



COLOMBIA
NATIONAL PLASTIC
ACTION PARTNERSHIP

Plastic Pollution and Biodiversity in Colombia: Pathways for Environmental and Economic Resilience

May 2026

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Contents

04	Abbreviations
06	Introduction
06	Purpose and scope of the assessment
06	Plastic pollution and biodiversity at the national level
07	Methodology summary
07	Alignment with national biodiversity strategies
08	1 Identification of areas experiencing significant impact from plastic pollution
08	Areas where biodiversity is at greatest risk from plastic pollution
13	Description of the most affected urban areas and Indigenous and NARP communities
26	2 Evaluation of the impact of plastic pollution on biodiversity
26	Ecological and species-level impacts
29	Ecosystem and functional impact
36	Creative and localized responses: stakeholders linking biodiversity and plastic pollution
40	3 Evaluation of existing policies and mitigation measures
40	Review of national and subnational policies on plastics, waste management and biodiversity
43	Policy coherence and alignment with international frameworks
44	Regulatory, procedural and technical gaps in mitigating the risks to biodiversity from plastic pollution
46	Strategic role of NPAP Colombia and opportunities for systemic change
47	4 Mapping of stakeholders and initiative
48	Identification of key actors across sectors
53	Mapping of initiatives
55	Conclusions
58	Acknowledgements
59	Endnotes
68	Annexes



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Abbreviations

ACODAL	Colombian Association of Sanitary and Environmental Engineering	GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ACOPLÁSTICOS	Colombian Association of Plastics Industries	GPAP	Global Plastic Action Partnership
ANDI	National Business Association of Colombia	IDEAM	Institute of Hydrology, Meteorology and Environmental Studies
ANLA	National Authority of Environmental Licenses	INVEMAR	José Benito Vives de Andrés Marine and Coastal Research Institute
ATR-FTIR	Attenuated total reflectance Fourier transform infrared spectroscopy	IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
AUNAP	National Authority for Aquaculture and Fisheries	MADS	Ministry of Environment and Sustainable Development
CAR	Regional Autonomous Corporations	MARPOL	International Convention for the Prevention of Pollution from Ships
CBD	Convention on Biological Diversity	MCA	Multi-criteria spatial analysis
CEMPRE	Compromiso Empresarial para el Reciclaje	MPA	Marine Protected Area
CONPES	National Council for Economic and Social Policy	MRV	Monitoring, reporting and verification
DANE	National Administrative Department of Statistics	NARP communities	Black, Afro-Colombians, Raizales and Palenqueros
DIAN	National Directorate of Taxes and Customs	NBSAP	National Biodiversity Strategy and Action Plan
DIMAR	General Maritime Directorate	NPAP	National Plastic Action Partnership
ECA	Classification and utilization stations	PADI	Professional Association of Diving Instructors
EPR	Extended Producer Responsibility	PE	Polyethylene
ETDH	Education for Work and Human Development	PET	Polyethylene terephthalate
GEF	Global Environment Facility	PNN	National Natural Parks

PP	Polypropylene	Super-servicios	Superintendency of Residential Public Services
PRO	Producer responsibility organization	UIS	Industrial University of Santander
PS	Polystyrene	UNAL	National University of Colombia
PVC	Polyvinyl chloride	UniAtlántico	University of the Atlantic
REDCAM	Network for the Surveillance, Conservation and Protection of Marine and Coastal Waters	W2W	Waste2Worth
SENA	National Learning Service	WWF	World Wide Fund for Nature
SINCHI	Amazon Institute of Scientific Research		

Introduction

Purpose and scope of the assessment

This assessment examines how plastic pollution is affecting Colombia's biodiversity and identifies priority areas and pathways to reduce these risks. It brings together information on national efforts to strengthen biodiversity protection and to inform the implementation of actions recommended by NPAP Colombia, an initiative supported by the World Economic Forum through GPAP and implemented by WWF Colombia. It also offers recommendations to advance the objectives of the NBSAP, especially those related to tackling pollution and strengthening ecosystem resilience.

To achieve this, the assessment aims to close key knowledge gaps and

identify the areas of Colombia most affected by plastic pollution. Its primary focus is on the impacts of plastics on the ecosystems, species and ecological functions that sustain biodiversity. Secondly, it reports on how these impacts affect the benefits nature provides to people.

Synthesizing the best available evidence, the assessment supports co-ordinated action and investment across sectors and informs Colombia's National Plastics Roadmap to 2040. By identifying the ecosystems and species most at risk and highlighting opportunities for targeted interventions, it advances Colombia's commitment to protect biodiversity on land and in water while tackling plastic pollution.



Colombia is the fourth most biodiverse country in the world and depends on biodiversity to sustain key sectors.

Plastic pollution and biodiversity at the national level

Colombia is the fourth most biodiverse country in the world¹ and depends on biodiversity to sustain key sectors, such as fisheries, agriculture and tourism, and to contribute to climate and disaster risk regulation. Plastic pollution is increasingly harming species, degrading ecosystems and eroding ecosystem services, posing a growing threat to biodiversity and to the well-being of communities.

According to NPAP Colombia's action roadmap, an estimated 31,000 tonnes of plastics pollute aquatic ecosystems each year. A further 98,000 tonnes contaminate soils and 202,000 tonnes are openly burned, deteriorating air quality.² These figures highlight how

water, land and air are all exposed to plastics-related pollution, underscoring the scale of risk to biodiversity.

The Magdalena-Cauca macro-basin is home to 77% of the country's population³ and delivers approximately 450 tonnes of plastic waste a year into the Caribbean Sea.⁴ This combination of high population and significant plastics leakage makes the basin a priority hotspot where targeted prevention, collection and treatment measures can yield the biggest reductions in plastic flows to freshwater and coastal ecosystems.

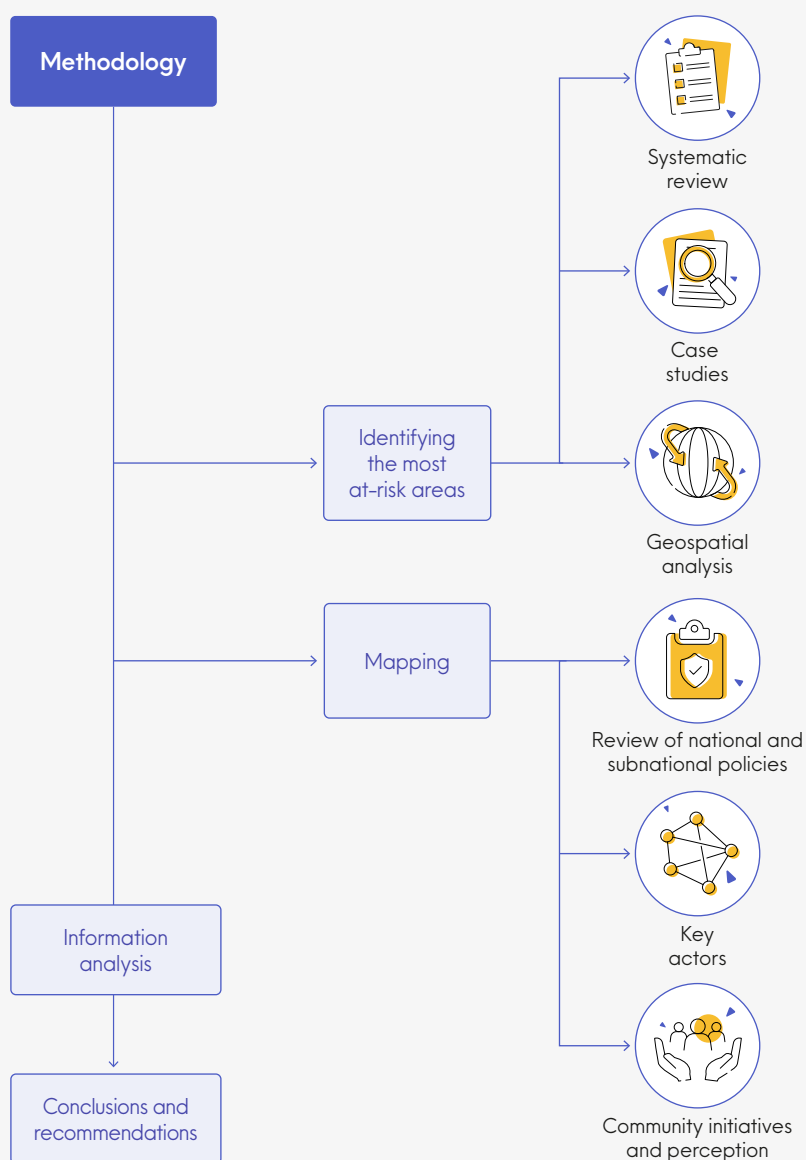
Plastic pollution affects multiple economic sectors through distinct

pathways.⁵ In the Caribbean and Pacific fisheries, ingestion of and entanglement with plastics by fished species contribute to reduced catches and quality.⁶ In Caribbean and Andean agriculture, poor management of plastic waste and agricultural plastics contaminates soils and waterways, obstructs irrigation and drainage infrastructure and increases operational costs for farmers. Tourism along the Caribbean coast is affected by littered beaches and degraded coastal landscapes. At an ecosystem level, mangroves, coral reefs and estuaries show signs of degradation, with particularly severe consequences for ethnic communities that rely directly on these environments.



Image credit: Jorge Dos Océanos, Help 2 Oceans Foundation

Figure 1: Process flow for identifying priority areas where plastic pollution impacts biodiversity



Methodology summary

The report combines spatial analyses using multiple criteria with case studies in selected river basins to identify areas significantly impacted by plastic pollution, describe the main pressures from plastic pollution and explore possible responses to the pollution's effects. These analyses bring indicators of plastic pollution's impacts together with demographic and socio-economic information, including plastic abundance, GDP per capita, dependence on key sectors and social vulnerability. This work is complemented by a review of existing policies on plastics and biodiversity and the main obstacles to implementing these policies effectively.

Alignment with national biodiversity strategies

The report proposes aligning its output with the work of Colombia's National Plastic Roadmap to 2040,⁷ the Convention on Biological Diversity, the Sustainable Development Goals, the Circular Economy Strategy and the Kunming–Montreal Global Biodiversity Framework. It also aims to contribute to the implementation of the NBSAP by providing key information on ecosystem risks and proposing integrated, multisectoral approaches to address the issue.

Identification of areas experiencing significant impact from plastic pollution

Areas where biodiversity is at greatest risk from plastic pollution

This study identifies and maps priority areas across Colombia's five major hydrographic areas – Caribbean, Magdalena-Cauca, Orinoquía, Amazon, and Pacific (Figure 2) – as established in Article 10 of Decree 1640 (2012).

To identify priority areas where plastic pollution is most likely to impact

biodiversity, the assessment applies a multicriteria spatial analysis using geographic information systems (GIS) at the national scale (Figure 3a). How plastic pollution is generated and reaches nature, including via water bodies, waste disposal sites and landfills, urban activities and the limits of local waste management, are assessed as **pressure factors**

(Figure 3b). **Vulnerability factors** capture where biodiversity and nature are most sensitive, including ecosystems, protected areas and ecosystem services (agriculture, livestock, fishing and tourism) (Figure 3b). The **overall risk** is derived by combining the perceived pressure and vulnerability. For full details of the methodology, see Annex 1.

Figure 2: Colombia's Major River Macro-Basins



Note: Major river basins used to assess biodiversity risk from plastic pollution (basin zoning by IDEAM, based on how rivers drain across Colombia's physiographic, morphological and climatic characteristics)

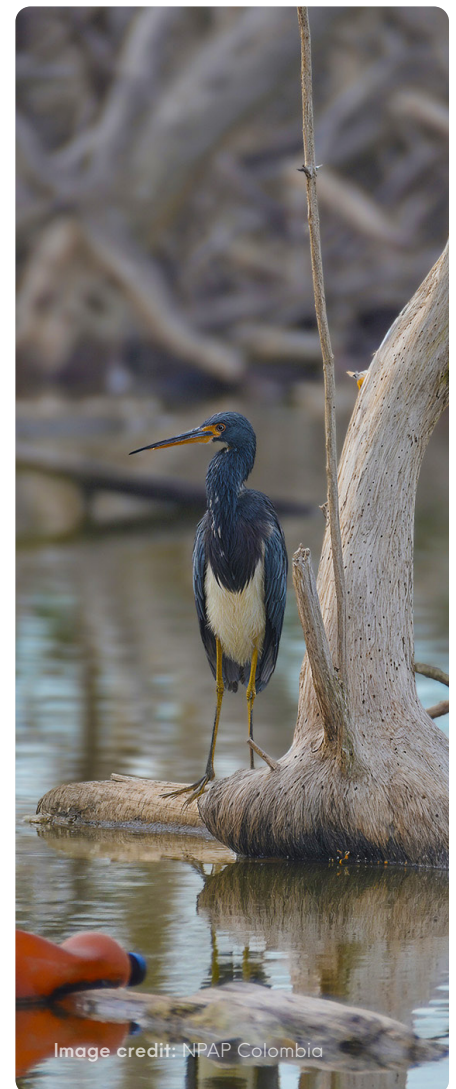
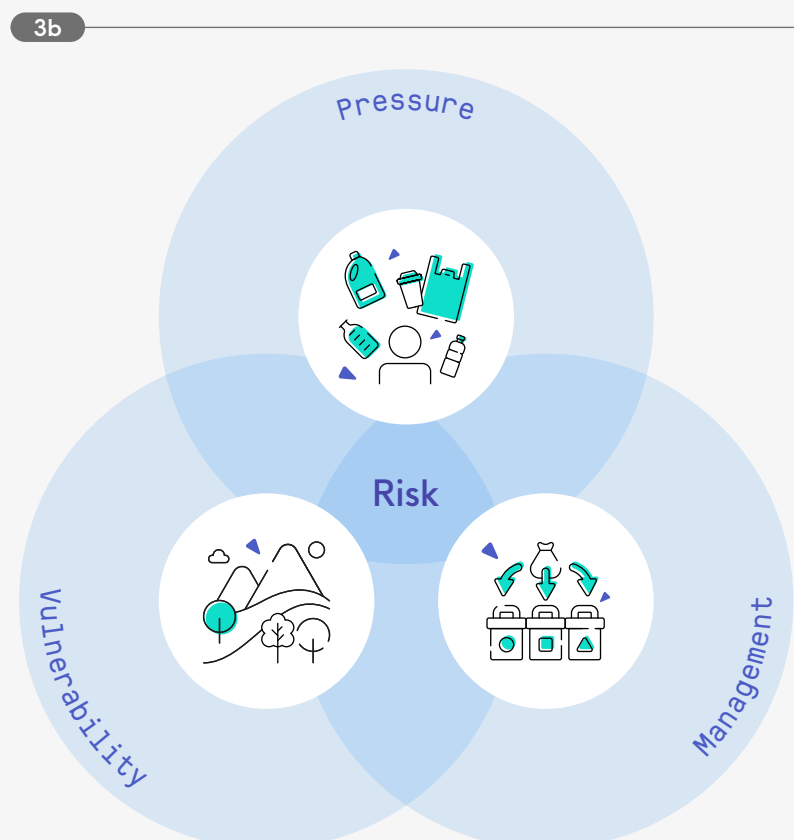
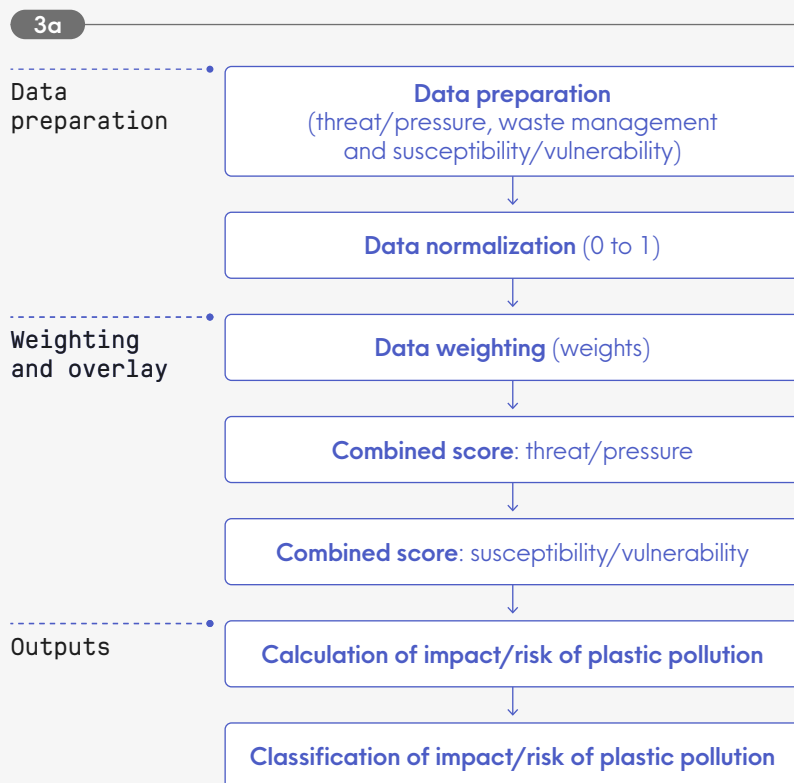


Image credit: NPAP Colombia

Figure 3: (a) workflow for data preparation, normalization, weighting and overlay; b) conceptual model of risk as the intersection of pressure, vulnerability and management

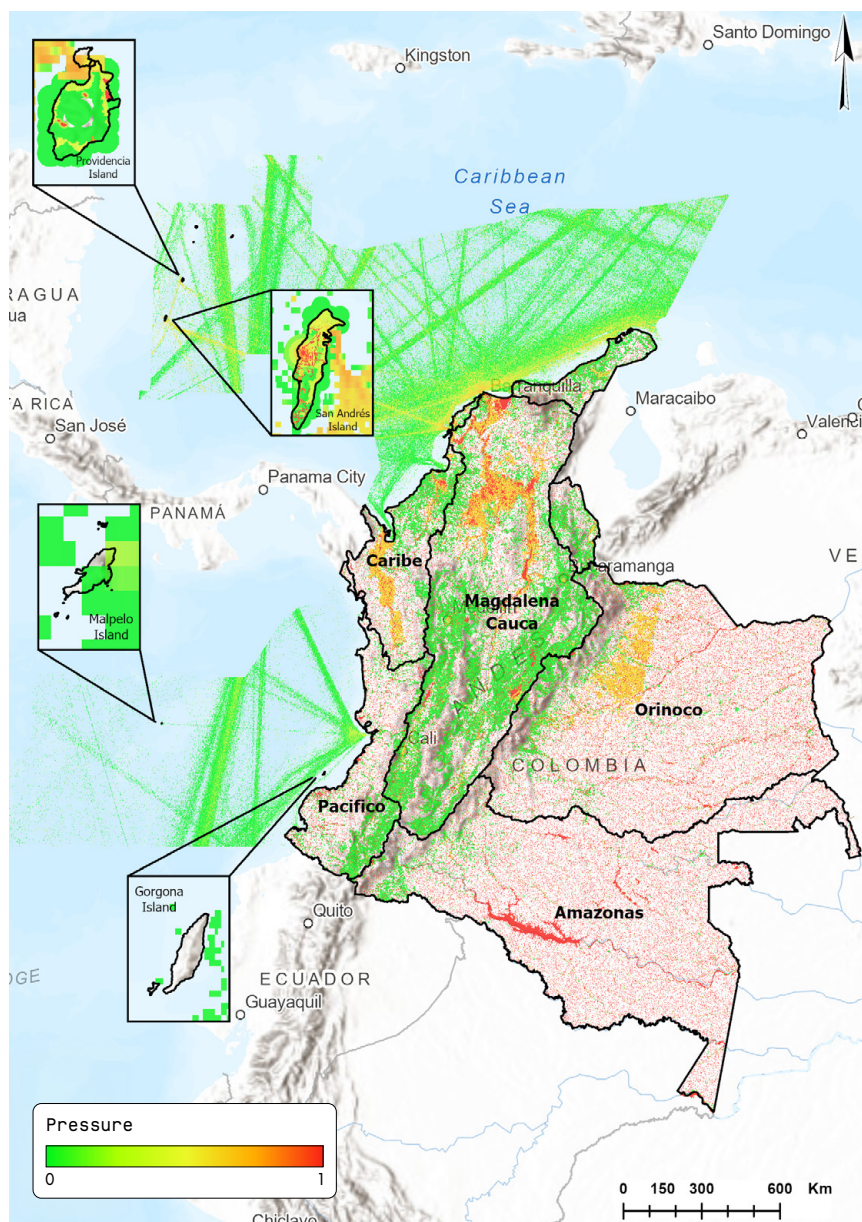


Plastic pollution hotspots: where biodiversity and ecosystem services are most at risk

Based on the geospatial analysis, critical hotspots were identified where plastic pollution poses the greatest risk to Colombia's biodiversity and ecosystem services. This section describes those hotspots, as well as the main sources of pressure driving the risk. The results of this analysis can inform Colombia's planning, investment and regional management decisions concerning plastics and biodiversity.

In this assessment, pressure reflects where plastic waste is most likely to be generated, transported and leaked into the environment. Figure 4 shows that plastic pollution pressure is not distributed evenly: The map also shows that pressure often follows major river catchments, reflecting how plastic waste can be transported downstream where waste management capacity is often limited; it tends to concentrate along transport catchments, particularly major river networks, indicating how plastic waste can move from source areas to downstream ecosystems. High pressure is observed in remote parts of the Orinoquía, Amazon, Pacific and Caribbean regions. Conversely, across a substantial portion of the central-southern Magdalena-Cauca basin, where the majority of cities are located, the pressure is perceived to be lower, partly because of better waste collection and management systems. However, pressure increases markedly in the northern (lower) Magdalena-Cauca basin as the river approaches its mouth, reflecting plastic discharges that are transported downstream and ultimately reach the Caribbean Sea. The map also highlights pressure patterns in coastal and offshore areas, as well as in insular territories shown in the insets (Figure 4).

Figure 4: Plastic Pressure Across Colombia



Note: Plastic pollution pressure in Colombia, representing the likelihood that plastic waste is generated, transported and reaches the natural environment through pathways such as water bodies, waste disposal sites and landfills, urban activities, and limited local waste management capacity. The index is presented on a scale from 0 to 1, where red indicates the highest pressure and green the lowest.



Image credit: Camilo Díaz/WWF-Colombia

Many ecosystems that provide essential services, such as pest control, water regulation and climate regulation, are highly vulnerable to plastic pollution (Figure 5). In this assessment, vulnerability factors are used to identify biodiversity and ecosystem services exhibiting the greatest sensitivity to damage from plastic pollution. As a result, an area may be highly vulnerable even if it is not perceived to be under the greatest pressure from plastic pollution sources. Vulnerability is determined by overlaying areas deemed to be of significance for biodiversity with key ecosystem services, including provisioning services, such as agriculture, livestock and fisheries, and cultural services like tourism. As a result, the Caribbean, Pacific and especially the Magdalena–Cauca macro-basin are considered to be the areas of greatest vulnerability (Figure 5).

