Amazon Assessment Report 2021

Chapter 18

Globalization, extractivism, and social exclusion: Country-specific manifestations

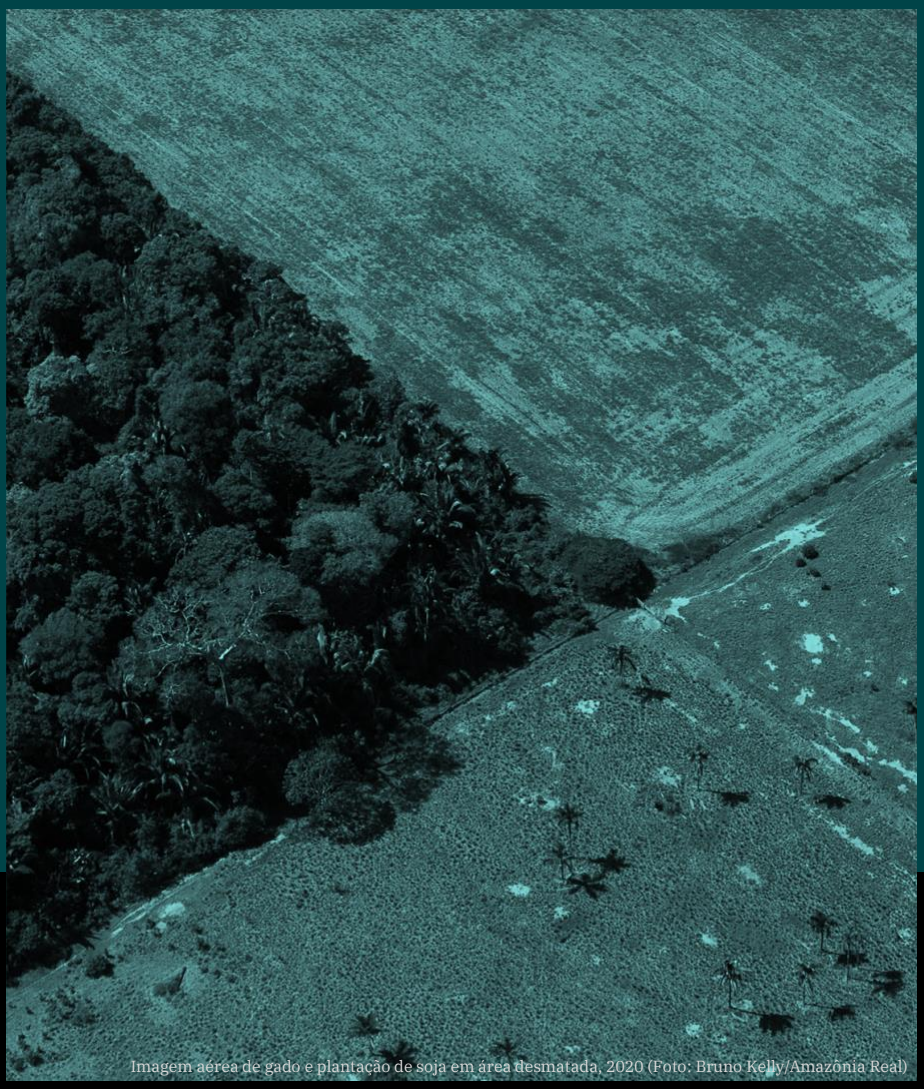

Imagem aérea de gado e plantação de soja em área desmatada, 2020 (Foto: Bruno Kelly/Amazônia Real)

THE AMAZON WE WANT
Science Panel for the Amazon

SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

About the Science Panel for the Amazon (SPA)

The Science Panel for the Amazon is an unprecedented initiative convened under the auspices of the United Nations Sustainable Development Solutions Network (SDSN). The SPA is composed of over 200 preeminent scientists and researchers from the eight Amazonian countries, French Guiana, and global partners. These experts came together to debate, analyze, and assemble the accumulated knowledge of the scientific community, Indigenous peoples, and other stakeholders that live and work in the Amazon.

The Panel is inspired by the Leticia Pact for the Amazon. This is a first-of-its-kind Report which provides a comprehensive, objective, open, transparent, systematic, and rigorous scientific assessment of the state of the Amazon's ecosystems, current trends, and their implications for the long-term well-being of the region, as well as opportunities and policy relevant options for conservation and sustainable development.

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Graphical Abstract

Country or Territory	Cumulative tree cover loss in primary forests 2001-2020 (% area 2000)	Level	% Protected areas 2020	% Indigenous territories 2020	Main degradation drivers	Public policies
Brazil	7.77	High	24.3	22.8	Cattle ranching, soybean, iron mining, infrastructure	Extractivism compensated with Protected Areas and Indigenous Territories (PAIT), reducing deforestation (2005-2012).
Bolivia	7.49	High	30.0	26.5	Cattle ranching, Large Scale Agriculture	Extractivism with conservation rhetoric and PAIT.
Peru	3.16	Medium	21.1	34.0	Cattle ranching, oil, shifting agriculture, illegal drugs	Extractivism with PAIT.
Colombia	3.08	Medium	26.0	54.3	Cattle ranching, oil, illegal drugs, illegal gold mining	Extractivism with conservation rhetoric and PAIT.
Ecuador	1.86	Medium-low	26.8	55.9	Oil, shifting agriculture, cattle ranching	Extractivism with conservation rhetoric and PAIT.
Venezuela	1.41	Low	46.0	56.5	Illegal gold mining	Weak state presence, mining promotion.
Suriname	1.05	Low	-	-	Gold mining	Mix of intervention and conservation, weak state presence.
Guyana	0.79	Low	-	-	Gold mining	Mix of intervention and conservation, weak state presence.
French Guyana	0.65	Low	50.7	13.1	Gold mining	Mix of intervention and conservation.
Total	**5.45**		**24.9**	**27.0**		

Figure 18A. Graphical Abstract

Globalization, Extractivism, and Social Exclusion: Country-Specific Manifestations

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Key Messages

- Local manifestations of deforestation and degradation are particular to national and local contexts as a function of their natural, historical, social, political, and economic conditions.
- Two antagonistic ideas have predominated as models for the region, "extractivism" and "conservation". The current Amazonian development model is not sustainable, and the transition to an alternative path is necessary. A new model must achieve forest conservation and meet the self-determined welfare objectives of Indigenous peoples and local communities (IPLCs), redefining economic activities, rules, incentives, and business models, while being regionally coordinated and sustainable in the long term.
- The Amazon is characterized by severe social inequality, particularly unequal land distribution; when coupled with land tenure irregularity, this hinders sustainable development. The disproportionate impact of COVID-19 on the most vulnerable populations, in particular Indigenous peoples, is a clear example.
- The transition to a low-emission and sustainable development path must include effective policies to reduce inequalities and involve the just distribution of land and regularization of tenure, considering, where necessary, different cultural notions of property. This should be coupled with social policies that help maintain ties to the land and enhance the ability to obtain good standards of living.

Abstract

This chapter presents country-specific descriptions of human intervention in the Amazon. In general, a rapid expansion of agricultural and extractive activities, mostly for export but also for domestic markets, and to a lesser degree small scale agriculture, have led to extensive deforestation and environmental degradation without improving the living conditions of the population. Government policies and the extent of State ascendancy in the area also seem to be a powerful determinant of the nature and scale of the process. Despite the common underlying international and domestic economic and political forces in the Amazon, each country has its own particularities. In the case of Colombia, the process was shaped by the guerilla presence and deteriorated after the Peace Treaty, which does not mention "deforestation" and perpetuates Colombia's extractivist model. Ecuador's case is representative of the link between fossil fuel extraction, environmental deterioration, and social exclusion. The case of Peru shows an Amazon perceived as a territory awaiting to be "conquered, occupied, and exploited", subjected to an unwavering extractive and market-orientated drive. In Bolivia, contradictions between conservation and state-led development policies and business activities, which have transformed it into the second-highest deforestation hotspot

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after Brazil, are presented. The Venezuelan Amazon is subject to rampant violence and illegal activity driven by the political geography of gold in mixed configurations of governance, with blurred boundaries between legality and illegality and prevailing negligence concerning conservation. The Guianas share low deforestation levels and lower environmental pressures, but the recent expansion of gold mining poses a serious threat. The Brazilian case presented in the previous Chapter is referenced here when comparing countries' experiences. Conservation experiences are also included. In all cases, unsustainable extractivist models have outpaced conservation policies; however, these experiences can prove useful in the design of effective conservation policies, reduction of greenhouse gas emissions, and improvements in living conditions of Indigenous peoples and local communities.

Keywords: Globalization, extractivism, deforestation, conservation policies, development policies.

18.1 Introduction

Human intervention in the Amazon has accelerated since the 1970s, threatening the rainforest, its environmental benefits, and the integrity and survival of its diverse Indigenous peoples and local communities (IPLCs). The rapid expansion of agricultural and extractive activities, geared mostly towards export but also to supply domestic markets, has driven significant deforestation and environmental degradation without improving the living conditions of the population. Extensive cattle ranching, soy cultivation, oil, gas, mining, illegal gold extraction, and drug trafficking, coupled with roads and mega infrastructure projects, such as hydroelectric dams, has contributed to an unequal and unsustainable development process (Chapters 14 and 17; WWF 2016).

Although the underlying international and domestic economic and political forces generating these processes are common to all Amazonian countries and territories, there are country-specific manifestations, transformations, and conservation policies (Box 18.1). This chapter explores the specific traits of country cases and the underlying causes, which serve to understand the complex and changing character of current human intervention in the Amazon.

The analysis in this chapter includes two comprehensive national cases in the Andean Amazon (Colombia and Ecuador), and succinct studies of cases in Bolivia, Peru, Venezuela, Guyana, Suriname, and French Guiana. The Brazilian case was explored in-depth in the previous chapter. The first case is the Colombian experience after the peace agreement with the Fuerzas Armadas Revolucionarias de Colombia (FARC) guerrilla group, which resulted in increased deforestation. The second case is Ecuador's oil-driven intervention in the Amazon, illustrating the link between fossil fuel extraction, environmental deterioration, and social exclusion. To complement the mosaic of experiences, other cases are briefly analyzed: Peru, a country with an unwavering extractive and market-orientated profile; Bolivia, a pioneer in environmental legislation but subject to critical contradictions between conservation and state-led development policies and business activities; Venezuela, where the Amazon is subjected to rampant illegal activity and mixed configurations of governance driven by the political geography of gold and limited ascendancy by formal state structures; and finally, the Guianas (here inclusive of Guyana, Suriname, and French Guiana), a subregion where deforestation rates are the lowest in the Amazon, but where environmental threats are rising rapidly.

National experiences differ, not only by their specific drivers of environmental degradation, but also by magnitude (Costa 2020). Taking primary forest tree cover loss between 2001 and 2020 (World Resources Institute 2021) as an indicator, forest deterioration is led by Brazil, with a 7.8% loss. Containing 58% of the Amazon rainforest area in 2000, Brazil accounted for 77% of primary forest tree cover loss across all Amazonian countries (Figures 18.1, 18.2, 18.3; Table 18.1).

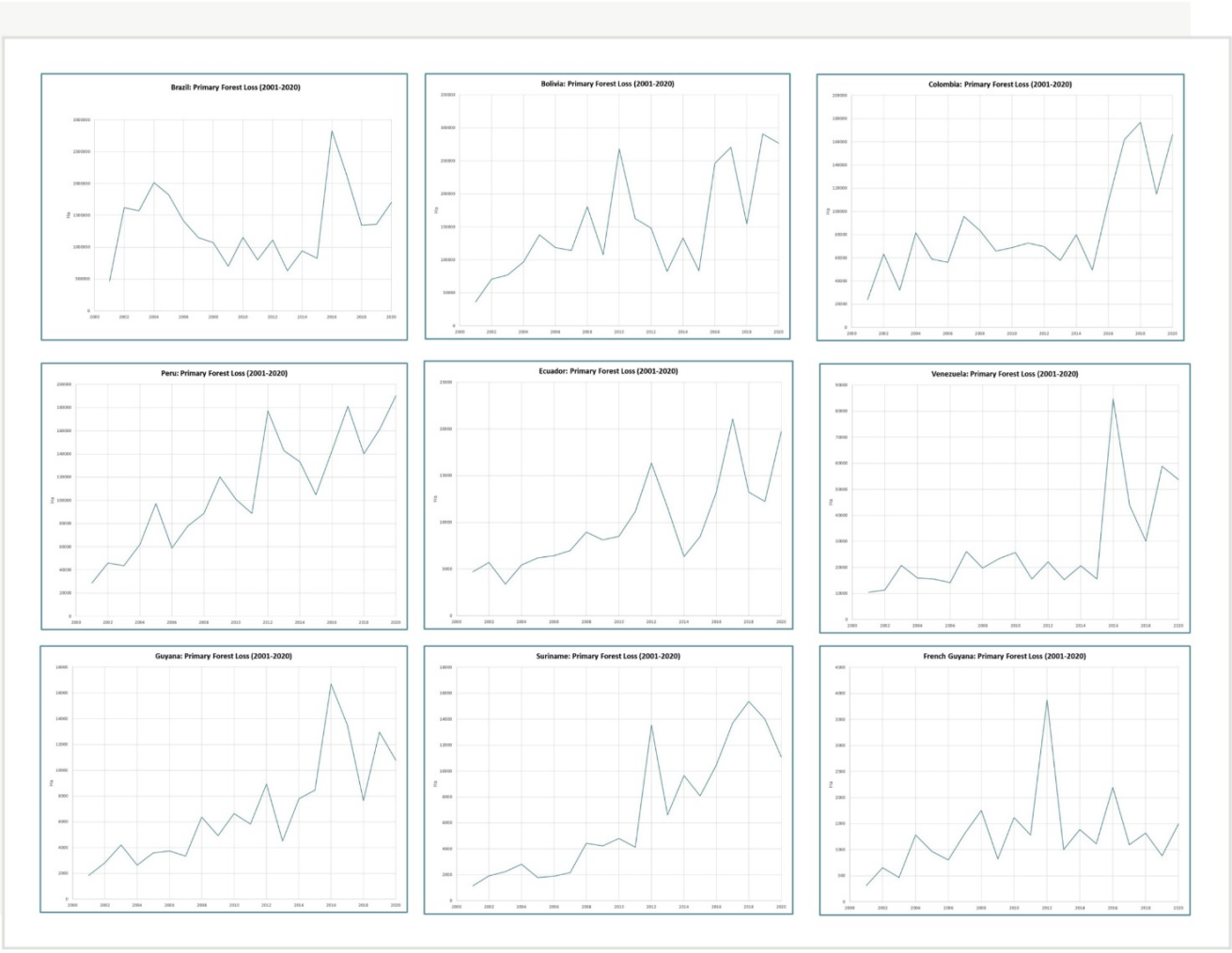

Figure 18.1 Primary Cover Loss by Countries (2001-2020). Tree cover loss is not equivalent to deforestation. Source: World Resources Institute (2021).

Between 1985 and 2019, the bulk (89%) of deforested land in Brazil's Amazon was transformed into pastures, and 9% for soy cultivation (RAISG 2021). Pasture area increased more than three times in the period, except during the 2005–2012 interval, when deforestation declined (Chapter 17). Soy cultivation began in 2000 and increased 20 times, with an average growth rate of 17% per year. Extensive cattle ranching and soy cultivation have been the leading direct factors in Brazilian deforestation (Chapter 17), but in both cases the growth declined or stopped when deforestation was controlled, and resumed with lower intensity when the policies launched in 2003 and 2004 to control deforestation and establish a sustainable development model in the Brazilian Amazon (PAS, PPCDAm and among others Plano BR-163 Sustentável) were reversed, as covered in detail in Chapter 17 (Figure 18.4). Brazil also has most of the Amazon's large-scale mining operations, particularly for iron ore. Large infrastructure projects — roads (Initiative for the Integration of the Regional Infrastructure of South America, or IIRSA) and hydroelectric dams — are significant drivers of environmental degradation (RAISG 2020).

