4th National Communication and 2nd Bienal Update Report of Ecuador

to the United Nations Framework Convention on Climate Change

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Agua y Transición Ecológica

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Acronyms and Abbreviations

2BUR	Second Biennial Update Report
4NC	Fourth National Communication
AbE	Ecosystem-based Adaptation
AICCA	Andes Adaptation to the Impacts of Climate Change on Water Resources Project
ATPA-RAPS	Amazon Productive Transformation Agenda – Sustainable Agroproductive Reconversion
BTR	Biennial Transparency Report
CACC	Catalog of Climate Change Activities
CBT	Climate Budget Tagging
CDM	Clean Development Mechanism
CEPAL	Economic Commission for Latin America and the Caribbean
CIS	Sustainable Intermediary Cities Program
CMIP6	Coupled Model Intercomparison Project
CPEIR	Climate Public Expenditure and Institutional Review
DMCC	Climate Change Mitigation Directorate
DO	Dissolved Oxygen
EFIC	Ecuador's National Climate Finance Strategy
ENCC	National Climate Change Strategy
ENSO	El Niño Southern Oscillation
ETF	Enhanced Transparency Framework
FORECCSA	Enhancing resilience of communities to the adverse effects of climate change on food security, in Pichincha Province and the Jubones River basin
FREL-D	Forest Reference Emissions Level from Deforestation
GAD	Autonomous Decentralized Government
GADM	Autonomous Decentralized Municipal Government
GAP	Priority Attention Groups
GCI	Climate-Smart Livestock
GHG	Greenhouse Gases
GIDDAC	Integrated Management to Combat Desertification, Land Degradation and Climate Change Adaptation
IFF	Investment and Financial Flows
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
L&D	Loss and Damage
LULUCF	Land Use, Land Use Change and Forestry

Acronyms and Abbreviations

MAATE	Ministry of Environment, Water and Ecological Transition
MEF	Ministry of Economy and Finance
MREMH	Ministry of Foreign Affairs and Human Mobility
MRV	Monitoring, Reporting and Verification
MSL	Mean Sea Level
MSM	Sectoral Mitigation Mechanism
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NCRES	Non-Conventional Renewable Energy Sources
NGHGI	National Greenhouse Gas Inventory
NGO	Non-Governmental Organization
NMVOC	Non-Methane Volatile Organic Compounds
NNAJ	Children, Adolescents, and Young Adults
ODS	Ozone Depleting Substances
PA REDD+	REDD+ Action Plan "Forests for Good Living" 2016-2025
PCEIR	Private Sector Climate Expenditure and Institutional Review
PDOT	Land Management Plan
pH	Hydrogen Potential
PI-NDC	Nationally Determined Contribution Implementation Plan
PLANACC	National Adaptation Plan Project in Ecuador
PNGIDS	Integrated National Solid Waste Management Program
PNGS	National Sustainable Livestock Project
PNR	National Reforestation, Watershed Protection and Alternative Benefits Program
PPR	Results Based Payment Project
PPVS	Wildlife and Landscape Project
PROAmazonía	Integrated Amazon Program for Forest Conservation and Sustainable Production
PSB	Socio Bosque Project
PSF	Financial Sustainability Project
RCOA	Environmental Organic Code Regulation
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RedINGEI	Latin American Network on Greenhouse Gas Inventories

Acronyms and Abbreviations

REM REDD	Early Movers Program
RNCC	National Climate Change Registry
SAG	Food Sovereignty, Agriculture, Livestock, Aquaculture and Fisheries
SCC	Undersecretariat of Climate Change
SENPLADES	National Secretariat for Planning and Development
SIGMA	REDD+ Measures and Actions Management System
SIS	Safeguards Information System
SLM	Sustainable Land Management
SNAP	National System of Protected Areas
SNGHGI	National Greenhouse Gas Inventory System
SNGRE	National Risk and Emergency Management Service
SNMB	National Forest Monitoring System
SST	Sea Surface Temperature
UNACEM	Andean Cement Union
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USCUSS	Use of Land, Change in Use of Land and Silviculture
USW	Urban Solid Waste

Foreword

Ecuador is known as the country of the four worlds because it encompasses the Galapagos archipelago, the Coast, the Andes and the Amazon region. Our nation leads the list of the world's megadiverse countries since in a relatively small territory it has the largest number of species per square kilometer. In addition, it is home to varied natural landscapes, ethnic groups, and unique flora and fauna. Despite its great natural wealth, Ecuador is highly vulnerable to the adverse impacts of climate change due to its geographic location, climate variability, and social and economic conditions typical of a developing country.

In response, for more than a decade, the Ecuadorian State has been committed to safeguarding the rights of nature as a legacy for future generations and the world. Increasingly aware of the effects that climate change is having on our country's economy, food sovereignty and livelihoods, we have seen the need to set more ambitious goals for sustainable development.

As a nation, we have taken on the challenge of implementing substantive changes in the management of environmental policy, promoting a different development model that promotes economic growth without disregarding the value of biodiversity and natural heritage. The country has focused on reducing environmental impact and promoting the regeneration of natural resources, since it perceives opportunities and benefits that might be brought about by this change in technical and economic terms.

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, Ecuador presents itself to the world as a country committed to the global fight against climate change. Despite contributing only 0.16%[1] of global greenhouse gases (GHG), the country recognizes its shared responsibility to protect the climate as a common good of humanity, but not in a uniform manner, based on the Principle of Common but Differentiated Responsibilities and Respective Capacities.

In this context, Ecuador submitted its first Nationally Determined Contribution (NDC) in 2019, voluntarily setting ambitious mitigation targets in accordance with its capabilities. In turn, as a priority for the country's development, strategic adaptation measures were established, considering cross-cutting aspects such as intergenerationality, interculturality and gender equality, ensuring respect for human rights and nature.

Thus, Ecuador is pleased to present its Fourth National Communication and Second Biennial Update Report, in compliance with its international commitments under the UNFCCC. Both national reports were prepared in accordance with the guidelines of the Convention and the principle of transparency established in the Paris Agreement. The reports include information for 2016 - 2020, on national circumstances, National Greenhouse Gas Inventory (NGHGI) for 2018, measures for mitigating and adapting to climate change, barriers and needs related to climate change management, and climate finance received and needed, among other relevant information. This is a continuation of what was previously reported in the First Biennial Update Report (2016) and Third National Communication (2017).

This work was led by the Ministry of Environment, Water and Ecological Transition (MAATE, by its acronym in Spanish) in close collaboration with public and private institutions, international cooperation agencies, non-government organizations, academia, experts, and representatives of civil society. We thank all of them for the information, knowledge, and experience provided for the drawing up of these national reports.

This publication is evidence of the Ecuadorian government's voluntary effort to mitigate global climate change and its ongoing commitment to reduce vulnerability and increase the resilience of human and natural systems to climate change. Ecuador will continue to work to ensure sustainable and fair development in accordance with the current climate reality and its impacts.

Gustavo Rafael Manrique Miranda
Minister of Environment, Water and Ecological Transition

[1] Value corresponding to the representativeness of the total GHG emissions estimated for Ecuador in 2018, with respect to the total global GHG emissions estimated by the World Bank for the same year (www.datos.bancomundial.org/).

Presentation

Climate change has become a worldwide problem, evidenced by alarming rise in global temperatures caused by an excess of greenhouse gases (GHG) in the atmosphere, changes in sea water levels, and polar melting, among others. All these disturbances generate periods of drought, forest fires, heat waves, floods, torrential rains, hurricanes, and other natural disasters. The Intergovernmental Panel on Climate Change (IPCC) reported that limiting global warming to 1.5°C will require serious commitments from all countries to reduce the impacts that lie ahead.

According to World Bank data, as of 2018, Ecuador globally contributes just 0.16%[2] of GHGs. Although it is not a major contributor to the problem, it is one of the most vulnerable territories to the effects of climate change due to the fragility of its ecosystems and the social conditions of its population. The impacts of this global phenomenon are evident in the country through the intensification of extreme weather events such as those caused by the El Niño phenomenon, the increase in sea level, the retreat of glaciers, the increase in the incidence of tropical diseases, the extinction of species, and the loss of sensitive ecosystems, to name a few.

Aware of the country's high vulnerability and the negative impact that climate change has on the economy, development, food security and the general well-being of the population, the Government of Ecuador has made a great effort to implement a sustainable development model aimed at decarbonizing its economy. In this regard, the country has been developing policy and regulatory instruments aimed at strengthening climate change management. They are based on the recognition of the rights of nature established in the Constitution since 2008 positioning the country as one of the most ambitious in terms of conservation and promoting a more responsible climate action.

The country's commitment to mitigate the impacts of the climate phenomenon and to contribute to the global goal of limiting the increase in global temperature became evident with the ratification of the Paris Agreement in 2017. Through this Agreement, Ecuador undertook to meet national GHG emission reduction targets by implementing actions framed in the First Nationally Determined Contribution (NDC) and to strengthen transparency in the reporting of mitigation and adaptation actions taken, and the proper recording of financial support received. Adaptation to climate change has become a priority for the State and constitutes one of the central axes of the country's current and future development. For this reason, progress has been made in reducing the climate vulnerability of human and natural systems, focusing efforts on compliance with the adaptation actions and goals established in the NDC and other climate change management instruments. The aim is to build a society that is resilient to the impacts of climate change and to guarantee sustainable and fair development for the Ecuadorian population.

As a member country of the United Nations Framework Convention on Climate Change (UNFCCC) since 1994, Ecuador has fulfilled its commitment to jointly submit its Second Biennial Update Report (2BUR) and its Fourth National Communication on Climate Change (4NC), prepared in accordance with the guidelines detailed in Annex III of Decision 2/CP17, Decision 17/CP.8 and the User's Manual for National Communication Guidelines for Non-Annex I Parties to the UNFCCC.

This publication covers the 2016-2020 reporting period and provides an updated overview of the progress achieved by Ecuador in terms of GHG mitigation, making visible the actions taken by the public and private sectors in favor of sustainable, resilient and low-carbon growth. In this opportunity, we present the National Greenhouse Gas Inventory (NGHGI) updated for 2014, 2016 and 2018, estimated for the first time under the IPCC 2006 Guidelines.

This national publication also reports on the progress of strategic issues such as the First Nationally Determined Contribution (NDC), the Monitoring, Reporting and Verification (MRV) System, among others. It also includes information on the financial support received by Ecuador during the period in

[2] Value corresponding to the representativeness of the total GHG emissions estimated for Ecuador in 2018, with respect to the total global GHG emissions estimated by the World Bank for the same year (www.datos.bancomundial.org/).

question, highlighting the importance of mobilizing economic resources to achieve, strengthen and expand national climate goals. The opportunity is taken to reflect on the barriers and needs that the country faces in the framework of climate change management, in order to make efforts and seek solutions to solve them in the future.

In addition, it highlights the country's achievements in terms of the implementation of adaptation initiatives and the generation of key strategic information for decision-making and territorial planning, including atmospheric trends, future oceanographic projections, initial approximation of losses and damages associated with climate change, and evidence on the impacts of climate change on children, adolescents, and young adults related to access to water and sanitation, health and education; integration of the gender perspective in the field of climate change; education, training, research and awareness on climate change; and rescue of ancestral knowledge, among other topics of interest.

The work presented below was carried out under the leadership of the Ministry of Environment, Water and Ecological Transition (MAATE, by its acronym in Spanish)[3] with support from the United Nations Development Programme (UNDP) in close collaboration with public and private institutions, non-governmental organizations (NGOs), academia and representatives of civil society. With the delivery of this publication, Ecuador ratifies its commitment to the fight against climate change and its permanent effort to build a more resilient society.

[3] On March 4, 2020, by means of Executive Decree No. 1007, the Ministry of Environment (MAE) and the National Water Secretariat (SENAGUA) were merged, recognizing the formal creation of the Ministry of Environment and Water (MAAE). Subsequently, on June 5, 2021, the new Ministry of Environment, Water and Ecological Transition (MAATE) was formalized by Executive Decree No. 59.

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Introduction

The Fourth National Communication and Second Biennial Update Report of Ecuador report on the progress made by the country in complying with the objectives and principles of the United Nations Framework Convention on Climate Change (UNFCCC). This document covers the 2016-2020 reporting period and includes the update of the National Greenhouse Gas Inventory (NGHGI) as of 2018 and its 1994-2018 historical series, thus giving continuity to what was previously reported in the First Biennial Update Report and the Third National Communication, presented in 2016 and 2017, respectively.

Both national reports were prepared on this occasion as a joint publication in accordance with UNFCCC requirements and guidelines established for this purpose. This process was led by the Ministry of Environment, Water and Ecological Transition (MAATE, by its acronym in Spanish) with the support of the United Nations Development Programme (UNDP) as implementing agency and financial support from the Global Environment Facility (GEF).

The following is a brief description of the content of the ten chapters that make up this publication, which includes the following sections: (a) Chapter 1 describes Ecuador's 2020 national circumstances; (b) Chapter 2 includes the results of national greenhouse gas emissions; (c) Chapter 3 reports on climate change mitigation initiatives implemented by Ecuador on a voluntary basis; (d) Chapter 4 details the progress achieved in adaptation and reduction of vulnerability to climate change; (e) Chapter 5 presents an initial approximation on losses and damages potentially associated with climate change; f) Chapter 6 addresses the progress of the First Nationally Determined Contribution (NDC); g) Chapter 7 details the progress made by the country related to the future establishment of the National Monitoring, Reporting and Verification (MRV) System; h) Chapter 8 reports the funding received and needed for climate change management; i) Chapter 9 documents the barriers, needs and opportunities identified for the country in the context of climate change; and j) Chapter 10 contains other relevant information for the achievement of the UNFCCC objectives.

Chapter 1: National Circumstances

Ecuador is an Andean country located in northwestern South America, with 256,370 km^2 of continental and insular area and 1,358,440 km^2 of maritime area (IGM, 2020). It borders Colombia to the north, the Pacific Ocean to the west, and Peru to the south and east. The country is crossed by the Andes formed by a double mountain range that divides the continental territory into three natural regions: coast, highlands and Amazon region. It also has the Galapagos Islands region or archipelago, located almost 1,000 km from the mainland in the Pacific Ocean. Each region has its own distinctive climate, soils, landscapes, and biodiversity.

The country has an extraordinary variety of geographic systems, from high altitude glaciers to tropical rainforests. Despite being a relatively small country, in terms of surface area, it has the highest number of species per square kilometer, placing it among the 17 most biodiverse countries in the world (García *et al.*, 2014). Its unique ecosystems and biodiversity provide a

variety of environmental goods and services that are critical to rural livelihoods and urban well-being. Unfortunately, they are highly vulnerable and sensitive to climate variability[1], to the point that the pressure of modified climate patterns and other direct and indirect factors (deforestation, land use change, inadequate agricultural practices, mining, etc.) are expected to progressively deteriorate their quality and availability (WBG, 2021).

An increasing temperature trend in the country is predicted to range from 0.9 °C to 1.7 °C by mid-century, and from 0.9 °C to 2.8 °C for 2071 - 2100 (MAE, 2017). Such increases have already been occurring and have led to the loss of glacier surface area, variation in sea surface temperature, decreased precipitation in the Andes Mountains, reduced agricultural production, decreased water quantity and quality, expanded range of distribution of insects transmitting diseases such as dengue fever and malaria, and loss of biodiversity (CDKN, 2014; MAE, 2017; Lechón, 2020).

In the medium and long term, the intensification of extreme weather events such as El Niño Southern Oscillation (ENSO); sea level rise; further retreat of glaciers; decreased annual runoff and increased vulnerability of water resources; increased vulnerability to floods and prolonged droughts; higher transmission of tropical diseases; expansion of invasive species populations in Galapagos and other sensitive ecosystems of continental Ecuador; total extinction of certain species, among other impacts, are foreseen (UNDP, 2018).

