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Land Management Practices to Improve Ecosystem Services in the Amazon

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Abstract: This article examines the contribution of diverse land management practices to ecosystem services in the Amazon region and analyzes the roles of multiple stakeholders in their implementation. Drawing on qualitative research spanning 2001 to 2025, the study synthesizes case studies from eight Amazonian countries and French Guiana, incorporating government documents, community organization records, and academic literature. Findings reveal that Indigenous communities, traditional populations, and NGOs play a central role in sustaining biodiversity, mitigating climate change, and preserving cultural heritage through bottom-up initiatives such as bioeconomy practices, ecotourism, and agroforestry. For instance, Brazilian rubber tappers promote rainforest regeneration through non-timber forest product commercialization; Peru's Sustainable Productive Landscapes project coordinates multi-stakeholder efforts to reduce deforestation; and Venezuela's Indigenous meliponiculture enhances ecological resilience via pollination services. These practices challenge market-driven environmental governance by emphasizing community autonomy and traditional knowledge. However, the study also highlights contradictions in policies and the limitations of state oversight in sustaining equitable management. The article concludes by advocating for integrated, multi-stakeholder policies to reconcile ecological preservation with social equity, offering actionable pathways for building ecologically resilient societies in the Amazon.

Keywords: Amazon region; Land management; Sustainable development; Indigenous knowledge and traditional practices

1. Introduction

Environmental definitions from the last three decades of the 20th century underwent successive redefinitions, reflecting the accelerating ecological crises of the Anthropocene. These reorientations, shaped by the globalization of environmental concerns and the contradictions between economic growth and ecological balance, have underscored the interdependence of nature and society. As national governments and international organizations grappled with habitat degradation, biodiversity loss, and climate change, civil societies—particularly Indigenous movements, grassroots organizations, and environmental NGOs—emerged as critical actors in reframing sustainability paradigms. Their efforts have centered on participatory democracy, biocultural resilience, and alternatives to extractive economies, all while confronting the structural inequities embedded in global capitalism.

The Amazon region, spanning 7 million km² and encompassing 44% of the world's tropical forests, epitomizes these tensions. Home to 10% of Earth's biomass and 40% of South America's territory, it is a linchpin for global climate regulation, biodiversity conservation, and Indigenous cultural survival. Yet, since the 16th-century European conquest, the Amazon has endured cycles of exploitation—from rubber booms to modern agribusiness and mining—that have degraded

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ecosystems and marginalized Indigenous peoples. By the first quarter of the 21st century, the region's socio-ecological fragility reached a critical juncture, demanding urgent analysis of how territorial management practices can reconcile human needs with planetary boundaries.

This article examines land management practices across eight Amazonian nations and French Guiana (2001–2025), focusing on their contributions to ecosystem services and the role of diverse stakeholders. Ecosystem services, defined as the benefits humans derive from nature, including provisioning, supporting, and cultural services, are central to this inquiry. However, the commodification of these services under market-driven frameworks, such as Payment for Environmental Services (PES) or REDD+, risks reducing nature to a financial asset while sidelining local ecological knowledge.

Methodologically, this qualitative study synthesizes case studies, governmental and NGO documents, and academic literature to address two dimensions: (1) identifying actors in territorial management, such as Indigenous communities, NGOs, states, international bodies) and (2) evaluating how their actions enhance or undermine ecosystem services. Cases range from Brazil's Serra do Divisor National Park, where rubber tappers and Indigenous groups sustain bioeconomies, to Peru's "environmental defenders" resisting illegal mining, and Venezuela's Huottuja meliponiculture—a practice blending stingless bee conservation with cultural identity. These examples illustrate the potential of biocultural systems that integrate traditional knowledge with sustainable resource use.

However, systemic contradictions persist. State policies like Brazil's 2021 PES law, while ostensibly promoting conservation, often exacerbate land concentration and inequality. Similarly, ecotourism in the Amazon generates revenue but risks cultural commodification and ecological disruption. International interventions prioritize global climate goals but may neglect local socio-economic needs, perpetuating dependencies.

The following sections detail case studies, discussions and conclusions. Far from prescribing universal solutions, this work emphasizes context-specific practices that challenge extractivist paradigms, affirming the Amazon as a site of resistance and innovation in the Anthropocene.

2. Case Studies of Sustainable Territorial Management in the Amazon

2.1. Brazil

Brazil accounts for the largest share (61.8%) of the country's land use in the Amazon Region. The Serra do Divisor National Park—created in 1989—crosses several municipalities in Acre and borders the Peruvian border. The park, inhabited by indigenous communities and rubber tappers (seringeiros), covers approximately 843,000 hectares and is a transitional area between the Andes Mountains and the Amazon. In this territory, several native Amazonian plants are commercially exploited by local communities. Some even have great economic potential and are currently successful in both domestic and foreign markets. This is the case with andiroba, açaí, and the Brazil nut, as they are known internationally. Most of the almonds harvested in the country still come from native chestnut trees [1].

Other experiences in the Brazilian Amazon, aimed at strengthening the productive chains of açaí, Brazil nuts and pirarucu fishing, illustrate how local communities - indigenous peoples, fishermen and traditional peoples - are at the center of practices that could consolidate a bioeconomy, understanding the bioeconomy as a development model that seeks to use biological resources in a sustainable manner, integrating ancestral and scientific knowledge to generate economic, social and environmental benefits [2]. In any case, this perspective seeks to commodify the ecosystem services generated by these communities by incorporating the logic of the global market into local experiences of production, exchange of products and preservation of nature.

However, these experiences contribute to the preservation of biodiversity, mitigate climate change, and promote income and employment for local communities, providing opportunities for sustainable development. These practices, which rely on the Amazon rainforest as a source of resources, stimulate its regeneration and are regulated in the Brazilian Amazon states of Mato Grosso and Pará by the Forest Products Marketing and Transportation Systems (SISFLORA, in its Portuguese acronym), created to track the production, trade, and transportation of forest products.

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Brazil has also had Law 14,119 in place since 2021, passed during the Jair Bolsonaro administration, which instituted the National Policy on Payment for Environmental Services. Far from achieving broad benefits for community stakeholders who preserve the environment, this regulation has incentivized land concentration and the development of a financialized green economy.