The Magdalena–Cauca macro-basin is most vulnerable because it contains a wide range of high-value ecosystems and services, from páramos and other Andean high-mountain ecosystems with exceptional biodiversity and endemic species to tropical forests and wetlands.⁸ Inadequate waste treatment in many towns and urban areas further exacerbates the leakage of plastic pollution into nature.⁹

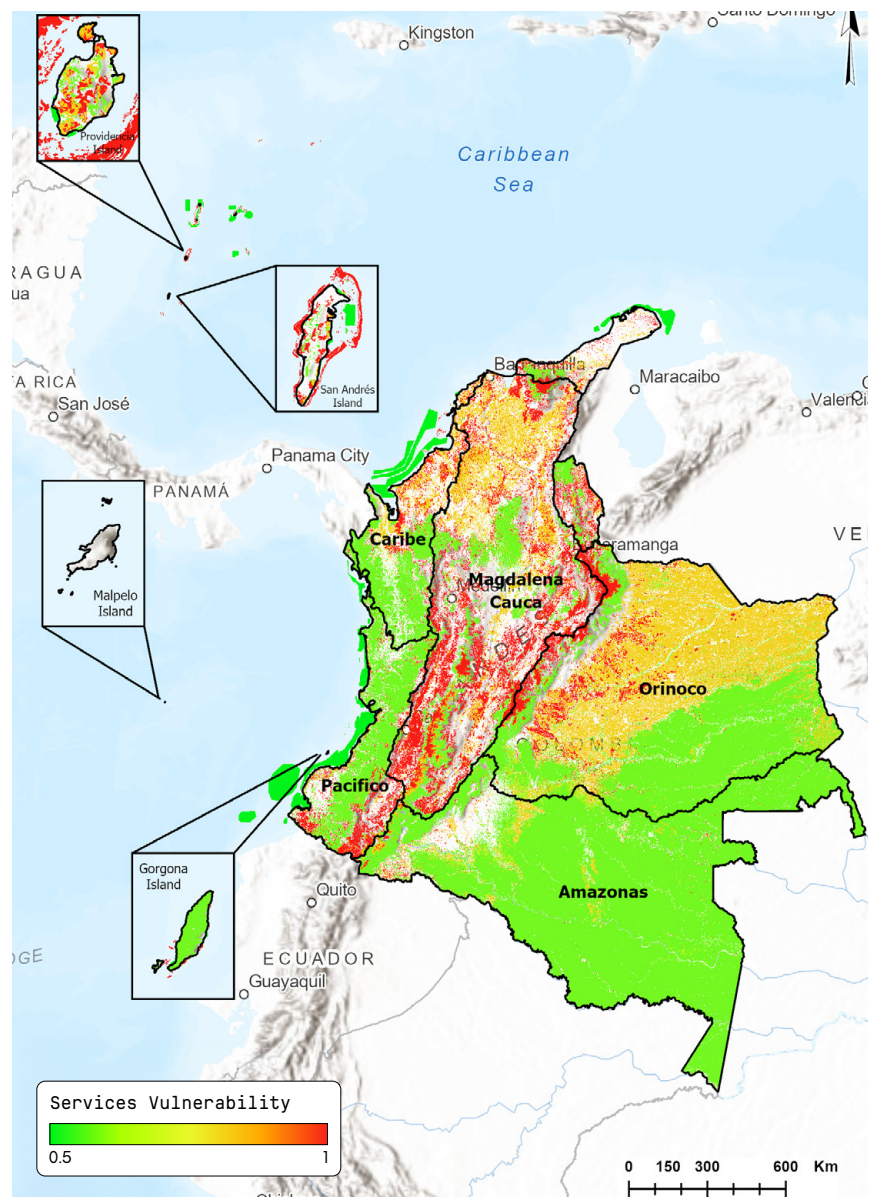
Vulnerability is particularly pronounced in the northern (lower) Magdalena–Cauca and at the mouth of the country’s main river on the Caribbean coast¹⁰ (Figure 5), where a lack of waste treatment may increase risks to coastal and marine ecosystems and the services they provide.¹¹ The impacts include well-documented effects on coral reefs, mangroves, seagrass beds,¹² rocky and sandy shores, and seafloor habitats.¹³ As ecosystem integrity declines, the benefits they bring to climate regulation, water supply, air quality, food security, recreation and disaster risk reduction are eroded, threatening the economic, social and environmental sustainability of the basin and increasing societal vulnerability (Annex 1).¹⁴



Available evidence indicates that plastic pollution risk is highest where sensitive coastal and freshwater ecosystems overlap with key ecosystem services (Figure 6). Along the Caribbean and Pacific coasts, higher levels of risk are concentrated around beaches, coral reefs, mangroves and seafloor habitats, threatening biodiversity and the ecosystem services that sustain coastal livelihoods, such as fishing and tourism.¹⁵ Inland, risk is also evident in páramos (for example, in Sumapaz), major river systems (Magdalena, Amazon and Orinoco), wetlands (such as the Ciénaga Grande de Santa Marta) and lakes, with potential impacts on services including agricultural production, water regulation and purification, and climate mitigation.¹⁶

The Pacific basin stands out because it combines areas of elevated risk with high socio-cultural importance: it is home to some of the country's largest Indigenous and Afro-descendant communities and hosts two maritime ports, including one of Colombia's main gateways through which approximately 40% of the country's commercial cargo is transported.¹⁷ The basin also hosts more than 160 endemic and migratory species,¹⁸ many reported as at risk from plastic pollution.¹⁹ Reducing this pollution is, therefore, essential for both safeguarding biodiversity and protecting the ecosystem services that local communities and the national economy depend on.²⁰

Figure 5: Strategic Ecosystem Vulnerability in Colombia to plastic pollution



Note: The vulnerability of strategic ecosystems and ecosystem services to plastic pollution in Colombia (0 to 1 decimal score). This map reflects ecological sensitivity, not where plastic waste is generated. Red areas indicate the highest vulnerability (1) and green areas the lowest (0). Vulnerability was normalized by assigning the maximum value (1) to páramos, mangroves, wetlands, coral reefs and dry forests. Tropical rainforests were weighted at 0.6 due to their lower degree of fragmentation and intervention.

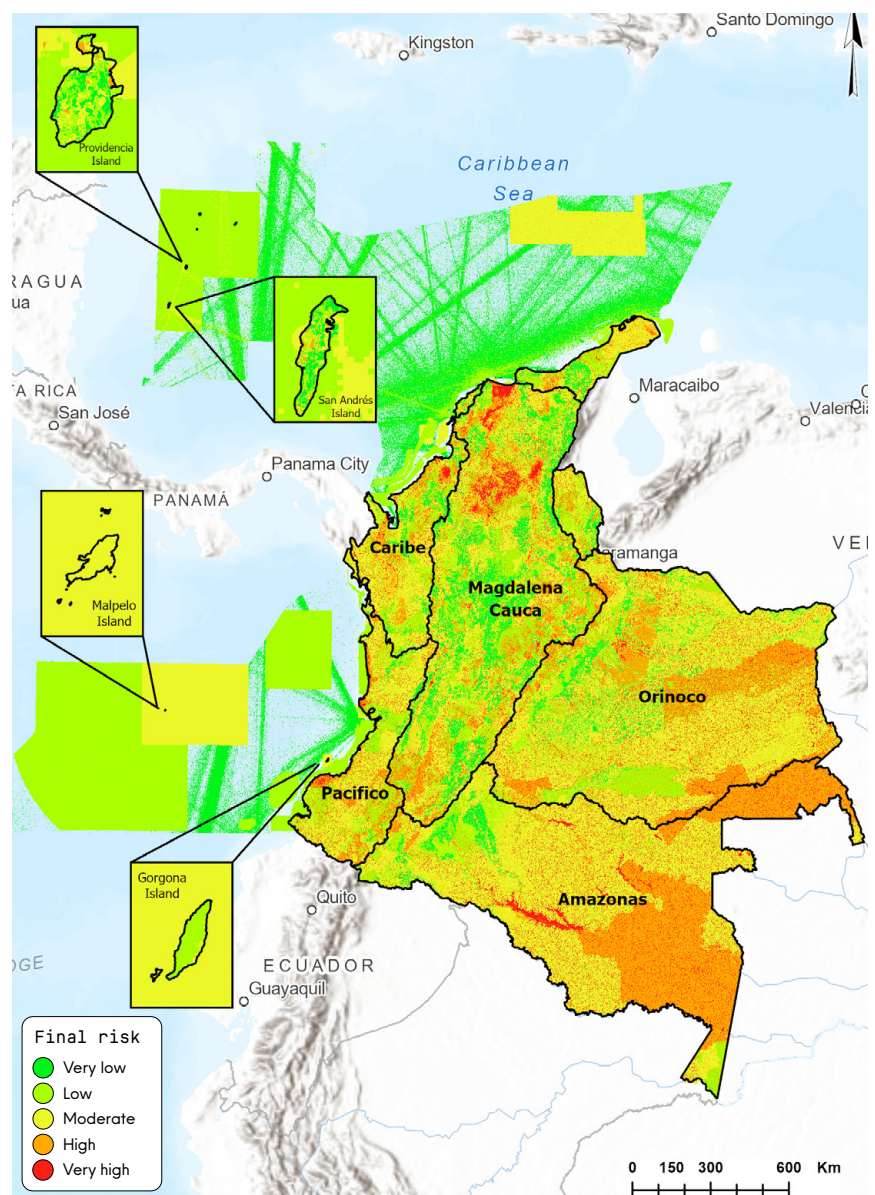


In contrast, the plastic pollution impacts on biodiversity in the Amazon and Orinoquía basins are far less studied. Despite lower population density, these regions provide highly important regulating, cultural and provisioning services, which could be severely compromised as plastic leakage increases. High numbers of NARP and Indigenous communities live in these basins²¹ – areas which are experiencing tourism growth²² – underscoring the need to strengthen monitoring of exposure plastic pollution's pathways and impacts, as well as priority responses to the issue. Poor waste management and open-air waste disposal also significantly impact overall risk (Figure 6).



The Amazon and Orinoquia basins provide important regulating, cultural and provisioning services, which could be compromised as plastic leakage increases.

Figure 6: Plastic pollution risk of Biodiversity in Colombia



Note: The overall risk of plastic pollution impacts on biodiversity in Colombia, derived by combining pressure (where plastic is most likely to reach nature) and vulnerability (where biodiversity and ecosystem services are most sensitive). The classification of risk is qualitative, from very low to very high, and highlights the areas where action should be prioritized, including coastal zones and insular territories shown in the insets.

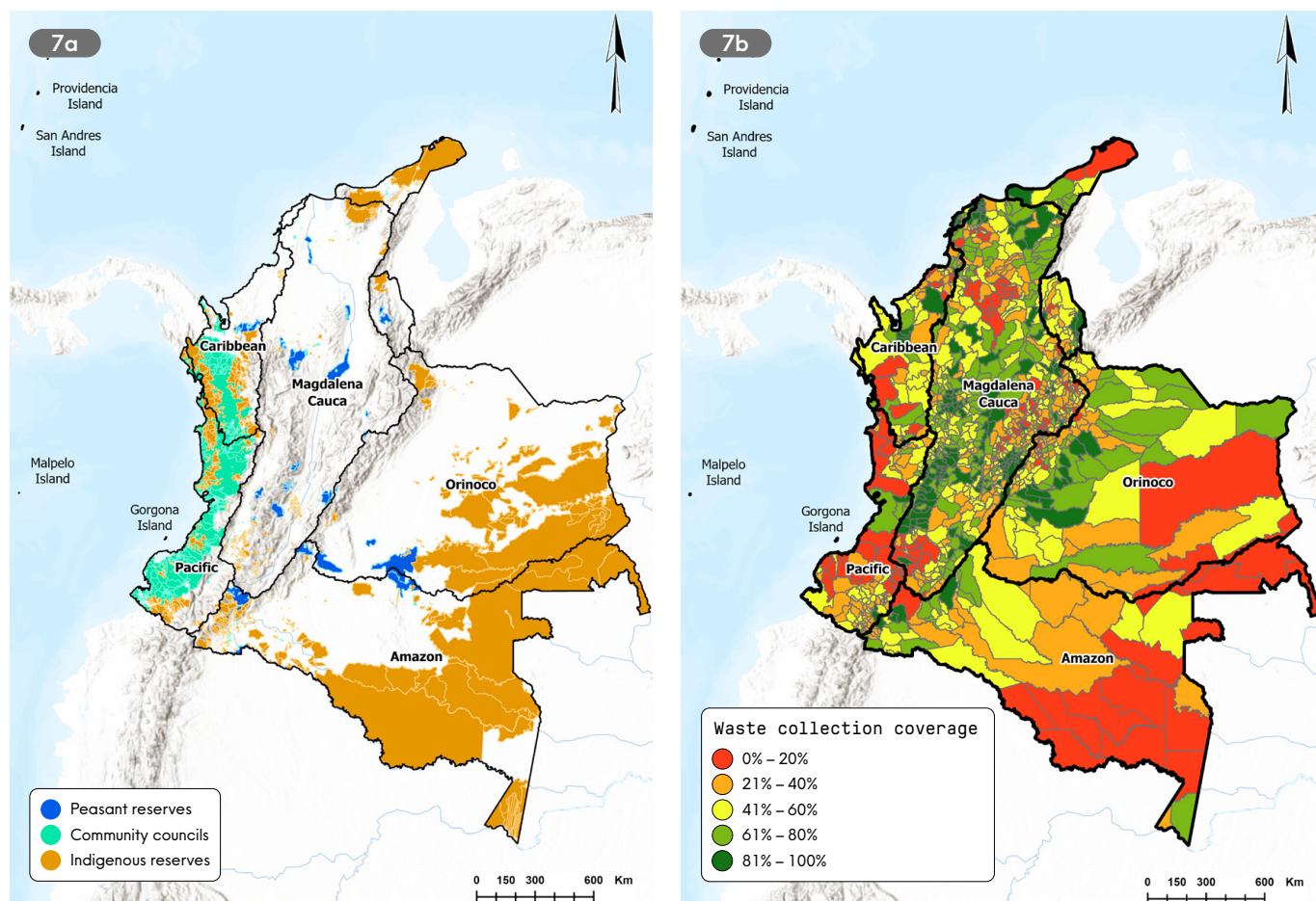
Description of the most affected urban areas and Indigenous and NARP communities

Identify qualitative and quantitative data on the communities most exposed to the risks of plastic pollution on biodiversity

An understanding of how poverty, inequality and environmental vulnerability intersect is essential for identifying the communities most exposed to the risks of plastic

pollution and associated biodiversity loss in Colombia (Figure 7a). This analysis pays particular attention to the pressures that plastic pollution creates for Indigenous peoples and NARP communities whose livelihoods often depend directly on local ecosystem resources.²³ According to Colombia's 2018 census, Indigenous peoples represent over 4% of the total population, while Afro-descendant groups represent more than 9 %.²⁴

Figure 7: Ethnic–territorial governance areas and household solid waste collection coverage in Colombia, highlighting locations with persistent service gaps



The richest 10% of Colombians control almost half of the country's income²⁵. Inequality limits access to basic necessities such as food, housing, education and healthcare, and also restricts civic participation and decision-making power, thereby increasing overall social vulnerability.²⁶ In 2021, national poverty levels disproportionately affected Indigenous peoples and NARP communities.²⁷ Monetary poverty affects 61% of the indigenous population and 46% of NARP communities, with extreme poverty rates of 33% and 17%,

respectively.²⁸ In departments such as Chocó and Sucre, over exceeds 60%²⁹ NARP communities live in poverty.

These communities often live among highly biodiverse areas, yet they face serious environmental challenges due to inadequate waste management infrastructure³⁰ (Figure 7b), which limits options for safe disposal or behaviour change.³¹ This overlap between social vulnerability and ecological fragility increases the overall risks for both biodiversity and the people who rely on these ecosystems.

According to the 2024 Superservicios report,³² 31% of final disposal sites are operating under emergency conditions or have less than three years of operational life remaining. In some locations, such as Puerto Carreño, disposal sites continue to operate as open dumps (Annex 2). Because safe alternatives are limited, more than 16% (331 kilotonnes) of solid waste leaks into nature through open burning and via aquatic and terrestrial systems,³³ increasing exposure and risks for nearby communities.

Descriptions of community exposure and vulnerability to plastic pollution in Colombia's major river basins

MACRO-BASIN 1

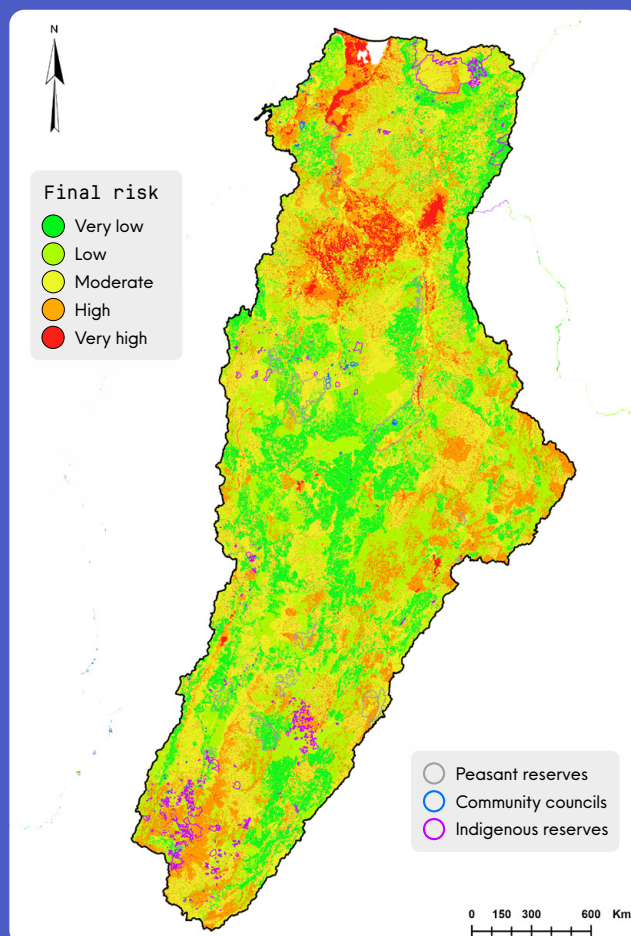
Magdalena-Cauca

This macro-basin functions as the economic and demographic engine of the country, contributing to over half of Colombia's national GDP and hosting 77% of the population in urban areas.³⁴ It is also the core of industrial development, which places disproportionate pressure on ecosystems that host rich biodiversity and are vital for water and climate regulation.³⁵ These ecosystems include the Andean region (páramos), mid-elevation zones (humid/dry forests) and river valleys (wetlands, marshes and mangroves in coastal areas), which face the highest risk of impacts from plastic pollution due to the Magdalena and Cauca rivers transporting plastic waste from major urban and industrial centers, such as Bogotá, Medellín and Barrancabermeja, into the ocean.

In terms of pressure, the macro-basin is facing an imminent sanitation crisis: it concentrates the highest waste generation in the country and, in key departments like Santander and Antioquia, includes landfills with critically low remaining capacity.³⁶ This pressure is further intensified by migratory dynamics, such as the transit of 275,928 migrants reported in Antioquia in 2024, placing additional strain on waste management services.³⁷

From an exposure perspective, approximately 330 local communities with recognized territorial rights intersect areas classified as high or very high plastic pollution risk within the basin (269 Indigenous Reserves, 50 Community Councils, and 11 Peasant Reserve Zones).

In addition, critical gaps persist in areas such as rural health: in rural valleys across the basin, 48.8% of households burn their waste due to lack of collection services, exposing families to toxic smoke.³⁸



Caribbean

The Caribbean macro-basin, which includes both the Caribbean and Insular regions, is home to key ecosystems, such as coral reefs, mangroves, seagrasses, tropical dry and humid forests, wetlands (marshes) and, at higher altitudes, páramos and high Andes forests.³⁹

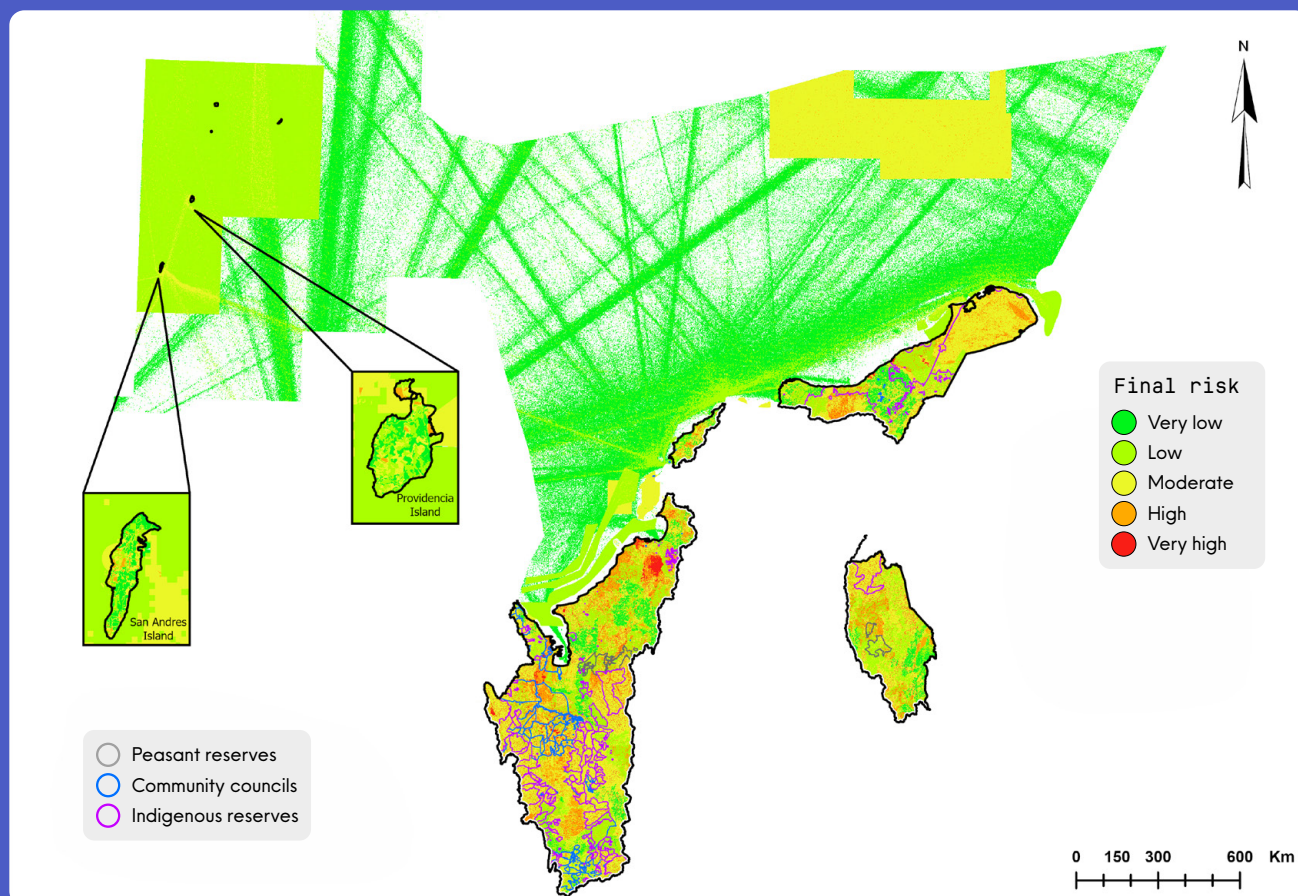
In terms of pressure, the Caribbean macro-basin has the second-lowest rate of household waste separation, with only 23% of households practising at-source separation.⁴⁰ Waste management services are under critical strain. In the department of La Guajira home to the largest Wayuu Indigenous population 79% of the population falls within the highest levels of extreme monetary poverty, which is associated with limited basic services, including irregular waste collection, the absence of a sanitary landfill and inadequate sanitation.⁴¹ As a result, communities are often forced to burn, bury or dispose of plastic waste directly into the natural environment, increasing the risk of impacts on biodiversity.

In the insular zone (San Andrés), high tourism pressure contrasts with limited waste management capacity, with only one waste picker per 5,189 inhabitants -

the lowest ratio in the country.⁴² This low coverage of collection and waste management increases the risk of plastic leakage into marine ecosystems, directly affecting cultural services (such as tourist beaches) and regulatory services (such as mangroves).⁴³ Fishing, a key provisioning service for local subsistence, is one of the most documented sectors being impacted by plastic pollution.⁴⁴

In terms of risk, impacts in the basin disproportionately affect 217 communities with recognized territorial rights: 146 legally established Indigenous Reserves, 68 titled Community Councils and three formally recognized Peasant Reserve Zones. This vulnerability is further compounded by extreme poverty conditions; for example, in Sucre, more than 60% of the Afro-descendant population faces multidimensional poverty.⁴⁵

From an exposure perspective, the impact on the basin disproportionately falls on 217 communities with recognized territorial rights: 146 legally established Indigenous Reserves, 68 titled Community Councils and three formally recognized Peasant Reserve Zones.