Degradation has also been intense in Bolivia (Figure 18.3). Despite its environmentalist rhetoric, the Bolivian government actively promoted land clearing for large-scale cattle ranching and agriculture,

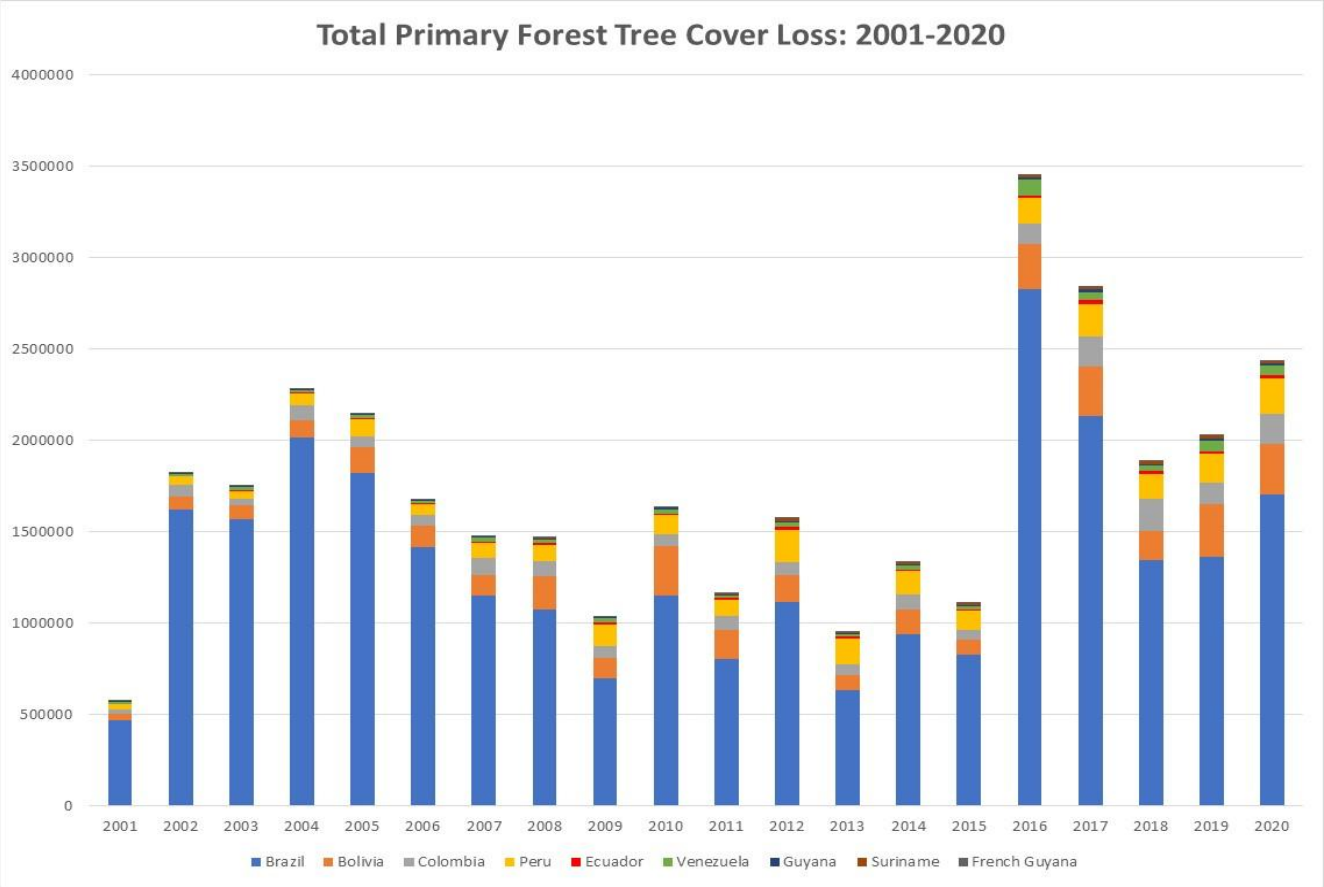

Figure 8.2 Source: World Resources Institute (2021).

extractive activities, and infrastructure, particularly roads and dams, all within and outside national parks. As a result, tree cover loss was also extensive in Bolivia (7.5%), which closely follows Brazil's case. Peru, Colombia, and Ecuador have lower primary forest losses (3.2%, 3.1%, and 1.9%, respectively).

Commercial agriculture has had an important role in the higher forest-loss countries, Brazil and Bolivia. In most cases, oil extraction has played a significant role as an environmental deterioration driver (Figure 18.5). Crude oil is currently the main export product of Ecuador and Colombia, whereas in Peru the Camisea megaproject provides natural gas for export (OEC 2021). Oil and gas extraction in the Andean Amazon has also led to severe environmental impacts in protected areas (PAs), such as Yasuni National Park in Ecuador, regarded as the most biodiverse place in the western hemisphere (Bass et al. 2010; Larrea 2017).

Ecuador's case study not only includes the detrimental environmental impact of oil extraction, but also the lack of social distribution of revenue in the region. The Amazon is still the poorest region in the country, and oil extraction areas are more socially deprived than non-oil subregions. In Ecuador's Amazon, deforestation is mostly conducted by poor migrant peasants, with large-scale livestock and plantations less frequent. The analysis finds that peasant families do not perceive lasting benefits from deforestation, as land productivity is low and declines over time (Larrea 2017; Wunder 2000).

Mining megaprojects are concentrated in Brazil and have recently expanded to Ecuador, whereas illegal gold mining causes heavy environmental

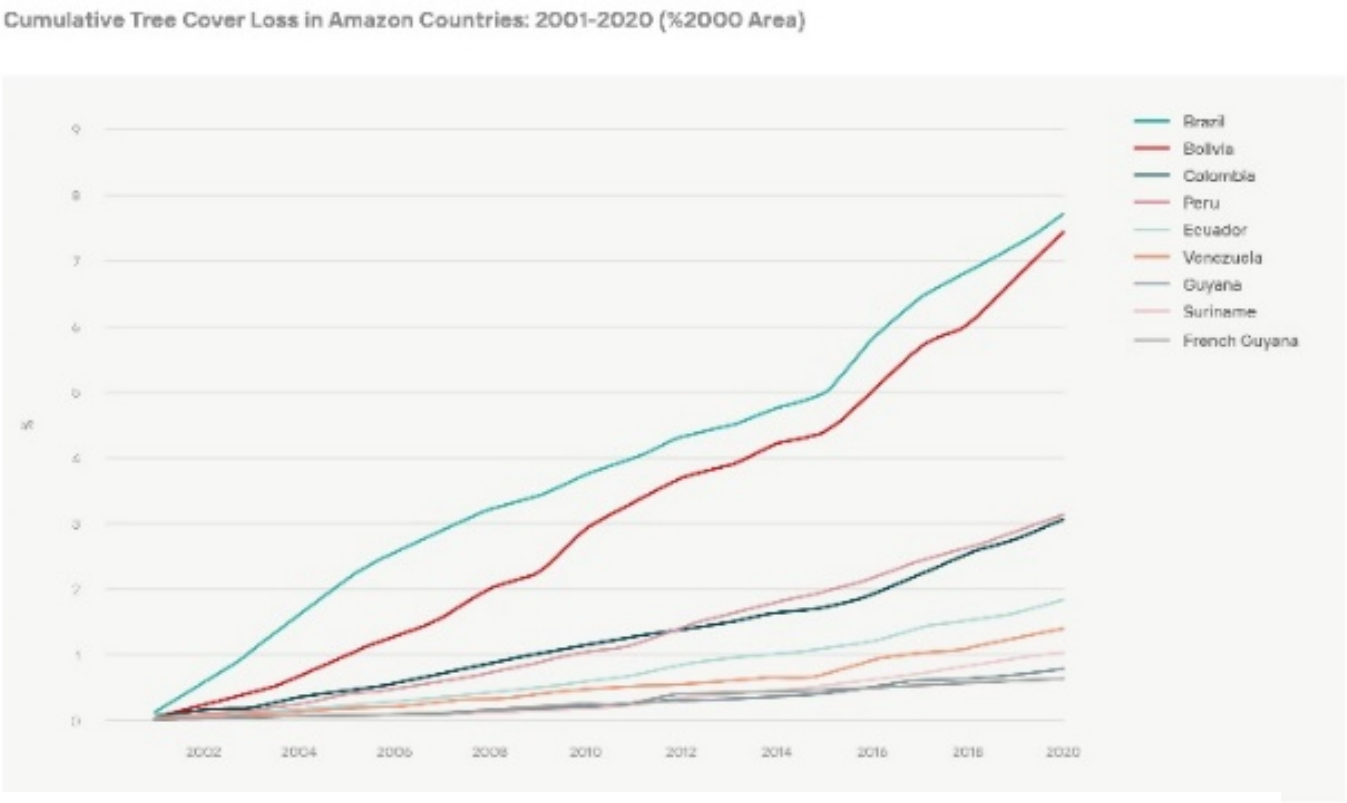

Figure 18.3 Tree cover loss is not equivalent to deforestation. Source: World Resources Institute (2021).

impact in all Amazonian countries. According to recent estimates, illegal gold extraction accounts for 28% of gold mined in Peru, 30% in Bolivia, 77% in Ecuador, 80% in Colombia, and 80–90% in Venezuela (Figure 18.6). It is estimated that the value of illegal gold exports is comparable to that of cocaine exports (GI-TOC 2016). Gold is the main export product in Suriname.

In the recent Colombian experience, increasing deforestation was registered in the Amazon region after the 2016 peace agreement. An extractive model predominates, with cattle ranching, oil expansion, and land grabbing prevailing. The study is also illustrative of the effects of illicit extractive activities, often linked with chronic violence, which are also present in Peru and Venezuela, and manifest in most other countries.

A third group of countries and territories with low forest loss are Venezuela (1.4%), Suriname (1.1%), Guyana (0.79%), and French Guiana (0.65%). Land-use change from forest to agriculture has been low in all of them, but forest loss is on the rise, principally driven by gold extraction, but also by unsustainable forestry and fishing practices, and poaching, with an incipient potential offshore oil and gas boom in Guyana and Suriname.

In Venezuela, where abundant oil reserves located outside the Amazon did not stimulate economic diversification, extractive pressures on the rainforest were weaker and deforestation remained low. During the so called “Big Crisis” (2013 to today), the government promoted mining in the Amazon Orinoco Arc. Although large-scale mining remained weak, expansion of illegal mining of gold, coltan, and other minerals took place, often linked to organized crime. As a result, environmental deterioration and social conflict increased, with particularly dire consequences for Indigenous peoples.

This chapter shows the varying configurations seen in the individual cases while the presence of

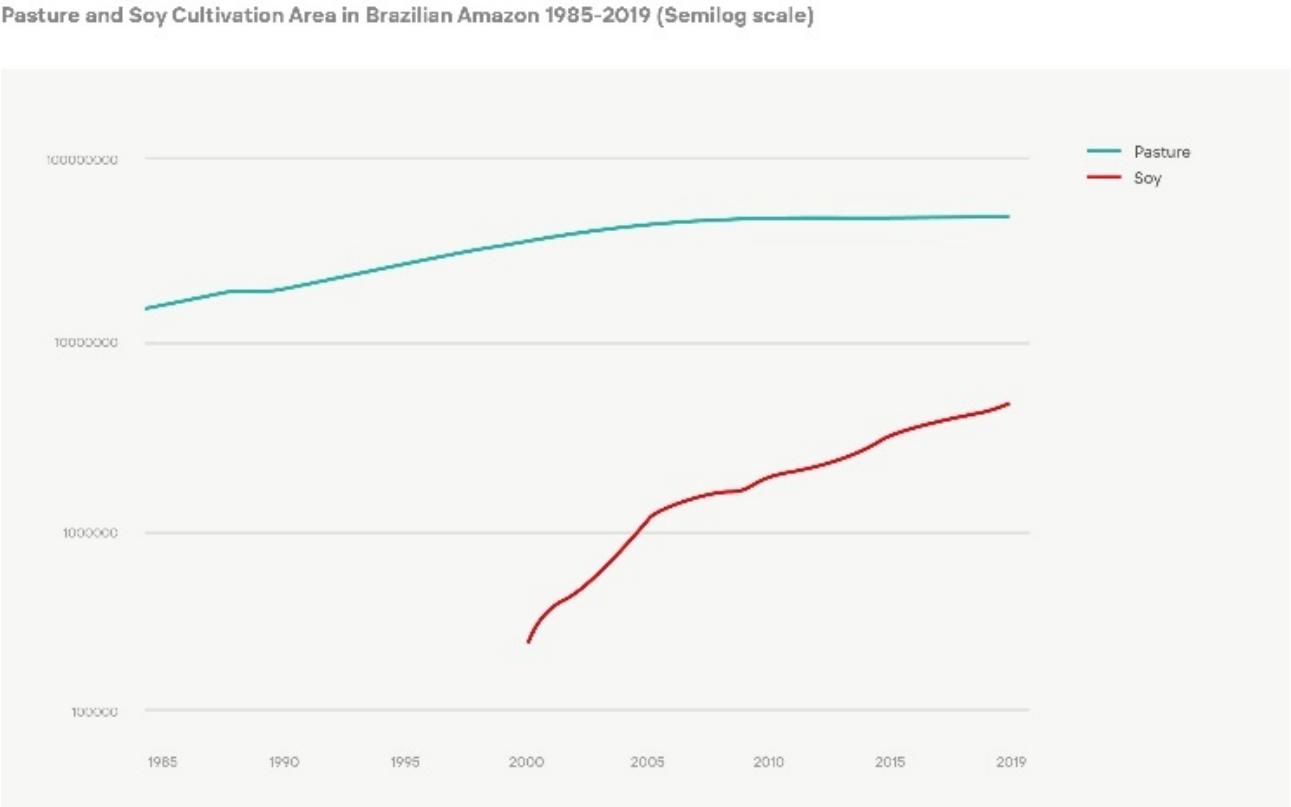

Figure 18.4 Pasture and Soy Cultivation Area in Brazilian Amazon. Source: RAISIG 2021.

underlying and cross-cutting common forces permeates the region. These common forces may involve shared internal factors, such as institutional weakness, or external influences, such as demand for commodities, but together their compounded effect is seen country by country and regionally in a degraded, plundered, and unsustainable Amazon.

18.2 Amazon Deforestation in Post-Conflict Colombia

Approximately 43% of Colombia is in the Amazon (Figure 18.7), making Colombia one of the five megadiverse countries in the world. In 2018, the Colombian Supreme Court of Justice declared the Colombian Amazon Subject of Right and disposed that the Colombian government must create a concrete mechanism to protect the Amazon (Bustamante et al. 2020; Sentence 4260-2018 of the Colombian Supreme Court of Justice).

However, in the twenty-first century, 5.7% of Colombia's forested areas (4.4 million ha) have been cleared (Global Forest Watch 2020). This is roughly equivalent to the area of Denmark. The main deforestation areas are within five Colombian departments: Caquetá, Meta, Guaviare, Antioquia, and Putumayo (Figures 18.8 and 18.9). Except for Antioquia, all departments are in the Amazon/Orinoquía region. Similar to other countries of the region, deforestation in Colombia has various facets: a) severe socio-cultural and socio-economic transformations that threaten the traditional lifestyles of Indigenous communities; b) massive biodiversity loss; and c) disastrous impacts on the global climate (IDEAM et al 2017).

Deforestation has significantly accelerated after the historic signing of the peace treaty between the Colombian government and the FARC-EP guerrilla group in 2016. This is no surprise, as international empirical evidence indicates that post-conflict scenarios often accelerate deforestation (Murillo-Sandoval et al. 2020). In the Colombian case, defor-

Table.18.1 Tree Cover Loss in Primary Forests. Source: World Resources Institute 2021. Tree cover loss is not equivalent to deforestation.

	Tree Cover Loss in Primary Forests (ha)									
Year	Brazil	Bolivia	Colombia	Peru	Ecuador	Venezuela	Guyana	Suriname	French Guyana	Total
2001	465543	36530	24082	28699	4701	10438	1835	1145	313	573285
2002	1621765	70601	63302	46059	5693	11323	2825	1932	655	1824155
2003	1570576	77167	32050	43733	3379	20775	4216	2243	465	1754604
2004	2016477	96611	81695	62035	5436	15924	2630	2814	1283	2284906
2005	1824425	137831	58906	97399	6205	15565	3579	1808	965	2146683
2006	1415580	118804	56051	58813	6438	14244	3744	1893	804	1676371
2007	1149563	114376	95539	77992	6995	26116	3346	2158	1313	1477398
2008	1075146	180575	83619	88797	8953	19859	6377	4431	1757	1469512
2009	700169	108163	65824	120186	8112	23435	4929	4227	820	1035865
2010	1153025	267751	68739	100970	8491	25809	6656	4797	1620	1637857
2011	803049	162625	72601	88886	11175	15590	5831	4125	1279	1165161
2012	1116088	148294	69587	177236	16354	22125	8942	13540	3872	1576038
2013	632094	82290	57713	142870	11590	15349	4512	6628	1001	954046
2014	940905	133268	80036	133107	6330	20609	7790	9659	1386	1333088
2015	828870	83299	49643	104864	8472	15546	8463	8080	1116	1108352
2016	2830977	246088	108566	142720	13198	84705	16689	10457	2195	3455595
2017	2134649	270346	161945	181090	21085	43759	13505	13718	1097	2841194
2018	1347133	154489	176977	140185	13220	30169	7628	15367	1318	1886485
2019	1361094	290499	115090	161590	12231	58827	12964	14013	883	2027194
2020	1704092	276883	166485	190199	19747	53702	10763	11076	1498	2434446
Total Loss	**24987130**	**2779604**	**1521963**	**1997230**	**178060**	**490167**	**126460**	**123033**	**24142**	**32227789**
% Area 2000	7.77	7.49	3.08	3.16	1.86	1.41	0.79	1.05	0.65	5.86
Area 2000	343383394	40833752	54836889	69170714	10652183	38666663	17297899	12775509	3923496	591540498
% By country	58.0	6.9	9.3	11.7	1.8	6.5	2.9	2.2	0.7	100.0
Loss % Area 2000	77.0	8.8	4.9	6.3	0.6	1.6	0.4	0.4	0.1	100.0

Figure 18.5 Oil and gas consessions in the Amazon. Source: RAISG, 2021.