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It is also worth highlighting the monitoring and territorial demarcation actions realized by indigenous communities (such as the Munduruku in the state of Pará and the Jupaú - also known as Uru-Eu-Wau-Wau - in the state of Rondonia) and traditional communities (ribeirinho) due to constant invasions, expansion of the agricultural frontier, mining, logging, hunting, and illegal fishing in the Amazon. The Munduruku initiated self-demarcation in 2014 due to the delays by the authorities (through the National Foundation of Indigenous Peoples, FUNAI for its Portuguese acronym) and the government's interest in promoting hydroelectric complexes on the Tapajos River [18,19,20]. The Jupaú have the support of NGOs such as the Kanindé Ethno-Environmental Defense Association and maintain a tense relationship with government institutions (such as FUNAI), which should support their actions but sometimes show a certain immobility in front of the abuses [3]. These actions preserve the environment and biodiversity while also preserving the cultural heritage of indigenous peoples.

The Regional Development Plan of the Amazon (PRDA, for its Portuguese acronym) is an important rural territorial development program in the Brazilian Amazon, with a focus on reducing regional inequalities. The PRDA 2024-2027, Considers Amazonian diversity and seeks to direct public interventions in the region, with a focus on sustainable development and environmental conservation.

2.2. Peru

The Peruvian Amazon represents the second largest proportion (11.3%) of the Amazon Region after the Brazilian Amazon, with an area of 782,880.55 km², equivalent to 62.36% of the national territory. This region primarily comprises the departments of Loreto, Ucayali, Madre de Dios, Amazonas, and San Martín. Eight other departments also have territories that are part of the Peruvian Amazon Region: Cajamarca, Huancavelica, La Libertad, Pasco, Piura, Puno, Ayacucho, Junín, and Cusco [5,6]. Conflicts over natural resources and land management are at the heart of the political situation in the Peruvian Amazon. In fact, the most significant socio-environmental conflicts in recent years have been related to regulations regarding the use and management of natural resources and land [7].

According to data from the United States Agency for International Development (USAID), population growth and territorial expansion in the Peruvian Amazon are linked to the rise of illicit activities, such as deforestation, illegal mining, the expansion of the agricultural frontier, and coca cultivation. These dynamics are facilitated by the weak presence of the State and limited institutional coordination in the region [8]. This assessment is supported by more recent research from the Igarapé Institute [9], which also warns of structural fragmentation between institutions, organizations, and territories.

Given this scenario of state absence, increased environmentally degrading activities, pressures on the territory, and associated socio-environmental conflicts, it is opportune to investigate the role of traditional, indigenous, and rural communities in the sustainable management of the Peruvian

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Amazon territory and their relationship with the generation and/or maintenance of ecosystem services generated by the Amazon forest.

First, it is important to highlight the work of the "Environmental Defenders of the Amazon," who are also members of Indigenous communities who protect the environment within the framework of territorial defense against the advance of deforestation and mining [10]. The protection of the Amazonian territory by these actors consists of confronting the perpetrators who advance on the territories by making the acts of environmental degradation visible, reporting them to the competent authorities, and leading actions of political and direct resistance in forest areas close to the communities. According to data provided by the USAID Prevenir Project [10], environmental defenders suffer persecution by perpetrators of environmental crimes related to illegal activities, with women defenders being the most vulnerable population to attacks by these perpetrators.

In this sense, territorial management is closely related to territorial preservation, resistance to the advance of illegal environmental activities, and environmental recovery actions after the perpetrators leave the territory. Given the limited state presence and the lack of public policies targeting rural and indigenous populations, self-managed initiatives have emerged, such as that of the Alto Mishahua indigenous community in the central Peruvian Amazon. Thanks to the efforts of a community member who gained access to university education abroad, international funding was obtained for a community electrification and internet project through the installation of photovoltaic panels. The initiative was made possible through a collaboration between LUTW Powering Opportunity, Student Energy Guided Projects, and a team from the Latin American Observatory of Energy Geopolitics [11].

This project not only improves local quality of life but also promotes key ecosystem services by fostering a clean energy transition, reducing pressure on traditional energy sources, and supporting sustainable practices that contribute to the conservation of the Amazonian environment.

There are also various territorial management initiatives, involving diverse public and private stakeholders, as well as international organizations such as the FAO, UNDP, and SDGs, among others. A notable case in Peru is the "Sustainable Productive Landscapes in the Peruvian Amazon" project, which aims to generate multiple global environmental benefits through the management of the Amazonian landscape with a comprehensive and integrated territorial approach. The PPS project is led by the Ministry of the Environment with technical cooperation from the UNDP and funded by the Global Environment Facility (GEF). The initiative responds to forest loss and degradation, and with it, the loss of biodiversity and ecosystem services. While the causes of this situation are multiple, the project focuses its actions on addressing the following areas: the conversion of forests for agriculture and/or livestock farming, development policies with inadequate incentives, and weak planning and governance frameworks [12].

In summary, the previously analyzed cases show that the socio-environmental reality of the Peruvian Amazon responds to structural patterns derived from extractive activities, a situation that shares similarities with other countries in the region. The struggles undertaken by rural and indigenous communities for access to basic services, the defense of their territories and the environment, are framed within a dispute for their very existence and for the possibility of managing their territories and autonomously developing their economic, cultural, and social activities. These dynamics are profoundly influenced by the advance of extractive actors who generate processes of environmental degradation and, consequently, socio-environmental conflicts. In this context, community organization, self-management, and coordination with other actors—including international organizations—are essential for implementing environmental remediation actions and sustainable territorial management. These actions are closely linked to environmental restoration and the generation and maintenance of key ecosystem services, such as access to healthy food, contaminant-free water, carbon sequestration, and the rehabilitation of soils and ecosystems, among others.

2.3. Colombia

According to the Territorial Environmental Information System of the Colombian Amazon (SIAT-AC), this region is conceived as incorporating the concepts of hydrographic, biogeographic,

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and political-administrative boundaries, seeking a comprehensive approach to environmental elements for monitoring, management, and administration of the region as a functional ecosystem unit [13]. This region occupies a total area of 483,164 km2, which represents 23.3% of the total national territory (including marine and 42.3% of the continental territory). Of the total Amazon, Colombia accounts for 6.8% of the regional territory [13].

