

## Forest restoration to promote a fair post COVID-19 recovery in the Brazilian Amazon

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### ABSTRACT

Forest restoration has attracted the attention of different organizations, investors, and donors with the launch of the UN Decade for Ecosystems Restoration (2021–2030), along with climate and biodiversity commitments. Restoration can address many of mankind's challenges, such as biodiversity loss, climate change, water security, and poverty. In the Brazilian Amazon, the ~28 million inhabitants are among the most vulnerable of the country, and this has only worsened during the COVID-19 pandemic. Meanwhile, millions of hectares are suitable for forest restoration. The growing demand for large-scale forest restoration projects have been prioritizing biophysical objectives (e.g., number of trees, hectares of land, and carbon) while it should be prioritizing the local people's well-being and a fair transition to a sustainable economy based on forest services' recovery. Nonetheless, many challenges need to be overcome to realize this potential. Amazonian states need to control illegality, enforce the existing policies and promote innovative ones to halt deforestation and enable large-scale restoration. Better governance and social engagement are urgently needed but depend upon, recognition of indigenous peoples and local communities' rights, needs, and knowledge. Forest restoration represents an opportunity for the emergence of a more inclusive development paradigm, much needed in the Amazon region, especially in the post COVID-19 world.

Forest restoration has attracted the attention of different organizations, investors, and donors with the launch of the United Nations (UN) Decade for Ecosystems Restoration (2021–2030), along with other international commitments, such as the 2030 Sustainable Development Goals, the post-2020 Biodiversity Framework and the Paris Agreement. Forest restoration encompasses a variety of techniques and combined

methods, delivering a safe transition to more productive and sustainable land uses. Indeed, ecosystem restoration addresses many of mankind's challenges, such as biodiversity loss, climate change, water security, and poverty alleviation (Cohen-Shacham et al., 2016). It is, therefore, a powerful strategy to promote social inclusion and local development (IRP, 2019), particularly in the Brazilian Amazon where deforestation

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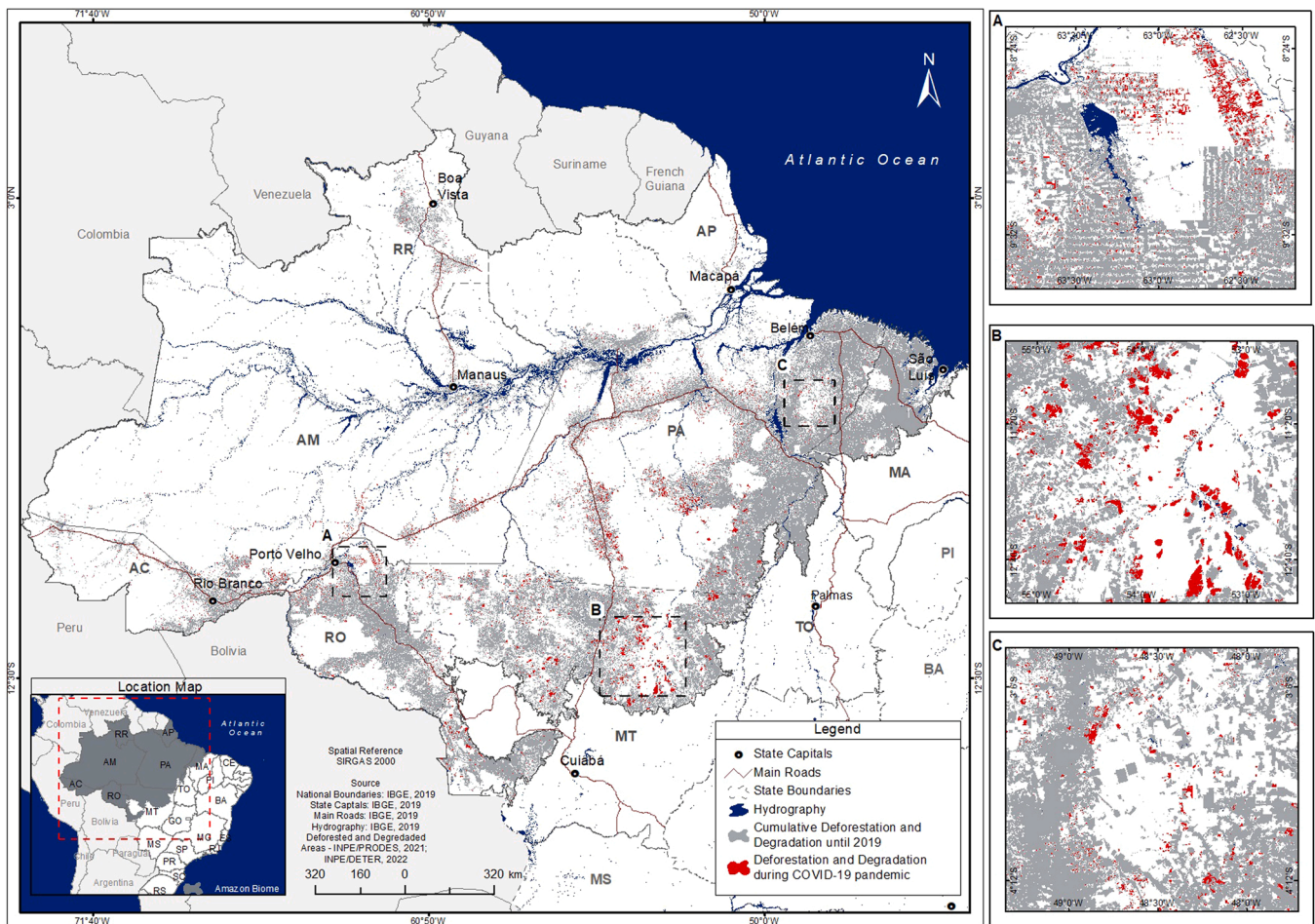
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**Table 1**