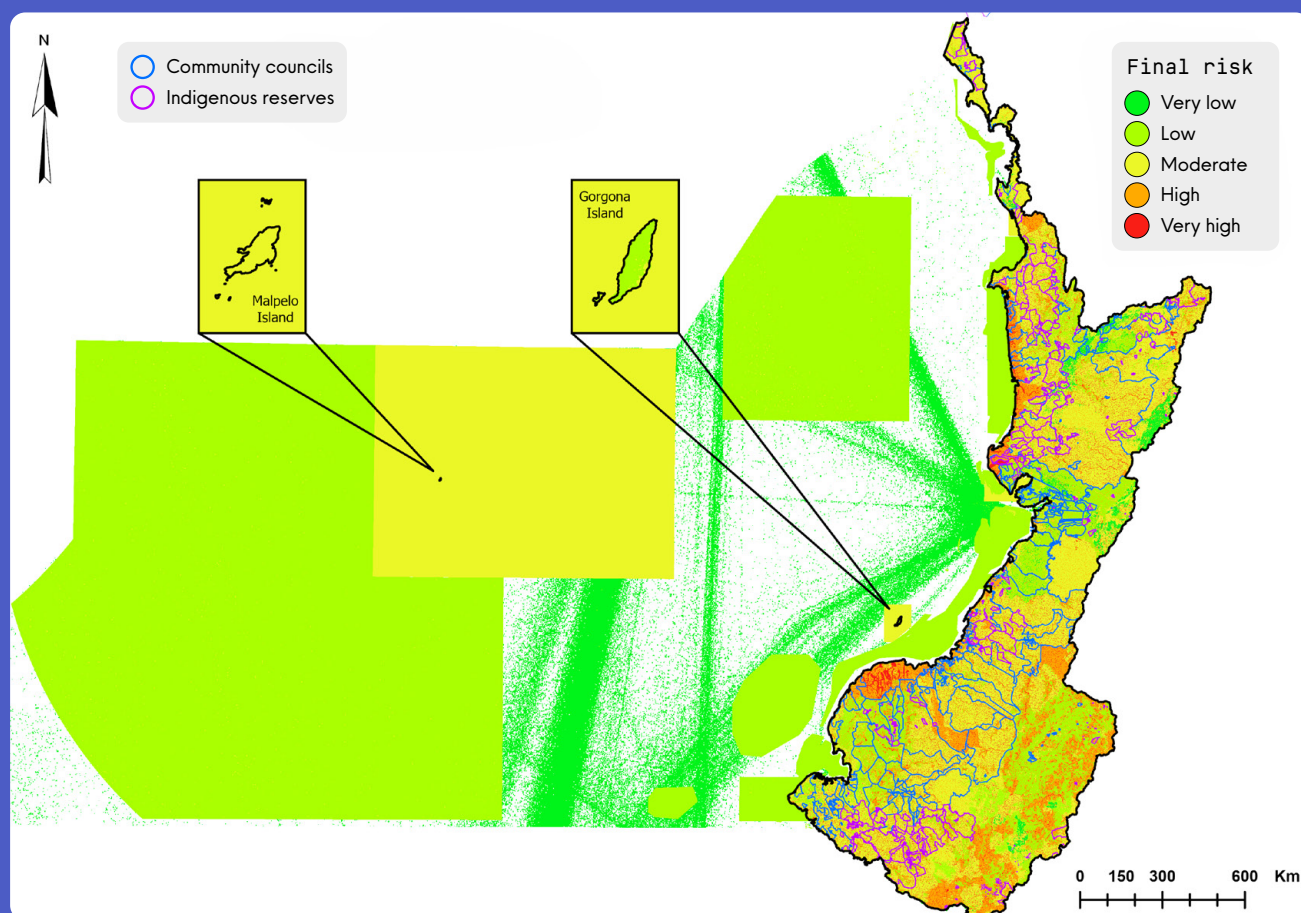
Pacific

The Pacific macro-basin corresponds to the region known as the Chocó Biogeographic Area, home to ecosystems such as mangroves, rainforests, cloud forests, wetlands and, at higher elevations, páramos. These ecosystems are connected by a network of fast-flowing rivers that descend from the Andes and empty into the ocean, forming a unique landscape where the jungle meets the sea.⁴⁶

In terms of pressure, the region faces a collapse in sanitation infrastructure. In departments such as Chocó, 86% of final waste disposal sites are either substandard or open dumps.⁴⁷ Poor waste management has led to severe environmental pollution. For instance, in Tumaco, 6,533 tonnes of plastic waste have been reported.⁴⁸ Of this total, 13% corresponds to waste that is not collected, while 87% is collected; however, an estimated 7% of the collected waste still leaks into the environment (e.g., to nearby mangroves and beaches).⁴⁹

Taken together, this implies that roughly one-fifth of the total reported plastic waste can end up leaking into nature. Regarding microplastic concentrations, levels of 416 to 832 items/m² have been recorded in mangrove sediments,⁵⁰ and more than 17 items/m² on beaches,⁵¹ highlighting that plastic contamination affects multiple vital coastal ecosystems.

From a risk perspective, approximately 305 communities with recognized territorial rights are located within the basin, including 159 legally established Indigenous Reserves and 146 titled Community Councils. The region is also home to almost 50% of the country's Black, Afro-Colombian, Raizal and Palenquero communities (NARP).⁵² In this context, high poverty levels reaching 62% among these groups in Chocó can constrain household and community options to prevent, manage, or recover from pollution-related impacts, thereby intensifying the consequences of the plastic waste crisis.⁵³



Orinoquía

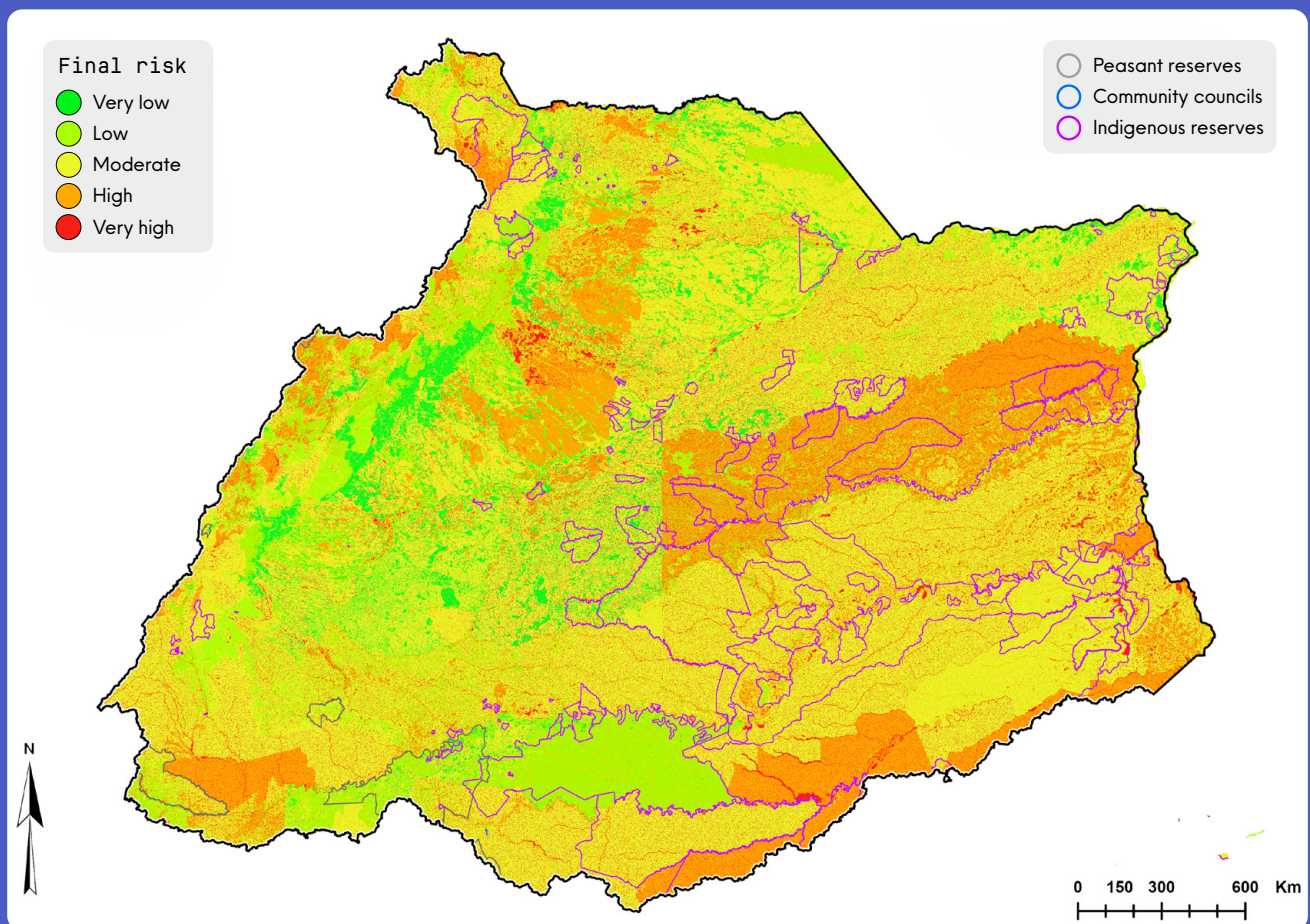
The Orinoco macro-basin is home to a wide variety of ecosystems, including vast savannas, gallery forests, wetlands, morichales (semi-aquatic forested wetland ecosystems) and the Andes foothills. These ecosystems are critical for biodiversity conservation and provide essential water reserves for the region.⁵⁴

In terms of pressure, this is the region of the country with the highest number of open-air dumps,⁵⁵ indicating widespread inadequate waste disposal practices. The pressure is particularly severe in departments like Vichada, where waste collection coverage is below 50%,⁵⁶ leading to the widespread burning and burying of plastic waste in ecologically sensitive areas.

From a risk perspective, the basin includes 142 communities with recognized territorial rights: 136 formally established Indigenous Reserves, two titled

Community Councils and four designated Peasant Reserve Zones. Territorial vulnerability is compounded by the region's demographic and socio-economic characteristics: it has the highest proportion of minority NARP communities in Colombia's continental territory, reaching 48%.⁵⁷

In the municipality of Puerto Carreño, Indigenous communities, such as the Amorúa, Sikuani and Jivi, have been displaced and have settled in urban areas near the landfill. There, they engage in waste sorting and recycling, which has become their main source of income. Non-Indigenous informal recyclers, including Venezuelan migrants, are also part of this emerging community-based recycling economy, reflecting how environmental challenges are reshaping local livelihoods.⁵⁸



Amazon

The Colombian Amazon macro-basin is primarily composed of tropical humid rainforest, along with aquatic ecosystems, such as flooded forests and savannas. It also features unique formations like the tepuis, rocky plateaus of the Guiana Shield, such as those found in the Serranía de Chiribiquete, an area characterized by nutrient-poor soils but an extraordinary geological and biological landscape.⁵⁹

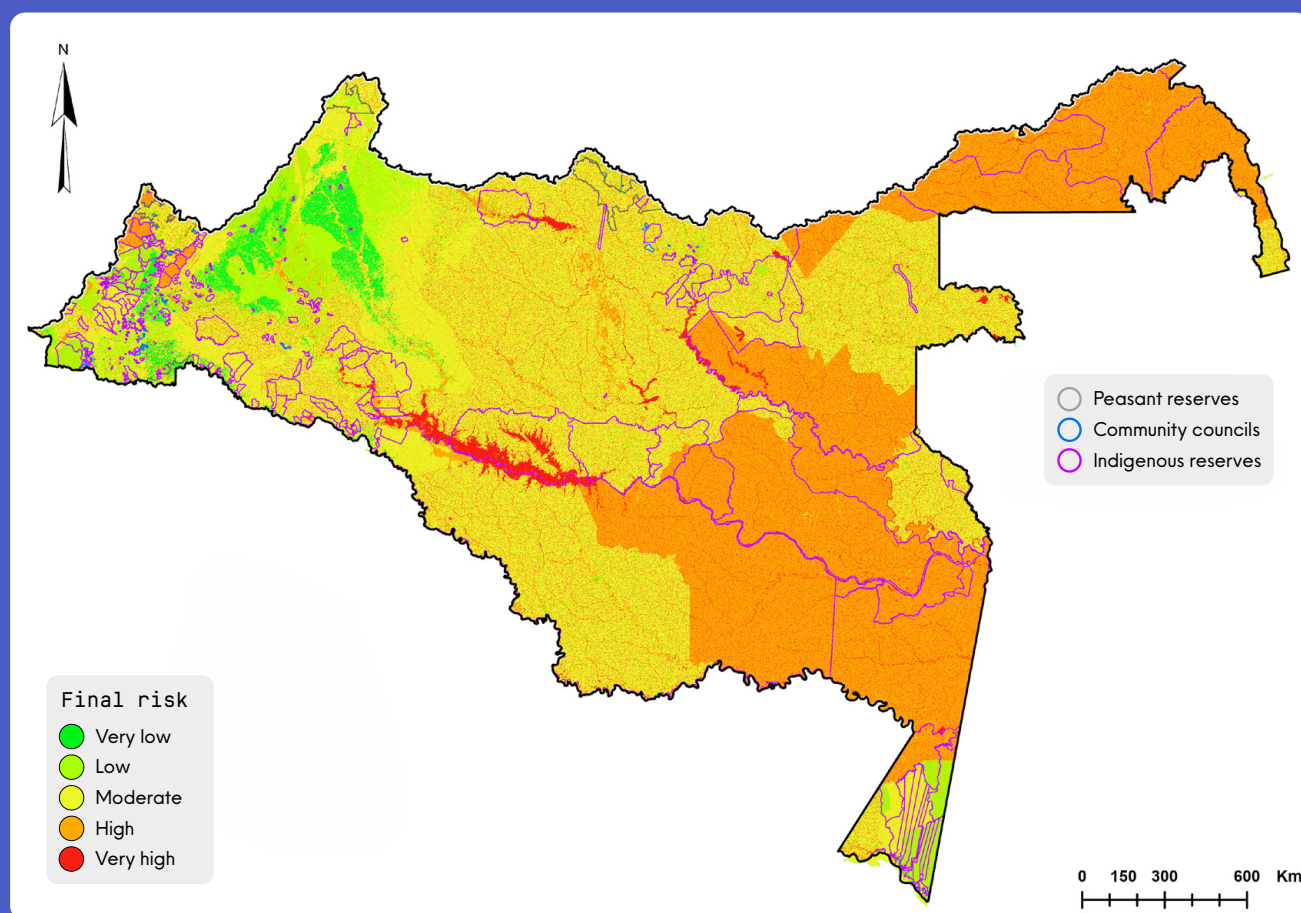
The Amazon River basin in Colombia spans a drainage area of 339,505 km², representing approximately 5% of the entire Amazon basin and around 42% of Colombia's territory. The use and management of its natural resources are closely linked to the water supply provided by the tropical rainforest.⁶⁰

Pressure: Many current economic activities in the Amazon disrupt the natural ecosystem dynamics responsible for the regulation and renewal of water resources, threatening the ecological balance. The region lacks adequate technical solutions for waste management and has the highest proportion of disposal sites with limited or expired operational lifespan, reaching over 50%.⁶¹ This situation leads to inadequate practices, such as dumping waste directly into water bodies or open burning.

Additionally, the introduction of plastic products has altered traditional cultural practices, replacing Indigenous utensils without offering any return or waste management systems.⁶² Another critical threat concerns food provision: in Leticia, where fish is the main source of protein, per capita consumption reaches 26 kg per year,⁶³ far exceeding the global average.⁶⁴

From a risk perspective, approximately 262 communities with recognized territorial rights in the basin, including 224 formalized Indigenous Reserves, 35 titled Community Councils and three designated Peasant Reserve Zones.

This region also exhibits Colombia's most critical inequality levels, with a 30-percentage-point gap in the Unsatisfied Basic Needs (UBN) index between municipal centers and rural areas. In the rural Amazon, where UBN reaches over 54%, there is an almost complete absence of basic public services.⁶⁵ Without waste collection systems or infrastructure for reverse logistics, communities are excluded from formal waste management systems and often have no alternative but to dispose of waste directly into the forest or water bodies, as documented in the Yahuaraca Lakes in Leticia.



Consider gender-specific impacts and vulnerabilities

Plastic pollution's impacts intersect with structural gender inequalities. While women may not control upstream drivers such as the production and marketing of plastics, they often play a central role in organizing household consumption and day-to-day waste handling. Globally, 89% of women report that they have shared or primary responsibility for daily shopping, household chores and food preparation.⁶⁶

Women can face a disproportionate burden in managing household plastics and in coping with the health, time and livelihood impacts associated with inadequate waste management services.⁶⁷ Where infrastructure is limited, particularly in rural areas, open burning is a common practice for managing waste, releasing toxic substances such as bisphenols and phthalates,⁶⁸ which pose risks to reproductive health, foetal development and babies and mothers during breastfeeding.⁶⁹

In Colombia, migration has made waste management challenges more complex. Over 2.8 million people arrived from Venezuela between 2022 and 2023, increasing demand for waste collection, safe disposal and related municipal services in the areas where they have settled in the areas where they have settled.⁷⁰ More than half of this migrant population is women and girls (over 33% and 18%, respectively)⁷¹, who can face heightened health risks where waste services are overstretched or inadequate, especially as many of these women are increasingly drawn into informal recycling activities and often live near open dump sites, which heightens their daily exposure to waste, smoke, leachate and other environmental hazards⁷²

In both large cities and rural areas, a significant proportion of waste handling and recycling is carried out by the informal sector.⁷³ In Bogotá, women make up 42% of the informal recycling workforce. These women typically earn low incomes, have

limited access to protective equipment and face significant exposure to hazardous waste.⁷⁴

It is essential to explicitly incorporate these gender-specific vulnerabilities into strategic planning to ensure that actions addressing plastic pollution do not reproduce or deepen existing inequalities. Some private sector initiatives are already doing this. For example, the *Guardianas del Manglar* (Mangrove Guardians) project by Fundación Carvajal empowers communities in Buenaventura, particularly women who gather shellfish and crabs or practice artisanal fishing, by engaging them in plastic waste recovery activities in mangrove ecosystems. These are among the ecosystems most affected by plastic pollution in Colombia's Pacific and Caribbean regions.⁷⁵

Highlight community dependence on ecosystem services

By speaking directly with communities and sensitively observing their daily realities, this section seeks to understand how plastic pollution impacts highly biodiverse environments and how this affects the symbolic and economic services these environments provide for local people.

Fieldwork was conducted in three locations to represent contrasting Colombian contexts and plastic pollution pathways: San Andrés, an island territory; Puerto Colombia, a Caribbean coastal municipality; and Puerto Carreño, an inland river-basin setting. In each location, interviews were conducted with 100 community members, complemented by targeted interviews focused on successful, community-led initiatives. Communities in each location co-exist with plastic pollution in unique ways. Listening to local voices reveals how people live with, perceive and respond to plastic, and how its presence alters not only ecosystems but also the economic, emotional and symbolic connections between people and places.



Image credit: Carvajal Foundation

San Andrés and Providencia: tourism, fishing and threats to Raizal cultural identity

In the archipelago of San Andrés, Providencia and Santa Catalina, tourism accounts for approximately 90% of GDP. While this activity sustains thousands of jobs, it also places growing pressure on this island's ecological integrity.

In such a small territory, surrounded by open sea and dependent on a constant flow of visitors, waste management is a defining challenge for the island's future, with local communities leading the response.

Led by Relis Arigan Forbes, the Schooner Bight Ethnic Association is a family-run Raizal enterprise formally established as an association in San Andrés. It has taken on environmental education, as well as the separation and collection of waste and the transport of recyclable materials off the island. Since 2019, through a strategic partnership with LATAM, the association has successfully removed 298 tonnes of waste from the archipelago.

Also noteworthy is Sepia ROV, a local company that has developed its own underwater drone technology to monitor the impacts of pollution in deep marine zones, combining local knowledge with applied science. This includes documenting changes to marine habitats: tyres becoming unintended refuges for marine life, mesh entangling species such as corals, turtles, sharks and many coral fishes, and crabs and seahorses trapped inside plastic containers that must be released one by one.





Perception in San Andrés (n=100): interview reveals high socioeconomic vulnerability linked to environmental degradation



Economic fragility: 44% of workers in tourism and fishing depend exclusively on these incomes (representing 100% of their monthly earnings), directly tying their financial stability to the health of the ecosystem.



Impact on strategic habitats: 53% of residents report the presence of waste on coral reefs and 49% on seagrass beds, both of which are essential for coastal protection and marine life. Additionally, 44% of the population has directly witnessed animals entangled in plastic, and 29% have observed wildlife ingesting plastic waste.



Risk perception: 77% of the community identifies the sea as the ecosystem under greatest threat surpassing any other environmental concern on the island.



Disconnect in waste management: Despite the island being part of the Seaflower Biosphere Reserve, source separation is low 52% mix plastics with general waste, and 74% are unaware of where their waste ends up.

Profile of the survey respondents:

24% Raizal population

63% Men

Women 37%



There's a lot of accumulation of glass and plastic bottles. At great depths, we find tiny fragments of plastic, eroded by the sea so small they can be ingested by fish.

Image credit: Sepia ROV

Puerto Colombia: at the meeting point of local and regional pressures

In Puerto Colombia (Atlántico), a municipality where identity is deeply tied to the sea, mangroves, marshes and artisanal fishing, plastic pollution has become a growing threat to biodiversity and community well-being. Much of this waste arrives through the mouth of the Magdalena River, forming accumulations of “trash islands”, and is compounded by limitations in local collection and disposal systems as well as littering by residents and tourists.⁷⁶ At the same time, much of the plastic entering these systems originates upstream from mass-produced consumer goods and packaging placed on the market, highlighting the need for action not only on local waste management but also on prevention and producer responsibility.⁷⁷ This directly impacts a population where nearly 30% of those who are economically active depend on nature-based activities such as fishing and tourism.

A project led by W2W, an organization focused on promoting the transition to a circular economy, and supported by GlZ, the Ministry of Environment and the Puerto Colombia Mayor's Office, is aiming to boost sustainable business models in hotels, restaurants

and other local establishments to reduce plastic pollution and improve waste management. A wide range of stakeholders are involved in the initiative, including tourist and commercial establishments, community organizations, informal recyclers and local authorities. One key achievement has been to encourage hotels and restaurants to recognize themselves not only as part of the problem but also as part of the solution. Many have adjusted purchasing practices, reduced the use of single-use plastics and reorganized how they sort and deliver their waste. Though operationally small, these changes represent a cultural shift: sustainability is now integrated into daily decisions in the kitchen, storage areas and customer service.

Recyclers involved in the project have become strategic allies in the recovery chain, helping to promote circularity is especially strengthened through the role of recyclers. Their knowledge of the territory, how waste patterns shift with the seasons, what businesses and communities consume and how materials circulate have become essential for designing more efficient collection and recovery systems. By

integrating this historically overlooked group into the project, material recovery has improved, businesses are better connected to the recycling value chain and the recyclers get opportunities for more dignified and stable working conditions.

One of the central lessons of this project is that behavioural change is possible when individuals are given clear information, a chance for active participation and access to tangible benefits. As establishments began to see improvements in environmental performance, reputation and operations, their commitment grew. At the same time, the community started to see itself as a guardian of the territory, understanding that environmental degradation is not just an ecological issue but a social and economic one as well.

The implementing team believes that, with political will, institutional coordination and strong local stakeholder involvement, this pilot could be scaled to the municipal, departmental, or national level, aiding the transition to a circular economy and driving behavioural change in coastal contexts highly vulnerable to plastic pollution.



At first it was difficult because we didn't understand the recycling part...we reduced plastic cups, bags, and straws; switched to cardboard and started using glass cups.

Employee at Viejo Muelle restaurant

Image credit: NPAP Colombia



Perception in Puerto Colombia (n=100): 75% of respondents highlight the negative impact of plastic pollution in their territory.



Perceived threats: 84% of the community identifies the sea as the ecosystem most at risk, followed by 67% who point to freshwater sources. Socially, 56% perceive direct risks to human health, and 57% believe that food may be contaminated with plastics. (Multiple responses allowed.)



Critical points: Pollution is visible in tourist areas: 77% of respondents report frequent presence of plastic waste on beaches, 72% in the sea, and 62% in freshwater sources.



Impact on wildlife: The community has witnessed how plastic pollution affects biodiversity: 55% have seen animals entangled in plastic, 51% have observed ingestion of plastic waste, and 43% have seen animals strangled by plastic.



Behavioral gap: There are ongoing deficiencies in waste management culture and infrastructure: 42% of households still dispose of plastic waste with general garbage (without separation), and 74% are unaware of the final destination of their waste.

