Sri Lanka

(Output Paper)

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

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www.projectpromise.eu

Project Contribution to SDGs:

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List of Abbreviations:

BOP	Biaxially Oriented Polypropylene
HDPE	High-Density Polyethylene
LDPE	Low-Density Polyethylene
MFA	Material Flow Analysis
NA	Not Applicable
NCPC	National Cleaner Production Centre
NGOs	Non-Governmental Organizations
PET	Polyethylene Terephthalate
S2S	Sources to Sinks
SMEs	Small and Medium-sized Enterprises

Project Implemented by:

1. Executive Summary

The "Prevention of Marine Litter in the Lakshadweep Sea (PROMISE)" project, led by adelphi Research gGmbH and STENUM Asia, addresses the critical issue of marine litter in Kalutara Beach, Sri Lanka. 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, Non-Governmental Organizations (NGOs), and Small and Medium-sized Enterprises (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 in 2022. In 2023, a focused study at Kalutara Beach revealed significant plastic waste accumulation, with plastics accounting for over 78% of total debris by item count and 46% by weight. This underscores the urgent need for improved waste management practices in the region.

Key findings indicate that tourism-related activities, such as hotels, guesthouses, and local restaurants, are a primary source of waste, contributing significantly during peak tourist seasons. Current waste management practices remain inadequate, with significant gaps in waste segregation, collection, and disposal. These inefficiencies are compounded by limited formal waste collection services and reliance on informal collectors.

The S2S methodology, piloted in Kalutara, provided valuable insights into waste pathways. It involved detailed assessments of eight hotels and seven guesthouses, correlating waste generation with guest numbers to enhance precision in waste management efforts. For instance, plastic bottles alone accounted for 19.7% of the total waste in hotels, highlighting the need for targeted waste reduction strategies. Seasonal variations and tourist influxes further amplify waste challenges, 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 importance of 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

This document is produced as part of the project PROMISE.

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 the Lakshadweep Sea from selected project locations need to be carried out. The MFA consists of two key data collection activities:

•   Manual sampling of waste from beaches

•   Interviews with focus groups

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. The project team piloted the methodology also in Sri Lanka in November 2021 and in 2023 the team has conducted the second MFA in Sri Lanka. The National Cleaner Production Centre (NCPC) team identified a suitable location in a section of the beach in Kalutara, Western Province, Sri Lanka (6°36'43.2'' N, 79°56'52.4''E) to conduct the study. The third MFA activity, interview with focus groups, was also tested.

The activities were conducted in the week of the 26th of April 2023.

The identified beach of approximately 250-meter length is shown in the figure below.
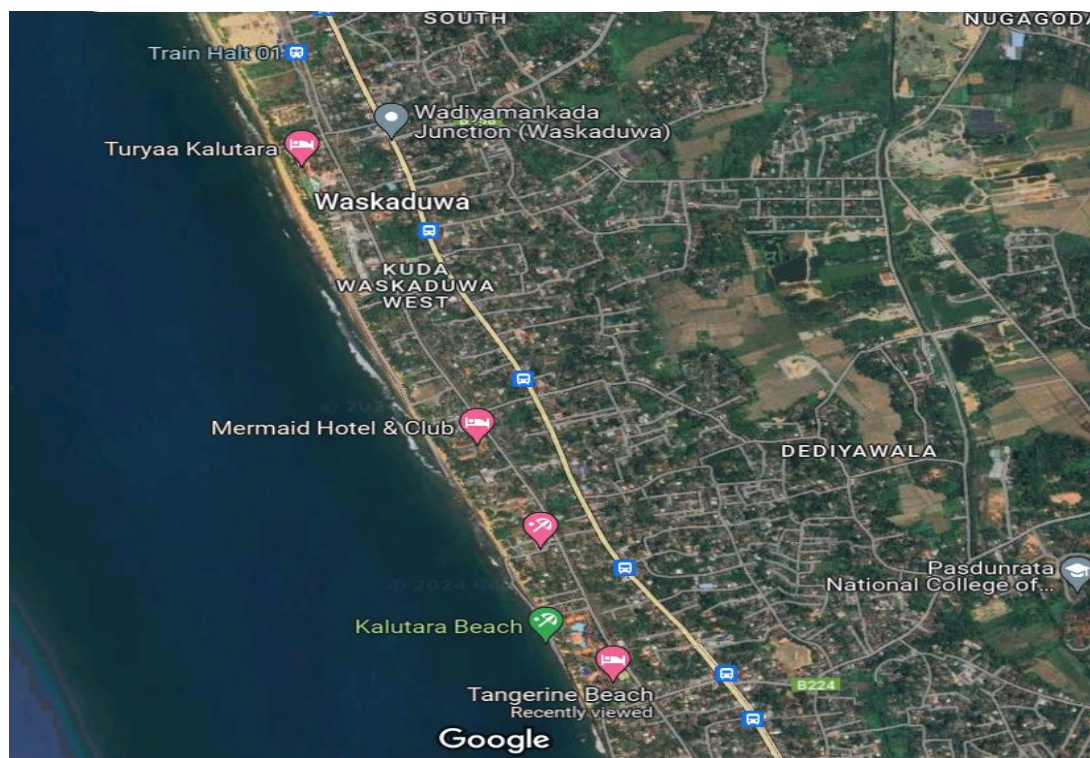
Figure 1: Satellite image of Kalutara Beach

3. Methodology

As a first step, the selected beach area was divided into segments of 10m each by the NCPC 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:

- Low Pollution Segment

- Medium Pollution Segment

- High Pollution Segment

Then, 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 will be then used to estimate the total level of pollution for the entire beach.
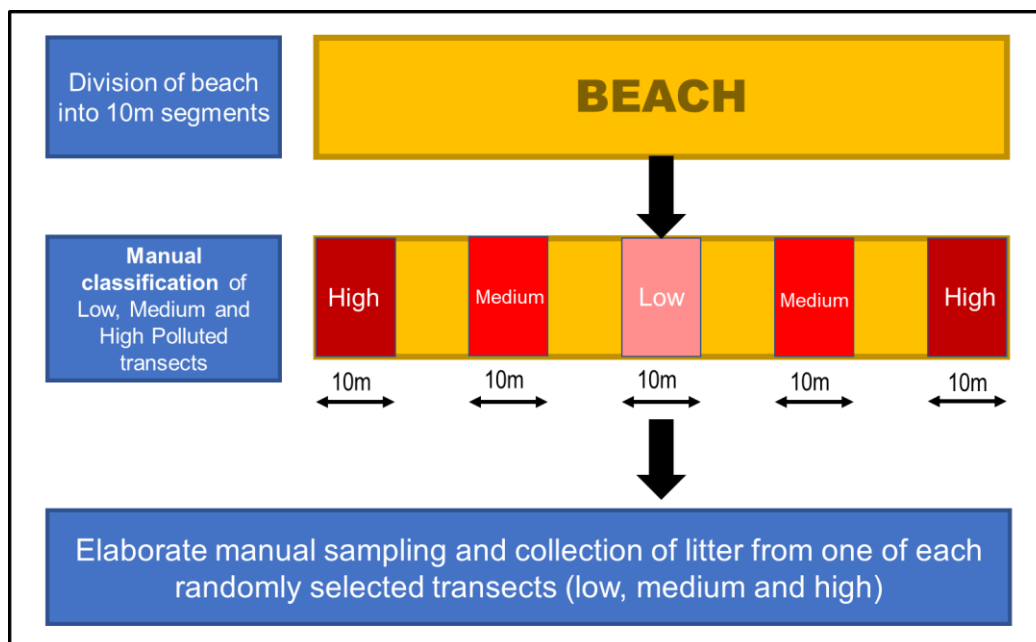
Figure 2: Data Collection Methodology

4. Manual Beach Sampling

On the 26th of April 2023, the PROMISE Team composed of experts from NCPC conducted an inspection of the Kalutara Beach and divided the area of the beach into 10m segments, for a total of 25 segments. Then one segment from each category was randomly selected with approximate size of L: 10 meters W: 20 meters and marked with a signalization tape.

Figure 3: Segment Marking

Figure 4: Photo of Marked segment

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

1. High Pollution segment

2. Medium Pollution Segment

3. Low Pollution Segment

The litter collected from each of the three segments was put in plastic bags which was labelled accordingly. Then the waste collected was categorised based on its nature and use (i.e. plastic bottle, cigarette buts, paper and cardboard, etc.). Once the segregation was concluded the different item group was counted and weighted.

Figure 6: Waste Collected from High Pollution Segment

Figure 5: Waste Collected from Medium Pollution Segment

Figure 7: Waste Collected from Low Pollution Segment

5. Data Collected

In the analysed high pollution segment, plastic is the predominant material, accounting for 90.4% of the items and 70.6% of the total weight. The most common plastic items found were plastic fragments (loose) and disposable cutlery. Styrofoam constituted 3.6% of the items and 4.2% of the total weight, with fragments of food containers being the main form identified. Glass and ceramics represented 1.2% of the items and 5.2% of the total weight, primarily in the form of fragmented glass bottles. Metal, paper, cardboard, rubber, and polylaminates were also present, though in smaller quantities compared to plastic and Styrofoam.

Table 1: Items collected in the high pollution segment

Material	Article	Quantity (n. items)	%	Weight (grams)	%
Plastic	Plastic fragments (loose)	6		0.003	
	Plastic fragments (hard)	52		0.1025	
	Beverage bottles (PET)	6		0.0945	
	Plastic bottle caps & rings	90		0.1885	
	Pharmaceutical packaging, medicine and ointments (plastic)	1	301	0.0015	675
	Disposable cutlery (plastic)	71	90.4%	0.078	70.6%
	Plastic wrapping and packaging & bags	47		0.162	
	Nylon ropes	6		0.022	
	PVC wire with metal	6		0.023	
	PVC wire without metal	4		0.019	
	Multi-layered plastic packaging	30		0.042	
Styrofoam	Fragments of food container (smooth Styrofoam)	12	12	3.6%	40	40	4.2%
Glass and Ceramics	Glass bottles in fragments	4	4	1.2%	50	50	5.2%
Metals	Lids	3	4	1.2%	5	10	1.0%
	Pen	1			5		
Paper and Cardboard	Paper pieces	4	4	1.2%	1	1	0.1%
Rubber	Flip-flops	3	3	0.9%	125	125	13.1%
Polylaminates	Tetrapack	3	3	0.9%	45	45	4.7%
Others	Masks	2	2	0.6%	10	10	1%
		333	100%	956	100%

High pollution segment - material type breakdown based on the quantity of the articles

- Plastic
- Styrofoam
- Glass and ceramics
- Metals
- Paper and Cardboard
- Rubber
- Polylaminates
- Others

