Executive summary

Global challenges, regional solutions

Latin America and the Caribbean in the face of the climate and biodiversity crisis

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Global challenges, regional solutions: Latin America and the Caribbean in the face of the climate and biodiversity crisis

The planet's climate is changing, and biological diversity is declining at an accelerating rate. Both phenomena pose major threats to humanity, but it is precisely human activities that are responsible for this crisis.

Over the last two centuries, economic growth has led to improvements in the living conditions of the global population. However, this progress has come at the cost of increased consumption of fossil fuels, drastic changes in land use, and the overexploitation of natural resources, resulting in dire consequences for life on Earth.

While Latin America and the Caribbean bear less historical responsibility for the current environmental and climatic situation compared to other parts of the world, the region is not immune to these phenomena. It faces numerous challenges that extend beyond this environmental crisis, but it also has opportunities to preserve its natural wealth, adapt, and contribute to climate change mitigation through policies that simultaneously promote more sustainable and inclusive economic development.

Key concepts

What is climate change?

Climate change refers to a persistent alteration in the distribution of climatic variables such as temperature, wind, or precipitation. At present, the climate is changing as a result of human activity. One of the most notable changes is the rise in the planet's average surface temperature, which was 1.1°C higher during the decade 2011-2020 compared to the pre-industrial era (1850-1900).

Other changes include increased variability in precipitation patterns, rising ocean levels, acidity, and temperature, and increased frequency and intensity of floods and droughts, heat waves, and other extreme weather events (IPCC, 2021).

What are ecosystems and biodiversity?

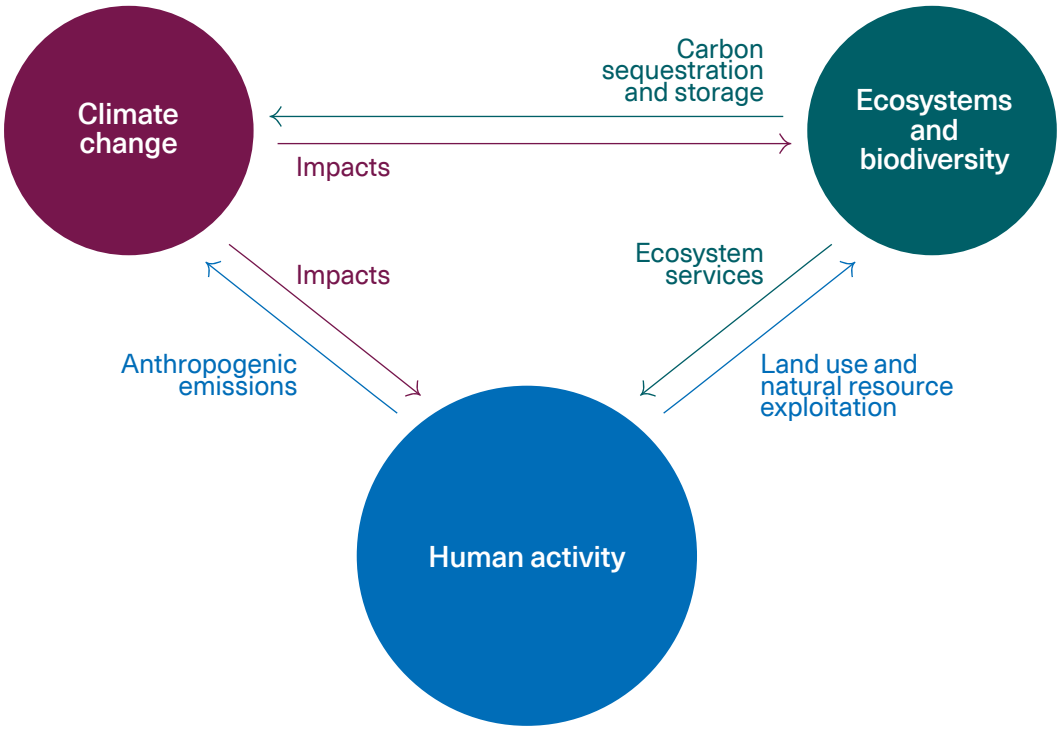
An ecosystem is a "dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit" (CBD, 1992). The definition of a specific ecosystem depends on the question of interest and, therefore, its scale can vary considerably. For instance, the entire biosphere of the planet forms a vast ecosystem, containing multiple ecosystems of varying levels.

Biodiversity refers to the diversity of life in all its forms, encompassing the variety of genes and species within an ecosystem, as well as the diversity of ecosystems themselves. Biodiversity is a critical dimension of both the state and resilience of ecosystems against external disturbances.

What is the relationship between climate change, ecosystems, and human activity?

Climate change is closely related to ecosystems and biodiversity; these, in turn, are directly linked to human activity (Figure 1). The planet's climate is changing as a result of the accumulation of greenhouse gases (GHGs) released into the atmosphere by human activities such as the burning of fossil fuels and land use patterns (e.g., deforestation). Climate change threatens human well-being and the continuity of all life forms on the planet. Estimates indicate that exceeding 2°C of global warming would lead to irreversible impacts, including massive species extinctions, permanent flooding in certain areas, and loss of crop viability, among others.

Figure 1
Interrelationship between climate change, ecosystems, biodiversity, and human activity



Source: Authors.

Ecosystems provide multiple services to people, including the provision of food, fresh water, medicines, and materials, as well as environmental regulation and maintenance, recreational opportunities, and are a source of identity and inspiration, particularly for communities inhabiting them. These services play a crucial role in economic development and human well-being. In this context, ecosystems and biodiversity are part of what is known as natural capital (Dasgupta, 2021; Vial, 2023).

Ecosystem services for climate regulation are central to addressing climate change. On one hand, ecosystems mitigate climate change by absorbing carbon dioxide (CO_2) from the atmosphere and storing it in biomass and soils. On the other, ecosystems contribute to climate change adaptation by moderating extreme weather events and regulating local climates.

The industrial revolution significantly improved global well-being, leading to unprecedented increases in life expectancy and material conditions. However, economic and population growth, increased demand for food, energy, and resources, and the prevalence of environmentally harmful production methods have led to an environmental crisis, including climate change. This crisis also manifests in significant biodiversity loss and ecosystem degradation, representing a loss of natural capital that jeopardizes the sustainability of economic development and the well-being of future generations.

Why are climate and conservation policies necessary?

Climate change and biodiversity loss are the results of market failures, particularly negative externalities and the underprovision of public goods. Externalities are side effects that the actions of an individual or group have on society as a whole, creating a gap between individual and societal benefits. For instance, too much fossil fuel energy is used or too many forests are deforested compared to the benefits these activities bring to society at large. On the other hand, the underprovision of public goods occurs because it is not possible to exclude third parties from its benefits. Biodiversity preservation exhibits public goods characteristics; for example, the region cannot exclude the rest of the world from the global benefits of preserving the Amazon. Climate change and biodiversity loss stem from global-scale market failures, as what happens in one country affects the rest.

Furthermore, managing the adverse consequences of climate change involves various market failures and equity considerations, thus warranting public policy intervention. Building infrastructure or nature-based solutions (NbS) to prevent floods, developing and adopting crops resilient to temperature increases or rainfall scarcity, and implementing early warning systems for extreme events, among other climate change adaptation measures, are subject to coordination or information problems that prevent the market on its own from providing them in sufficient quantity and quality.

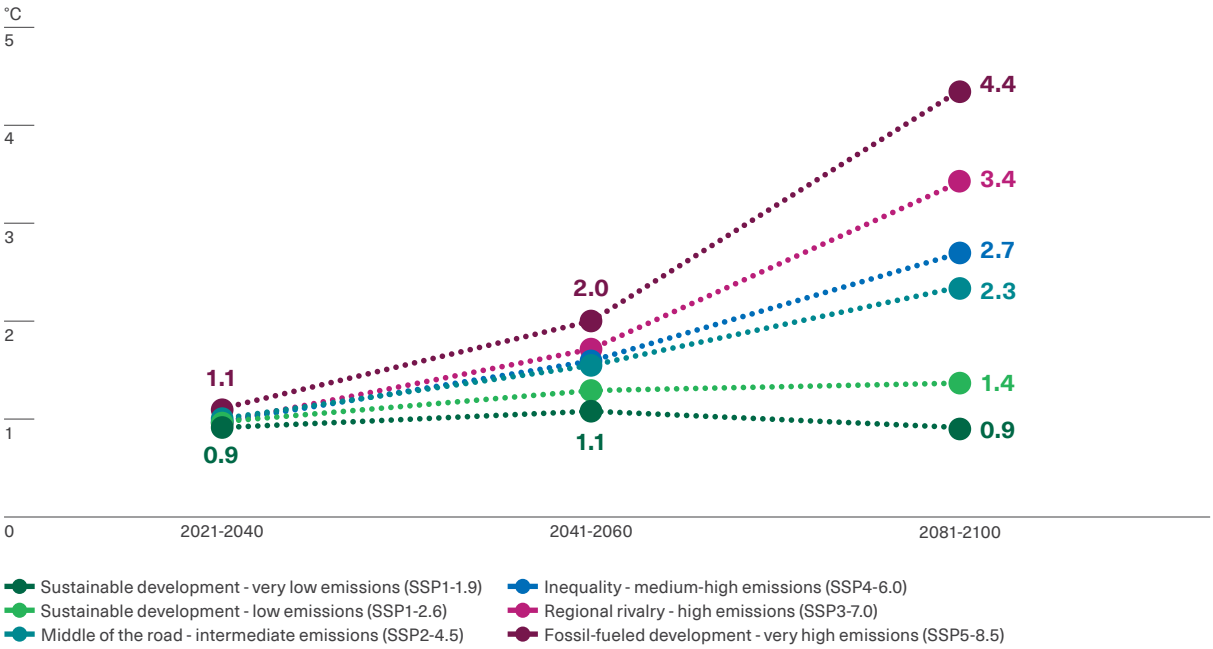
Public policy in climate and biodiversity conservation is necessary to ensure the sustainability of the development process. Adaptation policies seek to address climate change risks by anticipating, preventing, or minimizing potential damages, or managing them once they occur. Mitigation policies aim to reduce greenhouse gas emissions. Conservation policies aim to restore and protect ecosystems and biodiversity while promoting sustainable use of the services they provide. These policies are closely interconnected due to shared causes. Simultaneously, the pursuit of sustainable development requires integrating these policies with those promoting economic growth and social inclusion, leading to complementarities and trade-offs that require careful management.

An overview of climate change and ecosystems in Latin America and the Caribbean

Forecasts indicate that average temperatures will continue to rise, rainfall patterns will undergo increasing disruptions, and many parts of the region will become drier. Extreme weather events are also expected to increase in frequency and intensity. The magnitude of these changes hinges on the trajectory of global greenhouse gas emissions.

Climate projections for Latin America and the Caribbean formulated for this report by the UC Global Change Center indicate that the average temperature during the period 2021-2040 will be about 1°C higher than during 1985-2014 (when temperatures were already between 0.6°C and 0.8°C higher than in pre-industrial times) (GCC-UC, 2023). In subsequent periods, temperature increases will be more sensitive to the evolution of global emissions (Graph 1).