Given the current and projected effects of climate change, coupled with those caused by the COVID-19 pandemic, Ecuador's ability to respond to climate crisis conditions is likely to be severely diminished. It is estimated that the most severe impacts of climate change will continue to increase the levels of poverty and inequality of the most vulnerable population (see table 1). In countries such as Ecuador, the poor population will be the most affected, since they have fewer resources to face the negative impacts of climate change. Rural Indigenous and Afro-descendant populations are identified as the most vulnerable due to their high dependence on natural resources. However, they are also key actors in biodiversity conservation and the application of adaptation strategies in the territory thanks to their knowledge and ancestral practices.

In addition, climate change is affecting the development of activities that are the basis of the Ecuadorian economy, such as agriculture, fishing, aquaculture, livestock production, hydroelectric generation and tourism, among others. Historically, Ecuador's economic growth has been negatively affected by adverse weather events. During the 1970-2006 period, for example, there were several years (1997-1998, 1982-1983, and 1999) in which economic growth rates were negative, related to the impacts caused by the El Niño phenomenon (Falconí and Oleas, 2004). With regard to climate change, the occurrence of an El Niño phenomenon, with an intensity equal to or greater than those recorded in past years, is highly probable, which would cause significant damage to Ecuador and its economy.

[1] **Climate variability:** variations in the mean and other statistical characteristics (standard deviation, extreme events, etc.) of the climate on all spatial and temporal scales broader than those of meteorological phenomena. Variability can be due to natural internal processes of the climate system (internal variability) or to variations in natural or anthropogenic external forcing (external variability) (IPCC, 2013).

Table 1: Main Socio-Economic Indicators for the 2016-2020 Period

REAL SECTOR	2016	2017	2018	2019	2020
GDP (constant values in millions of US$) -	69,314	70,956	71,871	71,879	66,308
Percentage share of GDP by type of relevant activity					
Agriculture, livestock, hunting, forestry and fishing	7.73%	**7.88%**	7.71%	7.67%	8.26%
Mining and quarrying	9.88%	9.38%	8.71%	8.99%	8.87%
Manufacturing industries	11.57%	11.65%	11.64%	11.71%	11.82%
Wholesale and retail trade	9.93%	10.22%	10.26%	10.18%	10.13%
Miscellaneous services	6.56%	6.11%	6.22%	6.26%	6.41%
Rates of change of quarterly GDP by type of relevant activity					
Agriculture, livestock, hunting, forestry and fishing	-0.90%	0.20%	-1.40%	-1.80%	0.50%
Mining and quarrying	0.30%	2.00%	-27.80%	31.10%	-0.20%
Manufacturing industries	0.90%	1.00%	-10.10%	2.80%	0.60%
Wholesale and retail trade	1.00%	0.50%	-11.70%	3.20%	1.80%
Miscellaneous services	1.80%	0.60%	-10.10%	4.60%	0.50%
SOCIO-ECONOMIC SECTOR					
Annual inflation rate	-0.20%	0.27%	-0.07%	-0.93%	-1.47%
Total unemployment rate	6.52%	5.82%	4.80%	4.95%	8.59%
Adequate employment rate	47.64%	50.36%	49.28%	48.02%	39.32%
Poverty Index by UBN	32%	32%	34%	34%	33%
AGGREGATE INDICATORS AND EXTERNAL SECTOR					
Average total GDP growth for 2016-2020					-1.0%
Average GVA growth by major activity group for 2020					3.12%
Non-oil exports as % of total exports as of 2020					74.04%
Traditional exports[2] as % of total exports as of 2020					43.57%
Non-traditional exports[3] as % of total exports as of 2020					30.47%

Source: Central Bank of Ecuador (BCE, 2020a; BCE, 2020b).
Prepared by: MAATE / Project 4NC-2BUR.

Chapter 2: Greenhouse Gas Inventory

Since 1994, as a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), Ecuador undertook the commitment to "develop, periodically update, publish and provide to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties" (Article 4, Commitments, UNFCCC and Cancun COP16 Decision 1, 2010).

Within the framework of this commitment, Ecuador presents the results corresponding to the National Greenhouse Gas Inventory (NGHGI), for the historical series from 1994 to 2018 and reference year 2018. On this occasion, the NGHGI was quantified based on the Intergovernmental Panel on Climate

[2] These exports include: bananas, coffee, cocoa, shrimp, tuna, and fish
[3] This includes all non-oil products that are not included in the "traditional" group.

Change (IPCC) Guidelines for National GHG Inventories —2006 version— (hereafter referred to as IPCC 2006 Guidelines), complying with the most current international standards suggested by the UNFCCC.

In accordance with the 2006 IPCC Guidelines, the NGHGI comprises the estimation of greenhouse gas (GHG) source emissions and sink removals for the five emission sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture; Land Use, Land Use Change, and Forestry (LULUCF); and Waste. The results include anthropogenic GHGs not controlled by the Montreal Protocol[4] and include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds other than methane (VOCs) and sulfur dioxide (SO_2) (see table 2). In addition, updated results of the NGHGI previously submitted to the UNFCCC in the framework of the Third National Communication, are also included.

Table 2: Technical Aspects of the NGHGI year 2018

Entity responsible for the calculation	Ministry of Environment, Water and Ecological Transition (MAATE)
Year of reference	2018
Historical series	1994-2018
Methodology applied	GHG emissions for all sectors were estimated using country's activity data and emission factors provided by the 2006 IPCC Guidelines (Tier 1), except for the following sectors and subcategories: IPPU - cement production subcategory; Agriculture- enteric fermentation subcategory; and LULUCF- forest land subcategory, for which country-specific emission factors (Tier 2) were used.
Emission Sectors	Energy; Industrial Processes and Product Use (IPPU); Agriculture; Land use, Land Use Change and Forestry (LULUCF); and Waste
Estimated greenhouse gases	Carbon dioxide (CO_2), methane (CH_4), nitrogen dioxide (N_2O), carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and sulfur dioxide (SO_2).
Combined uncertainty	± 26.07%
Quality control	The internal quality control process was carried out by the technical team of the Climate Change Mitigation Directorate (DMCC, by its acronym in Spanish) of MAATE with the support of the sectoral inventory specialists of the Fourth National Communication and Second Biennial Update Report Project (4NC-2BUR) and the inventory working groups. This process involved reviewing the results and incorporating suggestions to adjust the NGHGI results to improve the transparency, consistency, comparability, completeness, and accuracy of the data.
Quality assurance	The quality assurance process was carried out through a third-party review by the Latin American Network on Greenhouse Gas Inventories RedINGEI).

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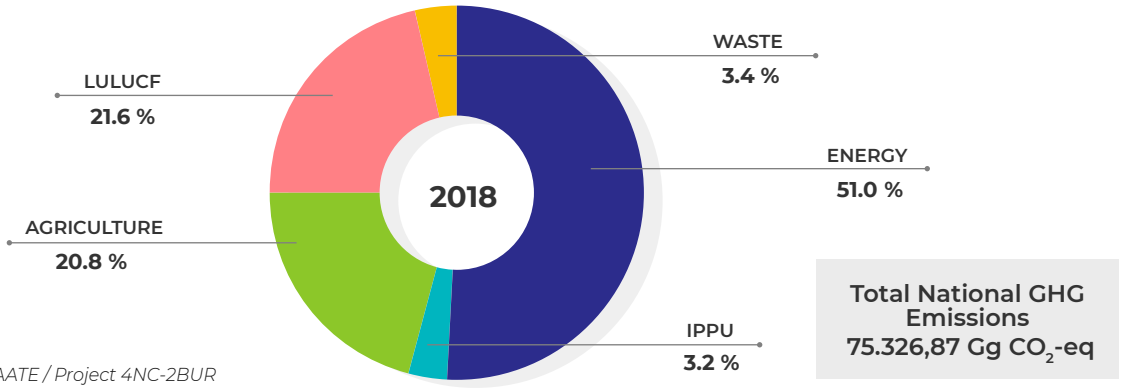
[4] For more information on the Montreal Protocol, see: https://observatoriop10.cepal.org/sites/default/files/documents/treaties/mp-handbook-2016-spanish.pdf

2.1 National Greenhouse Gas Emissions and Removals

As of 2018, Ecuador's total national greenhouse gas (GHG) emissions amounted to 75,326.87 Gg CO_2-eq[5], reflecting a decrease of 21% since 1994 and of 6.45% since 2012. The energy sector is the largest contributor, with 51.0% (38,400.06 Gg CO_2-eq) of total emissions, followed by the Land Use, Land Use Change and Forestry sector (LULUCF), with 21.6% (16,282.86 Gg CO_2-eq, and the Agriculture sector, with 20.8% (15,699.45 Gg CO_2-eq). The Industrial Processes and Product Use (IPPU) and Waste sectors contribute just 3.4% (2,540.80 Gg CO_2-eq) and 3.2% (2,403.70 Gg CO_2-eq), respectively (see graph 1).

Graph 1: Percentage of Contribution of GHG Emissions by Sector - NGHGI year 2018



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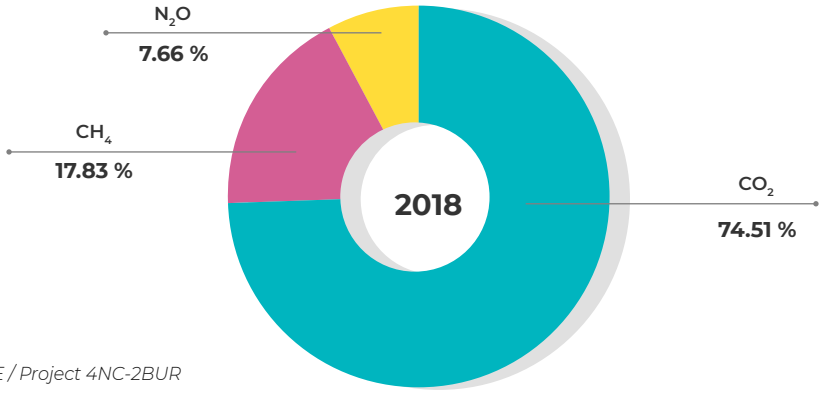
The national contribution of greenhouse gas (GHG) emissions by type of gas corresponds to 74.51% of carbon dioxide (CO_2) (net emissions)[6] ; 17.83% of methane (CH_4), and 7.66% of nitrous oxide (N_2O) (see graph 2).

Graph 2: Percentage of Contribution of GHG Emissions by Gas Type - NGHGI year 2018



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The emissions of precursor gases are as follows: NO_x with 991.01 Gg, CO with 4,196.27 Gg, volatile organic compounds other than methane (VOCVDM) with 1,152.88 Gg and SO_2 with 925.18 Gg.

[5] Gg= gigagram / 1Gg= 1000 tons.

[6] The term "net emissions" refers to the sum of GHG emissions and removals, expressed in carbon dioxide equivalent (CO_2-eq).

2.2 National Trend in Greenhouse Gas Emissions and Removals

For the national trend analysis of greenhouse gas (GHG) emissions and removals for the historical series from 1994 to 2018, two scenarios were considered, including and excluding the contribution of the LULUCF sector. This is due to the fact that this sector has a significant influence on the overall results of the NGHGI based on its contribution of emissions and removals.

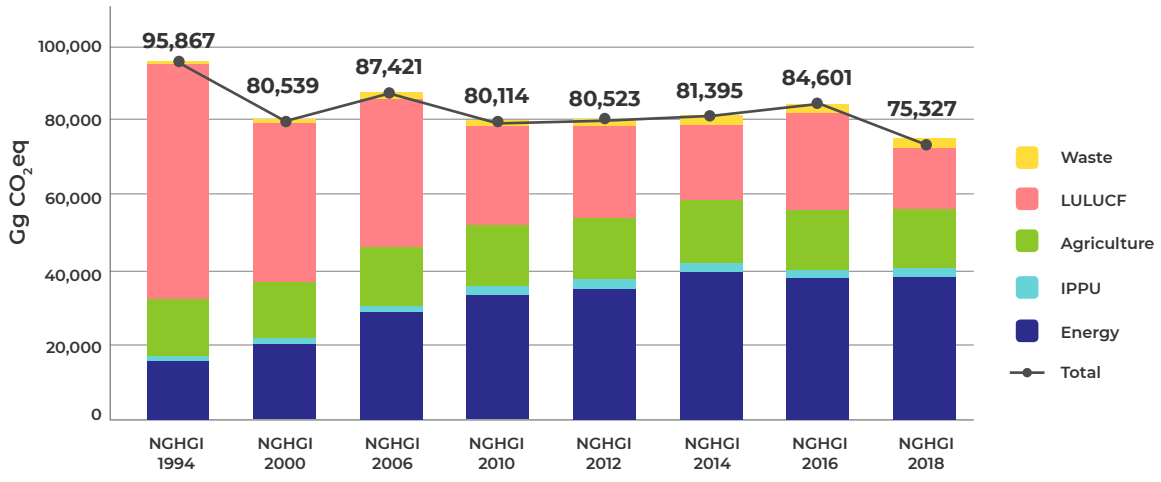
2.2.1 Trend Analysis of the Historical Series 1994 - 2018 including LULUCF Sector

Total GHG emissions reported for 2018 (75,326.87 Gg CO_2-eq) represent a 21% decrease compared to what was reported for 1994 (95,867 Gg CO_2-eq). In relation to the GHG emissions estimated for 2012 (80,523 Gg CO_2-eq), as of 2018, a decrease of 6.45% was recorded (see graph 3).

With respect to the total GHG emissions estimated for 2014 (81,395 Gg CO_2-eq), as of 2018, they show a reduction of 7.45%. A comparison of GHG emissions corresponding to 2016 (84,601 Gg CO_2-eq) with those recorded in 2018 shows a reduction of 10.96% (see graph 3).

The causes of these decreases in emissions are due to the following: 1) entry into operation of the Coca Codo Sinclair hydroelectric power plant as of 2016; 2) reduction in energy consumption on the Ecuadorian Coast due to the earthquake that occurred in April 2016; 3) reduction in aviation fuel consumption; 4) decrease in oil production; 5) increase in Forest Land removals and reduction of emissions in the Cropland; and 6) lower crop production and use of synthetic fertilizers, among others.

Graph 3: GHG Trend of the Historical Series 1994 - 2018 including LULUCF Sector



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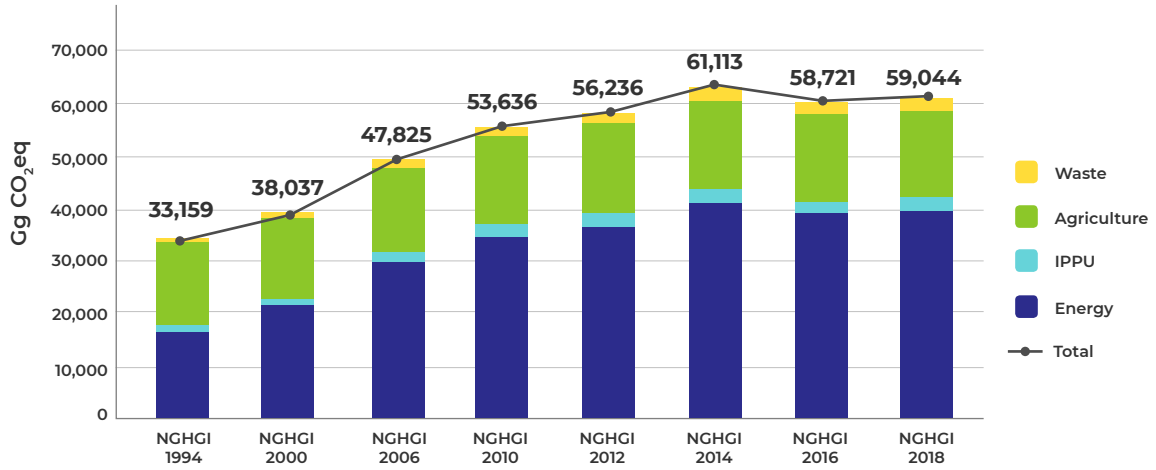
2.2.2 Trend Analysis of the Historical Series 1994 - 2018 excluding LULUCF Sector

Total GHG emissions reported for 2018 (59,044 Gg CO_2-eq) represent an increase of 78% compared to 1994 (33,159 GgCO_2-eq). In relation to the GHG emissions estimated for 2012 (56,236 Gg CO_2-eq), as of 2018, there is an increase of 4.99% (see graph 4). The causes of these increases are due to: a) augmented oil production and a rise of fuel consumption in the manufacturing industries and construction sector; and b) an increase in cattle numbers in the agriculture sector.

