Ecuadorian Waste Sector Methane Analysis

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About

About Clean Air Task Force

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The Waste Methane Assessment Platform (WasteMAP), a joint initiative by RMI and CATF, is an open online platform that brings together waste methane emissions data with decision support tools for stakeholders in the waste sector. The platform is supported by country engagement that involves collaboration with national and subnational governments, waste management officials, and other key decision makers to provide capacity building and technical assistance—providing a pathway to reduce solid waste methane emissions. Please visit **https://wastemap.earth/** to learn more.

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Abbreviations and Acronyms

AME*	Association of Municipalities of Ecuador
ARCERNNR*	Agency for the Regulation and Control of Energy and Non-Renewable Natural Resources
CODA*	Organic Code of the Environment
GADM*	Decentralized Municipal Autonomous Government
GHG	Greenhouse Gas
GRECI*	Solid Waste Management and Inclusive Circular Economy
INEC*	National Institute of Statistics and Census
ISWM	Integrated Solid Waste Management
MAATE*	Ministry of Environment, Water and Ecological Transition Water
MEM*	Ministry of Electricity and Mines
MPCEIP*	Ministry of Production, Foreign Trade, Investment and Fisheries
MSW	Municipal Solid Waste
MW	Megawatt
NDC	National Determined Contribution
RCODA*	Regulation on the Organic Code of the Environment
SNIM*	National System of Municipal Information

* Indicates an acronym is in Spanish

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SECTION 1

Introduction

Methane emissions from municipal solid waste (MSW) management present a critical challenge in Ecuador, particularly considering the country's growing waste generation and insufficient waste management practices. According to the Ministry of Environment, Water and Ecological Transition (MAATE) and the Solid Waste Management and Inclusive Circular Economy (GRECI) project, Ecuador generated more than 5 million metric tons of solid waste in 2022, with projections indicating this figure will exceed 15 million metric tons by 2030. However, gaps in financial resources for waste management, coupled with limited technical capacity and infrastructure for organic waste treatment, and short lifespans of landfills and disposal sites restrict the adoption of sustainable practices in Ecuador's 221 Decentralized Municipal Autonomous Governments (GADMs) and exacerbate the sector's environmental impact.

The MSW sector plays a significant role in Ecuador's greenhouse gas (GHG) emissions profile, with methane being a major contributor. Waste sector emissions in Ecuador have quadrupled since the early 1990s (see Figure 1), but only 15 major waste disposal sites are responsible for a substantial portion of these emissions. Notably, Guayaquil and Quito, Ecuador's largest cities, account for 42% of these emissions, underscoring the impact of urban centers on the national methane profile.[1]

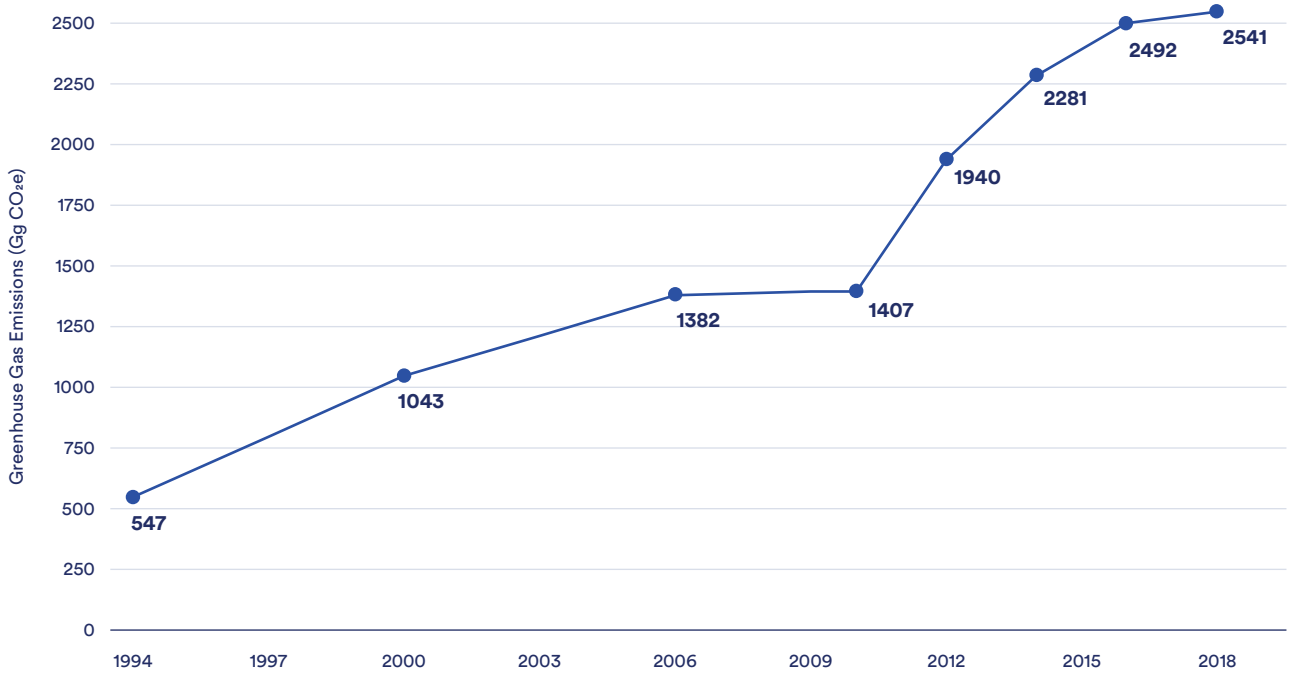
Nationally, efforts to address climate change include Ecuador's first Nationally Determined Contribution (NDC), which commits to reducing GHG emissions by at least 9% by 2030.[2] The recently launched National Climate Change Mitigation Plan 2024–2070 further emphasizes the importance of waste management in achieving long-term decarbonization goals, calling for reduced waste generation, elimination of open dumps, and enhanced financial and technical support for sustainable waste management practices.

1 Franco, A. Solano, J.L., Guamán, J.R. (2024). *Metano contaminación y mitigación, desde una mirada basura cero*. https://www.alianzabasuraceroecuador.com/wp-content/uploads/2024/05/Boletin-Metanoweb-100524.pdf

2 MAATE. (2022). *Contribución Determinada a Nivel Nacional: Ecuador*. https://www.ambiente.gob.ec/wp-content/uploads/downloads/2022/02/Folleto-NDC-2020-2025.pdf

Figure 1: Historic GHG Emissions from Ecuador's Waste Sector (1994–2018)

Source: MAATE. (2022). Fourth National Communication and Second Biennial Update Report of Ecuador to the United Nations Framework Convention on Climate Change.



Despite these commitments, challenges persist. At the national level, a lack of long-term planning exists for improved waste management. Current laws promote, but do not enforce, the application of the waste hierarchy, and local governments often lack the political will and resources to implement best practices. Organic waste management, in particular, is underprioritized, with limited infrastructure, weak regulatory frameworks, and a lack of integration with other waste recovery initiatives.

This report examines the methane emissions associated with Ecuador's municipal solid waste sector. It highlights the gaps in current management practices, the legislative and financial barriers to effective implementation, and opportunities for improving methane mitigation through enhanced waste recovery and sustainable management practices. The analysis aims to provide actionable insights for stakeholders, aligning local and national efforts with Ecuador's broader climate mitigation goals.

Section 2 of this report overviews methane emissions from the Ecuadorian Solid Waste Sector. Section 3 identifies key stakeholders involved in improving waste management and mitigating methane and outlines their responsibilities. Section 4 presents the country's institutional framework for waste management and methane mitigation. Section 5 discusses the current state of waste management through available data and trends in the sector. Section 6 presents challenges and key opportunities to mitigate methane pollution from the waste sector in Ecuador.

SECTION 2

Methane Emissions from the Ecuadorian Solid Waste Sector

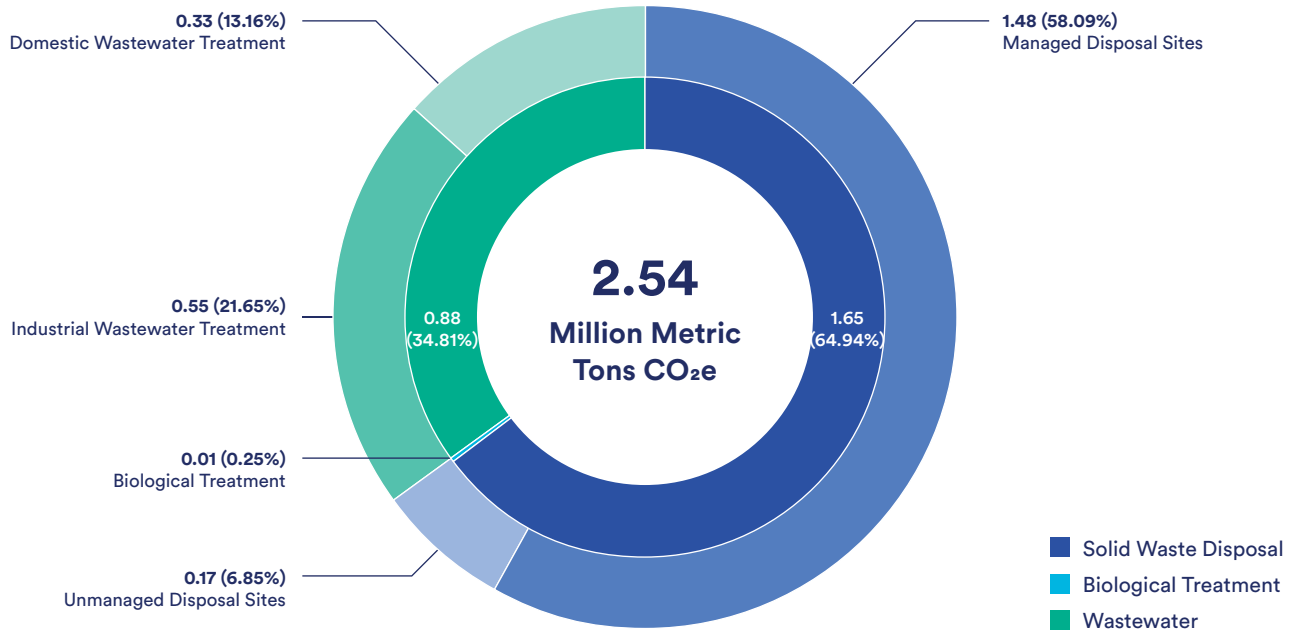
Ecuador's second Biennial Update Report, submitted to the United Nations Framework Convention on Climate Change, reported total national GHG emissions of 75 million metric tons carbon dioxide equivalent in 2018 and the waste sector (solid waste and wastewater) represents 3% of this total. However, the waste sector accounts for 18% of Ecuador's annual methane emissions, and on average 92% of GHG emissions from waste in Ecuador are methane pollution.

Of the approximately 2.5 million metric tons of carbon dioxide equivalent emitted by the waste sector in 2018, 65% stem from waste from disposal sites, 35% from wastewater, and <1% from biological treatment (Figure 2). Emissions from hazardous and industrial waste incineration are not included in the estimated national inventory for this year.[3]

[3] Incineration is not prohibited in Ecuador, but the Regulation of the Environmental Code requires the application of the waste hierarchy, which ranks incineration as a less preferred action that waste minimization, recycling, and treatment. The co-processing of hazardous and special waste is also regulated by Ministerial Agreement No. 048.