3.6% 1.2% 1.2% 1.2% 0.9% 0.9% 0.6%

90.4%
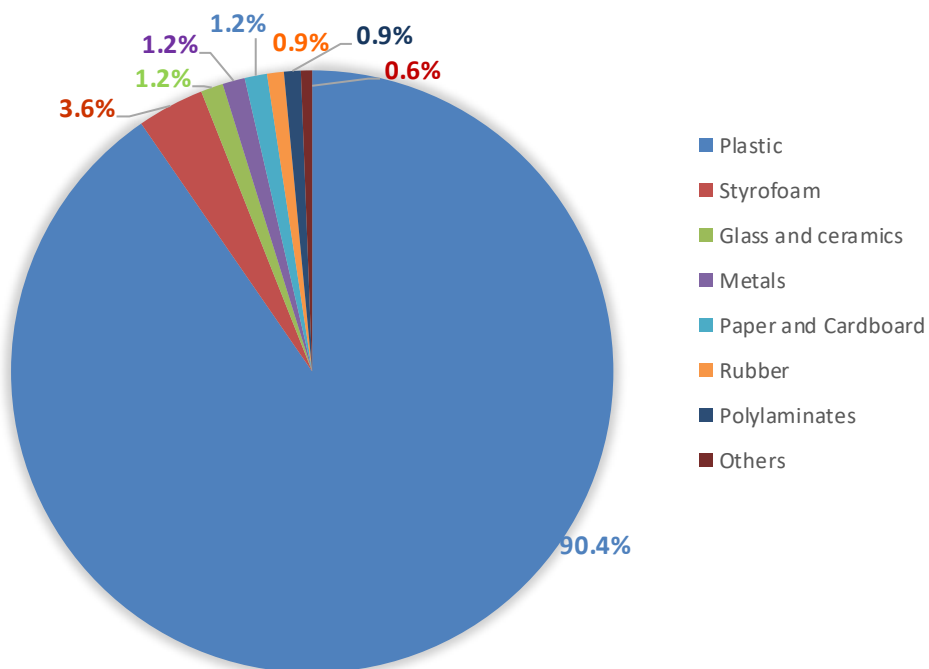
Figure 8: High pollution segment - material type breakdown based on quantity

High pollution segment - Material Weight breakdown

- Plastic
- Styrofoam
- Glass and ceramics
- Metals
- Paper and Cardboard
- Rubber
- Polylaminates
- Others

4.7% 1.0%
13.1%
0.1%
1.0%
5.2%
4.2%

70.6%
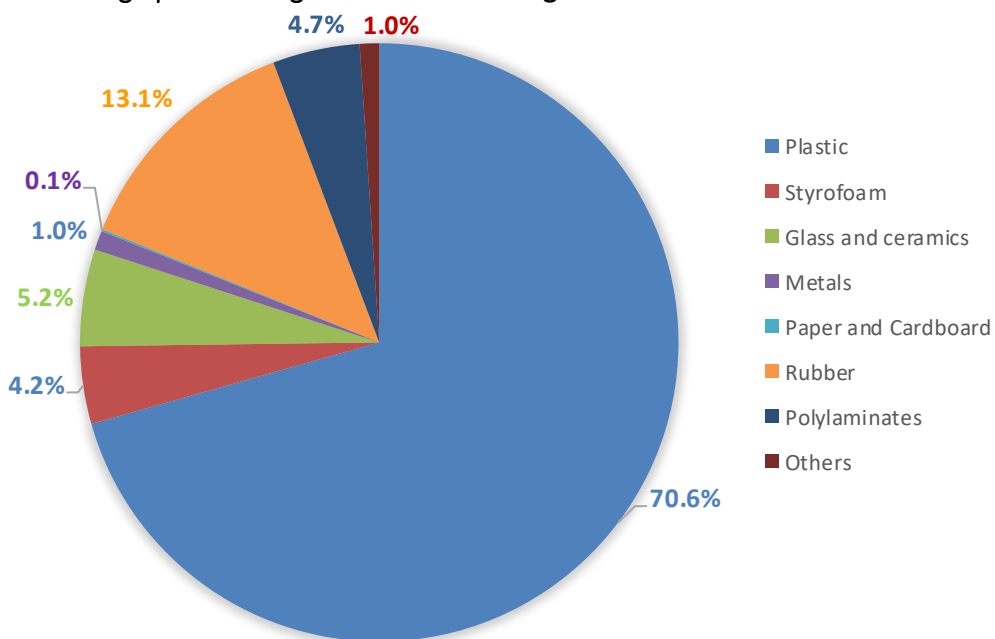
Figure 9: High Pollution Segment - Material Weight Breakdown

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High Pollution Segment- Source breakdown by weight

- Fishing Equipment (multi use)
- Food and snacks (single use)
- Home care/personal care (single use)
- Utilities (single use)
- Utilities (multi use)
- Tobacco products (single use)
- Undesignated
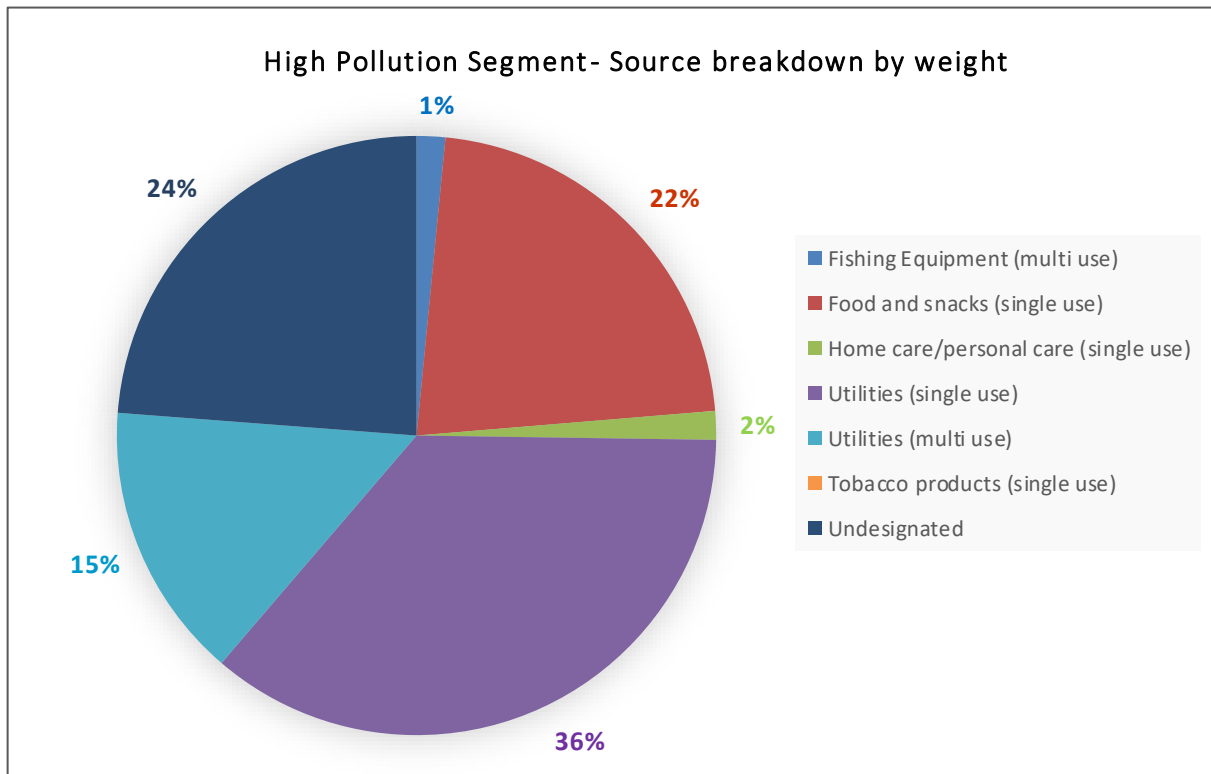
Figure 10: High Pollution Segment - Source Breakdown by Weight

The analysis of the medium pollution segment highlighted the dominance of plastic as the primary material, constituting 72.3% of the items and 46.5% of the total weight. Among the plastic items, loose plastic fragments and plastic bottle caps & rings were the most frequently encountered. Styrofoam followed, representing 4.0% of the items and 5.8% of the total weight, with granulated or laminated Styrofoam packaging fragments being the main form identified. Textiles, such as glows, accounted for 2.3% of the items and 10.4% of the total weight. Glass and ceramics were found in 1.1% of the items and made up 11.2% of the total weight, with fragmented glass bottles being the primary type identified. Metals, primarily in the form of cans and metal lids, represented 2.8% of the items and 5.0% of the total weight. Rubber fragments and flip-flops comprised 5.1% of the items and 20.5% of the total weight, while other items like lighters constituted 12.4% of the items but only 0.5% of the total weight.

Project Implemented by:

Table 2: Items collected in the medium-pollution segment

Material	Article	Quantity (n. items)		%	Weight (grams)		%
Plastic	Plastic fragments (loose)	1			0.0005		
	Plastic fragments (hard)	10			0.0365		
	Other PET bottles	1			0.0145		
	Plastic bottle caps & rings	19			0.022		
	Pharmaceutical packaging, medicine and ointments (plastic)	1	128	72.3%	0.0045	601	46.5%
	Disposable cutlery (plastic)	9			0.009		
	Plastic wrapping and packaging	20			0.0205		
	PVC wire with metal	6			0.014		
	PVC wire without metal	12			0.13		
	Multi-layered plastic packaging	12			0.0185		
	PVC rope	1			0.001		
Styrofoam	Styrofoam packaging fragments (granulated or laminated)	7	7	4.0%	75	75	5.8%
Textiles	Glows	4	4	2.3%	135	135	10.4%
Glass and Ceramics	Glass bottles in fragments	1	2	1.1	5	145	11.2%
	Whole glass bottles	1			140		
Metals	Cans	2	5	2.8%	60	65	5.0%
	Metal lids	3			5		
Rubber	Undefined rubber fragments	4	9	5.1%	5	265	20.5%
	Flip-flops	5			260		
Others	Lighters	1	22	12.4%	5	6	0.5%
	Matchsticks	21			1		
		177		100%	1292		100%

Medium pollution segment - material weight breakdown
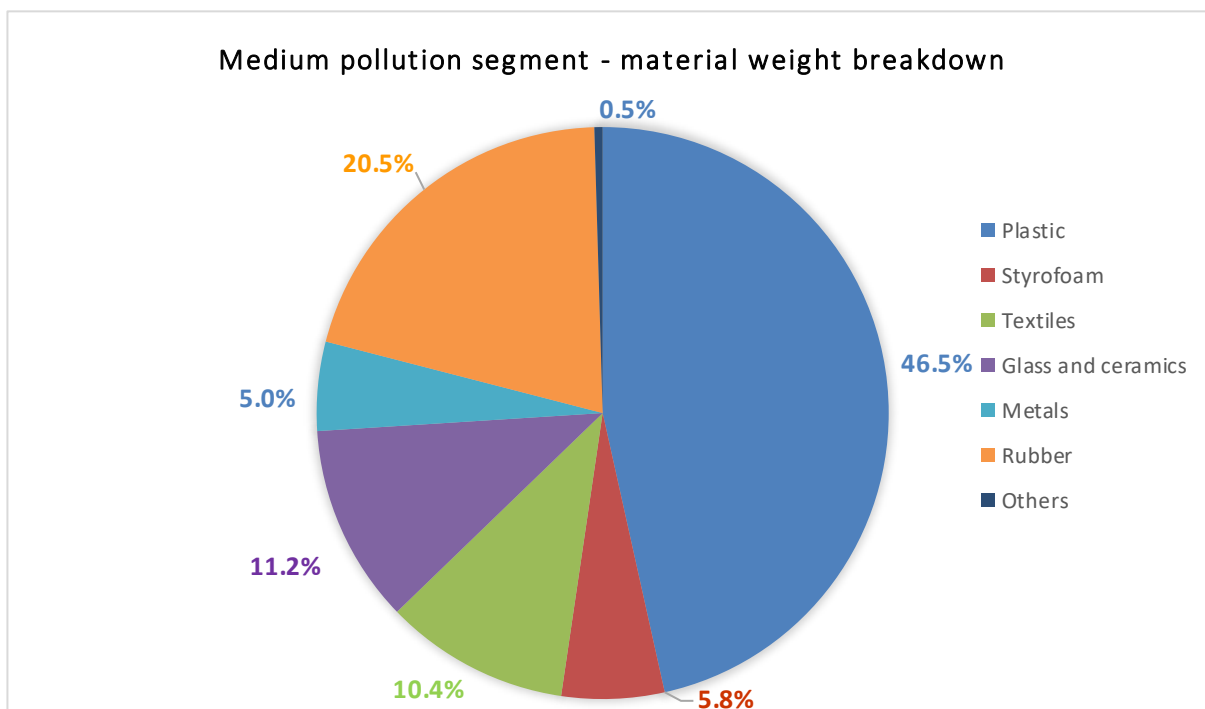
Figure 11: Medium pollution segment - material weight breakdown

