PROMISE
PREVENTION OF MARINE LITTER IN THE LAKSHADWEEP SEA

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Combined report on Material Flow Analysis and Source to Sink activities in Maldives

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List of Abbreviations:

MFA	Material Flow Analysis
MNU	Maldives National University
NA	Not Applicable
NGOs	Non-Government Organisation
PET	Polyethylene Terephthalate
SMEs	Small and Medium-sized Enterprises
SOPs	Standard Operating Procedures
S2S	Sources to Sinks
WAMCO	Waste Management Corporation
WM	Waste Management

1. Executive Summary

The "Prevention of Marine Litter in the Lakshadweep Sea (PROMISE)" project, led by adelphi Research gGmbH and STENUM Asia, addresses the pressing issue of marine litter across the Maldives, Sri Lanka, and India. Utilizing a holistic Material Flow Analysis (MFA) and the innovative "Sources to Sinks" (S2S) methodology, the project aims to understand waste generation dynamics, particularly in the tourism sector, and their impact on marine ecosystems.

Engaging local authorities, NGOs, and SMEs, the project developed and tested methodologies for measuring marine litter. Initial assessments at Paruvar Beach, India, in November 2021, expanded to Sri Lanka and the Maldives throughout 2022. In May 2023, a focused study on Maafushi Island revealed significant plastic waste accumulation, with plastics accounting for over 54% of total debris by item count and 26% by weight. This underscores the urgent need for improved waste management practices.

Key findings indicate that tourism-related activities, such as hotels, guesthouses, and water sports, are a key source of waste, contributing significantly during peak tourist seasons. Current waste management practices are inadequate, with significant gaps in segregation, collection, and disposal. This inefficiency is compounded by limited formal waste collection services and reliance on informal collectors.

The S2S methodology, piloted in Maafushi, provided valuable insights into waste pathways. It involved detailed assessments of 9 hotels and 8 guesthouses, correlating waste generation with guest numbers to enhance precision in waste management efforts. For instance, plastic bottles alone accounted for 11.8% of the total waste in hotels, highlighting the need for targeted waste reduction strategies. The project also emphasized the impact of seasonal variations and tourist influxes, necessitating adaptive management strategies.

Recommendations include enhancing waste management infrastructure, implementing stricter regulatory measures, promoting public awareness, and fostering partnerships with local stakeholders to encourage sustainable practices. By addressing these challenges, the PROMISE project aims to significantly reduce the inflow of plastic waste into the Lakshadweep Sea, contributing to marine biodiversity conservation and sustainable tourism in the region.

Overall, the PROMISE project underscores the critical need for integrated, community-centric approaches to environmental conservation, leveraging local knowledge and stakeholder collaboration to create impactful solutions for a sustainable and equitable future.

2. Overview of the activities

To establish a knowledge base for the status quo of marine litter along the shorelines of Lakshadweep Sea, an MFA of plastic waste entering into Lakshadweep Sea from selected project locations needed to be carried out. The MFA consisted of the following key data collection activities:

- Manual sampling of waste from beaches
- Interviews with focus groups to receive data

The PROMISE's MFA project team, composed of adelphi Research gGmbH and STENUM Asia, developed a data collection methodology in June 2021. The methodology was tested in India (Paruvar beach) first in November 2021 and then in Sri Lanka and Maldives in 2022. Based on the experience and findings from the first MFA pilots in India, Sri Lanka and the Maldives, the PROMISE team has revised and updated the methodology. For the second pilot MFA in Maldives, the Maldives National University (MNU) and Parley for the Oceans Maldives (Parley) team identified a section of the Water sports beach, in Kaafu Maafushi (3° 56' 41.2218"" N, 73° 29' 25.5186""E). The activities were conducted between the 3rd and the 8th of May 2023, with the sampling activities carried out on the 4th of May. There was heavy rain and wind present on the date of beach sampling.

The designated beach of approx. 100-meter length is shown in the figure below.

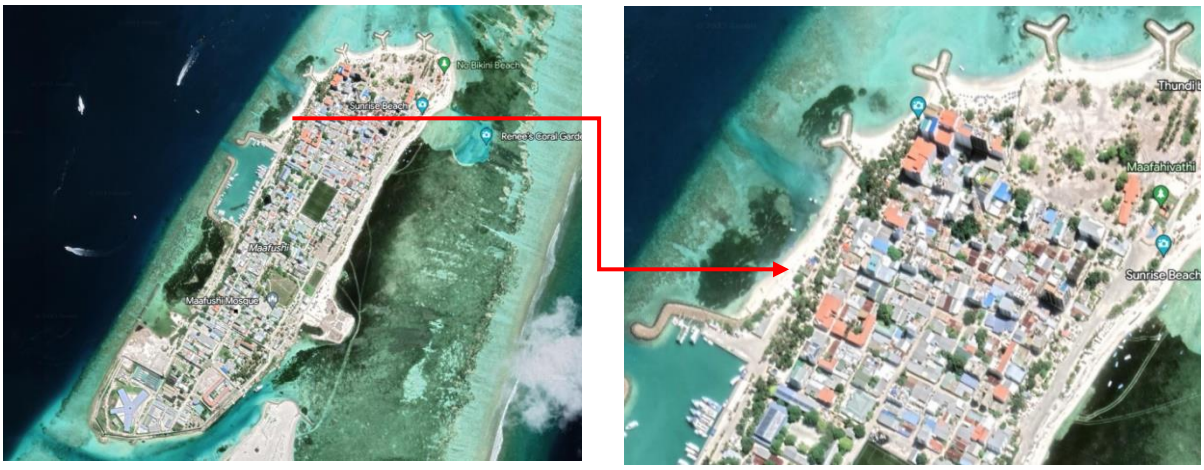

Figure 1: Satellite image of beach selected in Maafushi for Material Flow Analysis

3. Methodology

As a first step, the selected beach area was divided into segments of 10m each by the team. Then, the team members walked through each of the segments and classified them into three different categories based on visual inspection of the litter/ pollution present in that segment. The three segments were classified as follows:

1. High pollution segment

2. Medium pollution segment

3. Low pollution segment

After classification the team picked one of the 10m segments from each category and marked it for manual sampling. This was followed by manual collection and analysis of the plastic litters in the three selected segments. The data collected during the analysis was then used to estimate the total level of pollution for the entire beach.

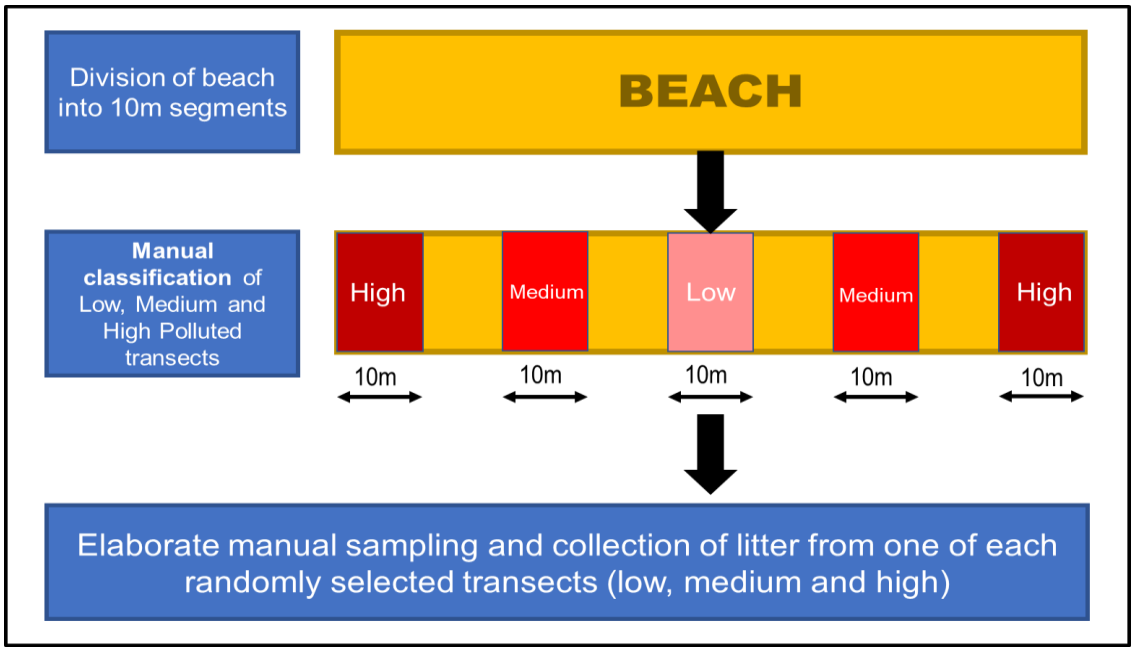

Figure 2: Data Collection Methodology

4. Manual Beach Sampling

On May 4, 2023, the PROMISE Team, consisting of experts from MNU and Parley, conducted an inspection of Maafushi's Water Sports Beach using the above specified methodology. They divided the beach into 10-meter segments for a thorough visual assessment. Each segment was then classified into one of three categories based on pollution levels: highly polluted, moderately polluted, and low pollution. Of the 10 segments evaluated, 2 were identified as highly polluted, 3 as moderately polluted, and 5 as low pollution areas. Subsequently, one segment from each category was randomly selected and marked with signal tape, each measuring approximately 10 meters in length and width. Below are some photos showcasing the preparation for the manual beach sampling activity.

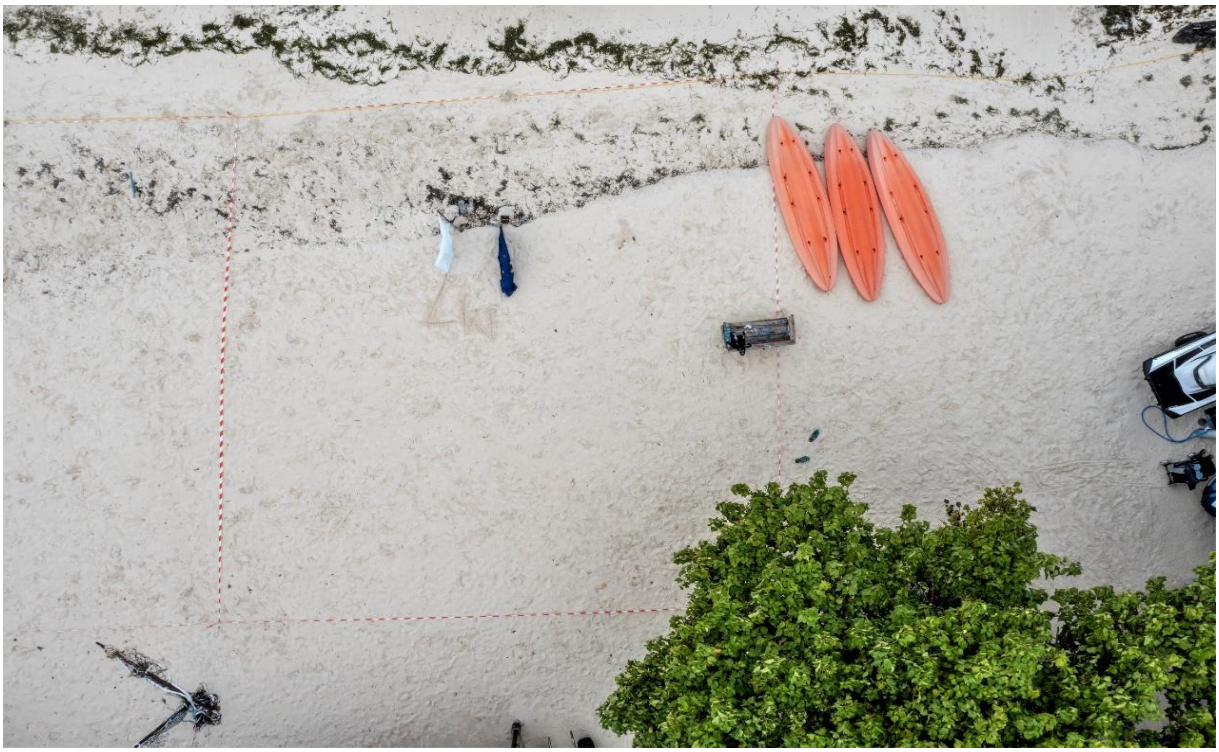

Figure 3: Beach Segment Marked for Sampling

Figure 4: Marking and sampling a section of the beach

Figure 5: Plastic waste present on Maafushi's dump site

Figure 6: Litter present on the beach sampled

The team then started the manual collection of all the litter present in each segment in the following order:

1. High pollution segment
2. Medium pollution segment
3. Low pollution segment

The litter collected from each of the three segments was placed in plastic bags which were labelled accordingly. Then the waste collected was categorized based on its nature and use (i.e. plastic bottles, cigarette buts, paper, cardboard, etc.). Once the segregation was concluded the different groups of items were counted and weighted.

Figure 7: Segregation of waste collected from the beach

5. Data collected

The analysis of material distribution in the high polluted segment reveals that plastic is the most prevalent material, accounting for 55.1% of the total number of items and 18% of the total weight (Table 1). The most common plastic items found were plastic fragments (loose) and Styrofoam packaging fragments. Glass and ceramics constituted a smaller portion in terms of the number of items (2 items), but their weight contribution was significant, making up 11.5% of the total weight due to whole glass bottles.

Metals represented 6.6% of the items and 10.3% of the total weight, with aluminum cans being the most common metal item. Paper and cardboard items were also found in substantial quantities, constituting 18.4% of the items and 32.7% of the total weight.