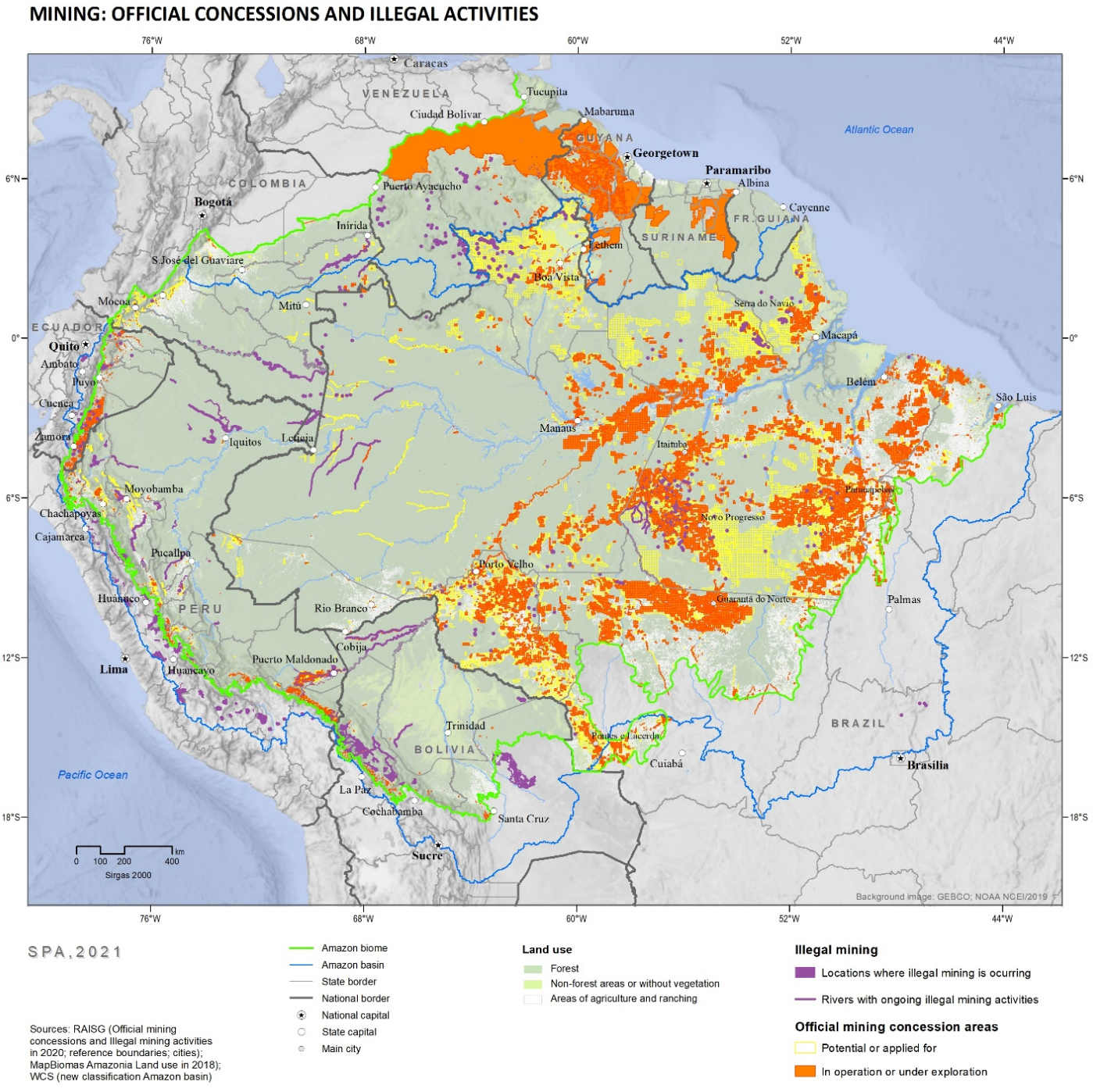

Figure 18.6 Official mining concessions and illegal activities. Source: RAISG, 2021.

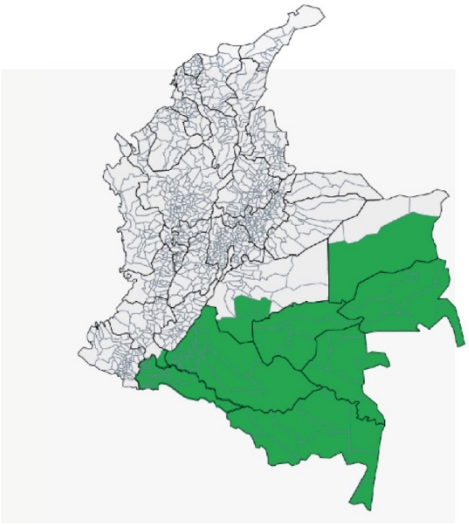

Figure 18.7 Colombian Amazon is distributed in the departments of Amazonas, Caquetá, Guainía, Guaviare, Putumayo, and Vaupés as well as parts of Meta and Vichada, and small parts of Cauca and Nariño. Source: Colombian

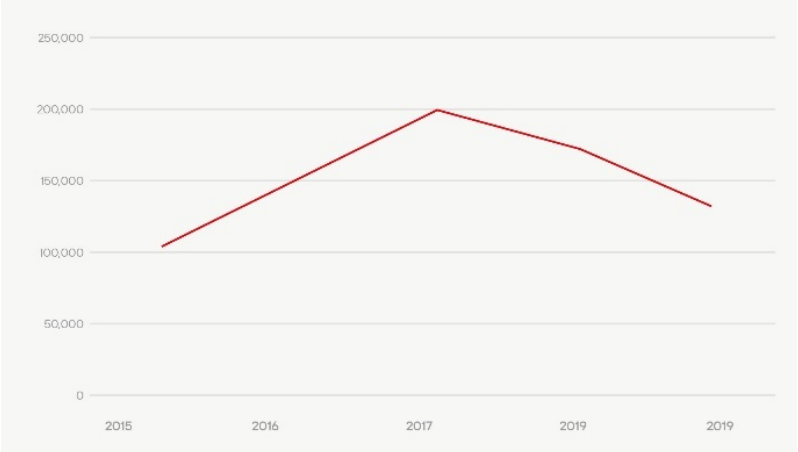

Figure 18.9 Top 10 Departments Deforestation in Hectares. Source. Own construction based on IDEAM (Colombian Institute of Environmental Analysis) deforestation reports between 2015 and 2019.

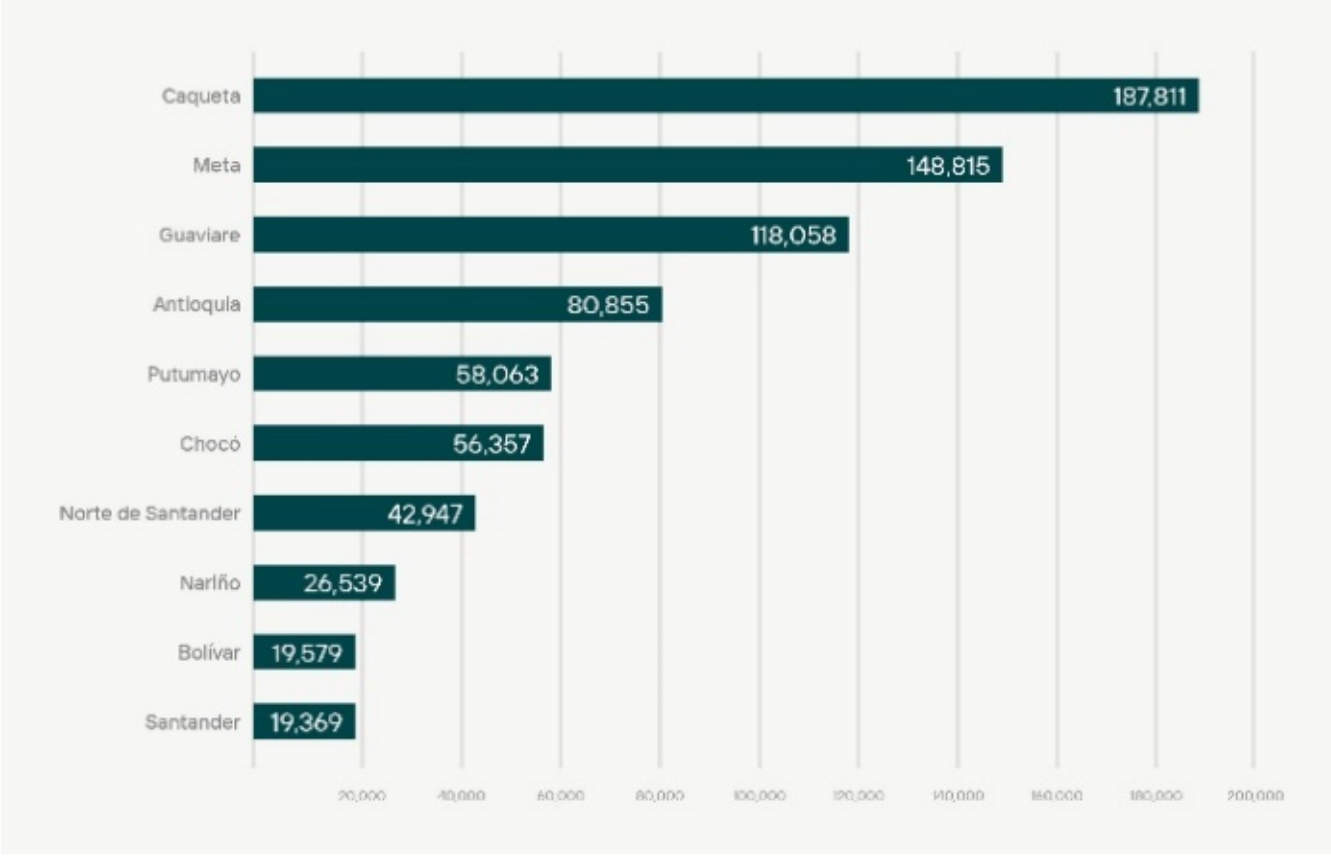

Figure 18.8 Accumulated deforestation top ten Departments in Colombia: 2015–2019. Source: Colombian Institute of Environmental Analysis- IDEAM,2020.

estation was not appropriately addressed during the peace negotiations, with the term "deforestation" not being mentioned in the final agreement. Instead, the document includes objectives to modernize the Colombian countryside, which would arguably trigger deforestation. However, the main challenge for forest protection is linked to the Colombian extractivist development model. The former federal administration (2010–2018) presented the extractivist development model as the backbone for financing the peace process (Ulloa and Coronado 2016), a vision also shared by the current administration (2018–2022) (DNP 2018: 695). However, the current administration introduced major political changes, slowing down the implementation of the peace agreement (Instituto Kroc 2021). The focus on the extraction and the "export of nature" (Coronil 1997) has far-reaching negative economic and social outcomes and implies harsh negative social-ecological consequences (Gudynas 2015).

The Colombian Amazon was a stronghold of the FARC-EP guerrilla group (Van Dexter and Visseren-Hamakers 2019; Krause 2020), which slowed deforestation through "gunpoint conservation" (Álvarez 2003: 57). The FARC conserved the forest as a natural barrier for their own protection against incursion, while the presence of armed groups curbed development projects and related forest clearing (Rodríguez-Garavito and Baquero 2020; Murillo-Sandoval et al. 2020). To avoid misunderstandings, the internal conflict in Colombia had multiple negative effects on the environment, such as oil spills and environmental damage owing to direct impact from battles, including in the Amazon region (Nuñez-Avellaneda et al. 2014; Pereira et al. 2021). The staged self-image of the FARC guerrillas as armed environmentalists is more myth than reality. However, although conflict did not prevent deforestation (Negret 2019), the strong guerrilla presence in the Amazon region indeed slowed down deforestation (Mendoza 2020).

The signing of the peace agreement was a game-changer. It reduced armed violence and represented a pre-condition for a better future for Colombia. Unfortunately, the environment is a victim of the fragile Colombian peace process, owing to accelerated development and modernization projects. Official figures (Reardon 2018) show how deforestation rates in Colombia have soared since 2016 (Figures 18.1 and 18.9). This is especially true for large parts of the Amazon region, in which "unintended peace-induced deforestation rates" (Prem et al. 2020: 7p.) dramatically increased during the peace process (Álvarez, 2003; Krause 2020; Graser et al. 2020). This also applies to PAs and Indigenous territories (ITs), where parallel markets for land are reported (Armenteras et al. 2019; Clerici et al. 2020; Murillo-Sandoval et al. 2020; Tobón Ramírez et al. 2021). This process is highly linked to the expansion of the extractive frontier in the Colombian Amazon (mining, hydrocarbons, and agrarian extractivism, including illicit crops), processes of land grabbing, and a deep-rooted sociocultural preference for land ownership by elites as a symbol of status and political power (Richani 2012).

18.2.1 Drivers of Deforestation and Extractivist Development Projects in the Colombian Amazon

Deforestation in the Amazon region does not follow a shared logic. Instead, the diversity of the region corresponds to the heterogeneity of the dynamics of deforestation and thus requires locally or regionally adapted protection strategies. The main drivers for deforestation include: i) cattle ranching; ii) land grabbing; iii) extractivism; iv) illicit drug cultivation; v) infrastructure development; and vi) the expansion of the agricultural frontier by smallholders (see Chapters 19 and 20). However, the various drivers of deforestation should not be considered as equivalently relevant for deforestation, nor should they be analyzed in isolation, but rather in their interdependence (Hoffmann, García Márquez and Krueger 2018).

Extensive cattle ranching is by far the most important driver of deforestation in Colombia in terms of area (Prem et al. 2020). In Colombia, the cattle ranching model combines the historical continuity of an extremely unequal distribution of land

with rentier logic that links land ownership with political power and social status. Extensive cattle ranching is supported institutionally by the fact that this form of land use is an easy and inexpensive way to demonstrate the productive use of land and is therefore undertaxed. However, cattle ranching should not be analyzed in isolation, as it is strongly linked to land grabbing.

Land is a major investment opportunity both for legal and illegal money. This leads to increased land concentration and deforestation, as clearing the land is seen as a productive improvement and backs legal land claims (Armenteras 2019; see also Chapter 14). In the context of the peace process, one objective is formalizing land titles throughout the country. Although this is an important advance for ensuring smallholders' rights, it might also support land grabbing and land concentration processes by giving legal certainty to investors. Moreover, cattle ranching is often closely linked to the illegal drug economy. Clearing forest for coca production is often followed by livestock farming, and land transactions are a preferred form of laundering drug money (Richani 2012; van Dexter and Visseren-Hamakers 2019; Vélez Escobar 2020).

The Colombian development model is based on extractivism (for a discussion of the term see e.g., Burchardt and Dietz 2014; Gudynas 2015; Svampa 2019; Peters 2021). This was decisively accelerated during the liberalization of the Colombian economy at the end of the 20th century. Extractivism in Colombia led to an increase in the share of primary goods in total value of exports between 2000 (67.5%) and 2018 (79.3%) (Peters 2021). Compared to other Latin American countries, Colombia has a rather diversified extraction structure, including oil production, mining, and monocultural agrarian extractivism. The expansion of the extractivist frontier has particularly strong impacts in the Amazon, including deforestation owing to mining projects and the start of new oil extraction projects, deforestation due to lumbering precious woods (International Crisis Group 2021a: 21) for export, and the expansion of extractivist monocultures with a focus on palm oil, also leading to new conflicts on land use with local communities (Marín Burgos and Clancy 2017; Pereira et al. 2021).

Coca cultivation is also an important driver of deforestation, especially in remote areas (Dávalos, Sánchez and Armentreras 2016; Mendoza 2020). Approximately 47% of coca cultivation in Colombia takes place beyond the agricultural frontier, mostly on small plots of land in adjacent areas, including Indigenous territories and Afro-Colombian communities. Coca production in Colombia has risen sharply in recent years and is increasingly found in the Amazon regions of Putumayo, but also in Caquetá, Guaviare, Meta, and Vichada (UNODC 2021: 26). Coca production implies severe negative consequences for forests and biodiversity (Rincón-Ruiz and Kallis 2013). However, impacts vary widely at the local level and data on cultivation on a municipality basis should be taken into consideration (Table 18.2).

Additionally, the activity implies further environmental degradation through the production of pasta base and the gradual expansion of the agricultural border. In the past, these were controlled by aerial spraying with glyphosate as part of the Plan Colombia**,** with worrying environmental consequences (Dávalos et al. 2021). The Plan Colombia was jointly agreed between the Colombian and US governments in 1999. It focused on improving security conditions in the Colombian countryside by fighting illegal armed groups and reducing production and trafficking of illicit drugs. Plan Colombia was financed by the USA and fostered their strategic position in the region. The current Colombian administration (2018–2022) considers the fight against coca to be the most important instrument to curb deforestation and blamed consumers for their responsibility for deforestation in the Amazon. Currently, there is a renewed increase in the number of voices calling for a return to aerial spraying, although there is abundant evidence of its detrimental socio-economic and socio-ecological consequences (Vélez and Erasso 2020; Pereira et al. 2021). Recent data suggest that coca cultivation decreased in 2019. However, this is not necessarily good news for forests. Instead, the current

Table.18.2 Coca Cultivation in selected Amazon municipalities: 2013-2019 (ha). List of Amazon municipalities that have at least in one year exceeded 1,000 hectares of coca cultivation.