With respect to total GHG emissions estimated for 2014 (61,113 Gg CO_2-eq), as of 2018, a reduction of 3.38% is recorded, due to the start of mitigation projects such as the Coca Codo Sinclair hydroelectric power plant, which became operational in May 2016, and the lower production of crops (grasses) and decreased use of synthetic fertilizers.

Comparing GHG emissions corresponding to 2016 (58,721 GgCO_2-eq) with those recorded in 2018, shows an increase of 0.55%. The causes of this increase in emissions are due to methodological adjustments to the activity data for the Energy, Agriculture and Waste sectors.

Graph 4: GHG Trend of the Historical Series 1994 - 2018 excluding LULUCF Sector



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2.3 Greenhouse Gas Emissions and Removals by Sector

2.3.1 Energy Sector

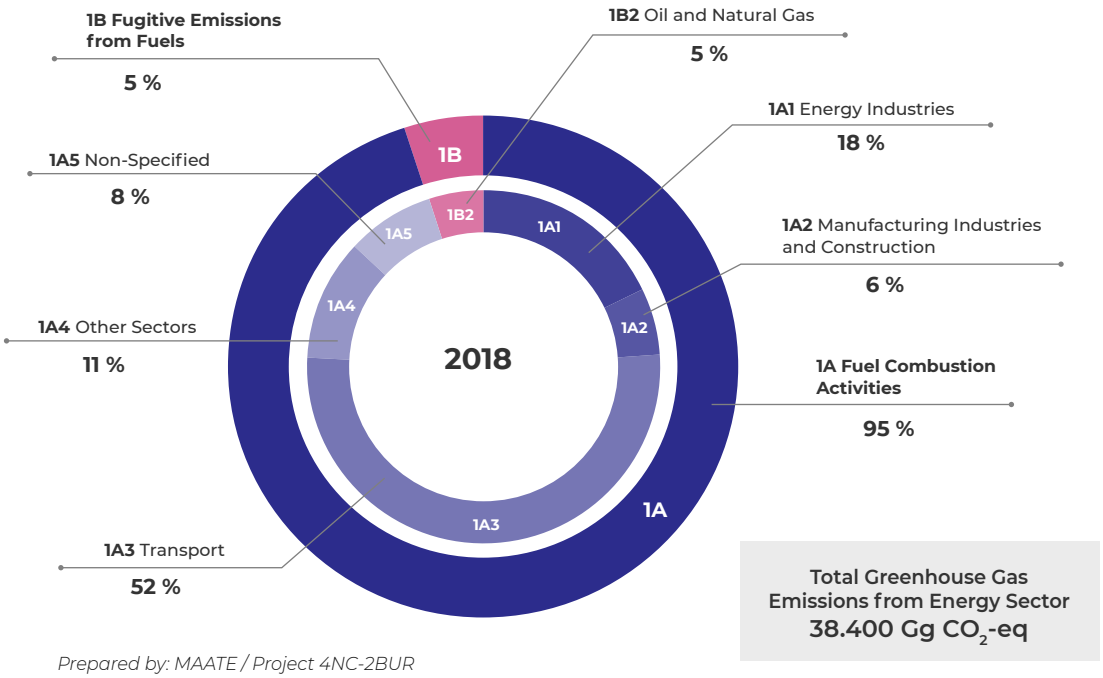
GHG emissions from the Energy sector for 2018 accounted for 51% (38,400 Gg[7] CO_2-eq) with respect to the national total. The category Fuel Combustion Activities (1A) contributes 95% (36,578 Gg CO_2-eq) of the sector's total emissions and the Fugitive Emissions from Fuels (1B) category contributes the remaining 5% (1,822 Gg CO_2-eq) (see graph 5).

The fuels accounted for in the calculation of the GHG inventory for this sector are those that come from combustion processes. Thus, most of the emissions are represented by carbon released directly as CO_2. However, other gases that could not be oxidized during this process are also released, including CH_4, N_2O, and carbon monoxide (CO), among others.

[7] Gg= gigagram / 1Gg= 1000 tons.

Regarding the total emissions from the Energy sector by type of greenhouse gas (GHG) it is reported that for the year 2018 97% of the emissions generated correspond to carbon dioxide (CO_2), 2% correspond to methane (CH_4) and 1% to nitrous oxide (N_2O).

Graph 5: Distribution of GHG Emissions from Energy Sector by Category and Subcategory (%)



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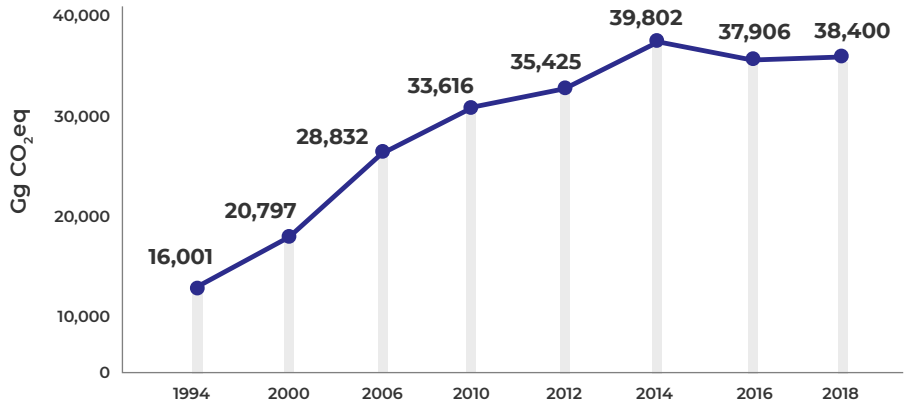
2.3.1.1 Trend Analysis of the Historical Series from 1994 to 2018

GHG emissions from the Energy sector reported for 2018 (38,400 Gg CO_2-eq) represent an increase of 140% compared to what was reported for 1994 (16,001 Gg CO_2-eq). In relation to the GHG emissions estimated for 2012 (35,425 Gg CO_2-eq), this sector registers a growth of 8.39% as of 2018. In both cases, the increase has to do with the increase in oil production, which reached its highest peak in 2014, and the rise in fuel consumption in the manufacturing industries and construction sector.

Compared to the GHG emissions estimated for 2014 (39,802 Gg CO_2-eq), this sector recorded a reduction of 3.52% in 2018. A comparison of GHG emissions corresponding to 2016 (37,906 Gg CO_2-eq) with those recorded in 2018 shows a reduction of 1.30% (see graph 6). The causes of this decrease in emissions are due to the following: 1) start of operation of the Coca Codo Sinclair hydroelectric power plant in May 2016; 2) reduction in energy consumption on the Ecuadorian Coast due to the earthquake that occurred in April 2016; 3) reduction in aviation fuel consumption; and 4) decrease in oil production.

Graph 6: Total GHG Emissions (Gg CO_2-eq) from Energy Sector, series 1994 - 2018



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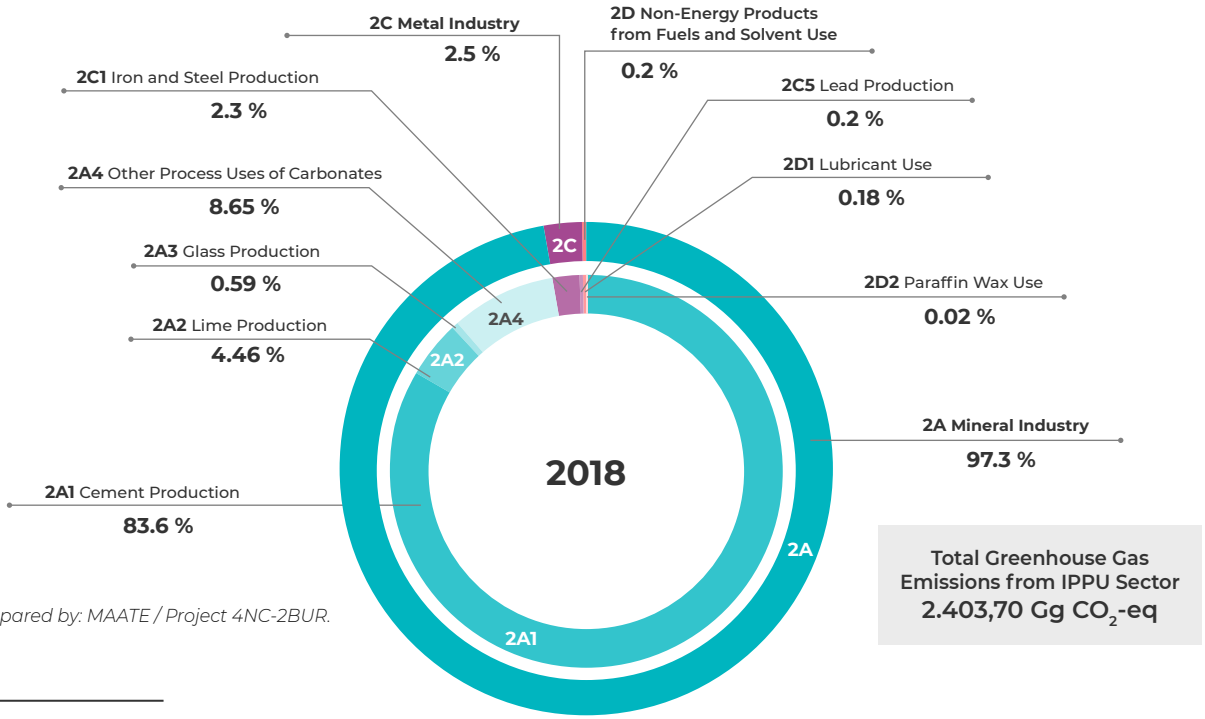
2.3.2 Industrial Processes and Product Use (IPPU) Sector

GHG emissions from the IPPU sector for 2018 represent 3.2% (2,403.70 Gg[8] CO_2-eq) of the national total. The Mineral Industry (2A) category contributes 97.3% (2,337.83 Gg CO_2-eq) of the total emissions of the sector. The remaining 2.7% (65.85 Gg CO_2-eq) comes from the contribution of 2.5% (60.40 Gg CO_2-eq) from the Metal Industry (2C) category and 0.20% (5.46 Gg CO_2-eq) from the Non-Energy Products from Fuels and Solvent Use (2D) category (see graph 7). Regarding the total emissions from the IPPU sector by type of greenhouse gas (GHG), it is reported that for 2018, 100% of the total emissions generated correspond to carbon dioxide (CO_2).

Graph 7: Distribution of GHG Emissions from IPPU Sector by Category and Subcategory (%)



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Total Greenhouse Gas Emissions from IPPU Sector
2.403,70 Gg CO_2-eq

[8]Gg= gigagram / 1Gg= 1000 tons.

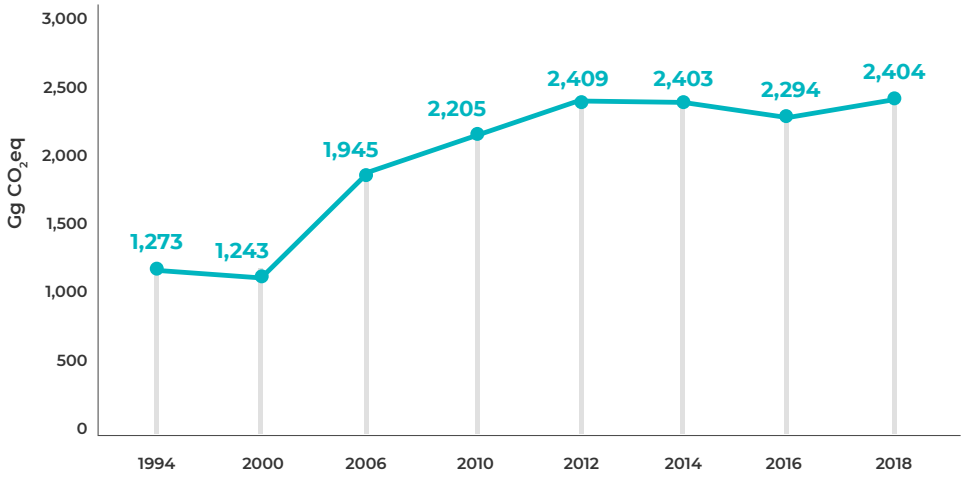
2.3.2.1 Trend Analysis of the Historical Series from 1994 to 2018

Greenhouse gas (GHG) emissions from the IPPU sector reported for 2018 (2,403.70 Gg CO_2-eq) represent an increase of 89% compared to what was reported for 1994 (1,273.26 Gg CO_2-eq), attributed to sustained growth in the production of cement and other carbonates in ceramic manufacturing processes and different uses of calcium carbonate.

In relation to the GHG emissions estimated for 2012 (2,409.15 Gg CO_2-eq), this sector recorded a slight reduction of 0.22% as of 2018, attributed to the decrease in oil prices which slowed down the execution of State construction projects.

With respect to the GHG emissions estimated for 2014 (2,402.93 Gg CO_2-eq), this sector recorded a slight increase of 0.03% in 2018. A comparison of GHG emissions recorded in 2016 (2,294 Gg CO_2-eq) shows a 4.8% growth rate in 2018. The increases in GHG emissions are attributed to the Ecuadorian government's significant investment in public works including road construction, hydroelectric plants, bridges and schools. Added to this is the growing private investment in residential works and the impact generated by the reconstruction of the cities affected by the earthquake that occurred in Manabí and Esmeraldas provinces in 2016 (see graph 8).

Graph 8: Total GHG Emissions (Gg CO_2-eq) from IPPU Sector, series 1994- 2018



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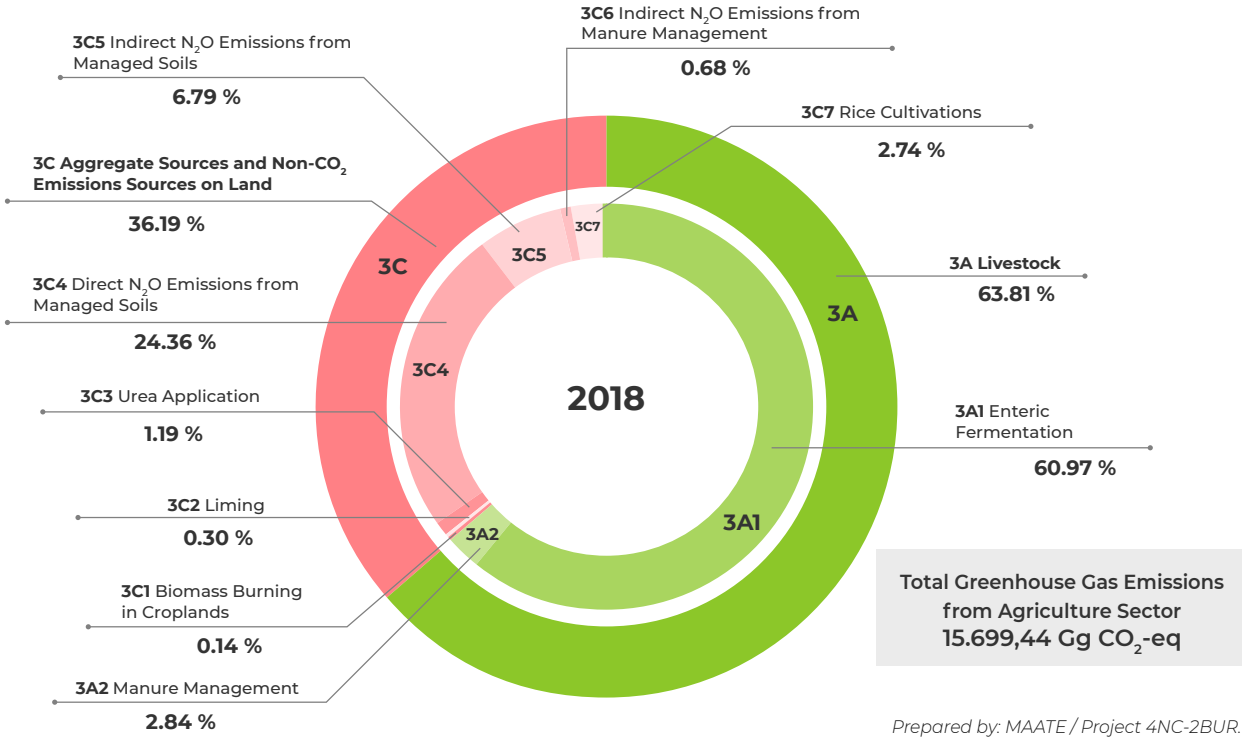
2.3.3 Agriculture Sector

GHG emissions from the Agriculture sector for 2018 accounted for 20.8% (15,699.44 Gg[9] CO_2-eq) with respect to the national total. The Livestock (3A) category contributes 63.81% (10,017.96 Gg CO_2-eq) of the sector's total emissions and the Aggregate Sources and Non-CO_2 Emissions Sources on Land (3C) category contributes the remaining 36.19% (5,681.48 Gg CO_2-eq) (see graph 9).