Figure 2: Ecuadorian Waste Sector GHG Emissions in 2018

Source: MAATE. (2022). Fourth National Communication and Second Biennial Update Report of Ecuador to the United Nations Framework Convention on Climate Change.



For national inventories, Ecuador uses a 100-year global warming potential of 25 to calculate the carbon dioxide equivalence for methane. If a 20-year global warming potential is used for methane instead, **waste sector methane emissions in 2018 rise from 2.5 to 8.1 million metric tons of carbon dioxide equivalent.**[4]

At the province or municipal level, GHG inventories have not been developed by the national government. However, information published by the Zero Waste Alliance of Ecuador in collaboration with the Andina Simón Bolívar and the Catholic University of Cuenca shows that the country's methane emissions come mainly from 15 municipal solid waste disposal sites (see Figure 3). These 15 municipalities account for 64% of the total emissions, amounting to 821 kilotons from 2014 to 2023. Guayaquil and Quito, the two most populous areas in Ecuador, account for 42% of methane emissions.[5,6,7]

[4] Using the GWP-AR-6 20-year non-fossil value for methane of 79.7.

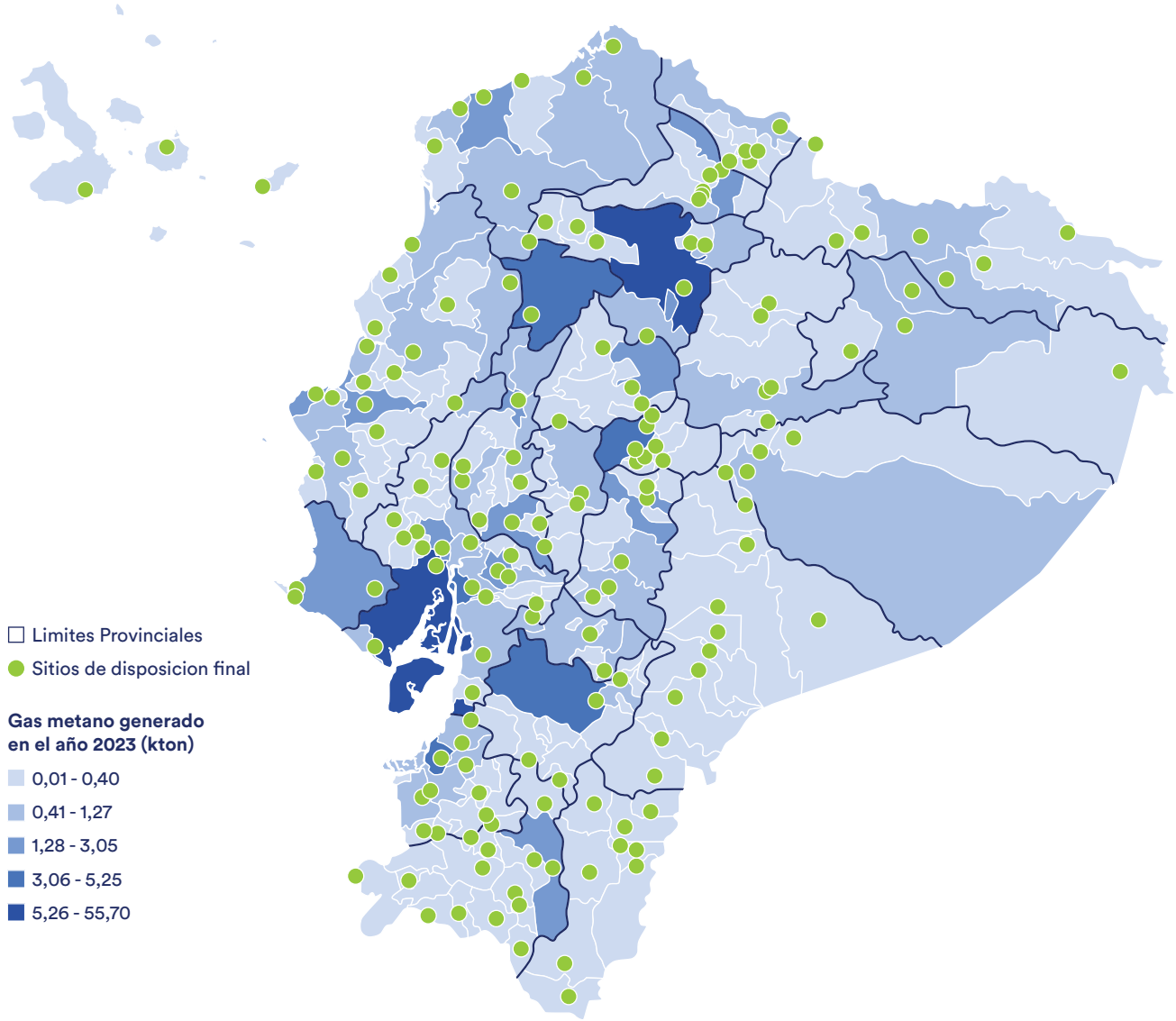
[5] The 15 municipalities are Guayaquil, Quito, Cuenca, Santo Domingo, Durán, Machala, Ambato, Portoviejo, Manta, Esmeraldas, Loja, Quevedo, Riobamba, Ibarra, and Babahoyo.

[6] Other influences on waste production such as lifestyle, waste generation per capita, poverty level, etc. were not considered in the study.

[7] Franco, Solano, and Guamán. (2024). *Metano contaminación y mitigación, desde una mirada basura cero*.

Figure 3: Methane emissions (kilotons) generated by municipalities in Ecuador in 2023

Source: Andina Simón Bolívar University, Catholic University of Cuenca, et al. (2024). Methane: Pollution and Mitigation from Zero Waste Perspective.



SECTION 3

Stakeholders Involved in Waste Methane

Key stakeholders involved in improving waste management and mitigating waste methane emissions in Ecuador include public institutions, private organizations, industries, local communities, waste workers, and other groups involved in the waste sector. Table 1 outlines relevant stakeholders and describes their roles in Integrated Solid Waste Management (ISWM), climate change initiatives, and GHG mitigation.

Table 1: Key Solid Waste Stakeholders in Ecuador

Source: GIZ. (2021). Ecuadorian Circular Economy White Paper.

Stakeholder	Role
MAATE	National environmental authority that leads the development of policies, guidelines, and directives on environmental management issues, control of environmental impacts from infrastructure, as well as climate change issues. The Undersecretariat for Environmental Quality includes the GRECI project, which focuses on implementing integrated waste management, emphasizing circular economy and inclusive recycling. Meanwhile, the Undersecretariat for Climate Change is responsible for climate change policy and projects, as well as GHG inventories and reports.
National Institute of Statistics and Census (INEC)	Conducts population, agricultural, economic, and other censuses. For national waste inventories, INEC provides population census data and official projections. It also collaborates with the Association of Ecuadorian Municipalities and the Development Bank of Ecuador in the planning, design, collection, processing, analysis, and dissemination of municipal waste management data.

Stakeholder	Role
National Secretariat of Planning and Development	Coordinates and articulates medium- and long-term planning, aimed at the sustainable and inclusive development of the country, considering improvements to the quality of life of the population. Leads the implementation of the National Development Plan 2021–2025.
Ministry of Production, Foreign Trade, Investment and Fisheries (MPCEIP)	Promotes sustainable development of the industrial sector and the use of waste as a raw material for industry, among other responsibilities. Leads the national circular economy agenda.
Ministry of Energy and Mines (MEM)	Issues public policies on electricity generation, including from biogas, among other responsibilities.
Development Bank of Ecuador (BDE)	Finances engineering studies, construction, and institutional strengthening for municipalities that provide drinking water, sewage, solid waste management, and latrines as a public service.
Superintendency of Popular and Solidarity Economy	Promotes the organizational strengthening of grassroots recyclers.
National Institute of Solidarity Economy	Government institution that promotes public policies that allow the use of solid waste with social and economic inclusion of grassroots recyclers in the country.
Decentralized Provincial Autonomous Government	Regional administrations that include a group of municipalities. These institutions develop strategies for productive development on a regional basis, including supporting and empowering primarily rural actors.
Consortium of Provincial Governments	Association of provincial administrations responsible, among other things, for implementing the Provincial Climate Change Strategy, which provides a provincial approach to implementing targeted measures to reduce GHG emissions at the regional level.
GADM	Implements local polices, including developing and executing municipal waste management programs, which should include recycling programs and appropriate treatment of organic waste, and providing public drinking water, sanitation services, and environmental sanitation activities.
Association of Ecuadorian Municipalities (AME)	Improves the management of local governments by helping municipalities deliver services to citizens, implement public policies, and fulfill legal obligations. Also, it leads the management of the National Municipal Information System Platform, which collects information on integrated solid waste management, drinking water, and sewage management, among others.
Commonwealths or Associations	Legal figure that allows regional, provincial, and municipal governments to group to integrate processes and improve the management of competency or provision of sanitation and other public services.
Sanitation Service Companies	Mainly in large- and medium-sized cities, public sanitation companies are responsible for the collection, transportation, transfer, treatment, and final disposal of solid waste. It is also common in Ecuador for private companies to be contracted for specific activities or services, such as heavy equipment rental, sweeping and collection, leachate management, etc.
Private and Community Organizations	Private and community organizations collect organic waste from households for treatment. Entities called "Organic Waste Collection Service Providers" contribute and improve waste management and promote environmental sustainability. Organizations such as Agrovivas, Biocompost, and ANUNA, among others, have emerged as key players in this sector, providing essential services that promote sustainable waste practices.
Informal Sector and Recyclers	Manage solid waste through collection, transportation, source selection, and commercialization, reducing the amount of waste reaching final disposal. Approximately 20,000 formal and informal waste recyclers exist in the country as of 2020.[8] The National Network of Recyclers of Ecuador (RENAREC) is the largest association in Ecuador. Ecuador has 50 national associations.

