Final Monitoring Report PROMAR

Prevention of Marine Litter in The Caribbean Sea

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Abbreviations

BMUV	The German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
CCI	Clean Coast Index
EPR	Extended Producer Responsibility
MFA	Material Flow Analysis
SWM	Solid Waste Management
WFD	Waste Flow Diagram

Content

1 Introduction

The PROMAR project aims to reduce waste streams, namely plastic packaging and single-use plastics, entering the Caribbean Sea while promoting Circular Economy solutions in the Dominican Republic, Costa Rica and Colombia. Since 2024, additional partner countries are the British Virgin Islands, St. Kitts and Nevis, Trinidad and Tobago, Guyana and Suriname.

The project is funded by the German Federal Ministry for the Environment and Nuclear Safety (BMUV) and coordinated by the Zukunft – Umwelt – Gesellschaft gGmbH (ZUG).

Four work packages (WP) were carried out under PROMAR. The project team, in coordination with local authorities, initiated a monitoring system for waste streams (WP I), tested and replicated Circular Economy solutions (WP II), raised awareness of the litter problem among stakeholders (WP III), and finally promoted the concept of EPR at a national and regional level and supported a policy dialogue on the issue (WP IV).

In order to establish a baseline of the pollution problem and its monitoring over time, different methods were used, namely a method for beach data sampling developed by PROMAR and in Costa Rica meanwhile officially recognized by the government, as well as a material flow analysis based on the Waste Flow Diagram developed by the GIZ.

During the course of the project, various local waste prevention projects (pilots) were carried out in the Dominican Republic, Costa Rica and Colombia with the aim of reducing plastic pollution. Based on the data collected near the pilot implementations, this report presents a comparison between the baseline data measured in 2021 and the subsequent monitoring data until 2024.

The present report relates to the data obtained in the Dominican Republic, where the local partner organization is Parley for the Oceans. Firstly, the results of the baseline measurement in the beginning of the project will be described. Then, the respective pilot interventions in the area are explained. Finally, the results of the measurements carried out after the implementation of the pilots and on a later project stage are presented. This allows to demonstrate the project progress from the initial baseline measurement up to the final status.

2 Methodologies applied

Marine plastic pollution represents a significant environmental issue, impacting marine ecosystems, human health, and local economies. To counteract this problem, **PROMAR developed the BlueBox**, a compilation of instruments, tools, guidelines, tutorials, training, dissemination materials, success stories and best practices. The included tools shall help applicants to focus actions and guide them through the process of defining and implementing Circular Economy actions to reduce marine litter in their municipality. The BlueBox is structured in six phases. **Phase (1)** lays the foundation with the Diagnosis and Baseline Establishment, **phase (2)** is about relevant Stakeholder Involvement, **phase (3)** about Sensibilization and Capacity-Building. **Phase (4)** contains the so-called Implementation of Prevention and Management Tools, based on the established PROMAR pilot projects in the partner countries. **Phase (5)** includes the evaluation and monitoring of the project and **phase (6)** the dissemination and multiplication of the project results and activities.

As stated above, phase (1) contains tools for the establishment of a baseline, meaning that the existing problem is identified and quantified as a basis for the work. To effectively address and mitigate this problem, it is crucial to understand the composition, sources, and distribution patterns of beach litter.

In the Dominican Republic, two methodologies were executed to generate a baseline that allows analyzing the flow of waste that reaches the Caribbean Sea, as well as knowing its flow, composition and characterization. In this sense, the Waste Flow Diagram (WFD) and the Methodological Guide for Sampling Solid Waste on Beaches were used in the demonstration sites initially selected for the project. Both methodologies are described below:

2.1. Waste Flow Diagram (WFD)

The Waste Flow Diagram is an interactive tool which helps map and visualize municipal solid waste management system material flows to quantify amounts, sources and fates of waste leakage into the environment. It was developed by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, University of Leeds, Swiss Federal Institute of Aquatic Science and Technology (Eawag) and RWA-Wasteaware to help stakeholders assess the quantities and fates of unmanaged municipal solid waste (MSW) released into the environment.

The WFD employs Material Flow Analysis (MFA) to map waste flows across all stages of the solid waste management (SWM) system, including generation, collection, transport, treatment, recovery, and disposal. This methodology was initially selected to have a comprehensive approach when developing municipal solutions and their potential to reduce plastic pollution in the environment.

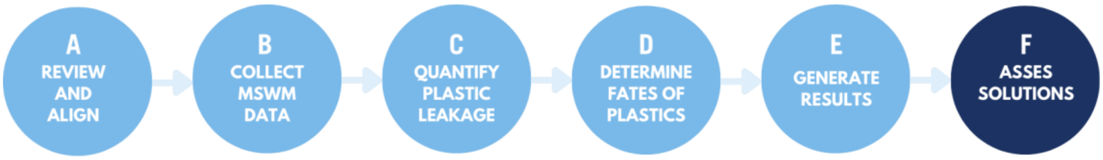
The methodology involves mapping out the sources, types, quantities, and destinations / leakages of waste, as well as identifying key stakeholders and processes involved in waste management. By creating detailed waste flow diagrams, practitioners can identify inefficiencies, potential areas for intervention, and opportunities for improving waste management practices. The main objectives of the WFD are to:

- Provide a rapid assessment of a city or municipality's municipal solid waste management system and visualize waste streams, including information for SDG 11.6.1 sub-indicators
- Assess and quantify plastic leakage from the municipal solid waste system and determine the fate of uncontrolled wastes
- Identify priority sources of plastic pollution for informed intervention
- Enable benchmarking between cities

- Develop scenarios to better understand the impact of proposed interventions on waste management and plastics pollution
- Quantify the effectiveness of implemented interventions

To proceed with the exercise, the tool requests information that needs to be collected and/or generated based on the selected demonstration site. For the purposes of baseline generation in the Dominican Republic, the municipality of Santo Domingo Este was selected, with the focus of building an exclusive flow model for plastic waste generated in the zone mentioned. The needed data to develop the flow model in the municipality of Santo Domingo Este took into account quantitative and qualitative information which included plastic waste leakages, destinations, composition, local recovery and waste streams, among some others.

To apply this methodology, a series of steps need to be developed in order to gather, analyze and interpret the information necessary for the process. The graph below summarizes the steps that were taken:



The methodology includes the delimitation of the geographical context and the definition of the scope of data collection (step A), the collection of information on MSWM (step B), the quantification of plastic waste leaks, as well as the factors that influence their generation (step C), the determination of the destination of waste leaks (step D), the analysis and generation of results (step E); and finally, the use of the results obtained in the design, execution and monitoring stages of the pilot solutions implemented within the framework of the PROMAR project.

2.2. Methodological Guide for Sampling Solid Waste on Beaches

The methodology for sampling solid waste on beaches focuses on the systematic collection and analysis of waste to better understand the quantity, type, and origin of waste in beaches and coastal areas. This methodology was initially developed by ABRELPE and adapted to the PROMAR context by Socya, Cegesti and Parley in their respective countries.