Profile of the survey respondents:

35% Mestizo population

67% Men

Women 32%



The pollution here is very sad. On the tours, you see plastics everywhere, along with metals, hospital waste, and even dead animals or abandoned appliances. Year after year, the marsh obviously suffers a great deal; it is dying, if you look closely. It has been agonizing for three or four years now because, apparently, it is drowning from so much filth and so much waste.

Local resident



Image credit: NPAP Colombia

Puerto Carreño: natural potential, structural challenges

Located in the far eastern region of Colombia, Puerto Carreño sits at the confluence of three rivers that are fundamental to the area's social, economic and cultural life: the Meta, Orinoco and Bitá. These waterways not only shape the landscape, they define the seasons, provide pathways for transportation, shape livelihoods and influence the way people live in the territory.

Renowned for its cultural diversity, where Indigenous languages are still spoken on reserves, all communities share a deep connection with water and the borderland. The same rivers that support fishing, trade and tourism also carry plastic waste, which accumulates along the banks when the waters recede after the winter floods.

This problem is compounded by limited waste management infrastructure and service coverage in a territory with difficult access and complex logistics. Survey results indicate that household-level sorting is not yet mainstream: 75% of respondents reported not separating their waste. Rather than a direct driver

of riverbank pollution on its own, this points to weak enabling conditions for effective waste management, such as consistent collection, appropriate downstream handling and incentives that support separation at source.

A project led by SENA, under the direction of environmental engineer Paula González and the research group Vichada Ambientalmente Sostenible, aimed to turn a local waste problem into a productive opportunity, transforming used plastic into useful items for the community, such as fence posts, beekeeping boxes and garden pots. The project was later paused due to a lack of sustained funding. While it demonstrated the feasibility of small-scale plastic transformation initiatives and helped raise local awareness, maintaining and scaling the approach would require stable financing, operational support and reliable end-markets for the products.

The initiative created a collaborative network involving key stakeholders. The Colombian Navy supported the project by establishing collection points and

ensuring the transportation of materials to the processing centre. The effort was further supported by seven educational institutions (basic schools of the region), three drinks companies (which produced large volumes of plastic waste), one foundation (which donated sacks for storage), one nutrition centre and private sector actors like Coca-Cola, through Manantial Water, which contributed information and outreach support.

The engine behind this circular initiative was local schoolchildren, students and their families. After initial challenges with the quality of the collected material, which were often dirty or of mixed type, the project shifted to actively involve schools, turning children into ambassadors of the process. The initiative ceased to be merely institutional, and local families began delivering clean plastic waste as children understood they were "helping the river."

Processing, conducted using a simple shredding mill, yielded approximately 28 kg of PET and 7.5 kg of HDPE.



The children said they were helping the river. That was already a win for us.

Paula González environmental engineer

Image credit: NPAP Colombia



Perception in Puerto Carreño (n=100): The community associates plastic pollution with concepts such as “environmental damage” and “destruction.” The term ‘oceans’ is mentioned repeatedly, suggesting a disconnect between the global narrative of the issue and the local reality.



Perceived threats: From an environmental perspective, 69% of respondents reported that wildlife is threatened by plastic pollution, while 63% highlighted risks to freshwater sources such as rivers and lagoons. From a social perspective, 58% perceived risks to human health and 62% felt that food is being affected. (Multiple responses allowed.)



Critical locations: Pollution is mainly observed in natural ecosystems. The frequent presence of plastic waste in water bodies (lagoons, rivers, streams) was reported by 43% of respondents, with 38% identifying it in forests and green areas and 27% in agricultural zones.



Impact on wildlife: As well as being victims of plastic pollution, wild animals are also seen as unintentional dispersers. In recreational areas, 40% of respondents attribute some waste accumulation to animals tearing open garbage bags in search of food.



Behaviour: Improper disposal is a major issue: 75% of respondents do not separate their waste, 66% use a general trash bin and 61% do not know the final destination of their waste after it leaves their home.

Sample composition:

31% of all people surveyed identified as part of the Mestizo population

65% Men

Women 35%



Image credit: NPAP Colombia



Image credit: Meridith Kohut/WWF-US

Evaluation of the impact of plastic pollution on biodiversity

Colombia is said to be the fourth most biodiverse country in the world, after Brazil, Indonesia and China.⁷⁸ It is home to nearly 1,800 bird species, 73 of which are endemic⁷⁹. It ranks first in bird, orchid and butterfly diversity, second in amphibians and third in plant diversity.⁸⁰ However, its biological wealth is increasingly threatened by plastic pollution; this review identifies species and ecosystems that are particularly vulnerable.

As of 2025, most documented impacts are found in aquatic systems, including microplastic ingestion reported in

52 fish species (Figure 8). At least seven species classified as vulnerable or near threatened by the IUCN have been found to have interacted with plastic, mainly through ingestion. Examples include terrestrial mammals, such as the Andes bear and the mountain coati, which inhabit the páramo ecosystems that are key areas for water provisioning.⁸¹ Also affected are ecologically and commercially important fish species,⁸² such as the tarpon and catfish, with implications for provisioning, supporting,⁸³ regulating⁸⁴ and cultural ecosystem services.⁸⁵



Studies indicate a high prevalence of microplastics in fish in Colombia, which can compromise organism growth and threaten vital provisioning services.

Ecological and species-level impacts

Species affected by ingestion, entanglement and habitat degradation

Plastic pollution affects wildlife through multiple critical pathways. One threat is the ingestion of plastic fragments, which can block or irritate the digestive tract. In Colombia, fish are the most studied animal group in relation to the effects of plastics, and there is a high prevalence of microplastics, especially fibres, documented in their systems.⁸⁶ Evidence indicates that this accumulation can

compromise organism growth,⁸⁷ thereby threatening provisioning services that many communities depend on for subsistence along the Caribbean⁸⁸ and Pacific coasts.⁸⁹

Other organisms, such as invertebrates⁹⁰ and plants,⁹¹ can be suffocated or lacerated when covered by plastic waste.⁹² In freshwater and marine systems, ghost nets are a lethal trap that can cause suffocation and exhaustion in entangled animals.⁹³ Beyond these direct physical impacts, floating plastic debris poses further risks by acting

as a vector for biofouling, enabling the spread of invasive species and pathogens.⁹⁴ It can also serve as a colonization surface for communities of microorganisms and invertebrates,⁹⁵ facilitating the transport of non-native species and potentially harmful bacteria.⁹⁶

Perception surveys conducted during this study revealed frequent reports of plastics found in bird nests, birds being one of Colombia's most diverse and endemic-rich taxonomic groups. However, there is currently no systematic data on this phenomenon.



Image credit: WWF

The following pages present summary fact sheets of the available evidence on the species and habitats most at risk, as well as how ecosystems are being affected by plastic pollution. Understanding these impact pathways allows Colombia to better target prevention and restoration efforts where they can have the greatest effect for both nature and people.

Figure 8: Taxa and number of species documented as directly impacted by plastic pollution in Colombia (ingestion, entanglement, biofouling or coverage), based on a systematic literature review up to 2025

 Fish	Impacted Species Observed 52	Microplastic ingestion causes accumulation in tissues and carries contaminants; it is associated with poorer body condition and impaired growth, with heightened risks at higher trophic levels. Entanglement causes injuries, stress, and immobility, increasing mortality and putting the food web and food security at risk. • Estuary: Magdalena, Valle del Cauca, Nariño, Córdoba, Bolívar • Floodplain: Tocagua, Luruaco (Atlantic) • River: Betania Reservoir, Hulila • Marine: Coastal waters of Cartagena, Santa Marta, San Andrés, La Guajira, Buenaventura, and Tumaco, Chocó	 
 Invertebrates	Impacted Species Observed 17	Floating plastics disrupt ecosystems by transporting invasive species through biofouling. When ingested, they harm marine life, causing stress and mortality that interrupt vital processes such as water filtration and nutrient cycling. • Estuary: Buena ventura Bay (Cauca Valley), Punta Soldado, and San Pedro • Beaches: Atlántico Department, San Antero (Córdoba) • Marine: Albuquerque Keys, Providencia Island, San Andrés Island, Puerto Velero (Atlantic) • Protected Areas: Salamanca Island Park Road (Magdalena)	 
 Arthropods	Impacted Species Observed 9	Microplastics contaminate urban pollinators through ingestion and entanglement, causing higher mortality rates in cities. This pollution disrupts critical pollination services essential for agriculture and ecosystem health. • Estuary: Buenaventura mangroves (crustaceans) • Beaches: Atlantic beaches (barnacles and crabs) • Marine: San Andrés, Providencia (marine crustaceans) • Urban areas: Bogotá Savanna and surrounding areas (bees)	  
 Mammals	Impacted Species Observed 3	Plastic ingestion causes intestinal blockage, malabsorption, systemic stress and pollutant exposure, raising mortality; Entanglement inflicts severe wounds, impairs locomotion, and can lead to necrosis and amputations. • Paramo: Within Tamá National Natural Park, Andean bear feces containing microplastics and a dead coati with macroplastics debris in its stomach were found. • Marino: Nuquí whale watching	 
 Plants	Impacted Species Observed 9	Plastic waste acts like a smothering blanket: it blocks light and gas exchange, clogs pneumatophores, and suppresses photosynthesis. This drives hypoxia, heat and humidity buildup, and pathogen growth, hindering established and recruitment and causing stress, dieback, and seeding mortality. • Estuary: Pacific and Caribbean mangroves and surrounding vegetation • Floodplains: Amazonian macrophyte mats	
 Bacterium	Impacted Species Observed 7	Floating plastics disrupt the ecosystems by transporting invasive species through biofouling. When ingested, they harm marine life, causing stress and mortality that interrupt vital processes such as water filtration and nutrient cycling. • Floodplains: Ciénaga Grande de Santa Marta, Caribe colombiano	
 Turtles	Impacted Species Observed 2	Plastic entanglement causes lacerations, impaired movement, abnormal buoyancy, and may lead to infection or amputations; ingestion causes gut blockages, false satiety, tissue damage and contaminant exposure, degrading condition and reducing fitness and survival. • Marine: Nuquí turtle watching	 
Key			
 Biofouling			
 Coverage			
 Entanglement			
 Ingestion			

Linking species-level plastic pollution impacts to ecosystem services

Plastic pollution can affect everything from individual organisms to the functioning of entire ecosystems. For example, when large numbers of fish ingest microplastics⁹⁷ or mangroves are smothered by plastic waste,⁹⁸ the ecological roles these organisms play can be restricted, potentially impacting the ecosystem services they provide.

To assess these connections, impacts documented in the systematic literature review were analysed across organism groups using the Common International

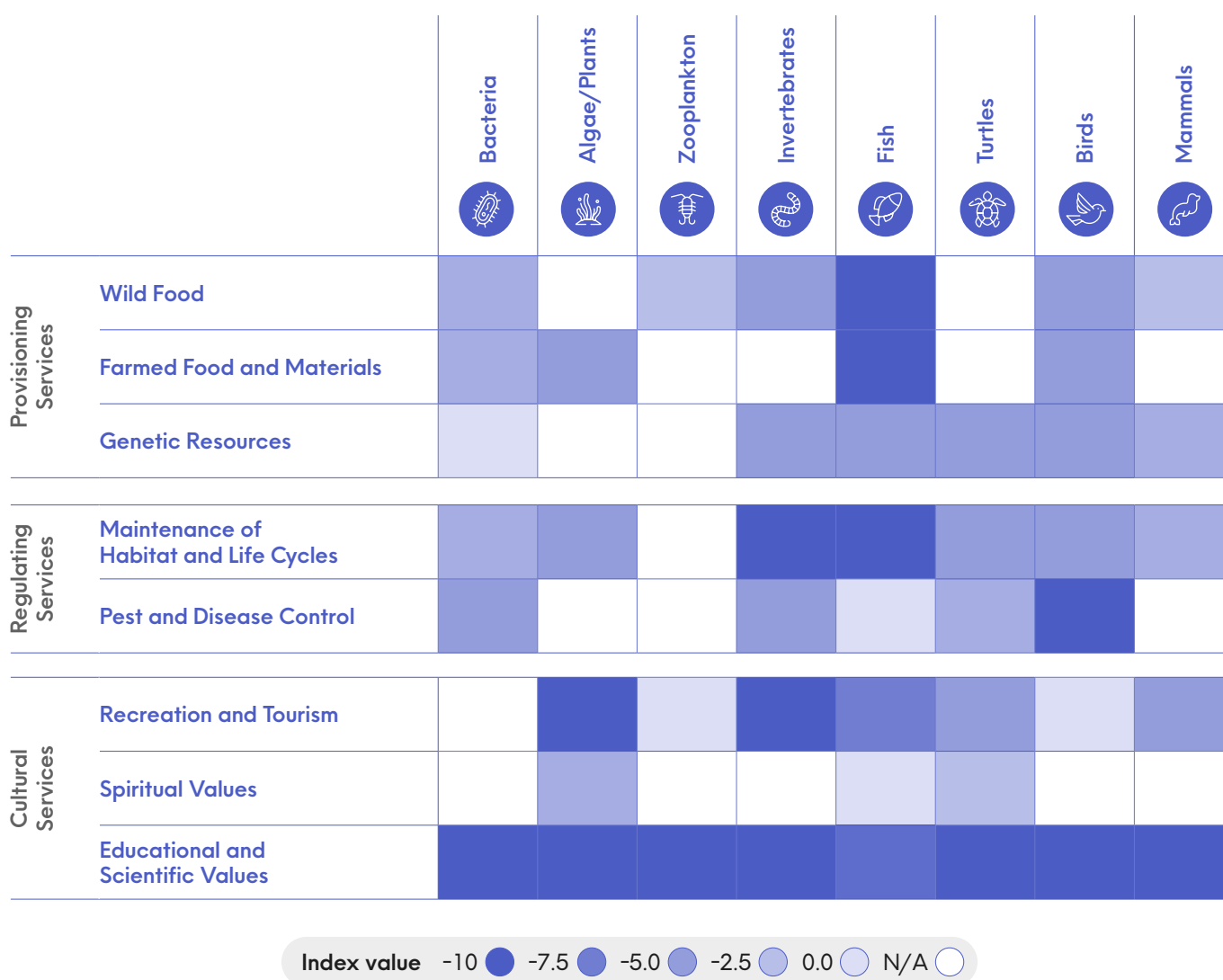
Classification of Ecosystem Services, as modified by Beaumont et al.⁹⁹ Using this framework, supporting and regulating services were combined to reflect the way that processes such as soil formation and the water cycle underpin all other services. The analysis used experts to validate the literature review and assign service-specific index scores for the Colombian context (Figure 9).

Ecosystem services were grouped into provisioning (for example, food, fibre and medicines), regulating (such as clean air, clean water and climate regulation) and cultural benefits (like recreation, inspiration and identity). Overall, results indicate that plastic

pollution has a largely negative effect for all the assessed service categories. The most negative scores are associated with provisioning services linked to wild food and regulating functions related to habitat maintenance and life cycles, particularly for taxa that underpin fisheries and coastal ecosystem functioning, including fish and invertebrates.

In Figure 9, dark grey cells indicate that the review did not identify sufficient or comparable evidence to score those service combinations. This should not be interpreted as an absence of impact. Instead, this missing information represents evidence gaps that would benefit from further study.

Figure 9: Impact of plastic pollution on ecosystem services by taxonomic groups



Note: Framework adapted from Beaumont et al.¹⁰⁰ Scores range from -10 to +10: -10 indicates a significant risk of negative impact on the ecosystem service contribution, whereas +10 indicates a substantial potential positive effect.



Ecosystem and functional impact

Understanding of the impact of plastic pollution on Colombia's ecosystems is distributed unevenly, with information concentrated in specific geographic areas. This is largely due to the priorities of the academic sector and research institutes, which have focused most of their investigations into plastic waste on marine environments. The Caribbean region accounts for over 62% of the studies, particularly focusing on beaches and estuaries, while the Pacific region comprises 18%, with an emphasis on mangroves. The Andean region represents 11% of the studies, mostly related to freshwater systems and the Insular region accounts for over 7%. Despite their ecological importance, there are significant gaps in available

information covering the Amazon and Orinoquia regions (Figure 10).

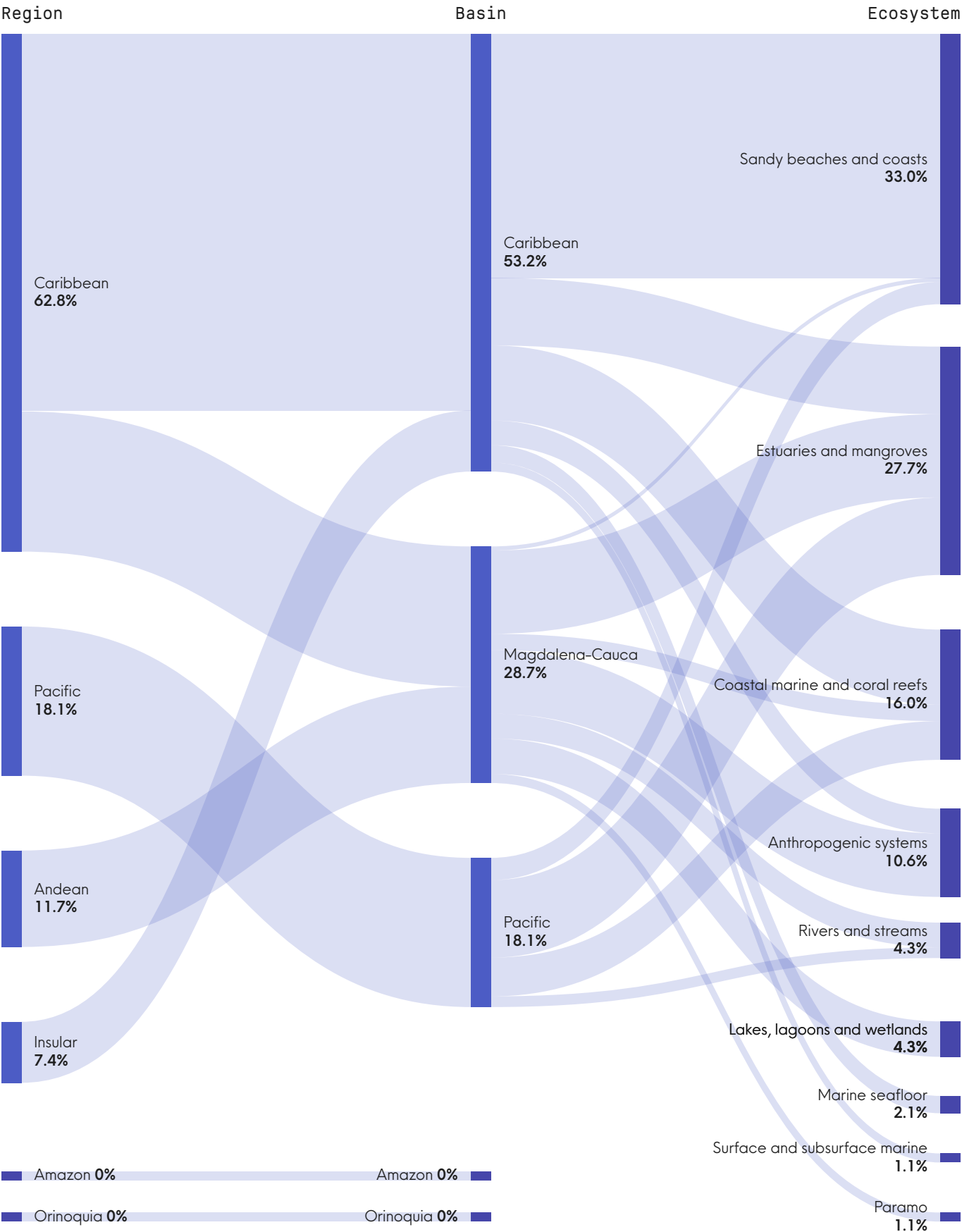
Analysis for this report indicates that coastal ecosystems are the most studied in terms of plastic pollution: sandy beaches and shorelines account for 33% of research efforts, while estuaries and mangroves represent almost 28%. This means that there is a more detailed understanding of the impacts of plastic pollution in these environments.

In contrast, continental water ecosystems (rivers and lakes), humid forests and marine floors remain under-researched, meaning that the true extent of plastic pollution in these systems is still largely undocumented (Figure 10).

33%

of research efforts focus on sandy beaches and shorelines, while estuaries and mangroves represent almost 28%.

Figure 10: Distribution of evidence on ecosystem impacts of plastic pollution in Colombia by region, river basin and ecosystem type, based on the systematic literature review conducted for this assessment (evidence up to 2025)



Ecosystems and their effects on supporting and regulating ecosystem services



Coastal ecosystems: beaches and shorelines

Extent: Colombia has 3,200 km of coastline, distributed as follows: 1,600 km along the Caribbean, 1,300 km along the Pacific and 300 km around its island territories.¹⁰¹

Coastal sites for which data is available: Puerto Colombia and Santa Marta in the Colombian Caribbean; Tumaco and Buenaventura on the Pacific coast.¹⁰²

Ecosystem services at risk: Coastal ecosystems provide key regulatory services, including water quality maintenance, filtration and coastal resilience, that are being severely compromised by plastic pollution in both the Caribbean¹⁰³ and the Pacific.¹⁰⁴

Microplastics transport contaminants: Microplastic accumulation alters physical and chemical conditions in Caribbean coastal environments,¹⁰⁵

promotes the adsorption of heavy metals¹⁰⁶ and persistent organic pollutants and reduces the system's natural capacity to filter contaminants and regulate nutrients.¹⁰⁷

Sediment and microbial disruption:

Changes in sediment structure and interstitial water affect microbial communities essential for organic matter decomposition and nutrient recycling, thereby altering key biogeochemical processes in coastal environments. This was supported by findings in Santa Marta bay.¹⁰⁸

Impacts on fauna and bio-dispersion:

Plastics and microplastics interfere with invertebrates, birds, and reptiles through the potential for ingestion and entanglement, and can act as a vector for pathogens and invasive species. This was supported by findings in Puerto Colombia.¹⁰⁹

Loss of resilience: Plastic pollution weakens the ability of coastal ecosystems to protect against natural disturbances. It can reduce oxygen in sediment spaces, make sediments less able to retain nutrients by turning them more impermeable, and increase temperatures, all of which undermine the resilience of these ecosystems.¹¹⁰



Plastics and microplastics interfere with invertebrates, birds and reptiles through ingestion and entanglement.





Mangroves and estuaries

Extent: Colombia hosts 7,500 km² of mangroves and estuaries, with 80% located along the Pacific coast and 20% in the Caribbean. These regions also support human communities.¹¹¹

Mangroves areas for which data is available: Buenaventura, Nuquí and Tumaco on the Colombian Pacific coast; Ciénaga Grande de Santa Marta and Urabá in the Colombian Caribbean.

Mangrove habitat and soil alteration: Mangroves protect against erosion, sequester carbon, support high biodiversity and improve water quality.¹¹² Plastic waste clogs waterways and becomes embedded in the soil, altering hydrodynamics, sediment physical properties and soil aeration.¹¹³ This affects gas exchange in roots and the habitat structure for associated biota.¹¹⁴

Impact of plastic pollution on infauna and benthic community structure: Changes in sediment conditions force burrowing species, such as crabs, to alter their activity patterns and habitat use¹¹⁵. This disrupts the functional composition of bottom-dwelling communities, with scraper gastropods

ousted by the dominance burrowing crabs in impacted mangrove areas.¹¹⁶

Mangroves as sinks for plastics and pollutants: The dense root systems of mangroves act like natural traps, capturing plastic waste and toxic substances.¹¹⁷ These materials are then transferred to benthic organisms and occupy the space needed for propagule establishment, limiting forest regeneration.¹¹⁸

Biochemical and microbial regulation: Plastic pollution is reshaping aquatic communities through two main mechanisms. First, floating plastics serve as vectors for invasive species to reach vulnerable habitats.¹¹⁹ Second, by forming a mobile 'plastisphere' with the potential to be colonized by approximately 1,760 bacterial genera, including pathogens such as *Aeromonas caviae* (appears in 47% to 50% of plastisphere colonies analysed), posing a risk of transmission to humans through contaminated seafood. In mangrove ecosystems, plastic debris fosters the growth of harmful microbes that disrupt organic matter decomposition and key biogeochemical cycles, negatively affecting molluscs and crustaceans living on mangrove roots.¹²⁰



Plastic waste clogs waterways and becomes embedded in the soil, altering hydrodynamics, sediment physical properties and soil aeration.