Municipality (Department)	2013	2014	2015	2016	2017	2018	2019
Cartagena de Chairá (Caquetá)	703	1,050	949	1,188	1,369	1,007	416
Milan (Caquetá)	359	530	696	1,040	1,135	1,226	461
MontaNita (Caquetá)	816	1,335	1,504	1,744	2,492	2,990	823
San José de Fragua (Caquetá)	488	611	1,084	1,031	1,415	1,593	1,410
Solano (Caquetá)	933	1,269	1,285	1,577	764	825	447
Piamonte (Cauca)	461	602	1,167	1,459	1,780	1,997	1,905
El Retorno (Guaviare)	1,314	1,600	1,615	2,192	1,406	1,545	1,195
Miraflores (Guaviare)	1,780	1,922	1,852	2,297	1,699	1,378	1,022
San José de Guaviare (Guaviare)	1,232	1,522	1,501	1,807	1,401	1,175	758
Puerto Rico (Meta)	1,101	1,616	1,620	1,593	1,773	1,082	617
Vistahermosa (Meta)	806	1,337	1,353	1,451	1,473	857	488
Orito (Putumayo)	784	1,639	2,190	2,988	3,970	3,949	3,073
Puerto Asís (Putumayo)	2,150	4,437	6,052	7,453	9,665	7,658	6,810
Puerto Caicedo (Putumayo)	682	1,046	1,481	1,782	2,998	2,905	2,617
Puerto Guzmán (Putumayo)	624	915	1,299	1,585	2,030	2,014	1,750
Puerto Leguízamo (Putumayo)	1,077	1,276	1,805	1,992	1,404	1,104	1,652
San Miguel (Putumayo)	659	1,094	2,338	3,128	3,554	3,329	3,752
Valle del Guamuez (Putumayo)	1,093	2,050	3,660	4,886	4,132	3,363	3,540
Villagarzón (Putumayo)	545	1,041	1,131	1,231	1,760	2,015	1,703

Source: https://www.minjusticia.gov.co/programas-co/ODC/Paginas/SIDCO-departamento-municipio.aspx

activities of manual eradication seem to push cultivation further into remote areas, leading to further clearings (Rincón-Ruiz and Kallis 2013). Simultaneously, global demand for cocaine grows, arguably strengthening the illegal drug economy (UNODC 2021).

In the context of the peace process, various infrastructure projects are planned in the Amazon. These include rural development measures, as explicitly provided for in the first section of the peace treaty, envisaging the construction of rural infrastructure as a means of improving market access for peasants. However, this is not the main driver of deforestation. More worrisome are large road projects that have both a direct impact on deforestation and are used to open the region for development and extraction projects, supporting further deforestation processes. In this respect, infrastructure projects included in the Amazon Hub of the IIRSA are under criticism (Uribe 2019). In addition, there is increasing economic interest in hydroelectric power generation in the Amazon region, especially at the Caquetá and Putumayo rivers (La Liga contra el Silencio 2019).

Expansion of the agricultural frontier is also driven by smallholders and peasants, historically owing to the extremely unequal distribution of land and associated lack of access to land for small farmers or landless people (Sanabria 2019). Another factor is the massive displacement of the rural population during the armed conflict and widespread rural poverty. In this vein, expansion of the agricultural frontier has been a political constant for attending to the agrarian question while preserving the historical privileges of the land-owning elites. However, it is important to highlight that at the same time, large amounts of land were given to a few arguably powerful individuals (CNMH 2017).

In practice, in the Colombian Amazon, land was often cleared by peasants and then appropriated by large landowners, preferentially using land for extensive cattle ranching. Population growth — especially in the context of unequal land distribution — generates further pressure on forests (Lara 2021). These trends (poverty, unequal land distribution, land grabbing, violence) continue in the Amazon today. Hein et al. (2020) similarly suggest that as an effect of the peace process and the “departure of the FARC from the territory”, other actors have

taken advantage of the power vacuum to access land through different means (Prem et al. 2020).

The large number of drivers of deforestation is by no means owing to academic reticence or the exacerbation of complex interrelationships. Importantly, and as described above, not all drivers are equally important. Moreover, regional and local differences are crucial. Although the Amazon is often homogenized in international debates, there is a great deal of variation on the ground. As a result, deforestation drivers also differ. When we talk about the Colombian Amazon, we need to distinguish among different regional processes. In the South of Colombia, especially in Putumayo, the extractivist development model revolves around mining, oil, and coca, whereas in Caquetá, in addition to coca and oil, there is extensive pasture farming, and in the Amazon municipalities of Meta, the agro-export model has been extended to include large palm oil monocultures. In Vichada and Vaupés, there is extensive pasture farming, above all else. These different models are complemented by large infrastructure projects, in particular hydroelectric power plants and roads, which are intended to accelerate development processes and thus increase deforestation (Interview with Estefanía Ciro, 2020/09/26).

18.2.2 Confronting Deforestation: Little Advances and Structural Voids

Past Colombian governments have lauded their own efforts to address deforestation and climate change. The previous administration stated that "environmental massacres" would no longer be allowed (El Espectador 2012). This commitment led to important international cooperation agreements. One example is Vision Amazonía, a project introduced in 2015 that relies on important financial support from Norway, Germany, and the United Kingdom (Krause 2020). The current administration also made climate protection and the fight against deforestation a political priority (El Espectador 2020). Although the deforestation rate declined in 2019, data for 2020 show it has skyrocketed again, and in general terms, figures remain well-above pre-2016 levels (Figure 18.1). Moreover, deforestation also takes place in thepro-

BOX 18.1 Successful Conservation Experiences. Conservation Agreements in the Department of Guaviare (Colombian Amazon). A Strategy from Science and Public Policy to Defeat Deforestation.

Colombian public policy included fighting deforestation as a significant goal. Recently, because of the environmental and social crisis caused by forest fires, and under the leadership of the Colombian government, the Leticia Pact for the Amazon was signed. This pact commits the signatory countries to issues such as protection, conservation, research, and joint management of this region, regarded as vital for the planet's climate balance.

In the department of Guaviare, Colombia, a conservation project based on non-deforestation agreements with peasants has been successfully applied. The framework was an agro-environmental approach developed by the SINCHI Institute, an NGO linked to public policies, which also considers the singularities of the Colombian Amazon. Science and technology have been used to implement agroforestry arrangements that include Non-Timber Forest Products (NTFP), technical assistance and technology transfer, and technological tools to follow up and monitor the agreements, which by 2020 benefited the inhabitants of the department and contributed to achieving the country's goals on reducing deforestation. The agro-environmental approach integrates food security and rural poverty reduction with climate change mitigation and adaptation. It has a systemic scope with multiple objectives based on the economic, social, and environmental dimensions of sustainability. This approach also recognizes the vulnerabilities and particularities of the various landscapes that make up the Colombian Amazon. In addition, in Colombia's Amazon, the agro-environmental approach has been oriented towards an alternative model of territory intervention based on reducing deforestation and conserving forests through activities that ensure the organization of communities, improving their incomes with com-

BOX 18.1 ***continued***

petitive market insertion, the establishment of agreements between actors aiming at reducing deforestation, and promoting sustainability.

Between 2017 and 2019, agreements signed with peasants in the department of Guaviare reached 1,046 families on 32,446 ha. In this way, a conservation index of 85% was achieved (Mos-CAL 2019). Seventy-five percent of the peasants chose to pursue the enrichment of stubble and degraded forests as part of their commitment to be implemented within the framework of the property planning, conservation, and restoration agreements.

Conclusions and Recommendations

- Research institutions play an important role in positioning priority issues on the country's political agenda.
- Actors responsible for public policy must engage in dialogue and find opportunities arising from the potentialities of territories.
- Conservation agreements and the agro-environmental approach have shown the effectiveness of science and technology for solving real problems with stakeholder participation.
- Amazonian countries must take concerted action to advance conservation of the region, with participatory approaches. The Leticia Pact provides an opportunity for this type of action.

Eco-harvest: Challenges and opportunities in the Bolivian Amazon

In Bolivia, the 2009 Constitution approved delimiting the Amazon into 23 municipalities (the "Constitutional Amazon"). This political-administrative delimitation includes in its limits all Amazon forests with Brazil nut trees (*Bertholletia excelsa*) in Bolivia, or approx. 84,000 km^2 (Larrea-Alcázar et al. 2018). The Constitution also refers to the elaboration and promulgation of a law to promote integrated development in the region, including tourism, ecotourism, or regional enterprises, and establishes a penalty for the felling of Brazil nut and rubber or "syringa" (*Hevea brasiliensis*) trees. Both non-timber species form part of the recent past and the history of the Bolivian Amazon.

The eco-harvest of Brazil nuts represents the main economic driver of the region (Guariguata et al. 2017). However, its contribution to the national GDP is low (approximately 2%, INEC 2019). The exploitation of Brazil nuts has limited conversion of the forest to livestock landscapes. High prices and demand for Brazil nuts in the international market supports an economic incentive to preserve standing forests. Furthermore, deforestation requires increased investment. Most of the land tenure or ownership in the Constitutional Amazon belongs to Indigenous territories and other rural communities, which represent the base of the Brazil nut production chain and other emerging resources in the process of consolidation (e.g., açai and other palm trees such as *Mauritia flexuosa* and *Euterpe precatoria*, *paiche* meat and leather [*Arapaima gigas*]). Currently, inter-institutional articulation efforts are underway to strengthen the use of Amazonian fruits in the region as a basis and input for planning in the area (PICFA 2020).

The Law of the Rights of Mother Earth (2010) and the Framework Law of Mother Earth and Integral Development to Live Well (2012) establish the foundation for and principles to promote integrated development of the country in harmony and balance with nature ("Mother Earth"). However, they do not relate or allude to the Constitutional Amazon. Subsequent laws on road construction, oil and gas exploration, and expansion of the agricultural frontier seem to contradict the principles proposed by both laws (Romero-Muñoz et al. 2019). Additionally, a resolution to solve the spillover of informal gold mining on the Madre de Dios River, currently the main threat to the Constitutional Amazon, is still pending; this requires clear policies and decisions.

tected conservation zones of National Natural Parks, an especially worrisome trend (Tobón Ramírez et al. 2021; MAAP 2020).

The government's emphasis on the protection of the Amazon Forest as part of its commitment to curb climate change is contradictory to its extractive development strategy. Instead, efforts to protect forests seem to be concentrated on the fight against illicit activities and especially coca production (Montaño, 2017; Vélez 2021; WWF 2021). The production of illicit drugs is one driver of deforestation, as previously discussed, but it is not the main one. Moreover, the relation between coca and deforestation is indirect through fueling cattle ranching, armed conflicts, and displacements, or the deforestation effects of measures to fight coca (Vélez and Erasso 2020; Dávalos et al. 2021). Given the variety of factors behind the alarming levels of deforestation in the Amazon, this focuses on combating illegal drugs seems arbitrary and, in some cases, counterproductive (Rincón-Ruiz and Kallis 2013; Dávalos 2016; Vélez and Erasso 2020). This is evident considering the current strategy against deforestation increasingly focuses on promoting the state's presence in the Amazon through militarization (including assigning tasks of forest protection to the military in the Plan Artemisa; Interviews with researchers and activists working on the Colombian Amazon in El Tiempo 06-12-2020). In fact, the Amazon is currently the setting of violent conflicts over territorial control between the military and different non-state armed groups (WWF 2021). In this context, the fight against coca legitimizes the militarization of environmental protection and, at the same time, combines it with counterinsurgency measures. The Plan Artemisa follows an approach that Wacquant (2009) called, although in a different context, "punishing the poor". In fact, Plan Artemisa prefers to present success by capturing poor peasants linked to deforestation instead of attacking structural problems; further, it practically excludes local participation. Keeping in mind the worrying human rights problems of the Colombian security forces and continuous tensions between military forces and peasants in remote Colombian areas, this has counterproductive effects. Moreover, the militarization of environmental protection increases the spiral of violence in remote areas and even worsens the already dangerous situation for environmental activists and civil society organizations (Gutiérrez Sanin 2021; Jones 2021; Oritz-Ayala 2021; WWF 2021). According to Global Witness, Colombia is the most dangerous place for environmental activists, who face criminalization, threats, violent attacks, and assassinations, with Indigenous groups being especially vulnerable (Global Witness 2020 2021). Furthermore, military approaches by no means solve the problem of expanding illegal drug cultivation, but rather shift it to more remote areas, thus contributing, albeit unintentionally, to the further expansion of the agrarian frontier. According to Prem et al. (2020), proximity to military presence increases deforestation in Colombia.

Colombia's strategy to combat deforestation by focusing on curbing coca production leaves several gaps, especially the lack of viable measures for alternative income generation for producers (Dávalos and Dávalos 2020; International Crisis Group 2021). Although the peace treaty rightly gives priority to rural development and the solution of the drug problem, progress in implementing the planned measures is very slow (Instituto Kroc 2020). However, in the absence of sustainable reforms for producers, the issue of illicit drugs will not be resolved.

Although the government highlights illegal activities as deforestation drivers, expansion of the extractivist development model is not addressed in the strategy to curb deforestation. In other words, land grabbing partly linked to the drug economy, extensive cattle ranching, and in general terms the extractivist development model, are excluded from measures to curb deforestation, and are even promoted by the government. The priority to reduce deforestation is very much welcomed; however, the focus on political interventions needs major changes to ensure that the environmental concerns of the official discourse will also achieve the results the Amazon's forests and the world's climate urgently need.

18.2.3 Structural Reforms Needed: Alternatives to Deforestation in the Colombian Amazon

Deforestation in the Colombian Amazon has multiple causes and cannot be reduced to simple formulas. Instead, a regionally or locally adapted strategy is needed to curb deforestation in the short term. In view of the enormous challenges, in the medium and long term, a selective reduction of pressure on the forest areas in the Colombian Amazon will not be enough to conserve forests and biodiversity and slow down climate change. It is necessary to think outside the box and include far-reaching transformations of the status quo.

The solution in Colombia is a shift away from extractivist development models and the construction of viable alternatives to unsustainable extractivism. Colombia is currently trapped in an "extractive imperative" (Arsel et al. 2016), which requires a continuous expansion of the extractive frontier and represents a continuous driver of deforestation. Therefore, economic diversification is key for social development and environmental protection (Peters 2019). Second, the country needs to reduce extreme inequalities in land tenure. The land question in Colombia has been a contested topic that also affects the Amazon. It was considered as one of the main triggers of the armed conflict (Fajardo 2014; Galindo and Pereira 2020), and some tension around land tenure in the Amazon is currently considered as an element that could lead to new, conflictive situations among the inhabitants. Therefore, reducing land inequalities continues to be a pressing and simultaneously conflictive topic. Policy options exist, especially regarding the reduction of the incentives for low-productive, land-consuming, and therefore environmentally damaging extensive cattle ranching. A key instrument would be an increase in land taxes. Third, alternative ways to tackle the problem of illicit drugs are needed. This should include a reorientation of international drug policy and increased political efforts towards decriminalizing the drug economy. At the national and local level, strategies that offer a decent life for peasants are of particular importance (Dávalos and Dávalos 2020). This includes opportunities for the commercialization of legal small-scale farming products, the creation of decent jobs, and the reduction of social inequalities. This also requires the development of infrastructure and transport routes in the Amazon that may lead to small-scale deforestation. Therefore, it is not a question of a radical reversal or even utopian considerations to totally stop deforestation in the short run. Instead, intelligent planning is needed to implement projects that promote sustainable development strategies, providing alternatives to nature exploitation and addressing the problem of land ownership inequalities and the need for socio-economic improvement of impoverished peasants. Such initiatives will need to encourage a new approach that allows inhabitants to cohabit the territory, contribute to radically decreasing deforestation, carry out activities that give them access to good living conditions, and recognize their organizational forms and participatory mechanisms, including social movements and local organizations.

18.3 Social and Environmental Impacts of Oil Extraction in Ecuador's Amazon

This section analyses the economic, social, and environmental effects of oil extraction in Ecuador since 1967. Although the country has a small share (1.6%) of the Amazon rainforest, Ecuador's Amazon, with other Andean countries, holds some of the highest biodiversity per square kilometer in the region, particularly in the upper Napo Basin and Yasuni National Park (Bass et al. 2010; RAISG 2015). It shares with the other Andean Amazon countries (Colombia, Peru, and Bolivia) specific climatic conditions, deforestation drivers, and impacts of extractive activities. Given the high significance of oil on its development performance, Ecuador lends itself as a representative case study on the impacts of oil extraction in the Amazon.

18.3.1. Oil and Development in Ecuador

In 1967, large oil reserves were discovered in the northern Amazon, and since 1972 Ecuador has been an oil exporter, turning this product into the

backbone of the economy. Five decades later, oil has contributed little to equitable and sustainable development, despite bringing about significant economic, social, and institutional transformations. Economic growth has remained evasive and unstable (Figure 18.11), with an average annual growth rate of 1.55% in income per capita between 1972 and 2019, lower than that the 2.07% of the pre-oil period (1950–1972; See a periodization of the 1950–2019 interval in Appendix Table 18.1B and Figure 18.11.). Despite important social achievements during the oil boom (1972–1982) and between 2006 and 2014, the social, ethnic, and regional disparities that have historically affected the country remained pervasive, with 30% of the population living below the poverty line and underemployment affecting 40% of the labor force in 2017 (Ayala and Larrea 2018). Social inequality barely declined, evidenced by the Gini coefficient remaining at 0.52 in 2015 (ECLAC 2015; Vallejo et al. 2015; Larrea, 2017). The COVID-19 crisis sparked an increase in poverty to 40% and underemployment to 48% (UASB 2020).