The scope of this methodology includes identifying sources of pollution, assessing plastic waste composition and, eventually, formulating marine litter prevention or mitigation strategies. The importance of this methodology lies in its ability to provide accurate and consistent data on beach pollution, which is essential for designing interventions and programs. After identifying the predominant sources of waste, the PROMAR project developed specific measures to reduce the plastic waste flows into the environment, specially into water bodies (small canals, rivers and sea). The graph below summarizes the steps that were taken to carry out this exercise:

The main steps of this methodology included selecting sampling sites, collecting samples at regular intervals, classifying and quantifying the collected waste, and analyzing the obtained data. These steps are complemented by detailed documentation of sampling conditions, such as date, time, weather, and beach usage. Possible outcomes of these samplings may include identifying critical pollution points, evaluating trends over time, and assessing the effectiveness of applied intervention measures. Ultimately, these results help build a robust database that supports concrete actions to reduce waste on beaches and protect the marine environment.

2.3. Clean Coast Index (CCI)

Subsequently, with the results of the general analysis we compared the pollution levels with other beaches, using the Coastal Pollution Index (CCI: Clean Coast Index) developed by Alkalay et al. (2007). This index allowed us to identify the level of pollution of the selected beaches by multiplying the amount of plastic waste within a square meter (units of plastic/m2) by the constant K=20, used in order to facilitate the interpretation of the levels of pollution.

The CCI results are used to categorize beaches depending on their levels of plastic pollution. To carry out this analysis, data from the selected location is used, such as the total amount of waste collected in the selected transect (only plastics and styrofoam) and the area delimited for the transect. The calculation of the index is carried out as follows:

$$CCI = \frac{total\ amount\ of\ items\ collected\ (plastic\ and\ foam)}{sampling\ area} \times K$$

To interpret the values assigned through the CCI, they are categorized using the following scale:

Clean Coast Index (CCI)	**(1) Very clean** No plastic waste is observed in the coastal region	**(2) Clean** No plastic waste observed in most of the coastal region	**(3) Moderate** Some plastic waste is observed in the coastal region	**(4) Dirty** Plastic waste observed in most of the coastal region	**(5) Very dirty** Plastic waste is observed covering the coastal region
Numerical Index	0-2	2-5	5-10	10-20	20+

3 Results of the Baseline Measurement using Beach Data Sampling and the Waste Flow Diagram

For the purposes of the Dominican Republic, two impact zones were selected to implement pilot solutions for the prevention of marine litter, these being Santo Domingo Este (see pilot area A) and Río Haina (see pilot area B). In this sense, after taking into account aspects such as leaks and waste flows, the interaction with bodies of water and the potential generation of waste, the beaches of Playa del Fuerte San Gil (point X), Playa Tortugas (point Y) and Playa Gringo, Bajos de Haina (point Z) were selected as demonstration sites to carry-out beach monitoring. Regarding the WFD, the Municipality of Santo Domingo Este (see pilot area A) was selected to carry out the study.

3.1. Waste sampling at Playa del Fuerte San Gil (X)

The Playa del Fuerte San Gil was one of the three locations selected for beach waste sampling purposes; It is located on the Malecón of Santo Domingo, in the National District of the Dominican Republic. This beach is not for recreational or tourist use, its use is not linked to productive activities, although it has improvised human settlements in its vicinity. There are those who take advantage of the morphology of the caves created by the rocky nature of said environment, and live in these spaces. Like the rest of the beaches located on the Malecón de Santo Domingo, this beach receives waste that floats through the waters of the Ozama River (located in the east direction), but it is also exposed to the waters of the Caribbean Sea (located to the south). The length of the beach is 95 meters (its extension from east to west), with an approximate width of 20 meters from where the beach begins to where the tide reaches at its midpoint.

For the purposes of the baseline report, two monitoring exercises were carried out on this beach. The most common type of waste in both monitoring was foam, representing 44.5% of the total waste. Plastics are the second most common type of waste (52.43%), from which several categories of products are released, taking into account their proportion. Within the plastics category, HDPE caps (18.9%), HDPE containers (15.2%) and PET bottles (11.3%) were the waste with the greatest presence within the sampling exercise on the beach of Fuerte San Gil. Counting foam as plastic waste, 96.8% of the waste found in Playa Fuerte San Gil is plastic.

3.2. Waste sampling at Playa Las Tortugas (Y)

Las Tortugas Beach, located on the Malecón de Santo Domingo, in the National District of the Dominican Republic, was selected for waste sampling purposes. This beach is not for recreational or tourist use, its use is not linked to productive activities nor does it have human settlements nearby, although it is located next to Playa Güibia, which does have recreational purposes. This beach is known for being visited by sea turtles that lay their eggs there. It is important to know that this beach receives waste that floats through the waters of the Ozama River (located to the east), but it is also exposed to the waters of the Caribbean Sea (located to the south). The length of the beach is 120 meters (its extension from east to west), with an approximate width of 12 meters from where the beach begins to where the tide reaches its midpoint.

Table X shows the results of the two monitoring exercises carried out at Playa Tortugas. In both surveys, foam fragments were the most common type of waste, making up 77.1% of the total waste found in both surveys. Plastic is the second most common type of waste, with HDPE caps being the most common type of plastic, followed by PET bottles and HDPE bottles. Counting foam as plastic waste, 99.1% of the waste found at Playa Tortugas is plastic. The rest of the waste makes up 0.9% of the total.

3.3. Waste sampling at Playa Gringo (Z)

Gringo Beach, located in the municipality of Bajos de Haina, San Cristóbal province of the Dominican Republic was also selected for sampling purposes. This beach is for recreational use, especially for the local community, especially for nightlife due to its close proximity to bars. The beach is located in an area where an energy park, the port of Haina, and an oil refinery are located.

On the beach, there is a natural lagoon that flows into the Caribbean Sea (Laguna de Ñaga), this lagoon has become a means of transporting solid waste and wastewater generated by nearby communities and industries. The length of the beach is 550 meters (its extension from east to west), with an approximate width of 20 meters from where the beach begins to where the tide reaches its midpoint.

In both sampling exercises, foam fragments were the most common type of waste, representing 73.2% of the total waste found in both surveys. Plastics are the second most common type of waste, accounting for 23% of the total waste. Counting foam as plastic waste, 97.6% of the waste found at Playa Gringo is plastic, with the rest accounting for only 2.4% of the total.