Regarding the total emissions from the Agriculture sector by type of greenhouse gas (GHG), it is reported that for 2018, 66% of the emissions generated correspond to methane (CH_4), 33% to nitrous oxide (N_2O), and barely 1% to carbon dioxide (CO_2).

[9] Gg= gigagram / 1Gg = 1000 tons.

Graph 9: Distribution of GHG Emissions from Agriculture Sector by Category and Subcategory (%)



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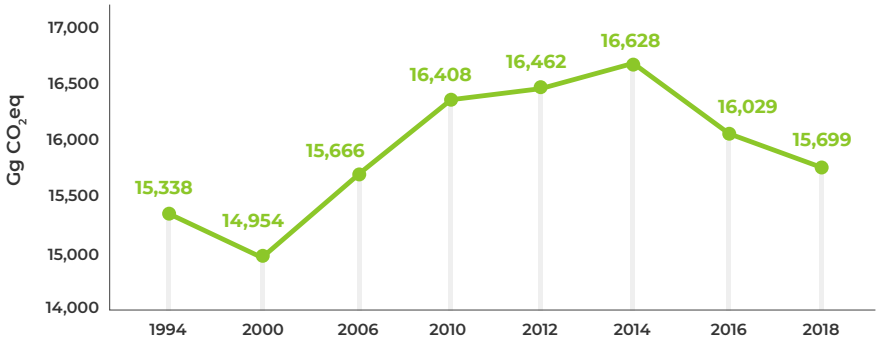
2.3.3.1 Trend Analysis of the Historical Series from 1994 to 2018

GHG emissions from the Agriculture sector reported for 2018 (15,699 Gg CO_2-eq) represent an increase of 2.35% compared to what was reported for 1994 (15,338 Gg CO_2-eq), which is attributed to the growth in cattle numbers in recent years. Compared to 2012 (16,462 Gg CO_2-eq), this sector recorded a reduction of 4.63% in 2018.

Compared to the GHG emissions estimated for 2014 (16,628 Gg CO_2-eq), this sector recorded a reduction of 5.58% in 2018. A comparison of GHG emissions corresponding to 2016 (16,029 Gg CO_2-eq) with those recorded in 2018 shows a reduction of 2.06% (see graph 10). The causes of this decrease in emissions are as follows: 1) decrease in cattle numbers; 2) lower crop production (grasses); 3) decrease in the use of synthetic fertilizers; and 4) social and economic factors that affected agricultural activity.

Graph 10: Total GHG Emissions (Gg CO_2-eq) from Agriculture Sector, series 1994 - 2018



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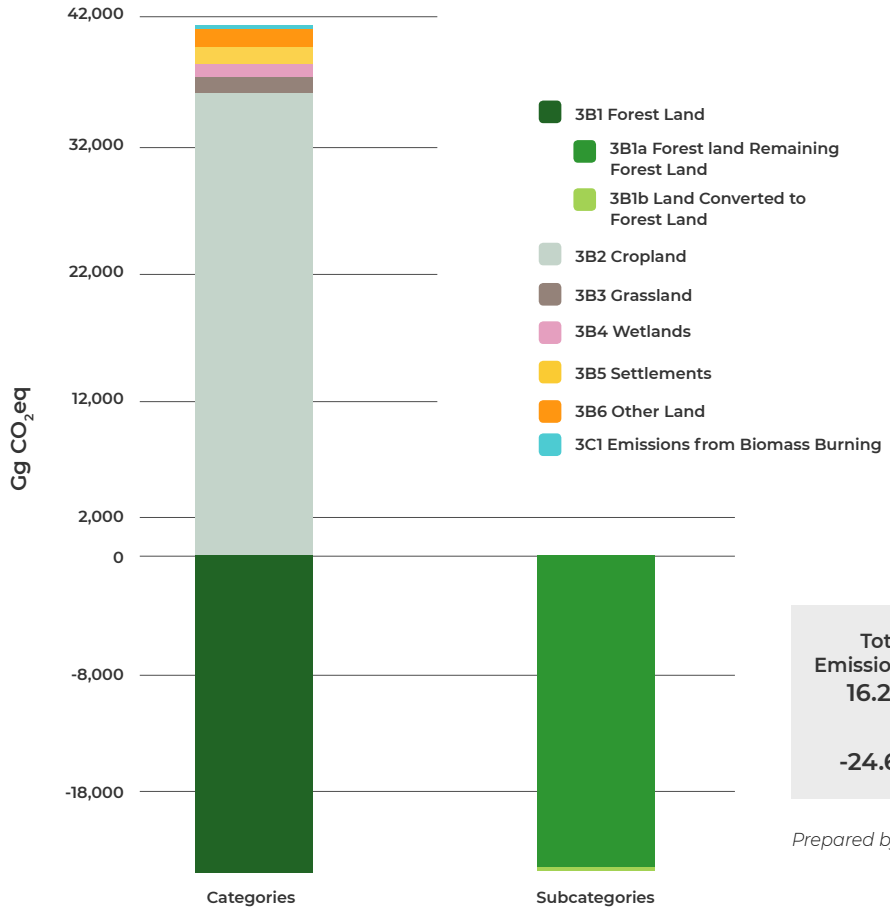
2.3.4 Land Use, Land Use Change and Forestry Sector (LULUCF)

Net GHG emissions[10] from the LULUCF sector for 2018 represent 21.6% (16,282.86 Gg[11] CO_2-eq) with respect to the national total. The Cropland (3B2) category accounts for 88.77% (35,924.40 Gg CO_2-eq) of the sector's total emissions. The Settlements (3B5) category accounts for 3.42% (1,398.89 Gg CO_2-eq), and the Other Land (3B6) category accounts for 3.33% (1,362.55 Gg CO_2-eq). The rest of the categories contribute in smaller proportions: Grassland (3B3) with 2.94% (1,201.41 Gg CO_2-eq); Wetlands (3B4) with 2.48% (1,014.96 Gg CO_2-eq), and Emissions from Biomass Burning (3C1) with the remaining 0.07% (30.23 Gg CO_2-eq).

On the other hand, the removals[12] of CO_2[13] from the LULUCF sector reached, as of 2018, -24,649.58 Gg CO_2-eq, associated with the Forest Land (3B1) category (subcategories 3B1a and 3B1b) (see graph 11).

Regarding the total net emissions from the LULUCF sector by type of greenhouse gas (GHG) it is reported that, for 2018, 99.93% of the net emissions generated correspond to carbon dioxide (CO_2), 0.05% corresponds to methane (CH_4), and 0.02% corresponds to nitrous oxide (N_2O).

Graph 11: Distribution of GHG Emissions (+) and Removals (-) from LULUCF Sector by Category and Subcategory (%)



Total Greenhouse Gas Emissions from LULUCF Sector
16.282,86 Gg CO_2-eq

CO_2 Removals
-24.649,58 Gg CO_2-eq

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[10] The term refers to the sum of GHG emissions and removals, expressed in carbon dioxide equivalent (CO_2-eq).
[11] Gg= gigagram / 1Gg= 1000 tons.
[12] Removals are represented with a negative sign (-) differentiating their carbon stock status.
[13] Removals comprise the capture of CO_2 through the biomass burning of any vegetation cover or land use.

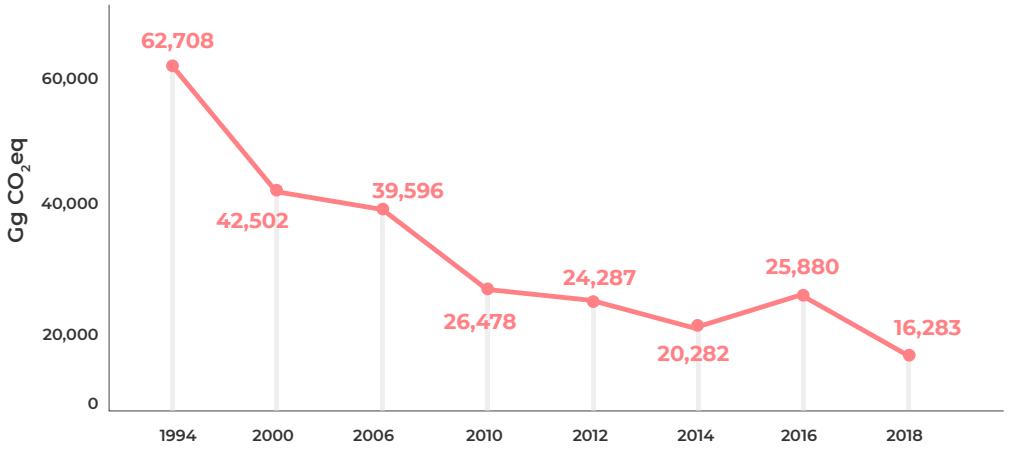
2.3.4.1 Trend Analysis of the Historical Series from 1994 to 2018

Net GHG emissions from the LULUCF sector estimated for 2018 (16,282.86 Gg CO_2-eq) represent a 74% decrease compared to 1994 (62,708.45 Gg CO_2-eq). Compared to 2012 (24,287.35 Gg CO_2-eq), this sector recorded a 33% reduction in GHG emissions as of 2018 (see graph 12).

With respect to the net GHG emissions estimated for 2014 (20,828.30 Gg CO_2-eq), this sector recorded a 20% reduction by 2018. Comparing GHG emissions corresponding to 2016 (25,880.29 Gg CO_2-eq) shows a 37% reduction by 2018.

For all the years analyzed in the historical series, the decrease in net emissions is mainly due to: 1) progressive increase in the area of forest land under legal protection regimes, including: National System of Protected Areas (SNAP, by its acronym in Spanish), Socio Bosque Project (PSB, by its acronym in Spanish) and Protective Forests; and 2) gradual decrease of deforestation in Ecuador[14].

Graph 12: Net GHG Emissions (Gg CO_2-eq) from LULUCF Sector, series 1994-2018



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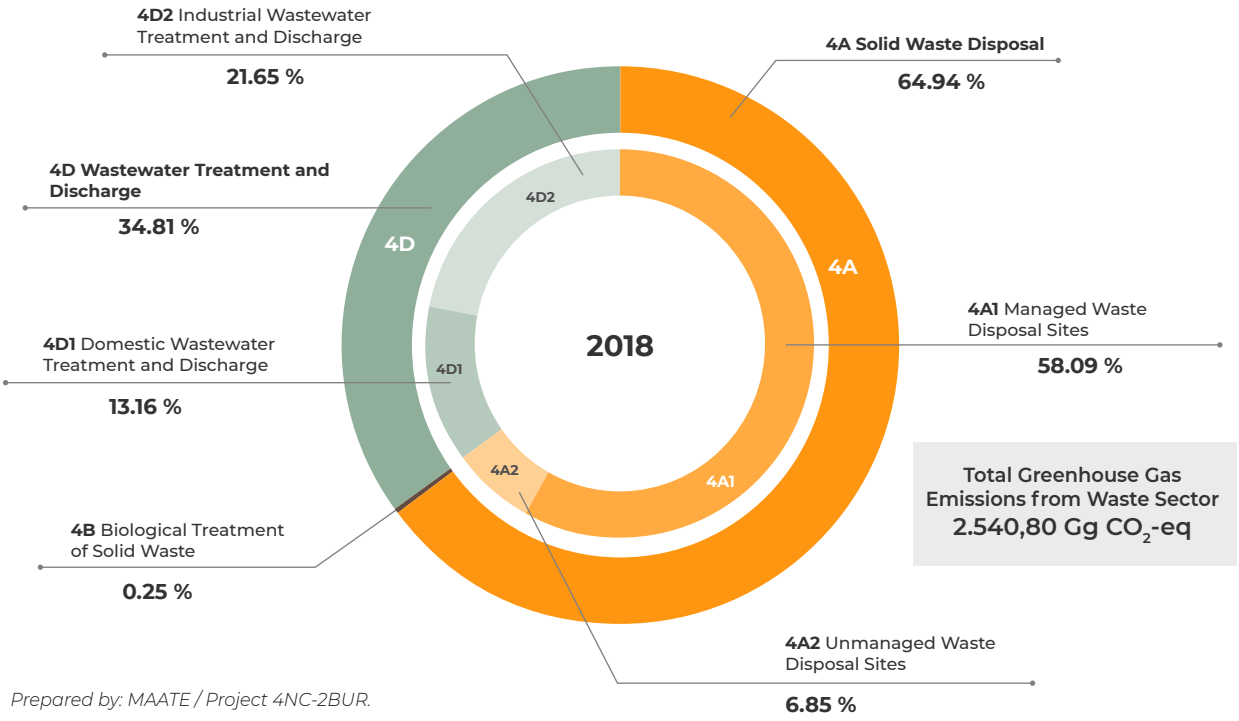
2.3.5 Waste Sector

GHG emissions from the Waste sector for 2018 accounted for 3.4% (2,540.80 Gg[15] CO_2-eq) compared to the national total. The Solid Waste Disposal (4A) category contributes 64.94% (1,650 Gg CO_2-eq) of the sector's total emissions. The Wastewater Treatment and Discharge (4D) category contributes 34.81% (884.41 Gg CO_2-eq), and the Biological Treatment of Solid Waste (4B) category contributes the remaining 0.25% (6.39 Gg CO_2-eq) (see graph 13).

Regarding the total emissions from the Waste sector by type of greenhouse gas (GHG) it is reported that, for 2018, 91.73 % (2,330.55 Gg CO_2-eq) of the total emissions generated correspond to methane (CH_4) and the remaining 8.27% (210.25 CO_2-eq) to nitrous oxide (N_2O).

[14] The reduction in deforestation can be seen in the decrease in the category Forest Land (3B1) - subcategory Land Converted to Forest Land (3B1b).
[15] Gg= gigagram / 1Gg= 1000 tons.