Oil extraction in Ecuador occurs in a formerly undisturbed region in the Amazon Basin, leading to severe socio-environmental effects, particularly deforestation, loss of biodiversity, pollution, and human health hazards (Herbert 2010; Amazon Defense Coalition 2012; Becerra et al. 2018). Between 2004 and 2014, a new development strategy was applied, strengthening state intervention in the economy, and promoting more inclusive social policies, in an international context of high oil and commodity prices. The whole strategy collapsed since the price of oil plummeted in 2014. Neo-extractivist strategies failed to diversify the economy, and under a heavy debt burden and limited oil reserves, the county is currently affected by a deep economic, social, and political crisis (Larrea 2019).

18.3.2 Threats to Conservation: Extractive Policies in the Amazon

Since the Spanish conquest, external forces, mostly articulated towards resource extraction (gold, rubber, and recently oil) have led to adverse impacts on ecosystems and Indigenous peoples in the Amazon. Among those cycles, the oil period has had the longest and deepest impacts. Colonial or national policies, fostered by international interests, have seen the Amazon as an unlimited source of raw materials and an almost empty space to be exploited, ignoring both Indigenous peoples and biodiversity. During extractive phases before oil expansion, the Amazon suffered from plundering, without any concern for the exhaustion of natural resources (Taylor 1994). In the oil period, although the resource-extraction vision prevailed, conservation concerns resulted in the creation of protected areas, partial recognition of Indigenous territories, recognition of the rights of nature, the inclusion of the "good living" concept in the 2008 constitution, and minor additional conservation policies that have failed to significantly reduce deforestation (Larrea 2015, Larrea and Bravo 2009). The environment ministry was created in 1996.

Protected areas now cover 20% of Ecuador's territory. The most important in the Amazon are Yasuni National Park and the Cuyabeno Reserve, both established in 1979. Oil extraction has been allowed in both reserves since the 1980s and the budget for PAs is low; therefore, the degree of protection is weak (Larrea 2017). Indigenous territories cover a large proportion of the Ecuadorian Amazon, approximately 3 million ha, with approximately 70% of them legally recognized in the form of collective property rights. Nevertheless, the legal competencies of ITs are weak, and several oil and mining concessions have been granted on Indigenous lands without properly consulting Indigenous peoples, as established by ILO (International Labour Organization) and recognized by Ecuador (Interview with Dr. Mario Melo, lawyer expert in Indigenous rights, Quito, August 22, 2020).

Since 1964, when the state signed a large oil concession in the Amazon to Texaco, public policies consistently promoted the expansion of oil extraction, as well as large-scale mining. The main issue in oil policies has been the debate between nationalistic policies aimed at increasing state participation in oil revenues versus transnational com-

panies and strategies to attract foreign investment with incentives. The former prevailed in periods of high oil prices and strong state negotiating capacity, whereas the latter was mostly evident in periods of low oil prices and economic crises. Little attention has been paid to public policies aimed at reducing the environmental impacts of extractive activities or introducing low-impact technologies, such as roadless oil exploitation (Larrea 1993, Larrea 2017). The only significant exception was the Yasuni-ITT Initiative, that stands for the oil fields Ishpingo, Tambococha and Tipu-tini, aimed to keep a large oil reserve in the Yasuni National Park indefinitely unexploited in exchange for an international fund for conservation and investment in renewable energy (Box 18.2) (Larrea 2017).

Transnational participation in oil extraction in Ecuador has changed over time. Between 1972 and 1993, the dominant company was Texaco (acquired by Chevron). Later, the participation of Occidental and other companies such as Repsol was significant, but the share of state companies increased particularly after 2007. During the last decade, the participation of Chinese companies (Sinopec and Petrochina) has become significant. In addition to extractivism, public policies fostered colonization in the Amazon during the 1960s and 1970s, to reduce demographic and political pressures on the coast and highlands, and as a strategy to build "living frontiers" in areas close to the Peruvian border.

18.3.3 Oil Expansion and its Regional Effects in the Amazon

Although the Amazonian provinces account for 47% of Ecuador's national territory, the region remained historically isolated from the rest of the country until oil discoveries in 1967. After the Spanish conquest, only two short periods of resource extraction deeply disrupted the region's Indigenous cultures; gold mining in the sixteenth century and rubber extraction in the late nineteenth to early twentieth centuries (Taylor 1994). The Amazon held only 1.7% of the nation's population in 1962.

Oil extraction stirred a rapid internal migration to the region, causing expansion of the agricultural frontier, deforestation, and severe environmental impacts. Between 1962 and 2010, the population of the Ecuadorian Amazon expanded more than ten times, reaching 739,814 (Appendix Table 18.2B). Unlike in Brazil, Colombia, and Peru, urbanization in the Ecuadorian Amazon has been moderate. Only 33% of the population lived in cities with more than 5,000 inhabitants in 2010, and the largest city, Lago Agrio, had only 48,500 inhabitants. Despite significant migration, Indigenous peoples still represent 33% of the population and 10 different Indigenous languages are spoken (INEC 2010).

The expansion of extractive activities, oil and recently large-scale copper and gold mining, has been the most important indirect driver of deforestation and degradation in Ecuador since 1967 (Gold mining in the Amazon started in the sixteenth century but stopped soon partially due to indigenous resistance). In 2018, cumulative deforestation accounted for 16.2% of original Amazon forests in Ecuador (Sierra 2020) (Figure 18.10). Unlike in Brazil, deforestation in Ecuador is mostly undertaken by small-scale farmers moving into the region along roads constructed by oil and mining interests (Wunder 2000; Becerra et al. 2018; Larrea 2017). Large cattle farms or plantations are less frequent.

Agriculture is the main employment source, despite the often-low aptitude of Amazonian soils for cultivation. Deforestation does not provide lasting social benefits to the peasants. As land yields decline, they must move to deforest another plot of land, approximately every 15 years. Agriculture in the Amazon is extensive, inefficient, and has low capital investment, with land productivity reaching only 31% of the national average and labor productivity only 35%. Pastures represent 73% of cultivated land (Table 18.3).

Although oil extraction contributes 65% of Ecuador's Amazonian GDP, its contribution to employment is extremely low at 0.9%. In contrast, agriculture accounts for only 4% of GDP but provides 54%

BOX 18.2 The Yasuni-ITT Initiative

The Yasuni-ITT Initiative, presented in 2007 and canceled in 2013, was the first and remains the only international proposal to keep a large oil reserve in a developing country unexploited to preserve a biodiversity hotspot in exchange for sustainable social development assistance. Despite its cancellation, it provides ideas and tools for keeping fossil fuel reserves underground in the Amazon and other rainforests. At least two-thirds of global fossil-fuel reserves must remain unexploited to fulfill Paris Agreement goals; therefore, oil and gas reserves in the Amazon should remain unexploited to prevent the high environmental impact of exploitation, conserve biodiversity, and avoid CO_2 emissions.

The Yasuni-ITT Initiative was launched in 2007 by Ecuador's president to maintain unexploited oil in the ITT fields of Yasuni National Park, one of the most biologically diverse hotspots in the western hemisphere. Ecuador committed to refrain from extracting the 846 million barrels of petroleum and requested the cooperation of the international community in the form of half of the income that would have been generated from extracting the oil. A capital fund was created, administered by the United Nations Development Programme (UNDP), with the participation of the Ecuadorian government and civil society, and international contributors. The Fund's capital would be invested in renewable energy projects throughout the country and in local sustainable development and forest recovery projects. In addition to mitigation, its purpose was to overcome Ecuador's dependence on fossil fuels and help the country transition to sustainable development, placing social and environmental values first and exploring ways other than oil to benefit economically from the Amazon. The strategy also aimed to reduce vulnerability to climate change. In addition, it involved respecting local communities and, particularly, allowing the Tagaeri and Taromenane peoples to remain in voluntary isolation.

The Initiative received unanimous support from the German parliament, the active participation of the United Nations, and economic contributions from Spain, Italy, Chile, and Peru, among other countries (Larrea 2015). According to members of the 2008 steering committee, the international support was adequate for maintaining the project, but the main reason for its cancellation was the lack of political support from the Ecuadorian president, who publicly discouraged donations, removed several of the managers, and persistently threatened to extract oil from the ITT fields.

Although the initiative did not prosper at the time, the idea should not be abandoned, considering the limits of the carbon budget and the universal endorsement of the Paris Agreement. If two-thirds of global fossil fuels are to be kept underground (Meinshausen et al. 2009; McGlade and Ekins 2015), reserves underlying areas of high conservation value must be among them.

In addition, it is time to take advantage of instruments that are embraced by the Paris Agreement, which calls for ambitious action and cooperation between developed and developing countries (Art. 6.1, 9.1). It also encourages actions to conserve and enhance greenhouse gases' sinks and reservoirs, including forests (5.1), and engage in adaptation (7.1). Launched in 2007, the Initiative is consistent with the precepts of the 2015 Paris Agreement. Additionally, it was designed to promote equitable access to sustainable development, food security, human rights (including the rights of Indigenous peoples), the integrity of ecosystems, and sustainable lifestyles, consistent with the principles held forth in the Paris Agreement. The Initiative could be transformed into an international cooperation instrument involving several megadiverse countries as beneficiaries, scaling up sustainability benefits and emissions reductions while having a more stable institutional structure.

Although the Yasuni-ITT Initiative had many strengths, it also had weaknesses; these must be addressed in any proposal to establish a similar initiative. As the first of its kind it was unlikely to be perfect, similar to Brazil's successful and subsequently abandoned policy to reduce deforestation. Neither policy should be discarded; instead, they are a powerful foundation upon which to build a sustainable and just low emissions future.

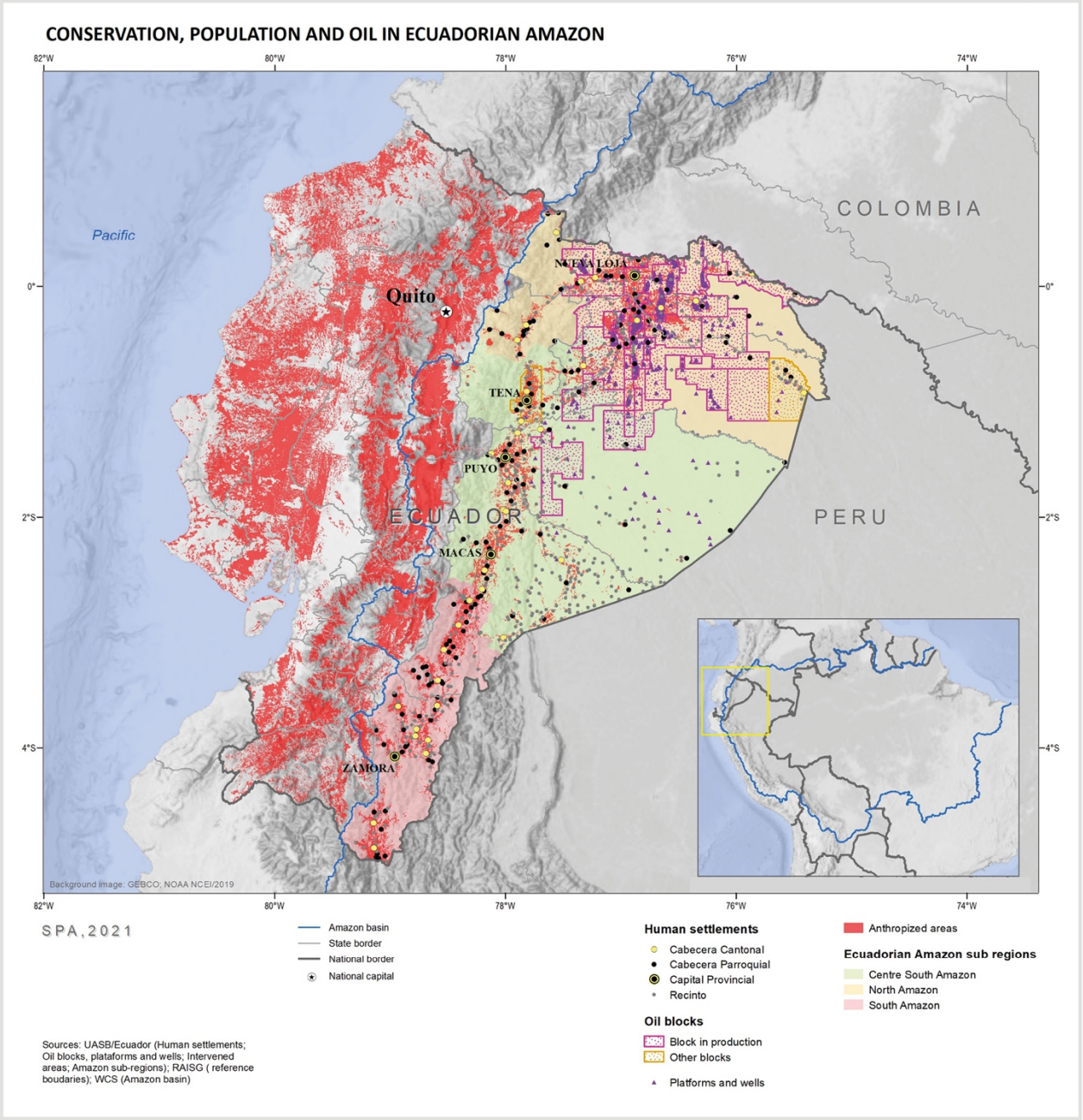

Figure 18.10 Conservation, Population, and Oil in the Ecuadorian Amazon. Source: Unidad de Información Socio Ambiental, UASB.

Table 18.3 Output, Labor and Land Use of Ecuadorian Agriculture by Region, 2018–2019.

				Productivity		
Region	Employment	Area	Output	Land	Labor	Labor per ha
	(Workers)	(ha)	(Thousand $)	($/ha)	($/worker)	(Workers/ha)
Coast	983949	2,884,000	6418415	2,226	6,523	0.34
Highlands	1069015	1,621,496	2842171	1,753	2,659	0.66
Amazon	234723	605,052	353811	585	1,507	0.39
Total	2287687	5,110,548	9614396	1,881.28	4,202.67	0.45

Source: Banco Central del Ecuador 2019, INEC 2019a, INEC 2019b.

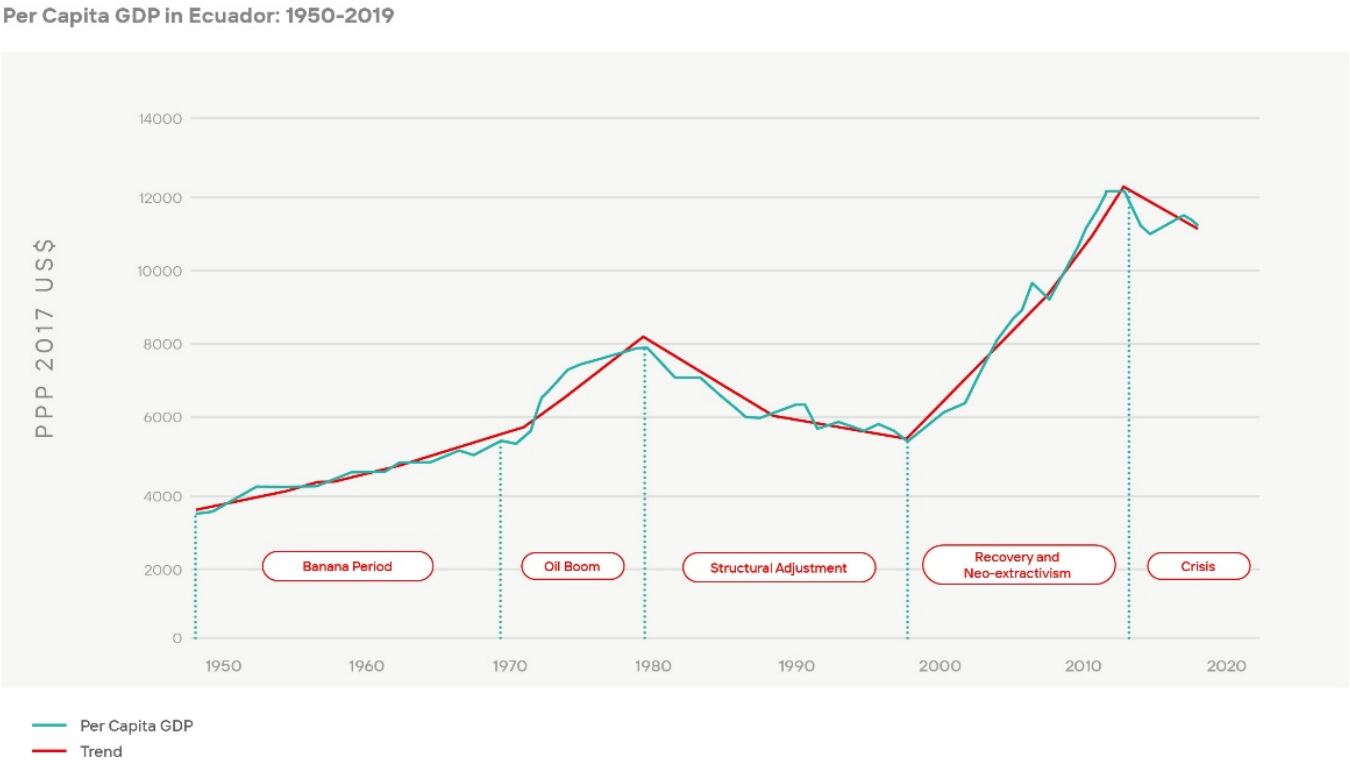

Figure 18.11 Per capita GDP in Ecuador, 1950 - 2019. Source: Author estimates based on PENN World Table, 10.0.

of employment. Public and social services are significant employment sources, and tourism has importance in particular areas, accounting for 4.2% of regional employment (INEC 2019; BCE 2018). The Amazon region remains the poorest in the country, both in urban and rural areas, with oil revenues benefitting mostly urban highlands, including Quito. The gap between the rural Amazon and the national average did not decline, according to the censuses of 1990, 2001 and 2010.

