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Fires in the Amazon Region: Quick Policy Review

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Summary

Motivation: The combination of institutional weaknesses, climate change, and overexploitation is increasingly recognized as endangering the Amazon forest. These three factors made 2020 the worst year for forest fires recorded in the previous 60 years. We analyse environmental policies across the nine countries of the Amazon Basin to develop national and regional forest programmes to tackle this scenario.

Purpose: The study synthesizes and compares key environmental legislation concerning protected natural areas (PNAs) and fire management in the nine countries of the Amazon Basin. To this end, the research question asks what directions can be drawn from a visualization and compilation of national regulations for future policy research and practice.

Methods and approach: We undertake a critical literature review of PNAs and fire-management policies across the nine countries of the Amazon Basin and their further alignment using analyses of previous policy reviews on forest codes and land distribution.

Findings: The article shows the heterogeneity of national fire-use and fire-management policies among the nine countries of the Amazon Basin. In addition, it suggests that top-down policies and regulations are likely to be characterized by misunderstandings (either direct or indirect) of local practice, rationale, and capacity; and, in some cases, risk criminalizing local and indigenous daily subsistence.

Policy implications: The study indicates the need for more in-depth research and policy on participatory governance platforms for the use and management of fire, rather than fire-suppression and fire-risk adaptation strategies. There are some positive, albeit often isolated, cases, to which scholars, policy-makers, and environmental practitioners should pay more attention.

KEYWORDS

Amazon Basin, fire governance, forest policies, land-use policies, management policies, wildfire policies

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1 | INTRODUCTION

The Amazon Basin comprises areas of Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname, and Venezuela. Over the past 40 years, its rainforest has been subjected to increasing deforestation, warming, and moisture, especially during the dry season (Gatti et al., 2021). In 2020, an alarming number of fires in the Amazon was recorded, along with the resulting deforestation. This made it an even worse year than 2019, which in turn had been observed as the most destructive year in the history of the Amazon. According to the World Meteorological Organization (WMO), this trend is causing irreversible damage to the region and beyond (WMO, 2020). For instance, while the world's largest rainforest stores about 10% of global carbon, recent studies show a major decline in its ability to regulate climate (Gatti et al., 2021).

Institutional weakness, anthropogenic disruption, and climate change are three of the major drivers of deforestation, overexploitation, and the changes in the use of land and natural resources (e.g. to make way for agriculture, livestock, logging, and mining) (Bellard et al., 2012; Ruiz Agudelo et al., 2020). Deforestation in the Amazon often goes hand in hand with fire practices (Van Marle et al., 2017) that also release particulate matter into the atmosphere, which reduces air quality and can affect human health (Johnston et al., 2012).

Beyond global and regional policy initiatives such as the United Nations Framework Convention on Climate Change (UNFCCC), the Amazon Cooperation Treaty Organization (ACTO), and the Leticia Pact, the nine Amazonian governments hold a significant share of responsibility with regard to the effectiveness and implementation of national regulations and how the issues of concern are being addressed.

Based on this assumption, the aim of this study is to synthesize, compile, and compare key environmental legislation, in particular concerning protected natural areas (PNAs) and fire management in the Amazon Basin. The choice to limit the focus to these two aspects addresses the inherent and often interdependent relationship between socio-ecological processes across PNAs' boundaries for their long-term ecological viability, including fire and fire risk (Mistry & Bizerril, 2011). To this end, our research question asks what directions can be drawn from a visualization and compilation of national policies for future policy research and practice.

The article proceeds as follows. We present updated information that is representative of the key environmental legislation concerning PNAs and fire management in the Amazon Basin in section 2. We then go on in section 3 to present a short discussion on each country, drawing on existing studies and policy reviews. Finally, in section 3, we offer remarks on shaping general possible and future policy implications and approaches.

2 | DEFORESTATION, FIRE USE AND MANAGEMENT POLICIES

In the Amazon Basin, nearly 80% of the forests are publicly owned, covering an area of 1.4 million km². There is, however, an increase in ownership and forest management by individuals, communities, and private companies (FAO and ITTO, 2011). In some countries, there is an upward trend in the involvement of communities and private companies in the management of publicly owned forests. Only in Brazil do communities (FAO and ITTO, 2011) manage a large proportion (37%) of publicly owned forests.