Graph 1
Future average temperature increases in Latin America and the Caribbean in different periods with respect to 1985-2014 according to a shared socio-economic trajectory



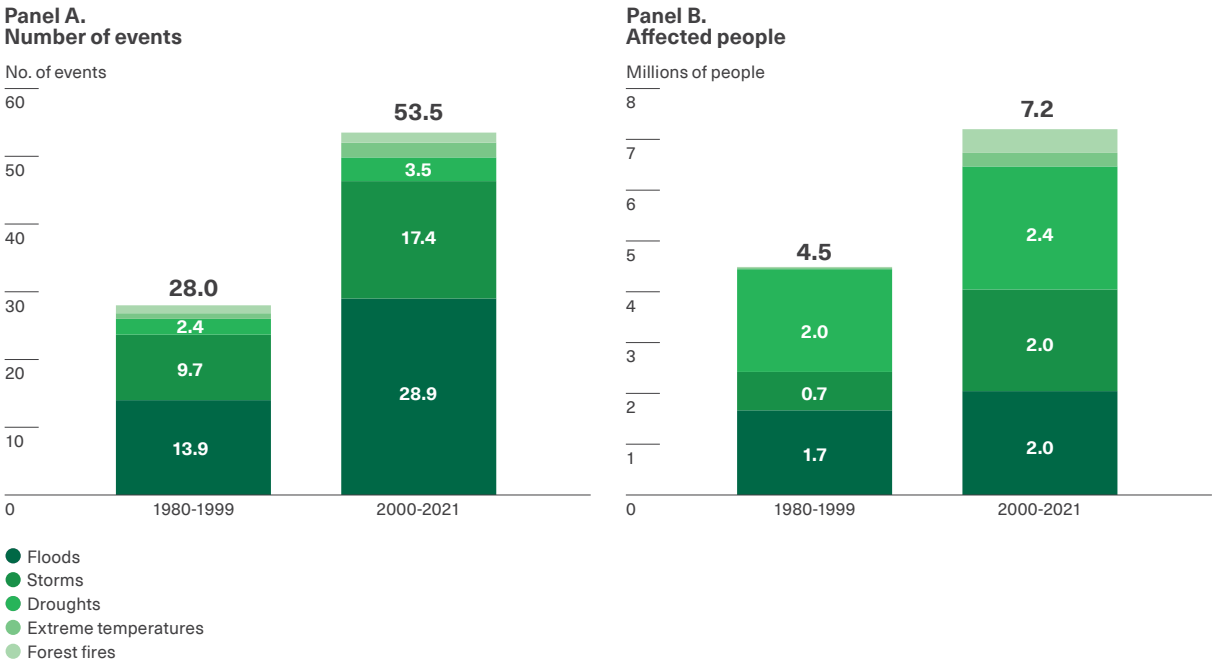
Note: The graph shows temperature increases for different shared socioeconomic pathways (SSPs), which describe future trajectories for the main global socioeconomic variables, combined with different emission reduction scenarios (represented by the numerical values 1.9, 2.6, 4.5, 6.0, 7.0, and 8.5, where a higher value is associated with higher emissions).

Source: Authors using data from GCC-UC (2023).

Likewise, precipitation is projected to increase along the coasts of Peru and Ecuador, the Río de la Plata basin, and northeastern Argentina, and decrease in northern South America, the Caribbean, Central America, parts of the Amazon, northeastern Brazil, central and southern Chile, and southern Argentina. Consequently, aridity is projected to increase over much of the region, with the exception of the coasts of Peru and Ecuador.

The frequency and intensity of extreme weather events are also on the rise, including tropical cyclones, floods and droughts, wildfires, and heat waves. The number of extreme weather events in Latin America and the Caribbean has surged from 28 per year during the 1980-1999 period to 53 per year during 2000-2021. The affected population has increased from 4.5 to 7.2 million people annually in the same timeframes. The most frequent events are floods and tropical cyclones, which, along with droughts, impact the most significant number of people each year (Graph 2).

Graph 2
Occurrence of extreme weather-related events and people affected in Latin America and the Caribbean by type of event in different periods



Note: The graph shows annual averages of extreme weather events and people affected (in millions) by type of disaster for the periods 1980-1999 and 2000-2021. The graph includes the 33 countries belonging to the Community of Latin American and Caribbean States (CELAC).

Source: Authors using data from EMDAT (2022).

Latin America and the Caribbean is highly exposed and vulnerable to climate change. The expected impacts and adaptation needs depend on the specific context.

The effects of climate change on people and ecosystems are influenced by exposure and vulnerability to various climate threats.[1] Encompassing a vast territory, Latin America and the Caribbean is a very heterogeneous region. As a result, exposure and vulnerability to climate threats can vary significantly among countries, communities, and individuals. This variability implies that expected impacts and adaptation investment requirements also differ according to the context.

The capacity to confront and adapt to climate threats is lower in regions with high levels of poverty and inequality, weak institutions, limited access to basic services, and low state capacities. The presence of these developmental deficits in numerous countries and communities within the region, particularly among indigenous communities, positions them among the world's most vulnerable to climate change.

Changes in temperature and rainfall affect agricultural production.

The gradual rise in average temperatures and shifts in precipitation patterns lead to increased aridity in certain areas, heightened drought risks, and elevated incidence of crop pests and diseases. These impacts negatively affect crop yields and reduce areas suitable for cultivation.

These effects vary based on location, crop type, production systems, and the implementation of specific technologies, such as artificial irrigation or climate-adapted crop varieties. Overall, the impacts of climate change on the region's agricultural sector are heterogeneous, with negative repercussions in tropical and subtropical zones and mild impacts (or even some positive effects) in temperate regions (Cristini, 2023).

In Central America and the Caribbean, the agricultural sector is particularly vulnerable to reduced precipitation levels, as 93% of production relies on rainwater for crop irrigation. This can pose a significant challenge for small-scale operations, jeopardizing food and nutrition security for small producers, especially those focused on subsistence farming (Molina-Millán, 2023). In these subregions, 64% of cultivated land consists of plots under 2 hectares (ha), and 86% are plots under 10 ha. These small-scale operations tend to be family and subsistence farms, employing a substantial portion of the sector's workforce, which in many countries constitutes a significant percentage of total employment. Moreover, they often employ traditional production systems and have limited access to financing and markets that would allow them to integrate into agro-industrial supply chains, resulting in low productivity.

This vulnerability to climate change has already manifested itself in significant agricultural production losses in Mexico, Central America, and the Caribbean (Lachaud et al., 2017).[2] These subregions, as well as the Andean countries, will bear the brunt of future negative impacts of climate change on agriculture, while countries in the Southern Cone may experience mild impacts or even potential production increases in certain areas (Prager et al., 2020).

1 Exposure is defined as the presence of individuals, livelihoods, economic resources, ecosystems, species, or natural resources in locations and environments that could be impacted. Vulnerability refers to the susceptibility to negative impacts and depends on factors such as sensitivity to harm and the lack of capacity to address and adapt to it (IPCC, 2022).

2 A consequence of the increasing vulnerability of crops to climate change is the rise in migration (Danza and Lee, 2022).

Decreasing and volatile water availability pose a threat to productive use and human consumption.

Rising temperatures and increased precipitation variability constitute a risk to water resources, particularly in areas lacking water storage or regulation capacity (Vicuña et al., 2020). One of the sectors most vulnerable to this is agriculture, accounting for about 70% of the region's total water usage (even though most cropland is rainfed). Another sector with high water demand compared to other regions is the energy sector, due to its use for hydroelectric power generation. Diminished water availability can deteriorate the quality of electricity services, leading to greater disruptions for households and businesses. Countries like Brazil, Colombia, Costa Rica, Ecuador, Paraguay, and Venezuela are among the most vulnerable to these risks due to their heavy reliance on this energy source for electricity generation.

In terms of human consumption, although access has improved in urban areas, in rural areas it continues to be a major challenge for many countries in the region. The availability and quality of safe drinking water for human consumption are particularly vulnerable to extreme weather events because of possible damage to the infrastructure that provides access to this resource (Vicuña et al., 2020).

Caribbean countries are highly vulnerable to hurricanes.

Caribbean countries are highly exposed to tropical cyclones and are particularly vulnerable due to their highly concentrated populations and poorly diversified economies. Consequently, the economic costs of extreme weather events are significant relative to the size of their economies.

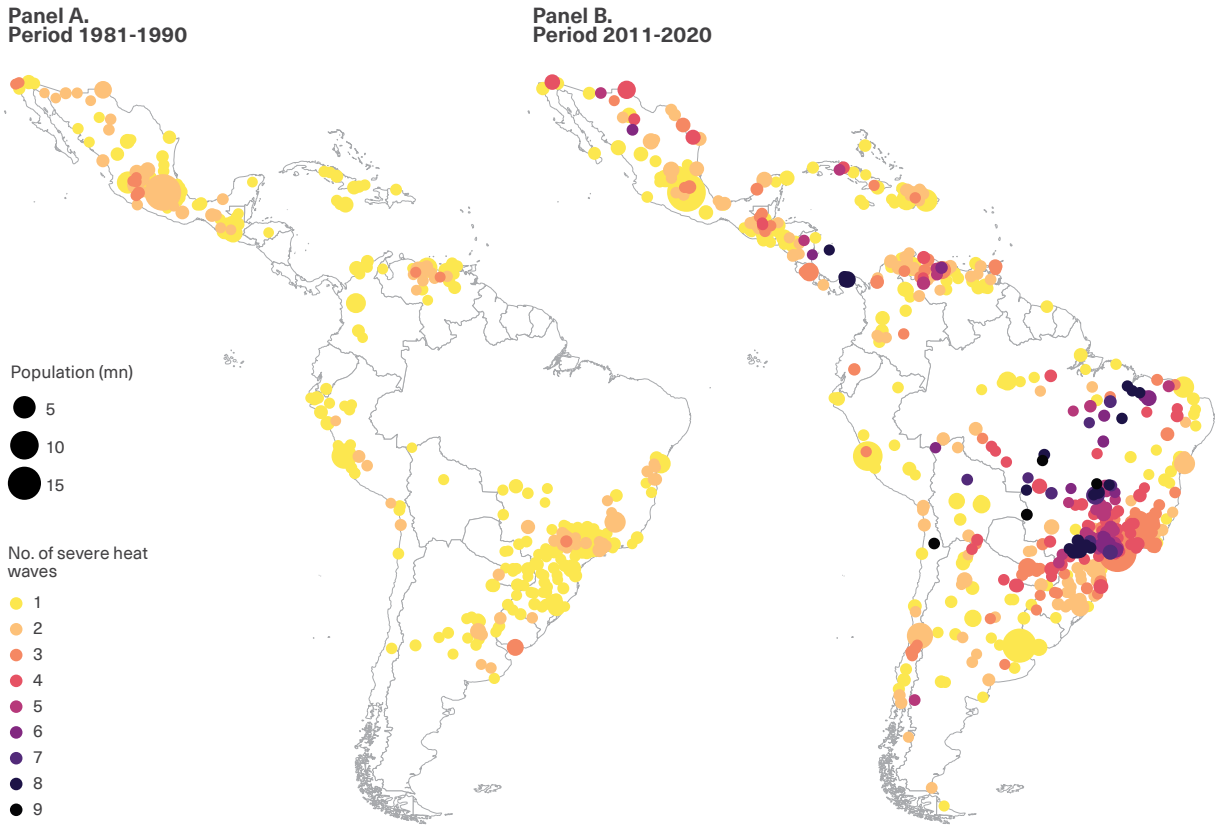
An estimate for Caribbean countries as a whole puts these costs at around 3% of Gross Domestic Product (GDP) on average per year (IMF, 2019). Additionally, the debt incurred for post-disaster reconstruction hampers investments in infrastructure that would facilitate adaptation and enhance resilience against such phenomena. This situation is aggravated by the higher cost of public debt faced by countries with high climate vulnerability in international financial markets (Cevik & Jalles, 2020).

Extreme heat increasingly affects cities.

Extreme heat has adverse health consequences for the population, disproportionately affecting vulnerable groups such as the elderly, children, and individuals with underlying or chronic health conditions (Deschênes, 2014; Deschênes & Greenstone, 2011). The inadequate coverage and quality of healthcare systems in the region render broad segments of the population highly vulnerable.

The consequences of extreme heat waves interact with the growing urbanization characterizing the region. Urban areas tend to experience higher temperatures than surrounding rural areas. The frequency and intensity of heat waves in the region's cities have markedly increased in recent decades. During the 1981-1990 period, 37 out of every 100 cities experienced at least one heat wave, and 14 out of every 100 heat waves were severe. In contrast, during the 2011-2020 period, 60 out of every 100 cities experienced heat waves, and 28 out of every 100 heat waves were severe (Graph 3). This presents challenges for urban planning, as well as building and construction design.

Graph 3
Incidence of severe heat waves and affected population in Latin American and Caribbean cities in the periods 1981-1990 and 2011-2020



Note: The color of the dots represents the number of severe heat waves per city and decade, while their size reflects the city's population (the larger the size, the larger the population, and vice versa).

Source: Authors using data from NOAA (2023) and Florczyk et al. (2019).