Table 1: Items collected in the high pollution segment

Material	Article	Quantity (n. items)		%	Weight (grams)		%
Plastic	Plastic fragments (loose)	141	267	55.1%	12.32	802.17	18.0%
	Plastic fragments (hard)	20			58.74		
	Beverage bottles (PET)	1			27.85		
	Other PET bottles (water)	7			200.05		
	Plastic bottle caps & rings	11			18.73		
	General plastic caps	1			0.84		
	Disposable cutlery (plastic)	1			0.86		
	Disposable cups (plastic)	2			6.96		
	Plastic wrapping and packaging & bags	30			29		
	Plastic bags (biodegradable)	18			72.25		
	Foams	4			0.16		
	Ethylene vinyl acetate (EVA - foam)	2			92.89		
	Sponges	4			8.3		
	Nylon ropes	2			1.5		
	Jute bags	1			61.45		
	Multi-layered plastic packaging	4			0.22		
	PVC rope	4			9.29		
	Plastic Buoy (soft)	2			3.44		
	Plastic Buoy (hard)	1			16.63		
	Black plastic bag	1			87.21		
	Plastic wrapping and packaging & bags (foiled)	4			2.05		
	Other PET bottles (colored)	2			78.69		
	Disposable cups fragment (plastic)	1			0.68		
	Disposable cups cap (plastic)	1			4.3		
	Fibre (plastic hard)	1			6.85		
	Plastic sachets (butter) (single-use)	1			0.91		
Styrofoam	Styrofoam packaging fragments (granulated or laminated)	18	24	4.9	43.44	44.47	1.0%
	Styrofoam packaging colored - small (granulated or laminated)	6			1.03		
Textiles	Clothing	2	5	1.0%	26.42	77.14	1.7%
	Yarn	1			16.99		
	Jute Rope	2			33.73		
Glass and Ceramics	Whole glass bottles (wine)	1	1	0.2%	509.75	509.75	11.5%
Metals	Aluminum cans (beverages)	2	32	6.6%	47.11	458.56	10.3%
	Aluminum foil	16			27.63		
	Stay on Tab (cans)	1			0.72		

	Crown cork metal caps for bottle and cans	1			5.28		
	Metal fragments (rusted & undefined)	12			377.82		
Paper and Cardboard	Disposable cups (paper or cardboard)	2	89	18.4	15.94	1451.79	32.7%
	Fragments of cardboard	87			1435.85		
Rubber	Balloons	11	17	3.5%	14.99	297.52	6.7%
	Flip-flops	1			277.26		
	BANDS	3			0.01		
	Elastic	1			0.23		
	Swimming Goggle rubber	1			3.74		
Wood	Undefined wood fragments	10	14	2.9%	9.01	18.63	0.4%
	Cutlery	3			4.44		
	Cork	1			5.18		
Polylaminates	Metallized snack packaging	4	10	2.1%	30.2	41.17	0.9%
	Other metallized packaging	6			10.97		
Others	Lighters	1	26	5.4%	10	743.07	16.7%
	Diapers	1			124.97		
	Cigarette packs	5			30.52		
	Pen cap	1			2.55		
	Plastic tape	7			23.14		
	Plastic lined paper	1			2.28		
	Plastic ribbon (gift)	1			0.48		
	Nylon fishing ropes	5			2.01		
	PVC paddle	1			519.4		
	Plastic container (colored)	2			26.84		
	Microfibre	1			0.88		
		485		100%	4444.27		100%

Figure 8: Plastic fragments seized from waste

Figure 9: PET Bottles found in the segment

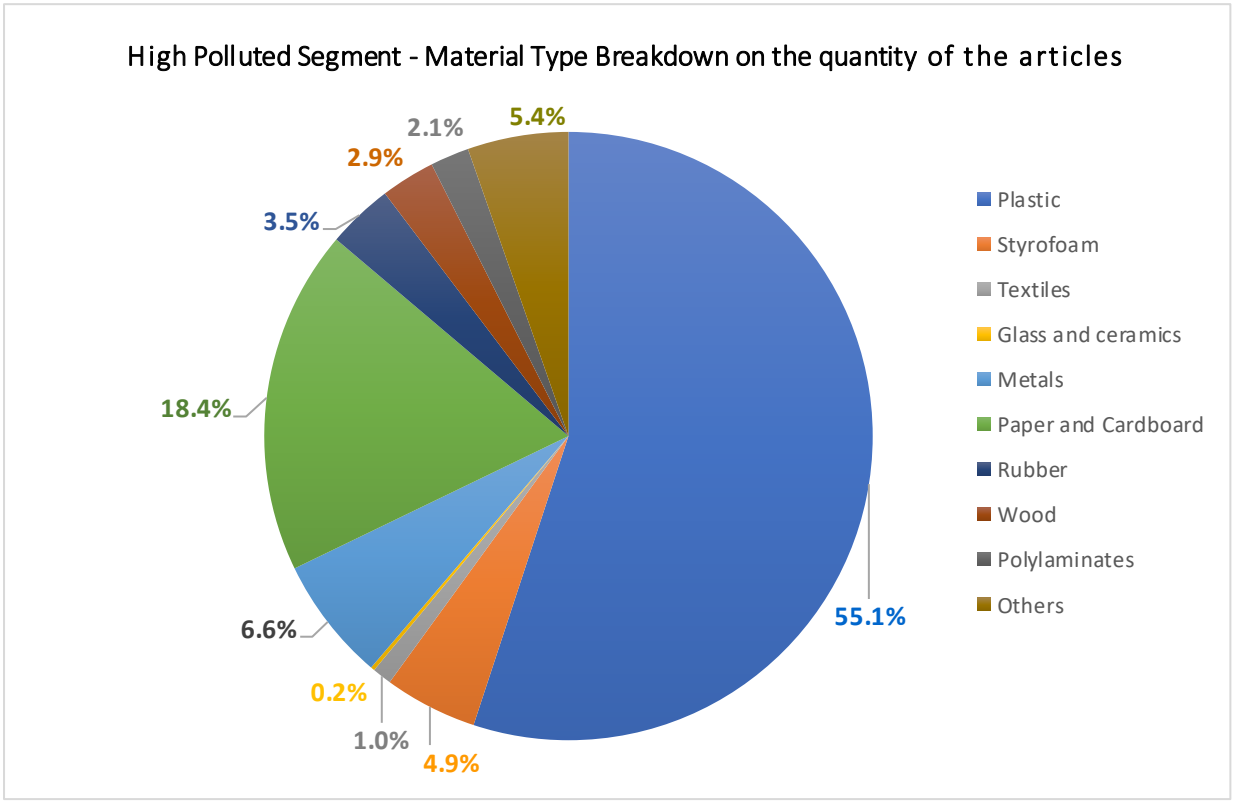

Figure 10: High Pollution segment – Material Type Breakdown

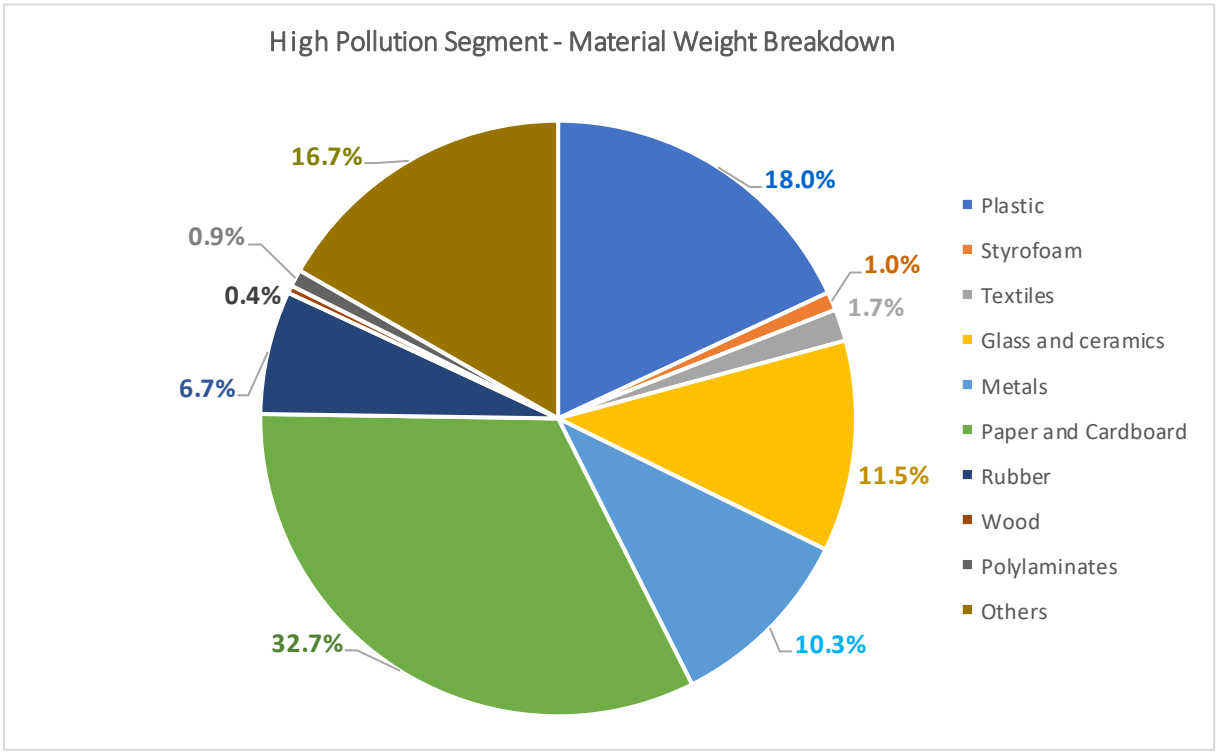

Figure 11: High Pollution segment - Material Weight Breakdown

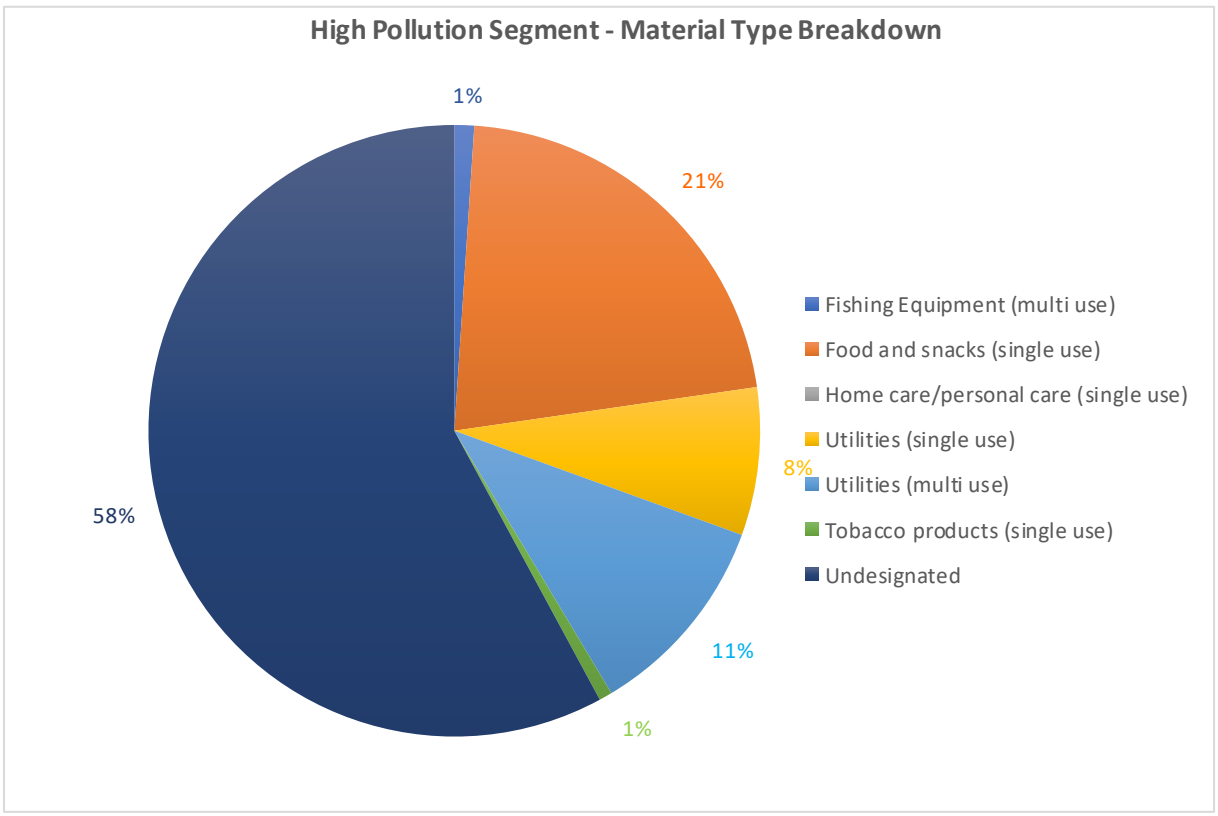

Figure 12: High Pollution segment – Source of Waste Breakdown

The analysis of the material distribution in the medium polluted segment (Table 2) shows that plastic is the most prevalent material, accounting for 59.1% of the total number of items and 84.5% of the total weight. Among plastic items, plastic fragments (loose) constitute the majority, while hard plastic fragments and various plastic bottles and caps were also present.

Styrofoam is the second most common material, representing 11.4% of the items and 3.4% of the total weight. Styrofoam packaging fragments were the primary form found.

Metals, paper and cardboard, wood, and polylaminates constituted smaller proportions, with stay-on tabs and cigarette butts being the most common metal and paper items, respectively.