There are approximately 522 PNAs across the whole of the Amazon Basin (Walker et al., 2020). Legal systems constitute the frameworks within which governments, non-government organizations (NGOs), communities, and individuals can work to preserve the globally important ecosystems of the Amazon region. Table 1 outlines the key environmental legislation concerning PNAs and fire management in the Amazon Basin in each of the nine countries. While the last 20 years have seen significant progress in environmental policies, as well as in the development of national and regional forest programmes, they have also revealed the virtual inability of national governments to restrain or reduce rising trends in wildfires and deforestation processes. Fires normally occur around the dry season as slash-and-burn methods are used to clear the forest to make way for agriculture, livestock, logging, and mining. Wildfire activity is

TABLE 1 Legislative Frameworks on Environmental Policies (Fire Management and PNAs)

BRAZIL			
Legislative frameworks	Original name	Institution	Year
Decree on National System for Forest Fire Prevention and Control (Prevfogo)	Decreto nº 2.661 de precaução relativas ao emprego do fogo em práticas agropastoris e florestais, e dá outras providências	President of the Federal Government of Brazil	1998
National PNAs Act	Lei Nacional de Áreas Protegidas	Ministry of the Environment	2000
Chico Mendes Institute for Biodiversity Conservation (ICMBio)	Lei que Estabelece ICMBio	Ministry of the Environment	2007
National PNAs Plan	Plano Nacional de Áreas Protegidas	Ministry of the Environment	2006
Public platform: monitoring and prevention efforts that fight against deforestation	Amazon Fund	The Kingdom of Norway and the Federal Republic of Brazil	2007
Brazilian Forest Code	Código Florestal Brasileiro	President of the Federal Government of Brazil	2012
Guarantee of Environmental Law and Order, Decree	Garantia da Lei e da Ordem (GLO)	President of the Federal Government of Brazil	2019
National Fire Policy	Política Nacional de Manejo Integrado do Fogo	President of the Federal Government of Brazil	2018
BOLIVIA			
Legislative frameworks	Original name	Institution	Year
Law on Wildlife, National Parks, Hunting and Fishing	Ley de Vida Silvestre, Parques Nacionales, Caza y Pesca	National PNAs Service (SERNAP)	1975
PNAs Regulations	Reglamento de Áreas Protegidas	National PNAs Service (SERNAP)	1997
Law 741 on land clearance up to 20 ha for small-scale and communal or collective agricultural and livestock activities	Ley de autorización de desmonte hasta 20 hectáreas para pequeñas propiedades y propiedades comunitarias o colectivas para actividades agrícolas y pecuarias	Constitutional President of the Plurinational State of Bolivia	2015
Law 1171 on controlled fire use and management	Ley de uso y manejo racional de quemas	Constitutional President of the Plurinational State of Bolivia	2019

(Continues)

TABLE 1 (Continued)

BRAZIL			
Legislative frameworks	Original name	Institution	Year
Supreme Decree 3973 authorizing the clearing of land for agricultural activities in the departments of Santa Cruz and Beni	Decreto que modifica el Artículo 5 del Decreto Supremo N° 26075, de 16 de febrero de 2001, autorizando el desmonte para actividad agropecuaria en los departamentos de Santa Cruz y Beni	Constitutional President of the Plurinational State of Bolivia	2019
Supreme Decree on PNAs	Decreto 2366: las Áreas Protegidas en Bolivia	Constitutional President of the Plurinational State of Bolivia	2015
COLOMBIA			
Legislative frameworks	Original name	Institution	Year
Law on the National Environmental and Territorial Co-ordination System (SINA)	Ordenamiento Ambiental Territorial y Coordinación del SINA	Ministry of Environment and Sustainable Development	1993
Decree on Regulations for Land Management Plans	Decreto 879: reglamento para los Planes de Ordenamiento Territorial	President of the Republic of Colombia	1998
Regulations on the National System of PNAs	Reglamento del Sistema Nacional de Áreas Protegidas	Ministry of Environment and Sustainable Development	2010
List of Threatened Species in Colombia	Lista de Especies Amenazadas en Colombia	Ministry of Environment and Sustainable Development	2014
Land Use Law	Ley del Uso del Suelo	Ministry of Environment and Sustainable Development	1997
Inclusion of Environmental Determinants in Territorial Planning	Inclusión de Determinantes Ambientales en la Planificación Territorial	Ministry of Environment and Sustainable Development	1997
Inclusion of Environmental Determinants in Watershed Management Plans	Inclusión de Determinantes Ambientales en los Planes de Gestión de Cuencas	Ministry of Environment and Sustainable Development	2012
Fire Management Law 221	Proyecto de ley 221 de 2019 sobre manejo integral del fuego	Ministry of Agriculture and Rural Development	2019
ECUADOR			
Legislative frameworks	Original name	Institution	Year
Law on Forestry and Natural PNAs and their regulations	Ley Forestal y de Áreas Naturales Protegidas y sus reglamentos	Ministry of the Environment	2004
Law for the Preservation of Reserve Areas and National Parks	Ley Para La Preservación De Zonas De Reserva Y Parques Nacionales	Ministry of the Environment	2004
Amazon without Fire Programme	Amazonia Sin Fuego (PASf)	Ministry of the Environment	2017

