People, Plastics & Palk Bay

Challenges, Opportunities and the Way Ahead

2023 Report

dakshin

Saahas Zero Waste

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

BCC	Behavioral change campaign
BOV	Battery operated vehicle
CPCB	Central Pollution Control Board
DTD	Door-to-Door
EPR	Extended Producer Responsibility
HDPE	High Density Polypropylene
GP	Gram Panchayat
IEC	Information Education and Communication
LCV	Light Commercial Vehicle
LDPE	Low-Density Polyethylene
MCC	Micro Composting Centre
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MLP	Multi Layered Plastic
MOHUA	Ministry of Housing and Urban Affairs
MRF	Material Recovery Facility
MT	Metric Tonne
NGO	Non-Governmental Organisation
OBP	Ocean Bound Plastic
PET	Polyethylene terephthalate
PIBO	Producer, Importer and Brand Owner
PP	Polypropylene
PS	Polystyrene
PWM Rules	Plastic Waste Management Rules, 2016
PWP	Plastic Waste Processor
PVC	Polyvinyl Chloride
RRC	Resource Recovery Center
SBM	Swachh Bharat Mission
SUP	Single use plastic
SWM	Solid Waste Management
SWM Rules	Solid Waste Management Rules, 2016
TNPCB	Tamil Nadu Pollution Control Board
TPD	Tonnes per Day
ULB	Urban Local Body

1. INTRODUCTION

India has witnessed a surge in generation of plastic waste due to population growth, increasing urbanisation, consumerism and economic growth. Over the last 5 years, the per capita plastic waste generation has almost doubled, culminating to 4.13 million MT of plastic waste generated in the year 2020-21. Among the states, Tamil Nadu stands as the second-highest contributor to the country's plastic waste generation, accounting for 430,107 MT of plastic waste in that year.[1] This substantial increase in plastic waste generation has overwhelmed the local government's capacity to collect, manage and process this waste in an ecologically responsible manner.

India also ranks 12th among the leading contributors to global marine plastic pollution[2]. An estimated 80 per cent of all marine pollution is caused by human activities on land including leakage of solid and plastic waste from inadequate waste management[3]. As per government data, only 1.1 million MT of plastic waste in India is managed per year through different processes and therefore, the remaining plastic waste is likely to be accumulated in dumpsites, landfills and in the open environment including the oceans[4]. This escalating plastic pollution poses a severe threat to marine ecosystems, river systems, and terrestrial environments, impacting biodiversity and human health adversely.

The Palk Bay is located along the southeastern coast of India between the southern tip of Tamil Nadu and the northern coast of Sri Lanka. It is recognised as a crucial biodiversity hotspot and is home to a diverse range of marine species. The Gulf of Mannar Biosphere Reserve, a UNESCO World Biosphere Reserve, also encompasses a substantial portion of Palk Bay. The region's economy heavily relies on fisheries, with numerous coastal communities engaged in traditional and modern fishing practices. Palk Bay also attracts a large number of tourists due to its natural beauty and religious significance of certain places in the region.

Currently, Palk Bay faces several environmental challenges, including overfishing, habitat degradation, and pollution including plastic pollution. The plastic pollution crisis is driven by increased waste generation, change in waste composition, rapid urbanisation, increased tourism and insufficient waste management infrastructure and processes. Given the extensive coastal areas, unmanaged plastic waste easily finds its way into the oceans and contributes to the marine litter in the region.

In light of the region's ecological significance and dependence of the local economy on marine ecosystems, there is an urgent need for measures to combat plastic pollution and establish a robust system for the management of plastic waste. An effective plastic waste management system not only has the potential of mitigating the adverse impacts of plastic pollution but also of enhancing the existing livelihoods and creating new employment opportunities for the local population.

Over 260,000 traditional fishing communities rely on the ecological wealth of the Palk Bay region for their livelihoods, which is being jeopardised by resource degradation and land, water, and marine pollution, largely fueled by unrestricted waste and plastics. Concern over marine plastic pollution has

1 https://cpcb.nic.in/uploads/plasticwaste/Annual_Report_2020-21_PWM.pdf
2 https://www.annualreviews.org/doi/pdf/10.1146/annurev-environ-102016-060700
3 https://www.unep.org/cobsea/what-we-do/marine-litter-and-plastic-pollution
4 https://cpcb.nic.in/uploads/plasticwaste/Annual_Report_2020-21_PWM.pdf

been growing globally, endangering both marine ecosystems and the health, social, economic and environment aspects of communities. A majority of marine debris primarily come from land-based sources made up of solid waste, single-use plastics, microplastics, fishing equipment, and ghost nets; and in this case of Palk Bay, tourist activities also partly contribute to waste generation.

Integrated and effective management of waste, active and informed community participation, outreach and proper regulatory measures are areas in need of foremost attention. An effective plastic waste management system not only has the potential of mitigating the adverse impacts of plastic pollution but also of enhancing the existing livelihoods and creating new employment opportunities for the local population.

As a part of the Recycling, Coastal Ecosystems and Community Wellbeing project in Palk Bay, Ramanathapuram, Dakshin aims to explore issues related to marine plastic debris and understanding income-support potential in plastic value-chains, support community grassroot leaders, maritime-based small-scale entrepreneurs and address exclusions in the distribution of government entitlements. The project does this by facilitating linkages to coastal research institutions, government programmes, civil society organisations and providing mentorship for grass-root actors.

With regards to plastic waste, a major focus of the study involved conducting a baseline assessment of plastic waste generation & characterisation of the waste generated at Dakshin's study sites; analysing the plastic waste value chain to determine the feasibility of generating local livelihoods through management of plastic waste. The study at its core is aimed at supporting the local governing bodies with decision-making and in building their capacities and solutions towards a better waste management system.

In the above context, Dakshin Foundation has engaged Saahas Zero Waste to carry out a scoping study on the existing plastic waste management systems in the Palk Bay region and explore the possibilities of generating livelihoods from improving these systems. Primarily the objectives of the project included the following:

- Conduct an assessment of plastic waste (including fishing nets) generated in the Palk Bay region including quantification and characterisation of such plastic waste
- Identify and map the key stakeholders, both formal and informal involved in the plastic waste value chain
- Evaluate the effectiveness of existing plastic waste management systems
- Examine the economic dynamics associated with the collection, trading and processing of plastic waste and livelihoods associated with them.
- Formulate recommendations aimed at improving and creating new livelihoods through enhanced and sustainable plastic waste management practices.