18.3.4 Social development in the Ecuadorian Amazon

From the mid-1960s onwards, oil has been the most significant indirect driver of environmental deterioration in Ecuador, and deforestation has taken place mostly by the expansion of agricultural frontier from immigrant peasants. In this section the social effects of oil on living conditions are explored, mostly by comparing social indicators, at the local level, between oil extraction areas and the remaining zones in the Amazon. Additionally, a statistical analysis on local effects of deforestation on the social conditions is presented.

To capture local basic needs satisfaction, a social development index (SDI) was elaborated, combining 19 indicators from the population censuses of 1990, 2001, and 2010, using principal component analysis. Six indicators deal with education, two with health, three with gender and employment, and eight with housing (Larrea 2017; Larrea et al. 2013). The Appendix for this chapter contains the complete list of indicators and the methodology of SDI. The selected social indicators and the SDI are directly relevant for the following Sustainable Development Goals (SDGs, see chapter 26): 1 (no poverty), 3 (health), 4 (education), 5 (gender equality), 6 (clean water), and 7 (energy). There are strong indirect links with SDG 2 (zero hunger), 8 (decent work), and 10 (reduced inequalities). To explore the social and regional distribution of oil revenues in Ecuador, the SDI was broken down by region and area of residence for 1990, 2001, and 2010 (Table 18.4).

To refine the analysis, the Amazon was divided into an oil extracting sub-region and the remaining part (Appendix Table 18.3B). The results illustrated that within the Amazon, oil extracting zones are consistently more affected by social deprivations than the corresponding non-oil zones, both in urban and rural areas. Lower differences in the number of average schooling years, a representative education indicator, were evident because of the high proportion of immigrants in the population (Appendix Table 18.2B).

Immigrants usually have higher than average levels of education in their original regions (Larrea 1993). In contrast, worse human health conditions are evident in oil extracting zones in the Amazon, compared with the remaining areas of the region. As shown in Table 8.4, the results for 1990 and 2001 were similar and inequalities remained consistent during the 20-year period.

These results indicate that the Amazon barely benefited from the regional distribution of oil revenues. Although the SDI improved in the Amazon between 1990 and 2010, the gap with the remaining regions persisted or increased (Appendix Table 18.6B). Not only did the region consistently remain the most socially deprived in Ecuador, but the oil

Table 18.4 Social Development Index in Ecuador by region and Area, 1990–2010

Region and Area	1990	2001	2010
Rural Highlands	42.1	49.0	59.0
Urban Highlands	67.3	72.1	78.4
Rural Coast	42.4	47.7	55.3
Urban Coast	59.6	63.1	69.6
Rural Amazon	41.0	45.8	54.3
Urban Amazon	54.1	60.5	68.3
Rural Galápagos	62.1	65.9	69.6
Urban Galápagos	65.5	66.8	74.6
Total	55.2	60.4	68.1

Growth rates were estimated from a kinked regression, controlled from first order autocorrelation, using Prais-Winsten and Cochrane-Orcutt models. Source: Author estimates based on PENN World Table, 10.0.

Table 18.5 Social Development Index by Subregion and Area: 1990-2010.

Subregion	Zone	1990	2001	2010
Urban Amazon	Oil extracting	47.6	55.3	64.1
	Non-oil extracting	58.3	64.8	72.5
Amazonia Rural	Oil extracting	40.4	44.9	53.0
	Intervened, Non-oil extracting	41.9	47.0	55.8
	Non intervened	31.1	35.6	42.3
Rural Highlands		42.1	49.0	59.0
Urban Highlands		67.3	72.1	78.4
Rural Coast		42.4	47.7	55.3
Urban Coast		59.6	63.1	69.6
Galápagos Islands		63.6	66.4	73.4
Total Nacional	Total	55.2	60.4	68.1

Sources: UASB-UISA, based on: INEC, Censos de Población y Vivienda, 1990, 2001, 2010.

extracting subregion also had lower social benefits than the non-oil part of the Amazon, both in urban and rural areas. The analysis suggests that oil extraction may have a detrimental net effect on local social development. However, the data in the tables does not demonstrate this relationship, given that social improvement is the result of multiple additional factors, such as differential soil fertility among zones, access to markets, opportunities for economic diversification, and the development of non-agricultural employment. To test the net effect of local oil activity on social development, including the available information on other factors that potentially influence social development, a spatially autoregressive multiple regression model was elaborated (Appendix, Methodological Notes). The model took the SDI as the dependent variable, and its independent variables included oil extraction proximity, soil fertility, access to markets, proportion of deforested area, a dummy variable for rural sectors, and three employment indicators (proportion of agriculture, wage earners, and tourism in the labor force). The model results and detailed main findings are presented in the Appendix, Methodology and Table 18.4B.

The model strongly suggests that; after controlling for observed factors influencing living conditions, such as soil fertility, access to markets, proportion of deforested land, and employment structure and diversification; the proximity or local presence of oil extraction has a net detrimental effect on basic needs satisfaction, statistically significant at the 1% level. The result is consistent with the negative effect of oil extraction on SDI presented in Table 18.5.

As oil extraction is highly capital intensive, its local contribution to employment is low, and usually concentrated on male skilled labor coming from outside the Amazon. Oil extraction only has an important, local, unskilled labor component during the brief construction phase. However, oil may have an important fiscal link with social development because of local investment of oil revenues in schools, health facilities, housing, credit, technical assistance, or other services and infrastructure. Social investment may come from the national government, local governments, or oil companies. On the other hand, the many detrimental effects include pollution, disincentives to tourism, social conflict, prostitution, and corruption. The negative coefficient suggests that in Ecuador, detrimental effects overcome social benefits from oil. The environmental impact of oil in Ecuador's Amazon has been evaluated as severe, particularly during the Texaco period (1967–1993), as mining waste was systematically dumped into the environment without treatment. Afterwards, the frequency of oil spills remained high, averaging approximately one a week (Herbert 2010; Amazon Defense Coalition 2012; Durango et al. 2018). In April 2021, a large oil spill severely affected several communities in the northern Amazon.

Deforestation has a strong impact on biodiversity and is the most important source of CO_2 emissions (36%) in Ecuador (WRI 2020). Deforestation rates

in Ecuador remain high due to the lack of effective control and may be increasing (Figure 18.1). Although there is no agreement on deforestation figures, according to FAO, Ecuador had a 0.6% yearly deforestation rate between 1990 and 2015 (FAO 2015).

To explore the social effects of deforestation on local living conditions, the regression model included the proportion of intervened areas in quadratic form (Appendix, Table 18.4B). Broadly speaking, the contribution of deforestation to peasants' local living conditions is low and takes a parabolic shape with decreasing returns. Local living conditions mostly improve at the initial stages of deforestation and later tend to disappear, so that the function reaches a stable level with no further gains when deforestation is higher than 65%, with a small decline after 80% of deforestation (Figure 18.12). According to the model, the total improvement of the SDI between 0% and 100% of deforestation is 7 points (from 30 to 37), and there is no improvement at all from 65% to 100% of deforestation. This weak and decreasing association between deforestation and living conditions may be owing to low and decreasing land productivity in most Amazonian soils. During the first years of deforestation, soil fertility remains relatively high and family income may improve by selling wood. Later, decreasing land productivity reduces agricultural revenue, as described above. These findings are broadly consistent with research on the Brazilian Amazon (Rodrigues 2009).

Oil has been the main indirect driver of environmental degradation in the Ecuadorian Amazon since 1967, leading to a cumulative forest loss of 13%, the second largest among Amazon countries after Brazil (see Chapter 19). Nevertheless, remaining oil reserves are limited, and the country may become a net oil importer in approximately a decade or less, potentially leading to a deep crisis (Espinoza et al. 2019; Larrea 2021). In this context, the Ecuadorian Amazon will probably soon face a transition towards a post-extractivist society, and a participatory process to promote a sustainable and equitable path should become a social and environmental priority.

18.3.5 Conclusions and recommendations of the Section

The Amazon remains the most socially deprived region in Ecuador, both in urban and rural areas. Among the most critical conditions are lack of appropriate health services and high levels of child mortality, while differences in education are less severe. A spatially autoregressive multiple regression model was built to explore the local effects of oil extraction, local deforestation, soil fertility, access to markets, and employment structure on social development. The model found local oil extraction had a negative and statistically significant effect of on social development, after controlling for all remaining variables.

The findings strongly suggest that in the Ecuadorian Amazon, the detrimental effects of environmental degradation, pollution, loss of biodiversity, and social conflict overcome the potential local benefits brought about by employment and local investment of oil revenues. The lack of a positive relationship between oil extraction and social improvement extends, at the microregional level, the conclusions of several national studies on the weak link between oil extraction and development in Ecuador. From an international perspective, the oil curse theory points out the detrimental economic, social, and environmental effects of oil export specialization on developing countries.

In Ecuador, oil expansion has been an important indirect driver of deforestation in the Amazon. The regression model suggests that deforestation has a small and short-lived contribution to improving living conditions of the local population. Some social gains are observed only in the initial phases of deforestation, but as local deforestation increases above 65% of the land, social benefits disappear. Unfortunately, the analysis shows that not only is the net local direct contribution of oil extraction to social development minimal or even negative, but also that the local improvement brought about from deforestation-based agriculture and cattle raising is modest and short-lived. Including the detrimental effects of deforestation on climate change and loss of biodiversity, the whole balance

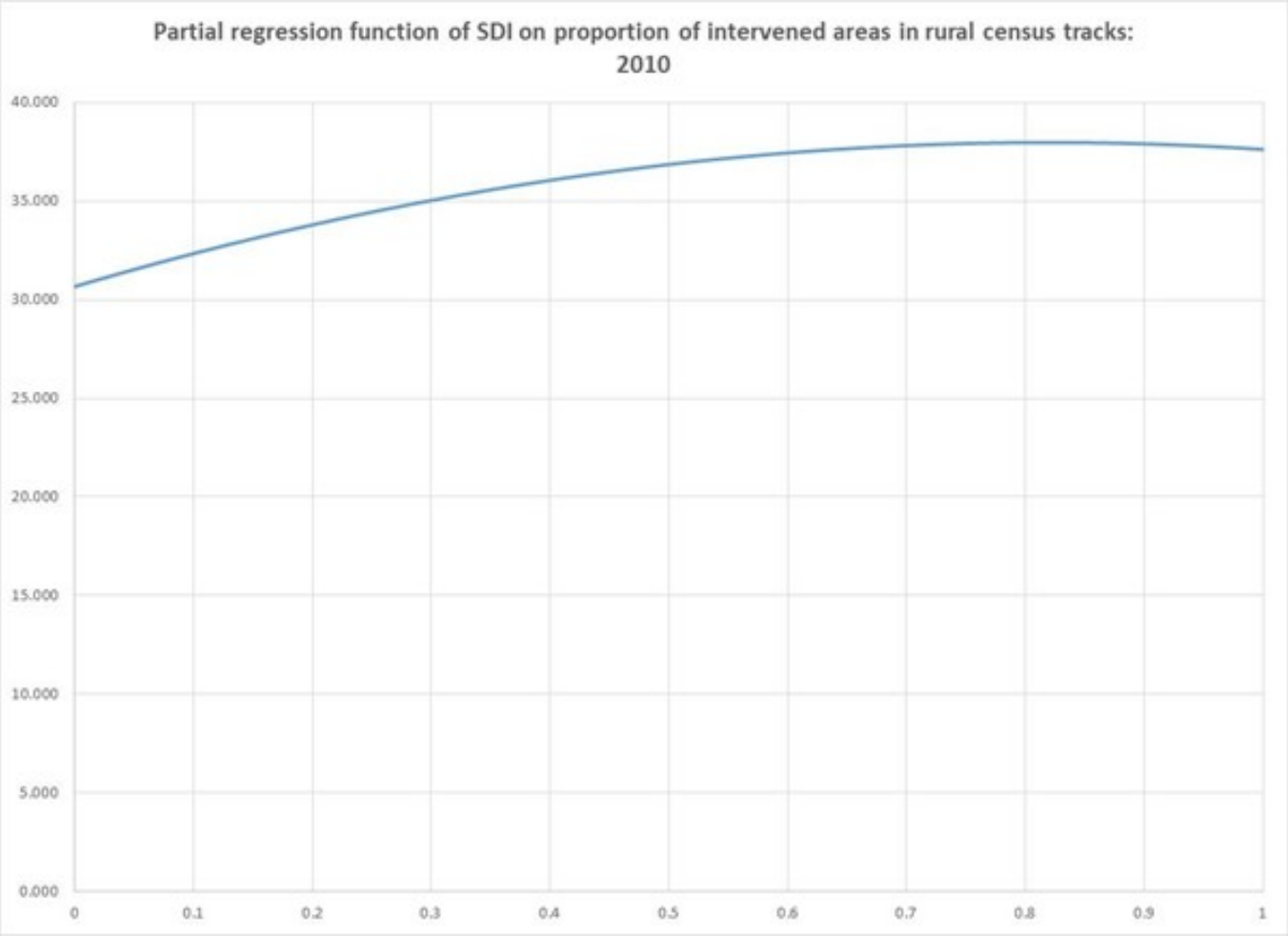

Figure 18.12 Partial regression function of DI on proportion of intervened areas in rural census tracks, 2010. Note: 1,509 rural census tracks were included in the model. Source: Appendix Table 18.1B.

of benefits may become negative. Therefore, the Amazon region requires a deep structural process of social and economic transformation to find alternatives toward sustainable and distributive social development. The social distributive effects of diversification towards tourism are rewarding. Ecotourism is an example of a way of diversification able to improve living conditions, simultaneously preserving natural and cultural heritage.

As remaining oil reserves in Ecuador are low, estimated to last no more than 7.4 years at current extraction levels (BP 2021), and the detrimental effects of current agricultural practices may exceed social gains, a structural transformation towards sustainable and distributive development strategies is required. Fortunately, a low emission development path, based on activities such as ecotourism, agroforestry, and agroecology, seems feasible (Larrea 2017). Deforestation can be drastically reduced or eliminated, as the Brazilian experience between 2005 and 2012 demonstrates (see Chapter 17). Nevertheless, the required transformation in regional development strategies requires further research, and available information only suggests some hypothetical transformative ways.

18.4 Extraction Activities in the Peruvian Amazon

Peru is the country with the highest percentage of its territory covered by the Amazon Forest after the Guianas. However, owing to its distance from policy and decision-making centers and Peru's historically centralized form of government, the Amazon has been relegated to the category of a territory

awaiting "conquest, occupation, and exploitation". Oil exploitation in the Peruvian Amazon began during the military governments of 1968–1975 and 1975–1980. It brought about massive environmental liabilities that have yet to be remediated. During the 1980s, the country returned to democracy and in 1981, Shell initiated its activities in the southern part of the Ucayali Basin in the Amazon. In 1982, oil companies were granted tax exemptions. During this period, Shell discovered the natural gas deposits of Camisea in the Cusco Amazon Region. This new resource became a priority for the next government (1985–1990), who signed an exploitation agreement with Shell.

Extractivist policies were further reinforced by the neoliberal model prevailing in the 1990s. During those years, a political narrative revolving around economic development based on extractivism penetrated and dominated, not only in the circles of economic and political power, but also in all social strata of the urban population. In this way, the dominant classes "succeed in naturalizing inequality and limiting the impact of socioenvironmental protest and discontent," which became much more frequent during this decade (Damonte 2014). The federal government adopted policies to stimulate mining exploitation in the Amazon, revising and withdrawing gold concessions from companies that were not using machinery and making them available to small scale or artisan miners, who were also given incentives for the purchase of equipment. These measures generated so-called "machinery fever" and enormous environmental impacts.

The extractivist logic continued during the following administrations. During the 2001–2006 administration, forest legislation was modified to grant a large number of timber concessions that eventually failed. Demands by Indigenous organizations for the creation of Reserva Territorial Napo-Tigre, where oil companies were operating, were stalled under corporate pressure. During the 2006–2011 administration, a confrontation with Indigenous peoples and peasant farmers began through a series of editorials in the newspaper *El Comercio de Lima*, known as "dog in the manger" articles. In these texts, the President expressed deep contempt for Indigenous peoples and peasants, a sentiment largely shared by a significant portion of non-Indigenous people in urban centers. He described them as perverse, limited intellectually and educationally, and susceptible to manipulation, and faulted Indigenous peoples for not cutting down forests. He lamented that these territories could not be granted in concession to large private companies, blamed pervasive problems such as unemployment on these "dogs in the manger", and was convinced that it was necessary to profit from public property and goods through privatization and land titling schemes.