The gradual rise in sea level and storm-surge flooding are putting coastal populations at risk.

Coastal populations are exposed to both flooding, generally linked to severe storms and other extreme weather events, and the slow but steady rise in sea level.

An indicator of Latin America and the Caribbean's exposure to these threats is the percentage of land area and population located in low-lying areas. In the region, the first 10 meters of land above sea level make up 3% of the total territory and house 7% of the population (around 45 million people). The situation is more dramatic in the Caribbean, where low-lying coastal areas house 12% of the population and represent one-fifth of the land area.

This situation calls for both short- and long-term adaptation measures. In the immediate future, barrier and protection systems are important to mitigate the effects of sudden floods on established

inhabitants and the infrastructure in those areas. In parallel, a medium- and long-term strategy must be adopted, including restrictions on development in areas that will be affected by the gradual rise in sea level.

Extreme weather events put infrastructure at risk.

Severe storms, floods, and other extreme weather events jeopardize service infrastructure in key sectors such as transportation, communication, energy, and water. They can also affect industry by damaging their facilities, operations, and supply chains. Without the necessary investments to create new infrastructure and strengthen the resilience of existing ones, especially those not designed to withstand the consequences of climate change, these impacts can affect productive sectors and households, leading to significant economic and social costs.

Climate change degrades ecosystems and threatens the benefits that nature provides to people.

Rising temperatures, decreased precipitation, and prolonged droughts—along with the increased fires that often accompany them—lead to the degradation of ecosystems and the services they provide (Gatti et al., 2021; Grantham et al., 2020). Additionally, changes in ocean conditions are affecting marine and coastal ecosystems in the region, such as coral reefs, estuaries, marshes, mangroves, and sandy beaches (IPCC, 2022).

These changes, in turn, have consequences for economic sectors closely linked to the services provided by these ecosystems. In the fishing sector, the potential catch of commercial fish species will decrease in the Caribbean Sea, off the Amazon and La Plata estuaries, as well as along the coasts of Peru and northern Chile, while it will increase in the southern waters of South America (Cheung et al., 2010). Tourism, of great importance to Caribbean economies, is also affected by the deterioration of these ecosystems and changes in overall climate conditions.

A region's contribution to global warming is explained by its historical carbon dioxide emissions. The pace of current greenhouse gas emissions determines the future trajectory of climate change.

Latin America and the Caribbean has generated 11% of the accumulated carbon in the atmosphere, while 45% of historical CO_2 emissions come from developed countries, and 24% from developing countries in Asia and the Pacific, including high-emitting nations over the past 50 years such as China and India. Eastern Europe and Central and Western Asia (11%), Africa (7%), and the Middle East (2%) account for the rest of emissions.

Of the 11% of emissions generated by Latin America and the Caribbean, 8.5% corresponds to South America, 2% to Mesoamerica, and the remaining 0.5% to the Caribbean.

According to 2019 data, Latin America and the Caribbean contribute 10% of current GHG emissions, developing countries in Asia and the Pacific make up 44%, and developed countries contribute 23%. Africa (9%), Eastern Europe and Central and Western Asia (6%), the Middle East (5%), and international transportation (2%) account for the rest.

Population size and production level are two important determinants of the total emissions generated in a specific territory. Each inhabitant of Latin America and the Caribbean emits, on average, 9.2 metric tons of CO_2eq (tCO_2eq)[3] per year, just slightly above the global average of 7.8 tCO_2eq per person. Similarly, the region's emissions per unit of output generated—a measure of the carbon intensity of economies—are slightly above the global average (0.61 tCO_2eq compared to 0.46 tCO_2eq per USD 1,000 of GDP, respectively).

Emissions in Latin America and the Caribbean primarily stem from agricultural practices and land use change, which contrasts with the situation in developed countries.

The agricultural, forestry, and other land use (AFOLU) sector accounts for 58% of emissions in Latin America and the Caribbean. These emissions are divided between those resulting from land use, land-use change, and forestry (LULUCF) activities (38%) and those originating from agricultural practices, such as the burning of agricultural residues, fertilizer use, rice cultivation, and livestock (the remaining 20%). In contrast, in developed countries, the LULUCF subsector exhibits negative net emissions, acting as a carbon sink that offsets part of the emissions generated in other sectors of the economy (Graph 4).

Other sectors of the economy play a less prominent role compared to global patterns. The energy supply sector, the world's major emitter in developed nations at 36% of produced GHGs, only represents 13% of emissions in Latin America and the Caribbean. This is due to the region's lower levels of development and its relatively clean electricity matrix. The rest of the region's emissions come from industry (16%), transportation (11%), and the building sector (2%).

The composition of emissions in the region based on the type of gas also differs from the rest of the world. Methane, the second most significant GHG after CO_2 in terms of quantity released, accounts for 23% of emissions in Latin America and the Caribbean. This proportion is higher than the global average (18%) and that of developed countries (13%). These emissions primarily originate from livestock activities and, to a lesser extent, from fossil fuel use and solid waste management. Reducing anthropogenic methane emissions is crucial for addressing short-term global warming and would bring additional benefits to public health and agricultural productivity due to decreased air pollution.

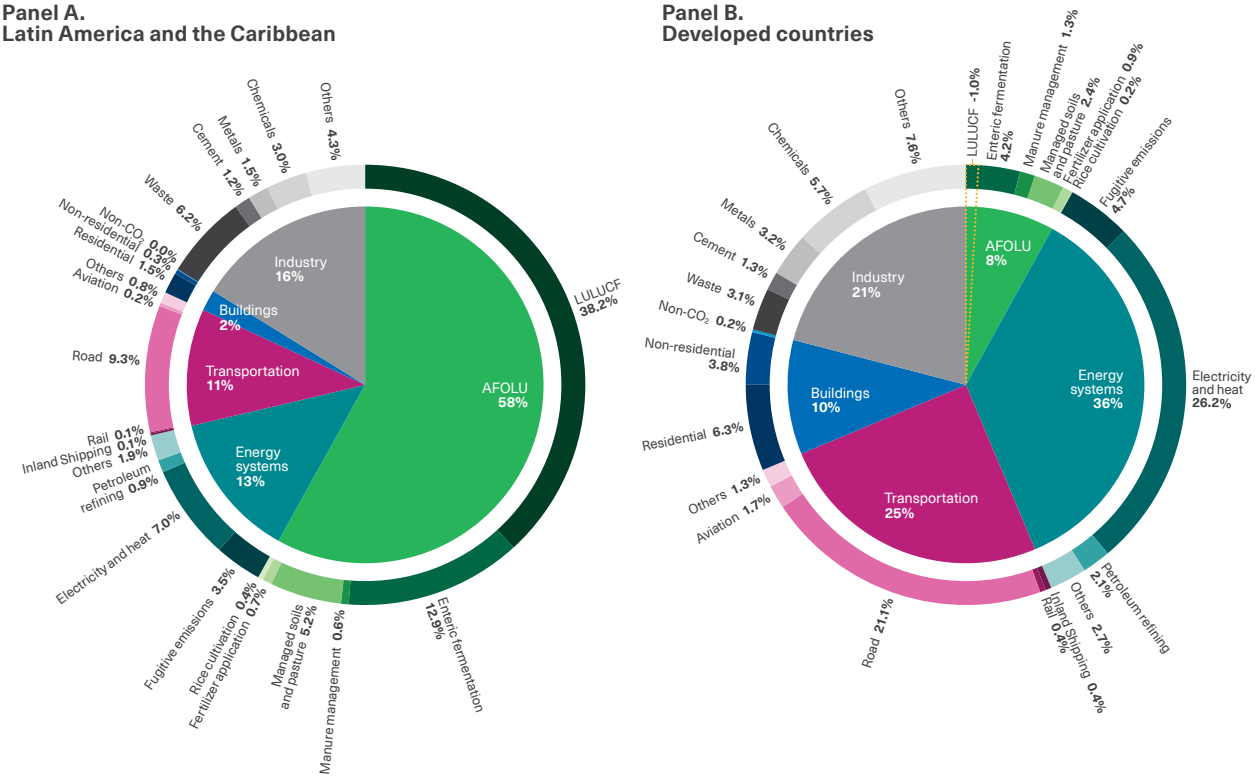
The enormous variation in the level and sectoral composition of emissions within the region means that the needs and opportunities for reducing them are also different.

Latin America and the Caribbean is a very heterogeneous region in terms of population size, income levels, and economic sector structure. This diversity is reflected in significant differences in the level and composition of emissions among countries, as follows:

- Five countries account for 80% of emissions in Latin America and the Caribbean: Brazil (45%), Mexico (17%), Argentina (8%), Colombia (6%), and Venezuela (4%).
- Caribbean countries have emissions per capita and output below global averages (Graph 5). The exceptions are Trinidad and Tobago in the former case and Haiti in the latter. The majority of emissions in this subregion come from the energy systems sector, accounting for 38% of the total due to having an energy matrix dominated by fossil fuels. The LULUCF sector, on the other hand, does not contribute to their CO_2 emissions and, in fact, serves as a carbon sink (Graph 6).

3 When using the CO_2eq notation, which stands for carbon dioxide equivalent, it refers to quantities of all greenhouse gases after converting gases other than carbon dioxide into their equivalent CO_2 units.

Graph 4
Sectoral composition of GHG emissions in Latin America and the Caribbean and developed countries in 2019



Note: The graph reports the sectoral share of total GHG emissions for LAC and developed countries. The regions are defined according to the IPCC classification in the Sixth Assessment Report of Working Group III, chapter two (Dhakal et al., 2022).

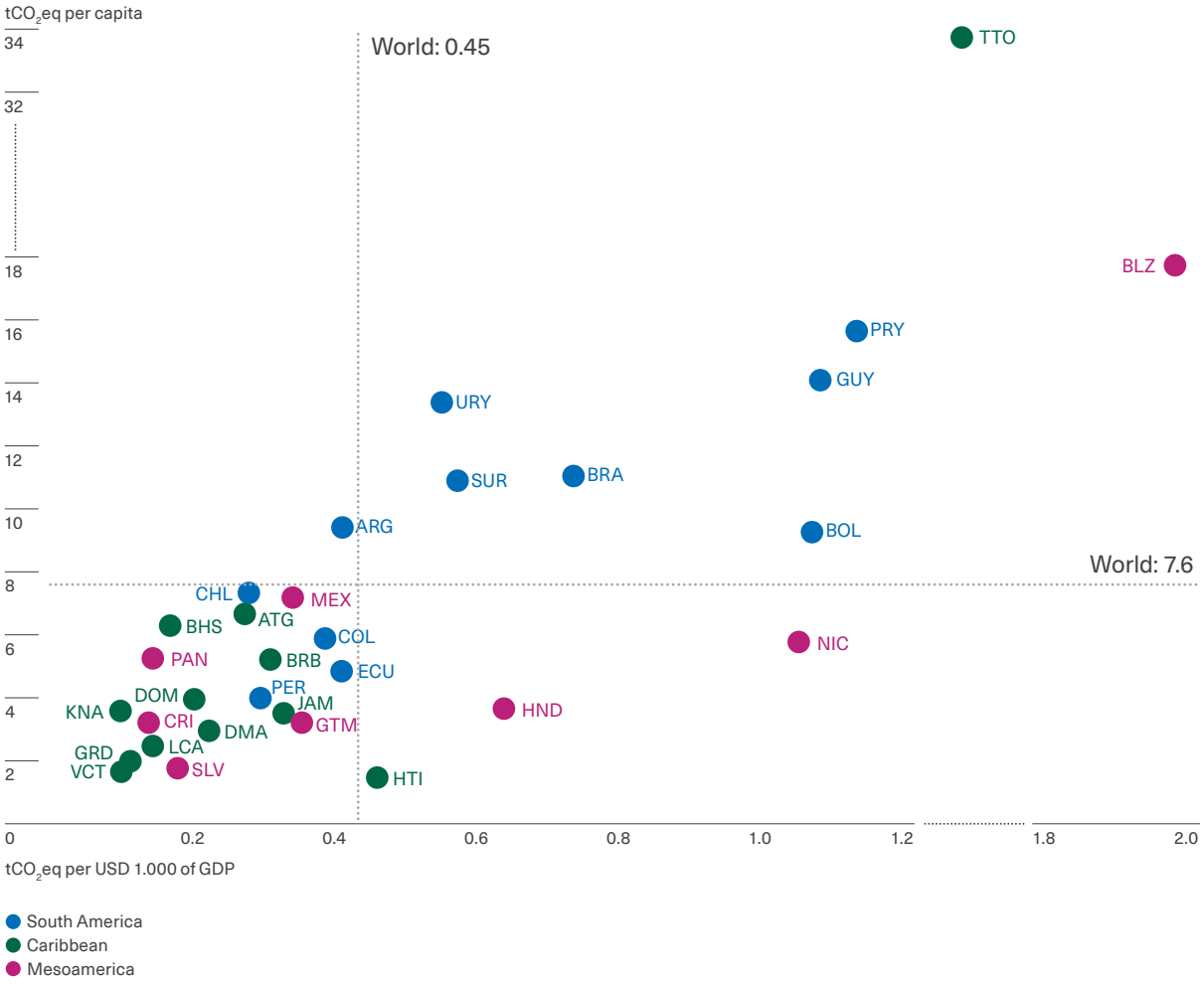
Source: Authors using data from Minx et al. (2021).