2. APPROACH AND METHODOLOGY

Palk Bay region covers 5 coastal districts in Tamil Nadu including Pudukkottai, Nagapattinam, Ramanathapuram, Thiruvarur and Thanjavur[5]. Given that these districts fall under different administrative zones in Tamil Nadu and Ramanathapuram has the longest coastline in the Palk Bay region, the baseline assessment was intentionally focussed on the specific geographical area of Ramanathapuram district. Within Ramanathapuram district, due to limited time and resources, the study centred on Rameswaram, Pamban, and Morepannai, collectively referred to as "Identified Locations". Rameswaram was selected for the study due to its geographical location, urbanisation, religious significance and inflow of tourists. Situated within 10 km of Rameswaram, Pamban represented a rural area in close proximity to an urban centre, providing insights into plastic waste management practices in rural-urban fringe regions. Morepannai is a rural area located more than 30 km away from any urban centre where Dakshin Foundation is carrying out its study relating to recycling, coastal ecosystems and community wellbeing. It is assumed that the plastic waste types and infrastructure in the Identified Locations is representative of the rest of the Palk Bay and therefore, an understanding of the plastic waste management ecosystem in these locations is expected to yield insights into the plastic waste management systems in the broader Palk Bay region.

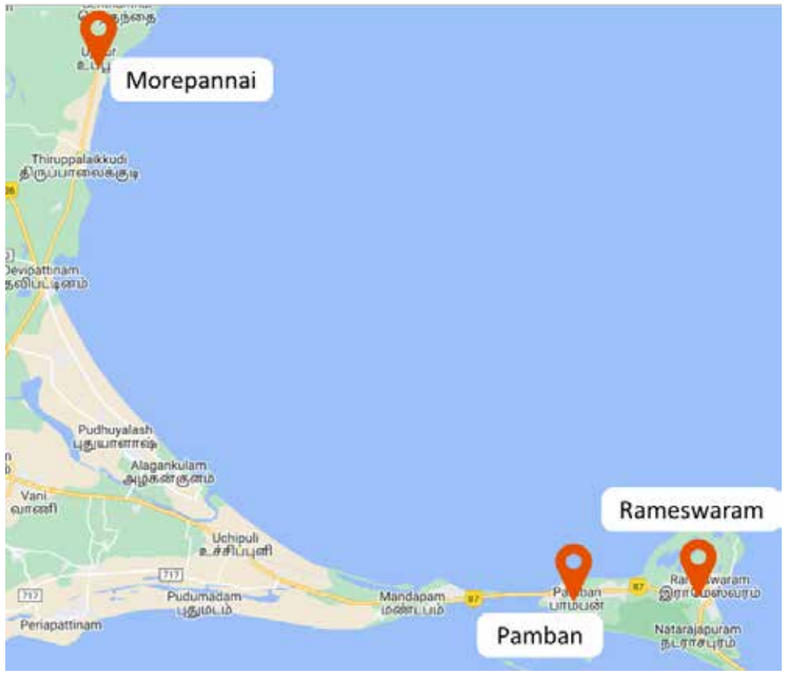

Figure 1: Identified Locations in the Palk Bay region

5 https://www.researchgate.net/publication/282332077_Livelihoods_assessment_of_the_Palk_Bay_region_for_GIZ_CSM-CMPA_project

The approach to conduct baseline assessment during the study was a combination of secondary desk research and primary data collection through site visits, waste audits and interviews at the Identified Locations.

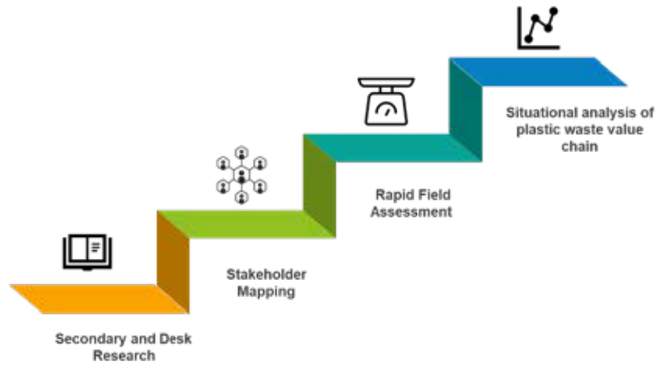

Figure 2: Approach and Methodology

2.1 Secondary and desk research

The first step of the baseline assessment was desk-based research on relevant regulations, data and information about the existing plastic waste management in the Identified Locations available in the public domain such as government websites, reports, relevant laws, policies, filings with the pollution control board and Swachh Bharat Mission (SBM) documents. This secondary research served as a foundational resource to understand the existing waste management systems, regulatory framework with respect to plastic waste management and map out potential stakeholders in the Identified Locations.

2.2 Stakeholder mapping

Complementing the secondary research, a series of interviews and discussions were conducted with key individuals and entities closely associated with plastic waste management in the Identified Locations. By combining the insights gained from secondary research and interviews, a comprehensive and multi-dimensional stakeholder map for plastic waste management in the Identified Locations was developed. This stakeholder map consisted of the following major categories of stakeholders:

Formal stakeholders

1. Government officials such as Urban Local Body (ULB)/municipal and Gram Panchayat (GP) representatives involved in plastic waste management systems
2. Private agencies contracted by the government to provide waste management services such as Hand in Hand in Rameswaram

3. Private and government waste collection staff and waste processing staff in facilities
4. Fishermen associations
5. Representatives of community-based organisations such as Green Rameswaram

Informal stakeholders

1. Waste pickers and itinerant buyers
2. Scrap dealers
3. Aggregators

These stakeholders were interviewed over the phone and/or met during the field visits and the list of the people interviewed is given in **Annexure I.**

2.3 Rapid field assessment

After completion of secondary research and initial telephonic interviews, there were rapid field assessments undertaken in the Identified Locations in July 2023 and September 2023 to collect data on plastic waste generation including quantification and characterisation and understand the plastic value chain and its stakeholders. The field visits included site visits to waste management facilities, dumpsites, waste collection routes, beach areas, fish landing sites among others. In addition, there were visits to scrap dealers and aggregators working in the informal waste sector in the Identified Locations to understand the economy and livelihoods around plastic waste management. At these locations, the data collection methodologies largely involved semi-structured interviews on the basis of prepared questionnaires, waste audits and field observations. These interviews and site visits were documented through detailed summaries and photographs. The details of the data collection methodologies are set out below:

2.3.1 Waste audits at households and hotels

The study team conducted a waste audit at 85 households over 4 consecutive days at the Identified Locations to understand the generation of plastic waste at the household level. Stratified Random Sampling was used to select households for the audit and the residents were provided with HDPE bags to store plastic waste generated at their households separately for 4 consecutive days. In addition, prior to the audit, short interviews were conducted by the study team to gather information on household size and whether residents sell their plastic waste to waste pickers and/or itinerant buyers.

Similarly, waste audits were conducted in 6 hotels in Rameswaram which included 2 large hotels (i.e., with 50 rooms and above) and 4 small hotels (i.e., having between 10 to 40 rooms) over 4 consecutive days. HDPE bags were provided to these hotels for separate storage of plastic waste generated in the hotel premises. During the audit, the survey team also conducted short interviews to gain insights into plastic management practices of each of the hotels.