The Colombian Amazon is composed of 10 departments, 61 municipalities, and 18 non-municipalized areas. The departments that comprise this territory are: the southern part of the department of Vichada, the southeastern part of the department of Meta, the department of Guainía, Guaviare, Vaupés, Amazonas, Caquetá, Putumayo, the Bota Caucana (Cauca Boot) in the department of Cauca, and the Amazonian slopes of Nariño (the upper reaches of the Guamuéz, Sucio, San Miguel, and Aguarico rivers [13].

The main indigenous ethnic groups in this territory are: Uitoto, Puinave, Sikuani, Awá, Yanacona, Inga, Tikuna, Kubeo, among others. According to figures from the National Administrative Department of Statistics (DANE), 1,905,617 people identify as indigenous in Colombian territory, representing 4.4% of the total national population. The indigenous population in the Colombian Amazon totals 728,067 individuals, with the department of Cauca having the largest indigenous population at 307,692, followed by Nariño with a population of 206,239.

However, in percentage terms, the departments with the highest indigenous population density are: Vaupés with 83%, followed by Guainía with 74%, Vichada with 59%, and Amazonas with 57% [14]. The indigenous peoples who live in indigenous reservation territories in the Colombian Amazon region contribute to the preservation of this biome, thanks to the ancestral practices of coexistence and interdependence with nature, according to a study executed by the National Organization of Indigenous Peoples (OPIAC for its Spanish Acronym) in collaboration with the World Wide Fund for Nature (WWF) and the support of the Norwegian Agency for Development Cooperation (NORAD for its Spanish Acronym) within the framework of the project "From REDD+ Agreements to REDD+ Results, 2016-2020" [15].

The presence of Indigenous peoples and their ancestral practices, related to traditional knowledge of management, administration, and preservation of the natural environment, contribute to the maintenance of associated ecosystem services such as carbon storage, preservation, management, and use of diversity and genetic material, maintenance of the hydrological cycle, and food security for communities and species, among others [15].

They also contribute to mitigating the impacts of climate change—which is considered an ecosystem service associated with nature management and preservation practices. These reservation areas store approximately 3.3 million tons of carbon. This is equivalent to just over 40% of the carbon captured in all the country's forests and almost 60% of the carbon stored in the forests of the Colombian Amazon [15].

Another ecosystem service linked to the ancestral practices of Indigenous peoples in reservation territories [Colombian legislation, Decree No. 1071 of 2015, compiles and updates provisions related to the agricultural sector and rural development in Colombia. Chapter 5, "Legal Nature of Indigenous Reservations, Management, and Administration," defines them as: a special legal and sociopolitical institution made up of one or more Indigenous communities that, with a collective property title, enjoy the guarantees of private property and own their territory. Furthermore, their land and internal life are governed by an autonomous organization protected by Indigenous jurisdiction and their own regulatory system. Indigenous reservations are the collective property of the Indigenous communities for whose benefit they are established and, in accordance with Articles 63 and 329 of the Political Constitution, are inalienable, imprescriptible, and non-sizeable [16].] is the conservation of regional ecological connectivity. In Colombia, protected forest areas represent only 17% of the Amazon region and are concentrated on the eastern slope of the Andean Mountain range, the foothills, and the basal area of the Amazon. The distance between these areas limits their comprehensive management for conservation. In this context, the preservation of Indigenous reservation territories contributes to the formation of broad ecological corridors that strengthen connectivity and ecosystem integrity [15]; these maintain the ecosystem services generated by the Amazon biome and the ecological balance of the region.

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2.4. Venezuela

The Venezuelan Amazon Region, also known as the Guayana Region or Guayanés Massif, is comprised of the states of Amazonas, Bolívar, and Delta Amacuro, which corresponds to the entire southern region of the country. The Orinoco River serves as the natural boundary of this biome. The region occupies a total of 608,345 km2, representing approximately 50% of the national territory [17] and 6% of the total Amazon region [18].

The region has three forest reserves with an area of 10,881,441.20 ha. These areas are managed and protected by the Ministry of Popular Power for Ecosocialism (MINEC for its Spanish Acronym) and the National Parks Institute (INPARQUES for its Spanish Acronym). It also has four large national parks, including Canaima National Park, known in the indigenous language as Jaua-Sarisariñama. There are also countless natural monuments of ecological, environmental, and tourist interest [19].

According to Article 5 of the Organic Law of Indigenous Peoples and Communities, published in Official Gazette No. 343,653 of December 27, 2005, indigenous peoples have the right to self-manage the territories they inhabit and their ways of life, as well as "the right to participate in the administration, conservation, and use of the environment and natural resources found in their habitat and lands" [20].

Furthermore, the Constitution of the Bolivarian Republic of Venezuela mainstreams social participation into all dimensions of national sociopolitical life, through the adoption of participatory and protagonist democracy as a model for its system of government. Consequently, social participation in territorial management is protected by the Constitution and the laws of the Republic.

In this sense, it is appropriate to highlight some community experiences in collaboration with the State regarding the conservation and sustainable use of the Amazonian territory, which have a high impact on the ecosystem services provided by the Amazon rainforest.

First, it is worth underline the experience of the collaborative work of community meliponary producers, the Huottuja indigenous people of the Ature municipality in the state of Amazonas, and scientists from the National Institute of Agricultural Research (INIA for its Spanish Acronym).

The Huottuja people have maintained a harmonious relationship with stingless bees since ancient times, establishing profound connections that transcend the merely utilitarian. Beekeeping practices have been passed down from one generation to the next, not only as a source of food and medicine, but also as a fundamental pillar of their culture, spirituality, and worldview. This ancestral relationship translates into a deep knowledge of bee habits, an understanding of the importance of forest conservation, the protection of wild colonies, and their sustainable use for the health of bees and the integrity of the ecosystems they inhabit [21] (Translated by the authors) [“El pueblo Huottuja, ha mantenido de manera ancestral una relación armónica con las abejas sin aguijón, estableciendo profundas conexiones que trascienden lo meramente utilitario. Las prácticas de manejo de estas abejas han sido transmitidas de una generación a otra, no solo como una fuente de alimentos y medicinas, sino como un pilar fundamental de su cultura, espiritualidad y cosmovisión. Esa relación ancestral se traduce en un profundo conocimiento de los hábitos de las abejas, en la comprensión de la importancia de la conservación de los bosques, la protección de las colonias silvestres y su aprovechamiento sostenible, para la salud de las abejas y la integridad de los ecosistemas donde ellas habitan” [21].].

