at the municipal level. The highland region in the southwest of the country shows no emissions from deforestation, because it lacks forest cover. The far north (Pando department), covered by the dense Amazonian rainforest, has been relatively spared from deforestation, due to its historical exploitation for various forest products (e.g. rubber, Brazilian nuts), resulting in limited emissions. A striking 70% of all forest-related emissions from deforestation and degradation are concentrated in Santa Cruz, a department located in Bolivia's eastern lowlands. The high emission level in this department can be explained by the rapid agricultural

Figure 3 - Estimated net CO_2 emissions from deforestation and gross emissions from fire-related degradation, 2010–2024.



expansion in recent years, carried out at the expense of the Amazon and Chiquitano forests, which have a high average biomass content per hectare. The municipality of San Ignacio de Velasco exhibits the highest emissions during the analysed period. Worryingly, this municipality is home to the Noel Kempff Mercado National Park, a UNESCO World Heritage Site.

Figure 4 - Estimated average annual CO_2 emissions from deforestation (net) and fire-related degradation (gross), by municipality, 2010–2023.



Source: Andersen et al. (2025) [3].

RECOMMENDATIONS

Our findings highlight the urgent need for coordinated action at both national and regional levels through effective public policies, sustainable financing, and active citizen engagement, in order to reduce deforestation and fire emissions. Key measures may include:

- **Funding programs that promote alternatives to the widespread use of fire in agriculture** — such as fireless clearing and agroforestry systems — which is a common practice that, when poorly managed, leads to uncontrolled wildfires but remains widely used due to its low cost and cultural acceptance among producers. In addition, increasing drought conditions driven by climate change exacerbate the risks of fires escaping control.
- **Strengthening institutions and governance** to ensure the effective enforcement and compliance of existing environmental laws — such as the Forestry and Environment Laws — that promote sustainable forest use, while reviewing and revising legal instruments that incentivize environmental degradation, deforestation, or fires, and simultaneously improving monitoring, accountability, and stakeholder participation.
- **Providing incentives for alternative livelihoods**, such as ecotourism, sustainable timber harvesting, and the use of non-timber forest products, offering Bolivians real development opportunities while preserving forest cover and its immense value as a carbon sink and reservoir, as well as a provider of vital environmental and social benefits, including water cycle regulation and dynamization of local economies, which is essential for the Amazon River basin and its inhabitants.
- **Building networks and fostering collaboration** among all levels of government, international agencies, and local actors, to explore bottom-up solutions that address this global concern without hindering national development. Ensuring that all involved stakeholders, receive adequate incentives and support for their well-being is essential for achieving realistic and lasting solutions.

BIBLIOGRAPHY

[1] **APMT. (2024).** Primer Informe Bienal de Trasparencia 2020-2022 del Estado Plurinacional de Bolivia. Autoridad Plurinacional de la Madre Tierra (APMT), Ministerio de Medio Ambiente y Agua.

[2] **Friedlingstein et al. (2023).** Global Carbon Budget 2023. *Earth System Science Data*, 15, 5301–5369

[3] **Andersen et al. (2025).** Assessing CO_2 emissions from deforestation and fires in Bolivia. *AFD Research Papers* n°391.

[4] **Andersen et al. (2016).** Net Carbon Emissions from Deforestation in Bolivia during 1990-2000 and 2000-2010: Results from a Carbon Bookkeeping Model. *PLoS ONE*, 11(3).

[5] **MapBiomas Bolivia (2024).** Colección 2 de la Serie anual de Mapas de Cobertura y Uso del Suelo. https://bolivia.mapbiomas.org/

[6] **MMAyA (2022).** Memoria Técnica: Mapa de bosque 2022. Ministerio de Medio Ambiente y Agua, Viceministerio de Medio Ambiente, Biodiversidad, Cambios Climáticos y de Gestión y Desarrollo Forestal. https://datos.siarh.gob.bo/biblioteca/686

[7] **Santoro, M., & Cartus, O. (2024).** ESA Biomass Climate Change Initiative (Biomass_cci): Global datasets of forest above-ground biomass for the years 2010, 2015, 2016, 2017, 2018, 2019, 2020 and 2021, v5.01. NERC EDS Centre for Environmental Data Analysis.

[8] **Van Wees et al. (2022).** Global biomass burning fuel consumption and emissions at 500 m spatial resolution based on the Global Fire Emissions Database (GFED). *Earth System Science Data*, 14(9), 4539–4557.

Publishing Director Rémy Rioux
Editor-in-Chief Thomas Melonio

Agence française de développement (AFD)
5, rue Roland Barthes | 75012 PARIS | France

Legal deposit 2nd quarter 2020
ISSN in process | © AFD

For other publications of the Policy dialogues collection: https://www.afd.fr/en/collection/policy-dialogues