Medium pollution segment - material type breakdown based on the quantity of the articles
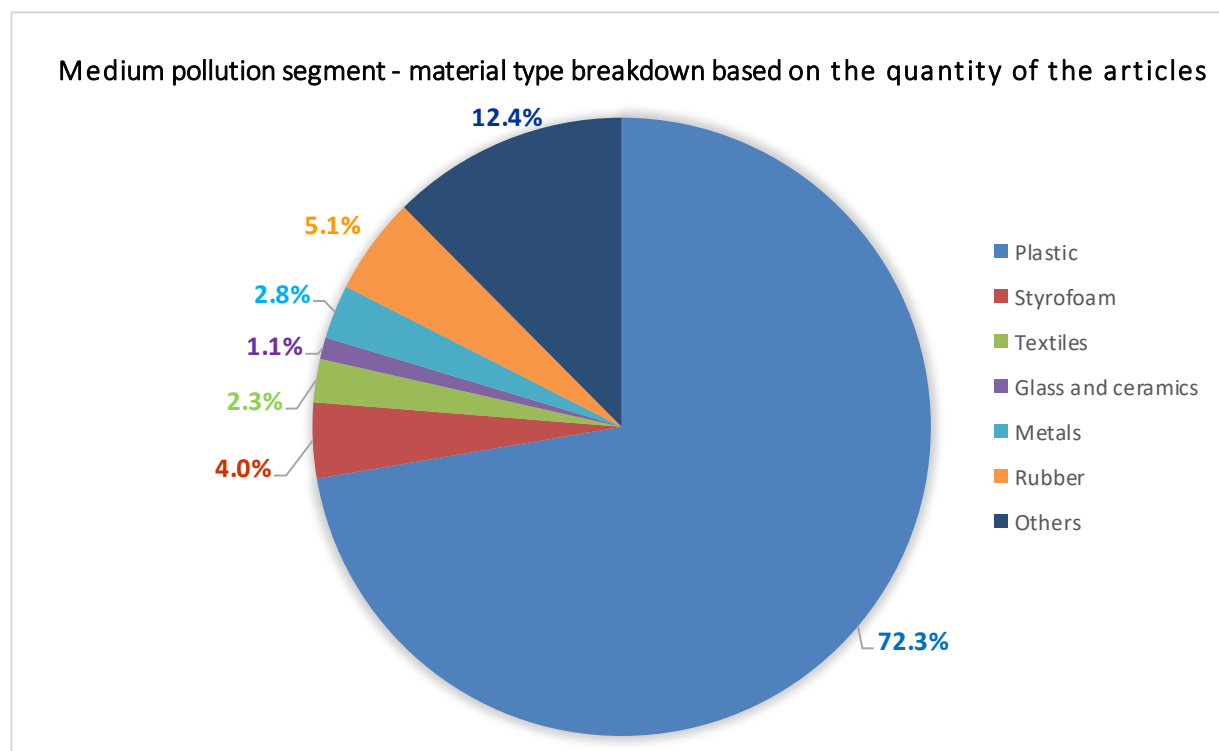
Figure 12: Medium pollution segment - material type breakdown by quantity

Medium Pollution Segment- Source breakdown by weight

Legend:
- Fishing Equipment (multi use)
- Food and snacks (single use)
- Home care/personal care (single use)
- Utilities (single use)
- Utilities (multi use)
- Tobacco products (single use)
- Undesignated

Pie chart values: 1%, 37%, 7%, 14%, 30%, 11%
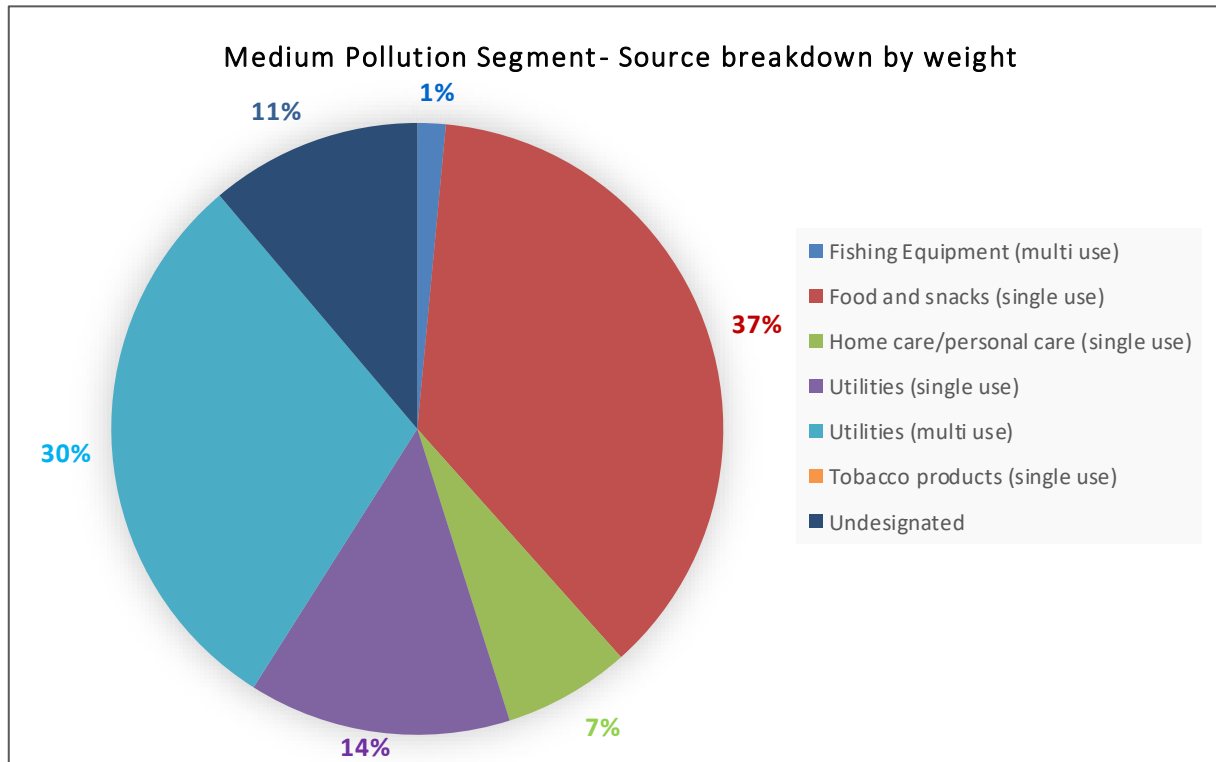
Figure 13: Medium Pollution Segment- Source breakdown by weight

The analysis of the items collected in the low pollution segment show that also here plastic is the predominant material, accounting for 75.2% of the items and 33.5% of the total weight. The most common plastic items found were hard plastic fragments. Styrofoam represented a smaller portion, comprising 2.3% of the items and 0.2% of the total weight, with granulated or laminated Styrofoam packaging fragments being the primary form identified.

Glass and ceramics constituted 0.8% of the items but had a significant weight contribution, making up 58.2% of the total weight, mainly due to a whole glass bottle found. Metal fragments accounted for 1.5% of the items and 0.9% of the total weight. Paper and cardboard fragments made up 7.5% of the items and 2.7% of the total weight.

Table 3: Items collected in the low-pollution segment

Material	Article	Quantity (n. items)	%	Weight (grams)	%
Plastic	Plastic fragments (hard)	1		0.005	
	Plastic bottle caps & rings	6		0.0065	
	Plastic wrapping and packaging & bags	35	100	0.031	187
	PVC wire with metal	2	75.2%	0.024	33.5%
	PVC wire without metal	8		0.107	
	Multi-layered plastic packaging	32		0.046	
Styrofoam	Styrofoam packaging fragments (granulated or laminated)	3	3 — 2.3%	1	1 — 0.2%
Glass and Ceramics	Whole Glass bottle	1	1 — 0.8%	325	325 — 58.2%
Metals	Metal fragments (undefined)	2	2 — 1.5%	5	5 — 0.9%
Paper and Cardboard	Fragments of paper and documents	10	10 — 7.5%	15	15 — 2.7%
Polylaminates	Tetra pack	1	1 — 0.8%	10	10 — 1.8%
Others	Masks	2	16 — 12%	10	15 — 2.7%
	Cigarette filters	14		5	
		133	100%	558	100%

PROM☉SE
PREVENTION OF MARINE LITTER
IN THE LAKSHADWEEP SEA

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Low pollution segment - material type breakdown based on the quantity of the articles

- Plastic — 75.2%
- Others — 12.0%
- Polylaminates — 0.8%
- Paper and Cardboard — 7.5%
- Metals — 1.5%
- Glass and ceramics — 0.8%
- Styrofoam — 2.3%

Legend:
- Plastic
- Styrofoam
- Glass and ceramics
- Metals
- Paper and Cardboard
- Polylaminates
- Others

Figure 14: Low pollution segment - material type breakdown based on the quantity of the articles

Low pollution segment - material weight breakdown

- Plastic — 33.5%
- Styrofoam — 0.2%
- Glass and ceramics — 58.2%
- Metals — 0.9%
- Paper and Cardboard — 2.7%
- Polylaminates — 1.8%
- Others — 2.7%