3.4. Comparing beaches using the Coastal Contamination Index (CCI)

Using the Coastal Contamination Index (CCI), a comparative analysis was made between the beaches selected as demonstration sites for waste sampling. The information collected at each location was used as a starting point, as shown below:

	Playa del Fuerte San Gil	Playa Las Tortugas	Playa Gringo
Área de la playa	1,900 m2 (95 m x 20 m)	1,440 m2 (120m x 12m)	11,000 m2 (550m x 20m)
Área de transecto	150 m2 (15m x 10m)	150 m2 (15m x 10m)	150 m2 (15m x 10m)
Total de residuos en el transecto	3,361 unidades	5,334 unidades	4,104 unidades
Plástico y foam	3,254 unidades	5,286 unidades	4,006 unidades
Concentración general	22.41 unidades/m2	35.56 unidades/m2	27.36 unidades/m2
Concentración de plástico y foam	21.69 unidades/m2	35.24 unidades/m2	26.7 unidades/m2
Índice general	448.2	711.2	547.2
Clean Coast Index	433.8	704.8	534
Estimado total de residuos en playa	42,579 unidades	51,206 unidades	300,960 unidades
Estimado total de residuos plástico y foam en playa	41,211 unidades de plástico y foam	50,746 unidades de plástico y foam	293,700 unidades de plástico y foam

According to the index parameters and the results obtained in each sampling, the following conclusions can be drawn:

- According to the CCI parameters, the three selected beaches fit within the "Very dirty" category, as plastic debris is observed covering the coastal area. This result corresponds with the reality faced by the three locations, where the level of plastic pollution on the shores of these beaches is visible from far distances.
- Of the three selected beaches, Playa Las Tortugas shows the highest concentration of waste per square meter (with a CCI = 704.8), followed by Playa Gringo (with a CCI = 534) and Playa del Fuerte San Gil (with a CCI = 433.8).
- According to the estimates made with this index, Playa Gringo is the location where the highest concentration of plastic waste is estimated in the entire beach area (with an estimate of 293,700 plastic and foam units); followed by Playa Las Tortugas (with an estimate of 50,746 plastic and foam units) and Playa del Fuerte San Gil (with an estimate of 41,211 plastic and foam units).

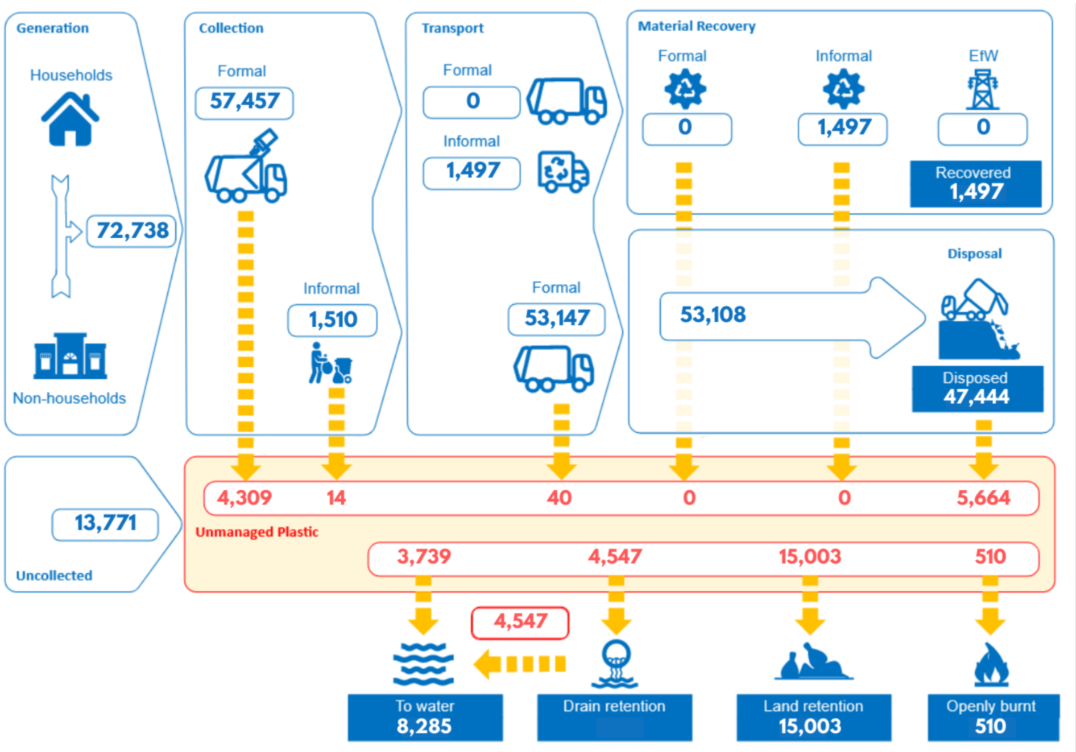
3.5. Waste Flow Diagram (WFD) at Santo Domingo Este

The municipality of Santo Domingo Este was selected as the site for the WFD. Santo Domingo Este is a municipality in the province of Santo Domingo, in the eastern or southeastern region of the country. Santo Domingo Este is the second largest municipality in the province of Santo Domingo and the most populated municipality in the country. The municipality is divided into three districts made up of sectors which in turn are divided into neighborhoods.

The WFD as part of the baseline study in Santo Domingo East sought to build a model describing the flow of plastic solid waste that comes from land-based sources in the municipality of Santo Domingo East and ends up in bodies of water (such as ravines, the Ozama River or the Caribbean Sea). Considering that this exercise employs data collection from primary and secondary sources, the period of 2018-2022 was taken as a window to select relevant and updated data. The WFD exercise was executed in Santo Domingo Este between March and August, 2022.

According to the generation calculations of the WFD tool, the Municipality of Santo Domingo East generates a total of 551,880 tons of solid waste per year. The waste management system composed of the municipal collection service manages to recover 73% of the total waste generated.

Figure A1 - Flowchart of plastic waste flows in Santo Domingo Este, according to the WFD tool results



The model describing the specific flow of plastic waste is shown in Figure A1. It shows that 72,738 tons of plastic enter the ordinary waste management system each year. Of this amount, 53,108 tons of plastic are disposed of in landfill, and only 1,497 tons are recovered for recovery. This represents just 2% of all plastic waste entering the system.

For the purposes of this study, the process of release into the environment encompasses everything that happens to the waste from the moment it is disposed of until it is recovered or reaches its final disposal point. Of the total that enters the system, 4,324 tons of plastic per year are released into the environment during the collection process. Similarly, 5,664 tons of plastic per year are released into the environment from the final disposal point (Duquesa landfill). The total amount of plastic waste reaching water bodies is 8,285 tons per year.

There are several reasons behind the high amount of plastic released into the environment during the different points of the waste management system. The main ones are:

- Waste is not collected on a regular basis in Santo Domingo East. This causes people to take out their waste on days when there is no collection and it remains exposed for a long time on the public streets. This exposure generates a source of waste release due to animals scavenging in the bags or wind and rain.
- People dispose of their waste on public thoroughfares because there are few public waste containers for collection and sorting. This also leads to the creation of temporary sources of contamination, as people begin to throw waste individually on the bags when they are left out in the open for so long.

- At the informal waste recovery points, the bags are broken in order to remove the recoverable waste, leaving the rest of the waste without any type of containment. As a result, there is a release of waste into the environment during recovery, transportation and final disposal point (which in turn functions as another informal recovery point).
- The final disposal point is an open dump; waste is disposed of indiscriminately and there is no waste containment, so the waste remains out in the open.
- The market for the revaluation of plastic is quite limited, especially when compared to the market for other materials such as metal. Most of the plastics recovered are HDPE plastic, as the weight of other plastics such as PET makes their recovery less profitable for collectors.