Meliponiculture [Meliponiculture is the practice of breeding and conserving stingless bees - commonly known as meliponas - for food and medicinal purposes. There are several known species of native stingless bees in the Venezuelan Amazon region, including Melipona favosa, Melipona fuscopilosa, Melipona compressipes, Scaptotrigona ochrotricha, Tetragona clavipes and Friseomelitta varia [22].] has a high socio-ecological value, contributing to the conservation of the Amazon forest's ecosystem services and its ecological dynamics. Stingless bees play a fundamental role as pollinators, promoting ecosystem health, in addition to providing world-renowned nutraceutical products with profound ancestral and cultural value. This practice offers significant potential in the food, medicine, ecotourism, and economic spheres for the Amazonian peoples and for the sustainable development of the Amazonas State [21].

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In this sense, Vit and others [21] say that sustainable development in the region is geared toward improving local capacities for sustainable management with science and technology through close coordination between local communities and government entities at the national, regional, municipal, and international levels, with a view to mitigating or avoiding the impacts of deforestation, forest fires, illegal mining, and other environmentally degrading activities.

The development of beekeeping in the region, driven by the Huottuja indigenous communities, transcends the simple extraction of food or medicinal resources. For this group, the coexistence and breeding of stingless bees constitutes a relationship of interdependence fundamental to the survival of their culture and the conservation of the natural environment they inhabit [21].

On the other hand, Infante and others [22] argue that the practice of beekeeping is executed by rural and indigenous communities in both jungle areas and urban areas. Therefore, pollination ecosystem services are observed in conucos [conuco is a small plot of land cultivated, usually in a traditional, family-run manner, for the cultivation of a variety of agricultural products, including cereals, grains, tubers, and fruits, primarily for personal consumption and family subsistence. These are typically located in rural areas or on the outskirts of urban areas and are cultivated intensively using subsistence farming techniques, which may include the use of organic fertilizers, terrace or furrow planting, and a variety of crops such as corn, cassava, plantains, beans, among others], urban agriculture, gardens, and urban forest areas, favoring the spread of species from urbanized areas.

We understand that the success of the experience in the Atures municipality is due both to the work of indigenous communities in preserving the environment and native stingless bee species, as well as to the work of urban beekeepers. This interrelationship between various actors focused on preserving native forests through beekeeping as a sustainable practice and economic activity is also possible thanks to the dialogue of knowledge, a fundamental process for building socio-environmental knowledge [23,24]. This dialogue of knowledge takes place through the interaction and work of various actors involved in the project: the scientific community (Universidad de los Andes, ULA for its Spanish acronym), the work of public servants from INEA, indigenous communities, rural and urban agricultural producers, the Venezuelan State through its institutions, among others.

This experience obtains special relevance considering that, on July 24, 2024, the Atures municipality, in the Amazonas state, was declared a Stingless Bee Sanctuary by the Municipal Chamber. According to Venezuelan environmental legislation, a natural sanctuary is an administrative entity aimed at conserving biodiversity, protecting ecosystems, and promoting environmental sustainability. Its declaration implies a legal commitment to the preservation of nature, generating benefits for both the environment and local communities [20].

This fact also highlights the importance of the active participation of diverse actors—organized traditional communities, Indigenous peoples, civil society, the scientific community, and the State—in the formulation and implementation of policies that promote sustainability. These actions must be supported by local sustainable practices and traditional knowledge, with the State playing a key role in their coordination, promotion, and financing.

On the other hand, the socio-environmental organization Wataniba [24] highlights two experiences that contribute to the sustainable development of the Venezuelan Amazon region: the first one is the project “Empowering Women through Community Savings Banks: An Experience in Economic Sustainability,” which aims to promote savings among indigenous women and finance entrepreneurial projects that have emerged in their hometowns. According to Wataniba [25], the participation of diverse actors in the community and civil society is essential to guarantee the success of these initiatives, which allows for the establishment of a resilient and sustainable economic and social fabric in the Amazon. The second one is the project "Cultivating and Marketing Organic Cacao for Community Well-being in the Amazon," which is based on the planting and marketing of organic cacao for community purposes as an economic alternative that strengthens community ties, generates income, and preserves the Amazon rainforest [25]. The project is configured as "a bond between the land, the community, and nature," [25] highlighting the deep connections of complex interdependence between societies and their surrounding environment. For this, the dialogue of knowledge and the participation of diverse actors become indispensable in the maintenance and

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conservation of forests for the generation of ecosystem services vital to the development of communities.

2.5. Bolivia

The territorial management of the Bolivian Amazon, according to the constitutional structure and hydrographic, ecological, and political criteria [26], encompasses the departments of Beni, Pando, northern Cochabamba, northern La Paz, and Santa Cruz. This territory, with an area of 475,278 km² [27], is the scene of interaction between indigenous communities, peasant groups, extractive companies, and forest protection areas. Productive activities such as mining, forest resource exploitation and energy transformation are carried out here.

The Amazonian departments comprise a territory that includes regional and national parks, reserves, ecological and hydrographic protection zones, as well as indigenous territories and integrated management areas [27]. These include: Yacuma Regional Park, Pedro Ignacio Muíba, Isiboro-Sécure National Park and Indigenous Territory, Eva Eva-Mosetenes Watershed Protection Zone, Beni and Pando Lagoons National Reserve, Rogaguado Lakes, Iténez Immobilized Reserve, Beni Biological Station and Pilón Lajas Biosphere Reserves (also an Indigenous Community Land), Chapare Immobilization Forest, Madidi National Park and ANMI, Manuripi-Heath Amazonian National Wildlife Reserve, and the Noel Kempff Mercado, Amboró, Otuquis and San Matías national parks and ANMI [28].