TABLE 1 (Continued)

BRAZIL			
Legislative frameworks	Original name	Institution	Year
National Strategy for Integrated Fire Management and the formation of the National Committee for Integrated Fire Management (Conamif)	Estrategia Nacional de Manejo Integral del Fuego y la conformación del Comité Nacional de Manejo Integral del Fuego (Conamif)	Ministry of the Environment and Water	2020
FRENCH GUIANA			
Legislative frameworks	Original name	Institution	Year
EU FLEGT (Forest law enforcement, governance and trade action plan)	Forest law enforcement, governance and trade action plan	European Commission	2003
Amazonian Park of French Guiana	Décret de création du parc amazonien de Guyane	Public administrative establishment (EPA)	2007
Environmental Code	Journal officiel de la République française (JORF)	Republic of France (https://www.legifrance.gouv.fr)	
EU BEST (voluntary scheme for Biodiversity and Ecosystem Services in Territories of European overseas)	BEST Initiative	European Commission (https://ec.europa.eu/environment/nature/biodiversity/best/regions/amazonia_en.htm)	
GUYANA			
Legislative frameworks	Original name	Institution	Year
Iwokrama International Centre for Rain Forest Conservation and Development		Co-operative Republic of Guyana and the Commonwealth	1996
National Parks Commission Act		National Parks Commission (Ministry of Agriculture)	1990
Kaieteur National Park Act		National Parks Commission (Ministry of Agriculture)	1999
National adaptation strategy to address climate change in the agricultural sector of Guyana: strategy and action plan		National Parks Commission (Ministry of Agriculture)	2009
National Land Use Plan (NLUP)		Ministry of Natural Resources and Environment, Commission Land and Census of Guyana	2013
PNAs Act		National Parks Commission (Ministry of Agriculture)	2011
The National Forest Plan		National Parks Commission (Ministry of Agriculture)	2018
Code of Practice for Timber Harvesting		National Parks Commission (Ministry of Agriculture)	2018
PERU			
Legislative frameworks	Original name	Institution	Year
Natural PNAs Act	Ley de Áreas Naturales Protegidas	National Service of Natural PNAs	1997

(Continues)

TABLE 1 (Continued)

BRAZIL			
Legislative frameworks	Original name	Institution	Year
Regulation of the Natural PNAs Act	Reglamento de la Ley de Áreas Naturales Protegidas	President of the Republic of Peru	2001
National Service of Natural PNAs by the state (SERNANP)	Servicio Nacional de Áreas Naturales Protegidas por el Estado (SERNANP)	Ministry of the Environment	2008
Bicentennial Plan: Peru towards 2021	Plan Bicentenario: El Perú hacia el 2021	National Planning Centre for Strategic Planning (CEPLAN)	2011
National Plan for Risk Management and Adaptation to Climate Change in the Agricultural Sector	Plan Nacional de Gestión de Riesgos y Adaptación al Cambio Climático en el Sector Agrario	Ministry of Agriculture	2012
Forestry and Wildlife Law	Ley Forestal y de Fauna Silvestre	Ministry of the Environment	2015
SURINAME			
Legislative frameworks	Original name	Institution	Year
Nature Conservation Act	Natuurbeschermingswet	Ministry of Spatial Planning, Spatial Planning and Forest Management	1954
State Land Issuance Decree	Decreet Uitgifte Domeingrond	Ministry of Spatial Planning, Spatial Planning and Forest Management	1982
Policy Development Plan	Ontwikkelings Plan 2017–2021	Republic of Suriname	2017
VENEZUELA			
Legislative frameworks	Original name	Institution	Year
National Parks Institute Act	Instituto Nacional de Parques	Ministry of the People's Power for Ecosocialism (MINEC)	1978
Law on Territorial Planning	Ley Orgánica para la Ordenación del Territorio	The Ministry of the Environment and Renewable Natural Resources; the Ministries of Internal Relations, Defence, Development, Agriculture and Farming, Energy and Mines, Transportation and Communications, Urban Development; and the Permanent Secretariat of the National Security and Defence Council	1983
Regulations on the Administration and Management of National Parks and Natural Monuments	Decreto 276: Reglamento Sobre Administración y Manejo de Parques Nacionales y Monumentos Naturales	President of the Bolivarian Republic of Venezuela	1989