3.6. Challenges in data collection for the Waste Flow Diagram

The development of the WFD for Santo Domingo Este faced several challenges that impacted the data collection process and the overall accuracy of the results. These challenges stemmed from the complexity of the local waste management system, the involvement of multiple stakeholders, including informal waste collectors, and the limited availability and consistency of data. Some of the key challenges encountered during the exercise included:

- **Difficulties in obtaining data from informal actors**: A significant portion of waste collection and recovery in Santo Domingo Este is managed by informal waste pickers and intermediaries who operate outside of official regulatory frameworks. Due to the informal nature of their activities, there is no structured data reporting, and access to reliable information depended largely on voluntary disclosures, which were often incomplete or inconsistent.

- **Limited access to public institutional data**: Government institutions responsible for waste management, such as municipal authorities and environmental agencies, often maintain fragmented or outdated records. In many cases, data requests were met with bureaucratic hurdles, delays, or incomplete datasets that did not provide a comprehensive picture of waste generation, collection, and final disposal.

- **Inconsistency of available data**: Existing waste management data from different sources frequently showed discrepancies due to variations in methodologies, timeframes, and scope of data collection. In particular, information on waste composition and quantities varied between institutions, private sector reports, and independent studies, making it challenging to establish a unified and reliable dataset.

- **Gaps in traceability of waste flows**: The tracking of waste from generation to final disposal or recovery was hindered by the lack of standardized reporting mechanisms across different actors in the waste management chain. Informal and semi-formal waste recovery systems often operate with multiple intermediaries, making it difficult to establish precise waste flow pathways.

These challenges highlight the need for improved data collection mechanisms, enhanced institutional coordination, and greater integration of informal sector actors into formal waste management systems. Addressing these gaps will be critical for refining future Waste Flow Diagram exercises and for the development of evidence-based policies aimed at improving waste management and circular economy initiatives in the Dominican Republic.

4 Pilot Identification and Interventions

For the Dominican Republic, two pilots were created for the prevention of marine litter based on a circular economy approach. Each of the selected pilots was developed taking into account the reality of the context, the flow of plastic waste and the opportunities for collaboration with various stakeholders. The Blue Stations were created for the area of Santo Domingo Este, and the RiverBoom underwent changes in the location that had initially been selected, in the end it was placed in the Yaque del Norte River, in the city of Santiago. The developed pilots are described below.

4.1 Pilot Implementation: Estaciones Azules

Blue Stations are a community space that offers communities the opportunity to responsibly manage their recyclable plastic waste in an effort to protect the environment from plastic pollution and raise awareness about the beauty and fragility of the oceans.

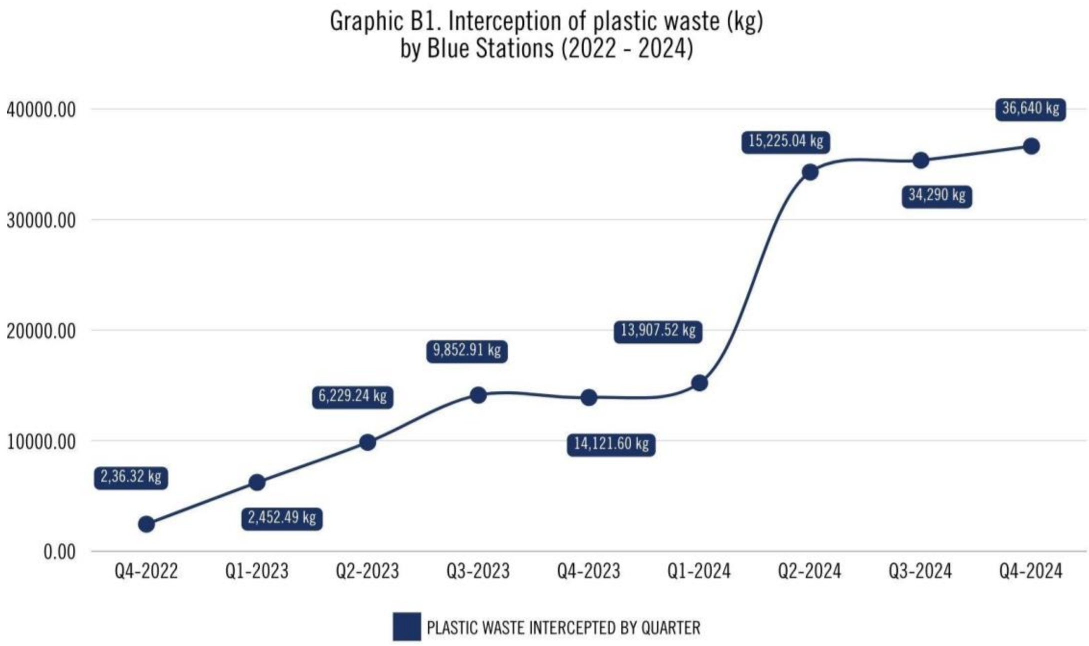
The Stations are made up of a modular structure that takes advantage of cargo containers to create a space that functions as a temporary collection center for solid waste; Functioning as a collection, classification and education space for the community, they are energy independent, with a solar panel roof and include personnel for citizen care and education. Additionally, they include a fleet of electric tricycles that facilitate the collection of recyclable waste previously separated by homes, through routes that collect waste from house to house.

Established in Santo Domingo Este since September 2022, the Blue Stations managed to become official as a model for comprehensive waste management under a collaboration agreement with the Santo Domingo Este City Council (ASDE). Since then, through the establishment of two Stations, it has been possible to raise awareness and mobilize members of different communities in the Villa Duarte Sector (in the case of the Ozama Blue Station, see map in Figure A2) and Los Frailes sector (in the case of the Caribe Blue Station) to participate in the classification and collection of plastic waste.

Figure A2 - Map with Blue Stations and demonstration beaches closed to it.

The Stations encourage the community to participate in recycling and create a lasting sustainable mindset. Each unit is managed and operated by local people who are trained and hired by Parley in sorting PET, HDPE and PP recyclable plastics. Residents of surrounding areas receive information about recyclable plastics and how to classify them correctly. The pre-selected recyclable material is temporarily stored in one of the containers before being transported to the Cilpen Global sorting site.

From September 2022 to December 2024, the Blue Stations had been able to carry out more than 60 thousand collections in the impact areas, intercepting around 157,630 kg of plastic waste, and preventing 11.40% of said amount from ending up in bodies of water, based on the WFD calculations.



The previous graph shows the amount of waste intercepted by the Blue Stations throughout their operations (see line in blue). In an effort to measure the co-benefits of the pilot intervention, a survey was developed for community members who participate in the collection routes offered by the Blue Stations;

52% of those surveyed indicated they experienced less local flooding in the community as a result of plastic waste collection routes.