Reported Cases and Deaths of COVID-19 by Amazonian state and Brazil until 23 February 2022 (Brazilian Ministry of Health, 2022), and area deforested (million hectares) in 2020 and 2021 during COVID-19 pandemic (Inpe, 2022).

| Amazonian States |    | Total Population | Total Cases | Total Deaths | Deaths/1 M pop | Deforestation (Mha) |
|------------------|----|------------------|-------------|--------------|----------------|---------------------|
| Acre             | AC | 906,876          | 118,436     | 1,962        | 2,163          | 0.16                |
| Amazonas         | AM | 3,483,985        | 570,599     | 14,098       | 4,047          | 0.39                |
| Amapá            | AP | 877,613          | 159,973     | 2,098        | 2,391          | 0.01                |
| Maranhão         | MA | 7,153,262        | 408,928     | 10,725       | 1,499          | 0.07                |
| Mato Grosso      | MT | 3,567,234        | 698,159     | 14,682       | 4,116          | 0.40                |
| Pará             | PA | 7,581,051        | 709,489     | 17,716       | 2,337          | 1.02                |
| Rondônia         | RO | 1,815,278        | 364,123     | 7,020        | 3,867          | 0.30                |
| Roraima          | RR | 652,713          | 151,785     | 2,125        | 3,256          | 0.07                |
| Tocantins        | TO | 1,607,363        | 295,954     | 4,093        | 2,546          | 0.01                |
| Amazon region    |    | 27,645,375       | 3,477,446   | 74,519       | 2,696          | 2.41                |
| Brazil           |    | 210,147,125      | 28,361,951  | 645,735      | 3,073          | –                   |



**Fig. 1.** Cumulative deforested and degraded forests in the Brazilian Amazon until 2019 (gray) and in 2021 and 2022 (red) – during COVID-19 pandemic (INPE, 2022).

and forest degradation have historically worsened people’s quality of life while increasing poverty, vulnerability, and violence (Celentano et al., 2012; Santos et al., 2021). The COVID-19 pandemic has evidenced these chronic social dilemmas and worsened the lack of infrastructure and basic services such as transport, sanitation, and health. As a consequence, the Amazonian states were responsible for a large share of Brazil’s COVID-19 contamination and death, with some of them presenting the highest number of infections *per capita* (Castro et al., 2020). The fatality rate of COVID-19 in the Amazon region by February 2022 was 2,696 deaths per 1 million inhabitants (Table 1), a rate 350% higher than the reported global average (Worldometers, 2022).

In the Brazilian Amazon, near 80 million hectares of forests were

degraded or deforested in the last three decades (Inpe, 2022; Fig. 1), because of historical developmentalism and inadequate public policies (Garrett et al., 2021). The main drivers of forest degradation are fires and logging (Silva Junior et al., 2021), and deforestation is mainly caused by the expansion of agriculture and cattle ranching (SPA, 2021). Currently, annual deforestation is increasingly high, even advancing on legally protected areas. In 2020 and 2021, during COVID-19 pandemics, 2.4 million hectares of forests were cleared in the region (Table 1; Fig. 1) – the highest rate of the last 15 years (Inpe, 2022). Indeed, according to Vale et al. (2021a), the current administration is taking advantage of the COVID-19 pandemic to weaken environmental protection in Brazil. These land-use changes are contributing to the large quantities of carbon

dioxide (CO<sub>2</sub>) emissions which are turning the Amazon forest into a carbon source (Gatti et al., 2021), rather than a carbon sink. Furthermore, forest loss and degradation lead to irreversible damage on hydrological cycles (Lovejoy and Nobre, 2018), and an enormous impact on economic and human development (Garrett et al., 2021) that reduce the resilience of the local society in the face of tragic events as the pandemic. Moreover, deforestation can promote the emergence of future new diseases in the region due to the high diversity of wildlife virus hosts (Vale et al., 2021b).