Graph 13: Distribution of GHG Emissions from Waste Sector by Category and Subcategory (%)



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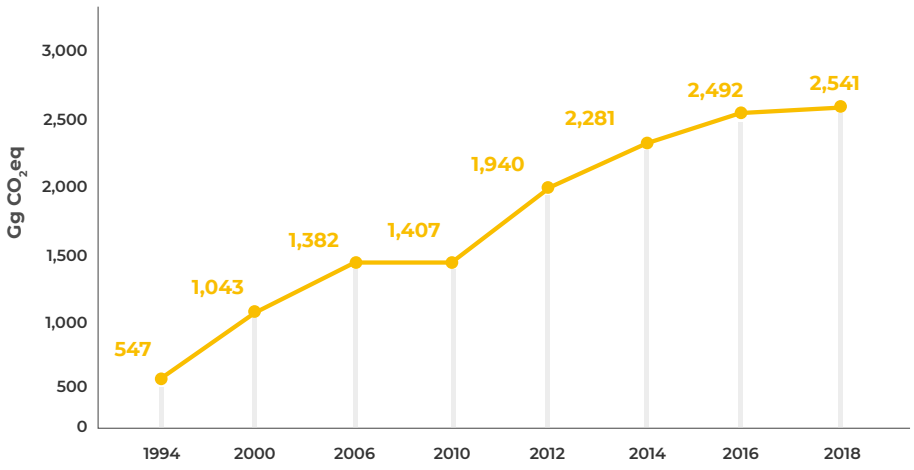
2.3.5.1 Trend Analysis of the Historical Series from 1994 to 2018

GHG emissions from the Waste sector reported for 2018 (2,540.80 Gg CO_2-eq) represent an increase of 364% compared to what was reported for 1994 (547.12 Gg CO_2-eq). In relation to the GHG emissions estimated for 2012 (1,940.16 Gg CO_2-eq) this sector registers to 2018 an increase of 31%.

With respect to the estimated GHG emissions for 2014 (2,280.54 Gg CO_2-eq), this sector recorded an increase of 11.41% compared to 2018, while the estimated GHG emissions for 2016 were 2,492.17 Gg CO_2-eq, which compared to those recorded for 2018, present an increase of 1.9% (see graph 14).

The increases recorded in the aforementioned years are mainly due to: a) population growth at the national level; b) improvement in the accuracy of activity data for the Solid Waste Disposal (4A) category; and c) inclusion of the Biological Treatment of Solid Waste (4B) category in the calculation of GHG emissions.

Graph 14: Total GHG Emissions (Gg CO_2-eq) from Waste Sector, series 1994 - 2018



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Chapter 3: Climate Change Mitigation in Ecuador

Ecuador has been part of the United Nations Framework Convention on Climate Change (UNFCCC) since 1994. Contributing to the reduction of greenhouse gas (GHG) emissions in order to reduce the impact of climate change is one of the commitments undertaken by the country. In this context, Ecuador, as part of the Non-Annex I countries, has been making voluntary efforts to reduce GHGs in accordance with its economic and social circumstances, as a contribution to the fight against climate change.

The following are some of the main voluntary GHG reduction actions and initiatives that have been implemented by Ecuador in the five sectors defined in the National Climate Change Strategy (Energy; Industrial Processes; Agriculture; Use of Land, Change in Use of Land and Silviculture; and Waste). Similarly, updated information is included on the Nationally Appropriate Mitigation Actions (NAMAs) developed by Ecuador (see graph 15).

3.1 Voluntary Actions and Initiatives to Mitigate Climate Change in Ecuador

3.1.1 Energy Sector

According to the results of the National Greenhouse Gas Inventory (NGHGI) for 2018, the Energy sector continues to be the largest contributor of greenhouse gases (GHG) in the country, with 51% of total emissions. The main contributions come from the Transport (1A3) subcategory, with 52%; Energy Industries (1A1) subcategory with 18%; and Manufacturing Industries and Construction (1A2) with 6%. In this context, Ecuador has set national mitigation goals for this sector focused on a) expanding from 60% to 90% electricity generation from renewable sources (hydroelectric and Non-Conventional Energy Sources -NCRES-); and b) increasing fuel savings from optimization in electricity generation and energy efficiency (SENPLADES, 2017).

Within the lines of action established in the Electricity Master Plan (PME, by its acronym in Spanish), for the 2016-2025 period, and the National Energy Efficiency Plan (PLANEE, by its acronym in Spanish) for the 2016-2035 period; the country has been promoting the change of the energy matrix through the development of hydroelectric and renewable

energy, and the use of more efficient energy technologies.

As of 2020, Ecuador produced 79.11% renewable energy, 20.09% non-renewable energy and 0.80% from imports. The entry into operation of 15 new hydroelectric power plants is emphasized. They were added to the National Interconnected System (SNI, by its acronym in Spanish), and which together contribute with 2,678.1 MW of installed capacity and a GHG reduction potential equivalent to 2.2 MM tCO_2-eq/year. In terms of electricity production from Non-Conventional Renewable Energy Sources (NCRES), the Villonaco Wind Farm with a nominal power equivalent to 16.5 MW; photovoltaic energy projects with 22.17 MW of effective power biomass projects totaling 136 MW of effective power; and biogas projects, together add up to a GHG reduction potential equivalent to 145,727 tCO_2-eq/year.

3.1.2 Industrial Processes Sector

According to the 2018 National Greenhouse Gas Inventory (NGHGI), the Industrial Processes sector accounted for 3.2% of total greenhouse gas (GHG) emissions nationwide. The Mineral Industry (2A) category is the largest contributor, accounting for 97.3% of total emissions in this sector, with Cement Production (2A1) subcategory being the largest contributor. The remaining 2.7% comes from the Metal Industry (2C) (2.5%) and Non-Energy Products from Fuels and Solvent Use (2D) (0.20%) categories.

In the Industrial Processes sector, the cement, manufacturing, chemical, steel and food industries are the main GHG emitters. For this reason, the country has implemented mitigation initiatives aimed at cleaner production in the private and public sectors, focused mainly on promoting energy efficiency and the sustainable management of resources and raw materials.

In this sector, the efforts made by the cement industry to reduce GHG emissions, mainly from the extraction of raw materials (clay, limestone and shale), the manufacture of clinker and its grinding, are noteworthy. Mitigation efforts have focused on implementing energy efficiency strategies in production processes and replacing clinker with other less polluting compounds.

During the 2016-2020 period, the destruction of Ozone Depleting Substances (ODS) reached a reduction of 30,836 tCO_2-eq/year by the cement company UNACEM. In terms of clean production, as of 2020, 295 Punto Verde certifications have been awarded in the country, of which 188 were Ecuadorian Environmental Certifications, 45 Ecuadorian Environmental Awards and 62 Green Initiative Awards.

3.1.3 Agriculture Sector & Use of Land, Change in Use of Land and Silviculture Sector (USCUSS)

According to the results of the 2018 National Greenhouse Gas Inventory (NGHGI), the Use of Land, Change in Use of Land and Silviculture (USCUSS, by its acronym in Spanish) contributes 21.6% of net emissions[16] of greenhouse gases (GHG), so it ranks second, after the Energy sector. The Agriculture sector is in third place, accounting for 20.8% of total GHG emissions.

Given the importance of the Agriculture sector in the national GHG emissions balance, the government has aimed its efforts on the formulation and implementation of environmental policies and mitigation initiatives focused on sustainable agricultural production free of deforestation. Among the main projects and programs implemented by the country in recent years are the Climate-Smart Livestock Project (GCI, by its acronym in Spanish); the National Sustainable Livestock Project (PNGS, by its acronym in Spanish); the Amazon Productive Transformation Agenda - Sustainable Agroproductive Reconversion (ATPA-RAPS, by its acronym in Spanish); and the Improvement of Animal Production Systems with emphasis on Dairy Livestock in the Andean Region in the Context of Climate Change.

In the USCUSS sector, mitigation efforts have focused on increasing protected areas, reducing deforestation, better

[16] The term net emissions refers to the sum of GHG emissions and removals expressed in carbon dioxide equivalent (CO_2-eq).

managing of natural resources and consequently increasing carbon sinks. The main initiatives implemented are the National System of Protected Areas (SNAP, by its acronym in Spanish); the Financial Sustainability Project (PSF, by its acronym in Spanish) for SNAP; the Wildlife and Landscape Project (PPVS, by its acronym in Spanish), the Socio Bosque Project (PSB, by its acronym in Spanish) and the National Reforestation, Watershed Protection and Alternative Benefits Program (PNR, by its acronym in Spanish).

3.1.3.1 Progress of the REDD+ Mechanism in Ecuador

At the national level, the REDD+ mechanism represents a unique opportunity to promote sustainable development by optimizing land use. In 2016, with the submission of the 2016-2025 REDD+ Action Plan "Forests for Good Living" 2016-2025 (PA REDD+, by its acronym in Spanish) to the UNFCCC, Ecuador became the second country in the world to finalize the REDD+ readiness phase. The PA REDD+ defines the measures and actions that Ecuador will implement until 2025 to reduce emissions from deforestation and forest degradation, as well as to achieve sustainable management and conservation of its natural resources.

In 2017, the country began the REDD+ implementation phase by implementing the Integrated Amazon Program for Forest Conservation and Sustainable Production (PROAmazonía, by its acronym in Spanish). The main achievements of this stage include the strengthening of territorial planning and life plans with a focus on conservation, sustainable production, climate change, gender and interculturality. In addition, Ecuador promoted the introduction of better environmental practices for the transition to sustainable, deforestation-free production systems in the palm, cocoa and coffee value chains. Work has also been done on strengthening forest control, implementing a forest product traceability system, sustainable forest management and biobusinesses, ecosystem conservation and restoration, and integrated water resource management, among others.

With the successful completion of the readiness phase and on par with the implementation of the REDD+ mechanism in Ecuador, in 2018 the country signed its first agreement of REDD+ payment for results cooperation. This marks the beginning of the REDD+ Payment for Results phase through the UNFCCC's economic recognition of the country's efforts to reduce greenhouse gas (GHG) emissions from the forestry sector. This phase is being implemented in the country through the PROAmazonía Program, the REDD Early Movers Program (REM) and the REDD+ Results Based Payment Project (PPR, by its acronym in Spanish).

3.1.4 Waste Sector

According to the 2018 National Greenhouse Gas Inventory (NGHGI), the Waste sector accounted for 3.4% of total national greenhouse gas (GHG) emissions, resulting from emissions from the Solid Waste Disposal (64.94%) and Wastewater Treatment and Discharge (34.81%) categories.

To address this situation, the Government of Ecuador has set a goal to increase the collection and proper disposal of non-hazardous solid waste from 73.6% to 80% by 2021. Similarly, it was proposed to raise from 17% to 35% recycled solid waste with respect to total waste generated (SENPLADES, 2017).

In this context, the Government of Ecuador has launched some initiatives to reduce the amount of GHG emissions linked to the waste sector, including the Integrated National Solid Waste Management Program (PNGIDS, by its acronym in Spanish), which aims to strengthen the integrated management of non-hazardous waste and solid waste. On the other hand, the Ecuador Recycles Program focuses on inclusive recycling, awareness and training on waste separation, solid waste management and good environmental practices, among other topics. Progress is also described regarding the establishment of the Sectoral Mitigation Mechanism (MSM, by its acronym in Spanish), through which the goal of reducing approximately 500,455 tCO_2-eq could be achieved by the end of the implementation period planned for 2021. Finally, the work carried out by the Autonomous Decentralized Municipal Governments (GADM, by its acronym in Spanish) in terms of the use of organic solid waste is highlighted.

Graph 15: Milestones of Climate Change Mitigation in Ecuador for the 2016-2020 period

MITIGATION SECTORS

Energy

Initiative		GHG Emission Reduction Potential
15 new hydroelectric power plants incorporated into the Integrated National System (SNI)		2.2 MM tCO_2 eq/year
Production of electricity from Non-Conventional Renewable Energy Sources (NCRES)		145,727 tCO_2 eq/year
Zero Fossil Fuels in Galapagos		6,441 tCO_2 eq/year
Energy Efficiency	Energy Efficiency Initiatives	59,277.8 tCO_2 eq/year
	NAMA (OGE&EE/PEC)	1,450 Gg CO_2 eq in 2025
	NAMA Secure	1,488.13 Gg CO_2 eq/year (2017-2021 period)
Clean Energy	NAMA DCH	2,700 Gg CO_2 eq in 2025
Sustainable Mobility	Low-carbon mobility initiatives	67,045.32 tCO_2 eq/year
	NAMA for Cargo and Passenger Transport	2,782.64 Gg CO_2 eq in 2035

Industry

Initiative		GHG Emission Reduction Potential
Sustainable Cement Industry	Replacement of clinker with volcanic ash (pozzolans) for cement production	900,290 tCO_2 eq/year
	Destruction of Ozone Depleting Substances (ODS)	30,836 tCO_2 eq/year
	PKS biomass utilization (Palm Kernel Shell)	237,340 tCO_2 eq/year
	Co-processing of used oils	30,594 tCO_2 eq/year
Energy Efficiency	Efficiency in the use of energy in Ecuadorian Small and Medium-sized Enterprises (SMEs)	2,415 tCO_2 eq/year
	Energy efficiency and good waste management in SMEs	1,642.96 tCO_2 eq/year
Cleaner Production	Cleaner Production Agreement	1,335.96 tCO_2 eq/year
	Guidelines for the Ponceano Alto Eco-efficient Industrial Park	161.14 tCO_2 eq/year

Agriculture

Initiative		GHG Emission Reduction Potential
Climate-Smart Livestock	Climate-Smart Livestock Project (2016 -2020)	75.271,2 tCO_2eq/year
Sustainable Agriculture	Amazon Productive Transformation Agenda – Sustainable Agroproductive Reconversion (ATPA-RAPS)	N/A
Sustainable Livestock	Improvement of Animal Production Systems	N/A

USCUSS

Initiative	Benefit
National System of Protected Areas (SNAP)	13.64% (18,409,843 hect.) of the territory under conservation.
Socio Bosque Project	6.7% (1.6 million hectares) of the continental territory under this conservation scheme
REDD+/GAD Mechanism	44,718.28 hect. undergoing forest restoration through agreements with local governments

Waste

Initiative	GHG Emission Reduction Potential
Sectoral Mitigation Mechanism	500.495 tCO_2 eq by 2021

Prepared by: MAATE / Project 4NC-2BUR.

3.2 Nationally Appropriate Mitigation Actions (NAMAs)

Among Ecuador's main advances in the formulation of Nationally Appropriate Mitigation Actions (NAMAs), three proposals pertaining to the livestock and energy sectors stand out. In the livestock sector, the Climate-Smart Livestock (GCI, by its acronym in Spanish) NAMA proposal focuses on reducing GHG emissions from cattle ranching in the coastal and highlands regions of Ecuador through climate-smart livestock management practices. The GCI NAMA has a GHG reduction potential equivalent to 52,787,881.1 tCO_2-eq, estimated for a period of 5 years.

In the energy sector, the proposed NAMA for Energy Efficiency in the Public and Residential Sectors (NAMA SECURE) aims to promote actions in the market that enable the transition to the use of efficient equipment. The SECURE NAMA has a GHG reduction potential equivalent to 1,488.13 Gg CO_2-eq/year. On the other hand, the proposed NAMA for Cargo and Passenger Transport focuses on evaluating the implementation of technological, operational and logistical measures in the transport sector, in order to improve energy efficiency and low-carbon mobility. This NAMA has a GHG reduction potential equivalent to 2,782.64 Gg CO_2-eq/year.

Chapter 4: Adaptation and Vulnerability to Climate Change

Due to its socioeconomic conditions, geographic location and high endemism, Ecuador is considered a country highly vulnerable to climatic and non-climatic events. Some of the impacts of climate change vary depending on the biogeographic region. For example, the coastal zone and the Galapagos islands region are exposed to sea level rise, ocean acidification and increased sea surface temperature, while the high mountain areas have considerable rates of glacier retreat and forest degradation due to land degradation and drought (Bucherie, A. *et al*., 2022).

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, the country is committed to strengthening its actions and measures to adapt to climate change. For Ecuador, adaptation is considered a fundamental pillar for development, thus betting on the generation of robust and planned multisectoral and multilevel processes that favor social justice and the rescue of local and ancestral knowledge, as well as the mainstreaming of gender, intergenerational and intercultural approaches in the communities and natural systems most vulnerable to climate change.