- Most countries in Mesoamerica have emissions per capita below the global average (except for Belize). The sectoral composition of emissions differs between Central America and Mexico. In the former, the LULUCF sector and agricultural practices account for 26% and 23% of total emissions, respectively, while the energy systems sector contributes only 10% due to a relatively clean electricity matrix. In contrast, in Mexico, the main emission sources are industry (31% of total) and energy systems (25%) due to a lower use of renewable sources for electricity generation, while the LULUCF sector and agricultural practices contribute 12% and 13% of emissions, respectively.

- South American countries have emissions per capita and per GDP above the global average. Exceptions include Chile and Argentina, whose emissions per GDP are lower than the global average, and Ecuador, Colombia, and Peru, which have both emissions per output and capita below the global average. At a subregional level, the primary source of emissions is the LULUCF sector, accounting for 35% of subregional emissions, followed by agricultural practices at 26% of the total. Energy generation

is responsible for only 12% of subregional emissions due to greater penetration of renewable sources in the energy matrix.

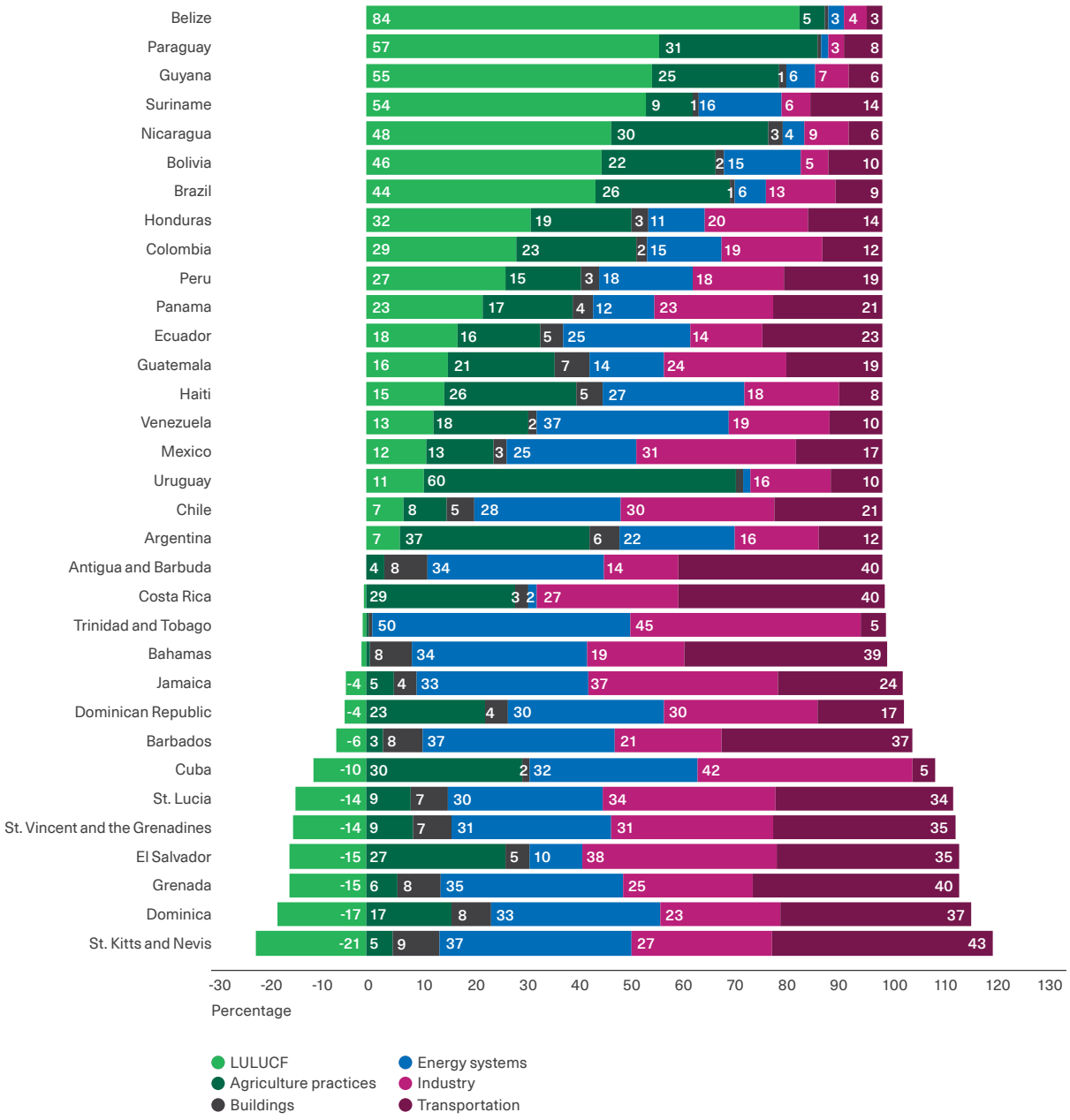
Graph 5
Anthropogenic GHG emissions relative to population and GDP for Latin American and Caribbean countries by subregions in 2019



Note: GHG emissions represented in the graph include the LULUCF sector in tCO_2eq per capita (vertical axis) and per USD 1000 of GDP (horizontal axis). The horizontal dotted line reflects emissions per capita for the world and the vertical dotted line reflects global emissions per USD 1,000 of GDP.

Source: Authors using data from Minx et al. (2021), Friedlingstein et al. (2022), and World Bank (2023a, 2023b).

Graph 6
GHG emissions by country and sector in Latin America and the Caribbean in 2019



Note: The graph reports the sectoral share of total GHG emissions for LAC countries ordered by the importance of the LULUCF sector. The percentages represented by each sector are calculated with respect to the country's total emissions, so in those cases where the LULUCF subsector has negative net emissions, the sum of the other categories exceeds 100% by a magnitude equivalent to the negative value of LULUCF.

Source: Authors using data from Minx et al. (2021) and Friedlingstein et al. (2022).

Latin America and the Caribbean is extraordinarily rich in biodiversity and ecosystems, which provide invaluable services to the world's population.

Encompassing 16% of the world's land area, the region hosts an enormous variety of known species: 33% of mammals, 35% of reptiles, 41% of birds, and 50% of amphibians (UNEP, 2011). Coastal and marine ecosystems cover an area of 16 million km^2 and over 70,000 km of coastline, also characterized by prominent biodiversity (Maldonado and Moreno-Sánchez, 2023).

The insular Caribbean has natural conditions of isolation, which, combined with mountainous islands, favor high species endemism and bestow unique characteristics upon its biodiversity. The Caribbean islands are considered one of the five most important biodiversity hotspots on the planet (Myers et al., 2000). The terrestrial ecosystems of this subregion are distinguished by the presence of both moist and dry broadleaf forests, while their coastal zones contain 16% of the region's total mangrove cover. Most islands are surrounded by coral reefs, which are vital for the reproduction of commercially important fish and sustain a significant tourism sector.

Mesoamerica has an intricate topography, resulting in a wide range of environmental conditions and endemic species (Myers et al., 2000). This subregion is crucial as a corridor for species movement between the northern and southern parts of the continent. Among its terrestrial ecosystems, there are moist and dry broadleaf forests, coniferous forests, deserts, and dry shrublands. The coastal zones have a significant presence of mangroves, seagrass beds, and coral reefs, with the Mesoamerican Barrier Reef being the second largest and most complex in the world.

South America has a very wide latitudinal and altitudinal spectrum, enabling the development of prominent biodiversity. Among the natural covers in this subregion, extensive moist broadleaf forests stand out, followed by grasslands, savannas, and various types of shrublands. The Amazon basin is home to the world's largest tropical forest and the longest, most voluminous river, while also conserving the most extensive primary forests (those whose ecological processes have not been significantly altered by human activity) on the planet.

Ecosystems serve as sources of protection and adaptation to climate change by moderating extreme weather events and regulating local climate.

Mangroves and coral reefs, for example, form barriers that protect coastal populations from hurricanes. Mangroves reduce the height of wind-driven waves by 31% and cyclone-driven waves by 60% on average (Narayan et al., 2016). In Latin America and the Caribbean, mangroves annually decrease flood damages by more than USD 12 billion and protect almost 1 million people (Menéndez et al., 2020; Worthington and Spalding, 2018). Additionally, coral reefs can diminish wave energy reaching the coast by 97% and wave height by 84% (Ferrario et al., 2014; Moomaw et al., 2018).

Wetlands also provide crucial adaptation services, primarily by moderating water cycles, absorbing excess precipitation, and slowing runoff during dry periods.

Nature can help urban environments adapt to rising extreme temperatures through local climate regulation. Urban forests, street trees and green terraces provide local cooling effects, mainly through shade and evapotranspiration. Thus, urban green areas can be approximately 1°C cooler than their surroundings during the day (Bowler et al., 2010).

The region's abundant forests hold great potential to increase its contribution to climate change mitigation.

Terrestrial ecosystems mitigate climate change by absorbing CO_2 from the atmosphere and storing it in biomass and soils. Due to their carbon potential and coverage, forests are pivotal to global climate change mitigation.

Spanning 9.3 million km^2, forests cover 46% of the region's territory, constituting a quarter of global forests. The region's forests annually sequester 1.1 $GtCO_2eq$. However, their carbon capture rate per unit area is low. A typical hectare of forest in the region has an annual net flux of -1.1 tCO_2eq, compared to the global average of -1.8 tCO_2eq and -2.9 tCO_2eq in developed countries. This is primarily due to two factors. First, while the prevalence of primary forests is positive for biodiversity and associated with higher carbon stocks, given their lifecycle, they capture less carbon than growing forests. Second, the region's forests are subject to higher deforestation and degradation. These two factors underscore the potential for increased mitigation through improved land management.

Economic activity, like all human activities, relies on ecosystem services in one way or another.

Numerous examples attest to this. The fishing industry has developed in Peru, Chile and Mexico—the largest in the region—thanks to the wealth of commercially valuable species in their coastal and marine ecosystems. Over 100 billion finfish benefit from mangroves in Latin America and the Caribbean every year, while habitat restoration could lead to an annual increase of 7.8 million finfish (Worthington and Spalding, 2018). Forests are a vital source of medicinal products. From 1981 to 2006, 28% of approved pharmaceuticals globally for disease treatment were natural or their derivatives, with an additional 24% synthesized from them (Cao and Kingston, 2009; Newman and Cragg, 2007).

The beauty of the Caribbean's beaches and coral reefs fuels tourism growth in this subregion's countries. The importance of ecosystems for tourism extends beyond coastal ecosystems. Approximately 70% of international tourists traveling in Argentina and Peru visit a protected natural area (Bovarnick et al., 2010).