Image credit: NPAP Colombia

Regulation of disturbance and ecosystem health: By altering soil structure, bottom-dwelling fauna and root dynamics, plastics reduce the mangrove's ability to perform key ecological functions¹²¹ and recover from disturbances, weakening its role as a natural coastal buffer.¹²²

Vector control and public health: Plastic waste that blocks water flow encourages the spread of flies and pathogens, increasing disease risk.¹²³ These environmental changes directly impact the well-being of ethnic and local communities whose cultural identity is closely tied to these territories.¹²⁴

Plastic waste that blocks water flow encourages the spread of flies and pathogens, increasing disease risk¹²⁵ and directly impacting the well-being of Indigenous and NARPCommunities whose cultural identity is closely tied to these territories.¹²⁶



Seawater quality in key ecosystems: impact on coral reefs

Extent: Colombia has a total of 4,405 km² of coral reefs, of which 4,390 km² is located in the Caribbean (including both oceanic and continental coral zones), with the rest in the Pacific region.^{127,128}

Coral reef sites for which data is

available: Caribbean: archipelago of San Andrés, Providencia and Santa Catalina; Corales del Rosario and San Bernardo National Natural Park, Pacific: Gorgona Island.¹²⁹

Supporting services: impacts on

the biological carbon pump: Plastic pollution in seawater can disrupt the ocean's biological carbon pump by altering how carbon moves from surface waters to the deep ocean, reducing the efficiency with which carbon is sequestered at depth.¹³⁰ Once in the water, microplastics may float, sink, remain suspended or be ingested by organisms.¹³¹ When zooplankton ingest microplastics, their feeding, growth and development can be impaired, which may reduce grazing and the production of

carbon-rich particles that normally sink and transport carbon downwards.¹³² Consequently, the ocean's capacity to mitigate climate change is compromised. In addition, because zooplankton are a key component of marine food webs, microplastics can be passed on to higher trophic levels.¹³³

Regulating services: disruption of key

organisms' life cycles: Wave action and sunlight breaks poorly managed plastic waste from coastal areas down into particles. These particles sink and act as carriers of chemical toxins and

heavy metals, which bioaccumulate in key marine organisms such as filter-feeding molluscs, corals and seagrasses.¹³⁴ This transport occurs across a wide range of polymers, including PE, PP, PET, PS, PVC and nylon and across various particle sizes, from microplastics (fibres, fragments, films, foams, pellets) to macro-debris, such as PET bottles, plastic bags and films (mostly PE), caps and wrappers (PP), expanded polystyrene and fishing gear (nylon/PE/PP), all acting as persistent floating vectors.¹³⁵



Image credit: Santiago Estrada Robledo



Image credit: Daniel Buitrago



Inland water ecosystems: rivers and reservoirs

Extent: Inland water bodies (swamps, lakes, lagoons, reservoirs and marshes) cover an area in excess of 8,000 km².¹³⁶

Sites for which data is available: Río Negro and the Peñol–Guatapé reservoir system; Betania Reservoir; and the Magdalena River mouth within the Magdalena Cauca basin.

Ecosystem services at risk: Freshwater systems support drinking-water supply, water-quality regulation, nutrient cycling and fisheries and aquaculture. These services are threatened when microplastics become pervasive across water, sediments and biota, leading to chronic exposure and transfer within inland food webs. Microplastics can remain suspended or settle into sediments, altering habitat conditions and increasing long-term particle loads that may reduce filtration and self-purification efficiency at the system scale.¹³⁷ Microplastics have also been reported in biota, including fish from Colombian wetland systems.¹³⁸ Once ingested, particles may move through the food chain and contribute to chronic biological

stress, weakening ecosystem integrity and the functioning of provisioning and regulating services.¹³⁹

Microplastics in water–sediment compartments: Evidence from Andes basins indicates that microplastics are found in both the water column and surface sediments.¹⁴⁰ Spatial patterns differ between river reaches and reservoir environments,¹⁴¹ suggesting that reservoirs can act as accumulation zones while rivers facilitate downstream transportation.

Biota exposure and trophic transfer: Comparative assessments report microplastics in freshwater fish, such as bocachico, catfish and tilapia,¹⁴² supporting the plausibility of food-web transfer and the subsequent potential for impacts on ecosystem health and fisheries-related services.¹⁴³

Loss of resilience: Because plastics persist and circulate between water, sediments and organisms, they can create long-term pressures that reduce the capacity of freshwater ecosystems to maintain water quality and recover from disturbances.¹⁴⁴ Over time, this erosion of resilience compromises the ecosystems' long-term ability to provide regulatory and provisioning systems.¹⁴⁵



Microplastics can remain suspended or settle into sediments, altering habitat conditions and increasing long-term particle loads.

91%

of fishers report burning old nets, which exacerbates ecological impacts and contributes to harmful emissions.

Impacts on ecosystem services: how provisioning and cultural values drive the nation's economy

In 2024, fishing, agriculture, livestock and forestry accounted for 9.3% of Colombia's GDP,¹⁴⁶ while tourism contributed 2.2%.¹⁴⁷ These sectors depend on the country's hydrological system and on the supporting and regulating services it provides water for human consumption, irrigation, aquaculture, industry, energy generation, and the maintenance of critical ecosystems.¹⁴⁸ In this context, plastic pollution constitutes a cross-cutting pressure: it degrades water quality, contaminates provisioning resources, and erodes the natural and cultural values that underpin recreation and tourism.



Fishing: impacts on food provisioning and coastal livelihoods

Plastic pollution affects fisheries through direct biological exposure and through operational and livelihood impacts. Microplastic ingestion has been reported in several commercial species, particularly at juvenile stages in nursery areas, with potential consequences for development and local food security.¹⁴⁹ Trophic transfer from zooplankton to omnivorous fish has also been documented, with reported microplastic burdens ranging from 5 to 35.8 particles per individual, threatening water quality, aquaculture performance and aquatic biodiversity.¹⁵⁰

A complementary pathway of impact is **ghost gear** (lost or abandoned fishing nets), which continues to entangle marine fauna and damage habitats,¹⁵¹ adding pressure on fishery resources.¹⁵² This reduces fish availability and increases vulnerability among fishing-dependent communities, which also absorb the cost of replacing lost gear. Where end-of-life management options are limited, burning of old nets is widespread reported by 91% of fishers, exacerbating ecological impacts and contributing to harmful emissions.¹⁵³

These pressures are not limited to marine settings. In floodplain systems such as the Yahuaracaca Lakes (Colombian Amazon), solid and plastic waste enters water bodies directly, diminishing water quality and disrupting plant and fish life cycles. Some aquatic plants can absorb micro and nanoplastics, enabling transfer through the food web.

Increased gillnet use is also a major pressure on pink river dolphins, as lost or poorly managed nets act as near-invisible barriers that entangle both commercially valuable fish and, accidentally, dolphins, potentially contributing to population declines.



Agriculture: water quality, water footprints, and productivity risks

Agriculture's reliance on water makes it particularly sensitive to contamination in the systems that store, transport and deliver water for irrigation and other uses, and evaluating how plastic contamination affects Colombia's water footprint supports sustainable planning.¹⁵⁴

A green water footprint refers to rainwater stored in soil and used by crops. A blue water footprint denotes the use of surface water and groundwater. While a grey water footprint describes the volume of water required to assimilate pollutant loads and comply with water-quality standards.¹⁵⁵ Plastic inputs can degrade blue-water quality and increase the grey footprint by raising the contaminant load that must be removed to meet environmental standards.¹⁵⁶

Nationally, the Magdalena–Cauca macro-basin accounts for 59% of Colombia's agricultural green water footprint, followed by the Orinoco (19%) and Caribbean (11%) macro-basins. The Pacific and Amazon macro-basins represent less than 8% each.¹⁵⁷ At the departmental level, Meta, Valle del Cauca, Magdalena, Tolima and Bolívar together account for 41% of the country's agricultural and post-harvest water footprint. These figures show that water-dependent agricultural demand

and, therefore, vulnerability to water-quality degradation is concentrated in a limited set of basins and territories.

Evidence from rice systems in Chicoral (Tolima) indicates that microplastics are already present in both soils and irrigation water across seasons, consistent with inputs linked to irrigation-water transport and inadequate plastic-waste management.¹⁵⁸ This is relevant for productivity and water reliability in irrigated systems and for the continuity of ecosystem services that support rural livelihoods and broader economic stability.¹⁵⁹

These findings suggest that the water bodies responsible for storing and distributing water for agriculture, energy and urban uses are receiving significant plastic waste loads, degrading water quality and increasing risks for irrigation systems and water supply.



Tourism: cultural services, coastal heritage, and public health

Tourism depends on cultural ecosystem services, such as scenic quality, recreation opportunities and coastal heritage, that are highly sensitive to litter accumulation and perceived environmental degradation. The sector contributes to foreign exchange earnings, employment and regional development and supports related activities, such as transportation, hospitality and gastronomy.¹⁶⁰ Inadequate solid-waste management poses a direct risk to the sustainability of coastal destinations, diminishing

visitor appeal and affecting local incomes.¹⁶¹ It also increases operational costs associated with beach clean-up for local governments and tourism operators.¹⁶²

Available evidence from the Colombian Caribbean illustrates the scale of the challenge. In an assessment of 25 beaches, 76% were classified as extremely dirty under the Clean Coast Index. Plastics were recorded on almost 89% of sites,¹⁶³ and poor scenic quality was reported for 57% of evaluated

beaches.¹⁶⁴ Beyond aesthetic impacts, plastic pollution can create additional ecological and public-health pressures that further compromise tourism viability. It can facilitate the spread of invasive species, including the Asian green mussel established in Colombian waters since 2009.¹⁶⁵ In addition, in cities such as Santa Marta, Puerto Colombia and Buenaventura, waste can block drainage systems and canals, promoting stagnant water and increasing the likelihood of disease outbreaks by encouraging vector proliferation.

Creative and localized responses: stakeholders linking biodiversity and plastic pollution

Across Colombia, communities are turning the challenge of plastic pollution into an opportunity for innovation, inclusion and environmental restoration. Drawing on traditional knowledge and local creativity, Indigenous and NARPCommunities,

microenterprises and NGOs are leading initiatives that transform waste into value: from producing school furniture made from plastic waste to promoting circular economies for agroindustry and organizing group clean-up events to protect Amazonian lakes.

The following examples demonstrate how community-led plastic waste management grounded in effective business models can generate environmental, social and economic benefits, while placing local actors at the heart of the country's transition towards sustainable waste management.



Image credit: Breno Coelho



ECOWORKS

BOGOTÁ, PACÍFICO AND AMAZON

Main Stakeholders: NGO

What do they do?

This NGO has participated in Colombia's National Plastics Roundtable and sectoral stakeholder workshops. Since 2012, ECOWORKS has been working in the Colombian Pacific through its **Pacific Without Plastics** programme. It promotes inclusive recycling (working with informal recyclers), community collection points (under the #ParaLaBotella banner) and the transformation of waste into products (such as plastic wood), creating local circular value chains and practical, marketable goods.

Social impact and circular model:

The initiative connects coastal and riverside communities with waste sorting, collection and education efforts aimed at sustained behaviour change. Its participatory model has been adopted by Colombia's Department of Social Prosperity and is now being replicated in the Amazon region. By making recycled resin available to local markets, the programme reduces demand for virgin materials and minimizes the risk of plastic leakage across the supply chain, helping to keep the environment cleaner for fisheries and cultural services alike.

Lagos de Yahuaracaca

LETICIA, AMAZON

Main stakeholders: Indigenous and community-led initiative (Tikuna, Kokama, Yagua) with support from the Universidad Nacional de Colombia

What do they do?

The community works across 21 interconnected floodplain lakes, organizing *Mingas de limpieza* (collective clean-up efforts). These involve clearing water channels, sorting waste (approximately 2 kg of plastic removed per event) and sharing a communal meal to strengthen local governance. Recyclable materials are sent to Fundación Hábitat Sur, which transforms the collected plastics into construction bricks.

Ecosystem health and service recovery:

Clean-up efforts based on collective work and the reopening of water channels help restore hydrological connectivity, improving spawning and nursery conditions for floodplain fish and enhancing habitats for aquatic birds and mammals.

Community governance enhances waste management, stewardship and monitoring activities around sacred lakes, strengthening cultural ecosystem services by keeping plastics out of carbon-rich sediments, supporting water provision and subsistence fishing.



Banaservice S.A.S.

SANTA MARTA, CARIBBEAN

Main stakeholders: Private microenterprise classified as a green business

What do they do?

The company collects, transports and recycles banana agroplastics, including LDPE bags and tape, PP ropes and LLDPE stretch film, from the departments of Magdalena and La Guajira. These materials were previously burned, buried or dispersed uncontrollably along the coast. Today, they are processed and returned as high-quality recycled resin for local manufacturing, generating employment and providing environmental training in the process.

Ecosystem health and service recovery:

This initiative helps prevent agroplastic leakage onto beaches, seagrass beds and coral reefs, while promoting circularity within the agricultural sector. The use of recycled resin replaces virgin inputs, reducing upstream risks

and fostering nature-positive supply chains. Formalized collection and training programmes also improve local livelihoods and contribute to a cleaner coastal environment.



Image credit: Banaservice

Plástico Precioso

BAHÍA MÁLAGA, COLOMBIAN PACIFIC

Main stakeholders: NGO

What do they do?

Since 2019, this NGO has been working closely with the local community, actively participating in workshops on the impact of plastic on biodiversity. Through local co-operation, they have removed approximately 16 tonnes of plastic from coastal areas, particularly beaches and mangroves in Juanchaco, Ladrilleros, a key region for tourism and whale watching. The recovered material (HDPE) is transformed into components for school desks (about 5 kg of plastic used per desk). In addition, they manage a plastic market and plastic 'currency' system to engage children and young people, using the Sueño Pacífico library as a hub for environmental education and stewardship.

Ecosystem health and service recovery:

Cleaning up mangroves and beaches lowers the risks of entanglement and suffocation to flora and fauna, restoring vital nursery habitats for fish and invertebrates in the Colombian Pacific. Keeping plastics out of tidal flats through mechanical recycling reduces microplastic fragmentation and improves coastal water quality. The use of a plastic currency reduces the volume of waste returning to the environment by creating an incentive-based take-back system: participants bring sorted plastic to collection points and receive plastic 'coins' that are redeemable for donated items, such as school supplies, books, toys and clothing, and for community activities, including film screenings and snacks at the Sueño Pacífico library.



Image credit: Plástico Precioso Uramba Bahía Malaga

Fundación Salva tu Río

SANTA MARTA, COLOMBIAN CARIBBEAN

Main stakeholders: NGO

What do they do?

The NGO designs, installs and operates 'trash trap barriers' in urban rivers to intercept floating solid waste before it reaches estuaries and the sea. The captured material is then removed and managed (including sorting and potential recovery). The initiative, which was established in 2022, also promotes environmental awareness and education with nearby communities

Ecosystem health and service recovery:

By intercepting floating waste at critical points, the installed barriers substantially reduce plastic leakage from the Manzanares river system to the coastal environment. According to the NGO, two barriers prevent at least 80% of the floating material like macro and mesoplastic reaching the sea at the estuary, helping protect coastal habitats and improve conditions that support fisheries and recreation services. Routine monitoring of the Manzanares river barriers indicates that a single barrier retains approximately 1 m³/day on low-waste days and up to 6 m³/day on high-waste and high-flow days. The waste retained by the barriers is retrieved and categorized for potential reuse.



Fungal biodegradation of LDPE

COLOMBIA

Main stakeholders: Academia

What do they do?

Researchers in Colombia evaluated the biodegradability of LDPE fragments when incubated with three soil fungi under laboratory soil microcosm conditions.¹⁶⁶ Degradation was assessed through mass measurements before and after exposure. In the most effective treatment configuration, thin LDPE showed an estimated 18% mass loss over 60 days. Thicker LDPE showed negligible mass change, suggesting superior

results for thin films or pre-treated and shredded plastics with more-exposed surface areas.

Ecosystem health and service recovery:

A possible application is the use of **controlled, contained facilities** to treat **collected LDPE**, particularly thin films. However, mass loss alone does not confirm complete and environmentally safe mineralization; additional testing is needed to verify the degradation pathways and to rule out harmful residues or microplastic by-products.

Evaluation of existing policies and mitigation measures

Colombia has a broad and evolving regulatory framework for addressing plastic pollution and protecting biodiversity. The country has made significant progress by aligning its national legislation with international commitments, such as the Basel Convention, MARPOL and the Kunming-Montreal Global Biodiversity Framework. Regulations such as Law 2232 of 2022 and the resolutions governing EPR make it possible to chart a path towards the circular economy, with clear targets for reducing, collecting and recovering plastic waste.

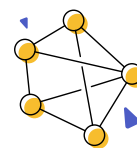
A key strength of this framework is the existence of technical and strategic instruments that promote traceability, recycling and the inclusion of sometimes excluded actors, such as grassroots recyclers. In addition, NPAP Colombia provides a public-private co-ordination space for accelerating concrete solutions and channeling investments.

However, the system has significant limitations. There are regulatory gaps for critical issues, such as microplastics, industrial pellets and plastics outside the packaging regime. Implementation is uneven across territories: while large

cities are making progress, many rural municipalities lack the necessary infrastructure, technical capacity and mechanisms to monitor compliance and enforce provisions.¹⁶⁷ Fragmented monitoring and reporting systems also limit evidence-based decision-making.

To achieve real benefits for biodiversity, it is necessary to strengthen institutional co-ordination, close regional differences, harmonize indicators and prioritize investment in infrastructure and local capacity, especially in strategic coastal-marine and terrestrial ecosystems.

Review of national and subnational policies on plastics, waste management and biodiversity



The current policy and legal framework for plastics, waste management and biodiversity in Colombia provides a robust basis for co-ordinating institutional and territorial action to address plastic pollution across multiple scales. The framework was reviewed for this assessment using a hierarchical process (international-national-subnational) to trace regulatory evolution, identify vertical and horizontal co-ordination mechanisms, and highlight regulatory innovations that preceded Law 2232 of 2022. The findings provide inputs to strengthen collaboration across governments and sectors.

The National Plan for the Sustainable Management of Single-Use Plastics¹⁶⁸ sets out the creation of the National Roundtable for the Sustainable Management of Plastics and frames its role as a co-ordination platform among ministries, the private sector,

academia and recyclers. It also outlines guidelines ranging from substitution and EPR to eco-design, plastic restrictions in protected areas and alignment with integrated solid waste management plans.

Overall, significant progress has been made in the timely issuance of regulations, the implementation of controls in protected areas and the rollout of EPR schemes for containers and packaging. However, implementation challenges persist across measures to prevent plastic pollution and protect biodiversity, particularly in monitoring, traceability and the coverage of recovery infrastructure. These constraints are especially evident in intermediate cities, limiting the assessment of results and highlighting priority areas for guiding investment, strengthening capacities and improving the traceability of waste flows (Figure 11).

The current policy and legal framework for plastics, waste management and biodiversity in Colombia provides a robust basis for co-ordinating institutional and territorial action.

Figure 11: Plastic management issues subject to this analysis, covering regulation, enforcement, infrastructure and co-ordination

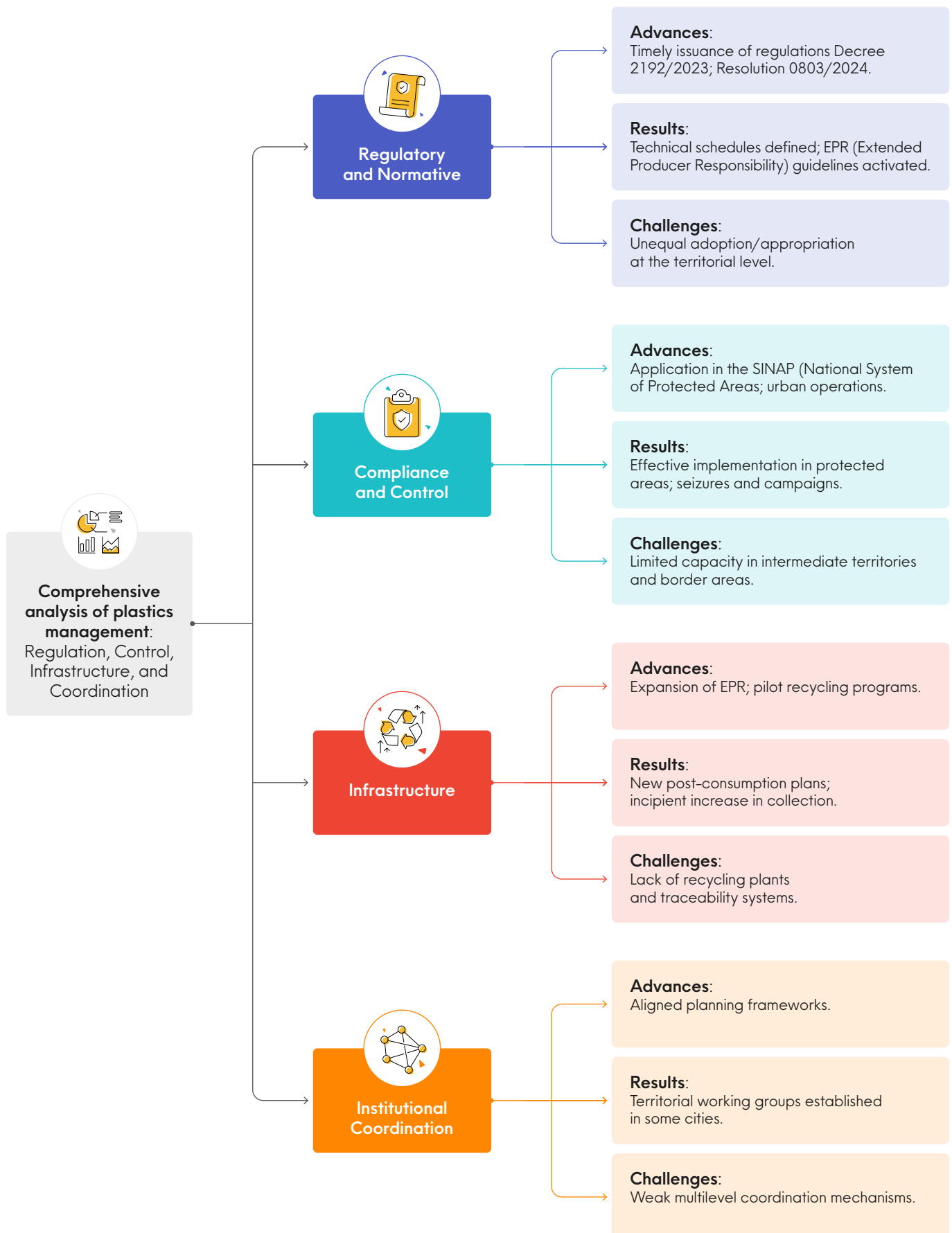




Image credit: Juliana Ciales

Colombia's regulatory architecture combines binding measures such as Law 2232 of 2022 and the administrative acts that make it operational through strategic planning policies and innovative local ordinances. This framework creates enabling conditions to strengthen institutional and territorial coherence and steer circular economy and biodiversity conservation agendas more strategically.

At the national level, Resolutions 1407 of 2018 and 1342 of 2020

issued by MADS operationalize EPR for packaging and container waste. Resolution 1407 of 2018 broadly defines recovery and valorization of materials, such as cardboard, plastic and glass (including recycling, energy recovery and co-processing). It requires an environmental management plan for packaging and container waste and annual reporting on progress to ANLA. It also establishes escalating recovery targets, from 10% of the total packaging placed on the market in 2021 to 30% in 2030.

Resolution 1342 of 2020 adjusts and clarifies this regime by creating the returnability efficiency indicator and imposing registration and reporting obligations on companies, strengthening traceability and control mechanisms and providing a basis for standardized performance metrics on recovery.

However, compliance tensions may arise if these rules are not fully harmonized with Law 2232 of 2022 and its implementing Decree 2192 of 2023. In particular, counting energy recovery as valorization can weaken the reduce–reuse–recycle waste hierarchy, and limiting the scope of the regime to packaging and containers excludes other plastic streams. These areas can be considered priorities for future regulatory adjustment and targeted incentives.