Forest restoration, as a key element of a broader conservation strategy, is urgently needed to avoid the Amazon collapse tipping point. More than 10 million hectares have been identified as restoration hotspots, where feasibility and benefits are maximized (Brancalion et al., 2019). However, area availability for restoration in the Amazon may be even greater considering the degraded forests that occupy a high proportion in the region (Matricardi et al., 2020).

The high potential for natural succession (passive restoration) – considered the most cost-effective method – is a huge opportunity for large-scale restoration projects in the Amazon (Silva Junior et al., 2020). Indeed, under appropriate conditions, natural regeneration can efficiently promote the restoration of forests and ecosystem services (Jakovac et al., 2021), such as hydrological cycles, local climate regulation, and biodiversity, while active restoration strategies, like tree planting and direct seeding, are required in very degraded landscapes (Vieira et al., 2021). In both cases, the restoration of ecosystem services along with its economic benefits have a great potential to promote a fair recovery. Several markets such as seeds and nurseries, carbon credits, or forest and agroforestry services and products have the potential to increase families' income, reducing social vulnerability. Indeed, the ~28 million inhabitants of the Amazon region are among the most socially vulnerable in Brazil (Santos et al., 2021), and this has only worsened during the COVID-19 pandemic (SPA, 2021), especially among indigenous people (Ferrante and Fearnside, 2020). Emergency assistances are very important in a time of crisis as during the pandemic, but investments for structural changes are essential to enable long-term sustainability and local development.

Forest restoration represents a unique opportunity to secure key ecological processes and to promote a positive impact on human welfare in the Amazon. Indeed, with adequate public policies and incentives, all restoration chains from seed collection, seedling production, planting to maintenance, can generate jobs and income for local communities (Daldegan et al., 2017). Community-based native seed production arrangements – the so-called seed networks – generate jobs, income and improve the livelihood of indigenous and local communities (Schmidt et al., 2019; Urzedo et al., 2020). In the Xingu region, the livelihood of seed collectors was improved in different dimensions: health and nutrition, home and shelter, local knowledge, cash income, and women empowerment (Urzedo et al., 2016). Management of timber and non-timber forest product from restored areas represent another opportunity for sustainable rural development, as well as the Payment for Environmental Services. Restoration through agroforestry also has been demonstrated to improve local livelihoods in the tropics, with income, sustainable production, and food security (Cardozo et al., 2015; Padovan et al., 2022).

Even though successful examples exist, they are still scarce and environmental, and social degradation prevails (Alliance for Restoration in the Amazon, 2020). Development constraints and the poor governance in the Amazon region still represent barriers for scaling up restoration. To overcome these challenges, local organizations and social movements must be strengthened, and infrastructure and capacities improved. Risks associated with governmental turnover and political instability, at state and federal levels, should be prevented. Local people can directly benefit from restoration projects with jobs, income generation, and food security; but more than 'beneficiaries' they must occupy the leading roles of the restorationist movements. Local knowledge and practices must be prioritized, and their participation must be ensured in

all restoration phases from project design to decision-making, including monitoring routines (Osborne et al., 2021; Elias et al., 2021). Misguided restoration efforts may jeopardize a unique opportunity to promote local development in the Amazon. Thus, strategic investments are needed to strengthen community organizations and build local capacities (Minang et al., 2021).

The growing demand for large-scale forest restoration projects must truly benefit local populations. Nevertheless ignoring the social dimension of restoration may lead to failure of the proposed interventions, or enhancement of social conflicts that marginalizes vulnerable groups and favors land grabbing and other illegal activities (Elias et al., 2021). Biodiversity recovery and atmospheric carbon sequestration should not be the only objectives of ecosystem restoration, but also a means to promote sustainability and welfare, among other goals (Osborne et al., 2021), as part of the so-called shift towards people-centered restoration strategies (Elias et al., 2021). Thus, investments that prioritize financial profits and target only in biophysical outputs (e.g., number of trees, hectares of land, and carbon) will not deliver the necessary ecological and social benefits needed in the Amazon.

The optimization of socio-ecological benefits arising from the restoration interventions depends on the increase of mandatory and voluntary contributions, at the international level, and on the amplification of financial flows (Osborne et al., 2021). However, the international investments necessary will not be secured without adequate enforcement of public policies. Amazonian states must combat deforestation and regulate the protection of restored and secondary forests to regain the necessary credibility. Indeed, the permanency of secondary forests is not secured by most States of the Brazilian Amazon legislation (Alliance for Restoration in the Amazon, 2020; Silva Junior et al., 2020), and existing policies are not properly implemented. Better governance depends primarily on the reduction of illegality and requires coordination between governments, civil society, indigenous people, and local communities. For example, existing participatory forums with multi-sectoral coalitions such as the Alliance for Restoration in the Amazon must be strengthened. Moreover, securing local livelihoods, cultural values, and connecting forest and agroforestry goods and services to markets is an important piece of the restoration process. In the Amazon, forest restoration might be the key to a fair COVID-19 recovery, as it values bio-cultural diversity, reduces inequalities, and promotes sustainable development at large-scale.

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