The Ecuadorian government, through the Ministry of Environment, Water and Ecological Transition (MAATE, by its acronym in Spanish), has been working to create the enabling conditions to manage adaptation to climate change. Significant progress has been made in strengthening the regulatory and institutional framework for climate change adaptation management by developing policies and instruments such as the First Nationally Determined Contribution (NDC) and its respective Implementation Plan (PI-NDC, by its acronym in Spanish); the progress made in the construction of Ecuador's National Adaptation Plan (NAP); the establishment of Ecuador's National Climate Finance Strategy (EFIC, by its acronym in Spanish); and the future establishment of the National Climate Change Registry (RNCC, by its acronym in Spanish).

In addition, methodologies, indicators, policies, capacity building programs and other useful tools have been promoted to reduce vulnerability and climate risk in priority sectors for adaptation (climate change toolbox and risk and vulnerability studies, among others). In line with the National Climate Change Strategy (ENCC, by its acronym in Spanish) and other planning instruments, the Ecuadorian government has implemented climate change adaptation actions for the six sectors identified as priorities.

From the point of view of climate change adaptation, generating information is essential because it enables the design of public policies aimed at mitigating the adverse effects of climate change, while facilitating informed decision

making, leading to the implementation of timely actions in the territory. The development of tools that facilitate the understanding of climate change and promote the application of such knowledge in national, subnational and local planning is strategic to foster a resilient society. On the other hand, the production of scientific and academic knowledge is important to understand the impacts that climate change is causing in the country. In this sense, Ecuador has permanently promoted the production of strategic information and the development of tools and instruments that bring the Ecuadorian population closer to understanding climate change, its impacts and opportunities for action.

Furthermore, multidisciplinary research focused on the different issues involved in this climate challenge is being promoted. For Ecuador, it is clear that understanding climate change requires interdisciplinary studies to find comprehensive solutions to build sustainable and resilient human societies. That is why, during the past few years (2016 - 2020), the country has been making efforts to improve climate databases and generate data and evidence to enable strategic adaptation. In addition, the country has sought to promote climate vulnerability and risk studies at the local level through the involvement of Decentralized Autonomous Governments (GAD, by its acronym in Spanish) to improve the understanding of the reality of the territories and thus providing them with opportunities to anticipate the impacts that climate change brings about. At the same time, it has been considered strategic to invest in the development of specialized research in different areas of climate science, recognizing the urgency of transdisciplinary studies that fill the existing information gaps and that are related to the reality and needs of the territories and their people.

Among the main milestones achieved by Ecuador, the updating of the Future Climate Projections (2020 - 2050) for temperature and precipitation variables, and the generation for the first time of the Future Ocean Projections for the variables of Sea Surface Temperature (SST), Hydrogen Potential (pH), Dissolved Oxygen (DO), Mean Sea Level (MSL), waves and inundation level (2021-2050, 2051-2080)[17], which were developed based on the high resolution models of the *Coupled Model Intercomparison Project 6* (CMIP6). This information will ensure adequate climate rationality of programs and projects, and promote the development of public climate policy and the mainstreaming of climate change in key aspects and areas for the country's development.

Taking into account that the processes of adaptation to climate change occur at the local level, through its programs and projects, Ecuador has made great efforts in the conservation and restoration of natural ecosystems; adequate management of water resources and watersheds; protection of carbon sinks (moorlands and mangroves); and afforestation and reforestation of forests. In turn, traditional agriculture and livestock farming has been oriented to include sustainable land management practices; the development of more resilient seed banks; the improvement of water use for irrigation; the strengthening of monitoring and early warning systems to reduce the risk of climate events; the reduction of land degradation and desertification; the improvement of livelihoods; capacity building for subnational governments; and mainstreaming climate change adaptation in local and national planning, among others (see table 3).

[17] The mean sea level (MSL) is presented for the same horizons, but based on the CMIP5 scenarios RCP4.5 and RCP8.5, while the results for waves and flood elevation are presented for a historical period (1985-2004), the midterm (2026-2045), and end of century (2081-2100) horizons in the RCP8.5 scenario.

Table 3: Adaptation initiatives, programs and projects implemented by Ecuador for the 2016-2020 period by type of measure

Initiative/ Program/ Project	Prioritized sector	Implementation period	Intervention areas	Beneficiaries	Type of measure	Current status (year 2020)	Amount (US$)
Regional Program for Ecosystem-based Adaptation Strategies for Climate Change in Colombia and Ecuador	Natural Heritage	2016 - 2018	Province of Manabí	550 people	Ecosystem services and natural resources	Completed	$6,000,000
Scaling up of Ecosystem-based Adaptation Measures in Rural Latin America (AbE LAC)	Natural Heritage	2020 - 2025	Province of Manabí	NI	Ecosystem services and natural resources	Under implementation	$1,070,950
ProCamBío II Program	Natural Heritage	2017 - 2020	Provinces: Napo, Loja, Zamora Chinchipe, Esmeraldas and Tungurahua	351 families	Ecosystem services and natural resources	Completed	$9,985,230
Andean Landscapes: Promoting integrated landscape management for sustainable livelihoods in the Ecuadorian Andes	Natural Heritage	2020 - 2025	Provinces: Imbabura, Cotopaxi, Bolivar and Pichincha	5.000 people	Ecosystem services and natural resources	Under implementation	$5,599,104
Adaptation to climate change of Andean populations through the management, conservation and restoration of moorlands (páramos)	Natural Heritage	2016-2019	Province of Pichincha	200 families	Ecosystem services and natural resources	Completed	$405,965
Umbrella IV Project	Natural Heritage	2020	National	NI	Management, handling and planning instruments	Completed	$63,000
Conservation and sustainable use of mountain ecosystems	Natural Heritage	2020 - 2023	Provinces: Cotopaxi, Tungurahua, Chimborazo, Bolívar, Cañar	NI	Ecosystem services and natural resources	Under implementation	$7,496,650

Table 3: Adaptation initiatives, programs and projects implemented by Ecuador for the 2016-2020 period by type of measure

Initiative/ Program/ Project	Prioritized sector	Implementation period	Intervention areas	Beneficiaries	Type of measure	Current status (year 2020)	Amount (US$)
Andes Adaptation to the Impacts of Climate Change on Water Resources Project (AICCA)	Water heritage	2018 - 2022	Provinces: Napo and Azuay	40 people	Ecosystem services and natural resources	Under implementation	$3,077,500
Adaptation to climate change for the human right to water and sanitation: replicable, scalable and resilient policies for future climate conditions	Water heritage	2020 - 2023	Provinces: Manabí, Bolívar, Esmeraldas, Sucumbíos	37 basin councils	Management, handling and planning instruments	Under implementation	$2,133,332
Women of the Moorlands: Regional experiences of adaptation to climate change and conservation of moorlands in Colombia, Ecuador and Peru	Water heritage	2017 - 2018	Provinces: Carchi, Imbabura and Chimborazo	NI	Capacity Building / Strengthening	Completed	NI
Climate vulnerability and flood risk reduction in urban and semi-urban coastal areas in Latin American cities (Adaptaclima)	Human Settlements	2020 - 2024	Province of Esmeraldas	NI	Capacity Building / Strengthening	Under implementation	$5,224,475
Sustainable Intermediary Cities Program (CIS)	Human Settlements	2017 - 2020	Provinces: Azuay, Tungurahua, Cotopaxi, Sucumbíos, Loja.	38,000 people	Monitoring and early warning systems	Completed	$6,425,700

Table 3: Adaptation initiatives, programs and projects implemented by Ecuador for the 2016-2020 period by type of measure

Initiative/ Program/ Project	Prioritized sector	Implementation period	Intervention areas	Beneficiaries	Type of measure	Current status (year 2020)	Amount (US$)
Enhancing resilience of communities to the adverse effects of climate change on food security, in Pichincha Province and the Jubones River basin (FORECCSA)	SAG	2011 - 2018	Provinces: Pichincha, Azuay, El Oro and Loja	20,865 people	Physical infrastructure	Completed	$7,449,468
Regional Program: Droughts and Floods	SAG	2019 - 2020	National	NI	Management, handling and planning instruments	Under implementation	$1,837,385
Binational Project for Strengthening adaptive capacity through food and nutritional security actions in vulnerable Afro descendant and Indigenous communities in the Colombian-Ecuadorian border area	SAG	2018 - 2023	Provinces: Esmeraldas, Carchi, Imbabura and Sucumbíos	2,000 people	Actions implemented in territory and/or social inclusion.	Under implementation	$6,451,600
Implementation of Sustainable Land Management (SLM) practices and capacity building in communities affected by land degradation Project	SAG	2017 - 2021	Provinces: Loja and Manabí	216 people	Ecosystem services and natural resources	Completed	$375,600

Table 3: Adaptation initiatives, programs and projects implemented by Ecuador for the 2016-2020 period by type of measure

Initiative/ Program/ Project	Prioritized sector	Implementation period	Intervention areas	Beneficiaries	Type of measure	Current status (year 2020)	Amount (US$)
Integrated Management to Combat Desertification, Land Degradation and Climate Change Adaptation (GIDDACC)	SAG	2014 - 2019	Provinces: Pichincha, Cotopaxi, Tungurahua, Chimborazo, Azuay, Loja, El Oro and Manabí	1,200 people	Ecosystem services and natural resources	Completed	$300,000
Climate-Smart Livestock Project (GCI)	SAG	2016 - 2020	Provinces: Guayas, Manabí, Santa Elena, Imbabura, Loja, Napo, and Morona Santiago	1,056 people	Ecosystem services and natural resources	Completed	$3,856,060
Climate Change Resilient Andes Regional Project	SAG	2020 - 2024	Provinces: Cotopaxi, Bolívar, Chimborazo and Azuay	NI	Management, handling and planning instruments	Under implementation	$1,200,000
Biodiversity and climate-smart agriculture best practices to improve resilience and productivity of family farming in Andean potato-based food systems	SAG	2019 - 2021	Provinces: Chimborazo and Tungurahua	12 producer organizations	Capacity Building / Strengthening	Under implementation	$1,362,668

Table 3: Adaptation initiatives, programs and projects implemented by Ecuador for the 2016-2020 period by type of measure

Initiative/ Program/ Project	Prioritized sector	Implementation period	Intervention areas	Beneficiaries	Type of measure	Current status (year 2020)	Amount (US$)
Adaptive livestock management model in moorlands and high Andean forests to improve income and reduce deforestation, soil degradation, water contamination and climate change impacts	SAG	2018	Province of Loja	40 people	Applied research and technological solutions (innovation)	Completed	NI
National Adaptation Plan Project in Ecuador (PLANACC)	Multisectoral	2019 - 2022	National	N / A	Management, handling and planning instruments	Under implementation	$2,727,273
Provincial Action on Climate Change Project	Multisectoral	2018 - 2019	National	N / A	Management, handling and planning instruments	Completed	NI
Capacity Building Program on Climate Finance	Multisectoral	2018-2020	National	55 people	Capacity Building / Strengthening	Completed	$559,516

NI = no information
N/A = not applicable
Prepared by: MAATE / Project 4NC-2BUR

Chapter 5: Losses and Damages Associated with Climate Change

Ecuador, due to its vulnerable condition, presents difficulties in dealing with economic and non-economic losses and damages (L&D)[18] as a result of extreme and slow onset climate-related weather events. The frequency and intensity with which extreme weather events occur in the country represent a great challenge for strategic territorial planning and the effective formulation of public policies for the benefit of vulnerable and poor communities.

In the case of Ecuador, there is no quantification of L&D associated with the impacts of climate change, but there is national data in the Historical Database of Affectations, generated by the Adverse Events Monitoring Directorate of the National Risk and Emergency Management Service (SNGRE, by its acronym in Spanish), which feeds the DesInventar Disaster Inventory System[19], and which have been used to support several studies reflecting the country's vulnerability to hydrometeorological and slow onset events[20], evidencing the importance of recording and quantifying L&D as a tool for planning and designing measures to prevent, minimize and address L&D.

According to the analysis carried out for goods, values and services with potential economic value, it was found that during the 2010-2020 period the total number of houses affected and destroyed by heavy rains in Ecuador amounted to 92,868 and 1,807, respectively. 90% (8,437) of the affected homes and 60% (1,105) of the destroyed homes were impacted by flooding. Educational establishments were particularly affected by floods (771 units), followed by landslides (71 units), windstorms (84 units) and others (18 units). During the same period, a total of 1,142 kilometers of roads were affected, 77% (875.71 km) of which were caused by heavy rains that caused landslides; 13% (157.90 km) by floods, and the remaining 10% by windstorms and other damages. Regarding crop areas, a total of 90,315 hectares were affected, of which 79% (71,531.51 hectares) were affected by floods; 17% (15,569.69 hectares) by windstorms, and the remaining 4% by landslides and other events (see table 4).

Table 4: Goods, values and services affected by hydrometeorological events registered in Ecuador during the 2010 - 2020 period

Goods, values or services	Unit	Hydrometeorological event				Total
		Floods	Landslides	Windstorm	Other events	
Affected Homes	Units	83,437	5,636	3,212	583	92,868
Destroyed Homes	Units	1,105	476	189	37	1,807
Affected Educational Establishments	Units	771	71	84	18	944
Destroyed Educational Establishments	Units	2	1	0	1	4
Affected Health centers	Units	29	0	1	5	35
Destroyed Health centers	Units	1	0	0	0	1

[18] Non-economic losses are the remainder of those elements that cannot be quantified monetarily, i.e., those items that are not usually traded in the market, since they lack a price (human lives, biodiversity, cultural heritage and ecosystem services, among others).
[19] DesInventar is a conceptual and methodological tool for the construction of databases of losses, damages or effects caused by emergencies or disasters.
[20] Slow onset events take place in a gradual manner over time, and their impacts are often based on a confluence of several events associated with temperature increase; biodiversity loss; land and forest degradation; glacier retreat and related impacts; ocean acidification; sea level rise; and salinization (UNFCCC, 2017).

Tabla 4: Bienes, valores y servicios afectados por eventos hidrometeorológicos registrados en el Ecuador durante el período 2010 – 2020

Bienes, valores o servicios	Unidad	Evento hidrometeorológico				Total
		Inundaciones	Deslizamientos	Vendaval	Otros	
Affected Bridges	Units	135	47	2	81	265
Destroyed Bridges	Units	26	16	0	23	65
Affected Public assets	Units	238	171	51	71	531
Destroyed Public Assets	Units	17	225	11	14	267
Affected Private assets	Units	277	249	38	100	664
Destroyed Private Assets	Units	27	35	4	21	87
Affected Roads	Km	157.90	875.71	7.56	100.83	1,142.00
Affected Crops	Hect.	71,531.51	1,876.82	15,569.69	1,336.98	90,315.00
Lost Crops	Hect.	34,564.02	827.10	207.19	1,221.26	36,819.58

Source: Historical Database of Affectations – Directorate of Adverse Events Monitoring of the SNGRE.
Prepared by: MAATE / Project 4NC-2BUR.

In terms of goods, values and services with non-economic value, during the same 2010-2020 period, 301 people died, of which 83% (252) were due to landslides; 13% (39) due to floods, and the remaining 4% due to windstorms and others. The total number of people whose health has been affected in some way amounts to 679,190, of which 74% (508,707) were impacted by floods; 20% (134,317) by landslides and 6% (36,166) by windstorms and other affectations. In the period analyzed, the number of people injured amounted to 555, of which 74% (410) were affected by landslides; 12% (67) by floods; 10% (56) by windstorms, and the remaining 4% by other events (see table 5).

Regarding human mobility caused by hydrometeorological events, a total of 71,807 people has been exposed to forced mobility during the 2010-2020 period. The two main causes of human mobility have been floods and landslides. Of the 69% (49,506) of people affected by floods, 19% (9,650) were stricken; 36% (17,962) were evacuated, and 45% (21,894) were sheltered. On the other hand, of the 26% (18,788) of people affected by landslides, 23% (4,249) were stricken; 30% (5,711) were evacuated, and 47% (8,828) were sheltered. The remaining 5% were affected by windstorms and other events (see table 5).