The plastic waste was collected by the study team on the 5th day and it was sorted into 7 plastic resin types i.e., Polyethylene Terephthalate (PET or PETE), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC or Vinyl), Low-Density Polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS or Styrofoam) and Others such as multi-layered plastic (MLP). Each category

was weighed and recorded as part of the quantification and characterisation process.

Figure 3: Distribution of HDPE bags at households for waste audits

2.3.2 Waste audit at dumpsite/landfill

To understand the plastic waste generation and characterisation at the panchayat and village level, the survey team carried out quantification and characterisation of plastic waste generated using the coning and quartering method (ASTM method D5231-92) at the dumpsites located in Pamban and Morepannai over 3 consecutive days. Rameswaram does not have a centralised dumpsite/landfill and therefore, waste audit through coning and quartering method was not carried out there.

2.3.3 Commercial establishments

Given the varied nature of commercial establishments and the absence of separate waste collection vehicles for them, accurately quantifying the waste generated by commercial establishments was challenging. Therefore, the survey team conducted informal interviews with 40 commercial establishments at the Identified Locations to understand their plastic disposal methods.

2.3.4 Informal waste value chain actors

Semi-structured interviews were conducted with different members of the informal sector at the Identified Locations that deal with plastic waste including old fishing nets. During the field

visits, interviews were conducted with 13 scrap dealers (L1 aggregators) and 2 L2 aggregators at their workplace. The survey team also visually observed the processes relating to management of plastic waste such as trading, aggregation, sorting, grinding and baling at their premises.

2.3.5 Fish landing sites

The survey team also visited 2 fish landing sites in Rameswaram and Pamban to understand plastic waste generation due to damaged and ghost nets. The team also interviewed fishers to understand the practices they follow with respect to plastic waste generated on the boats, damaged fishing nets and plastic waste that they encounter in the ocean during fishing expeditions. These interviews and site visits were documented through detailed summaries.

2.4 Situational analysis of plastic waste value chain

The survey team collated the primary data sets received through the interviews and site visits and thereafter, this data was reviewed, consolidated and categorised as quantitative (i.e., numerical and statistical data) and qualitative (i.e., process related) to understand the current plastic waste management system, identify gaps within and evaluate the potential for livelihood opportunities.

3. LIMITATIONS

3.1 The study is confined to the Identified Locations and not the entire Palk Bay region and was exploratory in nature.

3.2 One of the notable challenges in this study is the absence of accurate plastic waste data with the governmental authorities. In the Identified Locations only approximate data, based on theoretical formulas, were available with the respective ULBs and GPs. In the light of this, the government data can, at best, be considered as rough estimates.

3.3 Some scrap dealers were reluctant to provide responses regarding plastic waste data such as the quantum of plastic waste that they manage, operations, rates of various types of plastic waste, the details of the buyers and other monetary details. This was primarily driven by concerns about potential competition, loss of livelihood and general harassment that they could encounter due to government regulations. In addition, most informal stakeholders keep no formal records and therefore, the information provided by them are estimates and anecdotal.

3.4 Given the time period of the project, plastic waste generation due to fluctuations in seasons, tourist inflow and festivals have not been considered. In addition, ocean currents carry plastic waste across geographical areas and in some seasons, there are considerable deposits of plastic waste at the coastline at Palk Bay due to these currents. Furthermore, factors such as monsoons and tides can redistribute, bury and carry plastic waste into the ocean. The quantification of plastic waste under this study has not taken into consideration these factors.

3.5 Burning of plastic waste as a waste management practice is prevalent all across the Identified Locations. This impacts the study relating to quantification because the amount of plastic waste that is being measured in the dumpsites might be lower than what is actually being generated.

3.6 There is only one plastic recycler in Ramanathapuram district which is registered with Tamil Nadu Pollution Control Board (TNPCB). However, its operations were halted during the study period and therefore, telephonic semi-structured interviews were carried out with the recycler.

4. POLICY, REGULATORY AND VOLUNTARY FRAMEWORK RELATING TO PLASTIC WASTE MANAGEMENT

4.1 Legal framework

The legal framework for solid and plastic waste management in India has undergone significant evolution in recent years, with a focus on improving waste management and recovery of resources from waste. With respect to plastic waste management, there are primarily two regulations which are significant: Plastic Waste Management Rules, 2016 (PWM Rules) and Solid Waste Management Rules, 2016 (SWM Rules). The following paragraphs examine key provisions which are relevant for this study and its objectives.

4.1.1 Plastic Waste Management Rules, 2016 (PWM Rules)

Table 1: Responsibilities as per Plastic Waste Management Rules,2016

Stakeholder	Roles and Responsibilities
Local Bodies such as ULBs and GPss	1. Develop and establish infrastructure for various stages of plastic waste management, either independently or through external agencies 2. Ensure segregation, collection, storage, transportation, processing, and proper channelising of plastic waste to the respective end destination. 3. Raise awareness among all stakeholders, engage civil societies or groups working with waste pickers and ensure that open burning of plastic waste does not take place.
Waste generator	1. Minimise plastic waste generation, ensure source segregation, hand over the segregated waste to collection staff appointed by the local body. 2. Institutional generators of plastic waste are required to segregate and store their waste. They must then deliver the segregated waste to authorised waste processing or disposal facilities or deposition centres, either directly or through authorised waste collection agencies. 3. Individuals or entities responsible for hosting events in open spaces that involve serving food in plastic or multi-layered packaging must segregate and manage the resulting waste.

4.1.2 Extended Producer responsibility (EPR) under PWM Rules

Extended Producer Responsibility (EPR) as an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle[6]. In India, it is covered under the PWM Rules where Producers, Importers, and Brand Owners (PIBOs) of products that have plastic packaging are mandated to take responsibility for

6 https://www.oecd.org/environment/extended-producer-responsibility.htm

the end-of-life management of the plastic packaging (and not products) they introduce into the market. This includes collection and channelising plastic packaging waste to relevant processing and disposal destinations such as recycling at recycling plants, co-processing at cement factories, incineration at waste-to-energy plants, processing at pyrolysis units and use of plastic waste in road making, collectively referred to as "Plastic Waste Processors". Currently, every year, PIBOs have the obligation to collect, recycle and/or responsibly process the entire quantity and type of plastic that they have introduced into the market in that year. Furthermore, from the year 2024, there are targets for PIBOs to use recycled content in packaging and thereafter from 2025, there are specific targets for reusing plastic packaging.