[8] RENAREC. (2019). *RENAREC*. https://renarec.wordpress.com

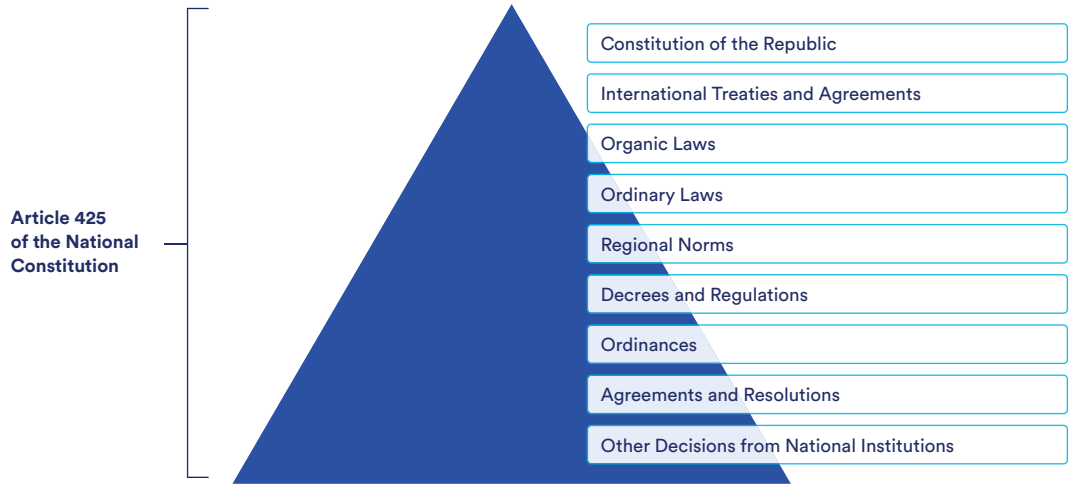
SECTION 4

Institutional Framework for Waste Management and Methane Mitigation

Ecuador's regulatory framework is framed within Article 425 of the National Constitution; Figure 4 outlines the hierarchical order of application of laws in the country.

Figure 4: Hierarchical Order of Application of Regulations in Ecuador According to Article 425 of the National Constitution

Source: MAATE. (n.d.). Presentation "Legal Framework for the Non-hazardous Solid Waste Management in Ecuador" by the Solid Waste Management and Inclusive Circular Economy Project.



National Framework on Waste Management

The following information provides an overview of waste management policies and programs at the national level in Ecuador. This overview is based on the national hierarchy established in the National Constitution and Figure 4. A more detailed list is included in Annex A.

The legal framework for waste management in Ecuador derives from environmental protection clauses in Ecuador's National Constitution, mainly Article 14, which gives the population the right to live in a healthy and ecologically balanced environment. Articles 265 and 415 also mention the responsibility of municipalities to provide public services, including solid waste management, and to implement reduction and recycling programs.

Following the Constitution, the Organic Code of Territorial Organization, Autonomy, and Decentralization in Articles 55 and 57 establishes that the GADM are responsible for MSW management in Ecuador's 221 municipalities, providing waste management as a public service in all phases, including collection and street sweeping systems to final disposal.[9]

In the environmental field, the Environmental Code and its Regulation regulate the general policy of waste management, introduce the principle of waste hierarchy, establish MAATE's responsibility to develop the National Solid Waste Management Plan, and the municipalities' obligation to develop local plans, programs, and projects in the waste sector, as well as the use of sanitary landfills for final disposal.[10]

The main regulatory mechanisms include:

- The National Constitution of Ecuador
- International treaties, such as the Paris Agreement, the Global Methane Pledge, the Global Plastics Treaty, etc.
- The Environmental Code (CODA) and its Regulation (RCODA)
- Organic Code of Territorial Organization, Autonomy and Decentralization[11]
- The National Development Plan[12]
- Various national laws, such as the Organic Law on the Inclusive Circular Economy
- Strategic Component of the National Solid Waste Management Plan[13]
- National Strategies, such as the National Climate Change Strategy 2012-2025[14]
- Various ministerial agreements and resolutions

Waste Management Strategies and Plans

Resolutions and policies in Ecuador that are centered on the concept of circular economy are focused on inorganic waste and represented by Extended Producer Responsibility. Since 2013, extended producer responsibility programs have been implemented for several waste streams, such as programs for the collection of tires, agricultural pesticide containers, batteries, mobile phones, luminaires and light bulbs, etc.[15] In addition, in recent years the following regulations have been published:

- 2020, Rationalization, Reuse, and Reduction of Single-Use Plastics Law
- 2021, Regulation to the Organic Law for the Rationalization, Reuse and Reduction of Single-Use Plastics
- 2021, the Inclusive Circular Economy Organic Law

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9 Presidencia de la República de Ecuador. (2015). *Código Orgánico de Organización Territorial, COOTAD*. https://www.gob.ec/sites/default/files/regulations/2020-10/codigo-organico-de-organizacion-territorial-cootad.pdf

10 These documents were published in 2017 and 2019 and updated in 2021.

11 Organic laws are a special category of legislation, higher than ordinary laws but lower than the Constitution. They deal with matters of great importance for the functioning of the State and the protection of fundamental rights.

12 The Development Plan for the New Ecuador 2024–2025 is in force, but as it is a policy that is constantly being updated, it is not detailed in depth in this document.

13 MAATE. (2024). *Strategic Component of the National Plan for the Management of Non-Hazardous Solid Waste and Solid Waste.* https://www.ambiente.gob.ec/wp-content/uploads/downloads/2024/05/Componente-EstratEgico-del-Plan-Nacional-para-la-GestiOn-integral-de-Residuos-y-Desechos-SOlidos-no-peligrosos.pdf

14 According to MAATE, the National Climate Change Strategy 2012–2025 is being updated.

15 MAATE. (2011). Ministerial Agreement 161. Regulation for the Prevention and Control of Contamination by Hazardous Chemicals, Hazardous and Special Wastes. https://www.ambiente.gob.ec/wp-content/uploads/downloads/2014/05/AM-161-Reforma-al-Titulo-V-y-VI-del-TULSMA-RO-631-01-02-2012.pdf

Currently, MAATE is developing the National Solid Waste Management Plan, and the Strategic Component of the National Plan for the Management of Non-hazardous Solid Waste is published.[16,17] The vision for 2035 emphasizes the active involvement of all sectors and stakeholders in an efficient integrated waste management model. This model aims to achieve environmental, social, technical, and financial sustainability through effective public policies and shared responsibility. It also highlights the importance of multi-level governance, an informed and engaged citizenry, and a focus on circular economy principles and climate change management. This instrument includes five strategic lines of action:

- Institutional strengthening and capacity building
- Sustainable innovation and technology
- Socialization, education, and environmental behavioral change
- Financial sustainability and financing mechanisms
- Circular and inclusive waste management

In addition, other sectors and legislation support the widespread adoption of practices that will help to improve ISWM. Examples are listed below:

- Standards for voluntary source separation of MSW were established by the Ecuadorian National Standards Body in 2014. These standards promote source separation of waste, primarily into recyclable, non-recyclable, and organic waste fractions, and assign colors for waste bins and containers, according to waste type, to help differentiate for collection. In 2017, Ecuador legally established in the CODA, the obligation to carry out separation at source, and in 2019, source separation was included as a necessary phase of waste management that municipalities are required to implement through the RCODA.[18]
- A law to prevent and reduce food loss and waste and alleviate hunger among vulnerable populations was published in 2022, and prior to its enactment, there were no explicit laws regulating food waste and food donation in Ecuador.
- Two voluntary guidelines were launched in 2024: the Guidelines for the Implementation of the Source Separation of Non-hazardous Solid Waste, and the Guidelines for the Quantification and Characterization of Non-hazardous Solid Wastes and Residues in the municipalities of Ecuador. These documents will improve the solid waste management sector, mainly in the quality of data and the implementation of successful organic and inorganic waste recovery initiatives.[19]
- A National Circular Economy Strategy is currently being developed by MPCEIP, but this focuses on inorganic recyclables.[20]

16 MAATE. (2024). *Strategic Component of the National Plan for the Management of Non-Hazardous Solid Waste and Solid Waste*.

17 The development of the Plan has been a participatory and gradual process that, at the time of publication of this document, has two instruments published on the MAATE website (https://www.ambiente.gob.ec/proyecto-gestion-integral-de-residuos-solidos-y-economia-circular-inclusiva-greci/). The first corresponds to the creation of an Integrated Waste Management Committee and the second to the Strategic Component.

18 MAATE. (2019). *RCODA*. https://www.gob.ec/sites/default/files/regulations/2019-09/Documento_RCOA%20RO%20507.pdf

19 MAATE. (2024). *Technical Tools for the Integrated Management of Non-hazardous Solid Wastes and Residues. & MAATE. (2023). Economic-Financial Diagnosis of Integrated Waste and Non-Hazardous Solid Waste Management in the Decentralized Autonomous Governments of Ecuador.* https://www.ambiente.gob.ec/proyecto-gestion-inMAATE

20 Ministerio de Relaciones Exteriores y Movilidad Humana. (2021). *Ecuador y su Estrategia Nacional de Economía Circular.* https://www.wto.org/english/tratop_e/devel_e/a4t_e/ecuador_100621.pdf

Cost Recovery for Waste Management Services

Each municipality calculates its unique waste management tariff and establishes it through a local ordinance in accordance with the Articles 566 and 568 of the Organic Code of Territorial Organization, Autonomy and Decentralization, which establishes the faculty of municipalities to set tariffs for public services, including the sanitation service and waste collection system.

Article 60 of the Organic Law reforming the Organic Law of the Public Electricity Service states that the waste collection tariff may be charged through public electricity bills. The law also states that municipalities must provide electricity companies with technical studies for setting the tariffs, together with the list of subscribers who receive the waste collection service.[21]

However, due to new regulation, electricity companies are no longer obliged to collect the tariff on behalf of a municipality, but to ease this transition, MEM provided a two year window—through December 31, 2025—for municipalities to identify a new collection mechanism.

Slightly more than half of municipalities use electricity bills as a collection mechanism for the waste tariff, 23% use drinking water, 13% use their own invoicing, and 10% use property tax.[22] Electricity bill collection is preferred due to its broad coverage and efforts to ensure higher fee collection rates for this utility. Smaller municipalities typically use water bills for collection because they are another municipal service, offering immediate access to information and fund management. Property tax is the least recommended method because it is collected annually and does not identify multiple housing units on a property.

Box 1: Financial Sustainability of Waste Management in Ecuador

On average, municipalities allocate most of their ISWM budget to the following phases:

- Collection and transport (42%)
- Final disposal (19%)
- Sweeping and cleaning (16%)

Activities related to temporary storage, source separation, transfer stations, resource recovery, training, debt, and administrative costs account for only 22% of total costs. However, only 40% to 60% of the costs incurred are recovered through the tariff, and only half of the municipalities in Ecuador have carried out specific studies to establish the total costs of services and corresponding rates to charge to users. The cost of the service varies between US$60 and US$135 per ton, with the smallest municipalities having the highest costs.

[21] FAO. (2019). *Organic Law Reforming the Organic Law of the Public Electric Energy Service*. https://leap.unep.org/countries/ec/national-legislation/ley-organica-reformatoria-la-ley-organica-del-servicio-publico-de

[22] MAATE. (2023). *Economic-Financial Diagnosis of Integrated Waste and Non-Hazardous Solid Waste Management in the Decentralized Autonomous Governments of Ecuador.*

Box 2: Inclusive Recycling in Ecuador

Grassroot recyclers play an important role in waste collection throughout Ecuador. According to the National Network of Grassroot Recyclers in Ecuador, there are approximately 20,000 formal and informal waste recyclers, as of 2020, who collect up to 208,000 tons per year of inorganic waste. Of the 1,707 tons per day of inorganic recyclables recovered, grassroot recyclers are responsible for between 50% and 85% of the total recovery.