Legend:
- Plastic
- Styrofoam
- Glass and ceramics
- Metals
- Paper and Cardboard
- Polylaminates
- Others
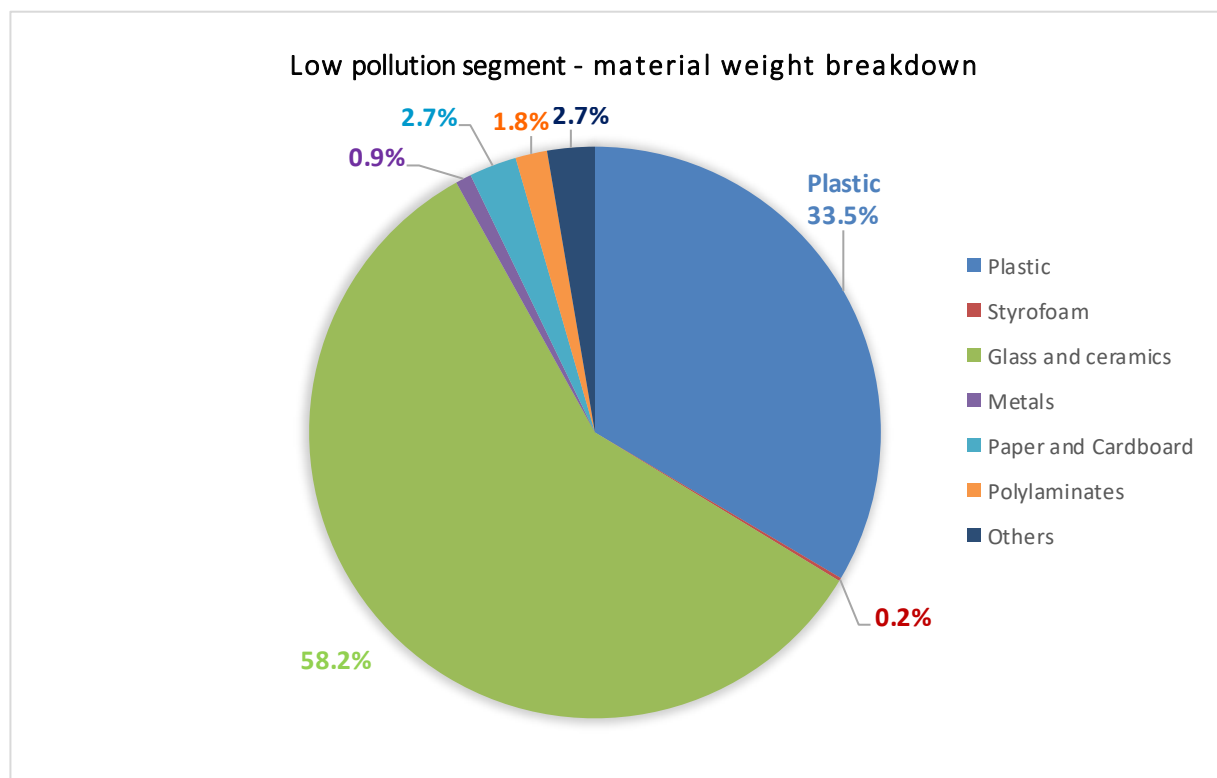
Figure 15: Low pollution segment - material weight breakdown

Project Implemented by:

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Data elaboration

Of the 25 segments identified during the visual inspection, 3 were classified as high pollution, 7 as medium, and 15 as low pollution. To estimate the total pollution load, we assumed that segments within each pollution category (high, medium, and low) have similar pollution characteristics (e.g., types of items and their respective weights) to those segments that were manually sampled. This assumption allows for extrapolating the total number and weight of items present in the 250-meter stretch of the beach. The table below shows the estimated number and weight of the items present in Kalutara beach.

Table 4: Extrapolation of items number and weight for Kalutara beach

Material	Total number of items	% of number items	Total weight of the items (g)	% of the items weight
Plastic	2,999	78%	8,476	46%
Styrofoam	121	3%	657	4%
Glass and ceramics	38	1%	5,065	27%
Metals	71	2%	545	3%
Paper and Cardboard	132	3%	183	1%
Rubber	72	2%	2,230	12%
Polylaminates	21	1%	255	1%
Others	380	10%	1,197	6%
Total	3,834	100%	18,608	100%

The analysis reveals a concerning dominance of plastic waste, constituting 78% of the total number of items and 46% of the total weight. This emphasizes the urgent need to address the plastic pollution issue. Styrofoam's presence at 3% of the items and 4% of the weight also raises environmental concerns, as it is a non-biodegradable material with adverse effects on ecosystems. The relatively smaller percentages of polylaminates, glass, ceramics, metals, paper, and cardboard materials indicate potential areas for recycling efforts, given their recyclable nature.

Entire beach extrapolation - material type breakdown

0.5%
1.9%
3.4%
1.9%
1.0%
3.2%
9.9%

- Plastic
- Styrofoam
- Glass and ceramics
- Metals
- Paper and Cardboard
- Rubber
- Polylaminates
- Others

78.2%

Figure 16: Entire Beach Extrapolation - Material Type Breakdown

Entire beach extrapolation - material weight breakdown

1.4%
6.4%
12.0%
1.0%
2.9%

- Plastic
- Styrofoam
- Glass and ceramics
- Metals
- Paper and Cardboard
- Rubber
- Polylaminates
- Others

45.6%

27.2%

3.5%
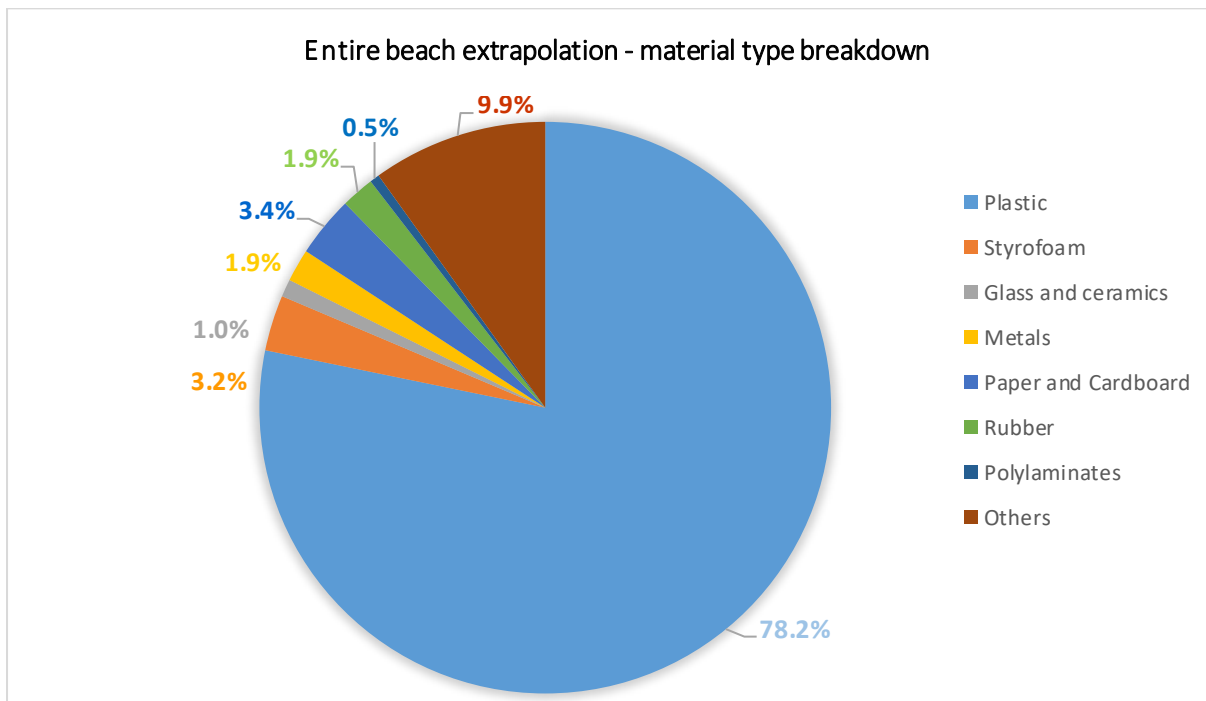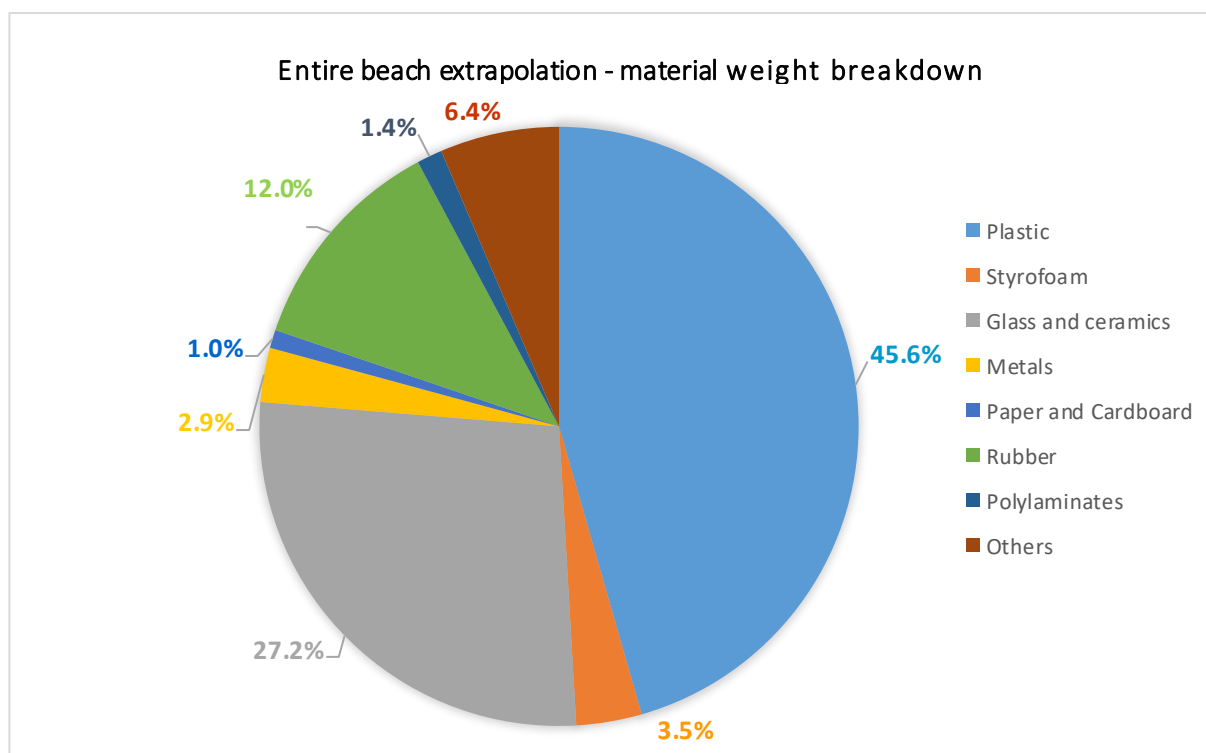
Figure 17: Entire Beach Extrapolation - Material Weight Breakdown

6. Interviews with local stakeholders

Through interviews with different focus groups active in the pilot area, the project team aims to understand the waste management behaviours, 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 NCPC Team was present in Kalutara from the 25th until the 27th of April 2023 and had a total of 17 interviews across three main groups of stakeholders:

- Stakeholders from the public sector, focusing on the Kalutara local authority and formal waste collectors
- SMEs
- NGOs

Local authority

1. Secretary of the Kalutara Urban Council

Secretary of the Kalutara Urban Council was interviewed on April 25. She told the team that the Public Health Inspector in the Kalutara area is responsible for waste collection of the beaches and surrounding areas twice a week. On a daily basis, they quantify the biodegradable and non-biodegradable waste. However, they do not qualify for further classifications. After the waste streams are separated mainly at source, they are transported and disposed of at the Pohorawatta dump site (Mihisaru Waste Management's Center). In terms of waste generation at the beach, she does not observe any significant seasonal variations.
Local SMEs must take the waste to the nearest road where the garbage truck passes.
As the biggest problem she mentions that on the one hand people dump their waste on the beach and on the other hand the waste is washed from the river Kalu to the beaches. To overcome these issues a program called "Kasala Pola" is conducted where the urban council sells the reusable and recyclable waste to buyers.

Figure 18: Example of track records from Mihisaru Waste Management Center about waste type

Formal Waste Collectors

2. <u>Compliance executive of the Eco Spindles recycling plant</u>

On the 27th of April, the compliance executive of the Eco Spindles recycling plant, was interviewed.