4.1.3 Solid Waste Management Rules, 2016

Table 2: Responsibilities as per Solid Waste Management Rules,2016

Stakeholder	Roles and Responsibilities
Waste generator	1. Segregate waste into three streams, biodegradable, non-biodegradable and domestic hazardous waste. 2. Should not burn or bury the waste generated by them.
Local authorities including municipalities	1. Set up a mechanism to identify and acknowledge organisations of waste pickers and informal waste collectors, while also developing a system to incorporate these authorised individuals into the framework of solid waste management. This includes enabling their involvement in activities such as door to door waste collection. 2. Support the establishment of Self-Help Groups, furnish them with identity cards, and subsequently promote their engagement in solid waste management tasks, including door-to-door waste collection. 3. Establish Material Recovery Facilities (MRF) or secondary storage facilities equipped with ample space for the sorting of recyclable materials. 4. Ensure convenient access for waste pickers and recyclers to collect the segregated recyclable materials, such as plastic either directly from the source of generation or from these material recovery facilities. 5. Transport non-bio-degradable waste to the respective processing facility or MRF or secondary storage facility. 6. Make adequate provision of funds for capital investments as well as operation and maintenance of solid waste management services in the annual budget.

4.1.4 Guidelines for implementation and monitoring of solid waste management activities in rural areas of Tamil Nadu

There are various government orders from Rural Development and Panchayati Raj Department, Government of Tamil Nadu which also include the Guidelines for implementation and monitoring of solid waste management activities in rural areas ("TN Rural SWM Guidelines")[7]. The key provisions of these guidelines are set out below.

(i) Engaging eligible Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) workers as Thooimai Kaavalar (Environment Protectors) for

7 G.O. (Ms) No.208 issued by Rural Development and Pancha vat Rai (CGS.1) Department on 05.12.2020

implementation of SWM activities on an outsourcing basis through Village Poverty Reduction Committee (VPRC)/Panchayat Level Federation (PLF). The number of Thoimai Kaavalars is calculated on the basis of one worker per 150 households. As per the latest government order, the consolidated payment due to Thooimai Kaavalar is Rs. 5000 per month[8].

(ii) Thooimai Kaavalar's responsibilities include collection of non-biodegradable waste including plastic waste, sorting of such waste and sale of the recyclable waste and raising awareness on waste management among waste generators.

(iii) Procurement of collection infrastructure such as tricycles, pushcarts, bins and personal protective equipment at the GP for waste management activities.

(iv) Payment of salary for Thooimai Kaavalars from the State Finance Commission Grant which shall be disbursed by the districts to the village panchayats.

(v) 50 % of revenue generated through sale of recyclable waste by the village panchayats may be distributed to the Thooimai Kaavalars as an incentive on a quarterly basis.

(vi) Worksite facilitators engaged to supervise works under MGNREGS shall oversee the SWM activities.

(vii) Project Director, District Rural Development Agency, (DRDA) and Project Director, Tamil Nadu State Rural Livelihood Mission (TNSRLM) should ensure the conduct of training programmes for Thooimai Kaavalars at block level in regular intervals.

(viii) Solid Waste Management Committees shall be constituted in the Village Panchayat to monitor the day-to-day activities with respect to SWM.

(ix) Role and responsibilities of Village Panchayats, Unions Overseers, Zonal Deputy Block Development Officers, BIock Development Officers (Village Panchayats), District Level Zonal Officers of Blocks, Project Director, District Rural Development Agency and Project Directors, TNSRLM and Executive Engineers (RD) / Assistant Executive Engineers / Assistant Engineers / Junior Engineers with respect to solid waste management is provided in detail.

4.2 Policy framework

The Swachh Bharat Mission (Urban) and Swachh Bharat Mission (Grameen) are flagship programs launched by the Government of India in 2014 with the primary goal of making urban and rural areas in India clean and open-defecation-free. These missions emphasise on the construction of toilets, solid waste management infrastructure, and behaviour change campaigns to promote cleanliness and proper waste disposal.

4.2.1 Swachh Bharat Mission (Grameen) - Phase II

One of the main objectives of the SBM (Grameen) 2.0 relate to solid waste management in rural areas and it states:

8 G.O. (Ms) No.78 issued by Rural Development and Pancha vat Rai (CGS.1) Department on 09.06.2023

Effective waste management by at least 80% of the households and all public places (including primary schools, panchayat ghar and anganwadi centre). This includes management of plastic waste by an adequate segregation and collection system.

4.2.2 Swachh Bharat Mission (Urban) - 2.0

One of the main objectives of the SBM (Urban) 2.0 relate to solid waste management in urban areas and it includes the following sub-objectives:

(i) All households and premises segregate their waste into "wet waste" (from kitchen and gardens) and "dry waste" (including paper, glass, plastic, and domestic hazardous waste and sanitary waste wrapped separately);
(ii) 100% door to door collection of segregated waste from each household/ premise;
(iii) 100% scientific management of all fractions of waste, including safe disposal in scientific landfills;
(iv) All legacy dumpsites remediated and converted into green zones;
(v) Ensuring cleanliness and hygiene in public places to make all cities clean and garbage free, with 100% scientific processing of MSW;
(vi) Phased reduction in use of single-use plastic
(vii) Awareness creation along with large scale citizen outreach
(viii) Create institutional capacity to effectively implement programmatic interventions to achieve mission objectives.

4.3 Voluntary framework

In addition to the legal and policy frameworks in India, globally, there are also voluntary mechanisms to combat plastic pollution and promote sustainability. Among these, Plastic Credits and the Ocean Bound Plastic Program (OBP) have gained recognition as pioneering initiatives. Both of these frameworks aim to harness the power of voluntary participation by individuals, organisations, and industries in addressing the plastic waste crises.

4.3.1 Plastic Credits

Plastic credits are a market-based mechanism aimed at incentivising and quantifying the reduction, collection, and responsible management of plastic waste. Organisations, projects, or initiatives that successfully prevent plastic waste from entering the environment can earn plastic credits equivalent to the volume of waste they have managed. These credits can then be sold to companies, governments, or individuals looking to offset their plastic footprint or meet sustainability goals. Plastic credits help fund and support activities such as plastic recycling, waste collection, clean-up efforts, and community education programs, promoting a circular economy and mitigating the environmental impact of plastic pollution.

4.3.2 Ocean Bound Plastic Certification

Plastics that have the potential to end up in ocean/water bodies and thereby cause pollution are called Ocean Bound Plastic (OBP). It is categorised into 4 categories: potential OBP (plastic waste situated within a 50-kilometre radius of the coastline.), waterways OBP (plastic waste located 200m from rivers and in rivers), shoreline OBP (plastic waste located 200m from seashores) and fishing material (used fishing gears and plastic bycatch)[9].