Table 2: Items collected in the medium-pollution segment

Material	Article	Quantity (n. items)		%	Weight (grams)		%
Plastic	Plastic fragments (loose)	6	26	59.1%	1.09	150.21	84.5%
	Plastic fragments (hard)	7			9.36		
	Beverage bottles (PET) - water	2			61.43		
	Other PET bottles	1			51.51		
	Plastic bottle caps & rings	1			2.26		
	Plastic wrapping and packaging & bags	4			6.6		
	Plastic bags (colored)	1			3.84		
	Straws	1			1.51		
	Coffee capsule plastic (filled)	1			6.39		
	Plastic bubble wrap	1			2.12		
	Toys	1			4.1		
Styrofoam	Styrofoam packaging fragments (granulated or laminated)	3	5	11.4%	2.9	6.06	3.4%
	Fragments of food container (smooth Styrofoam)	2			3.16		
Metals	Stay on Tab (cans)	1	1	2.3%	2.12	2.12	1.2%
Paper and Cardboard	Cigarette butts	3	8	18.2%	0.79	4.24	2.4%
	Fragments of paper and documents	1			1.2		
	Napkins	1			0.88		
	Cigarette packs	3			1.37		
Wood	Cuttlery	1	1	2.3%	3.33	3.33	1.9%
Polylaminates	Tetra pack	1	2	4.5%	11.32	11.47	6.5%
	Other metallized packaging	1			0.15		
Others	Fragments of food container (smooth Styrofoam)	1	1	2.3%	0.26	0.26	0.1%
		44		100%	177.69		100%

Figure 13: Bottle caps found in the segment

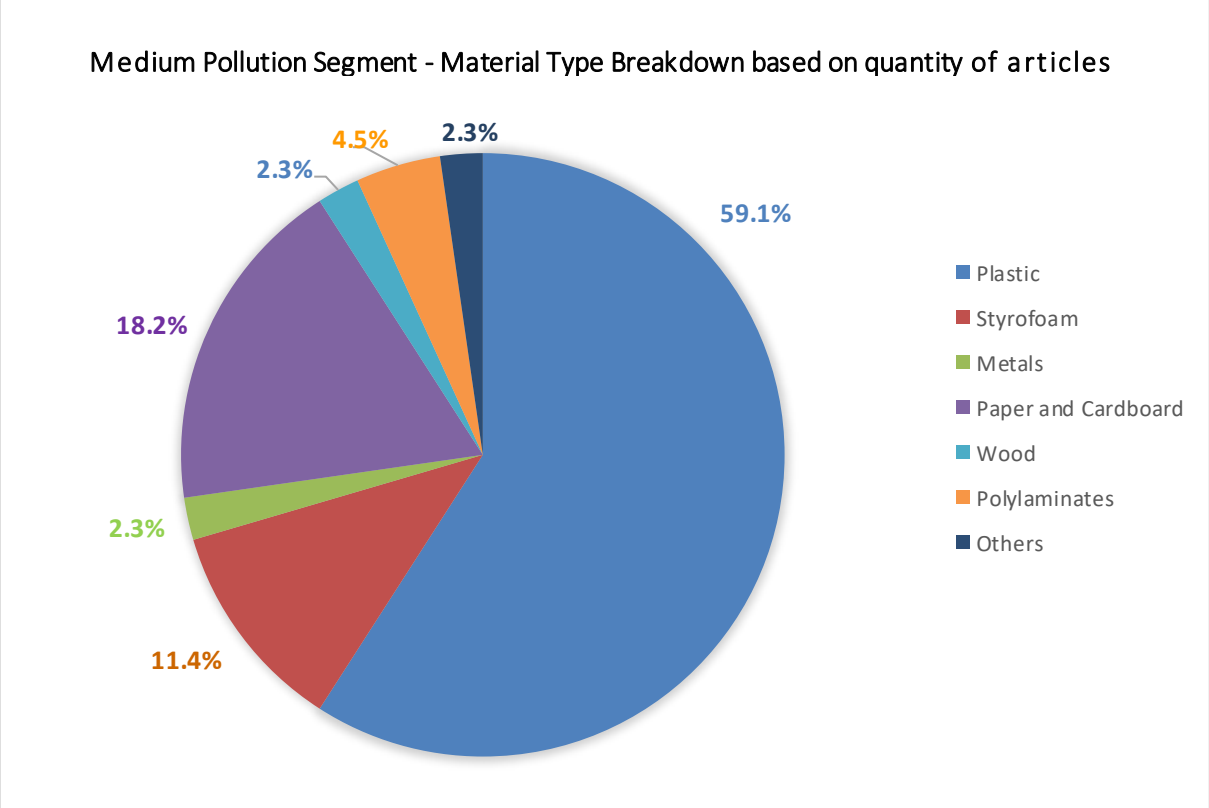

Figure 14: Medium Pollution Segment - Material Type Breakdown

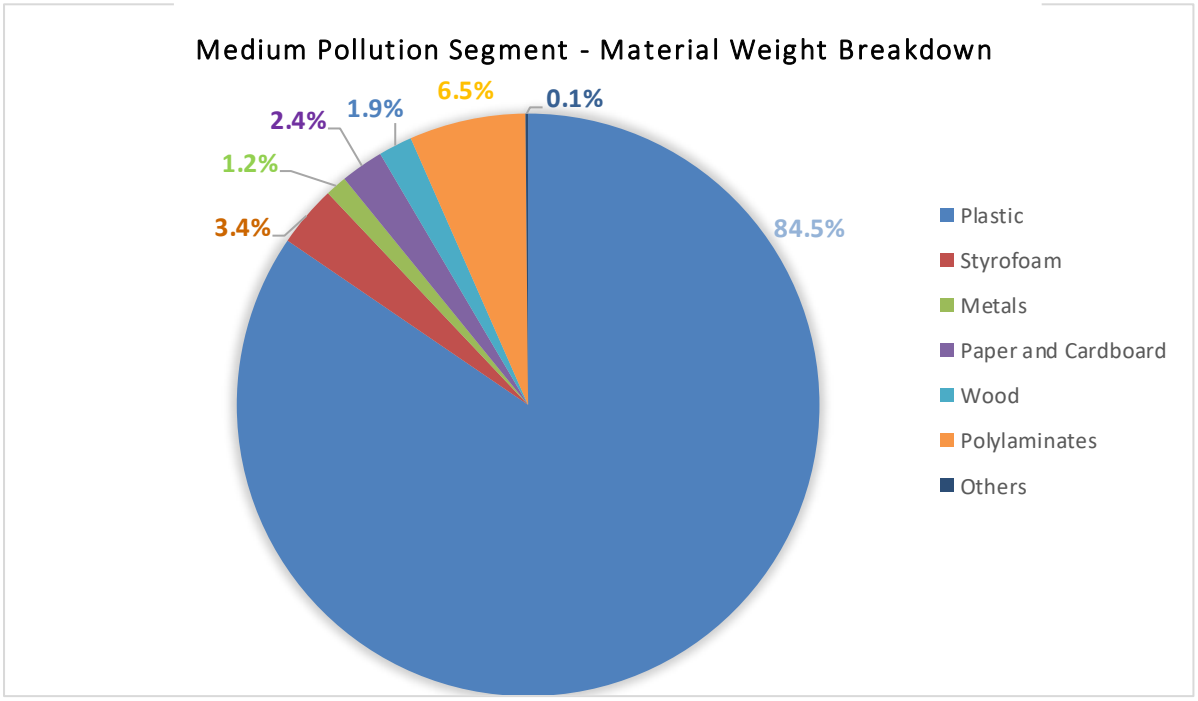

Figure 15: Medium Pollution Segment – Material Weight Breakdown

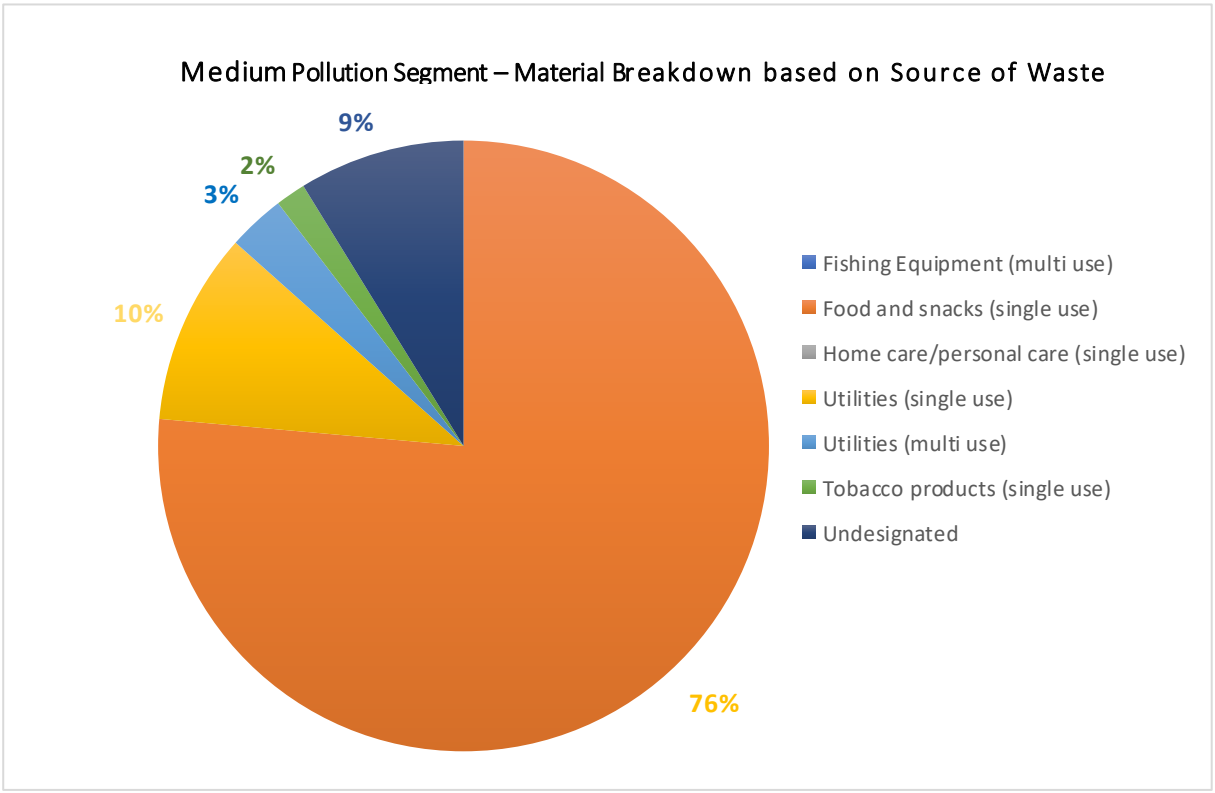

Figure 16: Medium Pollution Segment – Source of waste Breakdown

The analysis of material distribution in the low pollution segment shows that plastic is the most prevalent material, accounting for 49.2% of the total number of items and 74.8% of the total weight. The most common plastic items found were loose plastic fragments and hard plastic fragments, with plastic bottle caps, wrapping, and nylon ropes also present. Styrofoam follows, representing 23.7% of the items and 2.1% of the total weight, primarily in the form of granulated or laminated Styrofoam packaging fragments.

Other materials, including textiles, metals, paper, wood, and polylaminates, constitute smaller proportions of the total items and weight. Notably, PVC pipes, jute ropes, undefined wood fragments, and fragments of carton were identified among these materials.

Table 3: Items collected in the low-pollution segment

Material	Article	Quantity (n. items)		%	Weight (grams)		%
Plastic	Plastic fragments (loose)	4	29	49.2%	1.97	126.52	74.8%
	Plastic fragments (hard)	11			4.95		
	Plastic bottle caps & rings	1			1.36		
	Pharmaceutical packaging, medicine and ointments (plastic)	1			0.21		
	Plastic wrapping and packaging & bags	6			7.22		
	Straws	1			0.71		
	Nylon ropes	4			0.15		
	PVC pipe	1			109.95		
Styrofoam	Styrofoam packaging fragments (granulated or laminated)	11	14	23.7%	2.64	3.49	2.1%
	Fragments of food container (smooth Styrofoam)	2			0.46		
	Foam paper fragments	1			0.39		
Textiles	Jute Rope	2	3	5.1%	1.43	1.85	1.1%
	Elastic	1			0.42		
Metals	Stay on Tab (cans)	1	1	1.7%	0.31	0.31	0.2%
Paper and Cardboard	Fragments of carton	1	4	6.8%	5.79	6.78	4.0%
	Napkins	2			0.27		
	Multi-layered paper packaging	1			0.72		
Wood	Undefined wood fragments	2	2	3.4%	20.19	20.19	11.9%
Polylaminates	Metallized snack packaging	2	3	5.1%	1.78	1.89	1.1%
	Metallized snack packaging fragments (butter)	1			0.11		
Others	Candle	1	3	5.1%	8.1	8.1	4.8%
	Laminated foil party décor	1			0.01		
	Fishing line nylon fragment	1			0.01		
		59		100%	169.13		100%