He states that around ten tons of the waste collected per month is plastic waste. This plastic waste is used at the recycling plant to make yarn while other waste is disposed of through legal parties. He also indicates that there are seven recovery facilities available in the area. Waste is directly collected by the company but with support of a third-party collectors and there is a waste collectors' network available around the country. Additionally, a "waste to value" app is informing hotels and other tourism related companies about collection services. He says that there are collection bins available in some of the beach areas and beach clean-up happens on a quarterly basis.

On the 27th of April 2023 the project team also met the owner of "Navoda Enterprises".

He indicated an overall generation of waste is ten tons per day in the municipality. The waste, collected by his enterprise is separated into HDPE, LDPE and BOP. After segregation at the facility the waste which cannot be recycled are sent to INCEE for disposal. The company produces bags from recycled plastics in the area. According to him, waste is collected on a daily basis by his collectors. Also, third party collectors

support the collection of household waste and waste from hotels and tourism related activities. While this is a regular activity, he comments that there are no regular beach clean ups organized in the area by his company.

SMEs

In total, the project team interviewed 12 SMEs on the 25th and 26th of April 2023.

1. SME 1

On the first day, the 25th of April 2023, the owner of the SME 1 (Restaurant) stated that they generate about one bag of waste per day (2-3 kg) and that this amount would increase in the timeframe from September to April. Segregation of waste is not being conducted and parts of the waste generated are burnt. Otherwise, trash is stored outside the restaurant until it is picked up once a week by the municipality, with no fee. He estimates that the restaurant must dispose of about 15 plastic bottles and five plastic food wrappers a day that are not separated from other general trash. Selling of these valuable materials to informal collectors or any recycling company is not taking place until now.

Figure 19: Interview with SME 1 (Restaurant) on 25th of April 2023

2. SME 2

On the same day, the project team interviewed the manager of SME 2 (Restaurant). He indicates that one bucket of waste is generated per day and that this generation increases from December to February. They separate glass and plastic waste from the general waste streams and store their waste outside the restaurant until it is picked up by the municipality once a week, without having to pay a fee. Nevertheless, most of the waste gets burned in the premises (restaurant land).

Specifying the amount of plastic waste, he says that they collect around 100 plastic bottles per month which are separated at source and handed over for free to informal collectors or recycling companies.

Figure 20: Interview with the Manager of SME 2 (Restaurant), on 25th of April 2023

3. SME 3

Also, on 25th of April 2023, the owner of SME 3(Restaurant) stated that the restaurant would generate around one bucket of waste per day and that this amount increases from November to February. In his restaurant, there is no waste separation at the source, and waste is stored outside the restaurant until it is collected once a week by the municipality, without having to pay a fee for waste collection. He estimates a generation of 15 plastic bottles per day, which are not being separated from the other general waste.

Figure 21: Waste bins at SME 3 (restaurant)

4. SME 4

Another interview hold on this day, was with the owner of SME 4 (Restaurant), who states that approximately one bag of waste is generated in his business per day. In his restaurant glass and plastic waste is separated and al the waste is stored outside the restaurant until the urban council picks it up for free once a week. He estimates that there are about 50 to 60 plastic bottles per week, which are given away for free to informal collectors or recyclers in the area.

5. SME 5

The owner of SME 5 (Restaurant) stated that his business generates about one bag per day and that this amount increases by the end of march. There is no waste separation, and waste is stored outside the restaurant before being mainly burned or buried on the beach. He approximates an amount of ten to 15 plastic bottles being generated per day, which are not separated and therefore also not be handed over to informal collectors or recycling industries.

6. SME 6

The owner of the SME 6 (Restaurant), states that one bag of waste is generated per day. This waste is stored outside the restaurant and being mainly burnt. Only glass and plastic waste is being separated from the other waste streams and plastic bottles sum up to around ten bottles per day. Nevertheless, no material is being handed over to recyclers or informal waste collectors.

Figure 22: Plastic bottles and cans at SME 6 (Restaurant)

7. <u>SME 7</u>

The waste manager from SME 7 (Club), says that the business generates about 1.5 tons per month which is being segregated into plastic, glass, paper and food waste. The food is stored at the property and food waste gets collected on a daily basis while other waste gets collected weekly. He estimates a generation of about half a ton of plastics per month which gets separated and handed over to the formal collectors. He also states that composting possibilities would be available on site.

Figure 23: Interview with the waste manager of SME 7 (Club), on 24th of April 2023

8. SME 8

The manager of SME 8(Restaurant) informed the project team that one bag of waste is being generated per day. This waste is not segregated and gets stored in the property area until it gets collected once a week from the urban council or gets burned. He estimates a generation of 10 to 15 plastic bottles per day, which are not separated from the general waste and therefore also not sold or given to informal collectors or recyclers.

9. SME 9

The last interview on April 25, 2024, was conducted with the owner of SME 9 (Restaurant), who stated that there is one bucket of waste in his restaurant. Only glass and plastic waste are separated and stored outside the restaurant until the municipality collects them once a week without charging a fee. About 15 bottles are generated per day, the bottles are neither sold nor given for free to local recyclers or the informal sector.

10. SME 10

On the 26th of April 2023 three additional interviews were conducted with different hotels in Kalutara. The environmental executive from the SME 10 (Hotel) could give an exact breakdown of different waste streams (including plastic waste) which can be assessed in figure 11. The generation of plastic water bottles varies between 54 kg a month to 373 kg a month.

No	Type of Waste	Jan	Feb	March	April
1	Iron			15 kg	
2	Aluminium			59 kg	
3	Brass				
4	Burn Oil	140 L	100 L	180 L	4 L
5	Card Board		360 kg	481 kg	382 kg
6	Iron				
7	Coconut Shell		605 kg		
8	Copper				
9	GI Sheet				
10	Glass Bottle Green	153 kg	214 kg	277 kg	133 kg
11	Glass Bottle white	394 kg	364 kg	338 kg	661 kg
12	Glass Pieces				22 kg
13	Jam Bottle				
14	Metal tin	167 kg	6 kg	216 kg	156 kg
15	Paper				
16	Plastic Can 1L				
17	Plastic can 2L				
18	Plastic can 4L	203 No	60 No	269 No	257 No
19	Plastic Can 20 L	5 No			
20	Plastic Can 25 L	72 No	16 No	49 No	50 No
21	Plastic				214 kg
22	Plastic Water Bottles	373 kg	54 kg	367 kg	156 kg
23	Magazine				
24	Solid Fuel Cans				
25	Steel/ Iron				

Figure 24: Waste generation figures of SME 10 (Hotel)

She explains that the waste streams are generally higher in the period from January to April. They separate the waste streams into plastic, glass, paper and food waste and store them in a storage room at the hotel. Wet waste is collected daily, while dry waste is collected weekly. Separated plastic waste is given to the official collector, and garden waste is used for composting. Plastic waste is not only collected by the hotel itself, but guests are also encouraged to dispose of found bottles at the Ocean Waste Collection Center (see Figure 12 and 13). The hotel's sustainability efforts are also evident in the composting of garden waste and the handing over of clinical waste and e-waste to certified collectors. The collection of the clinical waste costs an annual fee of Rs. 9000, a per visit fee of Rs. 2000 and a per kg fee of Rs. 600.

Figure 25: Ocean Waste Collection Centre at SME 10 (Hotel).

ocean waste type	Jun-22	22-Sep	Mar-23
Pet bottles:	40 kg	31.65 kg	19.45 kg
Polythene and soft plastics	19.5 kg	11.75 kg	0.7 kg
Glass:	18 kg	40.70 kg	20 kg
Metal Tin:	1.5 kg	1.15 kg	1.85 kg
Styrofoam	3 kg	17.85 kg	
Total:	82 kg	103.1 kg	42kg

Figure 26: Breakdown of waste collected through the ocean waste centre at SME 10 (Hotel)

11. SME 11

Another interview was conducted also on the 26th of April with the manager of SME 11 (Hotel), who indicated a generation of about 500 kg of waste per month. This amount of waste is segregated into plastic, glass, paper and food waste and is stored in the property area of the hotel until it gets collected.

Food waste gets picked up on a daily basis while the rest of waste gets picked up weekly. He indicates that about 100 kg of the collected waste is plastic waste which is being separated and handed over to formal collectors.

12. SME 12

The last interview on the 26th of April 2023 was conducted with a staff member of SME 12 (Hotel), who indicates that the hotel generates one bag of waste per day. This waste gets segregated into glass and plastic waste and stored in the property area of the hotel until it gets picked up from the urban council once a week. He estimates the generation of plastic being at around ten bottles per day. Although they are segregated at source they are not handed over to informal collectors or recycling companies.

NGOs

On the 27th of April 2023, two NGOs were interviewed by the project team.

1. Pearl Protectors

The first interview was conducted with the coordinator of "Pearl Protectors", who indicates that the NGO conducts two to three beach clean ups per month. These clean-ups are also arranged in collaboration with local SMEs. The most common types of plastic found there are plastic bags, (food) wrappers, bottles and sachet packets. He explains that the bottles are mainly washed up on the beach from the sea and only in rare cases come directly from the SMEs. For him, tools for better waste collection would be needed to reduce the amount of littered waste.

2. Centre for Beach Cleanups

The second NGO interviewed on this date was the "Centre for Beach Cleanups". The founder of the NGO stated that they conduct one beach clean-up per month but have the intention to increase the number. Most common items found at the beaches are plastic bottles, according to him. He says that the correlation between local tourism and waste present on the beach is mainly noticeable in Dehiwala, Mt. Lavinia area as there can be found a lot of beer cans and cigarettes. He believes that improving waste management can be achieved in part with volunteers, but sponsors are also needed.

7. Waste sources and sinks

The MFA study shows that there are several sources of municipal solid waste and that this waste is either sent for processing, landfilling or leaks out to the environment. The sources and sinks identified thus far are listed and shown below. The current study did not quantify waste flows in Kalutara and therefore only qualitative relationship of waste flows are depicted here. The biggest concern of course is the leakage of waste, open burning and littering into the environment.

Sources:

- Tourism Activities: Individual tourists, hotels, events, and restaurants contribute significantly to the generation of municipal solid waste. Tourism-related activities often result in the production of single-use items, such as plastic bottles, food wrappers, and packaging.

- Domestic Activities: Waste generated from households and individual consumers is another major source of municipal solid waste. Daily activities in residential areas contribute to the overall waste generation.
- Commercial Activities: Businesses, including shops, offices, and SMEs, generate waste through their daily operations. Plastic packaging, food containers, and office waste are common contributors.
- City or Town Level Activities: Public spaces, street cleaning, and events organized by local authorities also generate waste. Waste generated in public areas can be significant, especially during gatherings and events.