TABLE 1 (Continued)

BRAZIL			
Legislative frameworks	Original name	Institution	Year
Law on Demarcation and Guarantee of the Habitat and Lands of Indigenous Peoples	Ley de Demarcación y Garantía del Hábitat y Tierras de los Pueblos Indígenas	Ministry of Indigenous Peoples	2001
Law on Indigenous Peoples and Communities	Ley Orgánica de Pueblos y Comunidades Indígenas	Ministry of Indigenous Peoples	2005
Law on Demarcation and Guarantee of the Habitat and Lands of Indigenous Peoples	Ley de Demarcación y Garantía del Hábitat y Tierras de los Pueblos Indígenas	Ministry of Indigenous Peoples	2001
Forest Law	Ley de bosques	Ministry of Indigenous Peoples	2013

Source: Authors' elaboration.

mostly illegal in the nine national legal systems concerning the Basin, but enforcement of environmental protection can be negligent or ineffective (Barlow et al., 2020; Börner et al., 2015; Malhi et al., 2008).

The following discussion should be considered in light of two main limitations. First, our review highlights directions in which Amazonian fire governance policy is headed, and which other researchers might explore further. Second, we do not address policies related to land ownership. However, we believe that our policy compilation and discussion may serve as the basis of, or support for, more in-depth studies.

3 | DISCUSSION

While fire management has been traditionally used by local and indigenous communities, and tropical grasslands and savannahs can be fire-prone ecosystems, the legal frameworks governing wildfire policies in most countries of the Basin do not consider the use and management of fire (Mistry et al., 2019). Norms are often focused on fire-suppression and fire-risk adaptation approaches, such as capacity building for fire brigades, rather than prevention and (sustainable) management.

In **Brazil**, the legislation on the use of fire has evolved over the years. Controlled burning is allowed in some cases and always with the authorization of the responsible agency. However, even with existing legislation, the lack of control and inspection contributes to the spread of forest fires and loss of biodiversity (Cabral et al., 2013). In response to the devastating 2019 Amazon rainforest fire outbreaks, the central government launched the "Green Brazil Operation Act" (*Operação Verde Brasil*) with the support of the armed forces, the Institute for the Environment and Renewable Natural Resources (Ibama), and the Chico Mendes Institute for the Conservation of Biodiversity (ICMBio). In addition, Decree No. 10.424 of July 15, 2020 suspended the permission to use the fire referred to in Decree No. 2,661, of July 8, 1998 in the national territory for a period of 120 days (Federal Republic of Brazil, 2020). The suspension in the decree did not apply to the subsistence agricultural practices carried out by traditional and indigenous populations. The current Brazilian Forest Code (Law n° 12.651/2012) maintained the prohibition of the use of fire in vegetation, but with some exceptions, which included the use of controlled burning in PNAs, in accordance with their management plan, aimed at the conservation management of native vegetation, whose ecological characteristics are evolutionarily associated with the occurrence of fire. Generally, Brazilian legislative frameworks attach great value to safeguarding PNAs in the Amazon as, among other objectives, they shield against wildfires in order to protect drier ecosystems of the Basin (Nelson & Chomitz, 2011;

Pereira et al., 2012). The National PNAs Act of 2000 and the National PNAs Plan of 2006 provide the legal basis to expand PNAs.