In this regard, it is worth mentioning that 88 municipalities include the Bolivian Amazon and, within this territory, indigenous Amazonian communities coexist: Cayubaba, Sirionó; Ts'imane, Takana, Movima, Cavineño, Chácobo-Pachahuara, Baure, Moxeño, Itonama, Moré, Canichana, Yuracaré, Moseten, Esse Ejja, Maropas, Yuqui, Yuracaré, Leco, Mosetén, Araona, Takana, Esse Ejja, Cavineño, Yaminahua, Pacahuara, Machineri, Chiquitano, Ayoreo, Guarayo and Guarasug'we [29,30,31,32,33,34,35, 36]. Various territorial self-management actions were identified by these communities, and those developed by the following ethnic groups stood out for their environmental services: Takana, Movima, Yuracaré, Mosetén, Machineri, and Leco.

The Takana nation is located in the departments of Beni, Pando and La Paz, in municipalities such as San Pedro, Gonzalo Moreno, Sena, Ixiamas and San Buenaventura [37]. Their traditional economic activities include hunting, fishing, agriculture, gathering, small-scale livestock farming and ethnomedicine [32][33]. Within the framework of the Madidi National Park, they develop community tourism, preserve medicinal species such as motacú, cedar, cat's claw and coca, protect rivers and exercise territorial control against poaching and indiscriminate logging.

The Movima nation, settled in Santa Ana, Exaltación, San Joaquín, and San Ignacio, manages a territory rich in forest species such as bibosi, motacú, royal palm and piraquina. They market their products in nearby communities [38]. With support from the CEJIS (National Commission for the Indigenous People of Movima for its Spanish Acronym) (SPIM) and the Subcentral of Indigenous Women of Movimas (SMIM for its Spanish Acronym), they promote the cultivation of wild cacao as a sustainable alternative to reduce pressure on forest resources [33].

The Yuracaré people live in the regions of Cochabamba, Beni, Santa Cruz, and La Paz. Their economy combines agriculture, hunting, fishing, seasonal harvesting, and wage labor on ranches. Within the framework of agroforestry management, they formed the Yuracaré Wild Cacao Collectors Association (ARCASY for its Spanish Acronym), which promotes the sustainable use of native cacao, with economic and ecological benefits geared toward alternative markets [33].

The Mosetén, located in Palos Blancos and San Borja (La Paz and Beni), are members of the Organization of the Mosetén Indigenous People (OPIM for its Spanish Acronym) and Mosetén Indigenous Women's Organization (OMIM for its Spanish Acronym) [Respectively, Organización del Pueblo Indígena Mosetén and Organización de la Mujer Indígena Mosetén in Spanish.]. Their economy is based on agriculture, organized territorially through the cultivation of cacao (marketed to cooperatives such as El Ceibo), plantains, papayas, and citrus fruits, and the extraction of motacú oil [30].

The Machineri nation, settled in Bolpebra (Nicolás Suárez province), is affiliated with Indigenous Center of the Amazon Region of Bolivia (CIRABO for its Spanish Acronym) and Confederation of

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Indigenous Peoples of Eastern Bolivia (CIDOB for its Spanish Acronym) [Respectively, Central Indígena de la Región Amazónica de Bolivia and Confederación de Pueblos Indígenas del Oriente Boliviano in Spanish.]. They practice family farming with vegetables and livestock, and harvest products such as chestnuts and rubber. These activities are carried out under the "Comprehensive Forest Management Plan," which promotes the sustainable use of timber and non-timber resources [39, 40].

The Leco people live in the municipalities of Guanay, Teoponte, Tipuani, Mapiri, and Apolo, in the north of the department of La Paz. Their main economic activity is agriculture, based on crops such as rice, cassava, coffee, plantain, cocoa, and coca, using the traditional slash-and-burn technique. This practice consists of clearing forested areas through the controlled cutting and burning of vegetation. This allows for soil regeneration, promotes natural fertility and maintains ecological balance when is based on a rotational and small-scale basis, thus generating ecosystem services linked to sustainable land management. In this context, the Indigenous Center of the Leco People of Apolo promoted the Bioculture and Climate Change project in 2023, with the support of the Development Cooperation of the Swiss Embassy in Bolivia, the Municipal Government of Apolo and the Wildlife Conservation Society [41].

Finally, it is important to note that the legal structure of the Plurinational State of Bolivia recognizes the autonomy of indigenous peasant nations and peoples, which strengthens their capacity for territorial self-management in accordance with their own ancestral norms and knowledge. This legal framework, established in the State's Political Constitution, promotes direct control of natural resources, fosters sustainable ancestral practices, and guarantees collective rights to land and territory. Therefore, indigenous management based on balanced biodiversity management systems contributes significantly to the generation and conservation of ecosystem services associated with sustainable land use practices.

2.6. Ecuador

Ecuador represents only 1.6% of the Amazonian territory, corresponding to 120,000 km², which covers 48% of the country's territory. It includes the provinces of Sucumbíos, Orellana, Napo, Pastaza, Morona and Zamora. Approximately 5% of Ecuador's population, approximately 740,000 inhabitants, lives in this area [42]. Many of the indigenous communities depend on subsistence agriculture, cultivating products such as cassava, plantains, and other traditional crops. This form of agriculture is fundamental to the communities' food security. Indigenous peoples also trade handicrafts and cultural products, which are important both for the local economy and for the preservation of their cultural identity. This includes the sale of textiles, ceramics, and other handicrafts. Ecotourism has begun to develop in the region, taking advantage of biodiversity and indigenous culture. However, the sector faces challenges related to sustainability and respect for local communities, according to a document published jointly by the Coordinating Ministry of Heritage and UNICEF (43).

In Ecuador, large areas of native forest are located especially in the Amazon region, on the outer slopes of the Andes mountains range, and in dry and humid coastal areas. These forests provide products such as timber, firewood, fruits, resins, hides, and other wildlife resources, in addition to providing habitat for indigenous communities and settlers who depend on these resources for their subsistence and income. The conservation of these forests is of utmost importance for the country's environmental future and use of its natural resources. Despite this potential, the country faces a historic rate of deforestation. Deforestation is intrinsically linked to the expansion of the agricultural and livestock frontier, the uncontrolled colonization of tropical forest areas, and the construction of infrastructure for oil exploration in the Amazon. Between 1972 and 1998, the area allocated to agriculture almost doubled, from 3.83 million to 7.74 million hectares [44].