Sinks:

- Recycling to make new products or materials: Some portion of the waste is sent for recycling, where it is processed to create new products or materials. Recycling efforts help divert waste from landfills and reduce resource consumption.
- Incineration in Cement Kilns: In neighboring states or regions, some waste is incinerated in cement kilns as a form of waste-to-energy conversion. This process can help generate energy from waste but requires proper waste segregation and environmental controls.
- Landfilling: A portion of the waste is sent to landfill sites for disposal. Landfills serve as a common method of waste management but may pose environmental challenges if not properly managed.
- Leakage into the Environment: Unfortunately, a significant portion of waste ends up as litter, leaking into the environment. This includes litter on beaches, in rivers, and marine environments, causing environmental harm and posing risks to wildlife.
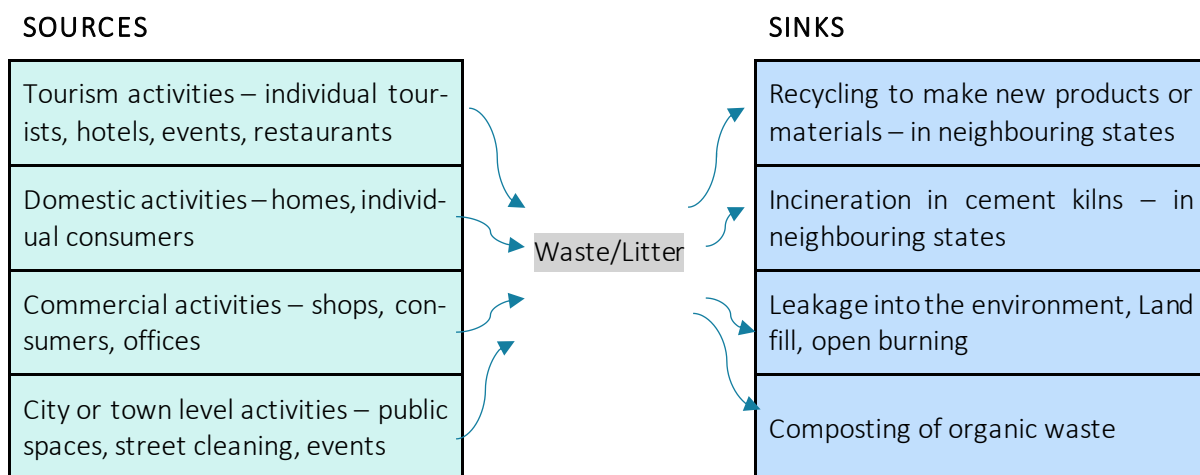
SOURCES

SINKS

Tourism activities – individual tourists, hotels, events, restaurants		Recycling to make new products or materials – in neighbouring states
Domestic activities – homes, individual consumers	Waste/Litter	Incineration in cement kilns – in neighbouring states
Commercial activities – shops, consumers, offices		Leakage into the environment, Land fill, open burning
City or town level activities – public spaces, street cleaning, events		Composting of organic waste

Figure 27: Sources and sinks of municipal waste from Kalutara beach area

8. Conclusions on the conducted activities

Based on the conducted activities in Kalutara under the PROMISE project, the following conclusions can be drawn.

In the high pollution segment, plastic waste dominated the findings, accounting for a staggering 90.4% of the collected items, with 6 plastic fragments (loose) and 52 plastic fragments (hard). Other notable items included beverage bottles (PET) (6 items) and plastic bottle caps & rings (90 items). Styrofoam fragments were also present in this segment.

Moving to the medium pollution segment, plastic fragments (loose) were again prevalent, comprising 72.3% of the collected items, with 1 item found. Additionally, 7 items of styrofoam fragments (smooth Styrofoam) were recorded, highlighting the persistence of this hazardous material in marine environments.

In contrast, for the low pollution segment a significant concern arose from the presence of whole glass bottles, constituting 0.8% of the items, but contributing a considerable weight of 325 grams (58.2%).

Overall, the results emphasize the severity of plastic pollution in the high and medium pollution segments, with plastic fragments being the most common items. Additionally, styrofoam fragments and glass bottles were found in both medium and low pollution areas, indicating the need for improved waste management practices to reduce their environmental impact.

Interviews were conducted with different focus groups, including local authorities, SMEs connected to the tourism sector, and NGOs active on the island. The key findings are:

Local Authority and Formal Waste Collectors:

They play a critical role in maintaining waste management practices in the area. They diligently quantify the biodegradable and non-biodegradable waste on a daily basis, demonstrating a commitment to understanding waste patterns. The waste is usually transported to the Pohorawatta dump site for disposal. However, challenges persist, such as waste dumping on the beach and the influx of waste from the river Kalu. To address these issues, the "Kasala Pola" program has been implemented, showcasing innovative efforts to combat littering and promote sustainable waste management. By selling reusable and recyclable waste to buyers, they encourage waste reduction and recycling, fostering a sense of responsibility within the community.

SMEs:

Tourism enterprises in the area generate varying amounts of waste, with some businesses producing around one bag of waste per day, while others experience increased waste generation during specific seasons. The willingness of some SMEs to segregate waste into glass and plastic shows an awareness of responsible waste practices. However, not all SMEs implement waste separation at the source, which represents an area for improvement in waste management efforts. Despite this, it is encouraging that waste is stored outside establishments and collected weekly by the municipality, showcasing a coordinated approach to waste disposal.

The issue of plastic waste, including plastic bottles and food wrappers, is apparent in SMEs' waste streams. While some plastic items are separated and handed over to formal collectors, there is room for further enhancement in recycling initiatives and collaborating with informal collectors to address plastic pollution more effectively.

NGOs:

Organisations such as "Pearl Protectors" and the "Centre for Beach Cleanups," engage with the community to address marine litter. Their regular beach clean-up initiatives, in collaboration with local SMEs and volunteers, demonstrate a strong commitment to environmental conservation.

The items commonly found during beach clean-ups, such as plastic bags, food wrappers, bottles, and

sachet packets, highlight the prevalent issue of plastic pollution along the shoreline. The consistent presence of glass bottles, primarily washed up on the beach from the sea, underscores the importance of tackling waste disposal and leakage points at the source. However, NGOs face challenges in their efforts, including the need for improved waste collection tools and sponsorships to support their clean-up activities effectively.

9. Lessons learned and next steps

From the activities conducted as part of the "Prevention of Marine Litter in the Lakshadweep Sea (PROMISE)" project in Kalutara, Sri Lanka, several key lessons have been learned:

Importance of Data Collection: The MFA and manual sampling activities provided crucial data on marine litter composition and pollution levels. Collecting accurate and detailed data is essential to understand the extent of the problem and formulate effective solutions.

Plastic Dominance: The data revealed a significant prevalence of plastic waste along the shoreline. Plastic fragments, bottles, and packaging were the most common items found. This highlights the urgent need to address plastic pollution and implement measures to reduce its impact on marine ecosystems.

Waste Segregation at Source: Some SMEs demonstrated responsible waste management practices by segregating glass and plastic waste at the source. Encouraging businesses and individuals to adopt waste segregation can streamline recycling efforts and reduce contamination.

Need for Education and Awareness: Public awareness campaigns about the consequences of marine litter and the importance of responsible waste management are crucial to instigate behavioral changes and reduce littering.

Addressing Leakage Points: Identifying and addressing leakage points where waste enters the marine environment is essential to prevent further pollution and protect marine ecosystems.

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 analyse 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. The 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.

- Our study found that hotels do not currently track their plastic waste generation. To address this issue, the PROMISE team considers to create 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. Utilizing insights from the MFA, such as understanding seasonal variations of waste, identifying key stakeholders, and mapping waste flow patterns, the PROMISE project developed a methodology called "Sources to Sinks" (S2S). This new approach 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.

10.   Sources to Sinks Methodology (S2S)

The S2S methodology was developed by adelphi Research GmbH and STENUM Asia to determine the quantity of waste generated in the tourism businesses and to understand how this waste is managed. This approach involves a detailed assessment of hotels and guesthouses within a 2.5 km radius of each pilot location, including recording the number of beds and their yearly occupancy rates. 8 hotels and 7 guesthouses were selected in the location, based on their operational differences: hotels are defined as establishments providing restaurant services, whereas guesthouses did not offer such amenities.

The project outlined requires two main activities to be conducted in the pilot area, focusing on guest-houses and hotels. 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 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.

Before this characterization, facilities were asked to set aside all waste produced on a specific day and were provided with any necessary logistical support, such as a location to conduct the analysis. It was advantageous if the waste was pre-separated, as this simplified the subsequent steps. Additionally, it was important to know the guest count on the waste collection day to correlate the amount of waste generated with guest numbers.

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 PROMISE team actively engaging in waste characterization with a hotel in Kalutara, Sri Lanka

Figure 28: The PROMISE team engaging with a hotel for preparations of waste characterization on ground.

11. Waste Characterization

During the waste characterization phase, records are being checked if the waste is already segregated; otherwise, manual separation was made necessary. All waste categories were weighed and documented accurately. This systematic process enabled a comprehensive understanding of waste generation and management methods in the selected guesthouses and hotels, providing insights into effective environmental management strategies. To improve the accuracy of the data, all assessments were conducted in the morning, ensuring only waste generated from the previous day was considered for effective characterization. The procedure was strictly 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 Kalutara 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 29: Sorting and Segregation of Waste from Guest Houses and Hotels

Figure 30: Collected Waste Bags from Guest Houses and Hotels

Figure 31: Collection and Recording of Waste from Guest Houses and Hotels

Figure 32: Weighing and Quantification of Waste from Guest Houses and Hotels

12.   Waste Composition

Two hotels and a 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 588 guests were accommodated, the waste generated at the hotels consisted largely of plastics, with plastic bottles alone accounting for 19,7% of the total waste (18,03 kg), which translates to almost half a pound per guest. Other notable waste fractions in the hotels included cardboard (11,9%) and textiles (11,5%), providing a range of waste streams with significant quantities.

In contrast, at the guest house with only 34 guests, the waste composition was entirely different. The total generated waste was 1,12 kg, with other plastic packaging being the predominant component (57,1%). Cardboard came next, at 22,3% of the waste produced. The total waste generated from the guest house was much less, at 1,961 kg, and thus the waste per guest was significantly reduced to around 0,0577 kg.

These data highlight the impact of scale and guest numbers on waste composition and volume. Although plastics are the most reported waste in both settings, the types and quantities vary dramatically from hotel to guest house, indicating the need for waste management strategies tailored not just to the type of accommodation but also to its size and guest capacity. Such a targeted approach is essential for enhancing the effectiveness of recycling and reduction initiatives, crucial for sustainable operations in the hospitality sector.