Ecosystems regulate climate and other vital natural processes for human life and certain economic activities. For example, ecosystems influence the water cycle, affecting water quantity and quality and mitigating risks like landslides, floods, and droughts. Upstream natural land-covers are crucial for downstream water supply. On a larger scale, the agricultural industry in Argentina, Paraguay, Uruguay, and southern Brazil benefits from abundant vapor flows (known as "flying rivers") originating hundreds of kilometers away in the Amazon rainforest. Beyond water cycles, agricultural productivity benefits from other ecosystem services such as those provided by natural pollinators, notably insects. Bees pollinate a wide variety of crops in the region (e.g., cocoa, squash, other vegetables, and to a lesser extent, soybeans), contributing to the industry's profitability. Around 30% percent of the production value of pollination-dependent crops in Argentina, Brazil, Chile, Mexico, and Uruguay is attributed to this ecosystem service (Basualdo et al., 2022).

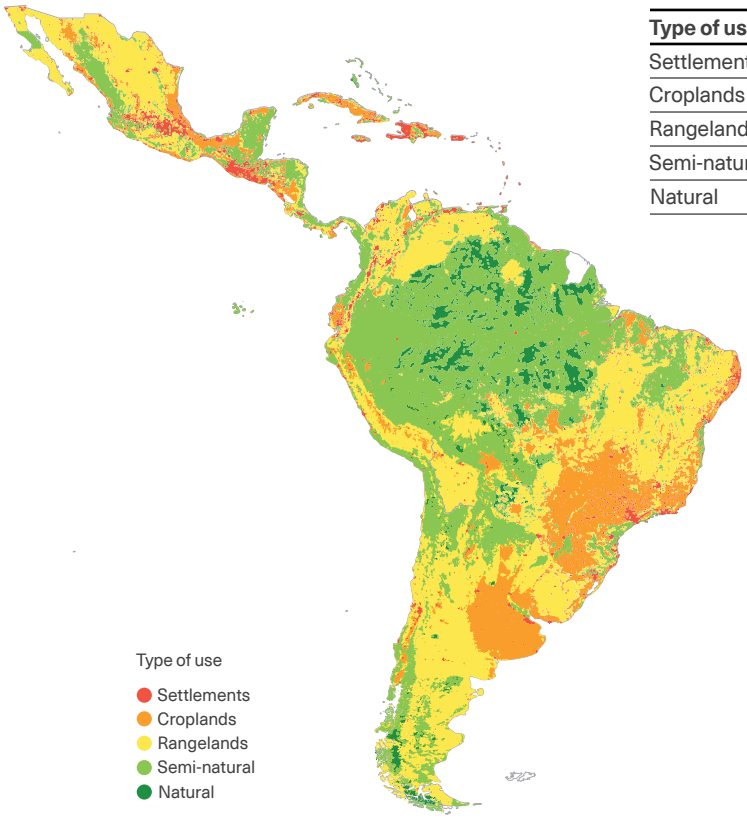
Land use change, through deforestation, wetland drainage, and replacement of natural grasslands, is the main channel through which human activity degrades ecosystems and biodiversity in Latin America and the Caribbean.

Other direct channels include (in order of importance) the overexploitation of natural resources, pollution, and the introduction of invasive species (Díaz and Malhi, 2022). To these direct channels, the indirect impact of climate change is added (as previously described) (IPBES, 2019).

Over half (55%) of the region's surface has a dominant anthropogenic use, while the rest (45%) remains in a semi-natural or natural state (Graph 7). The conservation of ecosystems in a semi-natural or natural state varies significantly between regions. In South America, it reaches 48%, whereas, in Mesoamerica and the Caribbean, it is 27% and 19%, respectively.

Graph 7
Land use in Latin America and the Caribbean in 2017

Panel A.
Land use in the region



Panel B.
Percentage of land use by subregion

Type of use	Caribbean	Mesoamerica	South America
Settlements	38	11	3
Croplands	35	19	16
Rangelands	8	43	34
Semi-natural	18	27	41
Natural	1	0	7

Note: The graph shows anthropogenic land use. Panel A shows this indicator for the entire region in 2017. Panel B does so for the LAC subregions, with their values expressed as a percentage. The 33 countries considered in LAC are those belonging to CELAC.

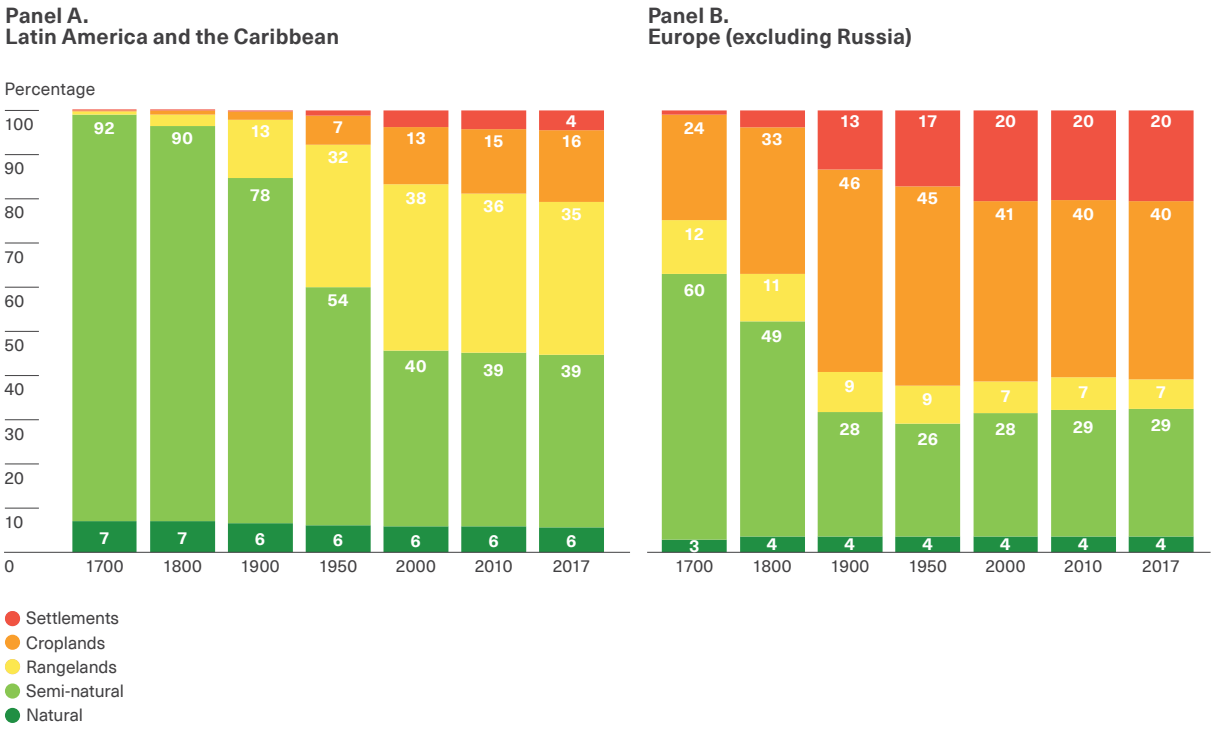
Source: Authors based on Gauthier et al. (2021).

In 1900, 87% of the region's surface was in a natural or semi-natural state. In other words, significant modification of ecosystems as an extensive phenomenon is relatively recent in the region. In this regard, it is useful to compare this scenario with Europe (Graph 8), a region that already had 51% of its surface dedicated to dominant anthropogenic use by 1800 (a similar level to that currently existing in Latin America and the Caribbean). The pace of change from natural and semi-natural covers to dominant anthropogenic uses in Latin America and the Caribbean over the last century is of considerable magnitude, equivalent to losing an area the size of Panama every year.

Land use change is strongly linked to the agricultural sector: 35% of the region's surface is dedicated to grazing and 16% to crops, while human settlements cover 4% of the territory. Although the importance of the agricultural sector remains, the Caribbean exhibits a land use pattern different from the regional average. In this subregion, the area dedicated to grazing is considerably smaller (8%), while the area for crops (35%) and human settlements is larger (38%).

Currently, deforestation is concentrated in tropical forests, notably those in the Amazon. This pattern is inefficient from a social perspective. Soils in tropical forests tend to degrade rapidly after the loss of natural cover, diminishing agricultural productivity. Moreover, these forests stand out for their biodiversity and their capacity for carbon capture and storage.

Graph 8
Evolution of land use in Latin America and the Caribbean and Europe in the period 1700-2017



Note: The 33 countries considered in Latin America and the Caribbean are those belonging to CELAC.
Source: Authors based on Gauthier et al. (2021).

Beyond the areas dedicated to human uses, parts of Latin America and the Caribbean that still exhibit low levels of human modification are becoming increasingly fragmented and disconnected, posing a threat to biodiversity. Fragmentation can lead to species extinction when (1) the preserved area is insufficient to ensure their long-term survival and (2) it restricts species' movements across latitudinal and altitudinal gradients, which is crucial in the face of global temperature rise.

Overexploitation refers to the extraction or use of renewable natural resources beyond sustainable rates over time. In the region, sectors such as fishing, tourism, and non-timber forest resource extraction are visibly impacted by this issue. In the Caribbean, overfishing and coral reef degradation are driving many fish species, including some with high commercial value like tunas and groupers, toward extinction (Linardi et al., 2017). In South America—the world's largest fishery by volume—, the anchovy population collapsed in 1973, 1983, and 1988 (FAO, 2016). In the agricultural sector, alongside the overexploitation of water resources, intensive and inadequate soil management has led to nutrient loss and degradation of soil properties. Additionally, pollution stemming from agriculture, industry, mining, and tourism has further contributed to ecosystem deterioration.

Ecosystems are resilient, but this resilience has limits.

There are tipping points beyond which ecosystem degradation and the loss of their services become irreversible. For instance, deforestation in the Amazon may reach a tipping point where the mechanisms of ecological equilibrium could trigger a desertification process that may be irreversible. Lovejoy and Nobre (2019) estimate that this tipping point could be set off by the loss of 20%-25% of its total forested area, of which 15% has already been lost.

The unprecedented increase in demand for food, materials, and energy is driving the overexploitation of natural resources and land use change for agriculture.

Land use pressure rises with population growth and per capita consumption, while it potentially decreases with increases in productivity. In turn, the higher consumption of animal-derived calories associated with higher income levels results in higher demand for land for food production, as plant-based calorie production is less land-intensive than animal-based.

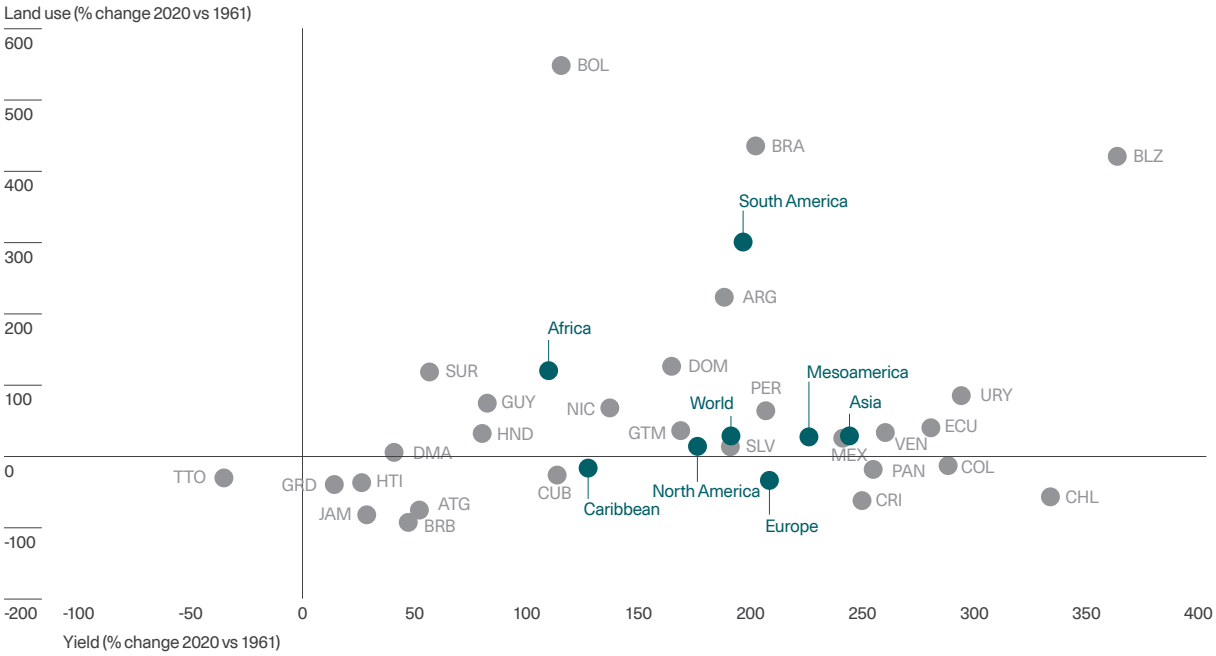
Not only is the agricultural and food sector pivotal for local and global food security but it also is a significant source of foreign exchange in various countries across the region. However, deforestation, overexploitation, and pollution lead to the loss of highly valuable ecosystem services for climate change adaptation and mitigation, as well as for economic activity and overall human well-being. Deforestation even impacts the whole agricultural production as it diminishes the flow of ecosystem services, including pest control, pollination, soil erosion prevention, and water cycle regulation.