At the local level, municipal ordinances and agreements support practical implementation of national policies by aligning actions derived from sustainable public initiatives with local restrictions and priorities. Adoption of subnational municipal agreements and departmental ordinances has been inconsistent, with higher compliance in capital cities and sensitive tourist areas. Intermediate and rural municipalities continue to face shortages in recovery infrastructure, traceability and enforcement.

In practice, the effectiveness of regulations depends on alignment with integrated solid waste management plans, enhancement of specific collection routes, provision of ECAs and surveillance in protected areas. Stark regional differences underscore the need to direct collaboration, capacity building and investment towards territories with weaker infrastructure and traceability, so that implementation translates into more equitable and measurable impacts on plastics management and biodiversity protection. The following section examines how this domestic framework aligns with Colombia's international commitments and where further coherence and reporting improvements are needed.

Policy coherence and alignment with international frameworks



Columbia has made progress in incorporating plastic waste amendments, strengthening control over plastic waste movement.

Coherence between national policies and international frameworks is a key component in assessing Colombia's capacity to meet its multilateral commitments and guide domestic action on plastic pollution and biodiversity.¹⁶⁹ Overall, Colombia's legal instruments are broadly aligned with the CBD and the Kunming–Montreal Global Biodiversity Framework (GBF), which calls for a significant reduction in pollution, including plastic pollution, by 2030.¹⁷⁰

It is important to note that the GBF adopted under CBD COP15 (Decision 15/4) sets global targets that are not self-executing and do not have direct legal effect at the national level. Colombia's NBSAP targets and treats plastic pollution as a cross-cutting driver of biodiversity loss, addressing it through national prioritized actions. The updated NBSAP includes ambitions to halt drivers of biodiversity loss, reduce pollution pressures across ecosystems, promote the transition to sustainable production models, restore ecosystems and tighten biodiversity governance with an inclusive conservation approach. Consequently, Law 2232 of 2022 anticipates and operationalizes GBF Target 7 by establishing a binding timeline to reduce or ban selected

single-use plastics. This is partially implemented through Decree 2192 of 2023 (including provisions on access to protected areas, institutional co-ordination and technical references). This creates an enabling framework for co-ordinated action among institutions, the private sector and civil society.

Beyond the CBD and GBF, Colombia is also party to key regional and global instruments relevant to plastic pollution and marine biodiversity, including the Basel Convention (Law 253 of 1996), the Cartagena and Lima Conventions, and MARPOL, and it is actively engaged in the ongoing negotiations toward a global plastics treaty.¹⁷¹ This international engagement reinforces a source-to-sea approach and multilevel environmental governance, while also highlighting outstanding compliance challenges and the need to consolidate comprehensive responses that connect regulatory frameworks, productive practices and biodiversity conservation.

In parallel, Colombia has made progress in incorporating the Basel Convention's plastic waste amendments, which strengthen controls over transboundary movements of plastic waste, and



in implementing MARPOL Annex V obligations, which prohibit the discharge of plastics from ships.¹⁷² These developments provide a shared reference framework for reducing plastic pollution and protecting biodiversity, and they complement national regulatory efforts to reduce single-use plastics, expand EPR and promote circular economy strategies.¹⁷³

Within this context, NPAP Colombia has emerged as a multistakeholder platform with strong potential to translate international commitments into operational agendas at national and regional levels. As Colombia's national chapter of GPAP, NPAP supports baseline analysis and mapping of plastic waste flows, develops action roadmaps, proposes enabling policy instruments and mobilizes investment targeting prevention, recycling and traceability.¹⁷⁴ This positions NPAP Colombia to help standardize goals and indicators, promote interoperability across information systems, strengthen MRV mechanisms and support the translation of international frameworks into measurable progress in plastic management and biodiversity protection.¹⁷⁵

Despite these advances, alignment remains primarily regulatory in nature. Reporting mechanisms are not yet fully developed, national indicators are not entirely compatible with international standards and operational gaps persist in strategic sectors such as maritime and customs control, as well as in waste management in intermediate and rural territories.¹⁷⁶ This reflects a common pattern among megadiverse countries: early formal alignment with global frameworks, followed by uneven implementation due to institutional, technical and information-related limitations.¹⁷⁷

Addressing these gaps represents an opportunity to develop specific standards on microplastics (including intentionally added microplastics, pellets and diffuse sources), strengthen monitoring, inspection and enforcement (including customs and market controls), and further harmonize local provisions with national mandates. These steps can help standardize metrics, improve traceability and catalyse investment in recovery and recycling infrastructure, generating tangible benefits for biodiversity and the communities that depend on marine-coastal and inland ecosystems.¹⁷⁸



On the regulatory front, the lack of specific controls for microplastics and plastic pellets urgently needs to be addressed.

Regulatory, procedural and technical gaps in mitigating the risks to biodiversity from plastic pollution

The analysis identified regulatory, procedural and technical gaps that limit the effectiveness of the framework addressing the impacts of plastics on the biodiversity nexus framework. At the same time, it uncovers key areas where co-ordinated action can generate systemic change.¹⁷⁹

On the regulatory front, the lack of specific controls for microplastics and plastic pellets urgently needs to be addressed. This includes introducing standardized monitoring and analytical methods to measure microplastics and pellet losses consistently and environmental quality standards (where feasible) to protect vulnerable

aquatic species and ecosystems by setting clear benchmarks for pollution levels (for example water and sediment quality).¹⁸⁰ In parallel, upstream controls are needed to prevent pellet leakage across production, handling and transport, and to strengthen market and customs controls. The development and adoption of relevant international protocols on hazardous additives used in plastics would further support ecosystem and human health protection. Despite progress achieved through Law 2232 of 2022, its regulations and the EPR schemes for packaging and containers established by Resolutions 1407 of

2018 and 1342 of 2020,¹⁸¹ there is still no regulation on oxo-biodegradable packaging, which has been banned in other countries due to documented risks to ecosystems, particularly soils.

In terms of procedures, monitoring and control systems remain fragmented and those that exist are concentrated mainly on the coasts. Limited research, control and follow-up capacity mean the extent of contamination in basins, such as Orinoquía and Amazonia, is still unknown, reducing states' ability to prevent, detect and sanction illegal or untraced flows of plastic waste, especially transboundary flows.



From a technical perspective, local variation in institutional capacity and infrastructure creates significant disparities in policy implementation.

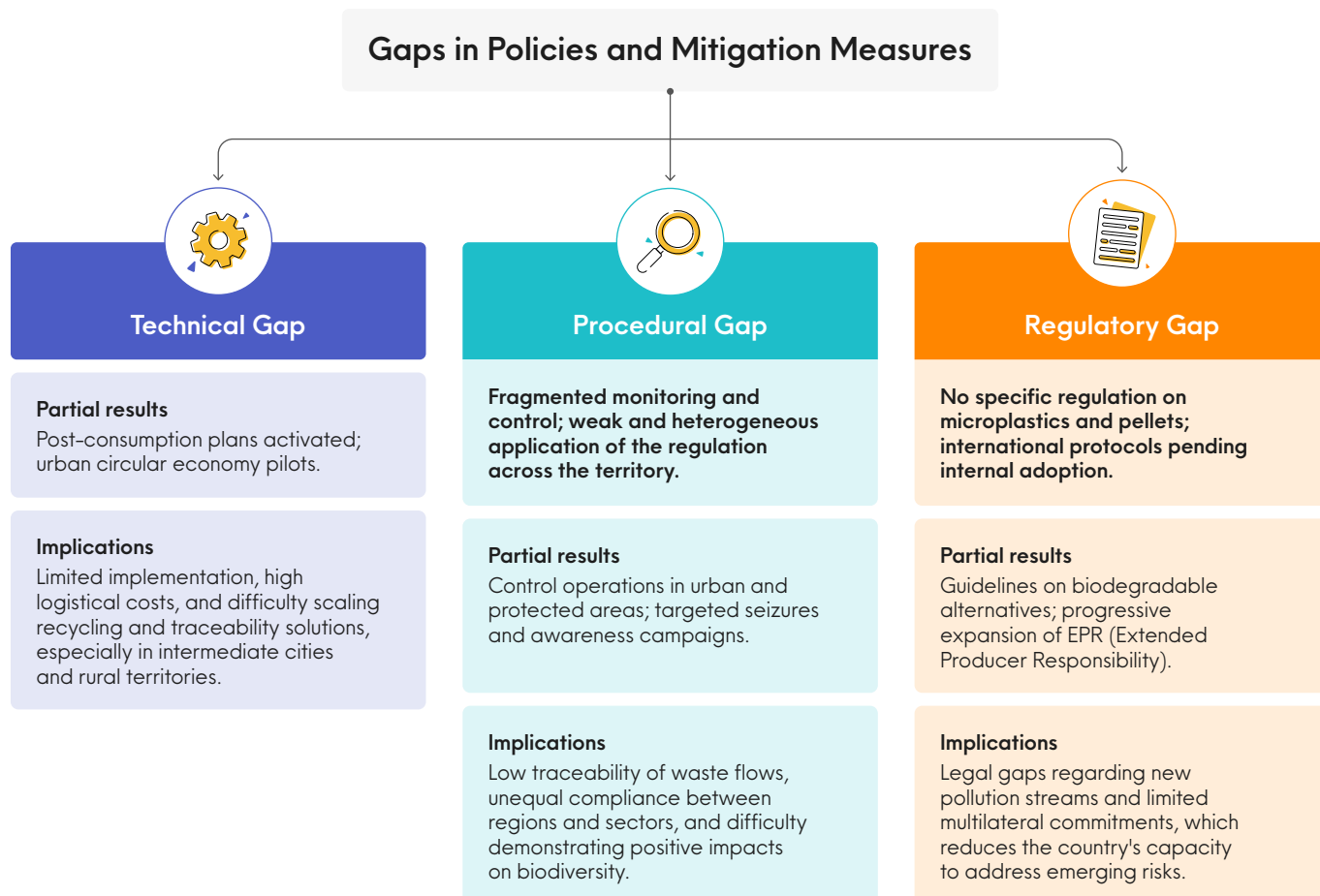
From a technical perspective, local variation in institutional capacity and infrastructure creates significant disparities in policy implementation: developments made in capital cities and tourist areas contrast with persistent gaps in recovery infrastructure, selective collection routes and information systems across intermediate and rural municipalities.¹⁸² In order to develop targeted mitigation strategies, it will be necessary to establish and report on indicators that highlight the impacts of plastic pollution on strategic ecosystems and ecosystem services by macro-basin.

Despite these gaps, there has been tangible progress in reducing the impacts of plastics on biodiversity. This has included issuing technical guidance, implementing post-consumer plans that promote the replacement of virgin plastics with reusable or biodegradable alternatives and conducting targeted controls to

restrict the entry of plastics into priority areas, particularly protected and coastal-marine ecosystems.¹⁸³ Closing the remaining gaps requires legal reforms, investment in technical and institutional capacities and sustainable collaboration among all stakeholders, reinforcing international commitments and circular economy objectives.¹⁸⁴ NPAP Colombia can help facilitate this by leveraging its mandate to align the priorities of public and private actors, identify regulatory and operational bottlenecks and catalyse investments aimed at prevention, recycling and traceability.¹⁸⁵

One of the cross-cutting challenges identified by the analysis is the fragmentation of MRV systems. Each regulatory framework has developed its own scheme and platform, managed by different public entities, which do not fully interoperate. This has led to redundant reporting, methodological

Figure 12: Gaps and shortcomings in policies and mitigation measures



inconsistencies (definitions, frequencies, data fields), increased administrative burdens on obligated parties and, consequently, difficulties with oversight and enforcement.¹⁸⁶

This dispersion weakens traceability and the comparability of indicators across instruments. This happens across many domains, including

between public sanitation service data and comprehensive solid waste management plans), EPR reports for packaging, protected area enforcement records and customs and maritime surveillance data. Fragmentation hinders an integrated view of performance and obstructs the translation of regulatory progress into verifiable outcomes at a regional level.

Strategic role of NPAP Colombia and opportunities for systemic change

NPAP Colombia launched in 2024 with support from GPAP, an initiative of the World Economic Forum. It provides a convening platform to align action on plastic pollution and biodiversity protection. While it does not replace competent authorities, it can:

- Propose a shared set of indicators and metrics to track plastic pollution and biodiversity impacts
- Enable interoperability across information systems and MRV platforms
- Direct public and private finances towards recycling, valorization and traceability infrastructure
- Ensure standards and investments embed social inclusion, including

the formalization of grassroots recyclers and safeguards for communities in high-risk territories

The systemic-change approach promoted by GPAP frames current gaps not only as deficits but also as entry points for collective action. A convergent regulatory framework aligned with international commitments, early progress on EPR and inclusive recycling, and a multi stakeholder platform such as NPAP Colombia create an opportunity to harmonize standards and metrics and catalyse investment aligned with biodiversity and social justice outcomes. These actions can combine to accelerate the transition to production and consumption systems that measurably reduce plastic leakage and its impacts on species, ecosystems and people.



The systemic-change approach promoted by GPAP frames current gaps not only as deficits but also as entry points for collective action.



Mapping of stakeholders and initiative



This chapter proposes a pathway for cross-sectoral collaboration to mitigate plastic pollution in the regions it most affects. It does this by identifying key stakeholders and collating their perspectives and experiences about the impact of plastics on biodiversity. This pathway is particularly relevant within the framework of the implementation of Law 2232 of 2022 and its associated policies, which require effective co-ordination among multiple public and private actors. It can be constructed using the NPAP Colombia platform and should emphasize the inclusion of historically underrepresented groups to ensure more equitable and effective environmental governance.

A total of 96 stakeholders were identified, 38 of whom participated

in workshops. There was a special emphasis placed on including groups often overlooked, such as Indigenous and NARP communities, vulnerable communities, young people and the informal recycling community. In parallel, existing programmes and alliances were mapped and evaluated in terms of their co-ordination, inclusiveness and effectiveness.

The workshops supported NPAP Colombia in shaping a multilevel, multistakeholder governance system, enabling the identification of roles, capacities and spheres of influence across 14 key sectors involved in plastic and biodiversity management, including government, private sector, academia and community-based actors.

Strategic co-ordination nodes between sectors were identified, highlighting MADS as a central co-ordinator, local authorities as key implementers and waste picker organizations as essential contributors to the effectiveness of the EPR system, both in terms of environmental outcomes and social and environmental inclusion.

A collaborative network was structured around NPAP Colombia to connect scientific evidence, private sector commitments and social demands, promoting alignment with both national and international regulatory frameworks, such as the Kunming-Montreal Global Biodiversity Framework, for the mitigation of plastic pollution impacts on biodiversity.

Figure 13: Stakeholder Engagement on Plastic Pollution and Biodiversity Impacts



Identification of key actors across sectors

The mapping of actors was supported and validated by organizations participating in sessions to understand the connections between plastic pollution and its impacts on biodiversity. These were held between May and August 2025.

Their contributions and feedback have enriched the technical accuracy of the analysis and highlighted the main challenges facing each sector, ensuring that the results reflect the real perspectives and needs of relevant stakeholders.

Figure 14: Actors involved in plastic pollution governance

Government19				
Ministry of Environment and Sustainable Development (MADS)	Ministry of Foreign Affairs	Regional Autonomous Corporations (CAR)	Superintendencies	
National Planning Department (DNP)	Congress of the Republic	Governorships	Office of the Inspector General	
Ministry of Commerce, Industry, and Tourism (MinCIT)	National Environmental Licensing Authority (ANLA)	Municipalities	National Natural Parks	
Ministry of Health and Social Protection (MinSalud)	National Customs and Tax Authority (DIAN)	Waste Management Service Providers	General Maritime Directorate (DIMAR)	
Ministry of Housing, City and Territory (MinVivienda)	Environmental Police	Colombian Ocean Commission (CCO)		
Multilateral17				
IDB (Inter-American Development bank)	GEF (Global Environment Facility)	UNESCO	IUCN (International Union for Conservation of Nature)	
GIZ (German Cooperation)	IFC-WB (International Finance Corporation - World Bank)	ECLAC (Economic Commission for Latin America)		
WEF (World Economic Forum)	Newton-Caldas Fund	IPBES (Intergovernmental Platform on Biodiversity)	ACTO (Amazon Cooperation Treaty Organization)	
Embassies	CPPS (Permanent Commission for the South Pacific)	RFMOs (Regional Fisheries Management Organizations)		
KfW (German Development Bank)	IOCARIBE (IOC Sub-Commission for the Caribbean)	GBIF (Global Biodiversity Information Facility)		
Academy12				
Waste Scientists	Universities	INVEMAR (Marine Research Institute)	CEMarin (Marine Excellence Center)	
Humboldt Institute	Territorial Research Labs and Groups	SINCHI (Amazonia Research Institute)	SENA (National Training Service)	
IIAP (Pacific Research Institute)	Schools with Environmental Education	ICIPC (Colombian Petroleum Institute)	Colombian Petroleum and Transition Energies Institute	
Private12				
ACOPLÁSTICOS (Plastics Industry Association)	Waste and Recycling Operators	National Business Association of Colombia (ANDI)	Regional Chambers of Commerce	
Ecopetrol	Circular Economy Enterprises	Essentia	Bio-packaging Producers	
Mass Consumption Companies and Retail Chains	Cempre	Bioplastics and Plastic Wood Manufacturers	Visión Circular	
NGO8				
The Ocean Clean-Up	PLAN Foundation	Wild World Fund (WWF)	National Association of Recyclers (ANR)	
Greenpeace	Plastic-free Pacific Alliance	MarViva	Regional Foundations	
Action platforms4				
National Plastic Action Partnership (NPAP) Colombia	REMARCO	Project Aware	REDCAM	
Civil society5				
Community Councils	Consumers	Indigenous Councils	Grassroots Recyclers	Youth and Women Organizations

Note: Categorization of stakeholders working in areas connected to plastic pollution and its impacts on biodiversity. In order to further identify the needs and priorities of actors, a participatory workshop was held to validate scientific and regulatory issues

Analysis of roles, influence and levels of commitment

Figure 15 shows MADS is a leading national environmental policy and co-ordinates the circular economy agenda, and is perhaps the primary stakeholder in this field. Its extensive connections with other ministries (Health, Commerce, Housing, Transport and Agriculture) and with national agencies, such as ANLA, IDEAM, DIMAR and DIAN, which contribute regulatory, technical and control functions, mean it has high power, influence and interest in plastic pollution and biodiversity. The cluster it is part of concentrates most legally binding relationships and provides the main direction-setting capacity for plastics governance.

Responsibilities then extend to territorial environmental authorities (CARs, municipalities, regional governments and AUNAP), which

translate national guidance into operational delivery. They apply regulations locally, monitor compliance, promote waste separation and recovery, and facilitate the inclusion of waste picker organizations. Their performance depends on technical guidance, monitoring tools and adequate financing, typically channelled from national authorities, and, in some cases, complemented by private-sector actors linking national mandates with regional implementation.

Accountability is reinforced by oversight bodies, such as the Office of the Inspector General, the Attorney General's Office and the Comptroller's Office. They enforce legality, sanction violations and increase transparency through audits and investigations, requiring disclosure of information. They publish their findings on public resource use and policy implementation.

Within the same network, producers and marketers are pivotal because they are responsible for EPR. They aim to finance reverse logistics, ensure traceability, comply with recycling targets and promote eco-design. The mandatory nature of these obligations creates strong binding links with the State. PROs facilitate collective compliance, while organized recyclers and waste picker organizations provide the operational backbone to waste management systems by collecting, sorting and supplying recyclable materials, enabling circular economy outcomes, improving traceability, reducing system costs and encouraging social inclusion.

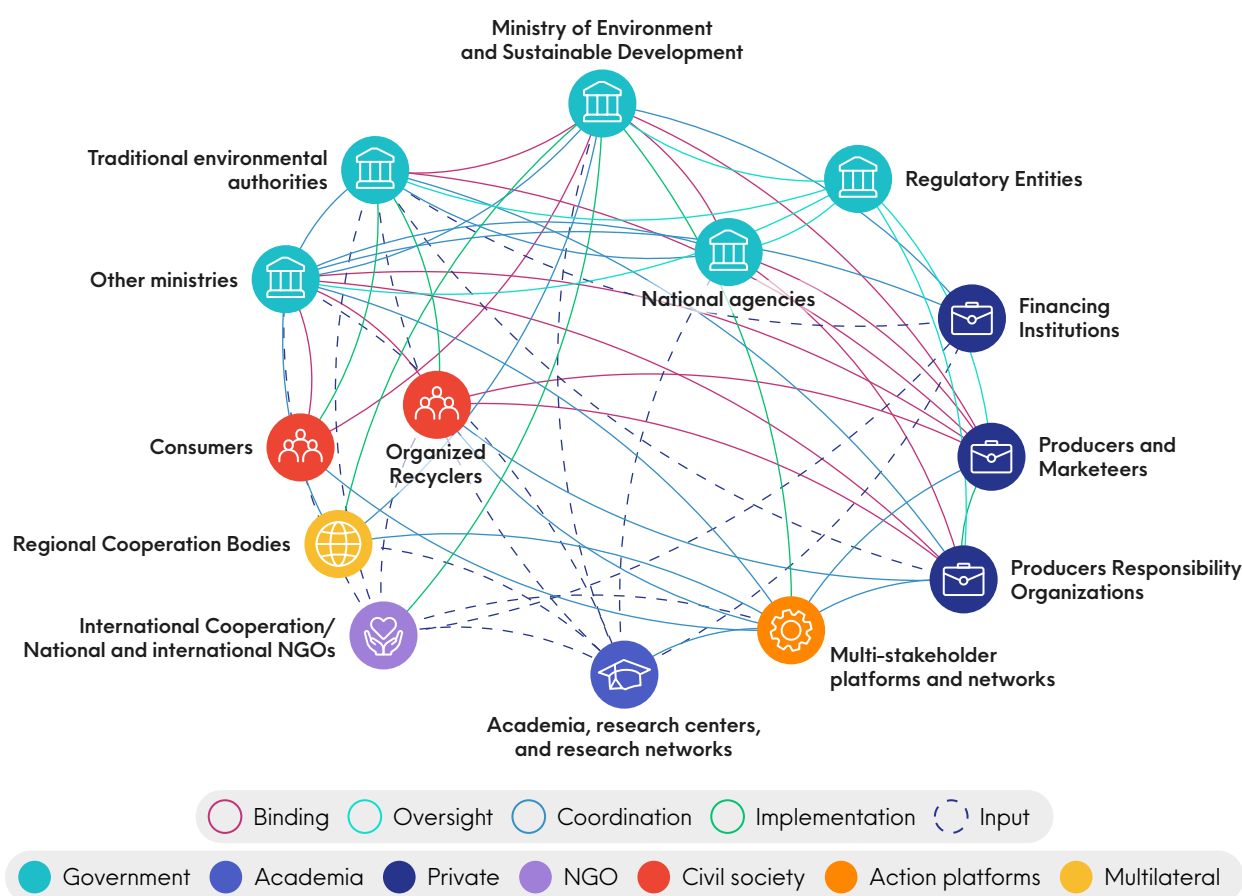
Knowledge and enabling functions surround these core roles. Academic institutions and research centres provide evidence, indicators and methodologies to inform decisions, while international co-operation agencies, NGOs and financing institutions contribute resources, standards and co-ordination support, helping align national action with commitments such as the GBF and the Cartagena Convention. Multistakeholder platforms such as NPAP Colombia connect governments, private sector actors, waste pickers, academia and international partners to facilitate co-ordination and work towards joint commitments. Consumers, in turn, influence outcomes through everyday behaviours that affect substitution, separation and recycling.

The system of stakeholders involved in plastic pollution and its impacts on biodiversity is a multilevel system in which regulation and enforcement sit primarily in the national core shown on Figure 15. Delivery is shared across regional authorities and value-chain actors, and enabling support comes from knowledge, finance and co-operation partners. Where co-ordination is sustained, inclusion mechanisms function and information is disclosed, this system can support ambitious environmental goals and clarifies who can act, through which instruments and where influence is concentrated.