Under normal conditions, fires routinely used by farmers and ranchers rarely spread into adjacent rainforests, which are too wet to burn. However, the prolonged drought caused by climate change is changing this scenario. Moreover, in the last decade, the growing pressure of the global demand for commodities has contributed to the increase of deforestation with the adoption of major land-use fire in the country, especially the burning of felled forest and improving the forage quality for cattle pastures. While federal rules prohibit natural resource exploitation in high biodiversity hotspots (such as national parks, biological reserves, and ecological research stations), the exceptions regarding the controlled burning of natural ecosystems in PNAs and indigenous reserves in the “National Fire Policy” (Durigan & Ratter, 2016; Nepstad et al., 2006) in accordance with the Forest Code, as highlighted above. To date, the National System for Forest Fire Prevention and Control (Prevfogo) controls 44 federal areas comprising agrarian settlements and indigenous lands, corresponding to the 3.19% of Legal Amazon (Prevfogo, 2015). In PNAs, however, the ICMBio exercises control over and monitors 1.42% of the Legal Amazon (Prevfogo, 2015). As for the rest of the area, which exceeds 4.5 million km², fire prevention and firefighting is the responsibility of the state and municipal governments. Such stratification and distribution of roles across administrative levels can contribute to unco-ordinated and inefficient practices in combatting fires in the Brazilian Amazon. This situation may explain why and how wildfires mainly affect those areas, including PNAs and indigenous reserves, which already had high rates of deforestation.

In **Bolivia**, the political agenda of the last decade has tried to consolidate a development model based on the extraction of natural resources, be they hydrocarbons, minerals or extensive agriculture and livestock. Since 2013, the government has enacted various regulations that permit the expansion of the agricultural frontier, unsustainable infrastructure development (e.g. road networks in the region), the violation of land rights and land tenure in forested areas, and the promotion of land-use change and land clearing (Bustillo Sanchez et al., 2020; Fundación Solón, 2020). For instance, Law 741 authorized the clearing of up to 20 ha of forest land for smallholders and collective properties for agricultural and livestock activities. Because such initiatives do not require any land or forest management plans or the payment of patents per cleared area, wildfires and the resulting deforestation have accelerated and increased markedly from 2015 (Fundación Solón, 2020). Further, in 2019, Law 1171 on controlled fire use and management established the guidelines for the national policy of integrated fire management, regulating all administrative sanctions for unauthorized burning. The enforcement of payment of debts and fines, however, was soon put on hold due to pressure from the agroindustry sectors (Fundación Solón, 2020). Finally, in 2019, Supreme Decree 3973 authorized the clearing of land for agricultural activities in two large departments of eastern Bolivia, adjacent to the Amazon rainforest.

In the post-conflict socio-economic and political context of **Colombia**, fires affecting its Amazonian departments are associated with the advance of agricultural and livestock activities, tenure inequality, the weakness of property rights, poor fire-management practices, and the increasing (and unregulated) use of fire in slash-and-burn practices (Armenteras et al., 2019; Tebbutt et al., 2021). Historically, the areas that suffered the greatest environmental impact during over five decades of armed conflict in Colombia are located in regions with the highest concentration of PNAs, and are therefore of particular interest for the conservation of the country's fauna and flora. While deforestation in and around Colombian PNAs was also affected by extensive illicit crop production (Andrade, 2004; Negret et al., 2019; Tebbutt et al., 2021), it increased further after a peace agreement between the largest guerrilla group, FARC-EP, and the Colombian government was signed on November 12, 2016 (Clerici et al., 2020). A number of regulations that make no clear rulings on the matter form the key legislative framework on PNAs and fire management. Hence, there are regulatory gaps in farmers' and local communities' use and management of fire, especially in the context of the Amazon rainforest. For example, Resolution 532 of 2005, which regulates slash-and-burn agriculture and mining, does not include forestry-related activities, such as the cultivation of forestry plantations or livestock, leaving some areas of activity either legal or illegal with no clear rationale (Cuesta & Giraldo, 2013). Likewise, other initiatives remain largely ineffective and unimplemented, such as the agricultural projects related to the so-called Fire Management Law 221, which was established in 2019 as a

social platform with the goal of designing and monitoring new policies on fire safety, awareness, and wildfire mitigation in natural areas and PNAs. Yet, the pressure and threats on forests and PNAs were exacerbated between 2018 and 2019. The Colombian government approved regulations to expand the agricultural frontier while at the same time launching the National Development Plan, which set inadequate environmental targets, resulting in increasing environmental degradation and violations of human rights related to property rights and land tenure, among other issues (Eufemia et al., 2018; Eufemia et al., 2019). The Colombian environmental agenda not only contravenes several international agreements on climate change but also the ruling of the National Supreme Court that recognizes the Colombian Amazon as a “subject of rights” (Eufemia et al., 2019). In the context of increasing fires in and around PNAs, this reflects weak multi-level and multi-sectorial governance resulting both from an extractive (often centralized) political and economic agenda (Eufemia et al., 2021), and from the challenges of peacebuilding in the context of huge inequalities (e.g. mobilization of guerrilla groups from these areas, the presence of dissidents, and the opening of land for agriculture and other development projects, and uncontrolled “new colonization”) (Armenteras et al., 2019). These may be partial drivers of increased wildfires, which are a proxy for illegal deforestation in the Colombian Amazon.