The OBP Certification Program aims to incentivise the removal of OBP from the environment by enhancing its value through efficient collection and treatment, preventing its entry into the oceans and water bodies. Similar to plastic credits, plastic manufacturers and/or consumers have the opportunity to balance their plastic consumption or production by removing a specific volume from the environment through the purchase of OBP credits. The OBP certification comprises of two sub programs:

(i) OBP Recycling Subprogram - Certifies the origin and traceability of high value OBP (commercially recyclable), incentivises and promotes its collection and recycling thereby increasing its market value.
(ii) OBP Neutrality Subprogram. - Certifies the collection and final treatment of low value OBP (non-commercially recyclable). Therefore, OBP credits issued under OBP Neutrality Subprogram, represent a category of plastic credits specifically designed to eliminate low-value Ocean Bound Plastic from the natural environment.

OBP credits enable the companies to fund projects that ensure collection of low value plastic waste which are usually refrained from collection because of its low value, contribute to improve the earnings of waste pickers as they collect and trade in a broader range of plastic waste and have an overall, positive impact with respect to marine litter.

5. UNDERSTANDING THE INFORMAL WASTE SECTOR WITH RESPECT TO PLASTIC WASTE

The informal waste sector are individuals, groups, and small businesses that perform peripheral collection, sale and processing of recyclable waste[10]. They are typically, not organised, financed, contracted, recognised, taxed (at certain levels) nor reported upon by governmental authorities[11]. In India, the informal waste sector is compensating for the inadequacies of municipal waste systems and plastic waste collection and recycling activities are majorly performed by them[12].

9 https://www.obpcert.org/what-is-ocean-bound-plastic-obp/

10 https://www.epa.gov/system/files/documents/2021-11/swm-guide-flyer-informal-sector-2020-08-06.pdf

11 https://cdn.cseindia.org/attachments/0.89670700_1626944339_integration-of-the-informal-sector-richa.pdf

12 Informal plastic waste recycling firms in rural eastern India: Implications for livelihood and health, https://www.sciencedirect.com/science/article/pii/S2213398423000738#:~:text=The%20widespread%20activities%20of%20waste,organised%20through%20associations%20and%20cooperatives.&text=However%2C%20in%20many%20developing%20countries,by%20the%20informal%20waste%20sector.

The informal waste sector works with high value plastic waste i.e., material that has high market value due to higher potential for recycling (such as PET, HDPE etc). Plastic waste such as thin flexible plastic (such as plastic carry bags) and MLP have low or negative value i.e., low market value due to low potential for recycling and other costs associated with its management, and the informal sector typically does not manage this type of waste.

Informal waste sector is socially and economically stratified in a pyramid with the waste-pickers at the base and the recyclers/re-processors placed at the top as represented in Figure 4.

Figure 4: Informal waste sector value chain

From the source of waste generation, plastic waste is collected by stakeholders termed 'waste collectors'. Within collectors, each stakeholder can be easily differentiated from the source of collection, method and type of collection and the process of selling[13]. The waste-pickers typically pick plastic waste from the streets and are on foot while itinerant buyers usually go house-to-house for purchase of plastic waste. Given the small quantities they collect, they then sell such plastic to the local scrap shops.

The scrap dealers (L1 aggregators) are engaged in aggregation, primary sorting as per some plastic types and trading and they typically have tie-ups with medium and large-scale aggregators located within the city and around.
The medium and large-scale aggregators (L2 aggregators), have tie-ups with re-processors and/or agents, for specific plastic waste. Depending on the type of aggregator, plastic waste can be sorted into over 35 categories on the basis of resin, colour, thickness and grade (virgin, recycled once or multiple

13 Valuing Urban Waste 2019: The need for comprehensive material recovery and recycling policy at https://hasirudala.in/wp-content/uploads/2020/09/Valuing-Urban-Waste-2019.pdf

times)[14]. Following finer secondary sorting of plastic waste, pre-processing of plastic waste which includes washing, cutting, bailing and grinding, is carried out. Finally, the processing of plastic waste in the informal sector includes other steps such as melting, extrusion and granulation of plastic waste.

6. BASELINE ASSESSMENT OF THE IDENTIFIED LOCATIONS

6.1 Overview of plastic waste management in Rameswaram

Table 3: Rameswaram municipality profile

Name of the Identified Location	Type of governing body	Population[15]	Number of HH[16]
Rameswaram	Municipality	56,736	13,386

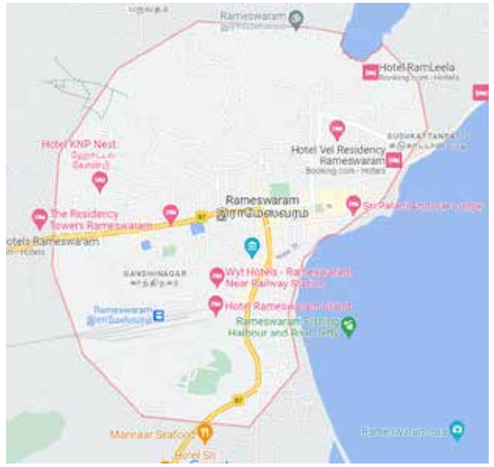

Figure 5: ULB boundary of Rameswaram

As per the data provided by the Rameswaram municipality and reported in the annual report prepared by the Tamil Nadu Pollution Control Board (TBPCB) on implementation of SWM Rules, 2016 for the year 2022-23, the total municipal solid waste (MSW) generated in the city is 663.9 MT per month or 22.13 TPD[17]. Out of this waste, approximately 35% of such waste i.e., 7.75 TPD is estimated to be dry waste[18]. As per the normative standards provided by Ministry of Housing and Urban Affairs (MOHUA), 46% of dry waste is assumed to be plastic waste[19] and therefore, the total plastic waste generated in Rameswaram is estimated to be 107 MT per month or 3.5 TPD. It should be noted here

14 Valuing Urban Waste 2019: The need for comprehensive material recovery and recycling policy at https://hasirudala.in/wp-content/uploads/2020/09/Valuing-Urban-Waste-2019.pdf

15 Data was provided by Rameswaram municipality

16 https://tnpcb.gov.in/pdf_2023/AnnualRptSWM22_23.pdf

17 https://tnpcb.gov.in/pdf_2023/AnnualRptSWM22_23.pdf

18 Data was provided by Rameswaram municipality

19 https://mohua.gov.in/pdf/627b8318adf18Circular-Economy-in-waste-management-FINAL.pdf

that when using per capita waste methodology[20] and data as per the waste audits[21], the plastic waste generation amounts to roughly 1 TPD for the resident population. Therefore, it appears that the remaining 2 - 2.5 TPD can be attributed to a floating population such as tourists, devotees etc and waste generated in public areas such as markets and beaches.
In addition to the above, textile waste is also of significant concern in the city because the devotees discard the clothes after completion of religious rituals in the temple and beach areas. During the auspicious days, it is estimated that 5 to 6 MT of textile waste is generated per day[22].