Given its importance, the government of Ecuador has issued regulations to improve the working conditions of grassroot recyclers, mainly through the General Law on Inclusive Circular Economy, which is an important regulation that recognizes their work and creates a legal basis for financial compensation for it. The law also helps recyclers access infrastructure, equipment, transportation, training, social security benefits, and credit to help improve their working and living conditions. Additionally, the Organic Law of Popular and Solidarity Economy opens the way to participation in decision-making spaces and promotes the creation of cooperatives.

However, the inclusion of informal grassroot recyclers is one of the main barriers and challenges to waste methane mitigation. Many lack access to training, resources, and infrastructure necessary for effective waste separation, leading to practices like open dumping.

Sources:

Solíz Torres, María Fernanda, Durango Cordero, Juan Sebastián, Solano Peláez, José Luis, Yépez Fuentes, and Milena Alía. (2020). *Cartografía de los residuos sólidos en Ecuador.* https://repositorio.uasb.edu.ec/handle/10644/7773

MPCEIP et al. (2021). *Libro Blanco de Economía Circular de Ecuador.* https://www.produccion.gob.ec/wp-content/uploads/2021/05/Libro-Blanco-final-web_mayo102021.pdf

Fundación Avina. (2021). *Ecuador Passes the First Inclusive Circular Economy Law in Latin America.* https://www.avina.net/wp-content/uploads/2022/11/ecuador-passes-the-first-inclusive-circular-economy-law-in-latin-america.pdf

National Framework for Climate and Methane Mitigation from Waste

Mitigation strategies in the solid waste sector include reducing emissions through waste prevention and minimization, reducing food loss, implementing waste diversion, promoting organic waste treatment, and capturing and using methane from landfills. This section overviews significant policies, laws, resolutions, and decrees related to climate change, mitigation, and methane pollution in the solid waste sector in Ecuador. Figure 5 overviews the regulatory climate change development in Ecuador.

Article 414 of the Ecuadorian National Constitution states that the State shall adopt appropriate and cross-cutting measures to mitigate climate change. In addition, the CODA, in Articles 257 and 259, establishes that actions shall be taken to reduce GHG emissions, increase carbon sinks, and create favorable conditions for the adoption of such actions. Articles 675 and 677 of RCODA refer to contributing to the reduction of GHG emissions and the enhancement of carbon sinks through the management of mitigation mechanisms.

[23] MAATE. (2022). *Fourth National Communication and Second Biennial Update Report of Ecuador to the United Nations Framework Convention on Climate Change.*

Figure 5: Evolution of the Legal Framework on Climate Change in Ecuador

Since 2010, MAATE has been working to include specific funds for climate change projects in the Ministry of Finance's annual planning. In 2017, the Paris Agreement was ratified through Executive Decree No. 98, and in 2019, Ecuador's first NDC was published. Likewise, a set of regulations has or will be developed for different economic sectors, to promote compliance with the objectives of the Paris Agreement.[23] Under Ecuador's regulatory framework, there are decrees and ministerial agreements from MAATE for each of these main regulations, which are shown in Table A-1 and Table A-2.

In addition to the policies mentioned above, the National Climate Change Law is currently being developed.

Methane Mitigation from Waste

The main elements related to climate change mitigation in the solid waste sector are reflected in two national documents, the NDC and the recent National Climate Change Mitigation Plan, which are detailed below.

NDC 2020–2025

Ecuador's first NDC set an *unconditional* goal of reducing 9% of GHG emissions from the energy, industrial processes, agriculture, and waste sectors, compared to a "business-as-usual" scenario by 2030; and a *conditional* goal to reduce GHG emissions from these sectors by 20.9% by 2030. Additionally, in the solid waste sector, under the *unconditional scenario*, Ecuador plans to promote landfill methane capture through initiatives in Quito and Cuenca. In the *conditional scenario*, Ecuador aims to capture methane from landfills in Santo Domingo and Ambato. The NDC also promotes public-private partnerships to implement waste sector mitigation measures, raising awareness of the circular economy, and composting for organic waste from markets and gardens with forced aeration.[24] The country is in the process of formulating its next NDC (2026–2035), which aims to be more ambitious, inclusive, with a territorial approach, and to mainstream gender, intercultural, and intergenerational approaches.[25]

[24] República del Ecuador. (2019). *Primera Contribución Determinada a Nivel Nacional Para el Acuerdo de París Bajo la Convención Marco de Naciones Unidas Sobre Cambio Climático.* https://unfccc.int/sites/default/files/NDC/2022-06/Primera%20NDC%20Ecuador.pdf

[25] MAATE. (n.d.). *The Nationally Determined Contribution (NDC) Process in Ecuador.* https://www.ambiente.gob.ec/proceso-de-la-contribucion-determinada-a-nivel-nacional-ndc-en-ecuador/

National Climate Change Mitigation Plan 2024–2070

The National Climate Mitigation Plan is the first long-term planning strategy that will set Ecuador's transition path toward decarbonization for the next 46 years, to achieve a sustainable future with low GHG emissions with specific lines of action related to solid waste management and climate change mitigation. Total GHG emissions in the 2070 scenario are expected to show a 50% decrease compared to the baseline scenario for all sectors. Although the plan sets specific reductions for the waste sector (see below), these goals are not sufficient to adequately address climate challenges in the sector:[26]

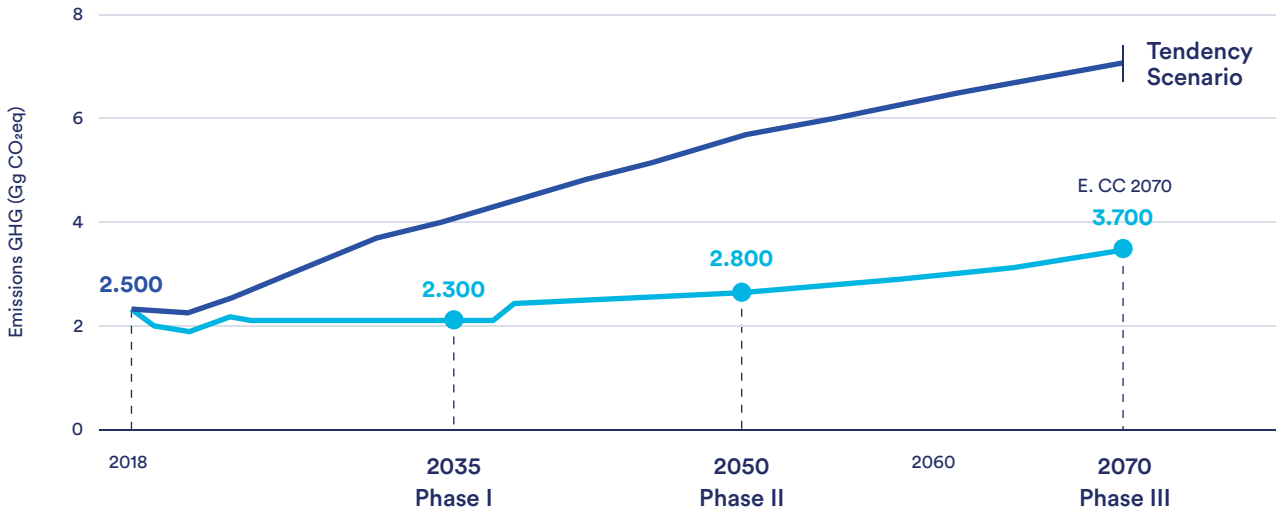
- Reduce solid waste generation per capita by 9% by 2070.
- Implement sustainable management measures for organic and inorganic waste, including mechanical-biological treatment plants, mainly in intermediate cities, as well as specific measures for the management of organic waste from large generators. The target is to manage 11% of organic waste in mechanical-biological treatment plants by 2070.
- Eliminate 100% of open dumps by 2070 and promote the transition to engineered sanitary landfills, which could include biogas recovery.

Figure 6 presents the emissions trajectory in the waste sector (including solid waste and wastewater) presented in the National Mitigation Plan Summary document.

Finally, the Agency for the Regulation and Control of Energy and Non-Renewable Natural Resources published **Resolution ARCERNNR-004/2023** for the *Generation of Electricity from Municipal Non-Hazardous Solid Waste or Residues,* which allows landfill operators to sign a contract with the State to sell electricity at a preferential price of US$74.7/Megawatt-hour for 15 years.[27]

Figure 6: Emissions Trajectory in the Waste Sector

Source: MAATE. (2024). National Mitigation Plan Summary.



[26] MAATE. (2024). Climate Change Mitigation Plan 2024–2070. https://planmicc.ambiente.gob.ec/

[27] ARCERNNR. (2023). Regulation No.004/2023 for the Generation of Electricity from Municipal Non-Hazardous Solid Waste or Residues. https://www.controlrecursosyenergia.gob.ec/wp-content/uploads/downloads/2023/02/Anexo-004-2023-Regulacion-002-23_rev-DE-signed-signed.pdf

SECTION 5

Solid Waste Management in Ecuador

GRECI divides municipalities according to population with the aim of analyzing groups of cities with the same needs and challenges; the categorization is shown in Table 2.

There are 221 municipalities in Ecuador; of these, 30% correspond to the "micro" category, 39% are "small," 24% are "medium," 6% are "large," and only 1% correspond to "special." In addition, 41% of municipalities are in the Andes region, 39% in the coastal region, 19% in the Amazon region, and only 1% in the islands.[28]

AME collects data from all municipalities through the National System of Municipal Information (SNIM) platform.[29] Eleven different portals collect data on waste management, wastewater, international cooperation, etc. Specifically, the SNIM-GIRS on Municipal Integrated Waste Management and the SNIM-ILGEI, which includes a first version of a local GHG inventory of six municipalities.

Table 2: GRECI Municipal Categorizations

Source: MAATE & GRECI project. (2023). Quantity and Characteristics of Non-Hazardous Waste and Solid Waste.

No.	Categorization	Range of Population
1	Special	More than 1,000,000 inhabitants
2	Large	200,001 to 1,000,000 inhabitants
3	Medium	50,001 to 200,000 inhabitants
4	Small	15,001 to 50,000 inhabitants
5	Micro	Fewer than 15,000 inhabitants

28 MAATE & GRECI project. (2023). Quantity and Characteristics of Non-Hazardous Waste and Solid Waste. https://www.ambiente.gob.ec/wp-content/uploads/downloads/2023/07/1.pdf

29 The National System of Municipal Information is a web portal that allows Ecuador's municipalities to register information annually in order to obtain a historical record of data for the formulation of development and land management plans, as well as for capacity building and the calculation of indicators. https://www.snim.ame.gob.ec

Currently, the information collected by the SINM-GIRS is not public, but it is reviewed and published annually by INEC in the Environmental Economic Information Statistics in Decentralized Autonomous Municipal Governments.[30] Conversely, the SNIM-ILGEI is part of an initiative of the Global Covenant of Mayors for Climate and Energy and is currently being implemented in Ecuador in a coordinated effort between AME and the World Wildlife Fund, with support from the European Union.[31] In a first phase, local inventories are in development for Guayaquil, Cuenca, Lago Agrio, Ambato, Manta and Montecristi.