These results could be achieved thanks to the implementation of collection routes in its operations that allow the interception of recyclable plastic waste, taking into account the existing mechanisms for its management and use. These routes are carried out by operational personnel whom Parley has equipped with electric tricycles for the collection of recyclable waste, as a sustainable and efficient transportation option in densely populated urban areas or in places where access to larger vehicles is limited..

4.2 Pilot Implementation: RiverBoom

The RiverBoom is a floating barrier designed to monitor and intercept floating solid waste in bodies of water such as rivers and canals. This device acts as a filter that is placed transversely in the course of the current, stopping the passage of garbage and plastic waste that would otherwise continue its journey to larger waters, such as oceans and seas. Its design allows water to flow freely, while waste is trapped in the floating barrier, facilitating its subsequent collection and proper handling. This system is especially useful in urban and coastal areas where the accumulation of trash in rivers can become a significant environmental problem.

A mechanized conveyor belt allows the material to be removed from the water to a collection container located on the river bank, serving as a temporary location to intercept the waste collected there and subsequently transported to its final disposal destination with the help of the Dominican recycling company Cilpen Global.

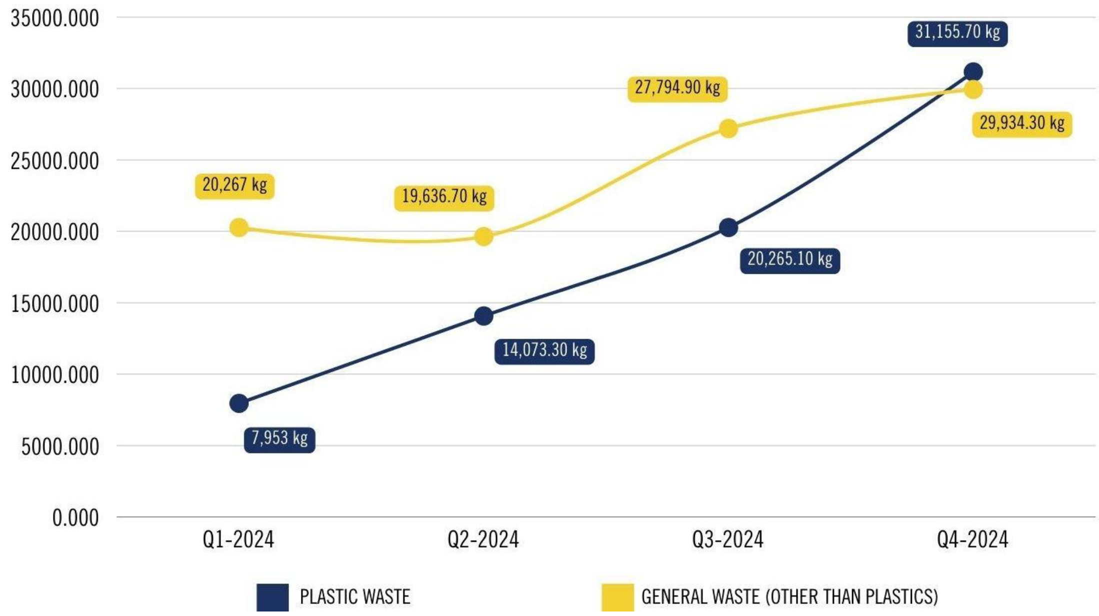
Initially, the RiverBoom was supposed to be placed in the Haina River, where it would have had a direct connection with the marine litter received at Playa Gringo (a beach selected as the location for beach waste sampling during the baseline study). However, due to complications with the legal status of the land that was identified together with the Ministry of Environment and Natural Resources of the Dominican Republic, which turned out to be in a status of unauthorized occupation by third parties, it was decided to select another location. The selected location became the Yaque del Norte River, in the city of Santiago de los Caballeros, one of the most important and longest rivers in the entire country. This new location was selected in coordination with the Ministry of Environment and Natural Resources, the Corporación del Acueducto y Alcantarillado de Santiago (CORAASAN) and Cilpen Global, organizations that became part of the RiverBoom's coordination round table.

Important: The management of the waste intercepted by the Barrier was assumed by CILPEN Global, as part of its commitments for the implementation of the project. Once at its plant, CILPEN facilitates the separation and compaction of the waste, as well as its use or final disposal, as appropriate.

During Pilot Phase 1 of the Blue Barrier in the Yaque del Norte River, between March and December 2024, the system intercepted 170,480.00 kg of waste (see Graphic B2 for reference). This pilot marked a milestone in the prevention of plastic pollution in the river, achieving tangible results that reflect the direct impact of the technology implemented. Waste collection not only prevented a large amount of waste from reaching the Atlantic Ocean, but also contributed to the improvement of water quality in the surrounding areas, benefiting both aquatic ecosystems and nearby human communities.

Of the total waste collected, 45% consisted of plastics, equivalent to 73,447.10 kg. This figure is significant, considering that plastics are the waste that takes the longest to decompose and generates the greatest pollution problems in aquatic ecosystems. By preventing +70 tons of plastics from flowing into the ocean, the negative impact on marine fauna and coastal habitats, where this waste could have caused irreversible damage, was substantially mitigated.

Graphic B2. Interception of plastic waste (kg) and general waste by Barrera Azul during 2024



5 Justification of monitoring methodology

The decision to not use the *Waste Flow Diagram* and *Waste Sampling in Beaches* methodologies to compare results with the baseline report for our marine litter prevention intervention in Santo Domingo Este was based on several critical factors. Firstly, the scale of Santo Domingo Este is a significant consideration. The city is too large for these methodologies to capture meaningful data, especially given that our intervention focused only on two specific zones within the broader urban area. This geographical limitation means that the methodologies would not adequately reflect the true impact of our efforts, as they would be unable to account for the waste patterns and flows in the entire city. Consequently, any data gathered would likely be skewed and not provide a clear comparison to the baseline report.

Another important factor is the influence of seasonal patterns and rainfall on waste flow. Santo Domingo Este experiences varying weather conditions that significantly impact the amount of waste transported from small canals and the river to the sea. During the rainy season, for instance, increased runoff can carry more litter into water bodies, thereby affecting the amount of marine debris found on beaches. These seasonal variations would introduce a high degree of variability in the data, making it challenging to distinguish between the effects of our intervention and natural fluctuations in waste flow. As a result, relying on these methodologies could lead to inaccurate conclusions about the effectiveness of our marine litter prevention measures.

Additionally, the methodologies in question are not well-suited to capturing the localized impact of our intervention. The waste flow diagram and beach sampling approaches are designed for broader assessments and may not detect changes within small, targeted areas like the ones we focused on. Our intervention's specific zones might show significant improvements that would be diluted when aggregated with data from non-intervention areas. Therefore, these methodologies would not effectively highlight the localized success of our project, undermining our ability to accurately demonstrate its impact to stakeholders.