6.1.1 Waste audit at hotels

Rameswaram receives a large number of tourists and therefore, hotels become a source of significant waste generation. In this context, waste audits were conducted at the 6 hotels (2 large hotels and 4 small hotels) over 4 consecutive days in Rameswaram. Since the other two Identified Locations (i.e., Pamban and Morepannai) did not have any hotels with accomodation, this audit was not conducted in those locations. During the audits, the study team observed that approximately 50% of the hotels sold their high value plastic waste such as PET to the informal sector and while the others handed over the plastic waste to the municipality waste collection staff. The decision to give waste to the municipality's waste workers rather than sell it to the informal sector was largely motivated by practical considerations such as inadequate storage space within the hotel premises as the aggregators prefer to buy high volumes of plastic waste. The results of the waste audits revealed that small hotels generate an average of 1.5 kg of plastic waste per day per hotel, while large hotels had a notably higher average of 7 kg per day per hotel.

Figure 6: Waste audit at hotels

From the waste audit, it is also observed that PET is the most predominant type of plastic waste generated by both small and large hotels and the main reason for this could be the large tourist inflow and related consumption of drinking water.

20 The per capita plastic waste generation for Tamil Nadu available in the CPCB Annual Report 2020-21 on Implementation of Plastic Waste Management Rules, 2016 is 6067.15435 grams per year.

21 Covered in Sections 6.1.1.1 and 6.4 of the report below

22 Data provided by Rameswaram municipality

6.1.2 SWM manpower structure and transportation infrastructure at Rameswaram Municipality

The municipality at Rameswaram has tendered the waste management activities in the city to a private entity, Hand in Hand which has deployed 2 supervisors and 110 waste workers to manage the solid waste generated in the city. At the municipality level, the following officials and personnel are involved in solid waste management.

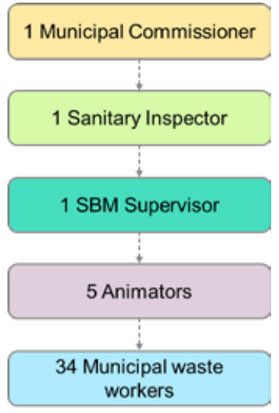

Figure 7: Organisation structure in Rameswaram Municipality

The vehicles used for waste collection from households, commercial establishments, hotels, and public areas such as temples, beach cleanups, and bus stands include tricycles, battery operated vehicles (BOV), light commercial vehicle (LCV), tipper, tractor, and backhoe loader. The study team was informed that the ULB has 21 tricycles, 4 BOVs, 9 LCVs, 2 tippers, 1 tractor, and 1 backhoe loader. However, during our field visits, it was observed that 3 Tricycles, 2 LCVs, and 1 Tipper were non-operational.

Figure 8: Interview with the Sanitary Inspector in Rameswaram

6.1.3 Waste flow through formal stakeholders

The waste generators in Rameswaram include households (HH), commercial establishments (CE), hotels, institutions such as schools and public areas such as temples, beach areas, bus stations, markets etc. In addition, given that Rameswaram is a tourist place, it receives tourists, whose numbers are often more than the residents of the city. The table below provides an overview of inflow of tourists:

Table 4: Tourist inflow in Rameswaram

Types of occasions	Tourist inflow per day[23]
Regular days	20,000 to 30,000
Peak days - Weekend and other auspicious days	50,000
Ammavasai (new moon day) and Panguni Uthiram (Regional auspicious day) - 4 times a year	3,00,000 to 5,00,000

The door-to-door (DTD) collection of solid waste including plastic waste is carried out by Hand in Hand. However, some plastic waste types such as PET, HDPE, LDPE (milk and oil covers), PP and PVC are directly sold by some of the waste generators to the informal waste sector such as itinerant buyers.

Figure 9: Door to Door collection of municipal solid waste

Figure 10: Waste collection staff selling the high value plastic waste from DTD collection to L1 aggregators

Once waste is collected as a part of the DTD collection, the waste collection staff segregates the plastic waste with value (such as PET, HDPE, LDPE (milk and oil covers) and PP) from other waste streams in the collection vehicles and sells them to L1 aggregators. Plastic waste with no value such as MLP and flexible

23 Data provided by the municipality which is based on the toll data and number of passengers who reach Rameswaram by train.

packaging is transferred to a secondary vehicle such as tractor which takes the waste to the Resource Recovery Centre (RRC) at Vadakadu. Currently, this low or negative value plastic is aggregated at RRC and has not been channelised for further processing. In addition, some part of this waste is dumped in the areas surrounding the RRC which is then burnt by the local waste pickers to recover the metal from such waste.

Figure 11: Resource Recovery Centre at Vadakadu

Figure 12: Low value plastic waste aggregated at RRC

6.1.4 Waste flow through informal stakeholders

There are approximately 23 L1 aggregators in Rameswaram who purchase plastic waste from the waste collection staff, waste pickers and itinerant buyers. The L1 aggregators deal only with valuable plastic types like PET, LDPE (mostly in the form of milk covers, oil covers and glucose bottles), HDPE, PP and PVC. They aggregate the plastic waste and carry out basic

sorting on the basis of resin and then sell such sorted plastic either to L2 aggregator located near Rameswaram or agents/recyclers located in Madurai.

Itinerant Buyer

L1 aggregator

Figure 13: Different informal waste sector stakeholders in Rameswaram

The Figure 14 represents the flow of plastic waste through formal and informal stakeholders in Rameswaram:

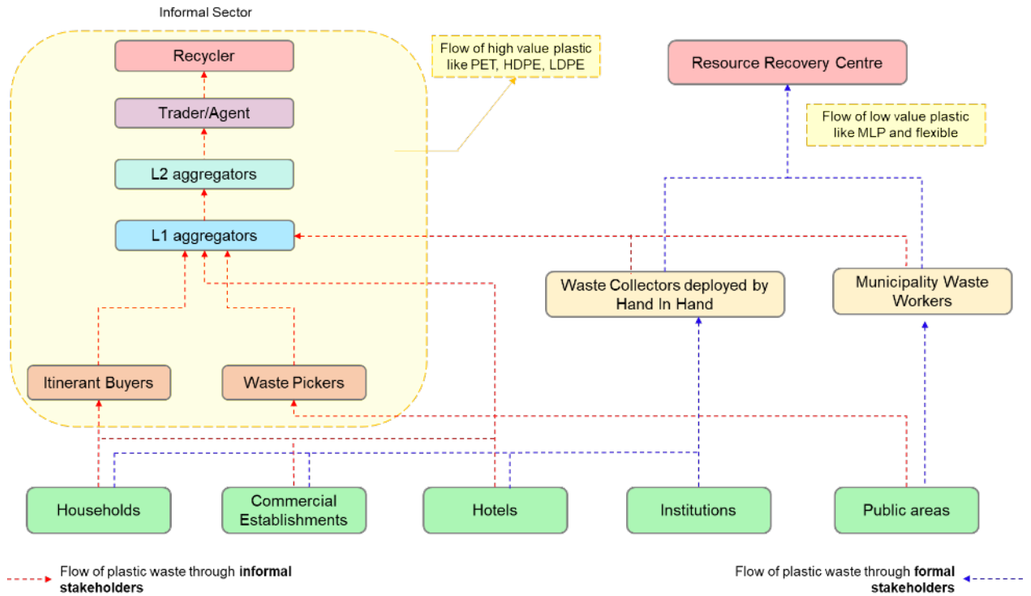

Figure 14: Flow of plastic waste through formal and informal stakeholders in Rameswaram

6.1.5 Gaps identified with respect to plastic waste management

(i) There is no management or processing of plastic waste within the municipal infrastructure and the entire plastic waste of the city is being managed by the informal waste sector.