Likewise, the problem of forest fires and deforestation seriously affects **Ecuador**, causing social, economic, and ecological damage in several provinces in the Amazon region. In the last 10 years, the country has lost more than 120,000 ha of tropical forest (FAO, 2015; MAE, 2018), including large areas of natural and protected forests. Further, the effects of the El Niño phenomenon and climate change are also leading to more frequent and more powerful forest fires. Historically, the Ecuadorian legislative frameworks on environmental policies have kept the topic of PNAs (e.g. the Law on Forestry and Natural PNAs and its regulations, and the Law for the Preservation of Reserve Areas and National Parks) and fire management isolated and disconnected/unconnected. Because of political instabilities and the lack of financial and administrative resources, there is no guarantee of proper and sustainable land-use management in and around PNAs. This situation has had a detrimental impact on the development of tourism and the economy of the provinces in the Ecuadorian Amazon (Marcinek & Hunt, 2019). A number of initiatives to reduce the incidence of wildfires, while also generating sustainable development activities, have begun only recently (Morra-Silva & Gutiérrez Villavicencio, 2020). For instance, preventive and alternative practices for the use and management of fire in agricultural activities are at the core of the national programme “Amazon without Fire” (PASF) and the creation of the National Committee for Integrated Fire Management (Conamif). Both are public policy instruments established in the Regulations of the National Environmental Code. Their aim is to develop capacity building on forest and wildfire use and management, through the implementation of best practices aimed at simultaneously conserving the environment (including in and around PNAs) and improving the living conditions of rural and indigenous communities (MAE, 2017). In brief, the PASF is establishing a new set of normative bodies, such as the development of the first National Strategy for Integrated Fire Management 2021–2025, the integration of fire management in the Regulations of the Environmental Code of Ecuador, as well as the development of policy briefs and proposals. Other methodological instruments for the development of operational plans, and contingency plans at the national, regional and local levels for incidents related to forest fires are also being promoted (OSBO, 2020). Despite a long delay with respect to the emergency in the Amazon region, Ecuador is showing a willingness to create the conditions for an integrated policy approach to the issue of fires. With an eye on PNAs, the inter-institutional planning instrument may minimize the negative effects of fire, recognizing the importance of its regulated and controlled use, by implementing alternative practices that contribute to protecting the environment and improving the communities' living conditions.

As a French overseas department, **French Guiana** responds to both French and EU legislative frameworks on environmental policies. Among the Amazon Basin countries, it has the largest percentage of forest in PNAs—around 50%—and the lowest levels of deforestation. However, there are increasing wildfires, especially in savannah ecosystems, and the activities of legal and illegal mining that are invading PNAs. Just 2.4% of the Amazonian savannahs fall within the current PNAs of the French Guiana (Stier et al., 2020), leaving these landscapes critically under-protected despite their potential to protect rainforests from uncontrolled fires. Pathways of human-induced

alterations in French Guiana's savannahs driven both by unsuitable agricultural practices and fire regimes and by the expansion of infrastructure and urbanization already pose a real threat to the protection of its rainforest landscapes. To date, the French Environmental Code, the national forest law, and several decrees on national parks, make fires in PNAs illegal. In this context, EU initiatives tend to promote sustainable and legal forest management, improving governance and trade in legally produced timber (e.g. forest law enforcement, governance and trade action plans, EU FLEGT), and voluntary schemes for biodiversity and ecosystem services (voluntary scheme for Biodiversity and Ecosystem Services in Territories of European overseas, EU BEST).