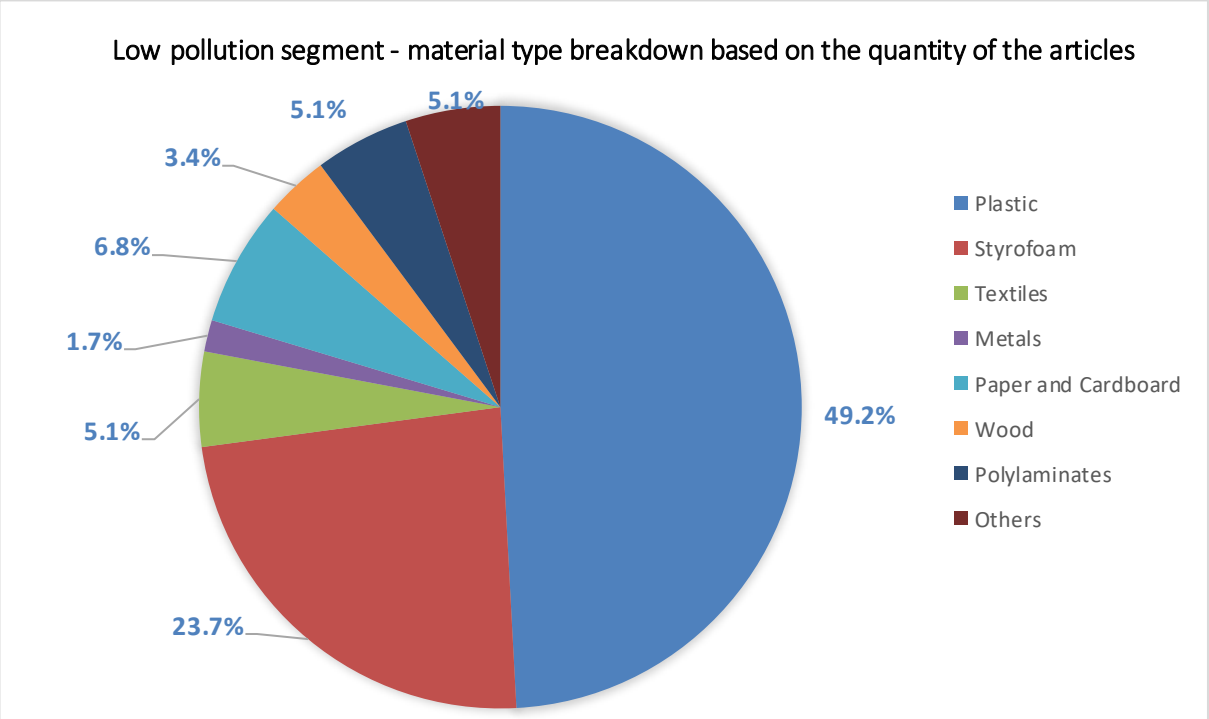

Figure 17: Low Pollution Segment – Material Type Breakdown

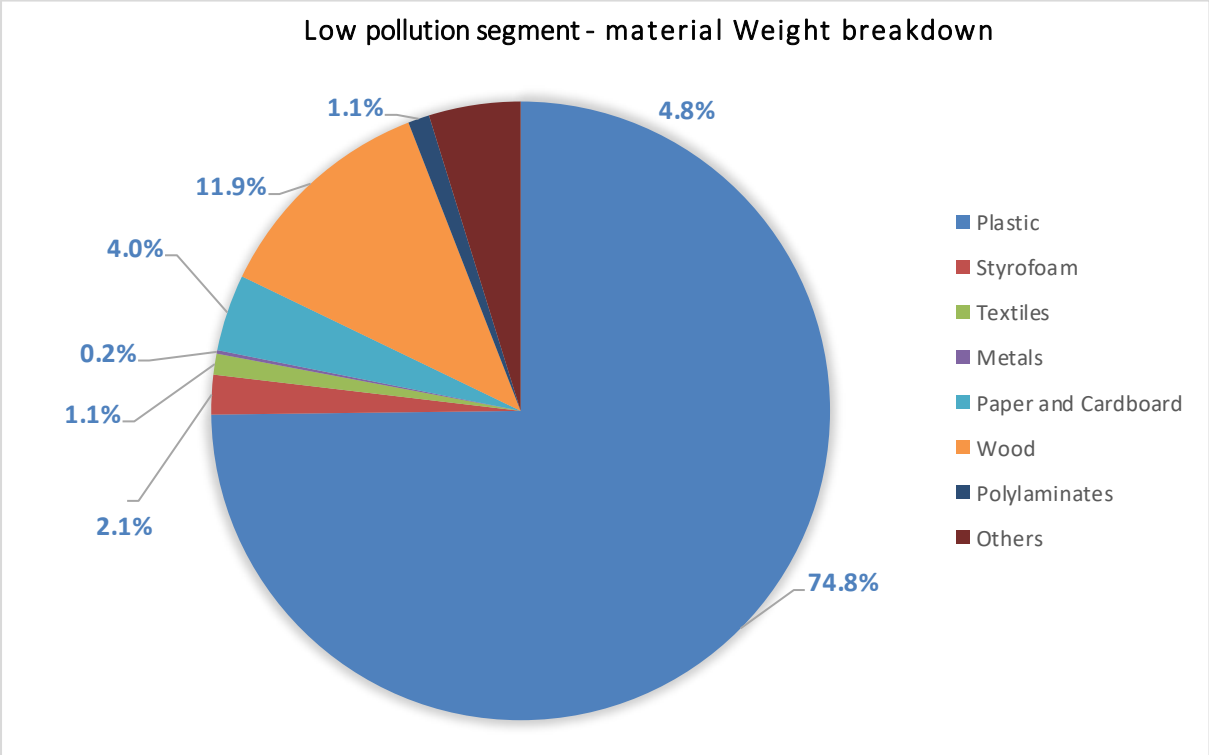

Figure 18: Low Pollution Segment – Material Weight Breakdown

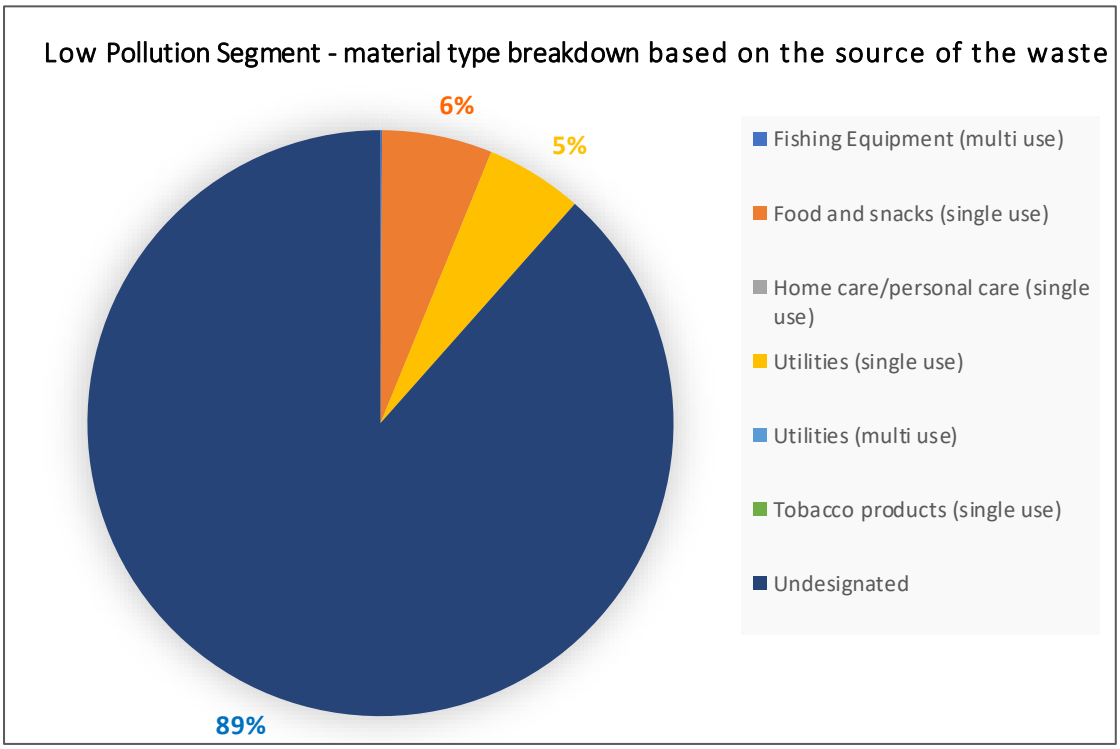

Figure 19: Low Pollution Segment – Source of waste Breakdown

Data elaboration

Of the 10 segments identified during the visual inspection, 2 were classified as highly polluted, 3 as medium, and 5 as lowly polluted.

Assuming that each type of segment has the same pollution characteristics in terms of the number and weight of items, the team identified how many of each type are present on the beach and applied the data to the total number of segments for each type. So, it is possible to extrapolate figures regarding the pollution present in the selected 100 meters of the beach. The table below shows the estimated number and weight of the items present in the designated area of Maafushi beach.

Table 4: extrapolation of items number and weight for Maafushi beach

Material	Total number of items	% of number items	Total weight of the items (g)	% of the items weight
Plastic	757	54%	2,684	26%
Styrofoam	133	10%	121	1%
Glass and ceramics	2	0%	1,018	10%
Metals	72	5%	927	9%
Paper and Cardboard	222	16%	2,949	29%
Rubber	34	2%	594	6%
Polylaminates	41	3%	125	1%
Others	136	10%	1,838	18%
Total	**1,397**	**100%**	**10,256**	**100%**

The analysis of the materials from the three segments reveals that plastic is the most prevalent material, accounting for 54% of the total number of items and 26% of the total weight present on the beach. Paper and cardboard follow with 16% of the items and 29% of the weight, while metals and rubber account for 5% and 2% of the items, respectively. Glass and ceramics, polylaminates, and Styrofoam are present in smaller quantities, comprising less than 10% each in terms of the number of items and total weight.

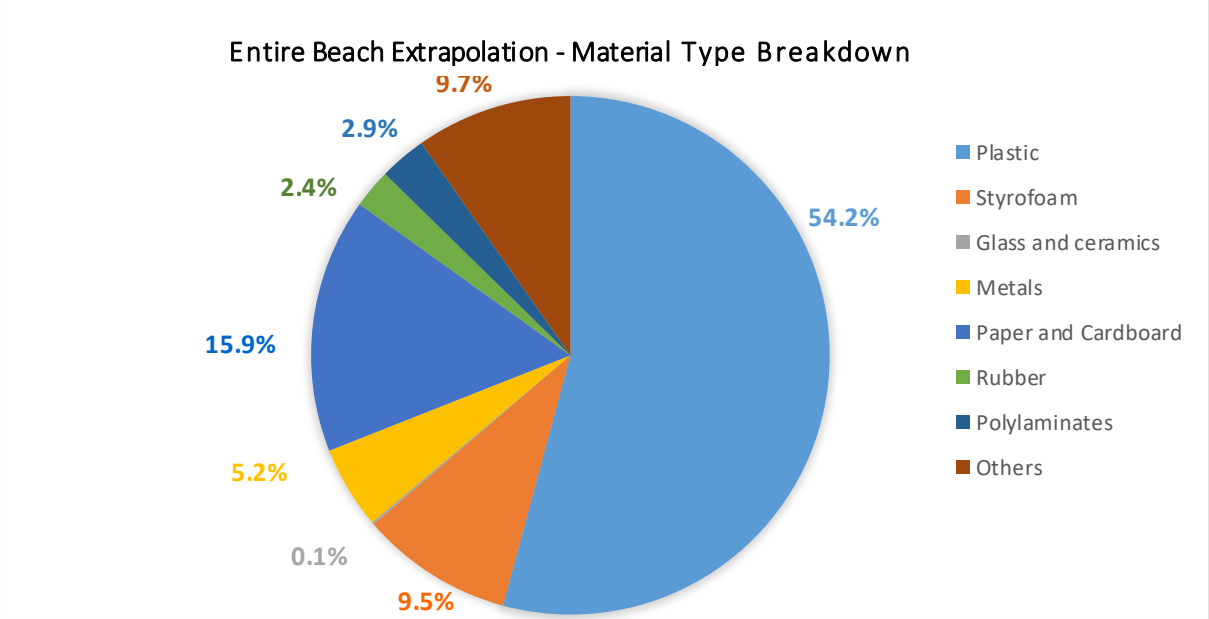

Figure 20: Entire Beach Extrapolation – Material Type Breakdown

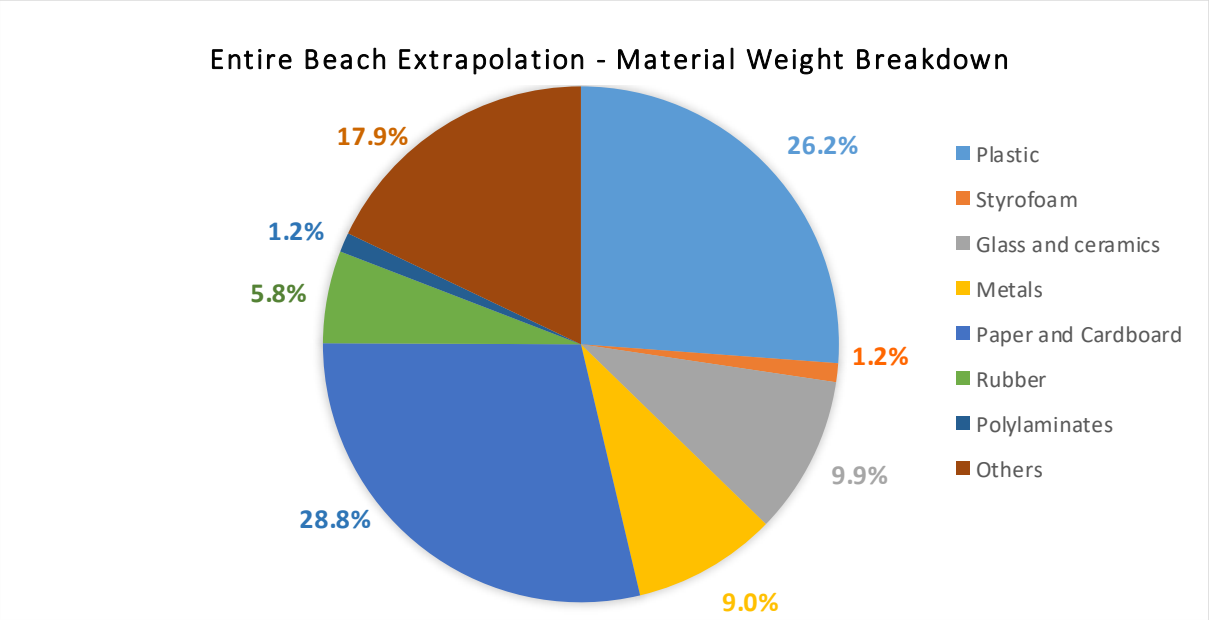

Figure 21: Entire Beach Extrapolation – Material Weight Breakdown

6. Interviews with local stakeholders

Apart from the beach samplings described in previous chapters, data collection was done through interviews with different focus groups active in the pilot area. This way the project team aimed to understand the waste management behaviors, the most generated type of plastic waste, and their leakage points. Leakage points can be both in terms of lack of waste management practices (e.g., not regular collection) and locations where materials get disposed of.