A peak in confrontation was reached in 2009 in the context of the Free Trade Agreement with the United States (US), when the Peruvian President promoted several legislative decrees to harmonize Peruvian legislation with that of the US, arguing that unless these changes were made, the US would leave the Agreement. Three of these decrees affected Indigenous territories and facilitated extractivism; one modified the forest and wildlife law, another reduced to 50% plus one the quorum necessary to expropriate communal lands, and the third changed administrative procedures for communal lands in the highlands and forests to match those of the coast (Morel 2014). This triggered an uprising by Indigenous organizations, which was repelled; 33 people lost their lives in a brutal clash between police and Indigenous organizations, known as "Baguazo".

Hopes were high with the new administration of 2011, which represented a change with regards to extractivism. Initially, steps were taken that seemed to point to a radical shift. Government policy regarding extractivism aimed to establish greater tax-system justice and the Mining Royalty Law was enacted (Lanegra 2015). This Law changed the tax base for the calculation of royalties from value of sales to operating income, thus increasing royalty amounts for firms having higher operating margins (Lasa Aresti 2016). To reinforce this initial step, the long-awaited Public Consultation Law was also approved and became a regional milestone. However, this momentum did not last. The 2012 commodity crisis led to a turnabout in federal policies. Seeking to promote foreign invest-

ment, policy shifted towards making social and environmental regulation more lenient. Despite the instability of recent years, this tendency in policy has not changed.

Socioenvironmental conflict accompanies this tendency, with Indigenous peoples demanding access to justice and respect for their rights. In July 2020, after many years of campaigning, the Federation of the Achuar Nationality of Perú (FENAP) and the Autonomous Territorial Government of the Wampis Nation (GTANW) succeeded in reversing a concession to the oil company GeoPark, which had been operating on their land without an environmental or social license. At the same time, Indigenous peoples face significant risks. At a protest of PetroTal installations in Loreto on 8 August 2020, to demand that the federal government honor promises made in 2019 to install basic services and better health care in the context of the COVID-19 pandemic, three members of the Kumala community were killed and several people were seriously wounded on both sides.

The logic of "conquest, occupation, and exploitation" of the Peruvian Amazon remains dominant. Petroleum production in 2019 neared 53,000 barrels per day, and the target for 2023 is 100,000. It can be expected that the new administration will implement actions to achieve that goal, with the likely outcome new social conflicts, environmental consequences, and increased emissions.

18.5 Venezuela: Predatory Extractivism, Illegal Economies, and Hybrid Governance

The Amazon bioregion covers 453,915 km^2 of Venezuela, representing 49.5% of the national continental surface area (EcoCiencia 2016). It houses 12 PAs and 29 Indigenous nations, including three groups in voluntary isolation or initial contact. It also contains significant mining resources, such as gold, diamonds, bauxite, iron, and coltan (MPPEFCE 2021). The territory has suffered from increasing environmental impacts since the nineteenth century, gaining force with the post-war development model, essentially focused on iron, bauxite, and hydropower. The 1980s represented a turning point due to the rise in international gold prices, which not only made new mining projects more attractive, but also illegal mining. Additionally, the historical decline of conventional crude oil reserves, located outside the Amazon, drove government elites to focus on new areas of oil exploration, such as extra-heavy crude oil from the Orinoco Oil Belt (OOB), and to diversify extractivism to activities other than oil. In the 1990s, mining, forestry, and tourism projects, connective infrastructure, and the expansion of new oil ventures in the Orinoco delta were prioritized (Terán 2015).

Since 1999, the "Bolivarian Revolution" has represented a significant change in the political strategy of the country, but extractivism has remained a priority. Despite the 1999 Constitution's protection of environmental and Indigenous rights, the government emphasized extractivist development policies in the Amazon that the previous government had promoted but had not been able to consolidate (Terán 2015).

In the first decade of the 2000s, the Bolivarian process reached its hegemony and extractivism acquired new dimensions. In addition to setting a target of 6 million b/d of oil production by 2021 essentially from the OOB, the government advanced towards the expansion of big mining, with enormous consequences for the Amazon. This period saw new oil, timber, agro-industrial, infrastructure, and energy projects. The boom in primary product prices provided an extraordinary incentive, leading to a new "gold fever" that impacted the Amazon, not only with new licit mining projects, but also with a notorious expansion of illegal mining (Terán 2016).

Mining concessions and investments, regularization plans, agreements with Chinese companies, and the nationalization of gold culminated in the President's announcement of a mega-project in the Amazon called the "Orinoco Mining Arc" (OMA), from where gold, bauxite, coltan, and diamonds would be extracted. This took mining in Venezuela to a new scale and represented a fundamental step in the changes that extractivism would undergo in the years of "The Big Crisis" (2013–2021) (Terán 2016).

The Big Crisis was a national collapse of multi-dimensional character leading to the disintegration of all spheres of a nation and economy built around the oil industry during the previous 100 years. The dissolution of the petro-state — not of the State in itself — involved a complete prevalence of impunity, the resolution of public affairs and conflicts by means of force, and an extraordinary boom in corruption and in underground economies, expressed itself in the acceleration of natural resource extraction and destruction, where mining prevailed as a fundamental tool for expanding local and national power structures. The Venezuelan Amazon became the most attractive frontier to materialize these power networks (Terán 2016).

The described factors led to the emergence of a new governance structure attuned to processes of territorial conquest and appropriation of natural resources that have resulted in a general landscape of predatory extractivism. In 2016, the Venezuelan President established a "special economic zone" in the OMA, a scheme promoted principally by China, and one that cut labor and environmental regu-lations. The plan was a call for international investment and a means to organize rampant illegal mining activities in the region, but the extractive dynamics of the area soon proved to be profoundly determined by the control of mines and territories by armed actors of diverse types, including criminal gangs ("mining syndicates"), Colombian armed groups, and official security squads, mostly belonging to the military. The political geography of gold ruled; local power structures, commercial transboundary relations (mostly Colombia and Brazil), and operation essentially outside the sphere of legality, be it because the activities themselves are illegal or criminal, or because they violate human rights, the Constitution, environmental regulations, or Indigenous rights. Violence was and continues to be the primary resource for operation and control (Terán 2018).

The government responded by increasing military presence in the region and in the management of the companies. Their unlimited access to tools for the management of natural resources placed them openly and thoroughly in the extractivist business. The continuing prevalence of illicit economies and local power networks resulted in various hybrid governance structures that blur the boundaries between legal and illegal operations and exhibit no concern for conservation (Terán 2018).

The plight of the Venezuelan Amazon, traversed and pervaded by the logic of violent territorial enclave economies, has profound consequences for the natural ecosystem and local peoples. Even before the crisis, advances on the territory generated immense environmental impacts, including high levels of deforestation, mercury pollution, and degradation of water bodies and watersheds. It also displaced local economies, had significant impacts on local populations, and spurred conflict and systematic violations of human rights. This critical situation was aggravated by the deepening economic collapse, increasing levels of institutional decomposition and political corruption, international economic sanctions on the country, the need for appropriating gold by local and national power circles, as well as the dynamics of the Colombian armed conflict and the migration to mining areas by transboundary actors. The crisis exacerbated the deterioration of the social, ecological, and cultural impacts that were already in place (Terán 2018).

Despite these circumstances, Venezuela has a relatively low rate of deforestation compared with other countries in the region (Appendix Table 18.1B). The described situation of an exposed Amazon, open to forces with an attitude of conquest and globalization, still offers an opportunity for conservation, if only those forces could be kept at bay.

18.6 Bolivia: The Amazon's Second Deforestation Hotspot

Bolivia has the second highest rate of primary-forest cover loss in the Amazon after Brazil, despite having one of the lowest human population densities in South America. The largest share of deforestation occurs in the lowland region, predominantly around the city of Santa Cruz de la Sierra and the Santa Cruz Department, the main agricultural center of the country.

Santa Cruz underwent an intense colonization process from the 1950s through to the 1990s. Between the mid-1980s and the early 1990s, deforestation accelerated due to the influx of agro-industrial corporations, farmers, and foreign producers who cleared large areas for agriculture. This process was facilitated by government policy and international development financing. World Bank financing aimed at promoting market-oriented production and economic growth. During the 2000s, the main drivers of deforestation were conversion of forest to pasture (with more than 50% of deforestation from 2000 to 2010); mechanized agriculture, mostly soybeans, largely by Brazilian and Argentinian producers (30%); and to a lesser extent small-scale agriculture (20%). Increased demand from the domestic market owing to growing urbanization, international investments, and greater integration of the agricultural economy with export markets' growing demand for soy and beef, increasingly became the major underlying causes of deforestation. Progressively, deforestation expansion radiated from Santa Cruz to the north and east, and eventually adopted a dispersed pattern, even reaching the northern border with Brazil (Kaimowitz et al. 1999).

In parallel to this process, Bolivia was a pioneer on many environmental issues. Beginning in the 1990s, faced with environmental and social problems, the government started adopting policies inspired by the Rio Summit ("Earth Summit") of 1992. However, it was not until the early 2000s that a new paradigm was introduced proposing non-market approaches to environmental policy and the principle of "Living Well", which was encoded in the country's Constitution of 2009 and proposed internationally. Bolivia became a pioneer of environmental legislation, passing the Law of the Rights of Mother Earth (2010) which recognized the rights of nature and the State's obligations to ensure these rights, and the Framework Law of Mother Earth and Integral Development for Living Well (2012), establishing the rights of Indigenous, rural, and Afro communities, within a development proposal for sustainable natural resource use (Romero-Muñoz et al. 2019).

However, despite this innovative legal framework and sustainable proposals, little progress was made in avoiding deforestation and forest degradation. In fact, these conservationist policies are in constant tension with agricultural promotion policies, and directly contradict plans to guarantee and increase food production and exports, widespread road and infrastructure improvement and expansion (after agriculture and pastures, the leading cause of forest degradation and deforestation), and allowing oil exploration in PAs. It is noteworthy that nearly half the expansion of the hydrocarbon frontier in the Amazon from 2008 to 2015 occurred in Bolivia (Romero-Muñoz et al. 2019).

Most PAs in the lowlands are directly or indirectly threatened by the rapid expansion of commodity frontiers. As a result, Bolivia has the second highest proportion of PAs under intense human pressure in all of South America. Agricultural expansion is causing massive biodiversity loss and eroding PA connectivity; 11 of the 22 PAs have overlapping oil and gas blocks covering at least 17% of the protected surface; at least nine Amazonian PAs are fragmented by roads and subjected to roadside deforestation; gold mining is rapidly expanding in the north, including inside PAs, causing water and soil pollution; nine hydroelectric projects, mainly for export to Brazil, are located inside or near PAs, and at least three dams are planned immediately upstream or downstream of seven ITs, inducing displacement (Romero-Muñoz et al. 2019).

Despite >40% of the national population identifying as Indigenous (the highest in Latin America), and constitutional guarantees of the right of Indigenous peoples to free, prior, and informed consent to infrastructure development and resource extraction in their territories, a 2015 Decree allows the government to decide the timing and procedure for consultation with national Indigenous organization rather than with affected communities, thus rendering the process ineffective and threatening conservation. Traditional knowledge and livelihoods are associated with forest conservation (Blackman et al. 2017, see also Chapter 10) and many Bolivian Indigenous communities retain their traditional culture and worldviews on which

the Living Well principle enshrined in the Constitution is based (Romero-Muñoz et al. 2019).

The future of the Bolivian Amazon is contingent on the government honoring the Rights of Nature enacted in the law and the principles established in the national Constitution.

18.7 Conservation Opportunities and Threats in the Guianas

The three Guianas (Guyana, Suriname, and French Guiana) form a unique Amazonian region, as the two countries and French territory are almost entirely Amazonian, with 85-95% of their total land area covered by tropical rainforest (Butler, 2020). In fact, the Guianas are among the most forested countries on Earth and, given their low population density of approximately four persons per km^2 (Worldometers 2021), they are among the top five countries with renewable internal freshwater resources per capita in the world.

Deforestation rates in the Guianas are the lowest in the Amazon region. Suriname lost 1.05% of its primary forest tree cover between 2001 and 2019, and Guyana lost 0.79% in the same period (Global Forest Watch 2021). The Guianas provide a counterbalance to the Amazon Basin and tropical ecosystems where large-scale deforestation, forest fires, intensive human settlement, and industrial development for agriculture have threatened the existence of wildlife and local communities for decades. However, environmental threats are on the rise, especially due to irresponsible gold mining, unsustainable forestry and fishing practices, excessive poaching, and climate change.

Gold continues to be the main economic earner, not only for national economies, but also as the main livelihood of tens of thousands of families. It is also by far the largest driver of deforestation, and the mercury used by artisanal mining affects freshwater ecosystems, biodiversity, and human health. An estimated 40,000 artisanal, small- and medium-scale miners in the Guianas use mercury in the extraction of alluvial gold. This toxic substance has been widely found in the fish upon which local communities rely (Watson et al. 2020). In 2008, researchers discovered that people from the Indigenous Wayana village of Kawemhakan in Suriname, where artisanal gold mining takes place, had mercury levels significantly higher than the safe limits defined by the World Health Organization. Researchers determined a causality between high mercury levels in the people and their fish consumption, also their main source of livelihood (De Souza Hacon et al. 2020; Peplow and Augustine 2012).

While forest cover remains high and deforestation is still relatively low despite gold mining, large areas of the Guianas are allocated as forest concessions. This has resulted in substantial forest degradation mainly from intensive logging and has the potential to become a primary source of forest carbon emissions. In Guyana, 13.5% of the overall forest carbon emissions were attributed to forest degradation, of which 96.3% came from timber harvesting (Guyana Forestry Commission 2020). Furthermore, the construction of logging roads also increases access for gold mining, hunting, and poaching.

Excessive hunting, poaching, and capture of wildlife, together with habitat destruction, have caused significant declines in populations of fish, birds, mammals, amphibians, and reptiles. These include endangered and protected species, such as the iconic jaguar, parrots, and marine turtles, which are captured for illegal wildlife trade.

Climate change over the next few decades will increase pressure on natural habitats and the species that live within them (see Chapters 22–24). A WWF study (2018) reports the impacts of various global climate scenarios on the extinction of various species groups within the Amazon-Guianas Priority Region. Plants and amphibians are most vulnerable, reptiles have an intermediate position, and birds and mammals seem less vulnerable. Dispersal ability reduces vulnerability of species groups. Global warming is predicted to constitute an "escalator to extinction" for species that live on mountains, because species are generally moving to higher elevations as temperatures increase. Species that live only near mountaintops may then run out of room (Freeman et al. 2018).

Guyana and Suriname are on the eve of a massive oil and gas boom. Exploitation of offshore oil fields is predicted to generate billions of dollars for these countries, which have been struggling to strengthen their economies for decades. The region is currently at a crossroad; they can follow the traditional development path of most oil producing countries, in which development is largely based on income from natural resource exploitation at the cost of the environment and the well-being of the people, or choose a more sustainable, green development pathway, which includes building a new relationship between people and nature through a sustainable, post-COVID-19 economic recovery (see Chapters 25 and 26). The success of REDD+ (reduced emissions from deforestation and forest degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks) in Guyana, paradoxically funded by Norway's largely oil and gas proceeds, could serve as an example, including for the use of oil and gas revenues. Norway agreed to support Guyana to maintain low levels of deforestation, providing up to USD 250 million over a five-year period ending in 2015 to implement a low carbon development strategy (LCDS) and REDD+. The program has also supported regular monitoring, reporting, and verification (MRV) of forest area changes. The Guyana Forestry Commission (GFC) has developed a MRV system, now in its tenth year, which has allowed for comprehensive, consistent, transparent, and verifiable assessments and reporting of forest area change. Funding has also created incentives and changes in the legal framework, such as strengthening law enforcement in the forestry and mining sectors (Benn et al. 2020). Suriname and Guyana may also receive support from a proposed global mechanism to compensate small oil and gas rich nations for foregoing oil and gas development. That said, if oil and gas are to be exploited by Guyana and Suriname, it must be done under the best environmental and social practices, while oil and gas revenues are invested in a sustainable economic transition.

18.8 Conclusions

Since the 1970s, and particularly during the early twenty-first century, the Amazon experienced the largest expansion of human intervention in its history. Facing a new wave of globalization and the expansion of commodity exports from Latin America, several commodities extracted from the Amazon boomed, mostly soy, beef, iron ore (Brazil), oil and gas (Colombia, Ecuador, Peru), gold (Peru, Venezuela and the Guianas), and illegal drugs (Colombia, Peru, Bolivia). Moreover, large infrastructure projects (roads, hydroelectric dams) complemented the transformation, becoming far-reaching indirect drivers of deforestation and forest degradation. The neo-extractivist development model has not generated significant improvements in living conditions of the local population, including countless Indigenous communities who have suffered the greatest impacts to the environment upon which they depend (Chapter 19).