Deforestation and environmental degradation have not stopped. According to the Map Biomas platform, between 1985 and 2020, the Ecuadorian Amazon Basin lost 56% of its glaciers. On the other hand, agricultural use increased by 38.7% (increasing by 496,000 hectares), reaching 1,780,000 hectares, and mining increased 24-fold (growing by 3,905 hectares), reaching 4,068 hectares [45]. Indigenous lands, specifically, encompass 8 million hectares and represent 62% of the Ecuadorian

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Amazon Basin. Between 1985 and 2020, they lost 124,000 hectares of natural vegetation cover, with a net loss of 119,000 hectares of forest [45].

With the aim of preserving the forest and biodiversity, the Waorani—with the support of the Ecociencia Foundation—have developed an indigenous monitoring system in Yasuní National Park that alerts about invasions, mining, logging, exploitation of flora, hunting, and illegal fishing [46].

Ecotourism in Ecuador officially began in 1969 in the Galapagos Islands with the implementation of excursions by Metropolitan Touring. These activities combined appreciation of natural beauty with an awareness of the importance of preserving it. In the Ecuadorian Amazon, ecotourism began in 1976 in the Limoncocha region, before the arrival of oil exploration. These pioneering projects laid the foundation for a sustainable tourism approach focused on environmental conservation and the benefit of local communities. One of the most successful projects in the Amazon is Sacha Lodge, located along the Napo River. The initiative, in addition to attracting tourists for its rich biodiversity – with more than 500 species of birds and 12 species of primates – also negotiates severe hunting restrictions with the Kichwa communities, which it integrates into the company's activities [47]. Another experience is "Ecoturismo Yasuní", a nature conservation experience for the Waorani people in Yasuní National Park, contributing to the protection of biodiversity and the sustainable development of the region [48].

The Ecuadorian Amazon, with its rich biodiversity and easy access, has enormous potential for ecotourism, seen as a sustainable alternative for generating employment and income, especially in the face of shrinking global biomes and future oil shortages [47].

To mitigate the growing impacts of population pressure and unsustainable practices, various permaculture projects, such as permanent agriculture and fish farming, have been implemented to reduce dependence on forest resources, promote economic autonomy, and restore harmony with the environment. These types of integrated farms have been developed among the Shuar, Achuar, Shiwiar, Kichwa, and Zapara ethnic groups, who inhabit the river micro-basins of the Morona Santiago and Pastaza provinces in the Ecuadorian Amazon [49].

According to the Ecuadorian Ministry of Tourism, the country has implemented various programs to promote sustainable tourism. Thus, the Ecuadorian State seeks to preserve and enhance culture, sustainability, and environmental preservation, encouraging tourism as a potential for sustainable territorial and rural development. Since 2018, the "Magical Towns and Corners" program has promoted destinations with cultural identity that offer attractions, services, and tourist experiences [50].

Some examples of ecotourism activities are Tena and Morona Santiago. Twenty kilometers from the city of Tena, indigenous Kichwa people participate in tourism activities at the Shandia ecovillage, which has been developed with the support of the Maquita Cushunchic Foundation, an NGO that promotes the conservation of nature and cultural heritage [51]. In Morona Santiago, activities include coexistence with indigenous Shuar communities, organized by the "Suwa" Shuar Community Tourism Center [52].

2.7. Guyana

In terms of ecotourism, Guyana's Amazon Region has some unique attractions, such as Kaieteur National Park, the Iwokrama Rainforest, the village of Surama, and the Rupununi, among others.

Kaieteur National Park was created in 1929, covers 62,700 hectares, and is located in the Potaro-Siparuni Region (Region 8), home to the highest waterfalls in the world.

A nature reserve was created in the Iwokrama Forest in 1996, which is managed by the Iwokrama International Centre for Rainforest Conservation and Development. This 371,000-hectare forest is also located in the important Region 8, a transitional region toward the country's Amazonian heartland, and is known for being one of the largest virgin forests in the world. Here, the Macushi communities practice so-called sustainable forestry with selective logging. The place has a high biodiversity with 420 species of fish, 90 species of bats and more than 500 species of birds [53,54].

Surama Village is a Macushi community of approximately 300 people located on the border between the Guyanese rainforest and the Rupununi savannahs in the Upper Takutu District of Upper Essequibo (Region 9). Visitors can learn about local cultural customs, including the use of medicinal

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plants and food preparation. Canoe trips down the Burro Burro River and access to the Pakaraíma Mountains are also available from the village. [55]

Another important tourist destination is the vast Rupununi region, located within the Upper Takutu/Upper Essequibo Amazon Region. The area encompasses a large number of ecosystems with more than 360 bird species, some of which are difficult to find in other regions, such as the Red Siskin (Carduelis cucullate), the Glass Doradito (Pseudocolopteryx sclateri), the Sun Parakeet (Aratinga solstitialis), and the Harpy (Harpia harpyja). Numerous reptile species also live here, such as the Black Cattleya (Melanosuchus niger), the Emerald Boa (Corallus caninus), the Green Anaconda (Unectes murinus), and the Giant River Turtle (Podocnemis expans). Regarding mammals, the Rupununi is home to several feline species, including the Jaguar (Panthera onca) and the Puma (Puma concolor). In this way, ecotourism as an economic activity coincides with biodiversity conservation policies implemented by the State of Guyana, such as the Low Carbon Development Strategy (LCDS) developed since 2013, the National Biodiversity Strategy and Action Plan (2012-2020) promoted since 2014, and the LCDS 2030, launched in 2022, among others.

2.8. Suriname

Three main forest types can be distinguished, corresponding to the three main biogeographic zones: (a) northern forests, comprising swamp forests, mangroves, and ridge and marsh forests; (b) xerophytic savanna forests in the savanna belt; and (c) the humid forests predominating in the Guyana Shield. The latter is the most predominant forest in the Amazon region of Suriname. National environmental NGOs are weak, but the influence of international environmental organizations in various aspects of natural resource management is high. The Amazon Conservation Team—an NGO founded in 1996 and operating throughout the Amazon region—is working on a survey for participatory land use involving local communities and the government [56].