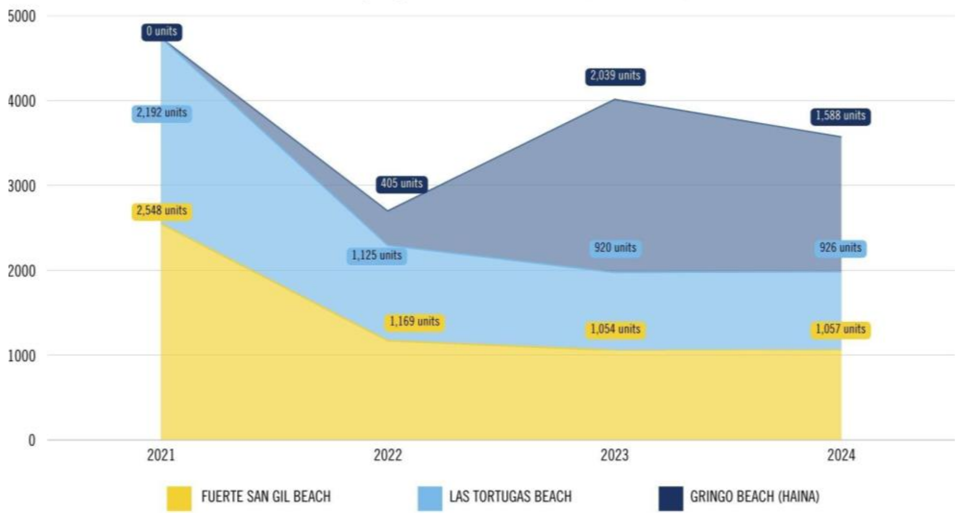
Furthermore, the resource-intensive nature of these methodologies also played a role in our decision. Conducting comprehensive waste flow diagrams across the entire city would require substantial time, manpower, and financial resources. Given our focus on two specific zones, it would be more efficient and cost-effective to employ alternative evaluation methods tailored to our intervention's scope. By using more targeted and context-appropriate approaches, we can obtain more accurate and relevant data that better reflects the outcomes of our marine litter prevention efforts.

6 Results of the monitoring

After establishing the baseline for monitoring, waste samplings were conducted annually between 2021 and 2024 to identify potential changes in the beaches initially selected for this purpose. Continuous beach monitoring allows for the assessment of variations in waste flows over time, providing valuable insights into pollution trends and the effectiveness of waste management interventions. This ongoing process serves as a crucial tool for improving decision-making at both the municipal and national levels, supporting data-driven strategies for marine litter prevention and coastal environmental management.

Following the implementation of the methodology and the training of technical personnel from academia, civil society, municipal governments, and the central government, the Ministry of Environment and Natural Resources of the Dominican Republic officially adopted the Methodological Guide for Beach Waste Sampling[1] in 2024. This institutional recognition reflects the methodology's effectiveness in standardizing monitoring practices and strengthening national capacity for assessing marine litter. The adoption of this methodology marks a significant step toward enhancing marine litter prevention policies and fostering long-term environmental sustainability in coastal cities.

Graphic B3. Waste (in units) collected during waste sampling exercises in beaches (2021-2024)



The waste samplings conducted between 2021 and 2024 provide valuable insights into the trends and flows of waste accumulation across the three monitored beaches: Fuerte San Gil, Las Tortugas, and Gringo (Bajos de Haina). Overall, the total number of waste sampled (by units) showed a significant decrease in Fuerte San Gil and Las Tortugas from 2021 to 2024 (beaches more impacted by the circular economy pilot projects developed by Parley and PROMAR in Santo Domingo Este), while Playa Gringo exhibited notable fluctuations, particularly with a sharp increase in 2023 (see Graphic B3).

In Fuerte San Gil, waste counts declined from 2,548 units in 2021 to around 1,054-1,057 units in 2023 and 2024. A similar trend was observed in Las Tortugas, where the waste count dropped from 2,192 units in

[1] Access to the Methodological Guide for Beach Waste Sampling published by the Ministry of Environment and Natural Resources here: https://ambiente.gob.do/wpfd_file/guia-metodologica-para-realizar-muestreos-de-residuos-solidos-en-playas-2/

2021 to 926 units in 2024. Conversely, Playa Gringo had no recorded waste in 2021, but by 2022 it reached 405 units, then surged to 2,039 units in 2023 before slightly decreasing to 1,588 units in 2024. These trends suggest that while some areas experienced gradual reductions, Playa Gringo saw an alarming increase, indicating potential shifts in waste flows or local waste disposal patterns.

6.1 Analysis per demonstration sites (beaches)

6.1.1. Playa Fuerte San Gil

At Fuerte San Gil, the most significant category of waste recorded throughout the years was foam fragments, peaking at 1,609 units in 2021 and later decreasing significantly to 460 units in 2022 (see Table C1 for reference). The presence of PET bottles, HDPE bottles, and HDPE caps also played a major role in the composition of waste, with PET bottle counts dropping from 133 in 2021 to 87 in subsequent years. Similarly, HDPE bottle counts started at 163 in 2021 but remained stable at 120 units from 2023 onwards.

The overall decline in total waste might suggest improvements in waste management or cleanup efforts in the area. However, the persistence of plastic waste, especially PET and HDPE products, highlights the ongoing challenges of plastic pollution in coastal environments.

Table C1. Waste flows identified through beach sampling in Fuerte San Gil
(Samplings done between 2021 and 2024)

Waste Categories	Years beach sampling were made			
	2021	2022	2023	2024
PP Products	0	9	0	3
Glass	0	3	2	2
Aluminum/Metal	0	4	4	4
Wood	0	0	0	0
Textiles	7	0	0	0
Tetrapak	0	11	3	3
Rubber	26	0	0	0
LDPE plastic packaging	15	4	0	0
Other HDPE products	76	74	0	0
HDPE bottles	163	309	120	120
PET bottles	133	117	87	87
HDPE caps	499	110	5	5
Footwear	0	21	20	20
PET fragments	0	47	0	0
HDPE fragments	0	0	4	4
Packaging	0	0	9	9
Foam packaging	20	0	0	0
HDPE containers	0	0	4	4
Cardboard	0	0	0	0
PP fragments	0	0	0	0
Foam fragments	1609	460	796	796
Others	0	0	0	0

6.1.2 Playa Las Tortugas

Waste composition at Playa Las Tortugas showed significant variation over the years, with plastic waste consistently dominating the samples. In 2021, foam fragments were the most prevalent category, with 1,037 units recorded, followed by HDPE caps (524 units) and PET bottles (263 units). However, these numbers significantly dropped in subsequent years, with foam fragments decreasing to 835 units in 2024 and PET bottles plummeting to just 8 units (see Table C2 for reference).

Another key observation is the presence of HDPE and LDPE packaging, which were prominent in 2021 and 2022 but were nearly absent in later years. Despite these reductions, the presence of footwear waste increased slightly in 2024, suggesting that while overall plastic waste decreased, specific categories of waste remained persistent or even grew. This variability indicates that while cleanup efforts or waste prevention strategies may have been effective in some areas, additional measures are needed to tackle ongoing pollution sources.