Generation, Composition, and Collection

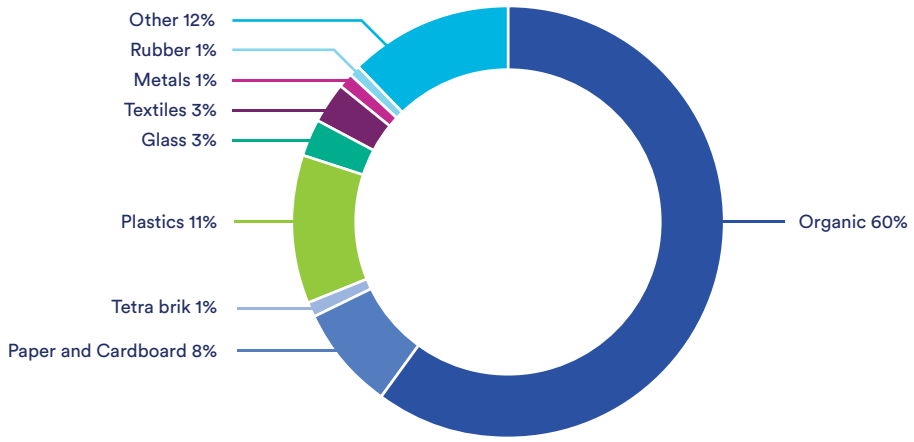
More than 5 million metric tons of solid waste were generated in Ecuador in 2022, and by 2030 this figure is expected to exceed 15 million tons. Ecuador's national average solid waste composition is approximately 70% organic and 30% inorganic (Figure 7).

In 2022, the national weighted average per capita waste generation was estimated at 0.9 kg/person/day, with the highest per capita generation recorded in Guayas province (1.3 kg/person/day) and the lowest in Azuay province (0.5 kg/person/day).[32] Moreover, at the national level, urban collection coverage is 94%, whereas in rural areas it is 69%. Most municipalities use door-to-door collection or a mixture of door-to-door collection and community bins, with 2% using only community bins.[33]

Regarding data on waste separation at the source, information sources in the country differ, with MAATE reporting that fewer than 17% of municipalities have established source separation, and INEC reporting that 35% of municipalities have initiated or implemented a source separation process. At most, slightly more than one-third of municipalities nationwide have adopted source separation practices.

Figure 7: Ecuador's Waste Composition in 2022

Source: Adapted from MAATE & GRECI project. (2023). Quantity and Characteristics of Non-Hazardous Waste and Solid Waste.



30 INEC. (2024). Statistics on Environmental Economic Information in Municipal Autonomous Decentralized Governments. https://www.ecuadorencifras.gob.ec/gad-municipales/

31 GCoM (n.d.). Ecuador National Implementation. https://pactodealcaldes-la.org/language/en/ecuador-national-implementation/

32 INEC. (2023). Statistics on Environmental Economic Information in Decentralized Autonomous Municipal Governments. *Solid Waste Management 2022.* https://www.ecuadorencifras.gob.ec/documentos/web-inec/Encuestas_Ambientales/Municipios_2022/Residuos_Solidos/Presentacion_GIRS_2022vFINAL.pdf

33 MAATE & GRECI project. (2023). *Municipal Diagnosis of the Stages of Integrated Waste and Non-Hazardous Solid Waste Management.* https://www.ambiente.gob.ec/wp-content/uploads/downloads/2023/07/2.pdf

Organic Waste Treatment

Composting is the most common type of organic waste treatment in Ecuador, with a few municipalities treating household and market waste. Currently, anaerobic digestors or other types of organic MSW treatment technologies are not utilized in the country.

According to the national data for the public sector, 51 municipalities report treating organic waste from markets; 70% of them compost the waste, 10% use vermiculture, and the rest use a mix of vermicomposting mechanisms (Table 3). Data are lacking on the quantities of organic market waste that are sent for treatment because this information is not reported to the national government in Ecuador.

A smaller number of municipalities report treating organic household waste. INEC reports that 93 tons per day of organic waste are treated in 47 municipalities around Ecuador. Nearly 60% of the treated waste is in six municipalities, which have recovery processes such as composting or vermicomposting (Table 4); these six municipalities are mainly located in the Andes. Only Cuenca is among the ten municipalities with the largest population in the country. Organic waste treatment projects are currently not required to report the GHG mitigation resulting from their operations and the diversion of waste from final disposal sites. More information on organic waste treatment in Ecuador is included in Table B-1 and Table B-2.

Moreover, the Zero Waste Alliance of Ecuador tracked facilities working with household organic waste in the country, establishing there are 15 compost facilities that directly charge users for this service. They also identified 9 food banks, 150 animal feed initiatives, and 139 decentralized composters. Together these providers recover 2,120 metric tons of organics per month.[34] These initiatives include Agrovivas, Ayllu, Easy Compost, Eco Inventragri, Entrejardines, Fundación Sembrar Esperanza, Kuyka, La Cuica Cósmica, La Movida Verde, Mi Jardinerita, Monte y Valle, Mutare Mundo, Muyu Compost, and Pacha Compost.[35]

Table 3: Municipalities Treating Organic Market Waste in 2022

Source: INEC. (2023). Statistics on Environmental Economic Information in Decentralized Autonomous Municipal Governments. Solid Waste Management 2022.

Type of Treatment Applied	Number of Municipalities
Compost	36
Vermiculture	5
Bokashi (anaerobic fermentation)	2
Takakura (aerobic compost, mixing microorganisms and nutrients)	2
Others	1
Compost & Vermiculture	2
Compost & Bokashi	1
Vermiculture & Takakura	1
Compost, Vermiculture & Bokashi	1

Table 4: Municipalities with Organic Waste Treatment in Ecuador in 2022

Source: INEC. (2023). Statistics on Environmental Economic Information in Decentralized Autonomous Municipal Governments. Solid Waste Management 2022.

Province	Municipality	Organic Waste Treated (metric ton/day)
Azuay	Cuenca	19
Imbabura	Antonio Ante	10
Morona Santiago	Morona	8
Zamora Chinchipe	Zamora	7
Imbabura	Otavalo	6
Imbabura	San Miguel de Urcuquí	4
Total of the above municipalities		**54**
National total		**93**

[34] ABCE. (2024). Methane. Pollution and mitigation, from a zero-waste perspective. https://www.alianzabasuraceroecuador.com/wp-content/uploads/2024/05/Boletin-Metanoweb-100524.pdf

[35] For more information, see https://www.alianzabasuraceroecuador.com/residuos-organicos/

Final Disposal of MSW

Waste is primarily disposed in Ecuador in sanitary landfills,[36] followed by emergency cells,[37] and dumpsites (55%, 28%, and 17%, respectively). As most municipalities in Ecuador are categorized as micro or small, the final disposal sites that serve these communities are also relatively small; only 26 of the 220 final disposal sites in Ecuador receive more than 30,000 metric tons of waste in a year. A detailed list of final disposal sites is included in Tables B-3, B-4, and B-5. As shown in Table 5, eight municipalities represent 60% of the total solid waste disposed in Ecuador in 2022. According to INEC, Guayaquil and Quito are the most populated cities in Ecuador, with per capita production of 1.47 kg/person/day and 0.88 kg/person/day respectively.

The fact that Guayaquil produces twice as much waste as Quito could also be due to the floating population working in the city (from towns such as Durán, Samborondón, Milagro, Nobol, and Isidro Ayora, among others). In addition, Guayaquil has the country's main port, which promotes trade in the city. However, no specific study on this subject could be identified.

Table 5: Total Amount of Solid Waste Deposited at Disposal Sites in 2022

Source: Adapted. INEC. (2023). Statistics on Environmental Economic Information in Decentralized Autonomous Municipal Governments. Solid Waste Management 2022.

Province	Municipality	Waste Disposal (metric ton/day)
Guayas	Guayaquil	4,844
Pichincha	Quito	2,051
Azuay	Cuenca	432
Los Ríos	Quevedo	400
Santo Domingo	Santo Domingo	360
Guayas	Durán	354
Manabí	Manta	348
Manabí	Portoviejo	320
Total of the above municipalities		**9,109**
National total		**15,070**

[36] According to waste experts and municipal technicians who participated in the workshop in Ecuador, there is a mixture of sanitary and controlled landfills.

[37] An emergency cell is a term used for technically designed area for the temporary storage of non-hazardous solid waste. The waste must be compacted and covered daily with suitable material, and includes systems for biogas extraction, leachate collection, etc. Typically, this type of infrastructure is permitted for about two years during the transition from a landfill to a sanitary landfill.

Active capture and flaring or use of landfill gas is not required by law in Ecuador; only venting of gas is required by MAATE. However, the three largest disposal sites in the country use landfill gas capture systems to mitigate methane pollution: the Pichacay landfill in Cuenca, the Las Iguanas landfill in Guayaquil, and the Inga landfill in Quito. The Pichacay landfill was established in 2001, and the energy production project began commercial operations in July 2017 with a capacity of 0.85 Megawatts (MW). Through an expansion plan, the project aims to accept more waste and increase its capacity to 3.5 MW, mitigating more than 33,000 metric tons of carbon dioxide equivalent per year over the 10-year crediting period from 2017 to 2027.[38]

The Las Iguanas landfill captures and flares methane emitted from the landfill, with a potential reduction of 260,000 tons of carbon dioxide equivalents per year. The gas capture and flaring system at the landfill was launched in October 2021 and included the installation of 65 wells. In the future, the plant could convert the biogas into an energy source.[39]

The Inga landfill produces approximately 3,100 cubic meters of biogas per hour, which is then converted to electricity. The facility has an installed capacity of 6.2 MW, allowing the reduction of approximately 250,000 tons of carbon dioxide equivalents per year.[40]

In the future, per resolution ARCERNNR-004/2023, MAATE, MEM, and the relevant regulatory agencies, could promote other active biogas capture projects for power generation in municipalities with similar characteristics (in terms of waste generation) to those of Cuenca, such as those mentioned in Table 5: Quevedo, Santo Domingo, Durán, Manta, and Portoviejo.

38 Yacht Carbon Offset. (2021). *Pichacay Landfill Gas Renewable Energy Project, Ecuador.* https://yachtcarbonoffset.com/projects/ecuador-methane-capture/#:~:text=Pichacay%20Landfill%20Gas%20Renewable%20Energy%20Project%20is%20a%20small%2Dscale,waste%20at%20the%20landfill%20site

39 El Universo. (2021). *En el relleno sanitario Las Iguanas, en el noroeste de Guayaquil, se inauguró proyecto de captura y quema de biogás.* https://www.eluniverso.com/guayaquil/comunidad/en-el-relleno-sanitario-las-iguanas-en-el-noroeste-de-guayaquil-se-inauguro-proyecto-de-captura-y-quema-de-biogas-nota/

40 MAATE. (2020). *Manual de aprovechamiento de residuos orgánicos municipales.* https://www.ambiente.gob.ec/wp-content/uploads/downloads/2020/07/MANUAL-DE-APROVECHAMIENTO-DE-RESIDUOS-ORGANICOS-MUNICIPAL.pdf

SECTION 6

Challenges and Opportunities to Mitigate Waste Methane

A lack of long-term planning coupled with poor implementation at the local level is a significant challenge for mitigating methane emissions from Ecuador's waste sector. For example, although more than 70% of municipalities in Ecuador report having a sanitary landfill, most facilities have a relatively short lifespan due to insufficient planning. Landfills often reach capacity before the plans and environmental permits for a new disposal site are approved, forcing the current administration to approve an emergency cell, and its use is extended until a new landfill is operational.