The challenge of halting deforestation is consequently linked to strengthening the sustainability of the region's agricultural sector.

Two areas of action stand out in this regard. Firstly, a credible commitment to curb the expansion of the agricultural frontier. Secondly, the enhancement of agricultural productivity and the adoption of sustainable practices within this sector.

Most countries in Latin America—and to a lesser extent those in the Caribbean—have made significant progress in terms of agricultural productivity. These improvements are necessary for building a sustainable sector, yet they are insufficient to halt deforestation. Over the past 60 years, productivity growth has been accompanied by a considerable increase in the land area dedicated to agricultural production, especially in South America (Graph 9).

Graph 9
Yield and land use change for cereal and soybean production between 1961 and 2020



Note: The graph shows the percentage change in yield (measured as tons per hectare) and land use in 2020 relative to 1961 for Latin American and Caribbean countries with available information and selected regions.

Source: Authors based on FAO (2023, 2022).

Putting an end to deforestation is challenging because it is economically profitable from a private standpoint. For landowners with forest cover, conserving it is often less profitable than using the land for agricultural production.

The majority of governments in the region have enacted legislation that severely restricts deforestation on both public and private lands. Consequently, most of the deforestation occurring today is illegal (Ferreira, 2023). These measures contrast with prevailing economic development policies since the mid-20th century, which incentivized deforestation through infrastructure projects, credit allocation, and weakening property rights on public and indigenous community lands, favoring their invasion by private producers.

International coordination in climate and biodiversity policy is necessary because both are issues where the actions of each country affect the others.

Both climate change mitigation and biodiversity conservation are global public goods: all countries benefit from emissions reduction and ecosystem preservation, regardless of who bears the cost of these actions. The need for international coordination to avoid the "free-rider"[4] issue and thus address the climate and environmental crisis is one of the biggest challenges (Stevenson, 2023).

Although they are related phenomena, the climate change and biodiversity negotiations have progressed through separate channels. Climate negotiations have made more progress due to a greater sense of urgency and the more synthesizable and measurable nature of the climate issue—which is easier to translate into concrete targets—compared to biodiversity.

The 2015 Paris Agreement marked a milestone in international climate negotiations, yet it has weaknesses in terms of goal compliance, international financing, and climate justice.

The agreement succeeded in achieving almost universal adherence, with mitigation commitments from most countries (over 190 to date). According to the agreement, countries set their commitments through Nationally Determined Contributions (NDCs), which must be updated every five years, aiming to increase ambition in each round.

NDCs should establish national mitigation and adaptation goals and ideally provide information on the financial strategy for their implementation, including international cooperation needs. Countries have flexibility in setting baseline comparisons for defining their mitigation goals.

A drawback of the Paris Agreement is that its decentralized governance is not designed to ensure that national commitments meet the global target, nor is there explicit negotiation on what each country's fair contribution is.

Current commitments under the Paris Agreement are insufficient to meet the goal of keeping global warming within 2°C (or less) and make it nearly impossible to limit it to 1.5°C. Globally, the 2030 targets outlined in the NDCs point to a small 0.5% increase in emissions compared to 2015 levels. However, to achieve the goal of limiting warming to 1.5°C, annual emissions need to decrease by 43% by 2030 compared to 2019 levels and then continue to decline until achieving carbon neutrality by 2050 (IPCC Press Office, 2022).

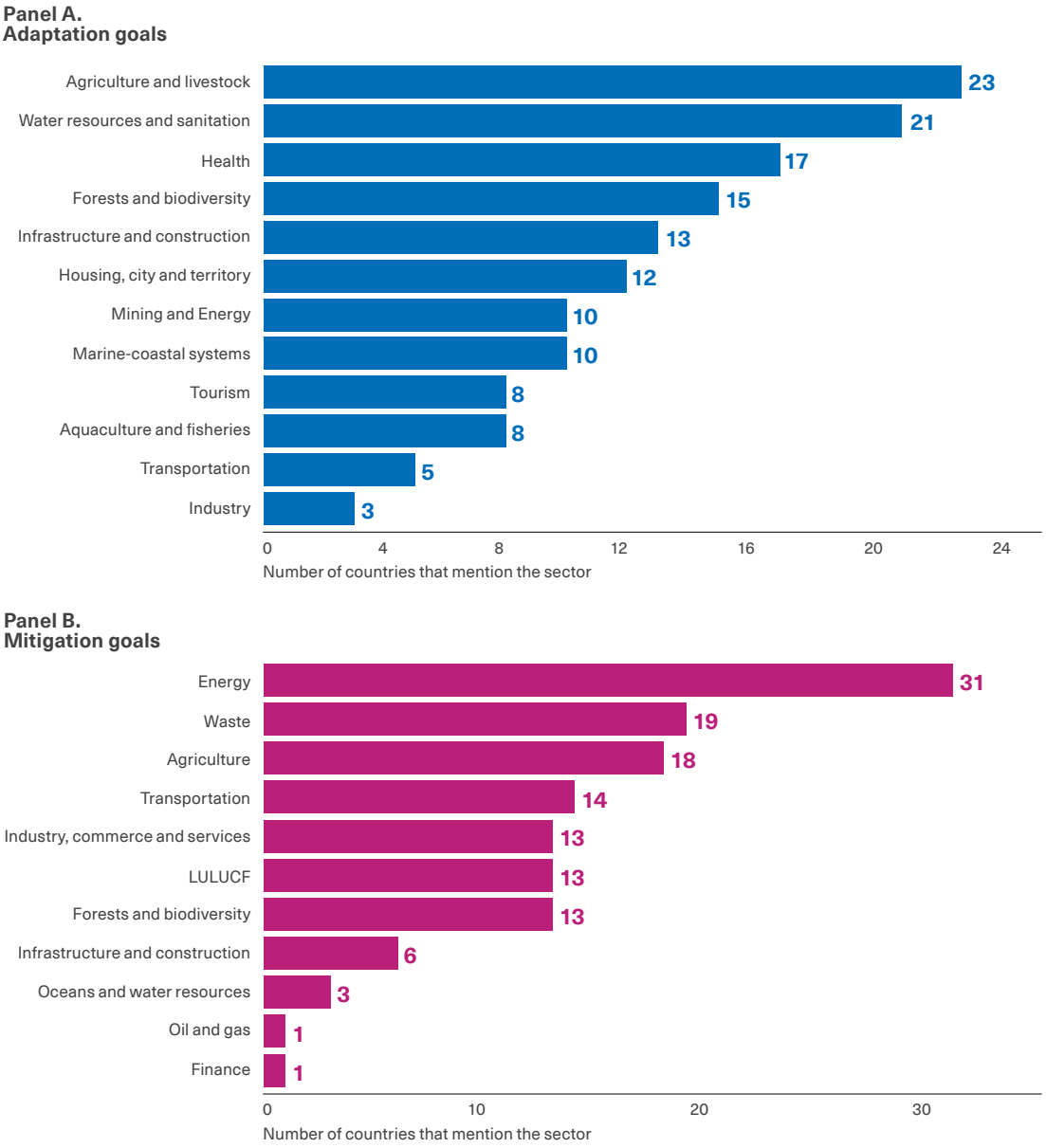
The magnitude of these reductions implies that mitigation efforts need to be global. This collides with the reality of many developing countries, including those in Latin America and the Caribbean, which are suffering the consequences of climate change—despite their low contribution to historical emissions—and see efforts to mitigate climate change as an additional development cost. In this context, climate financing is key to aligning global mitigation efforts and justice claims in the distribution of responsibilities.

The NDCs of Latin America and the Caribbean aim to collectively reduce emissions by approximately 10% by 2030 compared to 2015.

Countries in the region recognize the need to play an active role in mitigation and, in almost all cases, propose specific emission-level targets. The most mentioned areas of action in mitigation NDCs are electricity generation, energy efficiency, and electromobility, followed by industrial process and waste management (Panel B of Graph 10). Similarly, most NDCs include sector-specific adaptation goals (agriculture and livestock, water resource management, and sanitation being the most mentioned) (Panel A of Graph 10).

4 This concept refers to someone who receives the benefits of a public good without contributing to cover its costs.

Graph 10
Sectors included in the targets of the Latin American and Caribbean NDCs



Note: The graph shows the number of LAC countries that explicitly mention each sector in their adaptation (panel A) and mitigation (panel B) targets and actions. The 33 countries considered in LAC are those belonging to CELAC.

Source: Authors based on the versions of the NDCs of the countries in force as of January or February 2023.

There is room for improvement in the articulation and precision of national commitments.

The adaptation priorities of countries are often reflected in the adaptation targets within their NDCs and, in some cases, in their national action plans on climate change (NAPCC).[5] However, in many instances, these targets lack precision and are not linked to specific projects. Encouragingly, some countries have included in their national commitments the undertaking of studies and the development of methodologies to estimate the effects of climate warming on their territories.

More precisely identifying adaptation needs and concrete measures to address them is a priority on countries' agendas. This task, in turn, will allow for a more accurate estimation of the costs of adaptation and the financing requirements.

Regarding mitigation goals, while most countries in the region have included sectoral initiatives in their NDCs, their articulation and prioritization lack clarity. In general, there is a lack of connection between the global goal and the contribution of each sectoral initiative. Additionally, there's a need to define policy prioritization based on the sectoral emissions structure.[6]

The available information indicates that international financing has been insufficient so far, and future needs will be substantial.

The volumes of resources mobilized to date are low compared to the needs. A report by the Climate Policy Initiative (CPI) estimates financing directed toward Latin America and the Caribbean up to 2020 to be between USD 23-35 billion annually (Naran et al., 2022; Schneider, 2023).

Available estimates of future financing needs are subject to a high degree of uncertainty, although all agree that the investment effort required will be substantial. One policy priority should be to enhance knowledge about financing needs, particularly concerning international financial support requirements.

The gap in the progress of climate policies between the developed world and other regions could generate tensions in international trade. Two concrete cases are the European Union's carbon border adjustment mechanism (CBAM) and deforestation-free standards for products.

Developed countries often have higher carbon prices, which could lead to the imposition of tariffs or import restrictions to counter the competitiveness consequences of these price differences on their companies and to prevent emissions from shifting to countries with more lenient environmental policies (Blanchard et al., 2022). The EU's carbon border adjustment mechanism (CBAM)—recently enacted—stipulates payment for importing goods to the EU equivalent to what should have been paid for GHG emissions if those goods were produced within its member countries. The mechanism, set to take effect in 2026, covers a limited list of sectors: steel, aluminum, fertilizers, electricity, and cement, so Latin America and the Caribbean's exposure will initially be low.

This is not the only instance where developed countries' environmental policies can influence international trade. In early 2023, the EU enacted a regulation called "Deforestation-Free Products", which bans imports of agricultural and forest products originating from deforested areas. The included products are palm oil, livestock, soy, coffee, cocoa, wood, rubber, and derivatives of these products (European Commission, 2022). In this case, the affected sectors are important for countries in the region.

5 As of February 2023, only 13 countries in Latin America and the Caribbean had submitted a NAPCC to the United Nations Framework Convention on Climate Change (UNFCCC): Brazil, Chile, Colombia, Costa Rica, Grenada, Guatemala, Haiti, Paraguay, Peru, St. Vincent and the Grenadines, St. Lucia, Suriname, and Uruguay.