There are several systems for licensing timber, including concessions and communal logging permits for Indigenous and Maroon communities [56]. The presence of natural forests gives Suriname great importance in terms of global ecosystem services and strains national definitions regarding increased agricultural and timber production and the expansion of crops to reduce food imports. This tension is also part of cross-border disputes over the variety of land uses [57].

Regarding ecotourism in the Amazon region of Suriname, activities are practiced in the Central Suriname Nature Reserve, the Brownsberg Nature Reserve, Lake Brokopondo, and the small village of Palumeu (in the Sipaliwimi district) [58,59].

Among the ecotourism activities in the Central Suriname Nature Reserve is a visit to Raleighvallen (also known as Raleigh Falls), a series of cascading rapids located in the upper reaches of the Coppename River. The area also offers natural birdwatching and viewing of eight different species of monkeys. Also popular is the trek through the forest to reach Voltzberg, an island mountain of bare granite reaching 240 meters and represented on the Surinamese dollar (the country's official currency) [60].

As noted, Lake Brokopondo is a large man-made reservoir created by the Afobaka Dam. The site has exhibits explaining the project and its construction, which included the relocation of animals and indigenous and maroon villages in the 1960s. Currently, the Saramacca Maroons—as in the Brownsberg Nature Reserve—run an ecotourism project on Tonka Island that includes motorboat tours [58]. However, some studies suggest reducing the number of tourists and vehicles passing through, given the impact that these forest excursions have on the behavior of mammals, who tend to flee and avoid contact with humans [61].

In the small indigenous village of Palumeu - located at the confluence of the Palumeu and Tapanhahoni rivers - the Trio, Wayana and Aparai indigenous peoples enjoy direct contact with nature and the culture of these indigenous peoples of the Amazonian territory of Suriname. These ecotourism activities still coexist with predatory practices by the communities, which include hunting of native fauna for consumption or sale of bush meat [62].

2.9. French Guiana

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In 1987, Jacques Chirac established the Collective Use Rights Zones (ZDUC), in which Indigenous peoples hold communal lands for hunting, gathering, fishing, and farming in the Amazon region [63,64]. These peoples, according to researchers' estimates, represent a total of 4% of the Guianan population, or about 12,000 people. Currently, the right to "subsistence"—limited to hunting, fishing, and gathering—has been questioned by the communities themselves and Indigenous activists [65].

The Indigenous peoples, both Amerindian and Maroon, of French Guiana have a profound knowledge of the nature that surrounds them. The plants of the Amazon rainforest occupy an important place in the pharmacopoeia, and animals, minerals, and plants have an important place in cultural symbolism. For example, jaguar, snakes and amphibians have meanings of strength, eternity and fertility respectively [66].

In 2005, Ordinance No. 2005-867 (July 28, 2005) extended the French Land Law and Forest Code to French Guiana. The regulations consider the sustainable management of forest assets from an economic and ecological perspective [67]. Exceptions are made regarding free concessions to people who traditionally derive their livelihood from the forest. However, the extraction conditions are no longer traditional and end up affecting the ecosystem.

In 2007, Decree No. 2007-006 created a national park of nearly 3.4 million hectares in the south of the territory, named the "Amazonian Park of French Guiana" [68]. This park connects with the Tumucumaque Mountains National Park in Brazil. These two national parks form a protected tropical area of more than 7 million hectares. The management of the Amazon Park aims, in addition to safeguarding biodiversity, to preserve native cultures and their collective use rights that live in the territory [69].

Regarding ecotourism, the Amazon region of French Guiana offers some 8 million hectares of virgin forest and more than 5,000 animal and plant species. This area can be used for hiking in the forest, canoeing on the Maroni River, meeting local ethnic groups, and sleeping in small wooden houses in small towns and villages. The French government itself, through the National Tourism Agency, promotes this type of activity [70].

Table 1. Identification of Territorial Management Actors and Actions and Associated Environmental Services in the Amazon Region by Country/Territory. Year: 2001–2025.

Country/Territory	Social Actors	Territorial Management Actions	Associated Environmental Services
Brazil	-Indigenous communities and rubber tappers (*seringeiros*) of the Serra do Divisor National Park. -NGO Kanindé -IBAMA -FUNAI -Local communities related to açai, Brazil nut and pirarucú fishing chains.	-Bioeconomy practices and commercial exploitation of native plants. -Regional Plan for the Development of the Amazon (PRDA)	-Preservation of biodiversity. -Mitigation of climate change. -Promotion of sustainable development.
Peru	-Indigenous rural communities -USAID -Ministry of the Environment	-"Sustainable Productive Landscapes in the Peruvian Amazon" Project -USAID Prevenir Project	-Environmental and biodiversity preservation in front of deforestation and mining.
Bolivia	-Indigenous Communities (Takana, Movima, Yuracaré, Mosetén, Machineri and Leco)	- Monitoring deforestation and illegal activities.	-Preservation of the Amazon Rainforest and biodiversity.

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	-Madidi National Park -Center for Legal Studies and Social Research (CEJIS for its Spanish Acronym). -Subcentral of the Movima Indigenous People (SPIM for its Spanish Acronym). -Subcentral of Movimas Indigenous Women (SMIM for its Spanish Acronym). -Swiss Embassy in Bolivia. -Municipal Government of Apolo. -Wildlife Conservation.	-Tourism. -Preservation of medicinal plants. -Collection and cultivation of wild cacao. -"Comprehensive Forest Management Plan" -"Bioculture and Climate Change" project.	-Preservation of Indigenous cultural heritage. -Sustainable development. -Mitigation of environmental change.
Colombia	-National Organization of Indigenous Peoples (OPIAC for its Spanish Acronym) -World Wide Fund for Nature (WWF) -Norwegian Agency for Development Cooperation (NORAD for its Spanish Acronym)	-"From REDD+ Agreements to REDD+ Results, 2016-2020" Project.	-Ecological corridors that connect discontinuous areas of the Amazon Forest. -Carbon storage. -Biodiversity preservation and management. -Maintenance of the hydrological cycle. -Food security. -Preservation of ancestral cultural practices.
Venezuela	-Indigenous and rural communities. -Honey producers (meliponiculturists). -National Institute of Agricultural Research (INIA for its Spanish Acronym) -University of Los Andes. -Ministry of People's Power for Ecosocialism (MINEC for its Spanish Acronym). -National Parks Institute (INPARQUES for its Spanish Acronym) -Wataniba Ambiental	-Development of beekeeping. Creation of the Stingless Bee Sanctuary in the Atures municipality of Amazonas state. -Project "Empowering Women through Community Savings Funds: An Experience in Economic Sustainability." -Project "Cultivating and Marketing Organic Cacao for Community Well-being in the Amazon" -Project "A Link between the Land, the Community, and Nature"	-Forest maintenance and conservation. -Natural pollination of native Amazonian forest species. -Mitigation of deforestation and illegal mining. -Preservation of ancestral cultural practices of indigenous and traditional peoples.
Ecuador	-Private entrepreneurs. -Yasuní National Park. -Maquita Cushunchic Foundation.	-Sacha Lodge. -Yasuní Ecotourism. -Permaculture.	-Preservation of biodiversity. -Sustainable development.