Furthermore, no requirements exist at the national level for the installation of landfill gas capture infrastructure—beyond the need for passive wells to vent methane—or the prevention or diversion of organic waste from final disposal sites. That's not to say that Ecuador has not been improving solid waste management over recent years; as discussed in Section 5, the three largest landfills in the country do have gas capture equipment installed and small facilities for processing organic waste aerobically have been developed in a grassroots fashion all over the country. But no harmonized national vision guides those developments.

The lack of long-term waste management planning is exacerbated by other challenges faced by the country and the sector, including government changes, poor operating practices at disposal sites, data availability, technical capacity, and finance available for infrastructure investments. This section highlights key challenges and priority recommendations to help improve waste management and mitigate methane emissions within the Ecuadorian waste management system. This information is based on a review of public and academic literature, meetings with different national entities, and a Waste Clinic held in Quito, Ecuador, in April 2024. For more information on the waste clinic and the challenges identified by the participants, please see Box 3.

Box 3: Identifying Challenges in Ecuador's Waste Management Sector with Municipal Stakeholders

What is a Waste Clinic? A Waste Clinic is an expert and peer assisted group session that:

1. Focuses on the specific challenges faced by **local governments (the patients)** in managing their municipal solid waste
2. Draws on the perspectives and knowledge of each other
3. Is facilitated by **experts (the doctors)** who help diagnose problems and identify remedies
4. Results in a draft workplan that helps local governments identify specific activities to address their challenges and areas of technical assistance needed

Additional information on the Waste Clinic process can be found at https://waste-management-world.com/resource-use/waste-clinics-a-practical-approach-to-identify-challenges-and-solutions-for-solid-waste-management/.

On April 22–23, 2024, CATF convened 16 municipalities and national government representatives in Quito to discuss waste management and methane mitigation. As part of the waste clinic conducted during those two days, participants discussed challenges and solutions focused on three topics: (1) waste sector data, (2) source separation, collection, and organics treatment, and (3) final waste disposal. Challenges identified by the municipalities include:

Waste Sector Data

1. Outdated and unreliable MSW data
2. Lack of technical capacity to collect data and utilize waste management data systems
3. Lack of equipment and/or poor maintenance of equipment, necessary for data collection (e.g., scales at disposal sites)
4. Need for a national public entity to control, verify, and audit reported information
5. Waste management plans not updated regularly
6. Lack of information on formalization of recyclers

Final Disposal

1. Lack of financial resources for disposal site operations and maintenance (e.g., machinery)
2. Lack of funds for capital costs for landfill gas capture and utilization systems
3. Lack of technical feedback from national government
4. Poor leachate management
5. Fee collection under the tariff system does not uniform across country
6. Little focus on long-term planning for disposal sites

Source Separation, Collection, and Organic Treatment

1. Lack of prioritization and support for organic waste management from MAATE and municipalities
2. Need for education on source separation
3. Cost of organic waste management not included in the tariff
4. Lack of infrastructure for organic waste treatment
5. Lack of technical capacity to operate facilities effectively
6. Lack of regulatory framework to ensure quality of compost and promote sales
7. Need to integrate organic waste management with work of recyclers

Data Availability and Quality

Two main sources of information exist on municipal waste management in Ecuador that provide differing data. Information from INEC is published annually and is based on data collected by AME directly from the 221 municipalities.[41] Other data are available through MAATE's GRECI project, which is responsible for national waste control and management; this involves conducting nationwide site visits, corroborating information, and generating technical information on the sector, but it does not always contain annual data for all municipalities. MAATE uses the INEC and AME data to develop the National GHG Inventory but does not complement the Inventory with GRECI data. Furthermore, the data submitted by municipalities to AME may not be accurate because they are often estimated rather than measured and verified, as indicated by municipal representatives at the 2024 Waste Clinic. This lack of harmonized information and problems with data quality represents a challenge in planning for waste management as well as uncertainty for the sector's inventory calculations.

Municipalities do not estimate methane emissions from solid waste management or consider the potential reductions from improved waste management practices in planning processes. National reporting includes data on methane reductions from biogas capture and electricity generation at the Cuenca and Quito landfills, but no quantification or reporting of emission reductions exists from local (private or public) initiatives to minimize waste or divert organic waste from landfills.

Finally, remote sensing from either spaceborne or airborne systems can be a valuable source of methane emission estimates. For example, the U.S.-based Carbon Mapper conducted an airborne campaign in Ecuador in February 2023 and detected methane emission from the Inga landfill in Quito, with a total emission rate of 885 kilograms of methane per hour. NASA's spaceborne Earth Surface Mineral Dust Source Investigation instrument, more commonly known as EMIT, detected emissions from the same landfill in September 2023, with an estimated emission rate of ~501 kilograms of methane per hour. However, geographic and climate conditions may limit methane detection from spaceborne remote sensing in Ecuador, whereas airborne campaigns may be too expensive for a city to undertake. Finally, acquiring and interpreting remote sensing data requires technical skills that municipal staff may lack.

Priority recommendations to address emissions visibility include:

- Data quality is a major challenge in Ecuador. MAATE, through GRECI, should provide guidance and capacity strengthening to municipalities on strategies for improving the quality of waste sector data, including cost estimates of these measures (this initiative should feed into the SNIM platform currently managed by AME). In turn, to improve data quality, municipalities should use scales to weigh waste at transfer stations, treatment facilities, and disposal sites; conduct waste characterizations to better understand local waste streams; and conduct surveys of local initiatives to reduce or divert organic or recyclable waste from landfills. MAATE should allocate funding through grants and technical assistance funds to help municipalities cover the costs for staff, consultants, or technology needed to improve data collection in the field.
- Once AME finalizes SNIM-ILGEI, it should promote municipal participation in the portal to conduct local GHG emissions inventories. AME must provide training and capacity- strengthening resources to GADMs to facilitate their participation and raise awareness on the importance of local inventories for understanding emissions and planning waste mitigation measures.
- MAATE should coordinate with AME to provide resources for GADMs and use the data from SNIM-ILGEI to identify projects that can be incorporated into Ecuador's National Climate Change Mitigation Plan and methane mitigation targets. MAATE should also work with AME to develop a methodology to incorporate local inventories and GRECI data into the national GHG inventory development and validation process.

Finance

The lack of sustainable long-term funding for waste management is a recurring theme in solid waste management in developing countries, including Ecuador. INEC estimates that in 2022, the cost of solid waste management in the country was $27 million and that 47% of this amount was subsidized by the national government to cover the total cost of the service. Currently, the solid waste management tariff is set by each municipality based on its street sweeping, waste collection, and disposal costs. Many municipalities fail to conduct studies to assess these costs, which results in tariff revenues that do not adequately cover the full costs of these activities. Moreover, the tariffs do not consider costs for source-separated collection, organic waste treatment, recycling, and/or improved operational practices at landfills,

[41] For more information, see https://www.snim.ame.gob.ec and https://www.ecuadorencifras.gob.ec/gad-municipales/

so municipalities are unable to develop solutions for methane mitigation as they lack funding for infrastructure investments, staff training, outreach required to implement these initiatives, among other costs.

Additionally, Ecuador lacks systems to pay informal sector recyclers for their contributions to the country's waste management system. The informal recycling sector's impressive capacity to recover up to 208,000 tons per year holds the potential for cost savings in final disposal of up to $12.5 million over the next 20 years for cantonal municipalities.[42] Although the General Law on Inclusive Circular Economy recognizes the work of the informal sector and creates a basis for their financial compensation, a few cases exist of recyclers being paid by municipalities.

Priority recommendations for financing of waste management in Ecuador include:

- MAATE should establish a working group or round table to identify best practices and develop a transparent and common methodology for local governments to set their waste management tariffs. This group should include members from GRECI, BDE, RENAREC, and the Ministry of Finance, among other important entities. The group should work toward developing guidance for GADMs in conducting the economic analyses required to calculate tariffs that fully cover costs for all waste management services, including environmental costs such as leachate management, methane mitigation, and source-separated collection among others. Additionally, the guidance should specify best practices for allowing the informal sector to access tariff revenues to compensate for their work.
- MAATE should identify and publicize regularly, funding opportunities available at the national and international level for infrastructure capital costs (e.g., InterAmerican Development Bank, BDE, the Development Bank of Latin America and the Caribbean, the Global Methane Initiative, etc.) and coordinate with the local governments to submit and monitor project proposals.
- We recommend that all financing processes and determination of costs are done transparently to ensure tenders and concessions granting are competitive.

Enabling Policy and Regulatory Framework

Although Ecuador's current laws promote the application of the waste hierarchy and best practices for waste management, they are not uniformly implemented across the country due to a lack of political will at the local level as well as capacity and financial limitations. Furthermore, Ecuador has been subject to government changes, including an out-of-term presidential change and an 18-month interim presidency, that hinder a long-term vision and implementation of regulatory instruments at both a sectoral and country-level.

In addition, Ecuador's existing regulatory and policy framework for methane mitigation from the waste sector is not comprehensive, and a notable lack of specific regulations and support programs aimed at promoting the reduction of methane emissions from solid waste exist.

The CODA and RCODA establish the obligation to source separate waste and require municipalities to implement it. However, this requires the implementation of local ordinances, which are lacking in most of the country. Organic waste treatment, and the collection and active flaring or use of landfill gas at disposal sites are not mandatory in Ecuador, and, as discussed above, little infrastructure is currently in place for these activities.

Consequently, the need for a comprehensive strategy for waste management and methane mitigation at the national level becomes imperative to signal priorities and facilitate efficient coordination among all relevant stakeholders involved in ISWM. In addition to the lack of a national planning instrument, many municipal governments do not have waste management plans in place. This lack of long-term planning at the national and local levels puts Ecuador's waste management sector in a reactive space, which is further exacerbated by changes in leadership that have been frequent in the country in recent years.

[42] Solíz Torres, María Fernanda, Durango Cordero, Juan Sebastián, Solano Peláez, José Luis, and Yépez Fuentes, Milena Alía. (2020). *Cartografía de los residuos sólidos en Ecuador.* https://repositorio.uasb.edu.ec/handle/10644/7773

Priority recommendations for improving the enabling environment and regulatory framework in Ecuador include:

- MAATE must develop and implement a national plan for integrated solid waste management that incorporates principles of circular economy and sets a methane emission reduction target for the sector. This long-term planning instrument will set priorities for the sector that can trickle down into municipal and regional level plans and help to insulate the sector from governance changes. Municipalities can then revise local waste management plans to align with national policies, mainly PLANMICC, to achieve the targets by 2070.
- MAATE and AME should coordinate to provide technical assistance and guidance to municipalities in developing local ordinances that implement existing national-level requirements.
- MAATE and MEM should develop a study to investigate the impacts of different mitigation approaches to inform national planning and policy development. This can include looking at the technical feasibility of installing landfill gas capture systems at more final disposal sites, but as many of these are small and may not have sufficient generation for gas recovery, the study can also look into options such as mandatory flaring of biogas at landfills, use of improved cover soils and biocovers, the widescale adoption of organic waste treatment, and food waste prevention practices.
- MAATE should establish technical standards for composting and anaerobic digestion of organic waste and develop less burdensome environmental regulatory and permitting processes to facilitate the development of local, and private initiatives to collect and treat organic waste.