Table C2. Waste flows identified through beach sampling in Las Tortugas
(Samplings done between 2021 and 2024)

Waste Categories	Years beach sampling were made (Las Tortugas)			
	2021	2022	2023	2024
PP Products	1	105	0	17
Glass	4	3	0	6
Aluminum/Metal	4	4	0	0
Wood	4	0	0	0
Textiles	5	1	0	0
Tetrapak	6	5	2	0
Rubber	45	0	0	0
LDPE plastic packaging	47	64	0	0
Other HDPE products	49	0	0	23
HDPE bottles	203	8	16	0
PET bottles	263	62	150	8
HDPE caps	524	226	41	10
Footwear	0	17	12	27
PET fragments	0	0	0	0
HDPE fragments	0	88	0	0
Packaging	0	0	0	0
Foam packaging	0	0	0	0
HDPE containers	0	66	20	0
Cardboard	0	1	0	0
PP fragments	0	0	0	0
Foam fragments	1037	467	671	835
Others	0	8	8	0

6.1.3 Playa Gringo

Playa Gringo in Bajos de Haina exhibited the most dramatic changes in waste accumulation among the monitored beaches. In 2021, no waste was recorded, but by 2022, the beach had accumulated 405 waste units, which surged to 2,039 in 2023. This sudden increase could be attributed to changes in local waste disposal patterns or environmental factors affecting waste deposition (see Table C3 for reference).

Plastic waste was the most dominant category, with HDPE caps increasing from 173 units in 2022 to 451 units in 2024. PET bottles also saw a sharp rise from 0 in 2022 to 107 in 2024. One of the most concerning trends was the spike in foam fragments, which jumped from 111 units in 2022 to 1,465 in 2023 before dropping to 582 in 2024. This fluctuation highlights the challenge of managing lightweight plastic waste that can easily be transported by wind and water currents. The persistence of plastic packaging and HDPE products further reinforces the need for targeted interventions in this area.

Table C3. Waste flows identified through beach sampling in Gringo Beach
(Samplings done between 2021 and 2024)

Waste Categories	Years beach sampling were made (Gringo Beach)			
	2021	2022	2023	2024
PP Products	0	38	108	94
Glass	0	0	7	6
Aluminum/Metal	0	2	0	12
Wood	0	0	0	1
Textiles	0	0	0	4
Tetrapak	0	0	3	3
Rubber	0	0	0	1
LDPE plastic packaging	0	4	0	0
Other HDPE products	0	75	36	158
HDPE bottles	0	2	10	41
PET bottles	0	0	38	107
HDPE caps	0	173	201	451
Footwear	0	0	92	32
PET fragments	0	0	0	0
HDPE fragments	0	0	36	68
Packaging	0	0	35	28
Foam packaging	0	0	0	0
HDPE containers	0	0	0	0
Cardboard	0	0	0	0
PP fragments	0	0	8	0
Foam fragments	0	111	1465	582
Others	0	0	0	0

6.2 Comparative analysis between beaches

When comparing the waste flows and trends across the three demonstration sites, it is evident that plastic waste remains the predominant type of pollution in all locations, with styrofoam fragments, PET bottles, and HDPE caps being among the most frequently detected items. Fuerte San Gil and Las Tortugas exhibited gradual reductions in total waste counts, while Playa Gringo experienced a sharp increase, particularly in 2023.

Styrofoam fragments, which were the highest recorded waste category across all three beaches, showed different patterns: they steadily declined in Fuerte San Gil and Las Tortugas but spiked dramatically in Playa Gringo in 2023. PET bottles and HDPE caps followed a similar pattern, decreasing in Fuerte San Gil and Las Tortugas while increasing significantly in Playa Gringo. This suggests that while waste management efforts may be improving in some areas, new pollution hotspots are emerging, potentially due to shifts in waste disposal practices or external factors like ocean currents and urban waste leaks.

The data also highlights the persistence of plastic packaging waste, with LDPE and HDPE products consistently appearing in significant quantities. Despite some progress in waste reduction, the continued presence of these materials underscores the need for enhanced recycling, waste interception strategies, and stricter waste management policies to mitigate marine plastic pollution.

6.3 Fluctuations in total waste and key categories (2021-2024)

The waste flow evolution between 2021 and 2024 shows significant fluctuations in the quantity and composition of intercepted waste during the beach sampling exercises. The initial sampling in 2021 recorded high waste accumulation, particularly in foam fragments (1,609 units), HDPE caps (499 units), and HDPE and PET bottles (163 and 133 units, respectively). However, by 2022, there was a marked reduction in foam fragments (460 units), while HDPE bottles more than doubled (309 units), suggesting shifts in the type of waste accumulating in monitored beaches (see Table C4 for reference).

Table C4. Quantity of waste (by units) collected each year through beach samplings in all beaches

Waste Categories	Beach Samplings through the years (all beaches)			
	2021	2022	2023	2024
PP Products	0	9	0	3
Glass	0	3	2	2
Aluminum/Metal	0	4	4	4
Wood	0	0	0	0
Textiles	7	0	0	0
Tetrapak	0	11	3	3
Rubber	26	0	0	0
LDPE plastic packaging	15	4	0	0
Other HDPE products	76	74	0	0
HDPE bottles	163	309	120	120
PET bottles	133	117	87	87
HDPE caps	499	110	5	5
Footwear	0	21	20	20

PET fragments	0	47	0	0
HDPE fragments	0	0	4	4
Packaging	0	0	9	9
Foam packaging	20	0	0	0
HDPE containers	0	0	4	4
Cardboard	0	0	0	0
PP fragments	0	0	0	0
Foam fragments	1609	460	796	796
Others	0	0	0	0

Decline in certain waste categories: From 2021 to 2024, some waste types, such as textiles, rubber, and LDPE plastic packaging, disappeared almost entirely from the samples. For instance, rubber waste (26 units in 2021) was not recorded in later years, and textile waste, initially present in 2021, was absent thereafter. This could be attributed to changes in local waste disposal behaviors, shifts in ocean currents, or cleanup interventions. Similarly, HDPE caps, which accounted for 499 units in 2021, declined drastically to only 5 units by 2023 and remained constant in 2024.

Variability in plastic bottles and fragmented plastic waste: HDPE and PET bottles followed a fluctuating trend. HDPE bottles peaked at 309 units in 2022 but dropped to 120 units in 2023 and 2024. PET bottles, while steadily decreasing (from 133 in 2021 to 87 in 2023-2024), remained a consistent presence in the waste flow, highlighting the challenge of tackling plastic beverage container pollution. Meanwhile, foam fragments saw significant reductions in 2022 (460 units) but surged again in 2023 (796 units), stabilizing in 2024, reflecting the persistent presence of foam-based products in the marine environment.

Emerging waste categories and their implications: Certain waste types appeared sporadically across the years, such as fragmented plastics and packaging materials. For instance, PET fragments were recorded in 2022 (47 units) but disappeared in 2023-2024, whereas fragmented HDPE emerged in 2023 (4 units) and remained stable in 2024. The appearance of packaging waste (9 units in 2023) and HDPE containers (4 units in 2023-2024) suggests shifting consumer habits or changes in waste collection efficiency. These trends underscore the need for targeted interventions to prevent packaging-related litter.