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	-Indigenous communities (Kichwa, Waorani, Shuar, Achuar, Shiwiar and Zapara). Ecociencia Foundation.	-Monitoring of deforestation and illegal activities.	-Preservation of cultural heritage.
Guyana	-Iwokrama International Centre for Rain Forest Conservation and Development. -Macushi Indigenous Peoples. -National State of the Cooperative Republic of Guyana.	-Ecotourism -Low Carbon Development Strategy (LCDS) of 2013. -National Biodiversity Strategy and Action Plan (2012-2020) of 2014. -LCDS 2022.	- Environmental and biodiversity protection and preservation. -Preservation of cultural heritage. -Sustainable development.
Suriname	-Amazon Conservation Team. -Central Suriname Nature Reserve. -Brownsberg Nature Reserve. -Indigenous (Wayana, Aparai, and Trio) and Maroon (Saramacca) communities. State of the Republic of Suriname.	Ecotourism. -Community-based logging.	-Environmental and biodiversity protection and preservation. -Preservation of cultural heritage. -Sustainable development.
French Guyana	-French Guiana National Park. -Indigenous and Maroon communities. -State of France.	-Collective use of communal lands for hunting, gathering, fishing, and agriculture. -Sustainable management of forest heritage. -Collection of medicinal plants.	-Environmental and biodiversity protection and preservation. -Preservation of cultural heritage. -Sustainable development.

Source: Own elaboration based on case studies.

3.Discussion

The Amazon is a critical global ecological and cultural reservoir. However, currently, it is facing unprecedented pressures from climate change, extractive industries, and socio-political inequalities. The findings of this study illuminate the complex interplay between territorial management practices, ecosystem service preservation, and the agency of diverse stakeholders. While the case studies demonstrate significant advancements in balancing human needs with ecological integrity, they also reveal systemic contradictions and unresolved challenges that warrant critical reflection.

3.1. The Role of Indigenous and Traditional Communities as Custodians of the Amazon Forest

Across the Amazon, indigenous and traditional communities emerge as central actors in sustaining ecosystem services. Their practices rooted in ancestral knowledge and align closely with ecological cycles, as seen in Brazil's rubber tappers managing forest products sustainably, which challenge capitalist paradigms by prioritizing reciprocity with nature over extraction. However, the efficacy of these practices depends on legal recognition and territorial autonomy. In many Amazon countries, there is no clear demarcation of indigenous lands. Even in recognized territories, indigenous land still face encroachment, as illegal mining and logging persist due to weak state enforcement. This underscores a paradox: while indigenous management models are lauded globally, their implementation often lacks institutional backing, leaving communities vulnerable to external threats.

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3.2. The Role of Market-Based Mechanisms in Sustainable Land Use

The role of Market-Based mechanisms in sustainable land use issues in the Amazon region is questionable. Brazil's 2021 Payment for Environmental Services (PES) law exemplifies this contradiction. While ostensibly designed to reward conservation, it has inadvertently accelerated land concentration by favoring large landowners capable of meeting bureaucratic requirements, marginalizing small-scale indigenous and traditional communities. Similarly, ecotourism also illustrates the double-edged nature of market integration, which can easily lead to neglect and change of local culture. Therefore, it can be said that economic valuation of ecosystem services risks reducing nature to a tradable commodity, undermining intrinsic ecological and cultural values.

3.3. The Role of Transnational Actors

The involvement of international organizations (e.g., UNDP, USAID) and foreign governments in sustainable land management in the Amazon introduces both opportunities and dependencies. For example, the emphasis on carbon sequestration in REDD+ projects in the Amazon may overshadow indigenous demands for food security and cultural preservation. Moreover, the reliance on foreign aid raises questions about long-term sustainability. The withdrawal of external funding could destabilize the gains of sustainable land management, particularly in regions with limited state capacity. In addition, external interventions always address symptoms without tackling inherent problems like inequitable land distribution or extractive economic models.

4. Conclusions

Following our objective of identifying and describing different territorial management practices and their contribution in terms of ecosystem services in the Amazon, we have identified actors, actions, and associated environmental services. We identified a plurality of actors involved in territorial management in the Amazon Region. The main actors are Indigenous communities, maroon communities, and traditional local inhabitants. These actors often coordinate their actions with Indigenous NGOs, environmentalists, and universities, as well as with various government agencies, such as those linked to Indigenous, environmental, forestry, and tourism issues, and National Parks. Among the actions developed, we can mention various agroecological practices (permaculture, wild cacao harvesting, açaí, Brazil nuts, etc.), ecotourism, integrated forest management and sustainable exploitation, extraction and marketing of native bee honey, preservation and cultivation of medicinal plants, monitoring of invasions and illegal activities in the Amazon rainforest, product marketing, and various bioeconomic practices. Our identification goes beyond the economic valuation of ecosystem services and seeks to consider the contribution of territorial management as an agency that enhances these services, contributing to the protection of habitats, biodiversity, and Indigenous ancestral culture in front of the challenges imposed by the excesses of human activity and the destructive force of contemporary capitalist dynamics.

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Abbreviations

The following abbreviations are used in this manuscript:

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