Stakeholder Awareness and Capacity Strengthening

Insufficient awareness regarding the environmental and climate ramifications of waste management hinders support for these initiatives and can limit the implementation of mitigation measures. This is particularly prevalent at the local level in Ecuador where circular economy policies often focus on recycling and do not pay sufficient attention to organic waste. It is therefore important to promote more communication initiatives on the importance of organic waste management from an environmental and climate point of view and build capacities of municipal staff to work with this waste stream to mitigate methane.

Priority recommendations regarding stakeholder awareness and capacity strengthening in Ecuador include:

- GRECI and AME should provide training for municipal officials, waste operators, and entrepreneurs on best practices in organic waste management including types of technologies available, the best use cases for these technologies, costs, and co-benefits to support their inclusion in local waste management planning and implementation.
- The Ministry of education and the Secretary of Science should collaborate with MAATE to develop courses on waste management for students.
- GRECI should develop campaigns to educate the general public on the importance of waste prevention, food waste donation, and food banking, and source separation of waste. Campaigns can be used to promote recycling and encourage linkages between communities and local composting initiatives to reduce the amount of waste going to landfills.

SECTION 7

Conclusions

Ecuador has made progress in improving its waste management system over the last decade; however, steps must still be taken to address the different barriers that hinder their advancement towards a circular economy as well as an efficient and effective waste management system. Effective separation, diversion, and treatment of municipal waste (representing 68% of the waste),[43] as well as including such concepts in policy and program development will be key in achieving this goal and reducing sectoral methane emissions.

Effective organic waste management is particularly relevant in Ecuador as most of the country's municipalities are classified as small and micro, where organic waste management strategies may be a better and more cost-effective option with the support of the national government, as well as non-governmental and private organizations. Furthermore, existing private and municipal projects on organic treatment of municipal and market waste can be leveraged and scaled-up to amplify benefits. Organic projects will contribute to meeting the countries climate goals and to extending landfill lifetimes.

Although organic waste prevention, diversion, and treatment should be prioritized to reduce methane emissions, measures at landfills must also be implemented. Cities classified as special and large (e.g., Guayaquil, Quito), which have or have begun capturing, flaring, or using landfill gas, should be encouraged to improve gas capture rates, access other sources of funding. In addition, landfill gas capture and utilization should be scaled to municipalities with the potential for such initiatives.

Moving forward, Ecuador should address challenges on data, regulatory framework, and finance availability. As more data are available given current efforts by MAATE, INEC, and AME, Ecuador will be able to integrate this information and use it to strengthen and develop long-term waste management programs and regulations (and vice versa). Other opportunities for Ecuador exist by incorporating a climate change vision and sustainable financing in waste management throughout the development and implementation of its regulatory framework and, specifically, its waste tariff.

It is important to note that a transition towards a circular economy and the necessary improvements to the waste management system cannot be implemented by government actors alone, and the participation of local actors such as recyclers, composters, industry, civil society and the general public is key to success.

[43] MAATE & GRECI project. (2023). Quantity and Characteristics of Non-Hazardous Waste and Solid Waste.

ANNEX A

Detailed Information on Ecuador's Waste Management Regulatory Framework

Table A-1: National Level Policies for Waste Management and Waste Mitigation

Source: Adapted from MAATE. (2022). Fourth National Communication and Second Biennial Update Report of Ecuador to the United Nations Framework Convention on Climate Change.

National Level Policies	Description
Constitution of the Republic of Ecuador	The Constitution of the Republic of Ecuador was promulgated in 2008 and updated in 2021; it was the first constitution in the world that gave nature legally enforceable rights to exist and flourish.[44] Select articles in the constitution also serve as the legal basis for waste management in the country. These articles primarily include: • Article 14: "The right of the population to live in a healthy and ecologically balanced environment is recognized, which guarantees sustainability and good living…" • Article 395: The Constitution recognizes the following environmental principles: "Environmental management policies will be applied transversally and will be mandatory compliance by the State at all levels and by all natural persons…" • Article 265: "Municipal governments are responsible for providing public services for drinking water, sewerage, wastewater treatment, solid waste management and environmental sanitation activities." • Article 415: "The Autonomous Decentralized Government will develop programs for the rational use of water, and for the reduction of recycling and adequate treatment of solid and liquid waste…"[45] Regarding climate change, Article 414 stipulates that the State shall adopt appropriate and horizontal measures to mitigate the effects of climate change.
National Development Plan for the New Ecuador 2024–2025	Infrastructure, Energy and Environment Axis: "It is necessary to strengthen social awareness and good practices for the management of water resources, which are threatened by the advance of the agricultural and livestock frontier, the expansion of human settlements and industry, as well as the waste and residues they generate." Policy 7.4: Conserve and restore terrestrial and marine renewable natural resources, promoting sustainable, low-emission and resilient development models to the adverse effects of climate change. Strategies (b). "Promote climate change management with actions within territory in the adaptation, mitigation and production components; and sustainable development within the prioritized sectors." Goals: OBJECTIVE 7 12. Increase the residues and/or waste recovered within the framework of the application of the extended producer responsibility policy from 44.06% in 2022 to 56.06% by 2025.

[44] FAO. (2008). FAO. Retrieved from https://www.fao.org/right-to-food-around-the-globe/countries/ecu/es/#:~:text=La%20Constituci%C3%B3n%20de%20la%20Rep%C3%BAblica,facultativo%20fue%20ratificado%20en%202010

[45] MAATE. (2022). *Fourth National Communication and Second Biennial Update Report of Ecuador to the United Nations Framework Convention on Climate Change. Ministry of the Environment, Water and Ecological Transition (MAATE).* Quito, Ecuador.

National Level Policies	Description
Organic Code of Territorial Organization, Autonomy and Centralization	This Code establishes the guidelines and competencies of the 221 decentralized municipalities of the Ecuadorian government based on two important articles to consider: Article 55: "...d) To provide the public services of drinking water, sewerage, wastewater treatment, solid waste management, environmental sanitation activities and those established by law..." Article 37: "The responsibilities for the provision of public sewage services, wastewater treatment, solid waste management, and environmental sanitation activities, in all their phases, will be carried out by the Autonomous Decentralized Municipal Governments with their respective regulations.
Organic Code of Planning and Public Finances (2010)	It establishes that, for the design and implementation of public investment programs and projects, the incorporation of actions favorable to the ecosystem, mitigation, adaptation to climate change, and the management of vulnerabilities and anthropic and natural risks will be promoted.
Organic Code of the Environment (2017)	The CODA defines some competences in environmental affairs for the GADM, such as the elaboration of plans, programmers, and projects for the sanitation service, including transport and final disposal of solid waste.[46] It also establishes waste management as the responsibility of the State and sets the country's waste hierarchy from prevention and minimization to final disposal. Includes the waste management hierarchy (Article. 226): 1. Prevention 2. Minimization of generation at source 3. Use or recovery 4. Disposal 5. Final disposal Book Four – Title I "Climate Change" and Title 2 "Adaptation and Mitigation Climate Change." Article 247 "planning, articulation, coordination and monitoring of public policies aimed at designing, managing and implementing climate change adaptation and mitigation actions at local, regional and national levels."
Regulation of the Organic Environmental Code	• Article 572 establishes that the public entities involved in waste management are the environmental authority, the health authority, the energy authority, and the municipalities. • It also establishes the responsibility of the MAATE to issue normative instruments to promote the international management of waste and residues, as well as to provide technical assistance and technical accompaniment to all the actors involved (Article 573). • Conversely, it establishes the responsibility of municipal governments to provide integrated solid waste management services and promote local regulations (Articles 574 and 579). • It also establishes the following instruments for the management of climate change: the National Strategy (2012–2025), the National Plan for Mitigation (under preparation) and the National Adaptation Plan (2023–2027), the National Contributions and other instruments determined by MAATE (Articles 673 and 678).
Organic Law on Inclusive Circular Economy (2021)	This legislation aims to establish precise criteria and mechanisms to effectively incorporate the principles of eco-design, sustainable production and consumption, and waste reduction. Its primary objective is to delineate the authority and obligations of the entities, organizations, and agencies within the public sector, operating within the overarching framework of the circular economy. Finally, the regulatory process for this law has been ongoing for over a year, and as of now, it has not received official approval from the national government.[47]
Organic Law for the Rationalization, Reuse and Reduction of Single-Use Plastics (2020)	• MAATE will develop the National Plastics Plan for single use and adaptation of municipal plans. • MPCEIP and MAATE to develop and implement temporary exemptions. • Ban on the import of plastic waste (Article 12-c).

[46] Consejo Nacional de Competencias. (2019). *Mapeo de actores generadores de información a nivel territorial e identificación de fuentes de información de la competencia de desechos sólidos.*

[47] Asamblea Nacional. (2021). *Ley Orgánica De Economía Circular Inclusiva.* https://www.asambleanacional.gob.ec/sites/default/files/private/asambleanacional/filesasambleanacionalnameuid-29/Leyes%202013-2017/702-dsoliz/ro-488-4to-supl-06-07-2021.pdf

National Level Policies	Description
Organic Law for Integrated Disaster Risk Management (2024)	Establishes that the governing body for integrated disaster risk management and the National Environmental Authority shall submit to the governing body for planning the approaches to integrated disaster risk management, environmental management, climate change mitigation and adaptation to be included in the National Development Plan.
Circular Economy White Paper	The Circular Economy White Paper in Ecuador consolidates the principles and concepts of the circular economy, advocating for its integration into the regenerative and restorative development model of the country. It outlines strategic directions and proposed actions aimed at achieving this integration. The document is structured around four primary axes, namely Policy and Financing, Sustainable Production, Responsible Consumption, and ISWM. These axes provide a framework for guiding policies and initiatives that promote circular economy practices and support the country's sustainable development goals.[48] In the chapter dedicated to ISWM, the national government sets forth the aim of establishing a comprehensive and sustainable system for managing solid waste by the year 2035. This objective is aligned with five key goals outlined as follows: 1. Implement strategies to decrease the volume of solid waste requiring management by the GADM. 2. Emphasize the preferential utilization of generated solid waste over its ultimate disposal. 3. Ensure the incorporation of grassroots recyclers within the national-level management model of the ISWM. 4. Establish reliable mechanisms for securing financial resources to support the intended objectives. 5. Promote collaboration and coordination among the private, public, social sectors, and academia to facilitate the development of innovative and efficient ISWM mechanisms. In addition, different strategic lines are established with their action plan and monitoring through indicators to meet the proposed ISWM objectives.
National Climate Finance Strategy	Seeks to define Ecuador's vision, priorities and strategic lines on sources, uses, enabling conditions and access to climate finance.
National Climate Change Mitigation Plan 2024-2070	The long-term strategy aims to achieve significant GHG emission reductions, with a projected 50% decrease by 2070 compared to the baseline scenario. Key actions for solid waste management and climate change mitigation include: • Reducing per capita solid waste production in the medium term and stabilizing it over the long term. • Implementing sustainable waste management technologies for both organic and inorganic waste. • Eliminating all open dumps nationwide. • Building financial and technical capacities to support solid waste management initiatives with mitigation potential.