6 Positive examples are the NDCs of Paraguay and Uruguay, which highlight the role of the agricultural sector (the main source of emissions) in their mitigation strategy.

Policy priorities

Latin America and the Caribbean has yet to overcome the challenges of low economic growth and high inequality. These pending issues are further compounded by the need to adapt to climate change, mitigate emissions, and preserve the region's biodiversity and natural capital. There are trade-offs between these old and new challenges, whether due to limited resources needing to be allocated among growing needs, formidable investment requirements, or the fact that progress in one dimension may lead to setbacks in others. At the same time, certain interventions can harness synergies that enable progress on multiple fronts.

The best response to these challenges can vary across countries. There is no one-size-fits-all formula. Each country must allocate investments and efforts toward adaptation, mitigation, and conservation while taking these trade-offs into account. In pursuing the optimal policy portfolio, the costs and benefits of different alternatives must be weighed (not only statically but also from a dynamic perspective), along with the political feasibility of actions and their impacts on growth and equity. Presented below is a menu of policies centered around the goals of adaptation, mitigation, preservation of natural capital, strengthening regional coordination, and capitalizing on transition opportunities. Given the interrelation among the motivating challenges, policies can contribute to more than one objective.

Prioritizing adaptation policies should be at the top of the agenda in Latin America and the Caribbean, given the region's high exposure and vulnerability to climate hazards and the positive synergies that these policies have with economic growth and social inclusion.

The urgency of adaptation is further justified when considering that climate change could exacerbate existing inequities in a region already marked by substantial inequality. This is because socioeconomic vulnerability translates into climate vulnerability, creating a cycle that could become vicious if not broken by necessary adaptation measures. Vulnerability may be particularly high among certain socioeconomic and demographic groups, such as women, children, the elderly, ethnic and religious minorities, or indigenous communities.

Without adaptation measures, climate change could push between 2.4 and 5.8 million people in Latin America and the Caribbean into extreme poverty by 2030 (Jafino et al., 2020). In this regard, focusing adaptation policies on the most vulnerable populations, who have contributed minimally to global warming, also aligns with the objective of climate justice.

Households, farmers, and businesses can adopt various adaptation measures against climate change, such as managing climate risks through financial products or enhancing resilience by adopting technology and innovation. Due to market failures mentioned earlier, these measures are not sufficient to fully mitigate the impacts of climate change, indicating that adaptation policies will likely yield significant welfare gains (Kala et al., 2023).

Climate adaptation can create positive synergies with social inclusion and economic growth. This is because it averts losses; for instance, early warnings of a heat wave can save lives. Additionally, it carries economic benefits by reducing risks—for instance, constructing flood-prevention infrastructure enhances the value of flood-prone land—or through technological innovation—for example, introducing drip irrigation to address water scarcity simultaneously enhances crop productivity. Social and environmental benefits can also materialize, such as the protection of natural resources providing valuable ecosystem services (Global Commission on Adaptation, 2019).

To address adaptation needs in the region, five groups of policies stand out:

- **Sustainable agriculture practices**: These practices are cost-effective alternatives that achieve desired outcomes at minimal cost amidst rising temperatures, increased aridity, and shifting precipitation patterns. For instance, introducing climate-smart agricultural practices and technologies for small farmers in Guatemala's dry corridor exemplifies this strategy (Sain et al., 2017). The most widely adopted sustainable agriculture practices include conservation tillage (including no-till farming), agroforestry, crop rotation, and adopting crops resilient to water stress, high temperatures, and pests.

  Despite being profitable from a private perspective, factors like limited financing (as some practices require longer repayment periods) and lack of information on profitability hinder their adoption in the region.

- **NbS**: This adaptive strategy encompasses sustainable agricultural practices, which are usually cost-effective, as well as a range of actions such as restoring and conserving natural covers (forests, mangroves, grasslands, wetlands), rehabilitating riverine and marine-coastal ecosystems, and urban green spaces. NbS, besides enhancing adaptation to specific risks, often yield multiple benefits, including carbon capture for mitigation, improved agricultural productivity, air and water purification, soil recovery, and biodiversity conservation.

  Latin America and the Caribbean, alongside Africa, boasts the highest proportion of nature-based adaptation initiatives, although evidence suggests there is room for increased usage (Berrang-Ford et al., 2021; Browder et al., 2019).

- **Adaptation infrastructure investments**: These policies focus on improving the resilience of existing infrastructure, particularly for managing water resources for agricultural and domestic purposes, as well as hydroelectric power generation. As an example, Andean countries have taken measures to confront diminished freshwater availability due to glacier retreat, such as building water storage infrastructure and implementing efficient water management in Chile, Ecuador, and Peru (Rasul et al., 2020). These efforts often include building resource monitoring capacity; for instance, Colombia, Ecuador, and Peru joined a global glacier monitoring network (Rasul et al., 2020).

  In the Caribbean, notable examples of infrastructure projects to mitigate the risks associated with extreme weather events, such as flooding caused by storm surges associated with hurricanes and rising sea levels, include the construction of seawalls to prevent shoreline erosion along the southwest coast of Barbados and severe flooding in Georgetown, Guyana (Mycoo, 2018).

- **Disaster-risk management policies**: Encompassing early warning systems and other information provision mechanisms, they are among the most cost-effective adaptation options (Global Commission on Adaptation, 2019). Such initiatives have been implemented in Caribbean countries, including early warning systems, risk mapping, and land-use zoning (Mycoo, 2018). This group also covers funds for rehabilitating infrastructure affected by extreme events. An emblematic case in the region is Mexico's catastrophe-indexed fund, which accelerates economic recovery in disaster-stricken municipalities (Del Valle et al., 2020).

- **Regulatory measures**: These can apply across diverse activities and sectors, such as tourism (e.g., restricting tourism development in environmentally risky areas or promoting sustainable tourism), construction (e.g., certifying sustainable buildings), or urban planning (e.g., integrating adaptation criteria into land use regulations).

Lastly, in addition to financing, the adaptation agenda in the region faces challenges like the lack of metrics to assess progress and the need for more systematic evidence on the effectiveness of the implemented adaptation efforts. Furthermore, strengthening public sector capacities for risk assessment, policy design, and implementation is essential.

Contributing to global mitigation by curbing deforestation, modifying agricultural practices and supporting energy transition.

To achieve the emission reduction targets set forth in the Paris Agreement, collaboration across all nations is imperative. In the region, two direct avenues for action exist. The foremost is halting deforestation and curbing agriculture-related emissions. It is essential to implement policies aimed at ecosystem preservation (outlined below) while concurrently strengthening the productivity and sustainability of agricultural practices. This latter goal can be achieved through policies mentioned in the preceding section for the agricultural sector, which, in addition to promoting adaptation, can effectively reduce emissions and boost productivity.

The second avenue is energy transition—the substitution of fossil fuels with renewable energy sources. Global progress in this area has driven down costs and improved the technological feasibility of major renewable energy sources and electricity-dependent goods, rendering them competitive with, or even projected to become comparable with fossil energy costs in the coming years.

However, the challenges surrounding energy transition in our region remain substantial (Cont et al., 2022; Hancevic, Pedro I. et al., 2023). Large-scale adoption of renewable sources requires significant capital investment and resolution of transmission and intermittency issues. The reduction of coal and oil consumption will pose considerable challenges to production, investment, employment, fiscal revenues, external accounts, and the stock of wealth of the region's economies. These challenges will not be uniformly distributed across economies; instead, they hinge on fossil reserves availability and each country's energy matrix. Thus, countries must move forward at their own pace, factoring in a menu of policy alternatives that reduce emissions while also addressing their impact on other developmental goals. Within this context, certain policies are pertinent across the majority of the region's countries.

Latin America and the Caribbean hold significant geographic advantages for renewable energy development.

The region's geography offers substantial competitive advantages for solar and wind power generation. The Puna region—comprising Argentina, Bolivia, Chile, and Peru—has the world's highest practical photovoltaic energy potential. Moreover, the use of small-scale solar and wind energy can be a cost-effective way to reach isolated regions within the region's vast geography.

Carbon pricing is considered the most efficient policy to reduce emissions.

The mechanism's efficiency stems from its financial incentive for agents to cut emissions at the lowest possible cost, achieved through reduced fossil fuel consumption and the development of cleaner technologies.

This instrument can be implemented either as a tax or through emissions trading systems (ETS). Both alternatives increase the relative price of emissions-intensive goods and services, curbing their consumption. Although carbon prices almost exclusively target fossil fuels in practice (with the exception of New Zealand), they theoretically could encompass all GHG emission sources. This could potentially reduce emissions from the agricultural

sector and indirectly discourage agricultural expansion, thus mitigating LULUCF emissions (Blanchard et al. 2022).

In the region, five countries have enacted fossil fuel taxes (with varying degrees of scope): Argentina, Chile, Colombia, Mexico, and Uruguay. There are also state-level taxes in three Mexican jurisdictions: Baja California, Tamaulipas, and Zacatecas. Additionally, there is a pilot ETS denominated Mexican Emission Trading System. The effectiveness of these programs has been limited, in part, due to their failure to significantly elevate fuel prices (as such, their impact on consumption patterns is minimal).

Another priority should be the reduction or elimination of subsidies for fossil fuel consumption.

In several countries across the region, there exist both direct and indirect subsidies for fossil fuel use, which collectively accounted for 1% of GDP in 2020. These subsidies often manifest through reduced public transportation costs or utility tariffs.

A disadvantage of carbon pricing and subsidy removal lies in their distributive impact. Lower-income households spend a higher proportion of their income on energy and public transport. For this reason, the implementation of these policies requires the introduction of redistribution mechanisms to compensate for their regressive impact (Blanchard et al., 2022; Metcalf, 2007; Stavins, 2020).

Preserving and regenerating the region's extraordinary wealth of ecosystems and biodiversity.

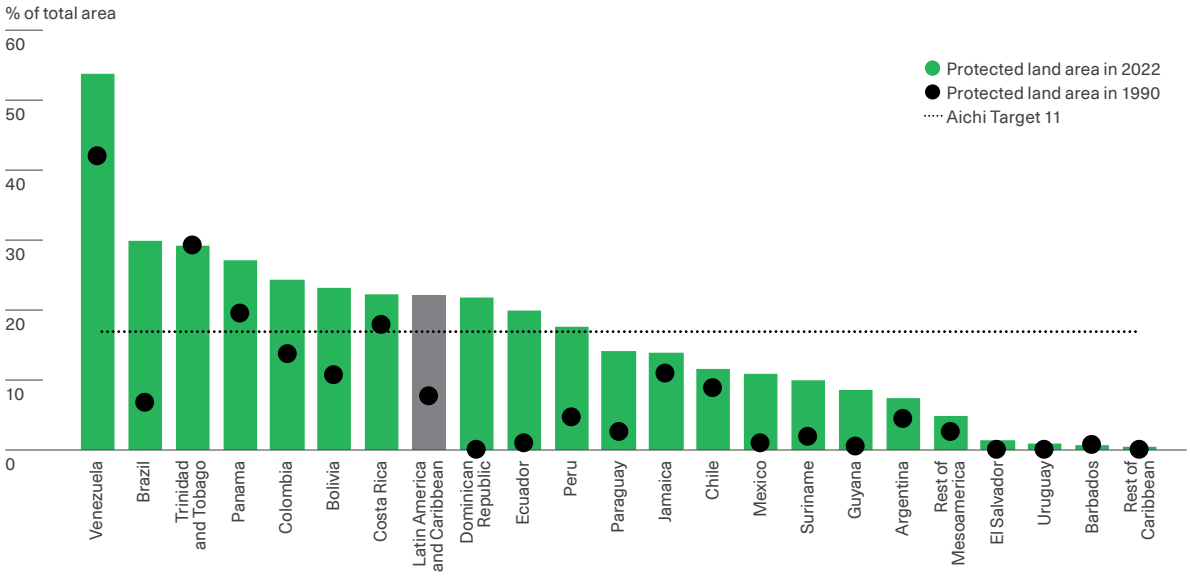
Conserving the region's ecosystems and biodiversity yields significant global-scale benefits. However, the paramount advantages of this agenda are experienced at the national and local levels due to their critical role in sustainable economic growth and social inclusion. The sustainable utilization of ecosystems requires both policies tailored directly to this objective and sectoral policies (although a clear demarcation between the two is not always apparent). Policies with preservation and regeneration objectives can be broken down into two categories: command and control (regulation-based) and market-based mechanisms.