Given below tables and pie charts illustrate detailed understanding on waste categorization and composition in hotels and guest houses:

Table 5: Waste categorization and composition from two hotels in Kalutara

Material	Item	Weight [kg]	Total Weight [kg]	Percentage (%)	Total Percentage (%)
Plastics	Plastic bottles	18,03	33,3	19,7	36,5
	Straws	0,00		0,0	
	Other plastic packaging	10,33		11,3	
	Other plastic items	4,91		5,4	
Glass	Glass bottles	3,10	3,5	3,4	3,8
	Other glass items	0,40		0,4	
Paper and Cardboard	Paper	7,08	27,0	7,7	29,5
	Cardboard	10,89		11,9	
	Other papers (e.g. tissues)	9,05		9,9	
Metal	Cans	2,11	2,3	2,3	2,5
	Other type of metal	0,18		0,2	
Residual	E-waste	9,52	25,5	10,4	27,9
	Textile	10,55		11,5	
	Shoes	5,46		6,0	
TOTAL AMOUNT OF GENERATED WASTE:		91,61			
TOTAL AMOUNT GENERATED PER HOTEL:		0,16			

Composition of Average of Waste Categorized in two hotels

- Plastic
- Glass
- Paper and Cardboard
- Metal
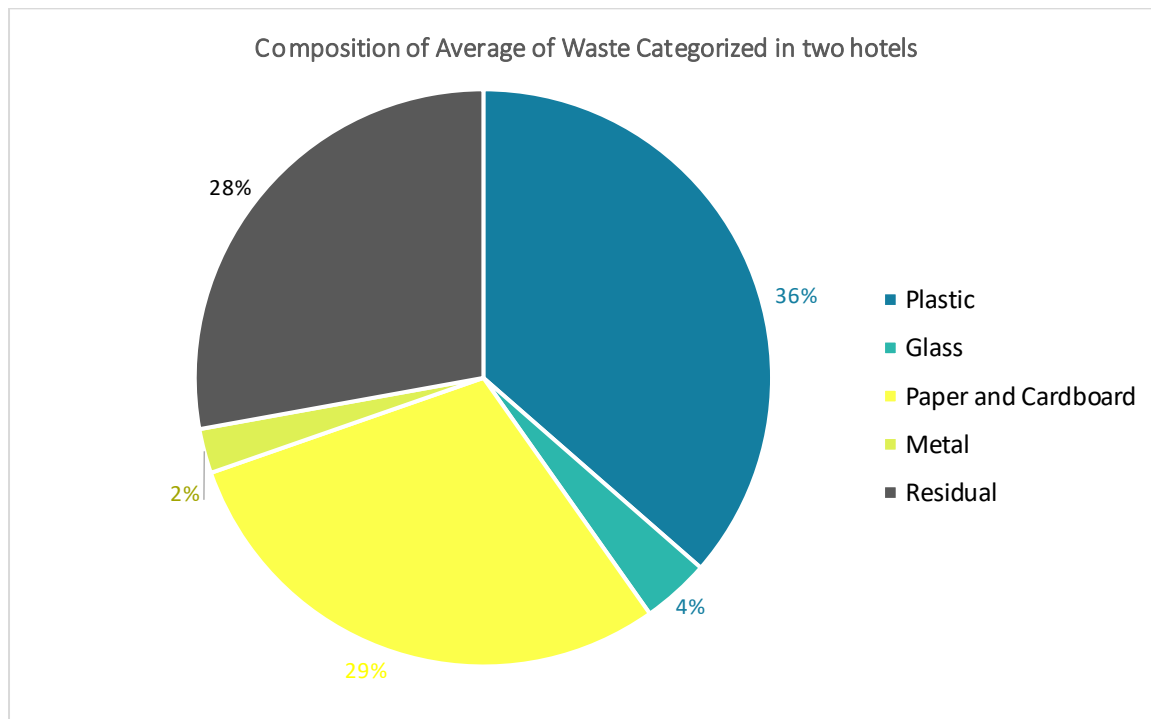- Residual

28%

36%

2%

4%

29%

Figure 33: Percentage composition of average waste categorized from two hotels in Kalutara

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

Material	Item	Weight [kg]	Total Weight [kg]	Percentage (%)	Total Percentage (%)
Plastics	Plastic bottles	0,11	1,26	5,80	64,70
	Straws	0		0,10	
	Other plastic packaging	1,12		57,10	
	Other plastic items	0,03		1,70	
Glass	Glass bottles	0,10	0,10	5,10	5,10
	Other glass items	0		0	
Paper and Cardboard	Paper	0,11	0,55	5,60	28,10
	Cardboard	0,44		22,30	
	Other papers (e.g. tissues)	0		0,20	
Metal	Cans	0,01	0,01	0,50	0,50
	Other type of metal	0		0	
Residual	*E-waste*	0,03	0,03	1,60	1,60
	Textile	0		0	
	Shoes	0		0	
TOTAL AMOUNT OF GENERATED WASTE:	1,96				
TOTAL AMOUNT GENERATED PER HOTEL:	**0,06**				

Composition of waste in two guest houses

- Plastics
- Glass
- Paper and Cardboard
- Metal
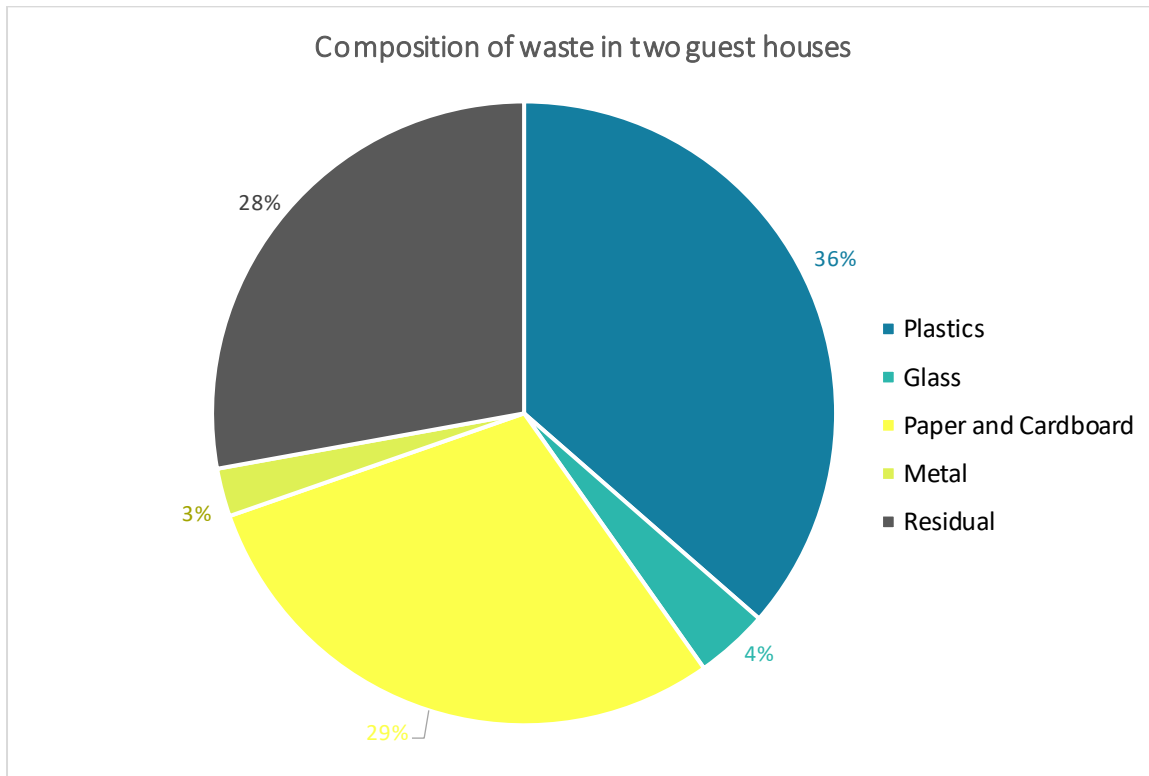- Residual

36%
4%
29%
3%
28%

Figure 34: Sankey diagram of the waste generated from the hotels for a year

Waste generated from hotels for a year

Over the past year, eight hotels in Kalutara, Sri Lanka, generated a significant amount of waste. Data on the fate of the waste was gathered from all eight hotels, while detailed waste characterization was conducted on samples from two representative hotels. The average composition from these samples was used to estimate the total waste for all eight hotels. The analysis revealed that these hotels generated approximately 28,737 kg of waste annually. The largest category was plastic bottles (8,774 kg), followed by paper (7,850 kg), cardboard (5,299 kg), and plastic packaging (excluding bottles) (5,028 kg). Glass bottles totaled 1,701 kg, while the smallest category was other metals at just 85 kg.

In terms of waste management fate:

- **Formally Collected:** Most of the waste, including plastic bottles (8,097.5 kilograms), plastic packaging (5,028 kilograms), and paper (7,850.3 kilograms), was formally collected, indicating a well-structured waste management system.
- **Informally Collected:** No waste was recorded as being informally collected in this dataset.
- **Burnt:** There was no data showing any waste being burnt, which might indicate good practices to avoid air pollution from waste burning.
- **Dumped in the Environment:** No waste was reported as dumped in the environment, which highlights effective management systems in place for controlled disposal.
- **Not Applicable (NA):** A notable portion of the waste, totaling 13,101 kilograms, was categorized as "Not Applicable" (NA), which indicates some inefficiencies or untracked waste in the system.
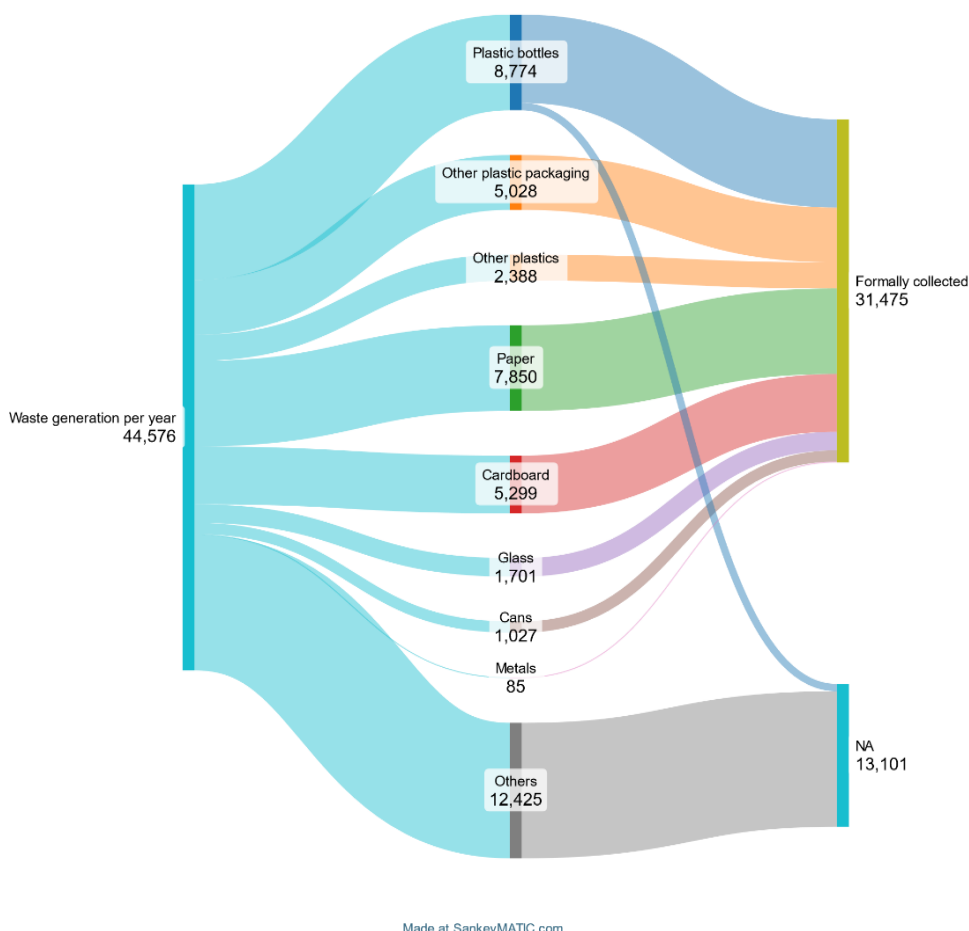
Figure 35: Sankey diagram of the total waste generated in the hotels for a year

Waste generated from guest houses for a year

This report presents a detailed analysis of waste generation and management across seven guest houses in Kalutara, Sri Lanka, over one year. Data on the fate of the waste was gathered from all seven guest houses, while detailed waste characterization was conducted on samples from two representative guest houses. The average composition from these samples was used to estimate the total waste for all guest houses. The analysis revealed 1,081.30 kg of waste generated annually, with plastic packaging (excluding bottles) being the largest category at 618.80 kg, followed by cardboard at 241.60 kg and paper at 62.30 kg. Other metals had no recorded contribution. This overview helps identify efficiency areas and gaps in current waste management practices.