The collection of these information can help to understand the connection between litter and generation source within the cluster and to define specific actions and targets for the PROMISE project.

The team conducted interviews in Maafushi on the 3rd of May 2023 and had a total of 15 interviews across three main groups of stakeholders:

- Local authorities
- SMEs connected to the tourism sector in the area
- NGOs

Local Authorities

Two stakeholders belonging to local authorities on Maafushi were interviewed on 3rd of May 2023.

1. Vice President of Maafushi Council

The first interviewee was with the vice president of Maafushi council. He stated that the responsibility for waste management activities lies within the local council and that they would organize beach clean-ups twice a week. On a weekly basis, the council member estimates that around half a ton to one ton of waste is collected from the beaches for which no further breakdown of materials can be made. They observed that most waste items are not items directly disposed of at the beach but have been washed there from other land-based sources. While most waste is mixed during collection and sent off to the Maafushi dump yard, plastics are segregated (plastic bags, PET bottles, ghost nets). On this note, the council highlighted on the essential need to implement effective waste management practices, including adequate segregation and recycling, to minimize the environmental impact of waste disposal. Until now only plastics are segregated at source and disposed of in specific Parley collection bins or special designated areas in the Maafushi dump yard. He also underlines that there might be seasonal variations in terms of waste generation at the beach. For example, during the 'iruvai' or northeast monsoon season, which is characterized by specific wave currents from the outer reef, a significant amount of plastic waste is deposited on the beach. This could be due to the movement of marine debris brought in by the currents. Monitoring and recording the amount of waste collected during different seasons can help identify trends and develop appropriate strategies for waste management.

Regarding the role of local SMEs in beach cleaning and waste collection he states that government authorities, schools, NGOs but also tourism SMEs would participate in the community beach clean-ups scheduled by the local council. These beach clean-ups are held regularly. He says, that additionally, some SMEs take their own initiatives in cleaning the beach area in front of their facility, recognizing the importance of maintaining a clean and sustainable environment for their businesses and the community.

In his opinion, the biggest issue regarding marine litter at the beaches includes the lack of proper infrastructure and maintenance of dump yards. It is mostly drifting items that end up on the beaches

and not litter thrown on the beaches by tourists or locals. He says that it is crucial to have well-maintained waste collection centers and proper infrastructure for waste management to ensure that the collected waste is handled appropriately. Additionally, the dumping of food waste into the ocean and the presence of small plastic items, such as butter/jam sachets and plastic bags, contribute to the litter problem and need to be addressed.

To overcome those issues, the council acknowledges the importance of proper waste management and disposal options on the island of Maafushi. There is a need to develop standard operating procedures (SOPs) for waste management and collaborate with organizations like the Waste Management Corporation (WAMCO) to improve waste handling practices. As a first step he sees the necessity of providing a waste composting system within the island to promote sustainable waste management. Raising awareness among the general public through education and sensitization sessions can additionally help encourage responsible waste disposal practices. He stated that Maafushi Council will be contracting/collaborating with WAMCO in the near future and that this would be a first step towards better waste management including establishing composting system in the island.

2. Waste Management Operation Supervisor at the Stat Electric Company (Stelco)

The second interviewee was the waste management operation supervisor at the State Electric Company (Stelco).

He states that Stelco manages the local dump yard but that all collection and (beach) clean-up activities lie under the island council´s responsibility. He notes, that just in rare cases, some guest houses directly bring waste by themselves without another party or collector being involved. According to his information, most of the waste is disposed of at the local landfill operated by his company. Most of the waste received at the dump yard is already segregated and packed into different bags for plastic, cans, papers, food and compostable waste. If this is not the case, segregation would be done onsite by Stelco. According to the supervisor, most PET bottles that end up in landfills come from local cafes or tourist day tours and excursion trips.

In terms of seasonal variation, he underlines that there is more waste incoming during the Ramadan period. According to him, during high season there is 100% occupancy of tourist beds in the island and in the low season the occupancy is 40% to 50%. Hence except for Ramadan, they do not observe much variation in the amount or type of waste coming in. While waste is normally collected by the local council, some guesthouses clean the part of the beaches in front of their facility on a daily basis and bring the collected waste to the dump site. Same practice is being applied by water sport businesses as they clean the section of the beach in front before starting the daily activities.

The Waste Management Operation Supervisor at Stelco, echoing the sentiments of the Vice President of Maafushi Council, the previously mentioned interviewee, asserts that littering on the beach is infrequent and not the primary concern. He explains that both tourists and locals typically utilize the trash cans available on the beach. The trash found on the shores is more often carried in by currents, originating elsewhere rather than being directly discarded on the beaches. Additionally, some waste comes from liveaboards, and other boats anchored nearby or leaks into the sea from the coastal garbage dump, which is exposed to the ocean.

While only plastic waste is collected in a separate area and sometimes in Parley Jumbo bags, other waste is declared as landfill and can enter the sea and marine environment very easily. In general, PET bottles and cooking oil containers are the most common type of plastic waste generated.

To overcome these issues routine clean-ups are conducted by the local authority. Also, guesthouses and water sport businesses also involve tourists in beach clean-ups to raise awareness and combat the waste problem on the coasts.

SMEs

In Maafushi the SMEs present are hotels, restaurants, cafés and water sports operators. Nine SMEs were interviewed on the 3rd of May 2023. This way the project team gathered industry-related insights on the problem of insufficient waste management and beach littering.

1. SME 1

A staff of SME 1, states that the business generates one black bag (40 liters) of segregated coconut waste and one (40 liters) of general waste per day. Collecting all the plastic waste separately it sums up to one black bag (40 liters) of plastic waste per week. He observes that waste generation doubles during tourist peak seasons on the island. Waste is collected and disposed of to the island waste site daily by the staff. No recyclables/plastics are sold to informal collectors or a recycling company.

2. SME 2

The manager of SME 2 indicated that seven to eight black bags (40 liters each) of total waste (food, plastic and general waste) are being generated daily. Plastic waste is separated and sums up to two black bags. In line with the first interviewee, the manager observes that the waste doubles during the tourist peak season. Also, for this business, waste is collected daily by their own staff and taken to the island waste site. They pay MVR 1,000 per month to the staff for this task instead of outsourcing to waste collection services.

3. SME 3

The manager of SME 3 says that in his business very few plastic wastes is generated because usually refillable water bottles are used. According to him approximately one small bag of plastic is generated daily. Food waste, plastics, metal and general waste are separated and taken to the waste site daily by the staff. The responsible staff is paid an additional monthly allowance of MVR 350 for the collection and routine disposal of waste.

4. SME 4

The manager of SME 4 states that a half bag (approx. 20 liters) of food and waste is generated daily. Plastic waste is separated and sums up to one black bag. The waste generated is doubled during the peak season. According to him the waste is stored outside of the hotel and collected by the council daily. Information about fees for collection and further processing of the waste is not given.

5. SME 5

The purchasing manager of SME 5 indicates a waste generation of nine black bags of 40 liters per day which sum up to around 360 liters. From this waste generated, plastic is separated and handed to Parley in two jumbo bags on a weekly basis. The other types of waste are collected daily and taken to the island waste yard by the hotel.

6. SME 6

The assistant manager of SME 6 states that on the one hand the hotel inclusive the kitchen normally generates four black bags (40 liters each) of waste, summing up to approximately 160 liters. On the other hand, in the rooms of the hotel produce between half to one black bag of waste. Waste is not

stored but taken by the staff on a daily basis to the waste yard. Although there is no segregation, he estimated that around 40% of all waste generated is plastic waste.

7. SME 7

A dive master from SME 7 says that approximately a quarter of a black bag (around 10 liters) is filled up with waste each day and that plastic waste is separated from the other waste streams. The waste is collected and taken to the waste site by the staff on a bi-weekly basis. He estimates that approximately 90% of the waste generated is plastic waste which goes separately to the waste site.

8. SME 8

The manager of SME 8 explains that a bucket containing 19 liters of waste is generated every day. The waste is not separated and stored in the water sports area before being collected twice a week for MVR 50 per trip. He states that 50% of the waste generated in the water sports business consists of plastic waste.

9. SME 9

A receptionist of the SME 9, reports that the hotel generates two black bags, containing up to approximately 80 liters of waste daily. Plastic waste is separated from the other waste streams and accounts for about 50% of the total waste generated. Storage of waste is not required, as it is picked up daily and taken to the local waste site by the hotel staff.

Figure 22. Interviews with SMEs on the island

NGOs

In total, 4 NGOs active in the island were interviewed by the project team.

1. Maafushi Women Development Committee

A member of the Maafushi Women Development Committee, indicates they collaborate with councils and schools whenever they conduct beach cleanups. According to her, all waste collected at the beach already gets segregated during the clean-ups. The most common types of litter found on the beaches are plastics, especially PET bottles, and diapers. Although she thinks that tourists on Maafushi are aware

and conscious of their waste and dispose them properly, she states that there is still need for educating visitors on the issue of marine litter. Simultaneously, the promotion of reusable products and the reduction of single use plastics should be encouraged. In her opinion, it is also important to work with local tourism SMEs to promote sustainable practices and to reduce the amount of waste generated on the island. This can include initiatives such as composting of food waste as well as the implementation of recycling programs. To reach progress, she demands a multifaceted approach, including education, outreach and collaboration between all stakeholders.

Until now she has mainly collaborated with the council to ensure more effective waste collection and management as well as to promote sustainable waste management practices by raising awareness about the importance of waste segregation, recycling and composting. According to the member, one of the biggest challenges faced by the island is the amount of waste that ends up in the ocean due to nearby safari or liveaboards. This is often due to a lack of proper regulation and law enforcement for such vessels, which can result in the dumping of waste in large black bags directly into the sea. She therefore recognizes the importance of engaging with SMEs as the collaboration can help to reduce the amount of waste that ends up on beaches and in the ocean and promote a more sustainable approach to tourism.

Most important to her is the emphasis on the individual responsibility and the role they can play to protect the environment, but also to promote a change in mindset among visitors and locals and to underline the importance of reducing waste, reusing materials and recycling. The latter can be reached by promoting eco-friendly products, encouraging businesses and locals to adopt sustainable waste management practices, improving waste segregation and collection and supporting recycling initiatives.

2. Maafushi Health Club

The general secretary of the Maafushi "Health Club" states that they collaborate with the council for beach clean-up events organized by the council itself. Most common types of litter found on the beaches during clean-ups include diapers, plastic bags and PET bottles. However, in recent years, the number of diapers has decreased, while the number of PET bottles has increased most likely due to tourist excursions where PET water bottles are used for convenience. He also notes that tourists who visit the island usually dispose of their waste properly, as there is greater awareness nowadays. In general, waste separation is carried out, especially of plastic waste. The problem, in his opinion, lies mainly with the safari boats and boats going on excursions, as they dump noticeable amount of trash into the sea that eventually washes up on nearby beaches.

To counter the problem, he recommends educational sessions on waste reduction strategies and alternative solutions. He also points to the importance of appropriate policies and regulations that promote responsible waste management, such as phasing out single-use plastics.

Until now they have only been collaborating with the local councils. During the beach cleanup activities and other events organized by the club, they have introduced no plastic policy and encouraging use of reusable bottles. He comments, that in the future they hope to engage with MSMEs to reduce and manage waste and to provide training on sustainable practices, like composting, recycling and waste reduction strategies. He notes that collaborating with local SMEs and industry associations can further help to build partnerships and more organized support for sustainable waste management practices.

3. New Star Sports Club

The vice president of "New Star Sports Club" points out that there is already a cooperation with the council for beach cleanups, but also with water sport operators. According to her experience the most common type of waste found on the beaches are PET bottles which are left behind or improperly disposed of into the sea during boat excursions. Nevertheless, she notes improvements in the beach cleanliness compared to the past and there is now a greater emphasis on encouraging individuals to use their own refillable water bottles.

To further improve the situation more awareness on waste minimization should be created and affordable alternatives made available to consumers. The council has planned to offer water filtration systems on an instalment basis to the households that would further limit the number of PET water bottles consumed.

Until now, the "New Star Sports Club" have not organized any activities specifically targeting SMEs, but they participate in activities organized by the island local council.

4. Biragan Sport Club

The manager of the "Biragan Sport Club" explains that they participate in beach clean-ups two to three times a month. They mainly participate in clean up days organized by the council or other parties. According to his observations during these clean-ups, the most common type of waste found are PET bottles, PET water bottles and plastic bags. He estimates that most PET bottles, as well as general waste, come from the guesthouses in the island. Part of the waste also comes from the Maafushi prison and only a small share is from the residential houses, as the latter usually have water filters installed and do not require the use of PET bottles for consumption.