Some command-and-control policies are:

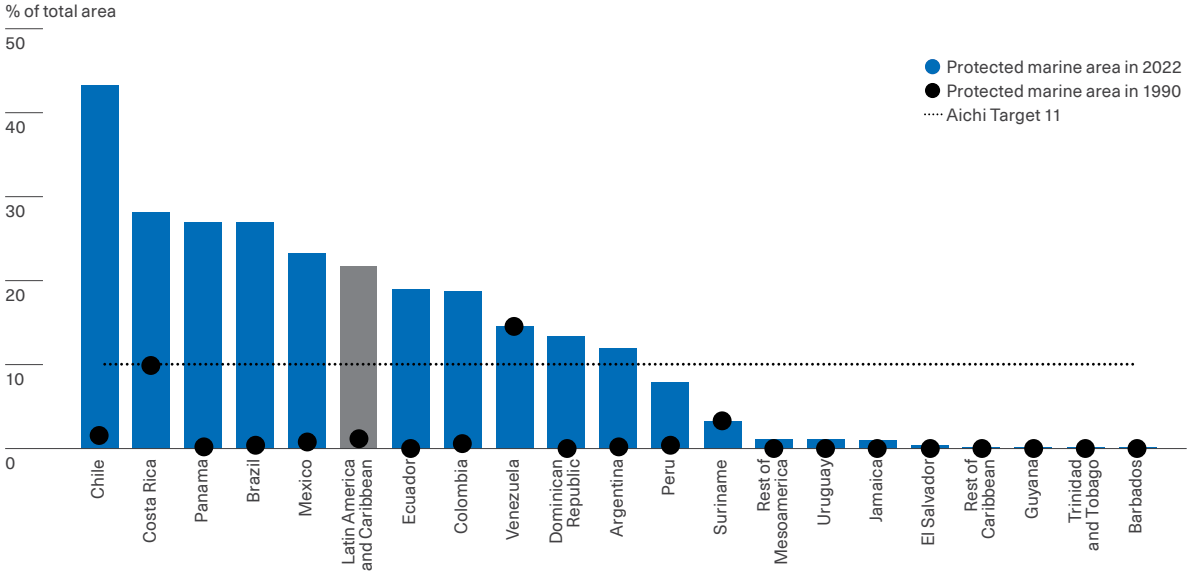
- **Protected areas (PAs)** are one of the most widely used conservation policies. Currently, PAs cover 22% of the region's land area and sea waters, albeit with significant heterogeneity across countries (Graph 11). Target 3 of the Global Biodiversity Framework calls for 30% of all land, sea, and freshwater ecosystems to be conserved through the establishment of protected areas (PAs) and other area-based conservation measures (OECMs) by 2030. Evidence indicates that PAs can aid in deforestation reduction, although their impact varies from one context to another (Rico-Straffon et al., 2022; Tanner and Ratzke, 2022). The efficacy of this policy is influenced by two factors. First, many PAs are situated in remote areas with little deforestation risk, possibly due to minimal opposition to their establishment. Second, institutional capacity to provide effective protection to PAs situated in human-pressured zones remains limited.

Graph 11
Protected areas in Latin America and Caribbean countries

Panel A.
Protected land areas by country



Panel B.
Protected marine areas by country



Note: The graph displays the proportion of protected areas in 1990 (circles) and in 2022 (bars) relative to the total land area of each country. Maritime areas are defined using exclusive economic zones, and all nationally designated protected areas from the Protected Planet database are included.

Source: Authors using geo-referenced data from Protected Planet (UNEP-WCMC and IUCN, 2022) and data from exclusive economic zones from the Flanders Maritime Institute (2019).

- **Co-managing** publicly owned **natural resources** with local communities and other key stakeholders presents an alternative for harnessing synergies between conservation and local development objectives. Allocation of rights typically extends to communities or collectives (although concessions to the private sector are also possible), conditioned upon the adoption of sustainable resource utilization practices. Examples of co-management include multiple use protected areas, community concessions such as exclusive artisanal fishing zones, and territories of indigenous or Afro-descendant communities in countries like Bolivia, Brazil, and Colombia.

Some market-based mechanism policies are:

- **Payments for ecosystem services (PES)** serve as a tool to compensate individuals and communities contributing to the provision of such services through conservation and regeneration efforts. The region is a leader in PES implementation, with over 250 programs in operation. Costa Rica and Mexico pioneered national PES programs, with the *Programa por Pago de Servicios Ambientales (PPSA)* and the *Pago por Servicios Ambientales Hídricos (PSAH)*, respectively. Most PES programs in the region seek to achieve their objectives through payments for forest conservation and regeneration, though recent initiatives have also addressed agricultural landscapes. Evidence indicates that PES can be effective when designed to uphold the principle of additionality, ensuring the flow of ecosystem services surpasses what would prevail in the absence of the program.

- Industry agreements are instruments where companies pledge not to purchase products or services from suppliers failing to meet environmental safeguards. The soy moratorium in Brazil is a successful example of this type of initiative.

- Eco-certifications seek to provide consumers with information on the environmental impact of certain goods or products. The region is a leader in the adoption of eco-certifications, mainly for products like bananas, coffee, and cocoa. However, evidence of their effectiveness is still limited.

Strengthen regional coordination to tackle international negotiations on climate change and biodiversity.

Greater regional coordination can offer significant benefits for Latin American and Caribbean countries. To achieve this, a shared position acknowledging the overlap between both agendas and the region's needs and strengths is essential.

Climate financing plays a pivotal role in aligning parties and striking a balance between the needed global mitigation effort and climate justice demands.

Available information suggests that international financing has thus far been insufficient, and future needs will be enormous, although estimates are subject to a high degree of uncertainty.

The discussion on the challenges of financing extends to the instruments used and the projects for which they are intended. In terms of instruments, more than 70% of the public resources mobilized from rich countries to developing countries take the form of loans and only a quarter are non-refundable transfers (OECD, 2022). Developing countries have grounds to demand more resources in the form of non-refundable transfers and concessional credits. An alternative is to centralize and channel contributions from industrialized countries through multilateral climate funds.

Regarding the projects these funds are earmarked for, a misalignment exists between the imperative for developing countries to invest in adaptation and

the incentives of industrialized countries to finance mitigation. Presently, nearly all climate financing is directed toward mitigation projects, with less than 10% dedicated to adaptation (Naran et al., 2022). This stems from the predominance of credits (as opposed to non-refundable transfers) and the financial profitability of projects: unlike mitigation investments, adaptation initiatives often do not generate direct income flows to repay loans.

As an alternative to the current approach of financing specific projects, developing countries could propose mitigation objectives in exchange for a defined amount of resources, not restricted to the cost of mitigation implementation. Funding could include a built-in compensation component (which recipient countries could use for adaptation investments, among other purposes).

Carbon credit markets are a tool to finance the conservation and regeneration of the region's ecosystems.

Carbon offset mechanisms provide flexibility to efficiently reduce emissions. They allow certain activities to continue generating GHGs in exchange for the removal of an equivalent volume of emissions through other means. Transactions in carbon offset markets are closely tied to the carbon price. For instance, Mexico and Colombia impose taxes on the use of certain fossil fuels but allow companies to partially or fully substitute these tax payments by purchasing carbon credits (García and García, 2023).

The key aspect of an offset market lies in certifying the additionality of projects and generated credits. Carbon credits are considered additional if the revenue generated from their sale leads to emission reductions that would not have occurred without the transaction. Ensuring that the registered credits achieve real mitigation hinges on this task.

Pre-determining the additionality of an investment is a complex undertaking, partly due to technical reasons and partly due to incentives to exaggerate the importance of credits, both from buyers and project developers. These problems are exacerbated in the forestry sector, where demonstrating additionality is particularly challenging, and projects face risks of lack of permanence and carbon leakage (emissions leakage instead of diminishing). Improving the governance of these processes must be the utmost priority for any offset mechanism.

Despite the difficulties, investing in developing robust governance in these areas and promoting forest-based offset mechanisms could prove highly valuable for some countries in Latin America and the Caribbean, especially in areas where significant progress could be made in reforestation and conservation efforts. Additionally, offset credits can serve two distinct roles: if integrated into national carbon pricing schemes (taxes or ETS), they offer greater flexibility and efficiency in achieving national mitigation objectives. Conversely, if sold on international markets, offsets generate monetary resources. Regardless of whether they are sold domestically or internationally, these projects contribute to increasing forest cover, with corresponding local ecosystem benefits.

Seizing transition opportunities and contributing to global emissions reduction.

The global energy transition can open up opportunities to harness the region's resource endowment and competitive advantages.

Tapping the substantial natural gas reserves in several countries in the region could lead to emissions reductions (for both Latin American and Caribbean nations and others) relative to current consumption of oil and coal (the most polluting fossil fuels). Over time, gas usage will also need to decrease, but its utilization can serve as a valuable bridge during the energy transition process. The exploitation of natural gas as a transitional fuel can also yield positive impacts on fiscal resources and

exports of both liquefied natural gas and electricity generated from its use.

Additionally, capitalizing on the energy potential of gas and harnessing renewable energy sources could foster comparative advantages for energy-intensive industrial processes, facilitating investment and production relocation to Latin America and the Caribbean. Eventually, low-carbon hydrogen could emerge as an alternative for this purpose. However, further technological advancements are needed to render its commercial use feasible.

Exploiting critical minerals in demand for electrification processes presents another relevant opportunity for the region. The extraction of copper, lithium, and other critical minerals abundant in Latin America and the Caribbean to meet the global demand surge can serve as a significant source of fiscal revenue and foreign exchange. However, such mineral extraction must occur under conditions that safeguard the environment and ensure the benefit of local communities.

Lastly, the relative abundance of forests and other natural covers in the region holds the potential to **monetize forest resources conservation efforts** through offset markets.

Global challenges, regional solutions

Climate change and biodiversity loss are global challenges that jeopardize human well-being and the continuity of all life forms on Earth. This report underscores three key messages of relevance for the entire region in response to these challenges: the importance of adaptation, the imperative to contribute to mitigation, and the urgency to preserve natural capital for sustainable development. The most appropriate solutions may vary across regions. Each country must devise a portfolio of policies by weighing the costs and benefits of different alternatives, considering the political feasibility of actions, and assessing impacts on equity and growth.

Collectively, the countries of Latin America and the Caribbean can greatly benefit from intensive regional coordination to ensure their voices and concerns are heard in international negotiations.

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Report on Economic Development 2023.
Global challenges, regional solutions: Latin America and the Caribbean in the face of the climate and biodiversity crisis.

The preparation of the Report on Economic Development (RED) is the responsibility of the Socioeconomic Research Division of CAF's Department of Knowledge. Pablo Brassiolo and Ricardo Estrada oversaw the editing of the report content, with the assistance of Florencia Buccari. Ana Gerez was responsible for style and editorial corrections.

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The climate of the planet is changing, and biological diversity is declining at an accelerated rate. Both phenomena pose significant threats to humanity, but it is precisely human activities that have led to this crisis. Latin America and the Caribbean is not exempt from these challenges, as the region faces them from a position of economic and social fragility. This is characterized by slow economic growth, high levels of poverty and inequality, and limited institutional capacities, among other development deficits.

This edition of the Report on Economic Development analyzes the challenges and opportunities that climate change and biodiversity conservation pose for Latin America and the Caribbean. The report emphasizes three vital messages for the region in its response to these global challenges: the importance of adaptation, the need to contribute to global mitigation, and the urgency of preserving natural capital for sustainable development. The most suitable solutions may vary among countries. Each one must define its portfolio of policies by weighing the costs and benefits of various alternatives, considering the political feasibility of actions, and assessing their impacts on equity and growth.

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