In **Guyana**, about 80% of the country's forests are state property, but only about 5% of the territory has been declared as a protected area (Bicknell et al., 2017) through the establishment of the Kaieteur National Park. Plans for expanding PNAs are embedded in both the National Forest Plan and Policy and the Code of Practice for Timber Harvesting, representing an incorporation of REDD+ into the existing policy frameworks (Benn et al., 2020). These include, among others, regulations supporting fire suppression/protection and fire-fighting through the implementation of forest carbon financing mechanisms, as well as capacity-building schemes of national forest fire management (Rodríguez et al., 2011). Although these instruments attempt to prevent and control the use of fire, the extensive burning of the landscape indicates a mismatch between fire policies and burning practices, possibly because of the lack of community-based approaches. In fact, indigenous peoples' role in fire management and control is limited, especially in decision-making and policy processes (Mistry et al., 2016). In the near future, the use and management of vulnerable ecosystems and the conservation of their resources will depend on the inclusion and participation of local and indigenous communities. Deforestation and forest degradation through human activity, especially in the Amazonian savannahs, may alter the current fireproof status of the Guyana Amazon by introducing higher fuel loads and drier microclimates and by increasing the chance of ignition whether by intention or negligence (GFMC, 2017). Protection will therefore be seen as a management and mitigation option to avoid emissions from deforestation and forest degradation (Mistry et al., 2016). The current situation is of slow progress in addressing issues related to land-titling and the recognition of indigenous tenure rights, weak governance, and high levels of corruption, all of which hinder fire-management strategies. To date, for instance, there seems to be no recognition in policy-making of traditional use of fire in savannahs by local and indigenous groups (Mistry et al., 2016).

In **Peru**, the Amazonian rainforest has lost over 2.1 million hectares since 2001, largely caused by small fires caused by shifting agriculture (Nolasco & León, 2004). From 2012 to 2016, Peru lost over 94,000 ha to forest fires (62,000 ha in 2016) (MINAM, 2020). Although natural conditions may be favourable for the spread of fire, such as temperature, dry seasons, and certain types and state of vegetation, especially on grassland and savannah ecosystems, 98% of forest fires are caused by illegal human practices, such as slash-and-burn agriculture (MINAM, 2020). Specific activities include plantations of cocoa and oil-palm plantations, illicit crops such as coca plantations, and illegal mining. To fight such high deforestation rates, the country's legislative framework on environmental policies has a broad focus on linking PNAs and climate change adaptation. The general approach is more reactive to large fire occurrences, for which the government focuses primarily on the extent of the burnt area rather than on the preventive measures to control and regulate fires or on the development of forestry (Mourao & Martinho, 2019). For instance, regulations in the National Service of Natural PNAs and National Plan for Risk Management and Adaptation to Climate Change in the Agricultural Sector include mechanisms to deal with existing fires in a timely and planned manner, aiming to minimize their impacts, especially on rainforests. Further, assigning fire management and control between two different ministries (Agriculture and Environment) may limit the implementation of current legislation, while shortcomings in decision-making processes may contribute to the increased severity of forest fires in the country (Nolasco & León, 2004). The conflicts or complementarity between various agricultural and forestry laws and policies lead to a lack of co-ordination between the institutions responsible for managing national natural resources in the Peruvian Amazon. This may facilitate illegal exploitation in the region.

Suriname has comparatively few environmental policy instruments at the national level, and it lacks subnational (institutional) capacity on fire management. Because of its rich deposits of gold and bauxite, the development of

mining, both legal and illegal, represents an increasing threat to the country's PNAs, covering 12% of the area. This situation is aggravated by the historical clashes between top-down policies on conservation and local resistance of organized indigenous communities. In some cases, indigenous peoples' rejection of new protected areas was built on (inadequate) consultation process and violation of human and land rights (Haalboom & Campbell, 2012). To date, the Surinamese government does not recognize indigenous or tribal communities, and there is no legislation that establishes or governs indigenous lands or other indigenous rights (Walker et al., 2020). Present plans build upon the Policy Development Plan 2017–2021 that sets out the broad outlines of Suriname's development priorities. It poorly covers fire and forest management in promoting an adapted disaster-risk strategy for specific planning regions, such as the Amazon, together with climate change planning to mitigate emissions through forest conservation (FAO, 2017).

In **Venezuela**, fire-management programmes and policies are designed with the aim of supporting local organizations and indigenous communities through central operations that provide transport, food, equipment, etc. In some regions, excellent economic incentives are provided to manage and prevent and control fires. Notwithstanding this general framework, wildfires remain an important challenge for the country given that illegal mining is the main cause of deforestation, with 80% of illegal mines in the Amazon region (FAO, 2015). From 2013 onwards, the new Forest Law established a new set of activities related to human–forest relations that promotes popular consultation at both the regional and the local level. In some cases, the burning of vegetation and the use of controlled fire for agricultural or livestock purposes are allowed and are managed on a community basis. In addition, participatory processes are in place that develop intercultural and participatory fire-management policies (Bilbao et al., 2019; Eloy et al., 2019). These include, among other things, scientific and local or traditional knowledge transfer and exchange, and co-management, and supportive strategies in and around PNAs. This approach gives priority to proactive and preventive measures rather than being simply reactive. The so-called “intercultural and participatory fire management” is a space for dialogue and collaborative research that supports a new paradigm based on the exchange of knowledge between indigenous people, farmers, scientists, and authorities (Eloy et al., 2019). Despite the importance and relevance given to participatory forms of governance for fire management, there are as yet no concrete policies with a national scope for PNAs and their surroundings. Unfortunately, the country remains in the grip of immense economic, political and, more recently, a heightened health crisis.