As a possible measure, he sees the installation of more dustbins, since in his opinion there are not enough dustbins in the beach areas. Also, in his opinion, more awareness-raising messages should be displayed in the area.

Figure 23. Interview with 'Maafushi Health Club'

7. Waste sources and sinks

It is apparent from the MFA study described above that there are several sources and types of municipal waste specifically plastic waste found in Maafushi Water Sports Beach area. The sources and sinks identified are depicted in figure 24 below. The study did not quantify waste flows in the area and hence only qualitative relationship is indicated in the figure. The waste is mainly originating from two sources: Waste drifted by the sea and waste littered on site. The MFA study shows that there are several sources of municipal solid waste and through some waste management activities the waste is either transported to the local waste site of the island or leaks out into the environment. More than 50% of the waste from the beach samples are plastics. One of the major sources of single use PET bottles leaking into the environment was identified as excursions boats that take tourists on day trips and liveaboards docked nearby.

The list of source and sinks identified is the following:

Sources:

- **Waste Drifted by the Sea:** Waste items, including plastics, are carried by the sea currents and deposited on the beach. These items originate from various locations and may be washed ashore from other areas or brought in by marine currents.
- **Waste Littered On-Site:** Some waste is directly littered on the beach by tourists, locals, or visitors. While the document mentions that littering on the beach is rare, it still contributes to the waste found on the beach.
- **Excursion Boats and Liveaboards:** One of the major sources of single-use PET bottles leaking into the environment is identified as excursion boats that take tourists on day trips and liveaboards docked nearby. These vessels may dispose of waste improperly, leading to marine litter.

Sinks:

- **Local Waste Site:** A significant portion of the waste, including plastics, collected from the beach is transported to the local waste site on the island for disposal.
- **Recycling Initiatives (Parley):** Some plastics, particularly PET bottles, are segregated and collected separately by organizations like Parley for recycling. These materials are taken to pre-processing facilities or appropriate disposal centers.
- **Ocean and Marine Environment:** Unfortunately, some waste, especially plastics, ends up leaking into the ocean and marine environment due to improper disposal practices. This occurs when waste, not properly managed, is carried back into the sea by tides or currents.

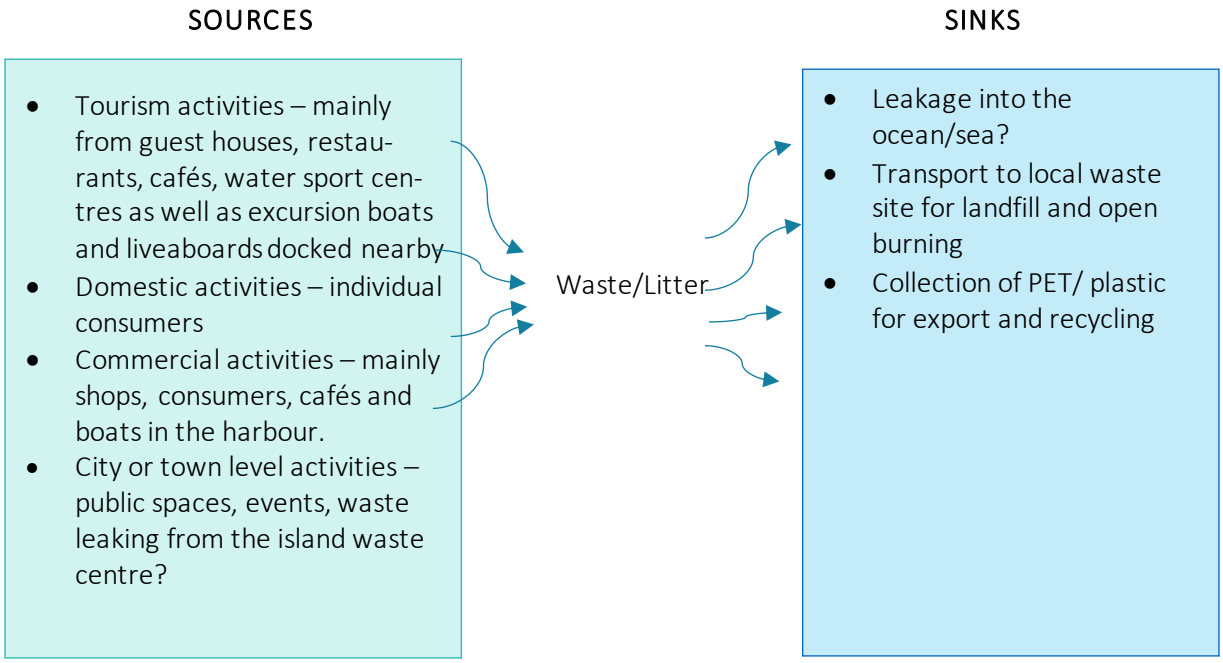

Figure 24. Sources and sinks of municipal waste from Maafushi beach area

8. Conclusions on the conducted activities

The manual beach sampling was carried out on a selected beach area in Maafushi, Maldives, which was divided into segments of 10 meters each. The segments were classified into three categories based on the level of pollution (low, medium, and high).

The key findings from the manual beach sampling for each segment are:

Highly Polluted Segment:

- Plastic fragments (loose) were the most prevalent item, accounting for 55.1% of the total weight of collected items.
- Styrofoam packaging fragments were the second most common, representing 4.9% of the total weight.

Medium Polluted Segment:

- Plastic fragments (loose) were again the most dominant, comprising 59.1% of the total weight.
- Styrofoam packaging fragments accounted for 11.4% of the total weight.

Lowly Polluted Segment:

- Plastic fragments (loose) remained the most prevalent, making up 49.2% of the total weight.
- Styrofoam packaging fragments represented 23.7% of the total weight.

Overall, the plastic waste collected from the three segments included various items such as plastic bottles (PET and other types), plastic bottle caps and rings, plastic bags, foams, nylon ropes, jute bags, PVC rope, and more. The total quantity of plastic waste collected from all three segments amounted to 4,444.27 grams.

These findings highlight the diversity of plastic waste items present on the beach. Loose plastic fragments were the most prevalent and abundant form of plastic litter, making up a substantial portion of the total plastic waste collected from the beach in Maafushi.

Styrofoam packaging fragments were found in all three segments, with the medium-polluted segment having the highest proportion. This information indicates the presence of Styrofoam litter on the beach and its varying degrees of distribution.

In addition to data collection at the beaches, the interviews conducted with various focus groups—comprising local authorities, tourism-related SMEs, and active NGOs on the island—revealed several key findings:

- Local Authorities: Local authorities, represented by the vice president of Maafushi council, highlighted the importance of waste management activities and regular beach clean-ups. They acknowledged the need for proper infrastructure and waste segregation to minimize environmental impacts.
- SMEs: SMEs, including hotels, restaurants, and water sports operators, reported their daily waste generation and the percentage of plastic waste. Some SMEs emphasized the need for sustainable practices, while others mentioned their efforts in segregating plastic waste.
- NGOs: NGOs emphasized the importance of collaboration with councils, schools, and local SMEs to conduct beach clean-ups and promote sustainable waste management. They mentioned PET bottles and diapers as common litter found during clean-ups, often originating from boat excursions.

Overall, the interviewees identified challenges such as lack of proper waste management infrastructure, waste from nearby safari boats, lack of proper regulations, and the need for education and awareness-raising. Recommendations included banning single-use plastics, implementing water filtration systems, and encouraging the use of reusable products.

9. Lessons learned from Material Flow Analysis and next steps

From the activities conducted as part of the PROMISE project in Maafushi, Maldives, several key lessons have been learned:

Seasonal Variations: Seasonal variations, such as the north-east monsoon season, can significantly influence the amount and type of waste washing up on the beaches. Understanding these patterns can help in the development of targeted waste management strategies for different times of the year.

Role of Local Authorities and SMEs: Local authorities play a crucial role in waste management activities, including organizing beach clean-ups and waste collection. Collaboration with small and medium-sized enterprises (SMEs) in the tourism sector is essential to promote sustainable practices and reduce waste generation.

Plastic Waste Sources: Identifying the main sources of plastic waste, such as water sports businesses and tourism-related activities, helps in devising strategies to target these specific sectors for waste reduction and responsible waste disposal.

Impact of Safari Boats: The dumping of waste into the sea by safari boats and excursion vessels can be a significant source of marine litter. Effective regulation and law enforcement for these boats are crucial to prevent marine pollution.

Importance of Education and Awareness: Raising awareness among tourists, locals, and businesses about the environmental impact of waste and the significance of responsible waste management is vital to promoting behavioral change and reducing littering.

Waste Management, Segregation and Recycling: Implementing proper waste segregation practices, establishing proper waste management infrastructure, including separating plastics and other recyclables, is essential to enhance the efficiency of waste management and facilitate recycling initiatives.

Involvement of Stakeholders: Engaging stakeholders, including local councils, SMEs, NGOs, and the public, is critical for developing comprehensive and effective waste management strategies. Collaborating with local NGOs can help in organizing beach clean-ups, promoting sustainable practices, and engaging the community in waste management efforts.

The experience of conducting this study further enriches the team's knowledge of on-ground realities and facilitated several lessons which will shape some of the next steps. These are:

- A detailed study such as the one conducted only provides insights at a point in time. Due to various external factors, such as tides, weather, tourist footfall (tourist seasons), the amount of litter observed on a specific section of the beach can vary significantly. Therefore, the PROMISE team may consider repeating such studies on the same stretch of the beach at another time, rather than to analyze another beach.
- Quantification of waste flows from SMEs, particularly small vendors is very challenging. Most of them do not weigh or track the quantities of waste they hand over to the formal waste collectors. PROMISE team may need to work closely and over several months with the SMEs and waste collectors in the area to quantify the waste flows.
- The PROMISE study found that hotels do not currently track their plastic waste generation. To address this issue, the PROMISE team considers creating a user-friendly plastic footprint calculator. This tool will enable the hotels to effectively monitor and manage their plastic waste, allowing them to identify their major sources of plastic waste generation and make informed decisions for waste reduction.

The findings from the conducted activities and interviews highlight the complex challenges in waste management, underscoring the urgent need for innovative methodologies to address these issues comprehensively.

In addition to the classical MFA methodology, which helps us understand seasonal variations in waste, identify key stakeholders, and map waste flow patterns, the PROMISE project has developed a new methodology called "Sources to Sinks" (S2S) which will be explained in the next chapter. This new approach by adelphi Research gGmbH and STENUM Asia focuses on tracing the pathways of waste through the tourism sector to enhance understanding of how and where waste is generated and managed, and its ultimate impact on marine ecosystems.

S2S serves as a logical extension of the MFA, aiming to identify, characterize, and quantify waste sources while determining their fates to inform strategies for practical sustainable management. The methodology involves a detailed assessment of 9 hotels and 8 guesthouses within a 100-meter radius of Maafushi beach. These facilities were selected based on operational differences; hotels generally provide restaurant services, whereas guesthouses do not. This approach enables the collection and analysis of various types of waste, correlating these with the number of guests to provide a more precise measure of

waste generation in this sector, thereby enhancing the project's capability to manage waste more effectively.

10.S2S Methodology

The S2S methodology of the project outlined two main activities to be conducted in the pilot area, focusing on guesthouses (GH) and hotels (HO). Initially, all GH and HO within the pilot area must be identified through interviews to gather crucial data. This data includes the annual number of guests and an understanding the waste management (WM) practices or 'fates' for different waste streams. Simultaneously, the waste generated by these facilities were characterized. Due to time constraints, only two hotels and two guesthouses were chosen for the waste characterization.

Prior to this characterization, facilities were instructed to set aside all waste produced on a designated day and were given any necessary logistical support, such as a location for conducting the analysis. Pre-separating the waste is beneficial, as it streamlines the subsequent steps. Furthermore, knowing the guest count on the waste collection day is crucial for correlating the amount of waste generated with the number of guests.

Exploration on the waste management was necessary to further understand the types of waste produced. Waste disposal methods were categorized into several options: Formally collected, informally collected, dumped in the environment and burned. Formal waste collection is organized and regulated by municipal authorities or licensed companies, ensuring waste is managed according to legal and environmental standards whereas, informal waste collection is carried out by individuals or small groups without official oversight, often relying on collecting and selling recyclable materials for income.

The figure below shows the waste collected by the PROMISE team actively engaging in waste collection and characterization from guest houses and hotels in Maafushi, Maldives.

Figure 25: Collection and Waste Segregation Process

11. Waste Characterization

During the waste characterization phase, records were reviewed to determine if the waste had already been segregated; if not, manual separation was required. Each waste category was meticulously weighed and documented. This systematic approach allowed for a thorough understanding of waste generation and management practices in the selected guesthouses and hotels, offering valuable insights into effective environmental management strategies. To enhance data accuracy, all assessments were conducted in the morning, ensuring that only waste generated from the previous day was included. The process was carefully monitored to prevent the inclusion of waste from multiple days.

Many guesthouses and hotels already practiced waste separation, which significantly aided the analysis process. To ensure data reliability and consistency across different periods and locations, waste characterization was ideally performed over two days, which did not need to be consecutive, in each guesthouse or hotel. This approach helped to discern day-to-day variability and establish more accurate baseline patterns of waste generation. Expanding the characterization to include more guesthouses enhanced the reliability and resolution of the data. Different types of waste materials, such as plastic, glass, paper, cardboard, metal, and others, were collected and segregated to determine the average daily waste generated per guest. This data was then extrapolated to estimate annual waste figures for all hotels and guesthouses near Maafushi beach. It should be noted that organic waste was not included in the analysis, as it falls outside the scope of the PROMISE project.