Image credit: Mateo Arteaga

Figure 15: Colombia's governance network for plastics and biodiversity: key stakeholders and the links between oversight, co-ordination, implementation, input, binding



Mapping this multilevel governance system highlights the diversity of actors engaged in plastics and biodiversity governance and clarifies how authority, instruments and commitments are distributed across the system. Building on the roles-and-relationships, the power-interest matrix (Figure 16) adds an additional lens by showing where influence (power to act) aligns or does not align with levels of engagement.

The matrix places MADS, key national authorities and enforcement and oversight actors (such as ANLA) in the high power / high interest quadrant, confirming their roles as primary political and regulatory drivers. At the same time, several technical-operational agencies (including IDEAM and AUNAP) appear with relatively high power but lower interest, reflecting mandates that are more specialized, technical or operational rather than agenda-setting. This asymmetry is important

because it suggests that strengthening implementation may depend as much on co-ordination and resourcing as on formal authority.

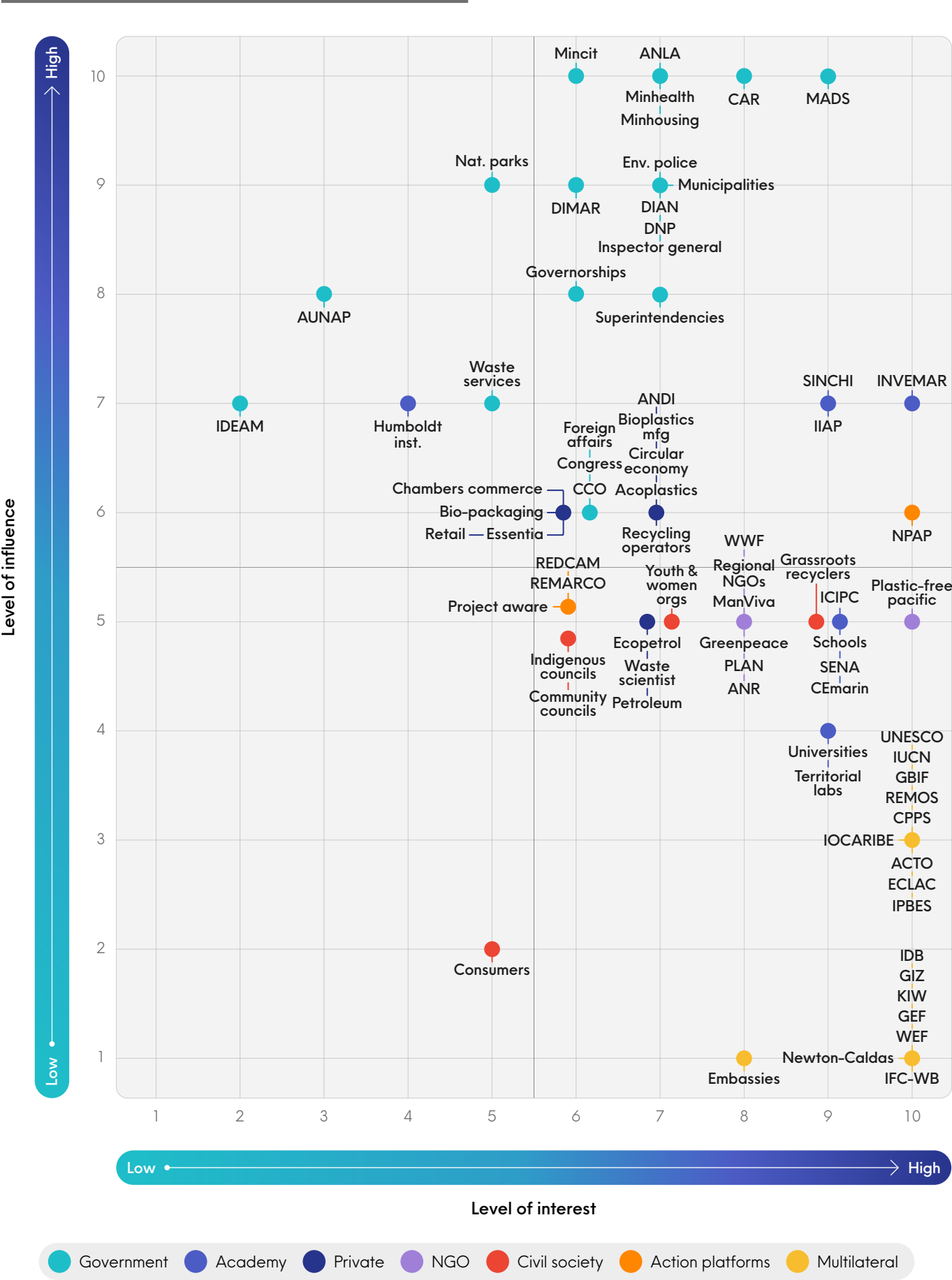
A second cluster of stakeholders sits in the middle of the matrix, including producers, retailers and industry associations (for example ANDI and Acoplásticos), alongside PROs and multi stakeholder platforms. These actors often function as practical bridges between regulation and delivery: they shape how obligations such as EPR translate into reverse logistics, collection arrangements, traceability and market demand for recycled content. Their position in the matrix reflects moderate-to-high influence combined with sustained engagement, making them central for the scaling of operational solutions.

By contrast, grassroots recyclers and NGOs congregate in the high interest / low-to-medium power area, signalling

strong commitment but limited leverage over formal decisions and financing. This has clear implications for governance: if outcomes depend on separation, collection, recovery and local stewardship, then these actors require more formal inclusion, predictable funding and clearer recognition of their operational and social role in the value chain.

Finally, Figure 16 positions consumers in the lower-to-mid power range with moderate interest, reflecting that their influence is mainly indirect and uneven across the population. While they do not shape policy directly, everyday purchasing and disposal behaviors affect source separation, littering rates and the quality of recyclable streams. This suggests that improved information, accessible collection systems and behavioral incentives are necessary for consumer actions to translate into measurable reductions in plastic leakage.

Figure 16: Matrix classifying stakeholders based on their level of power and degree of interest



Mapping of initiatives

The mapping of initiatives in Colombia reveals a dynamic and growing ecosystem of actions addressing plastic pollution from territorial, institutional and social perspectives. Led by government entities, the private sector, academia, civil society and international co-operation, these initiatives reflect sustained engagement and a widening set of responses across the country. Table 1 summarizes this diversity, ranging from national co-ordination platforms such as NPAP Colombia and the National Roundtable for the Sustainable Management of Plastics to local programmes led by communities, recycler organizations and public-private partnerships, implemented across urban corridors, marine areas and coastal zones. Key examples include scientific monitoring

programmes, post-consumer traceability pilots, underwater clean-up and prevention campaigns, context-specific environmental education, and EPR schemes that integrate recyclers into collection and traceability systems.

However, several structural gaps still limit effectiveness and scalability, including data interoperability, institutional co-ordination, financial sustainability, recycler formalization, fair compensation for local communities, and standardization of technical protocols. Addressing these gaps represents a clear opportunity to strengthen the governance ecosystem for example, by establishing governance hubs in priority watersheds and securing resources for stakeholders such as recycler organizations, ethnic communities and youth groups.



Several structural gaps still limit effectiveness and scalability.



Image credit: NPAP Colombia



Image credit: NPAP Colombia

Table 1: Summary of the initiatives currently being implemented in the country to mitigate the impact of plastic pollution

Initiative/platform	Sector/lead/promoter	Scope and geographic focus	Key gaps
NPAP Colombia	Multistakeholder/ GPAP/WWF	National	Data interoperability; uneven reporting.
National Roundtable for the Sustainable Management of Plastics	Government/Mixed/MAD	National; co-ordination on plastics and circular economy.	Continuity across administrations; overlapping agendas.
Plastics Pact	Private sector/CEMPRE, Carvajal, Coca-Cola and Nestlé, among others	National; articulation of value-chain actors for the circular economy of packaging and containers.	Standardized data traceability and insufficient infrastructure for hard-to- recycle materials.
Monitoring programmes	Government + academia/ REDCAM, PNN	MPA and basins	Stable funding; harmonized quality assurance and quality control.
Community-led monitoring	NGO + communities/ Tika, Guardianes del Mar, Guardianes del Océano, Guardianes del Océano, etc.	Amazon, Orinoquia and Pacific basins.	Compensation, safety, language access.
Universities and institutes with ATR-FTIR/RAMA laboratories	Academia (UniAtlántico, UNAL, UIS, INVEMAR)	Regional laboratory nodes (linked to basin).	Protocol differences; equipment time availability.
EPR – beverage container recovery (PET)	Private sector + municipalities (Coca Cola Company, Bavaria, Postobon, Pepsico, ENKA, EcoRed, Recimed)	Urban corridors; coastal cities.	Integration of informal recyclers; leakage into water bodies.
Tourism and diving sector – underwater waste clean-up and prevention	Private sector + NGOs/PADI, ACODAL/Decameron, Sepia ROV, Ecoworks, W2W	Priority beaches and dive sites.	Seasonal planning; equipment/resources, with limited funding; narrow industrial focus.
Education and outreach (schools/ETDH)	Government + NGOs	Urban and coastal schools.	Context-specific materials; local languages.
Seasonal clean-up and prevention at critical points	Municipalities + Private (tourism/ports) + NGOs + Informal recyclers	Target critical points: Pacific (Buenaventura Bay); Caribbean (Beaches of Puerto Colombia; Santa Marta Bay).	Seasonal planning; equipment/logistics; integration of the informal sector.
Post-consumer traceability with informal recyclers	Private sector (brands/PRO) + municipalities + recycler organizations	Urban–coastal corridors that feed basins: Bogotá– Soacha (Tunjuelo/ Tunjuelito); Cartagena– Barranquilla (Caribbean); Buenaventura (Pacific).	Fragmented collection; weak contracts; data gaps on end markets.
Co-operation projects	International co-operation + NGOs	Focus cities (B/ventura, Sta. Marta, Cartagena).	Financial sustainability when the international grant ends.

Conclusions

Plastic pollution poses a direct threat to biodiversity in Colombia. Multiple pathways leading to ecological impact from plastic pollution have been identified across diverse Colombian ecosystems, involving many possible physical, chemical and ecological mechanisms, especially ingestion, additive-related toxicity and habitat alteration. Fish, including species consumed by humans, are the most affected group, with higher incidences observed in the Caribbean and Pacific macro-basins, although this is where most studies take place. The presence of microplastics has been documented in organism tissues, sediments and water bodies, raising trophic and cumulative risks that remain insufficiently studied in the country.

The territorial analysis identified priority areas requiring attention due to waste accumulation and ecosystem vulnerability. The macro-basins under the greatest pressure from plastic waste and with the highest ecosystem vulnerability are Magdalena–Cauca, the Caribbean and the Pacific. These areas coincide with ecosystems of high ecological value and high levels of ecosystem services. Around 100 species affected by plastic pollution were identified; of these, 15 species have critical conservation status according to the IUCN and CITES.

Plastic pollution is degrading essential ecosystem services in the country, including provisioning (such as fisheries), cultural (nature-based tourism) and regulating (water quality), with effects across the entire territory. These impacts lead to economic losses due to reduced fishing activity, decreased tourist appeal and higher local clean-up and management costs. However, case studies show that it is possible to reverse these effects through concrete solutions, such as post-consumer traceability schemes that involve recycler organizations, clean-up programmes at critical points, participatory monitoring grounded in scientific evidence and public community alliances for the recovery of beaches and terrestrial ecosystems. When regionally co-ordinated, these actions can protect ecosystem services, reduce pressure on local economies and strengthen a just transition towards a circular economy.

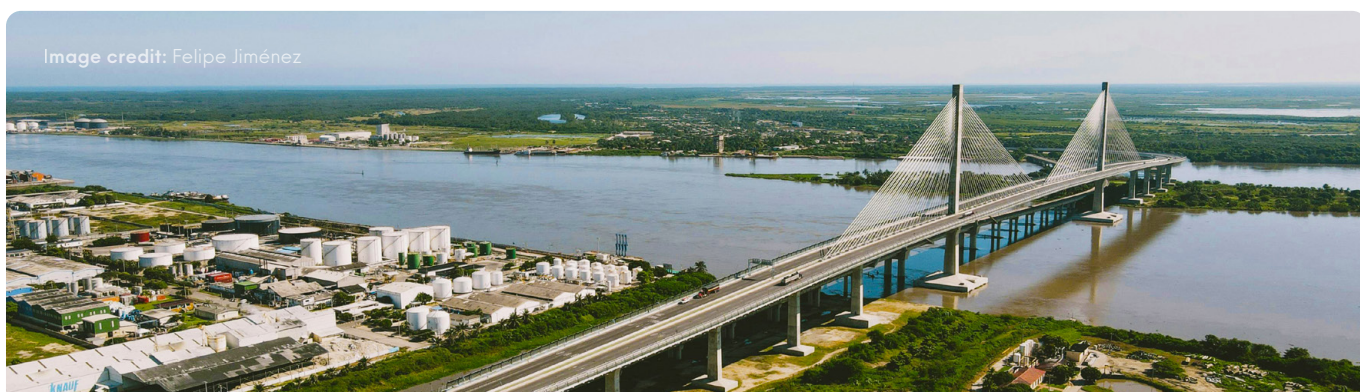
It should be emphasized that Colombia has made significant progress in establishing regulatory frameworks. But it still faces critical gaps in monitoring, traceability, recycling infrastructure and the participation of community actors. Likewise, there are inconsistencies in the application of standards across levels of government and sectors, which hinders a co-ordinated response.

The stakeholder mapping identified 14 strategic sectors with differentiated roles in regulation, implementation and financing. The Ministry of Environment and Sustainable Development acts as the main actor, followed by other national entities and territorial environmental authorities with high operational capacity. The level of integration points to a governance framework with high potential; its effectiveness depends on formally integrating stakeholders such as recycler organizations, Indigenous communities and citizen networks, which are currently excluded by structural barriers.

The power-interest matrix shows that actors with the greatest institutional capacity have the most leadership power, but to achieve effective results it is necessary to redistribute resources and establish formal inclusion mechanisms. This is where an opportunity lies in NPAP Colombia to act as a catalyst across all groups, providing the technical scaffolding and the inputs needed to close operational gaps and achieve effective on-the-ground outcomes that mitigate plastic pollution's impacts on biodiversity.

The initiatives currently under way show a diversity of approaches (regulatory, technical, social, operational) that address both plastic waste prevention and management, as well as an interest in mitigating the problem of plastic pollution. These actions require co-ordination among actors, data interoperability and impact measurement schemes linked to concrete environmental outcomes that can be scaled across the country.

Image credit: Felipe Jiménez



Possible actions to protect biodiversity from the impacts of plastic pollution



International level

- Position Colombia as a regional leader by strengthening co-ordination with key multilateral environmental agreements that address marine and plastic pollution, such as the Cartagena Convention and MARPOL, and by actively engaging in the negotiations for a global plastics treaty, ensuring that international commitments are fully reflected in national waste and pollution management policies.
- Align Colombia's biodiversity and waste management agendas with global frameworks, including the Kunming–Montreal Global Biodiversity Framework, so that efforts to reduce plastic pollution are clearly integrated into national biodiversity targets and contribute to the country's international commitments.
- Step up Colombia's participation in international co-operation mechanisms and climate and biodiversity finance windows (GEF, IKI, IDB, CAF, among others) to mobilize resources and co-finance scalable pilot projects in high-biodiversity areas, turning international commitments into concrete action on the ground.
- Promote post-consumer traceability and common standards for microplastics monitoring, with technical support from regional scientific networks (such as IPBES).
- Foster exchanges of good practice with countries facing similar challenges (Brazil, Ecuador, French Guiana, Guyana, Peru, Suriname and Venezuela), facilitating the adaptation and adoption of effective models in shared contexts.



National level

- Recognize plastic as both an environmental and an economic challenge given its impacts on key productive sectors, such as fisheries, agriculture, livestock and tourism, which together account for around 10% of national GDP.
- Prioritize differentiated interventions in critical areas, taking into account ecosystems, dominant economic activity and institutional capacity, realizing multisector regional efforts based on ecological and social vulnerability.
- Expand regulatory coverage to include plastics used in productive sectors (fertilizer and pesticide packaging), adjusting the law according to leakage risk and recyclability.

- Develop adaptive governance capable of updating measures based on new scientific evidence, connecting monitoring platforms and co-ordinating actions at multiple scales.



Local level – Strategic ecosystems and communities

- Scale successful circular economy initiatives led by public–private alliances, such as Bannaservice SAS, LATAM–EkoRed/Enka and PADI Project AWARE, with logistical and financial backing.
- Strengthen the role of grassroots recyclers as strategic actors in the EPR system through formal inclusion, traceability and dignified working conditions.
- Implement region-specific solutions for reducing plastic leakage into nature. For example, by adopting and implementing measures tailored to Amazonian, coastal and insular areas, such as controlling ghost nets, urban effluents and seasonal tourism waste.
- Support communities that already recognize the problem of plastic pollution by providing environmental education, sorting and recovery infrastructure, clear regulations and technical support for sustainable local actions.
- Link waste management with socio-economic well-being, promoting models in which conservation, local culture and the community economy are integrated into a vision of regional development.

The report shows that plastic pollution is not an emerging problem but an established environmental pressure that is already altering priority ecosystems, such as mangroves, hydrographic basins and marine areas. Based on a territorial and multisectoral analysis and supported by scientific evidence and concrete management experiences, this report has identified risks, gaps and opportunities for intervention.

The conclusions presented here provide grounds for informed and urgent decisions, while the recommendations articulate potential actions that can guide a co-ordinated response among the State, communities, private sector and international co-operators. This document calls for updating the way the problem of plastic pollution's impacts on biodiversity are addressed: recognizing its complexity, prioritizing the most affected territories and mobilizing sustainable solutions from the local to the national and global levels.

Figure 17: Territories that speak: Community perceptions of plastic pollution in Colombia

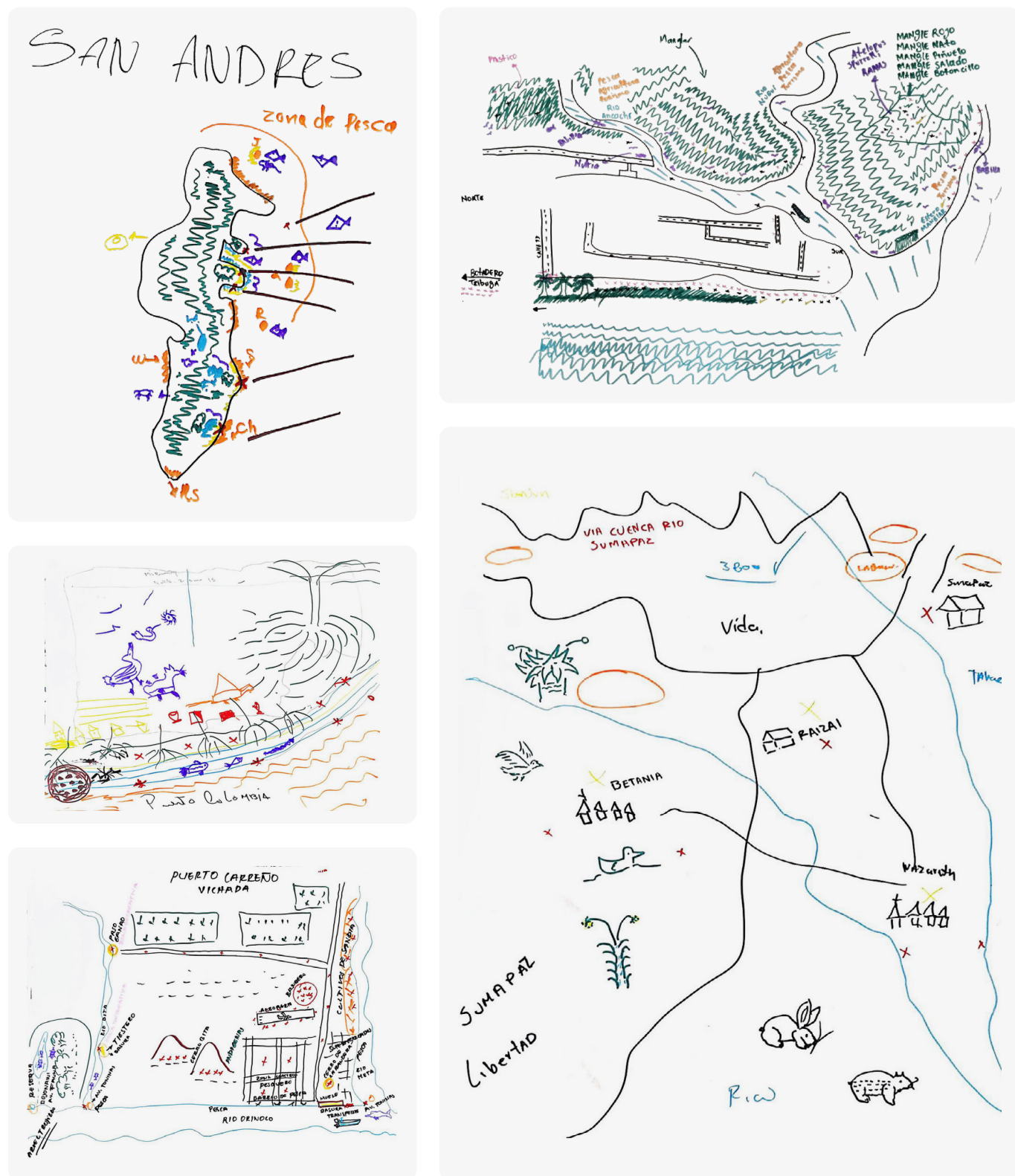


Image credit: NPAP Colombia

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ANNEXES

Annex 1: Strategic spatial analysis of the impacts of plastic pollution on biodiversity in Colombia

1. Objective

To identify and map high-risk areas for biodiversity affected by plastic pollution in Colombia, by integrating pressure factors (sources, pathways of dispersion and plastic accumulation), vulnerability (protected areas, strategic ecosystems and ecosystem services) and local waste management capacities, viewed through MCSA.

0. Environment and Cartographic Variables

Geospatial processes will be carried out using GIS and all data will reference the MAGNA-SIRGAS 2018 / National-Origin co-ordinate system with EPSG identifier: 9377. Additionally, data will be processed in raster format using geoprocessing tools suitable for this data type.

Given that the analysis was conducted at the national level, a working scale of 1:500,000 was chosen to identify broad regional patterns, as well as some more precise details depending on the theme, data sources and specific study areas.