4 | CONCLUSION

Our study shows the heterogeneous national fire-use and management policies among the nine countries of the Amazon Basin. In some cases, their application is largely ineffective (e.g. Bolivia, Peru), while in others, the focus is on the suppression of fire and fire-risk adaptation strategies (e.g. Brazil, Guyana, and Suriname). With regard to policies in and around PNAs, fire management is either illegal (e.g. French Guiana), addresses traditional fire use in savannah or grassland ecosystems by local and indigenous groups (e.g. Guyana), or is built on participatory platforms of governance for fire use and management (Colombia, Ecuador, and Venezuela). In addition, it suggests in a rather simplistic fashion that top-down policies/rules appear to be characterized by a misunderstanding (either direct or indirect) of local practice, rationale, and capacity, in some cases risks criminalizing local and indigenous practices of daily subsistence production (Berlinck & Batista, 2020; Carmenta et al., 2019; Morello & Falcão, 2020). Further, the constantly rising rates of deforestation serve to perpetuate the current mismatch between often obsolete or weak policy requirements and local management actions. To overcome these obstacles, we propose a two-pronged approach—one based on accidental fires and the resulting risk management, and the other directed at the analysis of local governance.

On the one hand, it is important to consider the role of the Amazon in the global economic context and large-scale interconnections between economic systems. Some of the literature refers to the so-called “fire economy,” an economic scheme for the management and maintenance of accidental fire risks (Nepstad et al., 2001). This

scheme is based on three aspects. The first is that fire is highly effective in removing residues from land-cover conversion and in providing wood-ash fertilizer. This could translate into high economic returns. The second is the flammability of the Amazon landscape that, although increasing (Barlow et al., 2016), is, on average, relatively low. The third aspect is the low population density and related level of urbanization and infrastructure, especially in the bordering areas. This gives rise to a low “economic density” as measured in accumulated wealth per hectare in both “liquid” and “solid” forms (Fonseca-Morello et al., 2017)—for instance, money in current accounts and physical goods (which are therefore liable to fire damage) such as facilities, fences, crop fields, pasture, etc. The spatial dispersion of solid wealth makes the impact of accidental fires look like isolated events, and the scarcity of liquid wealth prevents investment in fire-free practices (Fonseca-Morello et al., 2017; Nepstad et al., 2001). On the other hand, the study of local governance can help bring out multiple patterns of knowledge about region-specific ecologies. The territories that historically contained the advance of deforestation in the Amazon are located in areas close to PNAs and indigenous peoples' territories, which both demonstrates their role as the first line of defence and shows their vulnerability to these threats.

With the growing recognition across the world that combating landscape fires is not only ecologically but also socially and economically constrained, drawing on traditional communities and indigenous fire management could be a useful lens through which to find not only practical fire-management solutions but also lessons on how environmental governance could be structured and implemented more widely (Mistry et al., 2016). In this context, stimulating sustainable initiatives and technologies that support the coexistence of people and biodiversity is a key issue. One example is the Tipitamba project in Pará (Brazil), which offers alternatives to slash and burn by selective logging of forest/shrubs, and cutting and crushing of vegetation followed by immediate cultivation (Leão et al., 2020).

Potential interconnections between local and global governance of the Amazon should be further investigated. The present research offers an overall review, highlighting directions in the governance policy and the implications of fires in Amazon, which future research could explore in greater depth.

To conclude, politico-economic factors and local governance should be essential elements in the design and implementation of forest fire mitigation interventions. The devolution of power to local actors directly involved with the effects of fires is essential in order to achieve the balance of power among different actors at multiple scales in a co-ordinated manner, leading to an improved political economy (Purnomo et al., 2021) that affects the protection and sustainable management of the Amazon forest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable as no new data were created or analysed in this article.

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