Figure 26: Segregated waste from guest housees and hotels

Figure 27: Waste from guest houses and hotels weighed and quantified

12.Waste Composition

Two hotels and guest house were selected for waste characterization studies, showing pronounced differences in the generation and composition of their wastes corresponding to the number of guests present. For example, on a day when 356 guests were accommodated, the waste generated at the hotels consisted largely of plastics, with plastic bottles alone accounting for 11.8% of the total waste (4.53 kg). Other notable contributors in the hotels included cardboard (8.3%) and textiles (4.4%), providing a range of waste streams with significant quantities. The average of the total waste generated from the hotels per day accounted to 38.48 kg with 0.108 kg of waste generation per hotel.

In contrast, at the guest house with only 95 guests, the waste composition showed notable differences. The total generated waste was 30.76 kg, with cardboard being the predominant component, accounting for 26.7% (8.2 kg), followed by other papers (e.g., tissues) at 16.3% (5.02 kg) and glass bottles at 10.6% (3.25 kg). The average of the total amount of waste generated from the guest house was comparatively lesser, at 30.76 kg, with 0.32 kg of waste generation per guest house.

When scaled to annual figures, the waste composition underscores the variations between accommodation types. Hotels generate approximately 22,210 kilograms of waste annually, while guesthouses produce 11,336 kilograms annually. This stark difference in waste generation highlights the higher waste intensity in hotels compared to guest houses. Plastics remain the most reported waste category in both hotels and guesthouses, although the proportions and types vary considerably. While hotels exhibit significant contributions from plastic bottles and cardboard, guesthouses show a higher proportion of cardboard relative to total waste. These findings emphasize the impact of scale and guest numbers on waste composition and volume.

Such data highlights the need for tailored waste management strategies that account for both the type and size of accommodation. Hotels, with their higher per-guest waste generation, require targeted interventions that focus on reducing waste intensity and improving recycling practices. This approach is critical for enhancing the effectiveness of waste management initiatives, ensuring sustainable operations within the hospitality sector.

The tables and pie charts below provide a detailed understanding of waste categorization and composition in hotels and guesthouses:

Table 5: Waste Categorization and Composition from two Hotel in Maafushi

Material	Item	Weight [kg]	Total Weight [kg]	Percentage (%)	Total Percentage (%)
Plastics	Plastic bottles	4,53	13,5	11,8	35,1
	Straws	0,15		0,4	
	Other plastic packaging	3,13		8,1	
	Other plastic items	5,69		14,8	
Glass	Glass bottles	1,09	1,09	2,8	2,8
	Other glass items	0		0	
Paper and Cardboard	Paper	4,30	21,39	11,2	55,60
	Cardboard	3,20		8,3	
	Other papers (e.g. tissues)	13,89		36,1	
Metal	Cans	0,36	0,62	0,9	1,6
	Other type of metal	0,26		0,7	
Residual	*Wood*	0,04	1,90	0,1	4,9
	Textile	1,69		4,4	
	Batteries	0,17		0,4	
TOTAL AMOUNT OF GENERATED WASTE:		38,48			
TOTAL AMOUNT GENERATED PER HOTEL:		**0,11**			

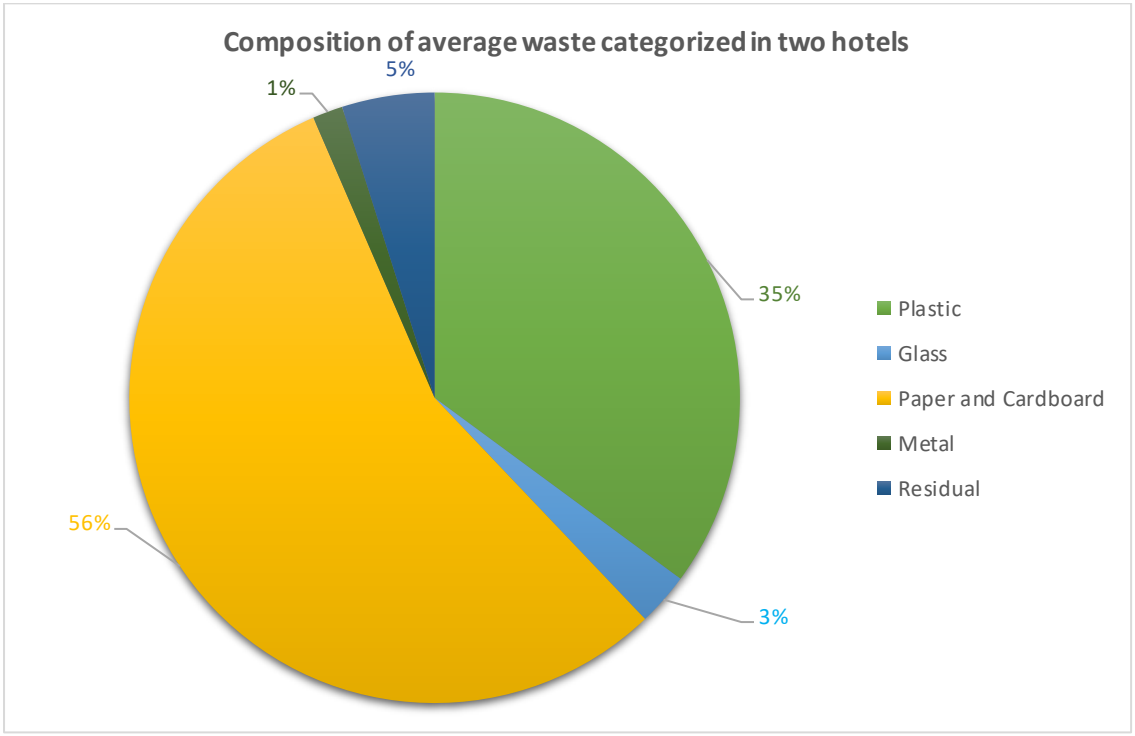

Figure 28: Percentage composition of average waste categorized from two hotels in Maafushi

Table 6: Waste categorization and composition from two guest houses at Maafushi

Material	Item	Weight [kg]	Total Weight [kg]	Percentage (%)	Total Percentage (%)
Plastics	Plastic bottles	2,65	8,69	8,6	28,2
	Straws	0,003		0	
	Other plastic packaging	2,59		8,4	
	Other plastic items	3,45		11,2	
Glass	Glass bottles	3,25	3,34	10,6	10,9
	Other glass items	0,09		0,3	
Paper and Cardboard	Paper	1,99	15,21	6,5	49,5
	Cardboard	8,20		26,7	
	Other papers (e.g. tissues)	5,02		16,3	
Metal	Cans	1,55	1,79	5,0	5,8
	Other type of metal	0,24		0,8	
Residual	*Wood*	0,05	1,71	0,2	5,6
	Textile	1,06		3,4	
	Others	0,58		1,9	
	Batteries	0,02		0,1	
TOTAL AMOUNT OF GENERATED WASTE:		30,76			
TOTAL AMOUNT GENERATED PER GUESTHOUSE:		**0,32**			

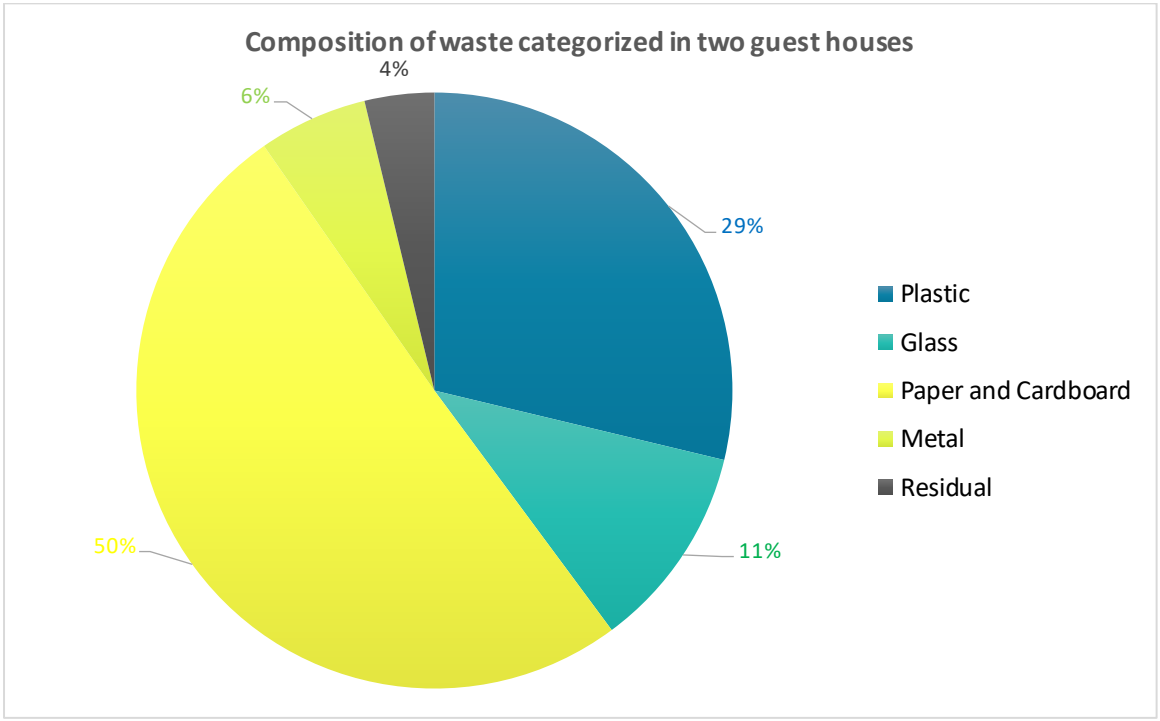

Figure 29: Percentage composition of average waste categorized from two guest houses in Maafushi

Waste generated from hotels for a year

Data collected during interviews, such as the annual number of guests at each guest house and hotel and their waste management practices, was integrated with results from the waste characterization study. This integration enabled the extrapolation of total annual waste generation across various categories, along with its subsequent allocation to final disposal or recovery pathways. The analysis revealed that hotels generate approximately 22,210 kilograms of waste annually. The largest waste category was paper, accounting for 10,499 kilograms, followed by mixed plastics at 3,369 kilograms and plastic bottles at 2,615 kilograms. In contrast, other metals represented the smallest category, amounting to 150 kilograms. This extrapolation provides a comprehensive overview of waste composition and its distribution, forming the foundation for informed waste management interventions within the hospitality sector.

In terms of waste management fates, the material sinks are distributed as follows:

- Formally Collected: A total of 1,258 kilograms of waste was formally collected. This includes contributions from plastic bottles, glass, cans, and metals.
- Informally Collected: 4,531 kilograms of waste was informally collected. This includes significant contributions from cardboard, plastic bottles, and others.
- Dumped in the Environment: The largest portion of waste, 16,385 kilograms, was dumped into the environment. Major contributors to this category include paper, other plastics, and other plastic packaging.

- **Not Applicable (NA)**: A small portion of 37 kilograms of waste is categorized as "Not Applicable," indicating waste that was not clearly assigned to any of the other categories.

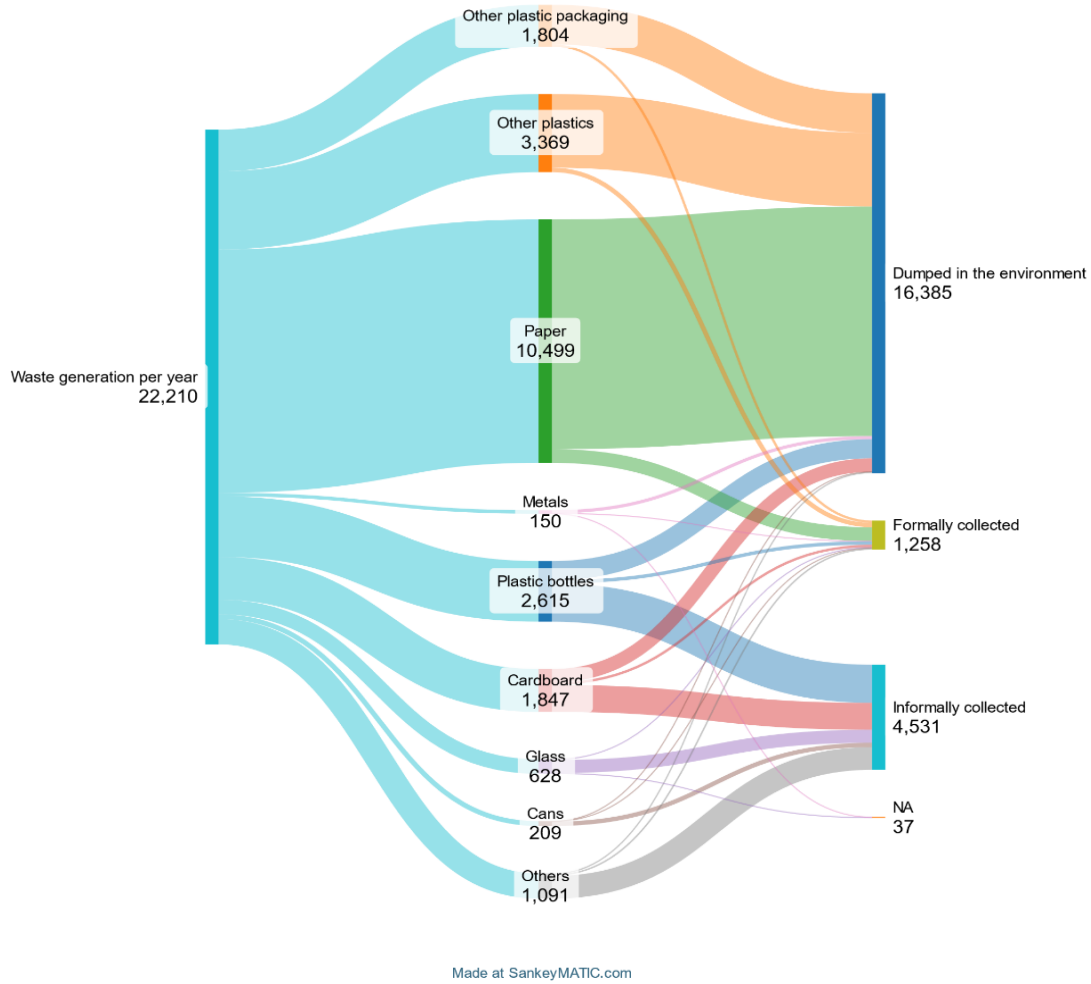

Figure 30: The Sankey diagram of the waste generated from the hotels for a year

Total waste generated from hotels and guest houses for a year

The analysis of waste generation reveals a total of 11,334 kilograms of waste produced annually. The breakdown of waste categories shows that cardboard is the largest contributor, with 3,021 kilograms, followed by paper at 2,588 kilograms, and other plastics at 1,274 kilograms. The smallest category is metals, contributing 88 kilograms.