(ii) Since the informal waste sector deals only with valuable plastic types like PET, certain types of LDPE, HDPE, PP and PVC, large quantities of low value flexible plastics such MLP, plastic carry bags, etc are not managed and are likely to contribute to marine litter.

(iii) The tourist inflow results in generation of large quantities of plastic waste due to packaged drinking water and food and other waste streams. However, the manpower deployed for waste management activities in the city does not take into account the large floating population which includes tourists and devotees and is therefore inadequate to manage the overall waste generated in the city.

(iv) There are approximately 23 scrap dealers located in Rameswaram and 4 scrap dealers were interviewed during the study. Based on the information collected from these scrap dealers, the study team was informed that each scrap dealer on an average manages 1 MT to 1.6 MT of plastic waste per month. Based on this data, the approximate quantity of plastic waste handled by 23 scrap dealers was calculated as 23 MT to 37 MT per month. The total plastic waste generated in Rameswaram is approximately 107 MT per month

and of this, only 0.7 MT[24] is channelised to the RRC. On the basis of the following formula, the quantity of unmanaged plastic waste can be estimated:
A - Total quantity of plastic waste generated in Rameswaram per month
B - Quantity of plastic waste managed by 23 scrap dealers per month
C - Quantity of plastic waste sent to RRC per month
D - Total quantity of unmanaged plastic waste per month

The total quantity of unmanaged plastic waste D = A-(B+C)

From the data collated and assumptions made[25], it is estimated that approximately 69 MT to 83 MT of plastic waste per month i.e. 2.3 to 2.8 TPD is unmanaged. This unmanaged waste which is likely to predominantly consist of low value plastic waste may leak into the open environment including the ocean and other water bodies.

6.2 Overview of plastic waste management in Pamban

Table 5: Pamban gram panchayat profile

Name of the identified location	Type of governing body	Population[26]	Number of HH[27]
Pamban	Gram Panchayat	17,100	6500

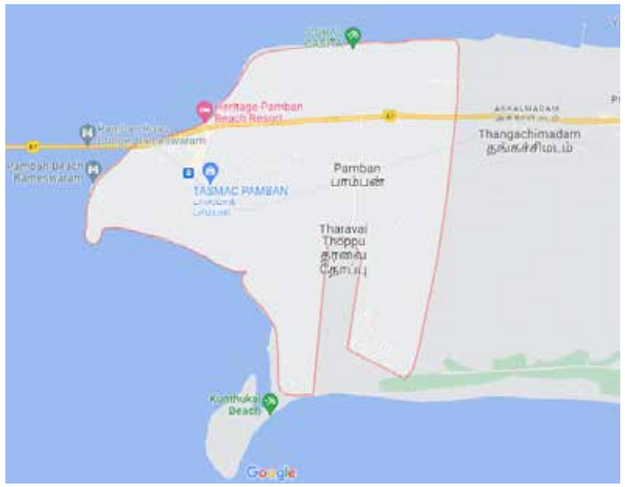

Figure 15: Gram Panchayat boundary of Pamban Gram Panchayat

24 Data collated from the log book at the RRC

25 This calculation is done on the basis of governmental data, anecdotal data from informal sector and theoretical formula/normative standards provided by MOHUA and should, therefore, be considered as rough estimates only.

26 Data shared by Gram Panchayat

27 Data shared by Gram Panchayat

Pamban Gram Panchayat comprises 15 villages and as per the data provided by the Pamban Gram Panchayat the total municipal solid waste (MSW) generated in Pamban is estimated to be 45 MT per month. If it was assumed that 35% of the MSW is dry waste[28] of which 46% is plastic waste[29], it is estimated that 7.25 MT of plastic waste per month or 0.24 MT per day is generated in Pamban.

6.2.1 SWM manpower structure and transportation infrastructure in Pamban Panchayat

The waste management in Pamban Gram Panchayat is overseen by the Panchayat Secretary and the manpower includes 1 motivator, and 26 waste workers. In addition, there are 6 Thooimai Kaavalar who compost the fruit and vegetable waste at micro composting center (MCC), located at Ayyanthoppu.

The vehicles used for collection of waste from households are BOVs. From commercial establishments and blackspots, the vehicles used are tractors, and these are shared among all the 15 villages under the Pamban Gram Panchayat. The study team was informed that there are 5 BOVs and 1 tractor for the panchayat[30]. However, during our field visits, only 1 BOV and 1 tractor were operational, while the remaining 4 BOVs were found to be in a state of disrepair.

6.2.2 Waste flow through formal stakeholders

While the Pamban Gram Panchayat comprises 15 villages, door-to-door (DTD) collection is carried out only in 10 villages. Even within these 10 villages, the waste collection is irregular and does not cover all areas.

Waste generators include households (HH), commercial establishments (CE) and public areas like churches, temples, etc. In areas covered by DTD collection, waste collection staff collect plastic waste and other waste streams from the waste generators, however, some plastic waste such as PET, HDPE and LDPE (milk and oil covers) are directly sold by the waste generators to the informal waste sector such as itinerant buyers.

Figure 16: DTD collection from households

Figure 17: DTD collection from commercial establishments and public areas

28 https://mohua.gov.in/pdf/627b8318adf18Circular-Economy-in-waste-management-FINAL.pdf

29 https://mohua.gov.in/pdf/627b8318adf18Circular-Economy-in-waste-management-FINAL.pdf

30 Data shared by Gram Panchayat

During the DTD collection, the waste collection staff segregate the plastic waste with value in the collection vehicles or at the dumpsite and thereafter, sell it to the L1 aggregators. Plastic waste with no value is transported to the regional dumpsite located at Ayyanthoppu, which is also used by nearby Thangachimadam Panchayat.

Figure 18: Black spot in Pamban Panchayat

Figure 19: Burning of waste in black spot by waste worker

In areas which are not covered by DTD collection, waste generators either dump their waste in nearby open areas or burn them. The study team observed at least 1 blackspot on each road, some of which are subsequently cleaned by the waste workers and then burnt.