In the matter of biodiversity, of the total number of animals killed by the physical effects potentially associated with climate change (823,361), 72% (594,242) were caused by floods; 10% (84,285) by landslides, and the remaining 18% (144,832) were caused by other physical effects such as hailstorms, alluvium, landslides, and underminings. Animals were also affected (18,519), of which 43% (7,932) by flooding; 36% (6,784) due to other causes, and the remaining 21% by landslides (see table 5).

Table 5: Non-economic losses and damages caused by hydrometeorological events in Ecuador during the 2010 -2020 period

Incidence	Type of non-economic L&D	Categories	Floods	Landslides	Windstorm	Other events	Total
Individuals	Loss of life	Deceased	39	252	3	7	301
	Health	Wounded	67	410	56	22	555
		Affected	508,707	134,317	18,030	18,136	679,190
	Human mobility	Stricken	9,650	4,249	665	202	14,766
		Evacuees	17,962	5,711	418	741	24,832
		Sheltered ind.	21,894	8,828	1,162	325	32,209
Environment	Biodiversity	Affected animals	7,932	3,803	0	6,784	18,519
		Dead animals	594,242	84,285	2	144,832	823,361

Source: Historical Database of Affectations - Directorate of Adverse Events Monitoring of the SNGRE.
Prepared by: MAATE / Project 4NC-2BUR.

In Ecuador, when the El Niño-Southern Oscillation (ENSO) event occurred in 1982-1983 and 1997-1998, damages and losses were recorded of US$ 42,388.4 and US$ 34,715.8 million, respectively, giving a cumulative total of US$ 77,104.2 million at the present 2018 value (CEPAL, 1983; CEPAL, 1998; Colectivo Ecuador con Gestión de Riesgos, 2018). On the other hand, in 2008, the country's coastal area was affected by floods that caused damages and losses of US$ 4,675.2 million (PNUD, 2012; Colectivo Ecuador con Gestión de Riesgos, 2018). Although there is not enough research to confirm that the losses and damages caused by ENSO and heavy flooding are directly linked to the impacts caused by climate change, there is a high probability that their intensity is being influenced by the climatic anomalies that have been recorded in the country.

River overflows and floods are among the main natural hazards faced by a large part of the population in the coastal region of Ecuador, representing 53% of the population affected in relation to other hazards (Puebla, 2020). Floods cause large annual losses in the country's productive and social sectors. In 2012, the National Secretariat for Planning and Development (SENPLADES, by its acronym in Spanish) prepared a cost analysis of flood losses, in which it is mentioned that overall losses due to floods amounted to US$ 237.9 million, with the agricultural sector reporting the highest losses (US$ 93.5 million), followed by the housing sector, with US$ 34 million and, in third place, the water sector with US$ 30.9 million. The provinces of Manabí, Guayas and Los Ríos were the most affected by the floods, accounting for 62% of total losses (SENPLADES, 2012).

In 2020, the Master Plan for Flood Risk and Disaster Reduction in the provinces of Guayas, Manabí and Los Ríos under climate change scenarios was developed (Puebla, 2020). According to this study, the provinces of Los Ríos, Manabí and Guayas were the most affected, especially in rural areas where the main economic activity is agriculture. Losses and damages were estimated at US$ 150 million, directly affecting 33,885 people, 9,246 homes and 8,800 hectares of agricultural land. Under climate change scenarios, an approximate 5% increase in precipitation in the country's coastal zone was estimated for 2040. Therefore, in the future, the costs of damages and

losses will potentially be greater, increasing the levels of damage and poverty in this area of the territory (Puebla, 2020).

In terms of drought, during the 2000-2017 period, about 375,758 hectares of cultivated area was lost with an economic cost of US$ 424,568,387. The years with the largest economic losses were 2009 and 2011, totaling US$ 65,436,354 and US$ 92,670,636, respectively. The coastal region reached 70.21% of the total economic losses recorded, while the highlands accounted for 23.13%, and the Amazon region and non-delimited areas accounted for 6.56% (see table 6) (MAAE, 2020).

Table 6: Economic losses caused by drought in Ecuador during the 2000-2017 period

Period/year	Area lost due to drought (hectares)	Economic losses due to drought (affected crops) (US$)
2000-2001	18,732	8,394,794
2002	4,931	3,890,527
2003	10,170	6,062,413
2004	18,803	11,398,148
2005	36,951	24,871,654
2006	27,022	14,947,517
2007	14,873	13,404,229
2008	4,079	5,014,277
2009	46,705	65,436,354
2010	23,011	44,946,080
2011	65,978	92,670,636
2012	12,589	17,241,234
2013	16,118	22,818,407
2014	18,321	26,316,900
2015	29,430	32,147,040
2016	20,758	26,439,959
2017	7,287	8,568,218
National total	375,758	424,568,387

Note: data on non-economic losses due to droughts are not available.
Source: MAAE, 2020.
Prepared by: MAATE / Project 4NC-2BUR.

Chapter 6: First Nationally Determined Contribution (NDC)

The formulation process of the First Nationally Determined Contribution (NDC), for the 2020-2025 period, was carried out during the 2017-2019 period, led by the Ministry of Environment, Water and Ecological Transition (MAATE, by its acronym in Spanish), with the support of several cooperating agencies, ensuring the participation and contributions of the different government portfolios and involving the private sector, academia, civil society and international organizations.

The First NDC was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in March 2019 (MAE, 2019), and it was validated and approved by the different instances of the Government. It was developed in relation to the principles described in the National Climate Change Strategy (ENCC, by its acronym in Spanish), which refers to regional and international organization, to the consistency with international principles on climate change, to the emphasis on local implementation, environmental integrity, citizen participation, proactivity, protection of vulnerable groups and ecosystems, intergenerational responsibility, and mainstreaming and integrality (MAE, 2019). Also, the formulation of the NDC is based on the sectors prioritized for the adaptation and mitigation components of the ENCC and includes the intersectoriality, participation and gender approaches in a cross-cutting manner.

In August 2019, Executive Decree No. 840 was published, establishing the First NDC for the Paris Agreement under the UNFCCC as a State policy (PRE, 2019). This marks the beginning of the construction phase of the NDC Implementation Plan (2020-2025 period).

Through the NDC, Ecuador contributes voluntarily to global efforts to mitigate GHG emissions and increase carbon sinks. At the same time, priority was given to increasing adaptive capacity and risk reduction in the face of the adverse effects of climate change. These actions and measures will be carried out respecting the principle of common but differentiated responsibilities and in accordance with the country's capabilities (see graph 16).

The following is a brief description of the mitigation and adaptation commitments made by Ecuador within the framework of the First NDC and its Implementation Plan.

6.1 Commitments of Ecuador's First NDC

6.1.1 Mitigation Component

6.1.1.1 Unconditional Scenario

The unconditional scenario refers to measures and actions that the country can implement based on its own resources and within its capabilities (UNEP DTU Partnership, 2015). For the unconditional scenario, Ecuador committed to reduce, by 2025, 9% of national GHG emissions generated by the Energy, Agriculture, Industrial Processes and Waste sectors.

In the case of the Use of Land, Change in Use of Land and Silviculture (USCUSS, by its acronym in Spanish) sector, by 2025, according to the unconditional scenario, a 4% reduction in GHG emissions is expected, equivalent to 16,078.32 Gg CO_2-eq, considering the current Forest Reference Emissions Level from Deforestation (FREL-D) (2000-2008), which corresponds to the average annual GHG emissions from deforestation estimated at 43,418.13 Gg CO_2-eq/year. This value corresponds to the implementation of REDD+ in Ecuador. In this scenario, the quantification corresponding to the 2020-2025 period will be used to report the progress of the NDC, maintaining the percentage values. In the event that the FREL-D is updated, the percentages assigned for this scenario will be maintained and the mitigation potential will be adjusted accordingly.

A total of 13 lines of action and 9 initiatives were identified in the unconditional scenario for all sectors.

6.1.1.2 Conditional Scenario

The conditional scenario is one that goes beyond the unconditional contribution and that the country is willing to undertake if means of support from international cooperation are available (UNEP DTU Partnership, 2015). For the conditional scenario, Ecuador committed to reduce, by 2025, 11.9% of national GHG emissions generated by the Energy, Agriculture, Industrial Processes and Waste sectors.

Regarding the USCUSS sector, by 2025, according to the conditional scenario, an additional 16% reduction in GHG

emissions is expected, equivalent to 62,074.31 Gg CO_2-eq, considering the current FREL-D (2000 - 2008) equal to the average annual GHG emissions from deforestation estimated at 43,418.13 Gg CO_2-eq/year. Values to be achieved through the implementation of REDD+ in Ecuador. To report the NDC progress for this scenario, the quantification corresponding to the 2020-2025 period will be carried out, maintaining the percentage values. In the event that the FREL-D is updated, the percentages assigned to this scenario will be maintained and the mitigation potential will be adjusted accordingly.

A total of 21 lines of action and 12 initiatives were identified in the conditional scenario for all sectors.

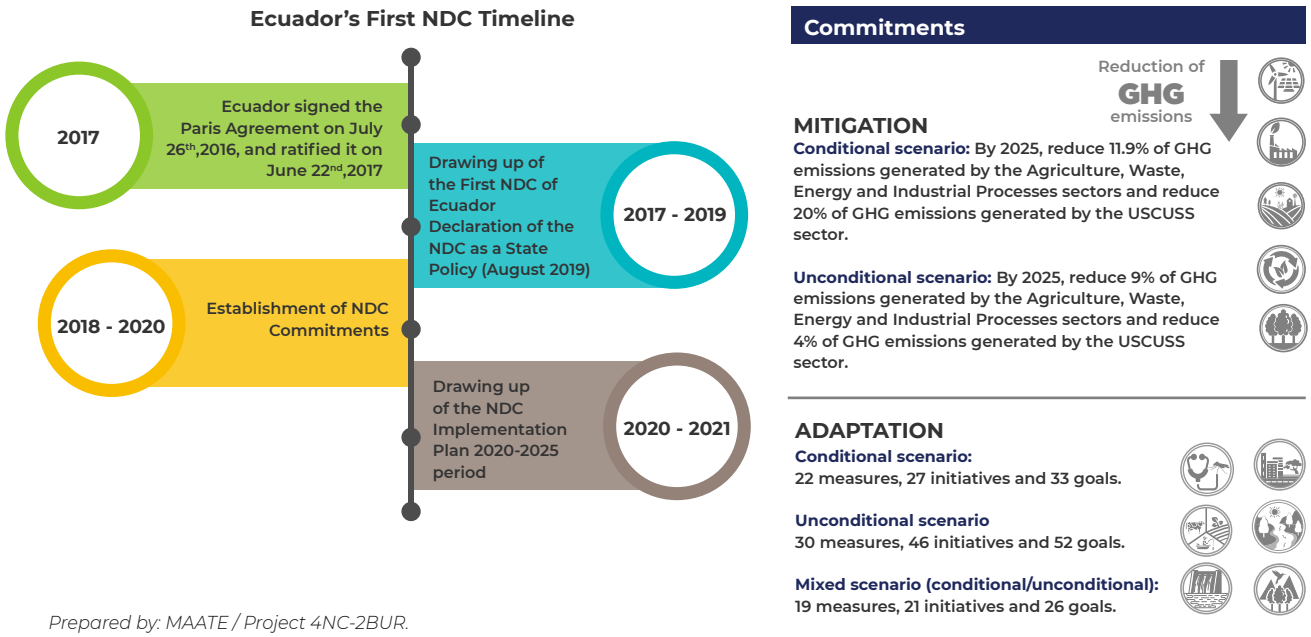
6.1.2 Adaptation Component

Regarding the adaptation commitments assumed by Ecuador under the NDC, in 2018, the country focused its efforts on building climate change adaptation scenarios (unconditional, conditional, and combined scenarios) for the six prioritized adaptation sectors, including: Natural Heritage; Water Heritage; Health; Human Settlements; Food Sovereignty, Agriculture, Livestock, Aquaculture and Fisheries (SAG); and Productive and Strategic.

During this process, adaptation measures, initiatives and goals were defined for the sectors described above and the gender approach was integrated thanks to the development of a specific methodology for this purpose. In addition, cross-cutting measures were considered for all sectors.

Thus, the NDC establishes 40 sectoral measures for this component and three cross-cutting measures for all sectors to be implemented under the unconditional and conditional scenarios. For the unconditional scenario, 30 measures, 46 initiatives, and 52 goals were identified at the sectoral level. The conditional scenario includes 22 measures, 27 initiatives, and 33 targets, covering all sectors. The mixed scenario (conditional/unconditional) includes 19 measures, 21 initiatives, and 26 goals, also at the sectoral level. All of them will jointly allow the country to reduce the risk of climate change and to increase the resilience of natural and human systems.

Graph 16: Milestones in the Formulation of Ecuador's First NDC during 2016-2020 period



Prepared by: MAATE / Project 4NC-2BUR.

Chapter 7: National Measurement, Reporting and Verification System

The establishment of Monitoring, Reporting and Verification (MRV) systems allows Parties to demonstrate compliance with national and international targets under the UNFCCC, ensuring the quality, consistency and transparency of the data and actions reported. In this context, since 2015, Ecuador has been developing actions aimed at strengthening the transparency, accuracy and comparability of information related to climate change. With Ecuador's subscription to the Paris Agreement in 2016, the agreements established in the new Enhanced Transparency Framework (ETF) have been implemented, including, among others, the development of robust MRV systems for actions aimed at the efficient management of climate change in the country.

With the entry into force of the Environmental Organic Code (COA, by its acronym in Spanish) in 2018, MAATE, as the National Environmental Authority, was empowered to coordinate with national monitoring and research institutes, public and private entities, the exchange, development and archiving of climate change information (COA, 2017). Since then, MAATE has been working on the design and implementation of the National MRV System in order to promote the organized and functional development of MRV systems under a centralized and coordinated approach among the different government portfolios.

In this regard, Ecuador has promoted the development of tools and IT platforms aimed at promoting the future establishment of a National MRV System. Progress has been made in the development of the National Greenhouse Gas Inventory System (SINGEI, by its acronym in Spanish), which will facilitate the consistent preparation of GHG inventories in accordance with UNFCCC guidelines, including inventory reporting guidelines for each sector, quality control and assurance procedures, an improvement plan, and a repository of documentation generated during the preparation of each inventory. In addition, progress is reported in terms of the interconnection of existing IT platforms in the country related to REDD+ issues, including the SINGEI, the National Forest Monitoring System (SNMB, by its acronym in Spanish), the Safeguards Information System (SIS), and the REDD+ Measures and Actions Management System (SIGMA, by its acronym in Spanish). The purpose of this is to improve the exchange of relevant information for REDD+ management in Ecuador.

Regarding adaptation, the progress achieved by the country in terms of establishing follow-up, monitoring and evaluation mechanisms based on impact indicators, developed by some Ministry's projects, among them, the Andes Adaptation to the Impacts of Climate Change on Water Resources (AICCA, by its acronym in Spanish) Project and the Enhancing resilience of communities to the adverse effects of climate change on food security, in Pichincha Province and the Jubones River basin (FORECCSA, by its acronym in Spanish) Project. In addition, the efforts to measure the effectiveness of the adaptation measures implemented in the territory through the establishment of the indicator called "Vulnerability to climate change in terms of adaptive capacity", whose data are being recorded since 2016, are highlighted.

In terms of means of implementation for climate action, Ecuador has worked in recent years to develop tools, methodologies, technical capacities and financial instruments to facilitate the determination of climate finance received and needed at the national level. The country reports progress in the application of climate finance methodologies including: (a) Climate Public Expenditure and Institutional Review (CPEIR); (b) Private Sector Climate Expenditure and Institutional Review (PCEIR); (c) Investment and Financial Flows (IFF) and (d) Climate Budget Tagging (CBT). Additionally, it is worth mentioning the development of some financial instruments, among them the Catalog of Climate Change Activities (CACC, by its acronym in Spanish) and the National Registry of Financing Accounting related to REDD+ Emission Reductions.