For the waste distribution, the material sinks are as follows:

- **Formally Collected**: A total of 4,745 kilograms of waste was formally collected. This includes contributions from categories such as plastic bottles, cardboard, and glass.

- **Informally Collected**: 152 kilograms of waste was informally collected, including a small fraction of others.
- **Dumped in the Environment**: 5,041 kilograms of waste was dumped directly into the environment. This includes significant contributions from paper, other plastics, and cardboard.
- **Not Applicable (NA)**: A total of 1,398 kilograms of waste fell into the "Not Applicable" category, representing waste for which specific handling or tracking was undefined.

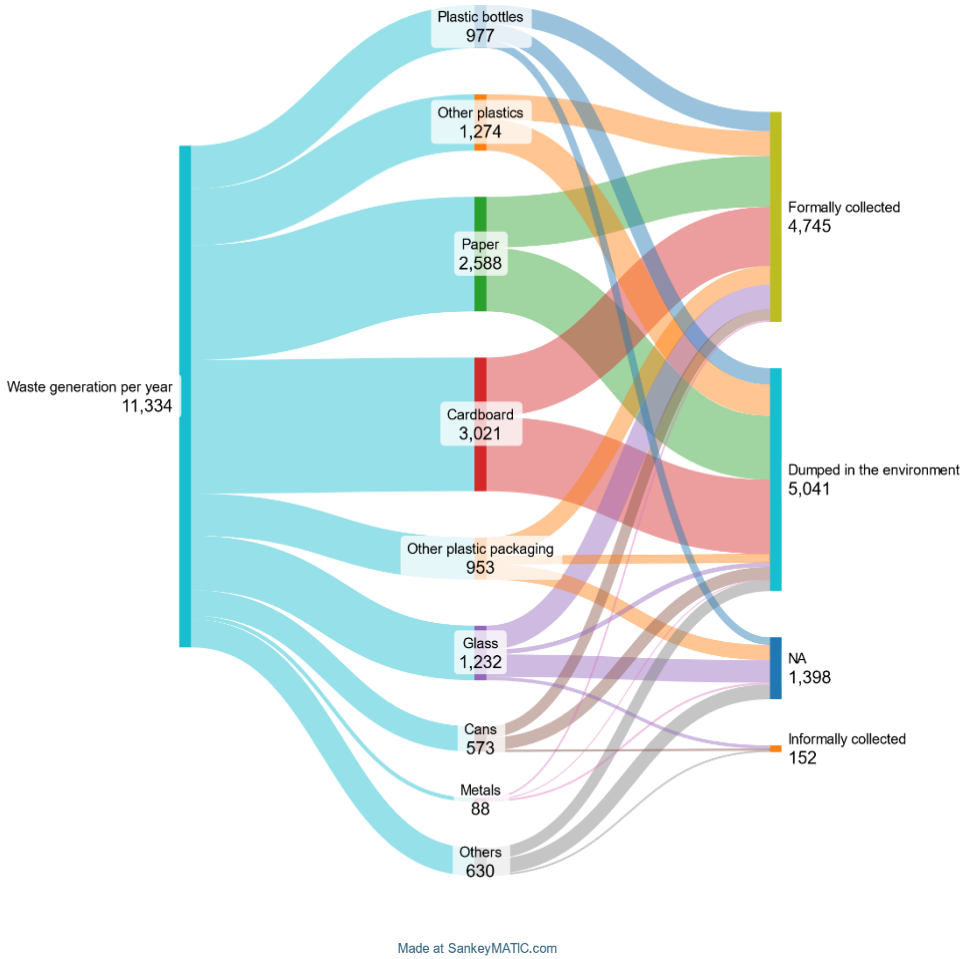

Figure 31: The Sankey diagram of the waste generated from the guest houses for a year

Total waste generated from hotels and guest houses for a year

The detailed analysis of waste generation reveals a total of 33,546 kilograms of waste produced from various sources, including guesthouses and hotels. The leading category of waste was paper, accounting for 13,087 kilograms, followed by other plastics at 4,642 kilograms, and cardboard at 4,869 kilograms. The smallest waste category was metals, totaling 238 kilograms.

For the waste mentioned, the material sinks are as follows:

- **Formally Collected:** A total of 5,999 kilograms of waste was formally collected, including contributions from categories like paper, plastic bottles, and glass.
- **Informally Collected:** 4,683 kilograms of waste was informally collected, including contributions from plastic packaging, cardboard, and other categories.
- **Dumped in the Environment:** The largest portion of waste, 21,425 kilograms, was dumped into the environment. This includes categories such as plastic bottles, paper, and other plastics.
- **Not Applicable (NA):** A total of 1,436 kilograms of waste fell into the "Not Applicable" category, covering various undefined or untracked waste handling methods.

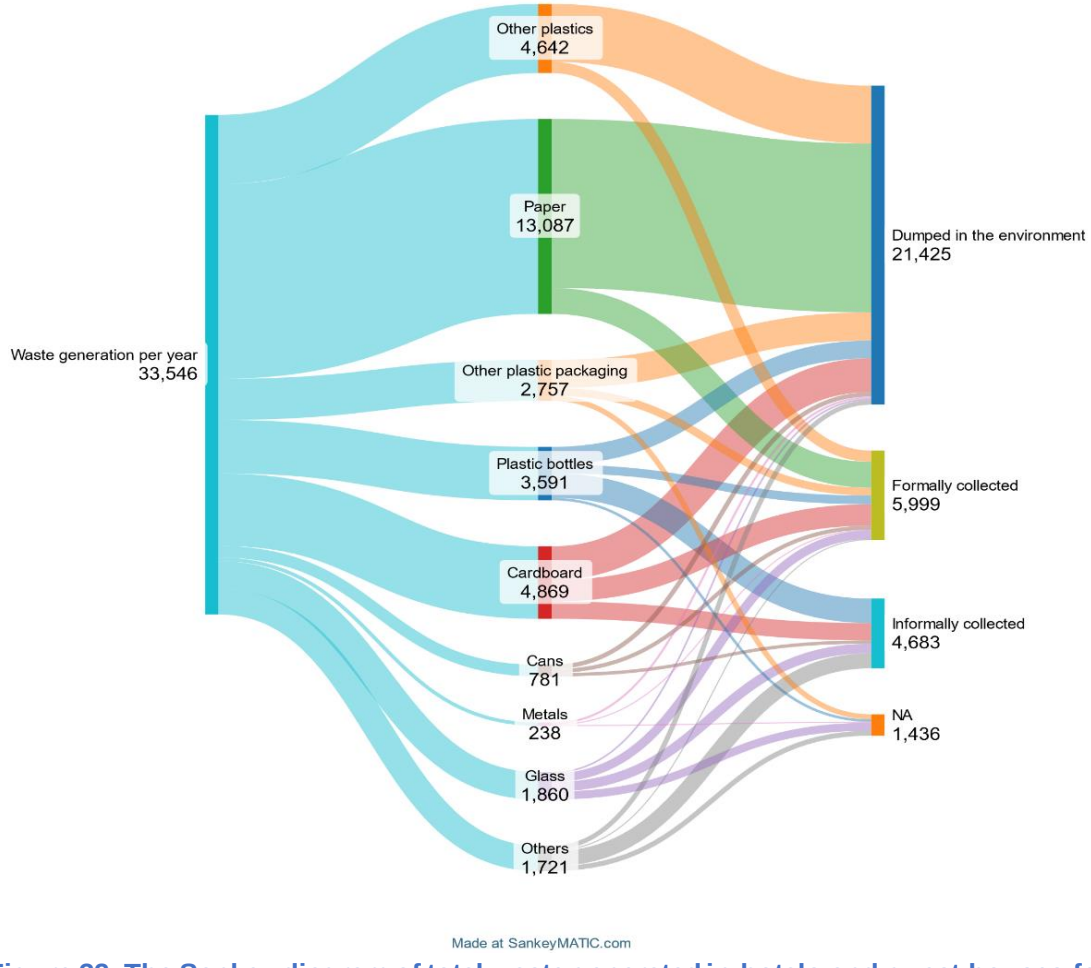

Figure 32: The Sankey diagram of total waste generated in hotels and guest houses for a year

13. Conclusion for findings of Source to Sink Methodology

The S2S activities carried out in the hotels and guesthouses surrounding Maafushi Beach have yielded pivotal insights into waste management practices within the local tourism sector. Through detailed waste characterization and stakeholder interviews, the project was able to map the journey of waste from its generation to its final fate. The significant findings indicate that plastic bottles (3591 kilograms), other types of plastic (4,642 kilograms), and paper (13,087 kilograms) dominate the waste profile, underscoring the urgent need for targeted waste reduction strategies.

The data revealed that a substantial portion of waste, especially plastic bottles, was collected formally, demonstrating effective aspects of waste management already in place. However, a notable amount of waste was also managed informally or irresponsibly disposed of through burning or dumping in the environment. These practices pose severe risks to environmental health and marine ecosystems, particularly given the proximity to the Lakshadweep Sea. In conclusion, improving formal waste collection and recycling efforts, as well as implementing stricter regulations against irresponsible disposal methods, will be essential for achieving sustainable waste management in the region.

14. Overall conclusions and recommendations

The MFA and S2S activities carried out as part of the PROMISE project at Maafushi Beach in the Maldives have provided crucial insights into the dynamics of waste management and plastic pollution within the tourism sector. These studies highlight the urgent need to address the pervasive issue of marine litter, exacerbated by the inflow of plastic waste from tourism-related activities and inadequate local waste management practices. Key findings from the project underscore the complex interplay between waste generation and disposal practices and their environmental impacts, especially in a sensitive marine ecosystem like the Lakshadweep Sea.

Key Conclusions:

1. **Prevalence of Plastic Waste:**

   Plastic waste dominates the litter profile on Maafushi Beach, accounting for over 54% of total debris by item count and 26% by weight. This is largely due to the high usage of single-use plastics in the tourism sector.

2. **Sources and Management of Waste:**

   The primary contributors to waste are directly linked to the tourism sector, including hotels, guesthouses, and water sports activities, which significantly contribute to waste during peak tourist seasons.

   Current waste management practices are inadequate, with significant gaps in waste segregation, collection, and proper disposal methods. This inefficiency is exacerbated by the limited scope of formal waste collection services and the reliance on informal waste collectors.

3. **Impact of Seasonal and Tourist Activities:**

   Seasonal variations and tourist influxes significantly affect the quantity and type of waste generated, emphasizing the need for adaptive waste management strategies that can respond to fluctuating waste volumes.

4. **Engagement and Awareness Challenges:**

   There is a notable deficiency in awareness and engagement regarding proper waste management and recycling practices among businesses and tourists, compounded by insufficient recycling infrastructure.

Recommendations:

1. **Enhance Waste Management Infrastructure:**

Invest in robust waste management infrastructure, including increased capacity for waste segregation at source, enhanced collection services, and expanded recycling facilities. This includes providing adequate bins and regular collection services to accommodate the high volumes of waste generated during tourist seasons.

2. Implement Policy and Regulatory Measures:

Introduce and enforce stricter regulations on waste management within the tourism sector. This could include policies that mandate waste segregation, reduce single-use plastic usage, and impose penalties for non-compliance.

3. Promote Public Awareness and Education:

Launch comprehensive awareness campaigns targeted at both locals and tourists to educate them about the impacts of improper waste disposal and the importance of recycling. This could involve collaborations with local businesses, schools, and NGOs.

4. Strengthen Local Capacities and Partnerships:

Develop partnerships with NGOs, private sector stakeholders, and community groups to foster a collaborative approach to waste management. Encourage local businesses to adopt best practices in waste management and to participate actively in community clean-up events.

5. Monitor and Evaluate Waste Management Practices:

Establish monitoring systems to regularly assess the effectiveness of waste management practices. Use data collected to adapt and improve strategies, ensuring that they remain effective under changing conditions.

6. Encourage Innovation and Sustainable Practices:

Support innovations in sustainable materials and waste management technologies that could reduce the reliance on single-use plastics. Encourage hotels and guesthouses to adopt such innovations and to participate in certification programs that promote environmental sustainability.

By implementing these recommendations, the PROMISE project aims to significantly reduce the inflow of plastic waste into the Lakshadweep Sea and mitigate its impact on marine ecosystems, ultimately contributing to the conservation of marine biodiversity and enhancing the sustainability of local tourism in the Maldives.