The analysis indicates that while total waste quantities have generally declined in some categories, others, particularly plastics, remain persistent. The disappearance of certain waste types could be due to increased awareness and improved waste management practices, while fluctuations in foam and plastic bottle waste suggest ongoing challenges in waste prevention. These findings highlight the importance of continuous monitoring, policy enforcement, and strategic interventions, such as extended producer responsibility (EPR) measures and improved waste collection systems, to reduce marine litter more effectively.

7 Conclusion

The PROMAR project, funded by the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), aims to reduce plastic pollution in the Caribbean Sea through a multifaceted approach encompassing waste stream monitoring, circular economy solutions, awareness-raising, and policy promotion. This report presented a comprehensive overview of the project's methodologies and findings, highlighting the pilots developed to intercept waste and prevent marine litter.

Back in 2022, the two main methodologies were employed in the Dominican Republic to establish a baseline and monitor progress:

- **Waste Flow Diagram (WFD):** This tool maps and visualizes municipal solid waste management system material flows to quantify waste leakage into the environment. It involves steps such as delimiting the geographical context, collecting data, quantifying plastic waste leaks, and analyzing results.
- **Methodological Guide for Sampling Solid Waste on Beaches:** This method focuses on systematic collection and analysis of beach waste to understand its quantity, type, and origin. This method helps identify pollution sources and formulate prevention strategies.

For the purposes of the baseline study conducted in 2022, the waste sampling in beaches covered three main locations in the Dominican Republic: Playa del Fuerte San Gil, Playa Las Tortugas, and Playa Gringo, as well as the whole municipality of Santo Domingo Este using the methodology of the Waste Flow Diagram. Some of the main results of this baseline were:

(a) **Playa del Fuerte San Gil:** styrofoam (44.5%) and plastic waste (52.43%) were the most predominant waste found in this beach.
(b) **Playa Las Tortugas:** Foam fragments (77.1%) and various types of plastics dominated the waste found in this beach..
(c) **Playa Gringo:** Foam fragments (73.2%) and plastics (23%) were the major waste types found in this beach.

Additionally, for this baseline study, the use of **Clean-Coast index (CCI)** allowed us to compare the pollution levels at these beaches, where **all of them were categorized as "Very Dirty" beaches**. Playa Las Tortugas had the highest waste concentration per square meter (CCI = 704.8 plastic units/m2), followed by Playa Gringo (CCI = 534 plastic units/m2) and Playa del Fuerte San Gil (CCI = 433.8 plastic units/m2).

On another hand, the WFD for Santo Domingo Este revealed **significant plastic waste generation in that city, with 72,738 tons entering the municipal solid waste system annually**. The baseline indicated that **around 11.40% of the whole plastic generation in the city leakages to water bodies** (small canals, Ozama River and the Caribbean Sea), while substantial amounts leaked into the environment during collection and disposal processes.

The **PROMAR project recognized that addressing the issue of marine litter in the Dominican Republic required practical, on-the-ground solutions tailored to the specific contexts of each region involved**. Therefore, pilot interventions were developed as a crucial component of the project. These pilots serve multiple purposes:

1. **Demonstration of practical solutions:** Pilots are designed to show how theoretical concepts and strategies can be effectively applied in real-world settings.
2. **Localized impact:** Each pilot intervention targets specific problem areas identified through the project's baseline assessments and monitoring activities.
3. **Scalability and replicability:** Successful pilot projects provide a model that can be scaled up and replicated in other regions.
4. **Community engagement and education:** Pilots serve as a platform for engaging local communities and stakeholders. They provide opportunities for education and awareness-raising about the importance of waste management and environmental protection.
5. **Policy and strategic development:** The data and outcomes from pilot interventions provide evidence-based results that can inform policy and strategy development at local, national, and regional levels.

Taking into consideration those approaches, the following pilots interventions were developed in the Dominican Republic as a way to prevent marine litter in the Caribbean Sea:

- **Blue Stations:** These are community spaces using modular structures for waste collection, classification, and education. Established in Santo Domingo Este, **the stations have intercepted approximately 157,630 kg of plastic waste**, preventing 11.40% from reaching water bodies. The stations also facilitated community engagement and awareness in two different locations in Santo Domingo Este (Villa Duarte - Estación Azul Ozama and Los Frailes - Estación Azul Caribe). Also, 52% of the community impacted by the stations reported to experience less local floodings when heavy rains happen, due to the interception of plastic before it reaches the public city scuppers.
- **RiverBoom:** Initially planned for the Haina River, it was relocated to the Yaque del Norte River due to land property issues. This floating barrier intercepts floating waste in the river, preventing it from reaching the sea and so far, it has intercepted around 170,480.00 kg, out of which 73,447.10 kg is plastic waste.

The project faced challenges in applying the initial methodologies used in the baseline study to demonstrate reductions at sampling sites due to:

01. The scale of Santo Domingo Este city being too large for these methodologies to capture meaningful data coming from pilots that were only applied in specific sectors and communities from the city.
02. Seasonal patterns and rainfall affecting waste flow and introducing variability.
03. The methodologies not being suited to capture localized impacts and co-benefits generated by the pilot interventions.
04. Resource-intensive nature of comprehensive waste flow diagrams and beach sampling.

Overall, while the project made significant strides in plastic waste interception and community involvement, the methodologies used presented limitations in fully capturing the impact on waste reduction at the sampling sites.

After developing beach sampling for the last four years, the observed changes in waste flows, particularly plastic waste, reaching the beaches of Fuerte San Gil and Playa Las Tortugas suggest variations in the composition and quantity of marine debris over the years. However, it is not possible to directly attribute these changes to the implementation of selective waste collection mechanisms, such as the Blue Stations developed by Parley for the Oceans between 2022 and 2024 under the PROMAR project in Santo Domingo Este. While these initiatives may contribute to waste interception and improved coastal cleanliness, multiple environmental and anthropogenic variables—such as ocean currents, seasonal variations, urban waste disposal patterns, and informal waste collection—also influence the quantity and type of waste that accumulates on these beaches.

Nevertheless, the impact of waste collection efforts, particularly through the Blue Stations, is evident in the broader context of ecosystem conservation. By intercepting waste before it reaches coastal and marine environments, these initiatives help reduce the exposure of marine biodiversity to plastic pollution, contributing to healthier ecosystems. While further studies are needed to assess the long-term effects of selective collection on waste reduction in monitored beaches, the role of such interventions remains crucial in mitigating the adverse impacts of plastic pollution and fostering sustainable waste management practices.

In summary, the development of pilot interventions within the PROMAR project is driven by the need to apply theoretical strategies in practical settings, achieve localized impacts, engage communities, and create scalable models that can inform broader policy and strategic initiatives. The Blue Stations and the RiverBoom are essential for demonstrating the effectiveness of proposed solutions and for gathering the necessary data to support long-term, sustainable changes in waste management practices across the Caribbean region.