At the moment, the country seeks to have the conceptualization and final design of the National MRV System integrated into the National Climate Change Registry (RNCC, by its acronym in Spanish) to meet, in a timely manner, the reporting requirements necessary for the Enhanced Transparency Framework of the Paris Agreement, as well as for monitoring the implementation of the National Climate Change Strategy (ENCC, by its acronym in Spanish), the National Climate Finance Strategy (EFIC, by its acronym in Spanish), the Nationally Determined Contributions (NDC), and other national policy and planning instruments related to climate change.

Chapter 8: Financing for Climate Change Management

Climate finance is considered a determining factor for the achievement of international and national climate change mitigation and adaptation objectives. For this reason, in recent years, the country has made progress in consolidating robust information on financing, technology transfer and capacity building related to climate change management. This has contributed to improving the transparency of financial data submitted to the United Nations Framework Convention on Climate Change (UNFCCC).

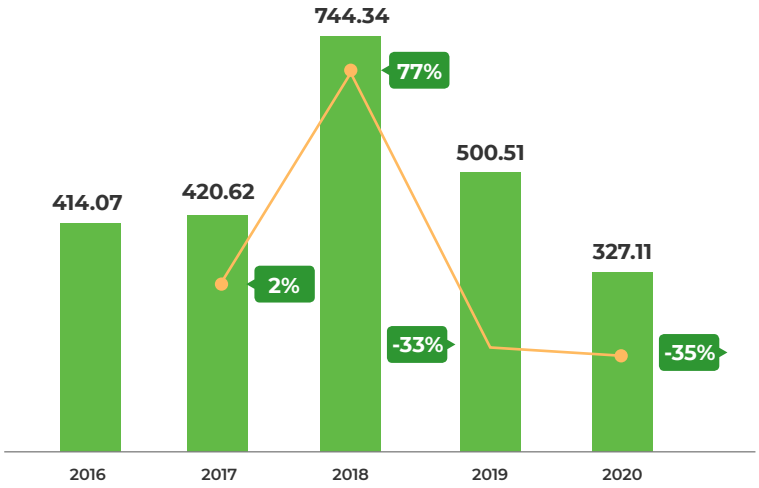
MAATE's efforts have focused on capacity building and the search for new financing opportunities that contribute to achieving increasingly ambitious national mitigation and adaptation goals. To achieve this, it has been strategic to carry out inter-institutional coordination with government entities such as the Ministry of Foreign Affairs and Human Mobility (MREMH, by its acronym in Spanish) and the Ministry of Economy and Finance (MEF, by its acronym in Spanish).

The consolidation of national regulations and the development of planning instruments linked to climate finance have also been considered a priority for the State. The main advances include the Environmental Organic Code (COA, by its acronym in Spanish) and its respective Regulation (RCOA, by its acronym in Spanish), which for the first time define specific guidelines on climate finance and regulate the development of financial monitoring, reporting and verification (MRV) systems for climate change management, including climate finance issues. In addition, this opportunity highlights the recent drawing up of the National Climate Finance Strategy (EFIC, by its acronym in Spanish) 2021 - 2030, an instrument that aims to guide access, management, allocation, and effective and efficient mobilization of international, national, public and private climate finance to enhance national and international climate change objectives.

8.1 International Climate Finance

International climate finance is essential to promote the formulation and implementation of climate change mitigation and/or adaptation projects. During the 2016-2020 period, Ecuador channeled financing for US$ 2,406.64 million. 2018 was the year in which the largest resources were approved for climate change management. In contrast, 2016 and 2020 recorded the lowest project approvals, with US$ 414.07 million and US$ 327.11 million, respectively (see graph 17).

Graph 17: Evolution of International Climate Finance in the 2016-2020 period (millions of USD dollars - Base 2007)



Source: National Climate Finance Strategy (MAAE-MEF, 2021) and MAATE administrative records.
Prepared by: MAATE / Project 4NC-2BUR.

Bilateral and multilateral funds are the country's most important sources of international financing, which together account for 90.3% of the total number of projects approved. Meanwhile, funds derived from the UNFCCC, combined, and international organizations barely represent 9.8% of the total.

Climate finance flows have been directed mainly to the area of mitigation with a 62% share (US$ 1.49 billion) of approved resources, while adaptation accounted for 12% (US$ 295.72 million). The Energy sector channels most of the funds, with US$ 1,182.27 million, representing 49% of the international resources channeled for initiatives related to energy transition projects, energy efficiency and renewable sources, among others.

8.2. Support Required for Climate Change Management

In order to meet the ambitious mitigation and adaptation objectives prioritized to address climate change, Ecuador has made an effort to identify the financing required to do so. For example, the implementation of mitigation actions outlined in the NDC will require US$ 2,654 million. The Energy sector accounts for most of the financing required, with US$ 1,906 million. This amount includes the future implementation of five strategic initiatives for the mitigation of GHG emissions under the conditional scenario. The investment required for the NDC adaptation component sectors amounts to US$ 102.8 million, corresponding to US$ 84.87 million for the unconditional scenario and US$ 17.93 million for the conditional scenario. The crosscutting measures require an investment of US$ 5.25 million.

The country is also working on the development of Ecuador's National Climate Change Registry (RNCC, by its acronym in Spanish), which will consist of the domestic MRV System and a Climate Change Information Repository. The approximate amount needed for the implementation of the first phase of Ecuador's RNCC is US$ 1.9 million. On the other hand, the implementation of the Clean Development Mechanism (CDM) project of the Toachi-Pilatón hydroelectric power plant, with a mitigation potential of 605,219 tCO_2-eq per year, with an electricity generation potential of 253 MW and a useful life of 50 years, will require a total investment of US$ 859 million. In addition, the country plans to prepare its First Biennial Transparency Report (BTR), the Fifth National Communication (NC) and the Second BTR, for which an estimated minimum

amount of US$ 1.67 million is required.

In summary, the financing required in the short term by Ecuador for the implementation of the aforementioned initiatives amounts to approximately US$ 3,624.68 million. Of this amount, 76.2% is needed for Ecuador's First Nationally Determined Contribution (NDC) and 23.7% for the implementation of the CDM. An additional 0.05% (US$ 1.6 million) will be required to comply with the submission of the next national reports (1st BTR, 5th CN and 2nd BTR), and 0.06% (US$ 2 million) for the implementation of the RNCC (see table 7).

Table 7: Summary of Financing Needs (millions of US dollars)

Items disaggregated by subject/sector	Investment amount (millions of US$)	Aggregate investment amount (millions of US$)
Nationally Determined Contribution (NDC)		**2,761.92**
Mitigation component (unconditional and conditional scenarios)		**2,653.87**
Energy	1,906.90	
Agriculture	70.36	
Waste	5.46	
USCUSS	671.14	
Industrial Processes*	---	
Adaptation component (unconditional and conditional scenarios)		**102.80**
Natural Heritage	74.26	
Water Heritage	6.20	
Health	0.78	
Human Settlements	2.32	
Productive and Strategic Sectors	0.88	
Food Sovereignty, Agriculture, Livestock, Aquaculture and Fisheries Sector	18.35	
Cross-sectional measurements		**5.25**
CDM projects		**859.00**
Toachi Pilatón CDM Project	859.00	
National Reports to the UNFCCC (2022-2026 period)		**1.67**
First BTR	0.68	
Fifth National Communication and Second BTR	0.98	
RNCC -MRV Requirements		**2.10**
SINGEI IPCC 2006 Update	0.11	
RNCC Strengthening Plan	1.99	
TOTAL FINANCING NEEDS		**3,624.68**

*Note: *In this case there is no sectoral information because there is not enough information available to calculate an estimate or, in turn, there are confidentiality agreements.*
Source: MAATE / Project 4NC-2BUR.
Prepared by: MAATE / Project 4NC-2BUR.

Chapter 9: Barriers, Needs and Opportunities for Climate Change Management

In recent years, Ecuador has made efforts in the development of regulatory frameworks, public policies, plans, programs, projects and coordination between sectors and subnational governments to address the needs of the most vulnerable territories to the adverse effects of climate change. However, within the framework of climate change management, barriers and needs are identified in terms of governance, coordination mechanisms, financing, knowledge management and research that slow down or hinder the achievement of adaptation and mitigation goals.

For Ecuador, the recognition of these limitations and difficulties is key to identifying opportunities for improvement that could strengthen climate change management at the national and local levels. This process is aimed at enabling the future establishment of innovative strategies, the efficient implementation of public policies, increasing installed technical capacities and improving the performance and response of national and subnational institutions in charge of executing actions in the territory, among other benefits.

In this sense, it was considered necessary to analyze the barriers, needs and opportunities that arise in the framework of climate change management based on the evaluation of the following topics considered strategic for the country: a) Climate change mitigation management; b) Climate change adaptation management; c) Means of implementation; and d) National Monitoring, Reporting and Verification System (MRV). In order to focus the analysis on the most relevant aspects, each strategic theme was evaluated based on the following cross-cutting areas: a) Institutionality/Governance; b) Coordination mechanisms; c) Financing; d) Knowledge management; e) Technology transfer; and f) Research.

In general, the analysis reflects that the strengthening of climate change management in the country will depend mainly on the role of MAATE, as National Environmental Authority, through the promotion of periodic and continuous sectoral dialogs that favor the development of sectoral regulations to support the implementation of mitigation and adaptation actions established in the country's roadmap. It is essential to encourage national, subnational, private and local stakeholders to participate in these policy building spaces, ensuring their empowerment and co-responsibility in the initiatives, projects and programs that are underway, including the First Nationally Determined Contribution (NDC), Nationally Appropriate Mitigation Actions (NAMA), the REDD+ Mechanism, Ecuador's National Climate Change Adaptation Plan (NAP), the National MRV System, and the National Climate Change Registry (RNCC, by its acronym in Spanish), among others.

Although the Environmental Organic Code (COA, by its acronym in Spanish) and its respective regulation establish that financing needs and priorities must be identified in all climate change management instruments, there are gaps in reaching agreements and establishing instruments, mechanisms and processes for quantifying, channeling and monitoring climate finance. There are also limitations related to access to the financing required to implement adaptation and mitigation measures and actions. The fact that there is no global adaptation objective formally recognized by the member countries of the UNFCCC makes it difficult to access and adequately allocate the financial resources required to address this strategic issue for national development.

In terms of mitigation, although the country has a clear roadmap that defines actions to be implemented in the short, medium and long term, in most cases there is no funding allocated to ensure compliance. Therefore, it is essential that the country implement its National Climate Finance Strategy (EFIC, by its acronym in Spanish), so it will be possible to access and improve governance and coordination mechanisms for the strategic channeling of funds at the national and subnational levels, while facilitating their transparent monitoring.

For Ecuador, it is clear that the implementation of mitigation and adaptation actions proposed in the framework of the NDC, MRV Systems, National Greenhouse Gas Inventory (NGHGI), and other key strategies for the country, requires, in many cases, a strong component of technology transfer from developed

countries. Although the country has implemented several projects to develop technologies adapted to the national reality, it is still necessary to work on protocols, and scalability and replication processes to promote their application on a local scale. One of the main barriers to the adoption of state-of-the-art technologies is the high cost of acquiring, installing and maintaining them. It is therefore crucial that developed countries guarantee access to these technologies at affordable prices and adapted to local requirements, backed by permanent technical advice.

With the support of international funding, Ecuador has included capacity building processes in the various climate change programs, projects and initiatives being implemented in the country, aimed mainly at public and private actors. However, in the particular case of the public sector, the constant loss or rotation of trained personnel weakens the progress and continuity of the processes implemented in the different sectors of adaptation and mitigation. There is also a need to broaden the access to capacity building processes developed within the framework of climate change programs, projects and initiatives led by the MAATE's Undersecretariat for Climate Change (SCC, by its acronym in Spanish). This is aimed at increasing the number of beneficiaries of the aforementioned processes and promoting the development of the technical capabilities required in the country. In addition, the development of IT platforms and tools to facilitate access to and management of knowledge on the subject is considered strategic.

With respect to research, challenges include the training of professionals in climate change science and the establishment of lines of research that contribute to the country's objectives and provide key information for the transparent preparation of IPCC assessment reports. Work should be done on the dissemination and application of scientific findings related to the impacts of climate change and improve the interpretation and communication of scientific information for decision-makers and the general public. To this end, it is necessary to promote alliances between universities, NGOs, research centers and subnational governments, so that research agendas, programs and projects can be carried out to support the generation of knowledge and information to facilitate informed decision making.

Chapter 10: Other Relevant Information

Ecuador, in accordance with the Guidelines on National Communications from Non-Annex I Parties of the United Nations Framework Convention on Climate Change (UNFCCC), presents information considered strategic and relevant for the achievement of objectives and commitments assumed in the fight against climate change.

In terms of gender mainstreaming, there has been significant progress in terms of governance, institutional framework and availability of information to promote gender mainstreaming in climate change management. In addition, the country has adopted tools and inputs for mainstreaming gender in concrete actions, making it possible to have methodological criteria that guide the processes of training, intervention, implementation, design of indicators and evaluation, among others.

In Ecuador, Children, Adolescents and Young Adults (NNAJ, by its acronym in Spanish) are considered as Priority Attention Groups (GAP, by its acronym in Spanish), protected by the Ecuadorian Constitution, and included in the strategies and instruments of National Planning, such as the National Climate Change Strategy (2012-2025), the National Development Plan, and the Nationally Determined Contribution (NDC). In this regard, evidence is presented on the impacts of climate change on Ecuador's NAAJ, related to access to water and safe sanitation, health and education. This analysis reflects that the socioeconomic conditions of this age group are non-climatic factors that could significantly increase their vulnerability.

On the other hand, the traditional knowledge of indigenous people and nationalities is considered and respected by Ecuador. For this reason, the country has been contributing with knowledge and technologies that promote the optimal use of natural resources, producing tools and inputs to promote sustainability and respect for Indigenous rights and their ancestral knowledge. In this way, efforts have been made to strengthen the coordination with local organizations and

communities through internal decision-making mechanisms and territorial planning expressed in the local vision of development through the Life Plans, stressing the importance of the fundamental vision of the territory based on local knowledge and wisdom. In addition, the drawing up of technical proposals has been promoted, both for restoration and conservation, based on inputs and proposals made by the Indigenous nationalities. This has ensured that the initiatives implemented have a local vision, which is unique and revitalizes the knowledge and development processes of the local communities.

The use and transfer of technological knowledge for the benefit of society and the productive sectors is a fundamental condition to bring about the decarbonization and resilience of the country. Ecuador was one of the countries that benefited from funding from the Climate Technology Centre and Network (CTCN), which focuses on providing technical assistance, capacity building, transferring climate technologies and exchanging knowledge with developing countries. Among the most important milestones in this area are the implementation of the projects named "Alternatives for the implementation of waste-to-energy systems in small and medium-sized livestock farms" and "Technology transfer, dissemination of gasifiers and residual biomass biodigesters to minimize Greenhouse Gas (GHG) emissions from Urban Solid Waste (USW)", which were financed by the CTCN.

Environmental education in Ecuador focuses on transmitting knowledge and lessons to the population regarding the importance of protecting the natural environment and thus generating values, habits and conscious behaviors that tend to prevent and solve current and future environmental problems, including climate change. Therefore, it constitutes a tool that stimulates the implementation of citizens' own skills to solve environmental problems and make decisions in favor of sustainable development. The development of research is a strategic axis to confront climate change and its results support the adequate implementation of mitigation measures, while facilitating the adaptation of the population to its adverse effects. This is possible by generating key scientific information and knowledge, strengthening informed territorial planning and technology transfer.

The country has been permanently strengthening capacities and raising public awareness of environmental issues through clear guidelines and instruments that advise research and the educational programs implemented, thus filling the gaps that are evident in specialized topics such as climate change. The State's efforts have been supported by educational initiatives, courses, training workshops and research promoted by non-governmental organizations (NGOs), research institutes, international cooperation agencies and citizens in general, whose contributions have helped Ecuadorians understand the repercussions of the climate crisis, motivating them to take action in the face of this global problem.

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