[48] AMBIRE, MPCEIP & GIZ. (n.d.). *Libro Blanco de Economía Circular de Ecuador.*

Table A-2: Regulations for Waste Management and Waste Mitigation Established by the Ministry of Environment, Water and Ecological Transition

Source: MAATE. (2022). Fourth National Communication and Second Biennial Update Report of Ecuador to the United Nations Framework Convention on Climate Change.

Regulation	Year	Description
Executive Decree No. 2148	1994	Ecuador ratifies the UN Framework Convention on Climate Change.
Executive Decree No. 1815	2009	Declares adaptation and mitigation to climate change as State Policy. This decree established that the Ministry of Environment would be the entity in charge of the formulation and execution of both the national strategy and the plan to generate and implement actions and measures against climate change.
Ministerial Agreement No. 086	2009	Establishes National Environmental Policies, including measures for climate change mitigation and adaptation.
Executive Decree No. 2148	2010	Establishes the Inter-institutional Committee on Climate Change, as the space for inter-institutional cooperation.
Ministerial Agreement No. 095	2012	Declares the National Climate Change Strategy to be State Policy, establishing climate change mitigation as a strategic line, and pointing out the relevance of creating favorable conditions for the adoption of measures to reduce GHG emissions in the prioritized sectors: Agriculture, Land Use, Land Use Change and Forestry, Energy, Solid and Liquid Waste Management, and Industrial Processes.
Ministerial Agreement No. 089	2013	It established a National Authority for Nationally Appropriate Mitigation Actions, chaired by the Minister of Environment in coordination with the Undersecretariat for Climate Change. This legal instrument established functions for the Undersecretariat for Climate Change (SCC), such as coordinating actions, overseeing the application of methodologies in the assessment of emission reductions, collecting information, and analyzing emission reduction options from different ministries.
Ministerial Agreement No. 137	2014	Establishes the general guidelines for climate change plans, programs, and strategies to be implemented by the Decentralized Autonomous Governments.
Ministerial Agreement No. 248	2014	Guidelines of the National Climate Change Plan that develops the National Climate Change Strategy, being the plan an instrument in continuous updating and designed to make effective the mainstreaming of Climate Change and as such can integrate within the framework of a sectoral approach, both aspects of mitigation and adaptation to climate change and concrete actions to be promoted from the areas identified as priorities.
Ministerial Agreement No. 141	2014	Establishes the National Environmental Authority for Carbon Neutral specifying representativeness, coordination, competences, and functions of the coordinator.
Ministerial Agreement No. 264 and No. 265	2014	It issues the Mechanism to grant the Ecuadorian Environmental Recognition "Carbon Neutral" and the procedure for qualifying and registering consultants within the framework of the Ecuadorian Carbon Neutral Award.
Executive Decree No. 064	2017	Ruling on the formation of the new members of the Inter-Institutional Committee on Climate Change.
Executive Decree No. 098	2017	Ratification of the Paris Agreement by Ecuador.
Ministerial Agreement No. 024	2017	Agrees to institutionalize the National Bureau of Agroecological and Organic Production of the Ministry of Agriculture as a specialized body in charge of promoting and fostering agroecological and organic production models.
Executive Decree No. 371	2018	Adoption of the 2030 Agenda for Sustainable Development as State policy.

Regulation	Year	Description
Official Gazette Supplement No. 449	2019	Approval of the Organic Law on Energy Efficiency, which declares the efficient, rational, and sustainable use of energy, in all its forms, to be of national interest and State policy, as a key element in the development of a society based on solidarity, competitive in terms of production, and concerned with economic and environmental sustainability.
Executive Decree No. 840	2019	Establishment of the First Nationally Determined Contribution as a state policy.
Ministerial Agreement No. 017	2021	It is decreed that the guidelines for the formulation, monitoring, evaluation and updating of climate change management instruments shall be issued.
Ministerial Agreement No. 018	2021	It creates the Zero Carbon Ecuador Program (PECC), which is aimed at mitigating and adapting to climate change, changing current patterns of production and consumption toward more sustainable ways of producing and using goods and services, through the quantification of greenhouse gas emissions, their reduction and neutralization.
Ministerial Agreement No. 046	2021	Technical standard of the Ecuador Zero Carbon Program with product scope.
Ministerial Agreement No. 047	2021	Guidelines and technical criteria for implementing the organizational and operational boundaries.
Executive Decree No. 059	2021	It establishes the prioritized development and implementation of public policies and public, private, public-private, and community initiatives that promote the transition to sustainable production and consumption systems, leading the country toward net zero emissions by 2050.
Ministerial Agreement No. 2022-001	2022	Declares the Solid Waste Management and Inclusive Circular Economy (GRECI) project as a flagship project.
Ministerial Agreement No. 2022-067	2022	Guidelines for the Application of the Extended Responsibility in the Comprehensive Management of Waste Electrical and Electronic Equipment of Domestic Origin.
Ministerial Agreement No. 2022-097	2022	Guidelines for the Application of Extended Producer Responsibility in the Comprehensive Management of Disposed Discharge Lamps and/or Lamps (LED).
Ministerial Agreement No. 2022-113	2022	Regulations for the Qualification of Programs, Funds and/or Projects for Prevention, Protection, Conservation, Bio-Enterprises, Environmental Restoration and Repair and for the Certification of the Beneficiaries of the Additional 100% Deduction for the Calculation of the Taxable Income Tax Base.
Ministerial Agreement No. 2022-131	2022	Guidelines for the Application of Extended Producer Responsibility in the Comprehensive Management of End-of-Use Tires.
Ministerial Agreement No. 129	2023	Guidelines for the External Management of Waste and Waste in Application of the Interministerial Regulation for the Comprehensive Management of Waste and Waste Generated in Health Facilities.
Ministerial Agreement No. 134	2023	Technical Standard for the Application of the Principle of Extended Responsibility in the Integrated Management of Medicinal Products and Pharmaceuticals.
Inter-ministerial Agreement No. 01-2023	2023	Government of Ecuador Sovereign Green Bonds Framework Document. The Ministry of Economy and Finance may issue Green Bonds to finance eligible green projects or refinance public debt on better terms to finance eligible green projects. In this document there is a focus on emissions reduction, as the eligible categories for this type of projects are oriented to promote a low-carbon economy.
Ministerial Agreement No. 053	2023	Scheme, guidelines, and technical criteria for the compensation of greenhouse gas emissions in Ecuador, through projects, measures, and voluntary actions called mitigation initiatives.

ANNEX B

Waste Disposal and Treatment Sites

Table B-1: Municipalities with Organic Waste Treatment from Markets in 2022

Province	Number of Municipalities
Azuay	3
Bolívar	3
Cañar	4
Carchi	3
Cotopaxi	1
Chimborazo	3
El Oro	3
Guayas	1
Imbabura	2
Loja	5
Manabí	1
Morona Santiago	5
Napo	2
Pastaza	2
Pichincha	4
Tungurahua	2
Zamora Chinchipe	4
Galápagos	1
Sucumbíos	1
Santo Domingo	1
National	**51**

Table B- 2: Municipalities with Organic Waste Treatment from Households in 2022

No.	Municipality	Province	Amount of Treated Organic Waste (tons/month)
1	Cuenca	Azuay	575
2	Antonio Ante	Imbabura	313
3	Morona	Morona	245
4	Zamora	Zamora	198
5	Otavalo	Imbabura	182
6	San Miguel de Urcuquí	Imbabura	131
7	Paltas	Loja	126
8	Loja	Loja	114
9	Catamayo	Loja	108
10	Aguarico	Orellana	107
11	Puerto Quito	Pichincha	82
12	Santa Cruz	Galápagos	61
13	Sucúa	Morona	54
14	San Cristóbal	Galápagos	50
15	Pastaza	Pastaza	46
16	Riobamba	Chimborazo	38
17	Yantzaza	Zamora	23
18	Mira	Carchi	23
19	Marcabelí	El Oro	22
20	Cayambe	Pichincha	21
21	Guano	Chimborazo	21
22	Archidona	Napo	20
23	Carlos Julio Arosemena Tola	Napo	19
24	Calvas	Loja	17
25	San Pedro de Pelileo	Tungurahua	15
26	Cuyabeno	Sucumbíos	13
27	Girón	Azuay	13
28	Cañar	Cañar	13

No.	Municipality	Province	Amount of Treated Organic Waste (tons/month)
29	Saraguro	Loja	12
30	San Miguel de los Bancos	Pichincha	10
31	Centinela del Cóndor	Zamora	10
32	Tena	Napo	9
33	Limón Indanza	Morona	9
34	Paquisha	Zamora	8
35	Montúfar	Carchi	8
36	Nangaritza	Zamora	7
37	Pedro Vicente Maldonado	Pichincha	7
38	San Pedro de Huaca	Carchi	7
39	Espejo	Carchi	6
40	Balsas	El Oro	6
41	El Empalme	Guayas	6
42	Quilanga	Loja	5
43	Santo Domingo	Santo Domingo	5
44	Puyango	Loja	5
45	Chunchi	Chimborazo	4
46	Baños de Agua Santa	Tungurahua	4
47	Chimbo	Bolívar	4
TOTAL			**2,782**

Table B-3: Final Disposal in Ecuador in 2022: 10 Municipalities with the Highest Amount of Waste Disposed of in Sanitary Landfills

Landfills		
Municipality	**Province**	**Amount of Waste (ton/day)**
Guayaquil	Guayas	4,844
Quito	Pichincha	2,051
Cuenca	Azuay	432
Santo Domingo	Santo Domingo	360
Durán	Guayas	350
Manta	Manabí	348
Machala	El Oro	290
Ambato	Tungurahua	279
Daule	Guayas	160
Ibarra	Imbabura	150

Table B-4: Final Disposal in Ecuador in 2022: 10 Municipalities with the Highest Amount of Waste Disposed of in Emergency Cells

Emergency Cells		
Municipality	**Province**	**Amount of Waste (ton/day)**
Quevedo	Los Rios	400
Portoviejo	Manabí	320
Riobamba	Chimborazo	220
Babahoyo	Los Rios	130
Latacunga	Cotopaxi	110
Montecristi	Manabí	70
Vinces	Los Rios	63
Bolívar	Manabí	60
Ventanas	Los Rios	58
Buena Fe	Los Rios	54

Table B-5: Final Disposal in Ecuador in 2022: 10 Municipalities with the Highest Amount of Waste Disposed of in Dumpsites

Dumpsites		
Municipality	**Province**	**Amount of Waste (ton/day)**
Santa Elena	Santa Elena	186
Esmeraldas	Esmeraldas	138
Salinas	Santa Elena	130
La Libertad	Santa Elena	120
Chone	Manabí	87
Orellana	Orellana	60
Playas	Guayas	50
El Guabo	El Oro	40
Guaranda	Bolívar	35
Pedernales	Manabí	35