In terms of waste management fate:

- **Formally Collected**: A significant portion of waste, including plastic bottles (321.68 kilograms), plastic packaging (18.40 kilograms), and cardboard (241.60 kilograms), was formally collected, reflecting an organized and controlled waste management system.

- **Informally Collected**: A substantial amount of waste was informally collected, including plastic packaging (437.30 kilograms) and plastic bottles (44.40 kilograms), indicating a reliance on non-formal waste channels that may not always follow regulatory standards.
- **Burnt**: Approximately 6.70 kilograms of waste, specifically cardboard, was burnt, which could pose risks related to air pollution and health hazards.
- **Dumped in the Environment**: Some waste, amounting to 11.60 kilograms, was dumped directly into the environment, which raises concerns about environmental management and the need for stricter disposal regulations.
- **Not Applicable (NA)**: Around 5.70 kilograms of waste was unaccounted for or handled through undefined means, signaling potential gaps in waste tracking and management.
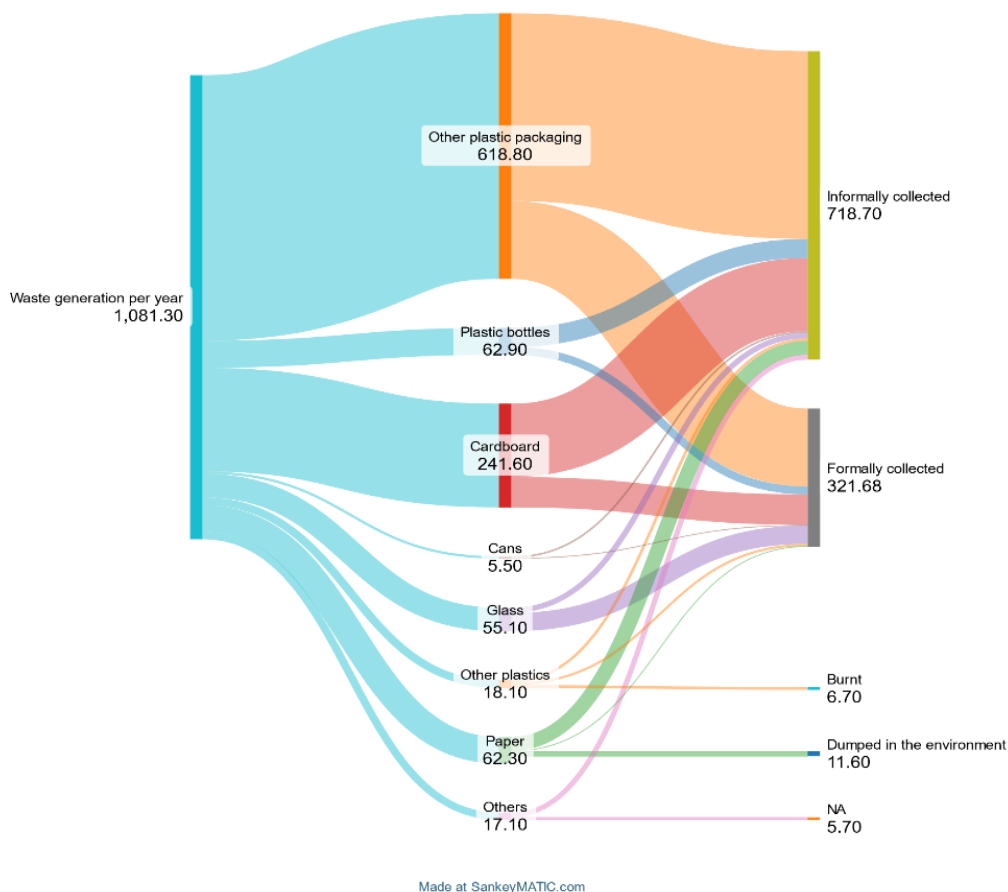

Made at SankeyMATIC.com

Figure 36: Sankey diagram of the total waste generated in the guest houses for a year

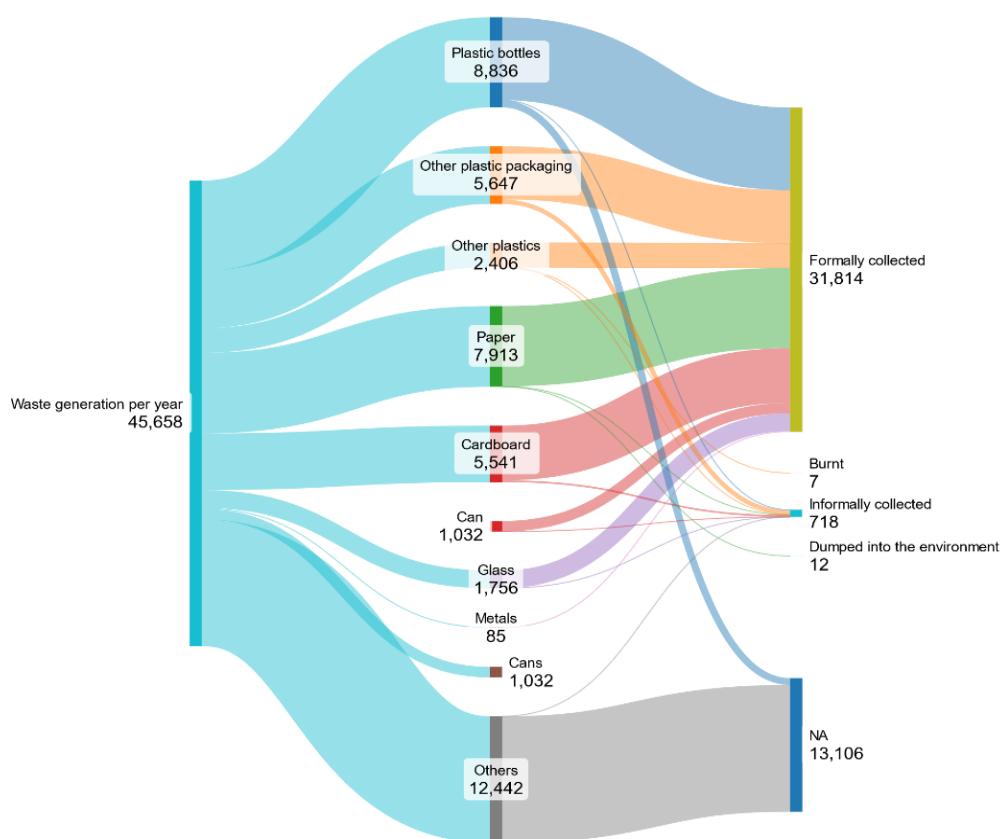## Total waste generated from hotels and guest houses for a year

The analysis of waste generation in guesthouses and hotel indicates a total of 45,658 kilograms produced across various categories. Plastic bottles emerged as the largest contributor, accounting for 8,836 kilograms, followed by paper at 7,913 kilograms, and cardboard, which made up 5,541 kilograms.

Project Implemented by:

Additionally, plastic packaging (excluding bottles) contributed 5,647 kilograms. Other metals represented the smallest portion, totaling just 85 kilograms.

Total waste generated from hotels and guest houses for a year

In terms of waste management fate:

- **Formally Collected**: A significant portion of the waste was formally collected, including plastic bottles (8,116 kilograms), plastic packaging (5,210 kilograms), and paper (7,869 kilograms), reflecting a structured waste management system.
- **Informally Collected**: Around 718 kilograms of waste, including plastic bottles (44 kilograms) and plastic packaging (437 kilograms), were informally collected, showing the presence of non-formal waste collection channels.
- **Burnt**: A small amount of waste, 7 kilograms, including other types of plastic, was burnt, which might indicate the presence of localized burning practices.
- **Dumped in the Environment**: Approximately 12 kilograms of waste, specifically glass, was dumped into the environment, raising environmental concerns.
- **Not Applicable (NA)**: A substantial amount of waste, 13,106 kilograms, was classified under "Not Applicable," suggesting inefficiencies or gaps in waste tracking systems.

Made at SankeyMATIC.com

Figure 37: Sankey diagram of total waste generated in hotels and guest houses for a year

13. Conclusion Sources to Sinks Analysis

The S2S activities carried out in the hotels and guesthouses surrounding Kalutara 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 glass bottles and plastic waste dominate the waste profile, underscoring the urgent need for targeted waste reduction strategies. The data revealed that a substantial portion of waste, especially plastics and glass, 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, the S2S activities have been instrumental in highlighting the critical areas where interventions are necessary. Enhancing formal waste collection, improving recycling efforts, and implementing strict regulations against burning and dumping are essential steps towards sustainable waste management.

14. Overall conclusion and recommendations:

The MFA and S2S activities carried out as part of the PROMISE project at Kalutara Beach in Sri Lanka 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:**
   o Plastic waste dominates the litter profile on Kalutara Beach, accounting for over 78% of total debris by item count and 46% by weight. This is largely due to the high usage of single-use plastics in the tourism sector.

2. **Sources and Management of Waste:**
   o The main sources of waste are directly linked to tourism activities, including hotels, guesthouses, and local restaurants, which contribute significantly to waste during peak tourist seasons.
   o Current waste management practices show mixed results, with some stakeholders implementing segregation and recycling, while others rely on informal or inadequate disposal methods.

3. **Impact of Seasonal and Tourist Activities:**
   o Seasonal variations and tourist influxes significantly affect the quantity and type of waste generated, emphasizing the need for flexible waste management strategies tailored to peak and off-peak periods.

4. **Engagement and Awareness Challenges:**

   o Limited awareness and engagement regarding proper waste management and recycling practices among businesses and tourists hinder efforts to reduce litter. NGOs and formal waste collectors face challenges in mobilizing community support and securing adequate resources.

Recommendations:

1. **Enhance Waste Management Infrastructure:**

   o Invest in robust infrastructure, such as bins for waste segregation at the source and increased formal collection services. Expand recycling facilities and implement composting systems for organic waste where applicable.

2. **Implement Policy and Regulatory Measures:**

   o Enforce stricter regulations to mandate waste segregation and reduce single-use plastic usage. Introduce penalties for non-compliance and incentives for businesses adopting sustainable practices.

3. **Promote Public Awareness and Education:**

   o Conduct awareness campaigns targeting tourists, locals, and businesses about the environmental impact of littering. Collaborate with NGOs, schools, and community groups to foster a culture of responsible waste management.

4. **Strengthen Local Capacities and Partnerships:**

   o Build partnerships among local authorities, SMEs, and NGOs to streamline waste management practices. Encourage businesses to actively participate in beach clean-ups and sustainable initiatives.

5. **Monitor and Evaluate Waste Management Practices:**

   o Develop monitoring systems to track waste volumes and management efficiency. Use this data to adapt strategies and refine policies for improved outcomes.

6. **Encourage Innovation and Sustainable Practices:**

   o Support research and development of sustainable materials and technologies for waste management. Promote certification programs for tourism businesses adopting green practices.

By implementing these recommendations, the PROMISE project can significantly mitigate the impact of marine litter on the Lakshadweep Sea, protect marine biodiversity, and enhance the sustainability of local tourism in Kalutara.

Project Implemented by: