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How Governance Can Contribute to Amazon Biome Conservation?

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Abstract

Forest conservation has transcended environmental concerns and become a determining factor in global social and economic issues. Therefore, setting forest conservation goals, including recovery and/or reforestation, is critical to help mitigate global warming and climate change. Although Amazonian countries have forestry policies for forest conservation, the forest continues to be degraded. The aim of this article is to suggest a regional governance

model for the nine countries that share the Amazon rainforest. The thesis of the paper is that the definition of a common legal basis for the nine countries can contribute to forest conservation. Through qualitative analysis of exploratory and descriptive variables, the main topics related to the proposal of a governance model were identified. Multi-level governance contributes to the environmental conservation process by creating an environment to engage local, national, and international stakeholders from diverse groups. As a result of this paper, we suggest the creation of a supranational governance, composed and regulated by each of the nine countries of the Amazon biome and having as reference the AFR100 initiative. The proposition and creation of governance among Amazonian countries are fundamental for achieving the objectives for the conservation of the biome; such governance must take into account existing public policies, institutional mechanisms, and financial commitments. Although the Amazon countries present a framework of policies and commitments that seek to preserve the biome, the reality is that forest degradation through deforestation with negative effects on the climate and on the communities that depend on the standing forest still exists.

Keywords: forest policy, environmental conservation, governance, deforestation, amazon

1. Introduction

The aim of this paper is to propose a multi-level governance model for the nine countries in the Amazonia basin that share the most abundant tropical forests, with the objective of curbing deforestation through forest conservation, including recovery and/or reforestation. This is crucial for mitigating the effects of climate change and ensuring the provision of environmental services. The thesis of the paper is that the definition of a common legal basis for the nine countries can contribute to forest conservation. Through qualitative research of an exploratory and descriptive nature, we have analyzed the main topics related to the research to propose the governance model.

We concluded that the governance model used by the AFR100 initiative can be equally applied to the Amazonian countries, as it also proposes a governance model for forest restoration involving African countries. The research leading to the conclusions presented in this paper may be considered original because, so far, no multilevel-international governance model focused on curbing deforestation, forest degradation, conservation, and reforestation has been previously identified. This article brings several implications for policymakers and government agencies engaged in climate policies, including mitigation through rainforest conservation.

Forest conservation has transcended environmental issues and become a determining factor in global social and economic issues. Therefore, public policies aiming to help mitigate climate change through forest conservation/preservation as well as reforestation are instrumental. Some alarming issues related to climate change were raised in the latest report published by the Intergovernmental Panel on Climate Change (IPCC, 2021). This report shows that, with the increase in the global average temperature on Earth's surface and the current levels of emissions from the burning of fossil fuels, consumption of raw materials, and land-use changes, particularly deforestation, there is a high chance of depletion of ecosystem services

provided by the Amazonia. Such a scenario could signal the end of any economic activity linked to (i) the standing forest and (ii) agricultural activities that benefit from deforestation, which, in this IPCC scenario, would also become unsustainable due to prolonged and frequent periods of drought.

On the one hand, there is a need to contain deforestation, keeping the standing forest through preservation and reforestation; on the other hand, there is a need for effective governance so that these objectives are met. One of the biggest challenges in public management is to transform strategies into policies and successfully implement them; and this is no different in international agreements. Thus, we believe that a well-defined, effective, and multilevel governance in the formulation and implementation of public policies is essential for maintaining the forests standing.

Still under development and with an unsophisticated economic base with low added value, the countries that share the Amazon basin (Brazil, Bolivia, Colombia, Ecuador, Guyana, French Guiana, Peru, Suriname, and Venezuela) are economically dependent on agribusiness. The conservation of the Amazon is fundamental for these countries, as the maintenance of their economic activities and the development of a more sophisticated economic base with greater added value depend on the standing forest. Forests are providers of ecosystem services – e.g., removal of carbon dioxide, water regulation, climate, and pollination – services on which agribusiness depends.

The Amazon may reach a tipping point in a few years, and in this scenario, the central, southern, and eastern regions of the biome would start to record less rainfall and have longer dry seasons. Furthermore, the vegetation of the southern and eastern regions could become similar to that of savannas. Such scenarios were confirmed by the last report published by the Intergovernmental Panel on Climate Change (IPCC, 2021), in which projections for the Amazon were not encouraging.

The IPCC is the international body for assessing issues related to climate change. The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation (IPCC – AR6, 2021). The IPCC provides future climate scenarios from global climate models from different research institutions around the world.

The Sixth Analysis Report (IPCC-AR6, 2021) elaborated five new scenarios of greenhouse gas emissions for the period 2015-2100, including: (i) two optimistic scenarios, in which emissions decline rapidly in the coming decades; (ii) an intermediate scenario, in which emissions remain stable until 2050 and gradually decrease thereafter; and (iii) two pessimistic scenarios, in which emissions continue to grow until the end of the century.

The first two scenarios are optimistic. In the first scenario, in addition to reducing GHG and reaching zero net emissions from 2050 onwards, there would still be practices to remove carbon from the atmosphere, such as planting trees to achieve negative emissions; the second scenario would be the same, but from 2080 onwards. In the intermediate scenario, we would

still have an increase in GHG in the next few years, with a projected reduction in emissions from 2050, but without reaching zero net emissions before 2100. In the last two, the negative ones, emissions would continue to rise at different intensities (IPCC – AR6, 2021). Thus, recovery and/or reforestation are important practices for removing CO2 and helping to reach the most optimistic scenario.

While there is such concern about the Amazon biome and its future, given the current stage of deforestation, there is another model of regional initiative to restore altered forest areas – this program is called AFR100 and focuses on restoring forest areas in Africa. The aim of this program is to restore 100 million hectares of degraded land in African countries by the year 2030. Due to the negative effects of forest degradation experienced by Africa in the socioeconomic sphere, the countries committed to a program that ensured long-term sustainable and economically viable solution to deforestation. For all countries on the continent to be covered, it was necessary to design a multilevel governance that encompassed them concomitantly. One of the main roles of governance is to formulate and implement public policies aimed at complying with international agreements, such as the Paris Agreement and the Bonn Challenge.

This article aims at presenting a governance structure consistent with the conservation and restoration of natural biomes to minimize or eliminate the risks of potential impacts of climate change through i) AFR100 and ii) a proposition of a multilevel governance model for the countries that share the Amazon basin. More specifically, a discussion on multilevel environmental governance, emphasizing its structures, goals and effectiveness is proposed.

This article is structured as follows. Subsequently, the theoretical framework is presented, bringing the most relevant topics for the development of this study. The Paris Agreement, the Bonn Challenge, the 20 x 20 initiative, and AFR100 are contextualized and governance is defined. Next, we bring some information about the methodology, followed by a more detailed analysis of the governance present both in the Amazon biome and in the AFR100. Greater attention was given to Brazil, as the country alone comprises approximately 60% of the entire Amazon rainforest. The work ends with the final considerations and suggestions for future studies.

2. The Amazon and Its Importance

Any approach to environmental governance, forest conservation/preservation, or soil recovery will necessarily have to consider the role played by the Amazon as a unique biome, despite being geographically spread across nine countries. The Amazon biome, defined as the paper's scope, was selected for its local, national, and global importance. It is the largest tropical forest in the world, responsible for controlling rainfall in Latin American countries and for climate regulation.

It is worth mentioning that the Amazon covers an area of 7.8 million km², consisting of twelve macro-basins and 158 sub-basins shared by 1,497 municipalities, 68 departments, states, or provinces distributed across nine countries, namely: Bolivia (6.2%), Brazil (64.3%), Colombia (6.2%), Ecuador (1.5%), Guyana (2.8%), Peru (10.1%), Suriname (2.1%),

Venezuela (5.8%), and French Guiana. The area occupied by Brazil is 4,196,943 km², corresponding to 49.29% of the national territory.

It is noteworthy that deforestation in the Brazilian Amazonia has been continuously monitored using satellite data. The National Institute for Space Research (INPE), through the Project for Monitoring Deforestation in the Legal Amazon by Satellite (PRODES), has been carrying out systematic, wall-to-wall monitoring of the Legal Amazon. Since 1988, INPE estimates the official, annual deforestation rates in the region, which are used by the Brazilian government to develop and implement public policies to prevent and control illegal deforestation (INPE, 2018).

Figure 1 shows the rate of deforestation for the period 1988–2020. After a period of sharp decrease of deforestation, from 2004, the second-highest rate after 1995 to 2012, the lowest rate ever, the deforestation rate started to grow again. This shows the complexity of sustaining low deforestation rates in the region, triggered mostly by illegal deforestation and land grabbing of public lands. According to PRODES, the total accumulated deforestation in the Legal Amazon in the monitored period (from 1988 to 2017) is 428,398 km², almost 18% of its territory (INPE, 2018). The deforestation includes only the natural forest.

Thus, given the great expressiveness of the biome, not only in the environmental context and in greenhouse gas emissions, but also considering its influence on economic and social dimensions of Brazil and other countries, the Amazon was approached as an object of research. A great rate of degradation and alteration of the original vegetation has been occurring over the past years, which can harm all countries depending on the Amazon.

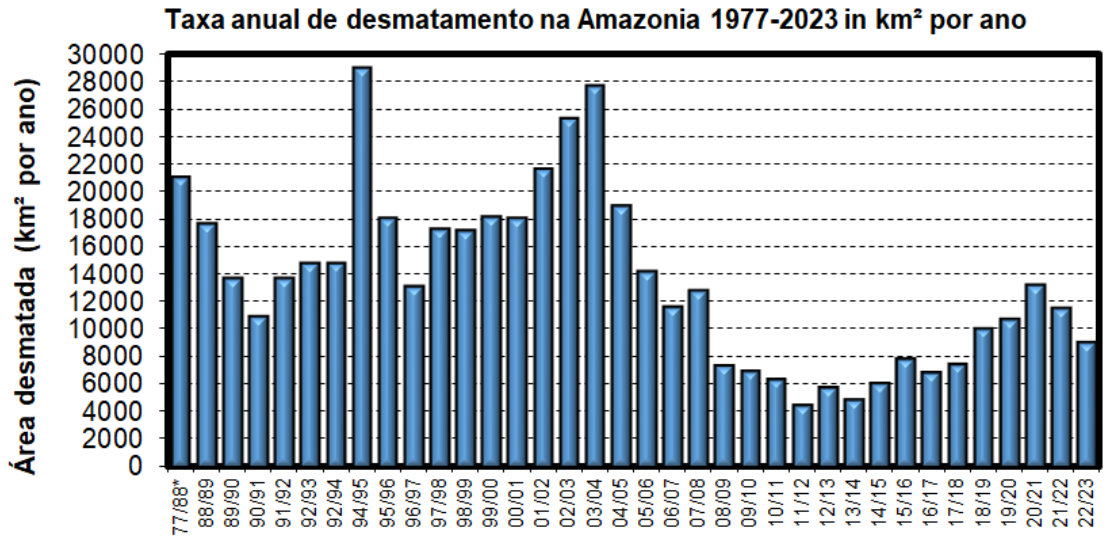

Figure 1. Annual deforestation rates in the Brazilian Legal Amazon

Source: INPE-PRODES, 2023.

2.1 Success Factors for Biome Conservation: Policy Frameworks, Institutional Mechanisms, and Financial Commitments

Considering the Amazon and its environmental and economic importance, this section aims to demonstrate some success factors for the conservation of the biome. Therefore, the IUCN Bonn Barometer reported in 2019 (Dave et al., 2019) was used as a reference to determine such factors. Thus, the dimensions analyzed were (i) political frameworks; (ii) institutional mechanisms; and (iii) financial commitments. Table 1 presents the main norms by theme of eight countries (French Guiana not included) that share the biome.

Table 1. Main national standards by Pre-Paris Agreement themes

Countries	General Environmental Standards	Specific Standards
Bolivia	Environmental Law No. 1333 (1992).	Forestry Law No. 1700 (1996); National Agrarian Reform Service Law No. 1715 (INRA, 1996) Biodiversity, Mining and Hydrocarbon Development Plan.
Brazil	National Environmental Policy (Law 6938/81).	Water Resources Law; Environmental Crimes Law; Forest Code; Public Forest Management Law; National System of Conservation Units.
Colombia	Code for the Protection of Naturales and Environment Resources (DL 1811 of 1974); SINA (Law 99 of 1993).	Promotion of Rational and Efficient Use of Energy; Guidelines for Integral Water Management; Territorial Planning Law (Law 388 of 1997); National Policy for Humedales (2001); Forestry Law (Law 1021 of 2006); National Biodiversity Policy (1995).
Ecuador	Environmental Management Law.	Forestry Law and the Conservation of Natural Areas and Wildlife.
Guyana	Environmental Protection Law (1996).	Forestry Law (2006); National Parks Decree; Wetlands Use Code; Water and Sanitation Decree (2002).
Peru	General Environmental Law; Law on the National Environmental Management System.	Water Law; Biodiversity Use and Conservation Law; Forestry and Wild Fauna Law; Protected Natural Areas Law; Solid Waste Law
Suriname	Ministry of Environment Policy (2006-2010).	Physical Planning Law; Nature Conservation Law; Fishing Law, Soils, Water, Forests, Air and Biodiversity.
Venezuela	Organic Law of the Environment (1976).	Communal Environmental Management; Water and sanitation; Guacaipuro Mission; Productive Reforestation; Land Code Recovery of Degraded Areas; Solid and Hazardous Waste Management.

Source: PNUMA/OTCA (2008)

In contrast, Table 2 gives an overview of institutional mechanisms and financial commitments, contextualizing the participation of countries.

Table 2. Success factors for the conservation of the Amazon biome

PROGRAM/FUND	CONTEXT
Paris Agreement	8 countries in the biome; yet only 3 reviewed the document
Bonn Challenge	XX
20 x 20 Initiative	4 countries in the biome
Native Vegetation Recovery Plan - PLANAVEG	Brazil
Amazon Cooperation Treaty Organization - OTCA	8 countries in the biome
Leticia's Pact	7 countries in the biome
Reducing Emissions from Deforestation and Forest Degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks - REDD +	Developing countries
Green Fund for Climate Change	7 countries in the biome
Amazon Fund	Brazil
Amazon 2030	Brazil
Amazon Plan	Brazil
Amazon 4.0	Brazil
Coalition Brazil Climate, Forests and Agriculture	Brazil
Consortium of Governors of the Legal Amazon	Brazil

From tables 1 and 2, it is clear that the Amazon countries converge in their ambition to preserve the forest, but have not succeeded at all times. The increasing rate of deforestation in the Brazilian Legal Amazonia from INPE (2018), particularly in the last years, demonstrates that the policies and actions in place have not been successful in curtailing deforestation and forest degradation. The changes in land use in Amazonia and the increasing frequency of droughts in the region might explain the recent results in the recent article in Nature (Gatti, LV et al. Nature 595, 388-393, 2021) indicating that the forest was not a sink of CO2 but started to become a source.

Despite the creation of strong forest-related policies, as in the case of Brazil with the Native Vegetation Protection Law (abbreviated as the LPVN), the lack of consistent governance indicates that policies are not effectively implemented. A good example of this lack of governance at the national level is the case of the state of Espírito Santo, in Brazil. The state was the first in the federation to create, through a specific law, a state program for payment for environmental services in September 2008 (State Law nr. 8995). The program aimed at the owner of rural areas in the state, who could allocate part of his/her property for preservation and conservation of forest cover (SEAMA, 2021).

After the creation of the law in 2008, the state produced a legal framework that supported and made the program viable and operational since 2011 under the Reflorestar Program. The framework has five laws, three decrees, and five ordinances that can be consulted on the SEAMA website. In this case, even though Brazil already had national legislation on forest cover, the state of Espírito Santo found it necessary to create its own regional legislation, also creating its own governance structure and designating its own agency (SEAMA) to

implement the instituted policies, resulting in positive results. Between 2015 and 2019, more than BRL 73 million were contracted, and of these, more than BRL 52 million were applied in recovery projects through payments for environmental services (SEAMA, 2021).

A study by WWF/Germany, "Enabling Factors to Scale Up Forest Landscape Restoration: The Roles of Governance and Economics Full Report with Case Studies" (Mansourian, 2020), points out that programs that specifically rely on intersectoral agencies that oversee forest restoration are more likely to succeed. Such programs bring together different actors and sectors that influence land and forest use, reducing the risk of contradictory policies and programs.

The study identifies successful cases in the forest restoration process precisely due to the presence of effective governance. In the cases of Costa Rica and Kenya, the environmental and forestry sectors, important in the restoration process, are grouped into a ministry; in Madagascar, inter-ministerial platforms are established at the regional level to ensure coordination around inter-sectoral issues such as restoration (Mansourian, 2020). The case of Espírito Santo is also one of the successful cases demonstrated in the WWF study for developing its own legislation and governance, i.e., SEAMA.

On the other hand, the WWF study provides another example for Ethiopia, where the lack of governance dedicated to environmental and forestry issues was probably the factor responsible for the low success rate of tree planting initiatives over the years (Mansourian, 2020). The study converges with the thesis of this paper; in other words, although the Amazon countries have developed policies and implemented actions to preserve and restore the Amazon Forest, the lack of consistent governance prevents these from being effectively implemented, putting the maintenance of the forest at risk.

The governance deficit appears to be linked to the fact that many countries focus on short-term gains. In other words, as several communities end up developing agricultural activities that often cause deforestation, the maintenance of the standing forest ends up being postponed mainly for two reasons. First, commitments to the preservation of the natural biome are long-term and subject to different national governments with different policy approaches. Moreover, they can be abandoned if a political management has a minority focus on environmental issues and a majority on issues related to increasing the national GDP through the export of commodities that are cultivated in Amazonian areas. Second, many government officials do not feel confident in making long-term commitments, as benefits of which will only be reaped through later terms.

3. Governance Model Proposal

3.1 Governance: Concept and Components

The concept of governance is approached from several perspectives in different organizational contexts. Governance used to relate to central government power (Commission of the European Communities, 2003; Jacobi & Sinisgalli, 2012; Mansourian, 2016), meaning that all decisions were centralized in the public sphere. According to the Commission of the European Communities (2003), governance refers to rules, processes, and

behaviors according to which interests are articulated, resources are managed, and power is exercised in society. According to the Brazilian Court of Auditors (TCU), governance is based on three mechanisms: leadership, strategy, and monitoring (TCU, 2014).

The search for a specific model for the preservation of the entire geographical Amazon is a strategy of convergence between the nine countries that share the region, its biodiversity, and ecosystem benefits, sharing experiences of success and failure, as presented in Mansourian (2020), Bonn Challenge Barometer Spotlight Report 2017 (Daves et al., 2017), and Bonn Challenge Progress Report 2018 (Daves et al., 2018). Multilevel environmental governance is one of the alternatives that can contribute to learning and adaptation in complex systems, such as the socioenvironmental (Armitage, 2008; Ball et al., 2014). For Armitage (2008), this arrangement should connect the community to national and international managers linked either to more scientific or traditional management, with the ability to share information and knowledge, in addition to promoting cooperation and dialogue to meet objectives. Ball et al. (2014) reiterate that civil society can play crucial roles in solving environmental problems and improving democratic participation, benefiting the good governance of resources.

Rantala et al. (2020) state that environmental governance must involve public and private actors, institutions, and the interaction between them, considering the effect on forests. The authors emphasize that, in the case of environmental governance, public values are relevant, as they include more effective and efficient public service delivery, greater collaboration between public, private, and civil society organizations, and more effective, transparent, and responsible management of forests.

One of the barriers pointed out by González and Kröger (2020) for environmental governance refers to the global definition of forest itself, which encompasses several different aspects, making it difficult to apply a common policy to all countries in each region; the institutional definitions, in turn, present a more technical approach to the definition of forests, environmental, and forest governance, which facilitates the sharing of guidelines and policies.

With regard to multilevel governance in the environmental and forestry areas, Dobrynin et al. (2020) warn of some dangers that may arise from this type of governance if its implementation is not effective and does not consider the relevance and preponderance of certain actors. The authors warn that multilevel governance can compromise the ownership of national forests; with this, the authors clarify that, in Russia, there was a transfer of responsibility from public governance structures to private companies and communities, without these having the capacity to conduct the process.

Thus, Dobrynin et al. (2020) defend multilevel governance and its importance for the preservation of forests, if there is no transfer of decision-making from state structures to community representatives. A similar example, this time in India, was reported by Gupta et al. (2020). The authors indicate that, with the decentralization of forest governance in the country, rights and responsibilities ended up being transferred without being able to guarantee the communities' capacity to continue the responsibilities attributed to them. For the purposes of this study, multilevel environmental governance corresponds to rules, processes, and behaviors that integrate networks of horizontal and vertical relationships, according to which

interests are articulated, resources are managed, and power is exercised to achieve the results desired by a public policy (Fernandes, 2019).

3.1 The Regional Initiative

Although the Amazon Forest is at the center of discussions when it comes to environmental conservation and climate change, no initiative has been taken to implement the international agreements committed by Brazil and the other Amazonian countries. The analysis for the definition of alternative governance models was divided into three dimensions, according to the Brazilian Court of Auditors (TCU, 2014) – (i) leadership, (ii) strategy, and (iii) monitoring. Therefore, it will be necessary to include in this model: (i) competent leadership capable of transforming goals into results; (ii) explicit and well-defined strategy for implementing the program, and (iii) monitoring of the forest for its maintenance.

Following a study by the WWF (Mansourian, 2020), which assesses the roles of governance and economics in enabling increased forest landscape restoration, programs that specifically feature intersectoral agencies that oversee forest restoration are more likely to be successful. This is because the agencies bring together different actors and sectors that influence land and forest use, reducing the risk of contradictory policies and programs. Thus, it is suggested in this article the creation of a network of institutions and stakeholders with the capacity to integrate the environmental agenda into the economic and social development agenda of countries, building a single concept concerning environmental conservation.

To ensure that forest preservation and restoration commitments are met, this governance must follow the multilevel model. By structuring alternatives for governance systems and processes, the model of multilevel environmental governance is achieved. According to Armitage (2008), this arrangement should connect the community to national and international managers, linked to qualified management with the ability to share information and knowledge, in addition to promoting cooperation and dialogue to meet objectives. Ball et al. (2014) reiterate that civil society can play crucial roles in solving environmental problems and improving democratic participation, benefiting the good governance of resources. Moreover, the participation of rural landowners and their managers is fundamental (Figure 2).

Figure 2. Actors involved in global environmental governance

Source: Adapted from Fernandes (2019)

It will be up to this multilevel articulation, in addition to the foundations of the Brazilian National Policy for the Recovery of Native Vegetation (abbreviated as the Planaveg), to focus on a strategy consisting of eight initiatives organized around three main axes: motivating, facilitating, and implementing. Thus, the roles of the regional agency will be: (i) to motivate, promoting the dissemination of the legislation in force, highlighting its benefits; (ii) to facilitate, generating environmental, market, and public policy conditions; and (iii) to implement, valuing regional and local leaders, incentives, and resources for environmental conservation/preservation, in addition to positive results.

Thus, the mission of the regional agency would be: (i) the implementation of the Nationally Determined Contributions (NDCs) and the Bonn Challenge through (ii) effective use of existing solutions, (iii) combining the preservation of the environment with the development of countries, ensuring the well-being of generations to come. The regional agency would, among others, be responsible for: (i) articulating and clarifying the compatibility between compliance with the Paris Agreement, Bonn Challenge, and economic and social development; (ii) ensuring the reduction of anthropogenic greenhouse gas emissions in relation to the sources presented by the Amazon INDCs, at least in the first version of the INDC presented by the countries; (iii) the preservation and conservation of the environment, ensuring biodiversity and ecosystem services; (iv) guaranteeing the conservation/preservation and recovery of vegetation cover in degraded and/or altered areas as the only means of taking up CO2 from the atmosphere; and (v) the implementation of existing solutions as a means of providing compliance with the Paris Agreement and Bonn Challenge.

The creation of the regional agency is important, since for the forest to remain standing, cooperation between the nine countries that share the biome is essential, including to avoid leakage or displacement of forest carbon stocks. With the common practice of escape, if there is no such alliance between countries, implementing solutions in search of the perpetuity of forests in a single country will prove ineffective, since the agencies that cause deforestation may migrate to another area and continue their degradation. This cooperation is necessary, since the forest may be reaching its maximum point of degradation and, after such tipping point, recovery will mostly fail (Lovejoy & Nobre, 2018). A proof of such statement is that recent studies indicate that the Amazon Forest started to emit more CO2 than it captures (Gatti, L.V. et al. Nature 595, 388-393, 2021), going against expectations of maintaining global warming at 1.5°C, as stipulated by the IPCC. Thus, if all nine countries that share the biome are not sensitized to the importance of its conservation, the rainforest will hardly survive in the way it exists today.

The proposed common base would establish the minimum commitments to be fulfilled by all Amazonian countries so that the objectives of the Paris Agreement and Bonn Challenge could be achieved. Viability would occur through well-defined legislation regarding the preservation and containment of deforestation, but would require effective implementation, encompassing all nine countries sharing the biome, and frequent and effective monitoring through structured governance.

3.2.1 International Experience: African Forest Landscape Restoration Initiative (AFR100)

As regional initiatives, the Bonn Challenge presents four initiatives, namely: (i) Africa, (ii) Asia and the Pacific, (iii) Europe, the Caucasus, and Central Asia, and (iv) Latin America. The AFR100 is highlighted here since the initiative has an already established governance and presents some positive results. AFR100 is a country-led effort to bring 100 million hectares of degraded and deforested land in Africa into restoration by 2030. It aims to accelerate restoration to enhance food security, increase climate change resilience and mitigation, and combat rural poverty through the restoration of deforested and degraded land. AFR100 contributes to the Bonn Challenge, the African Resilient Landscapes Initiative (ARLI), the African Union Agenda 2063, the Sustainable Development Goals, and other targets (AFR100, 2021). On the African continent, AFR100 complements the African Union Vision 2063, the Great Green Wall Initiative, TerrAfrica, the African Climate Smart Agriculture (CSA) Alliance, the Malabo Declaration on food security, the Cairo Declaration on Africa's Natural Capital, the African Landscape Action Plan (ALAP), among others (Messinger & Winterbottom, 2016).

AFR100 is based on a lean governance structure, aiming to catalyze national efforts and provide support where needed (Table 3).

Table 3. AFR100 based on a lean governance structure

The AFR100 Secretariat	Serves as the main contact for the initiative. Housed at the NEPAD Agency, the Secretariat's tasks include coordinating partners to jointly mobilize and sustain political support, providing technical assistance and facilitating investment, coalition building, knowledge management, monitoring and reporting. It also liaises with regional economic communities (REC). NEPAD's mandate, given by the African Union Heads of State and Government, provides a strong legitimacy to AFR100 and its ownership by African countries.
The AFR100 Board	Comprised of African country representatives, donors, and financial partner representatives, provides strategic guidance for achieving AFR100's goals, and advice to enhance the effectiveness of the Secretariat and the Technical Assistance Platform. The Board leads on resource mobilization efforts as well as building and sustaining partnerships.
The AFR100 Technical Assistance Platform (TAP)	Operates as a clearinghouse to facilitate partners' engagement to support AFR100. TAP provides technical support to assess restoration opportunities and support the implementation of FLR at scale, and facilitates information sharing, communication about FLR opportunities and successes, joint learning and capacity development.

Source: AFR100 (2021)

Five focal areas have been considered key to accelerate the restoration process, namely monitoring of progress, mapping opportunities, community mobilization, strong land and resource rights, and access to finance (Averna & Winterbottom, 2016). Restoring a deforested area is not a task to be carried out alone; restoring 100 million hectares is an enormous challenge that requires engagement of governments at all levels, communities, NGOs, civil society, and the private sector. Without the support of these actors, it is very unlikely to deliver maximum value from technical, human, and financial resources, which are needed to support African countries in meeting their environment and development objectives (Averna & Winterbottom, 2016).

As previously mentioned, the restoration of degraded lands – not only in Africa but throughout the world – is important not just for the environmental aspect per se, but for the maintenance of economic activities that depend and rely on the standing forest. Thus, the restoration of forest landscape involves the pursuit of productivity and ecological functionality – in Africa, restoration is expected to improve soil fertility and food security, facilitate access to clean water, and increase natural cover to provide ecosystem services, boosting economic growth and livelihood while mitigating the effects of climate change (Paap & Hol, 2016).

One of the success stories of the AFR100 is the case of Rwanda. In line with the Bonn Challenge, the commitment made by the government of Rwanda was to restore 2 million hectares by 2030. Since 2010, the baseline year for implementation on the ground, Rwanda has succeeded in bringing 708,628 hectares under restoration. This has been achieved through the work of smallholder farmers, along with grassroots organizations, government agencies, and NGOs. With this, Rwanda meets 35% of its goal (Dave et al., 2019). Ethiopian farmers, in turn, have restored more than 1 million hectares of degraded land through agroforestry and silvopasture, thus expanding farming into the dry season, increasing food security, and

generating economic opportunities (Messinger & Winterbottom, 2016).

Cameroon also provides an interesting example concerning AFR100. The country pledged in 2017 to restore forests and degraded lands over an area of more than 12 million hectares by 2030 as part of the AFR100. The Ministry of Forestry and Wildlife has played an important role in the process, as it has provided grants since 2006 and material and financial support to councils, NGOs, associations, and traditional chiefdoms – the Ministry was, however, not the only entity involved with the country's restoration plans; other state agencies and private organizations had to be included (Atyi & Mbonayem, 2018). Lack of synergy between government agencies, isolated interventions by private players, limited capacity of government bodies to provide the necessary resources for restoration, and lack of monitoring are some of the reasons cited by the authors as constraints to forest landscape restoration. These constraints are the reason why the initiative in Cameroon has been falling behind the achievements of other African countries.

In summary, from the enormous challenge imposed and faced by African countries, the AFR100 initiative was created precisely to translate the commitments into actions. Thus, the initiative mobilized the participation of private sector investors, foundations, development banks, bilateral and multilateral donations, and many other resources necessary for the process. Raising funds, equity investments, loans, risk management guarantees, and funds for specific interventions, the AFR100 supports restoration projects and mobilizes local communities committed to environmental preservation (Messinger & Winterbottom, 2016).

4. Discussion

Despite the forest still being degraded for several reasons, the Amazon countries share some common features that can facilitate maintaining the forest standing. Regardless of initiatives such as OTCA and Pacto de Leticia, they have not been effectively implemented, and there is still a lack of consistent governance for this to be achieved. In the success cases of environmental recovery and preservation presented in Mansourian (2020), governance is the main pillar.

The 2019 report IUCN Bonn Barometer (Dave et al., 2019) indicates four factors to ensure a successful outcome of the Bonn Challenge: (i) policy and institutional framework; (ii) financial flows; (iii) technical underpinning: restoration planning; and (iv) technical underpinning: monitoring FLR. These factors were identified both in the case of the state of Espírito Santo, Brazil, and Rwanda, which were also approached in the report. Despite these factors, without consistent governance, it will be difficult to fully implement them. This becomes clear when these two cases are compared: (i) the degradation of the Amazon as a whole, in which a deficit of governance is perceived; and (ii) the success in the state of Espírito Santo, in which jurisdictional policies and governance were established.

Although eight countries are signatories of the Amazon Cooperation Treaty Organization (OTCA), a cooperation agency for Amazon countries, it still has limited effectiveness. As previously mentioned, politicians tend to focus on short-term goals, often with an interest only in promoting their mandate. As environmental and forestry measures tend to be

long-term and should have continuity under a new government, this is not necessarily the case given the new government's priority might be different. Hence, the short-term vision of government cannot be used in the implementation of forest policies.

The AFR100 Initiative can be an incentive and a model to be followed for the implementation of regional governance among Amazonian countries, given that, in addition to establishing governance, the initiative already presents positive results. This type of governance is responsible for creating synergies to achieve forest preservation and restoration while fulfilling the agendas and commitments established by each country. As in the AFR100, the governance established for the Amazon biome should support financial and technical issues.

The international experience of AFR100, different from the OTCA where the focus is the government a priori, presents governance based on the tripod (i) government, (ii) partners, and (iii) investment funds. The multilevel governance proposed by AFR100 is supported by the AFR100 Board (consisting of country representatives, donors, and financial partner representatives), secretariat (serves as the main contact for the initiative), and the AFR100 Technical Assistance Platform (TAP) (operates as a clearinghouse to facilitate partners' engagement to support AFR100) in a configuration consistent with the network shown in Figure 2. Considering the Amazonian context, the Board would have a similar function to those of AFR100 and would consist of country representatives of the nine nations that share the Amazonia forest.

4.1 How it Applies to the Amazon Biome Context

The Secretariat and the TAP would be encompassed by the Land use, Land-use Change and Forestry (LULUCF) Unit. Following the model proposed by AFR100, this unit would not be led by, but would include representatives from international institutions, such as WRI and FAO, committed to the preservation and restoration of the Amazon biome. Donations and additional partner organizations would also be allocated in this unit.

Thus, the regional agency, i.e., the governance model adopted by the Amazon countries, should be composed of a board of directors with members from the nine countries, constituting the leadership according to the model proposed by the Brazilian Court of Auditors (TCU, 2014). In addition to members from the nine countries, the council would include donors and financial partner representatives. The board of directors should provide strategic guidance to achieve established goals. It will be its function to raise financial and human resources and to attract committed people with technical skills, establishing the necessary partnerships. Additionally, this group would be responsible for encouraging other departments and supporting already established initiatives, providing the necessary strategies for implementing existing success factors (Figure 3).

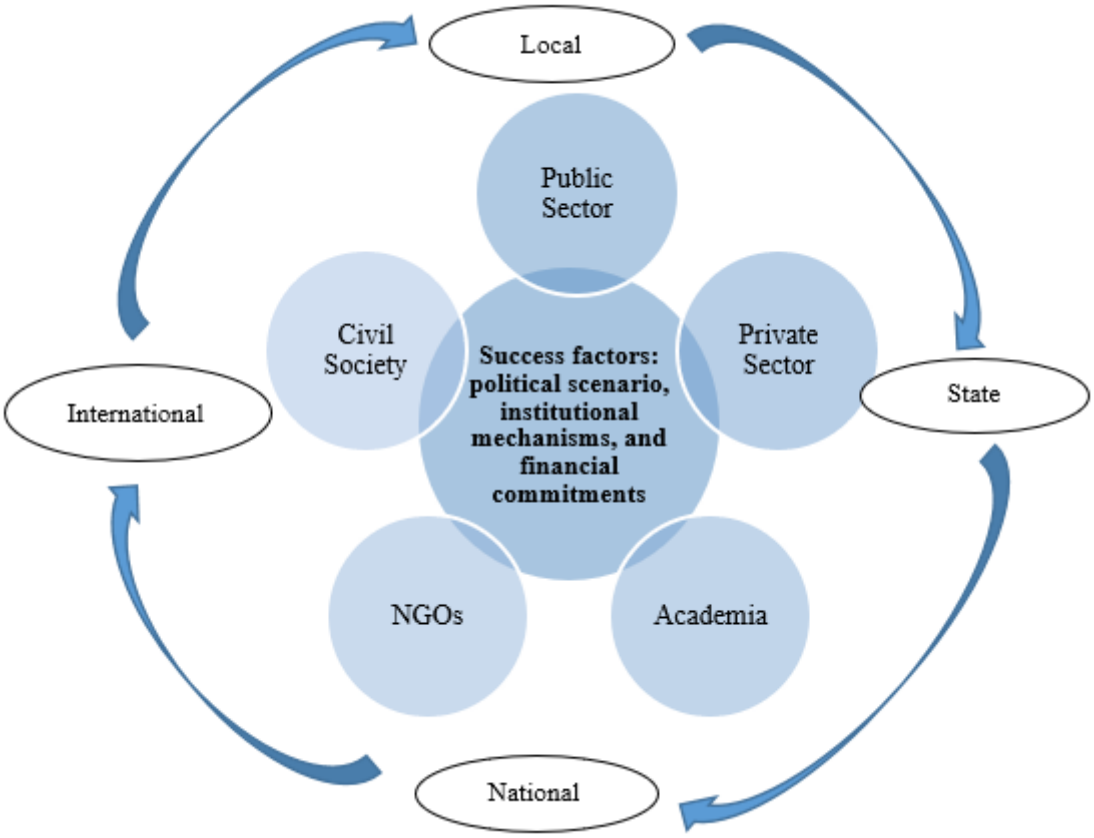

Figure 3. Disseminated leardership network

Source: Adapted from Fernandes (2019)

Supporting the board of directors, the LULUCF Unit, composed of actors appointed by the board itself, would have the function of designing and implementing a new mentality capable of translating this yearning for forest maintenance, recovery, and reforestation, based on a model of development. One of its tasks would entail coordinating partnerships to mobilize and sustain political support from the nine countries, providing technical assistance, and facilitating investment through coalition building, knowledge management, monitoring, and reporting. The proposal for the simplified structure of the regional agency is presented in Figure 4.

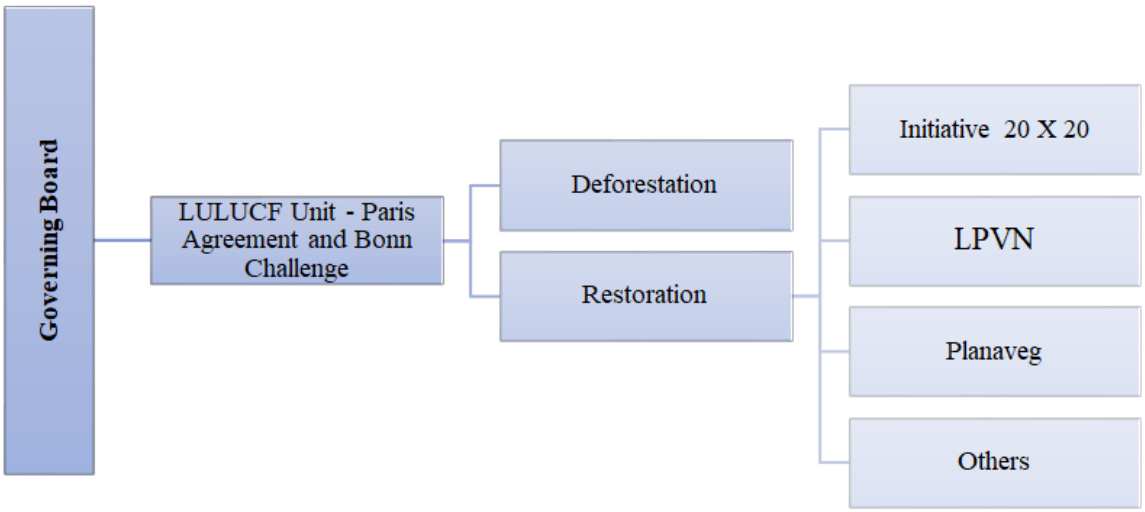

Figure 4. Simplified governance structure

Source: Adapted from Fernandes (2019)

Two other departments would fall under the LULUCF unit, namely: (i) deforestation and (ii) recovery and/or reforestation. Their members, with high technical capacity, would have the role of implementing existing success factors (Tables 1 and 2) such as the 20 x 20 Initiative, Planaveg, and the LPVN. For such, they would have tasks such as identifying opportunities, monitoring stakeholders throughout the production chain, providing the necessary technical support, disseminating success stories, and ensuring the effective implementation of existing solutions for forest conservation. At this stage, the participation of local communities and rural landowners is extremely important, both in implementing the solutions and in monitoring, as seen in the study by Mansourian (2020).

Regarding the proposed governance strategy, taking Brazil as an example, it is already outlined; the country has forestry policies in place that can guide the conservation plan. This is the case of Planaveg, which guides the process of recovery of native vegetation and the LPVN. Regulatory mechanisms are considered in the model so that they can later be adapted to other Amazonian countries, if they find it convenient. Thus, in a multilevel governance model, the Planaveg hierarchical level would be composed of representatives from all Amazonian countries that have similar plans for the recovery of native vegetation; the same would happen for the law for the preservation of native vegetation and for the 20 x 20 initiative.

Regarding control and monitoring, Brazil has extensive experience and knowledge, particularly through institutions such as the Brazilian National Institute for Space Research (INPE), Satellite monitoring, Agrosatellite, and MapBiomas. Obviously, improvements can be implemented to meet the needs for international reporting, e.g., to the Climate Change Convention. Brazil has satellite technology to monitor forest coverage, agricultural and livestock production areas, deforested areas, and areas in the process of recovery. Such

technology would then be shared with other countries belonging to multilevel governance so that the Amazon as a whole could be better monitored through the identification of points of deforestation, forest fires, and restoration.

In this context, the INPE and OTCA already have initiatives for the shared use of monitoring technologies. An example of this is the Monitoring of Deforestation, Forest Use, and Changes in the Use of Soil in the Regional Amazon, in which technical professionals from participating countries get involved in the mapping, monitoring, and inspection of deforestation and Amazon Forest cover. These professionals were trained and created knowledge through techniques and concepts of Remote Sensing, methodologies, and the use of the TerraAmazon system (Mesia, C. E. C., et al., 2015).

Initiatives presented by Mansourian (2020) have already demonstrated the need for governance for the success of environmental recovery and preservation. The AFR100 has already shown that such multilevel governance, which would take place in the Amazon through the regional agency, could bring positive results in issues related to deforestation and environmental preservation. Considering that the program encompasses a much larger number of countries, it is anticipated that 100 million hectares of degraded areas will be successfully restored. Bringing such governance to the Amazon, a similar result is expected, with the recovery of at least 20 million hectares of degraded areas.

The article presents as a limitation the identification of only some forestry policies in Brazil and in other Amazonian countries. Despite the importance of the Amazon in regional and international terms, little is known about common management practices among the countries that share the Amazon basin. Another limitation of the research is that it cannot be generalized to other ecosystems on the planet, nor to any and every country. The lessons presented here serve so that other governance can be directed towards restoring degraded areas and/or slowing down deforestation.

5. Concluding Remarks

The proposition and creation of governance among Amazonian countries are fundamental for achieving the objectives for the conservation of the biome; such governance must take into account existing public policies, institutional mechanisms, and financial commitments. Although the Amazon countries present a framework of policies and commitments that seek to preserve the biome, the reality is that forest degradation through deforestation with negative effects on the climate and on the communities that depend on the standing forest still exists.

As a result of this paper, we suggest the creation of supranational governance, composed and regulated by each of the nine countries of the Amazon biome and having as a reference the AFR100 initiative, which foresees the recovery of 100 million hectares of degraded and deforested areas in Africa. The main function of multilevel governance through the agency would be a priori to identify and implement existing success factors with a view to preserving the biome.

Regional governance would be responsible for setting the goals, in addition to monitoring,

supervising, raising awareness, and encouraging the fulfillment of the objectives established both in the Paris Agreement and in the Bonn Challenge. It would count on (i) trained leadership; (ii) strategy based on goals; and (iii) monitoring via indicators. Its purpose would be to implement existing solutions such as the 20 x 20 Initiative, Planaveg, and LPVN. The search for greater articulation between actors in a governance model capable of establishing synergy between different parties can contribute to greater effectiveness of forest conservation actions. Therefore, the creation of governance among all Amazonian countries for forest conservation is suggested.

An articulated planning between the different agents is recommended in the case studied. In addition, a structure that avoids redundancies and increases the coverage of actors' actions would be necessary. The joint deliberation by the leaders and the definition of which actor will contribute to which measure with clear indicators to be pursued can be decisive. The implementation of forest policies already defined and the formulation of new ones that present similarities among the nine Amazon countries are fundamental for the effectiveness of these actions. Thus, forestry agents and policies will have a central role in the design of this governance.

Multilevel governance contributes to the process of environmental conservation. Its purpose is to unite local, national, and international leaders, from the most diverse groups, including the public sphere – with the political class –, the private sector – with companies – academia, NGOs, civil society, local institutions, and cooperatives. A better integration of agents from countries that share the Amazon biome, a definition of the legal basis, and the application of multilevel governance can contribute to greater effectiveness in the conservation of these areas.

The article brings as a theoretical contribution the study of shared governance between these countries as a means of identifying and implementing forestry policies to preserve the biome. As a practical contribution, we suggest the creation of a national coalition through a multilevel governance structure. This proposition extends to the other countries that make up the Amazon biome and takes into account the governance model proposed by AFR100. This suggestion can help managers, both public and private, in the search for forest maintenance. The supranational international coalition would be responsible for inspecting, raising awareness, and encouraging the nine Amazon countries so that they could develop effective strategies. In addition to the maintenance and conservation of the biome, the coalition would aim to maintain the predominant economic activity in each Amazon region in a sustainable way.

As a recommendation for future studies, we suggest continuing this research with the identification of forest policies in other countries. Thus, mapping strategies for implementation based on the suggested governances are also suggested. Furthermore, the development of studies on new sustainable business models considering bioeconomy is suggested, in order to reconcile the standing forest with local sustainable development.

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Authors contributions

Dr. Carolina Cristina Fernandes and Prof. Jacques Marcovitch were responsible for the study design and revisions. Dr. Carolina Cristina Fernandes was responsible for data collection. Dr. Carolina Cristina Fernandes, Prof. Jacques Marcovitch, and Dr. Karen Esteves drafted the manuscript and revised it. Dr. Karen Esteves translated it, and Prof. Jacques Marcovitch revised it. All authors read and approved the final manuscript.

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No additional data are available.

References

AFR100 (2021). *AFR100*. [Online] Available: https://afr100.org/

Andonova, L. B. (2013). Boomerangs to Partnerships? Explaining State Participation in Transnational Partnerships for Sustainability. *Comparative Political Studies, 47*(3), 481-515. https://doi.org/10.1177/0010414013509579

Andrade, D. C., & Romeiro, A. R. (2009). Serviços ecossistêmicos e sua importância para o sistema econômico e o bem-estar humano. Texto para Discussão, *Instituto de Economia - Universidade Estadual de Campinas, 155*, 1-44.

Armitage, D. (2007). Governance and the Commons in a Multi-Level World. *International Journal of the Commons, 2*(1), 7, https://doi.org/10.18352/bmgn-lchr.28

Atyl, R. E., & Mbonayem, L. (2018, August). Reshaping the terrain Forest and landscape restoration in Cameroon. *GLF Factsheet*, 1-4, https://doi.org/10.13140/RG.2.2.11411.94249

Averna, E., & Winterbottom, R. (2016). *African Nations Poised to Rapidly Accelerate Landscape Restoration.* [Online] Available: https://www.wri.org/insights/african-nations-poised-rapidly-accelerate-landscape-restoration

Ball, A., Gouzerh, A., & Brancalion, P. (2014). Multi-Scalar Governance for Restoring the Brazilian Atlantic Forest: A Case Study on Small Landholdings in Protected Areas of Sustainable Development. *Forests, 5*(4), 599-619, https://doi.org/10.3390/f5040599

Brancalion, P. H. S., Garcia, L. C., Loyola, R., Rodrigues, R. R., Pillar, V. D., & Lewinsohn, T. M. (2016). Análise crítica da Lei de Proteção da Vegetação Nativa (2012), que substituiu o antigo Código Florestal: atualizações e ações em curso. *Natureza & Conservação, 14*, e1-e16, https://doi.org/10.1016/j.ncon.2016.03.004

Brasil. (2012). Lei nº. 12.651, de 25 de maio de 2012. Dispõe sobre a proteção da vegetação nativa; altera as Leis nos 6.938, de 31 de agosto de 1981, 9.393, de 19 de dezembro de 1996, e 11.428, de 22 de dezembro de 2006; revoga as Leis nos 4.771, de 15 de setembro de 1965, e 7.754, de 14 de abril de 1989, e a Medida Provisória no 2.166-67, de 24 de agosto de 2001; e dá outras providências. Portal da Presidência da República. [Online] Available: http://www.planalto.gov.br/ccivil_03/_Ato 2011-2014/2012/Lei/L12651.htm

Brasil. (2015). Pretendida Contribuição Nacionalmente Determinada para consecução do objetivo da Convenção-Quadro das Nações Unidas sobre Mudança do Clima. Portal do Itamaraty. [Online] Available: http://www.itamaraty.gov.br/images/ed_desenvsust/BRASIL-iNDC-portugues.pdf

Coalizão Brasil Clima, Florestas e Agricultura. (s/d.). Quem somos. Portal da Coalizão Brasil Clima, Florestas e Agricultura. [Online] Available:

http://www.coalizaobr.com.br/home/index.php/sobre-a-coalizao/quem-somos

Comissão das Comunidades Europeias. (2003). *Comunicação da Comissão ao Conselho, ao Parlamento Europeu e ao Comité Económico e Social Europeu: governança e desenvolvimento.* [Online] Available: https://eur-lex.europa.eu/legal-content/PT/TXT/PDF/?uri=CELEX:52003DC0615&from=PT

Dave, R., Saint-Laurent, C., Murray, L., Antunes Daldegan, G., Brouwer, R., ... Pearson, T. (2019). *Second Bonn Challenge progress report*: *application of the Barometer in 2018.* https://doi.org/10.2305/iucn.ch.2019.06.en

Dobrynin, D., Smirennikova, E., & Mustalahti, I. (2020). Non-state forest governance and 'Responsibilization': The prospects for FPIC under FSC certification in Northwest Russia. *Forest Policy and Economics, 115*, 102142, https://doi.org/10.1016/j.forpol.2020.102142

Fernandes, C. C. (2013). Conhecer para conservar - Museu da Amazônia (MUSA). In J. Marcovitch (Org.). *Fundo Amazônia: evolução recente e perspectivas* (pp. 68-76). São Paulo: FEA-USP.

Fernandes, C. C. (2019). *Governança ambiental para a recuperação florestal: um estudo para o bioma Amazônia*. Tese de Doutorado, Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo. https://doi.org/10.11606/T.12.2019.tde-18102019-175723

Gatti, L. V., Basso, L.S., Miller, J. B. et al. (2021). Amazonia as a carbon source linked to deforestation and climate change. *Nature, 595*, 388-393. https://doi.org/10.1038/s41586-021-03629-6

González, N. C., & Kröger, M. (2020). The potential of Amazon indigenous agroforestry practices and ontologies for rethinking global forest governance. *Forest Policy and Economics, 118*, 102257, https://doi.org/10.1016/j.forpol.2020.102257

Gupta, D., Lele, S., & Sahu, G. (2020). Promoting a responsive state: The role of NGOs in decentralized forest governance in India. *Forest Policy and Economics, 111*, 102066. https://doi.org/10.1016/j.forpol.2019.102066

IPCC (2021). *Sixth Assessment Report Climate Change 2021*: The Physical Science Basis, the Working Group I contribution to the Sixth Assessment Report.

Jacobi, P. R., & Sinisgalli, P. A. de A. (2012). Governança ambiental e economia verde. *Ciência & Saúde Coletiva, 17*(6), 1469-1478. https://doi.org/10.1590/s1413-81232012000600011

Kässmayer, K., & Fraxe Neto, H. J. (2016). *A Entrada em Vigor do Acordo de Paris: o que muda para o Brasil?* Brasília: Núcleo de Estudos e Pesquisas/CONLEG/Senado, Novembro/2016 (Texto para Discussão nº 215).

Lorenzetti, J. V., & Carrion, R. M. (2012). Governança ambiental global: atores e cenários. *Cadernos EBAPE.BR, 10*(3), 721-735. https://doi.org/10.1590/s1679-39512012000300014

Lovejoy, T. E., & Nobre, C. (2018). Amazon Tipping Point. *Science Advances, 4*(2). https://doi.org/10.1126/sciadv.aat2340

Maia, A. G., Romeiro, A. R., & Reydon, B. P. (2004). Valoração de recursos ambientais: metodologias e recomendações. Texto para Discussão. *Instituto de Economia - Universidade Estadual de Campinas, 116*, 1-38.

Mansourian, S. (2016). Understanding the Relationship between Governance and Forest Landscape Restoration. *Conservation and Society, 14*(3), 267. https://doi.org/10.4103/0972-4923.186830

Mansourian, S. (2020). *Enabling Factors to Scale Up Forest Landscape Restoration*: The Roles of Governance and Economics Full Report with Case Studies.

Marcovitch, J., Fernandes, C. C. (2018). O bioma Amazônia e o Acordo de Paris. Congresso de Gestão da Amazônia, 2018, Manaus. *ANAIS AMAS*.

Mesia, C. E. C., Gomes, A. R., & Marcuartú, B. C. (2015). Capacitação em Monitoramento de Florestas Tropicais utilizando Sistema TerraAmazon no âmbito do Projeto de Cooperação entre INPE e OTCA. *Anais XVII Simpósio Brasileiro de Sensoriamento Remoto.*

Messinger, J., & Winterbottom, B. (2016). African Forest Landscape Restoration Initiative (AFR100): Restoring 100 million hectares of degraded and deforested land in Africa. *Nature & Faune - Enhancing natural resources management for food security in Africa, 30*(2), 14-17.

Ministério do Meio Ambiente. (s/d.a). *Cadastro Ambiental Rural*. [Online] Available: http://www.mma.gov.br/desenvolvimento-rural/cadastro-ambiental-rural

Ministério do Meio Ambiente. (2014). *Plano Nacional de Recuperação da Vegetação Nativa*. Brasília: MMA. [Online] Available: http://www.mma.gov.br/images/arquivo/80049/Planaveg/PLANAVEG_20-11-14.pdf

Mota, J. A.; Gazoni, J. L.; Reganhan, J. M., Silveira, M. T., & Góes, G. S. (2008). Trajetória da governança ambiental. *Ipea Regional e Urbano, 1*, 11-20.

Paap, P., & Hol, P. (2016). Private sector ready to scale up commercial reforestation as part of forest landscape restoration. *Nature & Faune - Enhancing natural resources management for food security in Africa, 30*(2), 8-13.

Pnuma/Otca. (2008). Programa das Nações Unidas para o Meio Ambiente/Organização do Tratado de Cooperação Amazônica. *Geo Amazônia: perspectivas do meio ambiente na Amazônia*. Brasília: PNUMA/OTCA.

RAISG [Rede Amazônica de Informação Socioambiental Georreferenciada]. (2020). *Amazônia under pressure*. [Online] Available: https://atlas2020.amazoniasocioambiental.org/en/posts/amazonia

Rantala, S., Swallow, B., Paloniemi, R., & Raitanen, E. (2020). Governance of forests and governance of forest information: Interlinkages in the age of open and digital data. *Forest*

Policy and Economics, 113, 102123, https://doi.org/10.1016/j.forpol.2020.102123

Seama. (2021). *SEAMA - Secretaria do Meio Ambiente e Recursos Hídricos*. [Online] Available: https://seama.es.gov.br/

Tribunal de Contas da União. (2014). *Governança pública: referencial básico de governança aplicável a órgãos e entidades da administração pública e ações indutoras de melhoria*. Brasília: Tribunal de Contas da União / Secretaria de Planejamento, Governança e Gestão. *s.* [Online] Available: https://portal.tcu.gov.br/data/files/FA/B6/EA/85/1CD4671023455957E18818A8/Referencial_basico_governanca_2_edicao.PDF