National manifestations of this process are heterogeneous and vary according to resource endowments, social and political conditions, and changes over time. Yet, there is evidence of the shared importance of domestic markets, influenced by urbanization and rising incomes in other areas of the country, international markets, and global forces, especially associated with commodities (beef, cattle, oil, and minerals), and of the role of government policy.

Interestingly, government policy is observed to be determinant, either by positive action or by absence. The latter case is demonstrated in Colombia and Venezuela. A relatively low deforestation in Venezuela is associated with an Amazon that has consistently eluded intervention of the State, first because the region was forgotten as generous oil revenues came from outside it; and subsequently because of the difficulty of successfully intervening in the territory due to the existing informal but consolidated power networks. In Colombia, a rise in deforestation was experienced after the Peace Agreement with the FARC, which until then had restricted the intervention of the State and the advance of government policy in the region. Conversely, state policy, by concrete action rather than by omission, has been an important determinant of the influx of activities that have affected the territory in all other cases. Likewise, the degree to which the adverse effect of these activities has

been controlled is associated with political will and consistency of state policy, as well as with state capacity for law enforcement.

Except for Venezuela and the Guianas, agriculture and cattle ranching seem to be the most important deforestation drivers in terms of surface area. Countries differ regarding the importance of small versus large scale producers. This process may be influenced by natural conditions, government policy, and market access, among other factors, but it may also hide confounding factors associated with small-scale production, which collectively refer to a diverse universe with varying relationships to the market and with drastically different technological packages and environmental impacts (Murmis 1991). The cases presented here include small scale farmers, such as those who migrate to the Amazon from other regions and activities, and local small scale traditional farmers and harvesters. Another example comes from Peru, where small scale farmers supply domestic and international markets for cocoa and coffee (Ravikumar et al. 2016), shedding a different light on the drivers of deforestation and pointing to the importance of understanding the type and relation to market of the small-scale farming involved. However, the role of large-scale modernized agriculture and cattle ranching is clear; it radically accelerates deforestation and fragmentation where it is introduced (Brazil and Bolivia).

Infrastructure development, in particular road expansion, is an underlying indirect driver of massive changes in forest area by opening access to direct drivers, legal and illegal. Road construction and improvements have gone hand in hand with strong forest conversion, particularly in Bolivia and Brazil, where large scale agriculture is predominant. Road building plans are widespread in the region. It has been estimated that 75 projects are planned for the next five years in Bolivia, Brazil, Colombia, Ecuador, and Peru, extending 12,000 km and mostly lacking "rigorous impact assessments or even basic economic justification"; these could lead to 2.4 million hectares of deforestation in the following two decades (Vilela et al. 2020).

From the perspective of the intensity of the deforestation process, three main groups can be identified. Brazil and Bolivia share high tree forest loss, involving land-use change from forest to cattle ranching, intensive soy cultivation, oil and gas (Bolivia), mining (Brazil), and infrastructure development. A second group with medium includes three Andean countries (Colombia, Peru, and Ecuador). In all cases oil has been significant factor, while commercial farming is important in Peru, and peasant agriculture in Ecuador. The extent of illegal activities, such as coca cultivation (relevant mostly in Colombia and Peru), gold mining, logging, and drug trafficking, remains an open question, as they escape formal and comparable statistics. It is known that they cater to international markets, are deeply transnational, and may have a significant degree of integration (Castro Pereira and Viola 2021).

A third group, with relatively low tree cover loss, includes Venezuela, Suriname, Guyana, and French Guiana. In all cases, forest conversion to agriculture has been moderate, but the recent expansion of illegal mining and criminal activities, mostly in Venezuela, has created a well-defined increase in forest impacts.

It is interesting that the low degree of forest conversion in Venezuela has resulted from a lack of development policies in the region due to the absence of state presence in the area. Similarly, the lack of intervention of government policy in Colombia up to the signing of the peace agreement with the guerrillas kept deforestation relatively low. These facts and the developmentalist policies that have induced deforestation in other countries and periods, in contrast with the success of the Brazilian-government-led conservation policies between 2005 and 2012, point to the critical role of the state in the fate of the Amazon, be it by act or omission, and should be a major criterion in designing sustainable development paths for the future.

Overall, in all cases, the neo-extractivist model has been stronger than conservation policies, despite the fact that nearly half the region is covered by recognized PAs and ITs, as described in Chapter 16. The only national strategy with substantial

effects in curbing deforestation was the Brazilian experience between 2005 and 2012, with an 84% reduction in deforestation rates (see Chapter 17). Although this policy has been dismantled and the outcome is currently reversed, the model's success sheds light on the path needed for its replication and enhancement for long term viability, embedded in a comprehensive new paradigm towards conserving biodiversity and forest ecosystems, and reducing emissions while improving the living conditions of local peoples and respecting Indigenous cultures.

These different cases show how the manifestations of deforestation and forest degradation are particular to national and local contexts. Therefore, local context must be a central factor in designing policies and programs. Given the variety of experiences, there are no one-size solutions applicable to all countries or even to the entire Amazon within the same country. Moreover, a sustainable path for the Amazon requires the participation of local voices, particularly those that were most impacted by the negative consequences of the current model and were the least involved in the decision making that led to the current situation. It is also imperative that the presence of common, underlying, and cross-cutting major and, in many cases, global forces permeating local experiences be addressed. This requires action at the scale and level at which these forces operate, but policy measures in response to these forces must also be customized and incorporated in the locally adapted strategies.

18.9 References

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18.10 Annex to Chapter 18

Table 18.1B Average annual growth rates on Ecuador GDP by periods (1950-2019)

Period	Growth rate
1950-1965	2.14
1966-1972	2.42
1973-1981	4.23
1982-1990	-3.31
1990-1999	-1.29
2000-2004	6.31
2005-2014	5.40
2015-2020	-1.99

Note: Growth rates were estimated from a kinked regression, controlled from first order autocorrelation, using Prais-Winsten and Cochrane-Orcutt models.
Source: Author estimates based on PENN World Table, 10.0

Table 18.2B Ecuador's Population by Region: 1950-2010

Region and area	**1950**	**1962**	**1974**	**1982**	**1990**	**2001**	**2010**
Quito	209932	354746	599828	866472	1201954	1621646	1979831
Remaining urban highlands	191111	325261	537834	785349	1079922	1520092	1960146
Rural highlands	1453909	1591338	2008903	2150018	2117137	2319000	2509378
Total highlands	1854952	2271345	3146565	3801839	4399013	5460738	6449355
Guayaquil	258966	510804	823219	1119344	1535393	2007892	2307587
Remaining urban Coast	133072	334231	703649	1161982	1678402	2266478	2987451
Rural Coast	910059	1290559	1670771	1707631	1653063	1854439	1974168
Total Coast	1302098	2135594	3197639	3988957	4866858	6128809	7269206
Urban Amazon	0	0	0	32763	59575	152696	241236
Rural Amazon	46471	74913	173469	224915	312958	395723	498578
Total Amazon	46471	74913	173469	257678	372533	548419	739814
Urban Galápagos	698	1165	2381	4493	8013	14142	18085
Rural Galápagos	648	1226	1656	1626	1772	4498	7039
Total Galápagos	1346	2391	4037	6119	9785	18640	25124
Total Urban	**793779**	**1526207**	**2666910**	**3970403**	**5563259**	**7582946**	**9494336**
Total Rural	**2411087**	**2958036**	**3854800**	**4084190**	**4084930**	**4573660**	**4989163**
Total National	**3204867**	**4484243**	**6521710**	**8054593**	**9648189**	**12156606**	**14483499**

Sources: INEC. Population censuses.

Table 18.3B Selected Social indicators in oil extracting and remaining Amazon regions, 2010

Subregion	Area	Years of Schooling	Child mortality proportion	Social Development Index
Amazon oil extracting region	Rural	6.7	0.057	48.7
	Urban	8.6	0.044	64.1
	Total	7.7	0.050	56.8
Amazon non-oil extracting region	Rural	7.1	0.047	50.8
	Urban	9.8	0.034	72.9
	Total	8.2	0.042	58.7
National Total	Rural	5.9	0.046	51.9
	Urban	9.5	0.032	73.1
	Total	8.7	0.035	68.1

Sources: UASB-UISA, based on: INEC, Censos de Población y Vivienda, 1990, 2001, 2010.

METHODOLOCAL NOTES FOR ECUADOR'S SECTION

The social development index (SDI). The Social Development Index was estimated from 19 indicators from the 1990, 2001, and 2010 Ecuadorian census databases, broken down by parishes in the rural area and municipalities in the urban area. Six indicators deal with education, 2 with health, 3 with gender differences in education and employment, and 8 with housing. Parishes are the smallest administrative division in Ecuador, and the country was divided into 1024 local circumscriptions. The SDI was estimated as the first component using principal components analysis, maximizing its statistical representativity, and explained 50.5% of the total variance of its 19 components.

Education indicators were: 1. Average years of schooling for the population older than 23 years (ESCOL). 2. Proportion of literacy in the population older than 14 years (ALFAB). 3. Net assistance rate for primary education (TPRIM). 4. Net assistance rate for secondary education (TSECUN). 5. Net assistance rate for higher education (TSUP). 6. Proportion of population older than 23 years with access to higher education (TACSUP).

Health indicators were: 7. Weighted health personnel for each 10,000 inhabitants (PERSAL). 8. Proportion of dead sons and daughters from mothers aged between 15 and 49 (PNINMUER).
Gender indicators were: 9. Difference between male and female literacy rates (DISEXAL). 10. Difference between male and female schooling (DISEXESCOL). 11. Female proportion in the economically active population (PFEMPEA).

Housing indicators were: 12. Proportion of dwellings with access to piped water inside the house (PAGUA). 13. Proportion of dwellings with sewerage (PALCAN). 14. Proportion of dwellings with garbage collection service (PBASURA). 15. Proportion of dwellings with electricity (PELEC). 16. Proportion of dwellings with adequate walls (PPARED). 17. Proportion of dwellings with adequate floor (PPISO). 18. Proportion of households with less than 3 persons per room. 19. Proportion of dwellings with toilets inside the house (PSSHH).

The SDI was rescaled to an interval between 0 and 100 points. Its formula is:

SDI = 0.904 * ESCOL24 + 0.707 * ALFAB15 + 0.604 * TPRIM + 0.859 * TSECUN + 0.822 * TSUP + 0.771 * TACSUP - 0.452 * DISEXAL + -0.299 * DISEXESCOL + 0.714 * PERSAL - 0.722 * PNINMUER+ 0.233 * PFEMPEA + 0.802 * PAGUA + 0.749 * PALCAN + 0.848 * PBASURA + 0.734 * PELECT + 0.693 * PPARED + 0.602 * PPISO + 0.716 * PPERCUA + 0.839 * PSSHH (Larrea et al 2013).

The initial analysis broke down the SDI by area of residence (urban and rural) and natural region (Coast, Highlands, Amazon, and Galapagos). The urban area includes all cities and towns with populations higher than 10,000 inhabitants. The Amazon region was further divided into an oil extractive sub-region and the remaining part. The oil extractive subregion was integrated by the parishes or municipalities containing oil blocks in production in 2017.

The spatially autoregressive multiple regression model. In the regression analysis, the SDI was used as a dependent variable, breaking down the 2010 Census by census tracks (sectors). Ecuador was divided into 40,640 census tracks in 2010. The model included 2,408 census tracks in the Amazon region with valid data (145 tracks were excluded because of missing values). The Amazon region was defined as including all the six regional provinces, which incorporate not only the dominant lowlands but also the foothills of the Andean mountains, where many Amazon headwaters originate.

As information is spatially defined, OLS regression models may have a bias due to spatial autocorrelation, because of influences among neighboring or closer tracks. To control for spatial autocorrelation, a spatially autoregressive model was used, with a dependent variable lag and an inverse distance matrix among tracks.

Independent variables in the regression model

Proximity to oil wells index. Defined as the sum of inverse distances between the centroid of each census track and the surrounding oil wells. The PRAS map (2013) was used to identify wells. A radius of 50 km from the centroid was used to identify surrounding oil wells. The variable was included for identifying the effects of local oil extraction on social conditions.

Soil fertility index. Defined as the percentage of area with at least medium soil fertility in each census track. The source is the map of soil agricultural aptitude from the MAGAP-SIGTIERRAS (2015) program of Ecuador´s Ministry of Agriculture, which identifies four categories of fertility: very low, low, medium, and high. The variable intends to evaluate the effects of local soil quality on living conditions.

Proportion of intervened areas. Defined as the proportion of artificially modified areas on the total area of each census track, excluding natural water bodies. Modified areas include cropland, pastures, artificial water bodies, human settlements, infrastructure, and no forested-covered areas. The source is the 2016 map of land use of the Ministry of Environment. This variable was included in the regression model in parabolic quadratic form. The variable intends to measure the effect of deforestation on local social conditions.

Travel time to the closest agricultural market. Defined as the number of hours required to travel from the centroid of each census track to the closest agricultural market. The variable is expected to evaluate the social contribution of market access.
Dummy rural. Dichotomous variable included to differentiate rural sectors from small towns, concentrated (blocked) settlements, and cities.

Additionally, 3 local employment indicators were included in the regression model to capture the potential effect of economic diversification and the expansion of capitalist relations in the labor force. Information was obtained from the 2010 population census.

Proportion of agriculture in economically active population (EAP). Included as an indicator of economic diversification from agriculture, the traditionally dominant sector.

Proportion of wage earners in EAP. Expected to capture the influence of capitalist social relations of production, as opposed to traditional family-based or independent ways of production, which prevail among peasants and small urban producers.

Proportion of hotels, lodging, restaurants, and food services in EAP. Expected to capture the extent of tourism in employment.

To differentiate between deforestation leading to expansion of agricultural frontier and deforestation leading to urban expansion, an interaction term (Dummy rural) * (Proportion of intervened areas) was also included.

The model results are presented in **Table 18.4B.** Their main findings can be summarized as follows:

1. All independent variables have regression coefficients significant at least at the 5% level, and most of them were significant at 1% level.

2. The regression coefficient of proximity to oil wells is negative and statistically significant at 1% level. The result is consistent with the negative effect of oil extraction on SDI presented in Appendix Table 7, and strongly suggests that, after controlling for other observable factors that influence social conditions, such as soil fertility, access to markets, proportion of deforested land, and employment structure and diversification, the proximity or local presence of oil extraction has a net detrimental effect on basic needs satisfaction.

3. The soil fertility index captures spatial differences in the land aptitude for agriculture and has the expected positive regression coefficient at 5% significance level. Travel time for markets captures transportation costs of agricultural products and has the expected negative and significant association with SDI. Dummy rural captures differences in living conditions between towns and the countryside, which are high in Ecuador. Its regression coefficient is negative and statistically significant. All the remaining variables refer to employment structure. As a high proportion of agriculture in the labor force implies low diversification, their expected effect on SDI is negative. The proportion of wage earners, an indicator of expansion of capitalist relations, has an expected positive influence. Finally, the proportion of logging and food services, as an indicator of tourism, has a strong positive coefficient with 1% significance, as expected. Its high value suggests an important socially distributive effect of tourism in Ecuador´s Amazon.

4. The proportion of deforested areas, presented in quadratic form, has an effect on SDI with decreasing returns and low initial gains, after controlling for the remaining variables, suggesting a weak and short-lived association between deforestation and local living conditions.

Results of the spatially autoregressive multiple regression model

Table 18.4B Spatially Autoregressive model on factors influencing local social development in Ecuador's Amazon, 2010

Dependent variable: Social Development Index (SDI)
Number of observations = 2408
Maximum likelihood estimates:
Wald chi2 (11) = 8894.03
Prob > chi2 <= 0.0001
Log likelihood = - 7016.191
Pseudo R2 = 0.7842

InDesSoc100	Coefficient	Std. Error	z	P>|z|	[95% Conf. Interval]	
InDesSoc100					Minimum	Maximum
Proximity to oil wells index	-0.261	0.026312	-9.93	<0.001	-0.313	-0.210
Soil fertility index	0.854	0.4222169	2.02	0.043	0.026	1.681
Prop. of intervened areas	20.506	2.231269	9.19	<0.001	16.133	24.880
Prop. of intervened areas²	-10.879	1.392222	-7.81	<0.001	-13.607	-8.150
Travel time to markets	-0.482	0.0688226	-7	<0.001	-0.616	-0.347
Prop. Agriculture in EAP	-5.042	0.6216075	-8.11	<0.001	-6.260	-3.823
Prop. wage earners in EAP	7.233	0.6529073	11.08	<0.001	5.953	8.512
Prop. logging in EAP	22.438	3.684288	6.09	<0.001	15.217	29.659
Dummy rural	-2.675	1.202942	-2.22	0.026	-5.033	-0.318
DRural*PropIntAreas	-2.666	1.328097	-2.01	0.045	-5.269	-0.063
Constant	35.197	1.363232	25.82	<0.001	32.525	37.869
Widist2 distance matrix InDesSoc100	0.077	0.009	9.05	<0.001	0.061	0.094
var(e.InDesSoc100)	19.876	0.573			18.784	21.031

Note: To control for spatial autocorrelation, a spatially autoregressive model was used, with a dependent variable lag and an inverse distance matrix among tracks. The model was run with Stata statistical software (version 15).

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