Fuente	Entidad	Dato espacial	Año	Tipo	Nivel Detalle	Licencia
Colombia en Mapas	Instituto Geográfico Agustín Codazzi - IGAC	Modelo Digital de Elevación	2011	Raster	30 metros/px	CC BY 4.0
Colombia en Mapas	Instituto Geográfico Agustín Codazzi - IGAC	Superficies de agua, Entidades_Territoriales_y_Ur	2016	Vector	1:500.000	CC BY 4.0
Prosperidad Social	Prosperidad Social	Rellenos Sanitarios	2022	Vector	Departamental	No identificada
Geoportal DANE	Departamento Administrativo Nacional de Estadística - DANE	Viviendas, Hogares, Personas del CNPV2018	2019	Vector	1:100.000	Dato abierto
Registro Nacional de Áreas F	Parques Nacionales Naturales del Colombia	Áreas Protegidas	2025	Vector	Municipal	No identificada
Datos abiertos SIAC	Ministerio de Ambiente y Desarrollo Sostenible	Humedales RAMSAR	2024	Vector	1:100.000	No identificada
Datos abiertos INVEMAR	Instituto de Investigaciones Marinas y Costeras José Benito Vives	Manglares de Colombia	2023	Vector	1:25.000	Licencia personalizada
Datos abiertos INVEMAR	Instituto de Investigaciones Marinas y Costeras José Benito Vives	Unidades de las Áreas Coralinas	2020	Vector	Municipal	Licencia personalizada
Datos abiertos ICDE	Infraestructura colombiana de datos espaciales (ICDE)	Paramos Delimitados	2020	Vector	1:100.000	No identificada
Instituto Humboldt	Instituto de Investigación de Recursos Biológico Alexander von Humboldt	Bosque seco tropical en Colombia	2014	Vector	1:100.000	No identificada
Datos Abiertos ANT	Agencia Nacional de Tierras - ANT	Consejo Comunitario Titulado	2025	Vector	Municipal	CC BY 4.0
Datos Abiertos ANT	Agencia Nacional de Tierras - ANT	Resguardo Indígena	2025	Vector	Municipal	CC BY 4.0
Datos Abiertos ANT	Agencia Nacional de Tierras - ANT	Zonas de reserva campesida	2025	Vector	Municipal	CC BY 4.0
Datos Abiertos IDEAM	Instituto de hidrología, meteorología y estudios ambientales-IDEAM	Zonificación Hidrográfica 2022	2022	Vector	1:100.000	Dato abierto
Geoportal DANE	Departamento Administrativo Nacional de Estadística - DANE	Geovisor de Medida de Pobreza Multidimensional	2018	Vector	1:25.000	Dato abierto
Global Land Analysis and Dis	Departamento de Ciencias Geográficas de la Universidad de Maryland	Bosques tropicales húmedos primarios	2001	Raster	1:25.000	CC BY 3.0
Datos Abiertos IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales	Cobertura de la tierra 100K Periodo 2020	2020	Vector	1:100.000	Dato abierto
Datos Abiertos DIMAR	Dirección General Marítima - DIMAR	Zonificación de las Playas de Colombia. Escala 1:	2023	Vector	1:130.000	CC BY 4.0
Datos abiertos INVEMAR	Instituto de Investigaciones Marinas y Costeras José Benito Vives	Caladeros de Pesca (polígonos)	2022	Vector	Municipal	Licencia personalizada
Colombia en Mapas	Instituto de Hidrología, Meteorología y Estudios Ambientales - IDEAM	Áreas afectadas por inundación fenómeno de La Niña	2011	Vector	1:100.000	No identificada
Colombia en Mapas	Departamento Administrativo Nacional de Estadística - DANE	Cobertura de recolección de basura	2018	Vector	Municipal	CC BY 4.0

0. Spatial Data Sources

Below is the list of layers used for implementing the spatial analysis:

0. Considerations and Clarifications

When conducting a multi-criteria spatial analysis using diverse spatial sources such as those previously described, it is essential to consider several aspects to understand the validity and coherence of the study.

First, temporality: the data come from different years (2011 to 2024), which may lead to conflicts if combined without adjustments, especially in dynamic phenomena such as land cover, protected areas, or infrastructure.

Regarding scale and level of detail, there is variability from local data (1:25,000) to national datasets. This means that spatial resolution must be homogeneous or adjusted through generalization or refinement processes.

Coverage is another factor to consider: most information covers the continental territory of the country; however, maritime and insular areas lack spatial data coverage.

Moreover, precision and quality depend on both the data type (raster vs. vector) and the source. For example, digital elevation models with a 30-meter pixel resolution offer high precision for local analysis, while national vector data may have limitations for detailed or local analyses.

It is also necessary to review licensing and usage restrictions, as some layers are openly accessible (such as Creative Commons 4.0), while others have custom or unidentified licenses, which may limit

their integration and publication. However, it is noted that all accessed data corresponds to publicly available web-based sources accessible to anyone.

Finally, thematic consistency in the data must be evaluated, including definitions and methodologies used by each organization, the update frequency and cartographic projection, to avoid errors in spatial analysis.

0. Methodology

Data preparation: Initially, the listed geospatial sources in section 3 were prepared, followed by spatial analyses, including filtering, proximity, hydrological flow accumulation, kernel density estimation and the migration of these analyses to raster format or specialized imagery.

Normalization:

For this process, all data was standardized to a common data type. In this study, a raster format was selected with values ranging from 0 to 1 (minimum and maximum) so that the different sources could be comparable.

Clearly, a higher score implies greater pressure (e.g., more accumulated flow equals higher impact), or higher conservation value or vulnerability.

Weight Assignment:

Weights were defined for each criterion (e.g., Flow accumulation 0.30, distance to landfills 0.20, population density 0.15, proximity to water bodies 0.15, biodiversity 0.20). The method used for obtaining weight was the **consensus method** (expert workshop).

Calculation of Plastic Pollution Risk:

A formula was applied that assigned weights to each normalized variable:

$$\text{Impact/Risk} = \text{Weight}_1 \times \text{Flow Accumulation} + \text{Weight}_2 \times \text{Distance to Landfills} + \text{Weight}_3 \times \text{Population Density} + \text{Weight}_4 \times \text{Proximity to Water Bodies} + \text{Weight}_n \times \text{Variable}_n$$

Final Classification of Impact/Risk:

The risk was then reclassified into categories: Low, Moderate and High, using the most appropriate distribution method: percentiles, natural breaks (Jenks), or standard deviation.

0. Data Preparation and Normalization

The following section outlines the procedures implemented for the main variables, which require prior spatial processes and analyses in order to carry out the **MCSA**.

A. Water Accumulation Zones Based on the Digital Elevation Model (Flow Accumulation Source)

Process: Remove imperfections in data (Fill) → Calculate flow direction (Flow Direction) → Flow accumulation (Flow Accumulation) → Reclassify → Combine with *La Niña* phenomenon → Normalize
One of the most widely used methods for calculating flow direction is the **D8 (eight-direction) flow model**, which was used in this analysis. It is considered one of the most effective methods for flow direction calculation in **ArcGIS Pro**. This method uses the steepest descent, or maximum drop, from each cell to determine the direction of flow.

There is evidence that between 2010 and 2011, the impacts of the *La Niña* phenomenon in the country were significant. In this context, open data from **Mapas (Colombia)** was accessed, specifically the dataset “*Areas affected by flooding during the La Niña phenomenon in 2011*”, which represents flood-affected areas during the 2010–2011 *La Niña* event at a 1:100,000 scale, based on radar and optical image interpretation.

Output: A **raster image of water accumulation** (high values indicate potential areas where runoff-borne waste may accumulate such as estuaries, river mouths and meanders), integrated with areas affected by the 2011 *La Niña* event.

B. Proximity to Water Bodies (Dispersion Source)

Process: Generate buffer layers for proximity analysis → Merge all water bodies and their buffers → Normalize and convert to raster

The source for this variable is the **Basic Vector Database of Colombia**, developed by the *Instituto Geográfico Agustín Codazzi (IGAC)* at a scale of 1:500,000. The dataset elements used include all

water-related surface features, such as single and double drainage lines, single and double channels, swamps, reservoirs, wetlands, ponds, lagoons, oxbow lakes, springs and marshes.

For the hydrological component, the **riparian buffer** criterion was applied, as referred to in Article 83, section d) of Decree Law 2811 of 1974. In cases where the hydrological component extends more than 30 meters from the permanent watercourse or the high-tide line, the "parallel strip" is set at 30 meters.

Based on this criterion, a buffer of **30 meters** was defined with a **normalized value of 1**, corresponding to the riparian zone; **90 meters** with a normalized value of **0.6**; and **180 meters** with a value of **0.2**.

Water bodies can transport waste. When waste is located near them, rainfall and runoff may cause deposition and subsequent transport of that waste.

Output: A **raster dataset** showing the zones of influence or proximity to all water bodies in the country.

C. Distance to Waste Disposal Sites or Landfills (Pressure Source)

Process: Implement Python script for geocoding (script-IDE) → Correct and photo-interpret locations (Edit) → Generate buffer layer for proximity analysis (Buffer) → Normalize and convert to raster

After an extensive search through the country's open data sources, only analog information on national landfills was found on the *Prosperidad Social* government website. Given this limitation, geocoding of the acquired document was carried out using a Python script, resulting in a point-type geographic layer with the exact location of some landfills and approximate locations for others, based on municipal data.

To improve the quality of this layer, a photo-interpretation process was carried out for the identified dump sites. Additionally, landfill sites located within the project's priority areas were also photo-interpreted.

Finally, a polygon layer was created to represent the influence or proximity zones of the landfills, following the standards established by Decree 838 of 2005 and Resolution 1274 of 2006 from the Ministry of Environment, which define environmental criteria and reference terms for such sites. These studies must consider proximity to water bodies, aquifers, recharge zones and sensitive ecosystems such as wetlands or protected areas.

The following distance-weight criteria were applied: 0 to 250 meters → value 1.0 (high plastic pollution threat to surface water and sensitive ecosystems). 250 to 500 meters → value 0.8. 500 to 1000 meters → value 0.6. 1000 to 1500 meters → value 0.4. 1500 to 2000 meters → value 0.2 (lower influence of pollution threat)

Output: A raster dataset showing the influence or proximity zones of the identified landfills.

D. Population Density and Urban Dynamism (Pressure Source)

Process: Apply Kernel Density to grid → Normalize

For this variable, the vector layer of Housing, Households and People from the 2018 National Population and Housing Census provided by DANE was used. This layer corresponds to a 1-kilometer by 1-kilometer grid, reporting the number of people per cell.

Urban areas with high population density often show greater plastic generation and higher risk of poor waste management. A Kernel Density rasterization process was applied and then normalized according to the obtained maximum and minimum values. The Kernel Function is a mathematical formula used to estimate the density of events in a geographic space, smoothing the data to reveal spatial patterns.

Output: A normalized raster dataset of population density in Colombia.

E. Accessibility and Urban Infrastructure (Pressure Source)

Process: Apply filters to define infrastructure only (Query) → Generate buffer layers for proximity analysis (Buffer) → Merge all accessibility and infrastructure proximity layers (Union) → Normalize and convert to raster

The source of this derived variable includes road data from the vector database developed by IGAC at a scale of 1:500,000 and the Multidimensional Poverty Index (MPI) by the populated center from DANE.

For road infrastructure, the following normalization values were applied: Type 1, 2 and 3 roads → normalized value 0.3. Type 4 and 5 roads → normalized value 0.6. Trails and footpaths → normalized value 1.0. Hard-to-access areas typically have lower waste collection coverage and higher likelihood of dumping or burning waste.

For populated centers, the following normalized values were assigned based on the MPI 0%–33.33% → normalized value 0.4, 33.34%–66.66% → normalized value 0.7, 66.67%–100% → normalized value 1.0. When a household reaches a value of 33.33% or higher, it is considered to be in multidimensional poverty. A value of 0 was assigned to locations where DANE has not calculated the MPI.

Output: A raster dataset showing the zones of influence of the national road network and populated centers categorized by their MPI values.

F. Biodiversity and Ecosystem Variables (Vulnerability Source)

Process: Apply filters to isolate areas of interest (Query) → Merge all layers of strategic ecosystems, ecosystem services and protected areas (Union) → Normalize and convert to raster

According to the Ministry of Environment and Sustainable Development, strategic ecosystems in Colombia include páramos (high-altitude wetlands), wetlands, mangroves, tropical forests and coral reefs, which are vital for climate regulation, water provision and biodiversity conservation. These ecosystems are a national priority due to their essential role in sustainable development. As such, management and conservation plans have been implemented to protect them. All these areas were assigned a normalized value of 1, as they are considered highly sensitive or vulnerable.

For ecosystem services, the Corine Land Cover vector layer generated by IDEAM in 2020 was used. Land cover types related to livestock and agriculture were extracted. For fisheries, data from INVEMAR fishing grounds were used and for tourism, the tourist beach zoning from DIMAR was utilized.

Based on their contribution to Colombia's GDP and expert judgment, the following normalized values were assigned Agriculture → 1.0. Livestock → 0.8. Fisheries → 0.5. Tourism → 0.5

:

Additionally, based on Decree 1076 of 2015, Article 2.2.2.1.2.1, the Registered National Protected Areas (Registro Único de Áreas Protegidas) were considered. These areas were assigned normalized values according to their legal hierarchy, as specified in the regulation. The value assignments are detailed below:

Orden	Categoría	Nivel	Autoridad competente	Normal
1	Parque Nacional Natural	Nacional	Parques Nacionales Naturales de Colombia	1
2	Santuario de Fauna	Nacional	Parques Nacionales Naturales de Colombia	1
3	Santuario de Flora	Nacional	Parques Nacionales Naturales de Colombia	1
4	Santuario de la fauna y flora	Nacional	Parques Nacionales Naturales de Colombia	1
5	Área Natural Única	Nacional	Parques Nacionales Naturales de Colombia	1
6	Vía Parque	Nacional	Parques Nacionales Naturales de Colombia	1
7	Parques Nacionales Regionales	Regional	Compañías Autónomas Regionales	0,8
8	Reservas Forestales Protectoras Nacionales	Nacional	Ministerio de Ambiente y Desarrollo Sostenible	0,8
9	Reservas Forestales Protectoras Regionales	Regional	Compañías Autónomas Regionales	0,8
10	Distritos Nacionales de Manejo Integrado	Nacional	Ministerio de Ambiente y Desarrollo Sostenible	0,6
11	Distritos Regionales de Manejo Integrado	Regional	Compañías Autónomas Regionales	0,6
12	Distritos de Conservación de Suelos	Nacional	Ministerio de Ambiente y Desarrollo Sostenible	0,6
13	Áreas de Recreación	Nacional	Ministerio de Ambiente y Desarrollo Sostenible	0,6
14	Reserva Natural de la Sociedad Civil	Privado	Propietario Inscrito ante el Registro Único Nacional de Áreas Protegidas	0,4

7. Weighting, Overlay and Risk Calculation

For this process, all data was converted into raster format to facilitate operations within the GIS. Each variable was assigned a value between 0 and 1, where 1 represents high pressure or high vulnerability.

To calculate the risk of biodiversity impact from plastic pollution, variables related to pressure or threat were integrated; these include sources, dispersion pathways and accumulation zones of plastics across Colombia's maritime, fluvial and continental territories. Additionally, vulnerability or susceptibility factors were included, such as strategic ecosystems, ecosystem services and protected areas.

Following normalization, weights were assigned to each variable to enhance the analysis, based on criteria defined by an expert team. The formula applied through a raster calculator, which incorporated the weights for each normalized variable, was as follows:

$$\text{Risk} = \text{Weight}_1 \times \text{Flow Accumulation} + \text{Weight}_2 \times \text{Distance to Landfills} + \text{Weight}_3 \times \text{Population Density} + \text{Weight}_4 \times \text{Proximity to Water Bodies} + \text{Weight}_n \times \text{Variable}_n$$

Finally, these risk factors were compared against municipal waste management capacities. Good waste management translates into reduced pollution risk, while poor municipal waste management increases the risk.

This management capacity was assessed using data from DANE (2021), specifically the coverage of municipal solid waste collection services.

Analysis of public service coverage in Colombia in recent years reveals a significant rural-urban gap. Although some progress has been made, it remains insufficient to match the coverage levels in urban areas. According to the 2020 National Quality of Life Survey, in municipal centers, over 93% of households had access to public services, while in rural areas and scattered settlements, only 31.4% of households had access to waste collection services. Nationally, 82.6% of households had access, primarily concentrated in municipal centers.

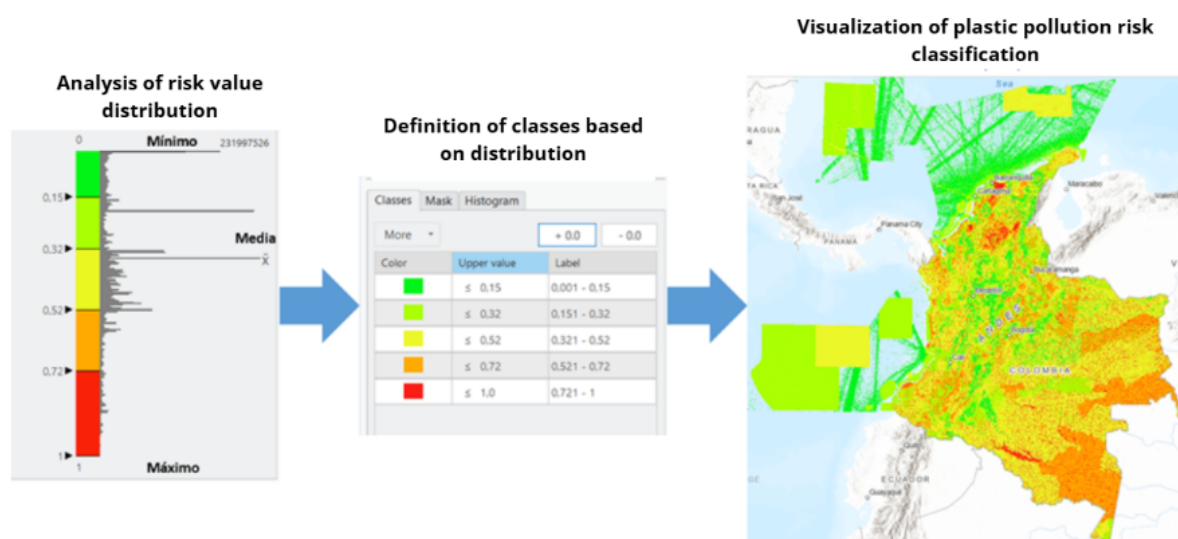
8. Outputs and Results

To generate the final product, an analysis was conducted on the values obtained from the normalized and weighted comparison between plastic pollution pressure, calculated vulnerability and municipal waste management capacity, with the aim of defining appropriate classes for risk classification.

It was observed that the resulting data showed a higher concentration of low values, ranging between 0 and 0.2, with an average value of 0.35.

Based on this analysis, five pollution risk classes were defined: Very Low, Low, Medium, High and Very High. The Medium Risk class includes the mean value of the dataset and the higher-risk ranges were broadened due to the low concentration of data in those intervals.

The risk classification ranges were defined as follows: Very Low Risk: 0 to 0.15. Low Risk: 0.151 to 0.32. Medium Risk: 0.321 to 0.52. High Risk: 0.521 to 0.72. Very High Risk: 0.721 to 1



1. Number of communities per Basin

Community/Basin	Magdalena-Cauca	Amazonas	Caribe	Pacífico	Orinoco
Peasant farmer reserve	11	3	3	0	4
Indigenous reserve	269	224	146	159	136
Community council	50	35	68	146	2

Percentage and area calculation of plastic-pollution risk across Colombia's macro-basins

Área en Hectáreas y %										
Riesgo/Cuenca	Magdalena-Cauca	%	Amazon	%	Caribbean	%	Pacífico	%	Orinoco	%
Very low	4.674.974,89	17%	809.790	2%	908.367	9%	205.125	3%	1.759.469	5%
Low	5.336.016,86	20%	2.022.923	6%	2.177.705	21%	1.762.647	23%	4.122.781	12%
Medium	10.240.577,40	38%	16.353.772	48%	4.896.277	48%	3.784.980	49%	18.794.736	54%
High	4.797.982,94	18%	10.969.201	32%	1.685.773	16%	1.404.508	18%	6.986.122	20%
Very high	2.036.752,48	8%	3.999.681	12%	615.906	6%	581.221	8%	2.944.500	9%
Total	27.086.305	100%	34.155.367	100%	10.284.028	100%	7.738.481	100%	34.607.608	100%

A2: Environmental Diagnostic of Study Cases: Basins and Threatened Ecosystem Services

Study case	Basin	Description	Ecosystems services
Santa Marta	Caribe	The Manzanares River is an urban ecosystem that links the city of Santa Marta to the Caribbean Sea, serving as both a natural corridor and a critical water source⁽¹¹⁰⁾. It plays a key role in supporting the health of marine ecosystems and local wildlife. However, the river currently faces severe pollution and flooding issues. Uncontrolled dumping of plastic waste and a lack of public awareness are degrading water quality and negatively impacting the bay and nearby ecosystems. During flood events, especially those linked to La Niña and heavy rainy seasons, the river carries large amounts of waste, mainly plastics into the bay, causing serious damage to marine life, coastal communities and local infrastructure.¹¹¹	Hydrological and Climate Regulation: The watershed contains montane and foothill forests that help regulate streamflows and moderate the local microclimate. Erosion Control and Mitigation of Extreme Events: Riparian and estuarine vegetation stabilizes soil and buffers flood impacts. Water Supply: The upper watershed provides water to Santa Marta's municipal aqueduct. Food Provision and Livelihoods: Agriculture and livestock are practiced in the foothill areas, while artisanal fishing, port operations and tourism sustain livelihoods at the river's mouth. Biodiversity Support: The upper and middle watershed serve as corridors for key species such as ocelots, deer, anteaters, frogs and birds while the lower watershed contains remnants of tropical dry forest. Cultural Services: Santa Marta Bay offers opportunities for recreation and tourism.
Buenaventura	Pacífico	Buenaventura Bay forms a large estuary that connects the Dagua River with the Pacific Ocean, hosting vital mangrove and tropical rainforest ecosystems. This area is crucial for both local and national economies, supporting activities such as fishing, agriculture, tourism and especially port development, as it is home to one of Colombia's most important ports. However, both artisanal and industrial fishing have led to a growing environmental problem: at least 19 areas contain abandoned fishing nets (so-called ghost nets), which contribute to plastic pollution and biodiversity loss. Additionally, about 80% of the local population lives in multidimensional poverty and the lack of public services has resulted in large volumes of solid waste being dumped into the estuary. This situation degrades water quality, leads to plastic accumulation in species (especially fish), harms biodiversity, accelerates coastal erosion and reduces fish availability.¹¹²	Regulación y protección costera: Los manglares de la bahía atenúan la energía del oleaje y reducen la erosión, ayudando a estabilizar las líneas costeras. Provisión de alimentos y medios de vida: Las actividades económicas clave incluyen la pesca artesanal e industrial de camarón, piangua, pargos, meros y otros. El puerto es un eje económico para el procesamiento y transporte de carga. En el bosque húmedo tropical también se realizan actividades agrícolas y forestales. Soporte a la biodiversidad: Hábitat para 28 especies con algún grado de amenaza, tanto acuáticas como terrestres, incluyendo camarón, piangua, jaguar y otros grandes felinos. El área marina es un foco de conservación por la presencia de ballenas, delfines, pargos, meros, nutrias y tortugas, entre otros.

Study case	Basin	Description	Ecosystems services
			Cultural: La rica herencia cultural del territorio está estrechamente ligada al entorno natural, fortaleciendo la identidad de las comunidades étnicas locales. La zona también sostiene un robusto ecoturismo y uso recreativo de playas, avistamiento de aves y ballenas, y deportes acuáticos.
Bogotá	Magdalena-Cauca	Doña Juana landfill, inaugurated in 1988, was originally conceived as a technical and environmental solution for waste disposal in Bogotá, with the promise of being converted into a green area and scheduled to close by the year 2000. However, more than three decades later, it remains in operation, receiving over 6,000 tonnes of waste daily and expanding onto neighboring agricultural lands.¹¹³ Its inadequate management has led to serious environmental problems, including contamination of surface water bodies such as the Tunjuelito River and the Yerbabuena and Botello streams, as well as groundwater pollution in the Bogotá savanna and the uncontrolled release of harmful gases such as methane, carbon dioxide and hydrogen sulfide⁽¹¹³⁾.	As a result, key ecosystem services have been degraded or lost, including regulation and provisioning (such as freshwater, vegetation cover and food), supporting and cultural services. The ecosystems surrounding the landfill are now at risk, including high Andean Forest, sub-páramo, páramo, riparian ecosystems of the Tunjuelo River basin, as well as wetlands and local drainage streams. In this case, ecosystem services have been lost and land use has been completely altered. Adjacent areas are at risk of losing their ecological integrity and the services they provide.
Puerto Colombia	Magdalena-Cauca	The coastal ecosystems of the Colombian Caribbean and the Magdalena River Delta have undergone dramatic changes since the Bocas de Ceniza project altered the river's natural course. Over time, the situation has worsened due to increasing amounts of solid waste, especially plastic, carried downstream from inland areas during the rainy season. Today, the Magdalena River Basin is home to over 30 million people, nearly 70% of Colombia's population and generates 80% of the country's GDP. It is estimated that up to 29,500 tonnes of plastic enter the river system each year. A striking example is Puerto Colombia, where waves push such large volumes of waste onto the shore that a so-called "island of trash" has formed, stretching over 15 kilometers about 20% of which is plastic first documented in 2019. This not only spoils the landscape, but also threatens tourism and local fisheries, undermines the cultural and recreational value of the coast and spreads macro- and microplastics throughout the Greater Caribbean, with real consequences for marine life.	Cultural Heritage: The history of Puerto Colombia, shaped by its historic pier and waves of immigrants, represents significant cultural heritage closely intertwined with the natural environment. Recreation and Tourism: Marine and coastal biodiversity attract visitors and serve as one of the area's main sources of income. Food Provision and Livelihoods: Marine resources and artisanal fishing are the primary sources of livelihood for the local population.



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