Figure 20: Sorting of high value plastic at dumpsite by waste collection staff

Figure 21: Storage of shredded flexible plastic waste at RRC

Figure 22: Dumpsite at Ayyanthoppu

For management of dry waste, there is a RRC near the dumpsite. Currently, the RRC is managed by the Thangachimadam Gram Panchayat and is equipped with a shredder, where the flexible plastics like flexible LDPE, etc are shredded and then stored in sacks for further processing, such as use in road making. While the RCC is common for both the Panchayats, only plastic waste from Thangachimadam gets processed in the RRC. It was also observed by the study team that the mixed waste (including low value plastic waste) collected by Pamban Gram Panchayat (which is not channelised to the informal waste sector) is being dumped in the dumpsite and/ or burnt by the waste collection staff.

Figure 23: Dumping of mixed waste at dumpsite

6.2.3 Waste flow through informal stakeholders

There are 4 to 5 L1 aggregators in Pamban and they deal only with high value plastic types like PET, LDPE (mostly milk covers and oil covers), HDPE, PP and PVC. Similar to Rameswaram, aggregators aggregate the plastic waste and carry out basic sorting on the basis of plastic resin and then sell such sorted plastic either to L2 aggregator located in Rameswaram or agents/ recyclers located in Madurai. The figure below depicts the flow of plastic waste through formal and informal stakeholders in Pamban Gram Panchayat:

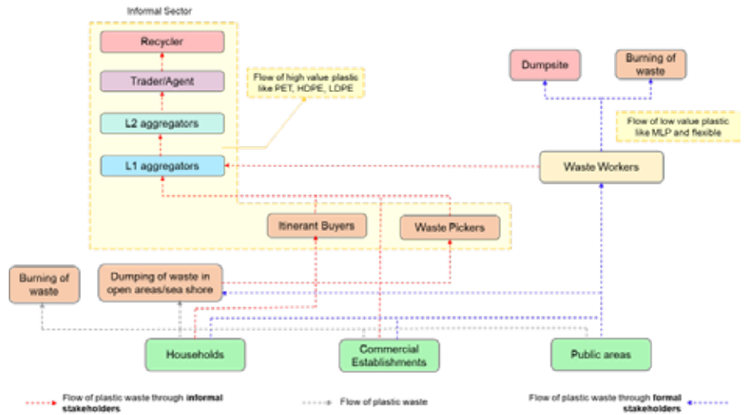

Figure 24: Flow of plastic waste through formal and informal stakeholders in Pamban

6.2.4 Gaps identified with respect to plastic waste management

(i) Due to inadequate collection systems, plastic waste is dumped at black spots across the panchayat area. Burning of waste is also a common practice among the locals and panchayat waste workers. Unmanaged plastic waste (which is not burnt) is entering into the open environment including the oceans.

(ii) Furthermore, there is no management or processing of plastic waste within the government infrastructure and plastic waste is being managed by the informal waste sector. Since the informal waste sector deals only with valuable plastic types like PET, certain types of LDPE, HDPE, PP and PVC, large quantities of low value flexible plastics such MLP, plastic carry bags, etc are not managed and are likely to contribute to marine litter.

(iii) There is inadequate manpower for collection from all waste generators across the Pamban Panchayat. The TN Rural SWM Guidelines requires employing 1 worker for every 150 households/small shops[31]. In Pamban, there are 6500 households with 3 operational electric vehicles and 26 waste workers. However, as per the normative standards, the panchayat should ideally employ at least 40 waste workers for door-to-door collection of waste from household/small shops. It should be noted that this calculation does not factor in the collection from commercial and public areas, nor does it consider the workforce required for processing facilities.

(iv) There are approximately 5 scrap dealers located in Pamban and all 5 were interviewed by the study team. Out of 5 only 4 scrap dealers deal with plastic waste and 1 scrap dealer deals only with fishing nets. Based on the information collected from these scrap dealers, the study team calculated that the approximate quantity of plastic waste handled by 4 scrap dealers is 3.8 MT per month. The total plastic waste generated in Pamban is approximately 7.25 MT per month. On the basis of the following formula, the quantity of unmanaged plastic waste can be estimated:

A - Total quantity of plastic waste generated in Pamban per month

B - Quantity of plastic waste managed by 4 scrap dealers per month

C - Quantity of plastic waste processed by Pamban gram panchayat per month

D - Total quantity of unmanaged plastic waste per month

The total quantity of unmanaged plastic waste D = A-(B+C)

From the data collated and assumptions made[32] approximately 3.45 MT of plastic waste per month i.e., 120 kgs of plastic waste per day is not managed properly and may leak into the open environment including the ocean and other water bodies. Given that the scrap dealers handle only high value plastic like PET, HDPE, etc. the unmanaged waste will likely consist of low value plastic.

31 http://nirdpr.org.in/nird_docs/sb/doc5.pdf
https://english.swachhamevajayate.org/wp-content/uploads/2021/01/Karnataka-State-Rural-Sanitation-Strategy_Eng.pdf

32 This calculation is done on the basis of governmental data, anecdotal data from informal sector and theoretical formula/normative standards provided by MOHUA and should, therefore, be considered as rough estimates only.

6.3 Overview of plastic waste management in Morepannai

Table 6: Morepannai village profile

Name of the Identified Location	Type of governing body	Population[33]	Number of HH[34]
Morepannai	Gram Panchayat	4500	900

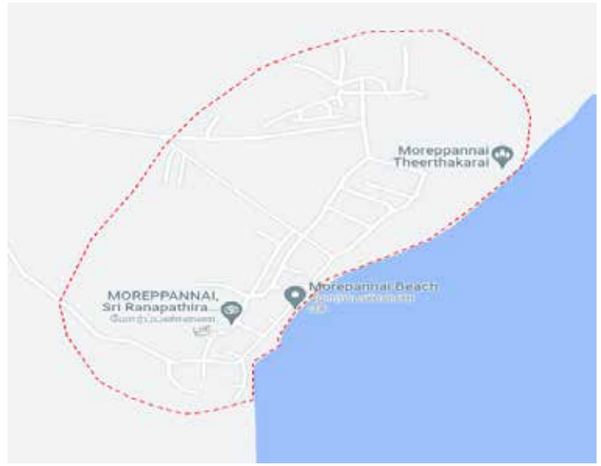

Figure 25: Village boundary of Morepannai

The Morepannai village is one of the 6 villages in Kadalur Panchayat and it is the largest both in terms of area and population among these six villages. Neither the village and/or the panchayat authorities have any data on waste generation and therefore, the total plastic waste generated was estimated using the per capita plastic waste generation available in the CPCB Annual Report 2020-21 on Implementation of Plastic Waste Management Rules, 2016. As per this report the per capita plastic waste generation in Tamil Nadu is 6067.15435 grams per year[35] and on the basis of Morepannai's population being 4500 persons, it is estimated that 2.28 MT of plastic waste is generated per month or 0.076 MT per day.

6.3.1 SWM manpower structure and transportation infrastructure in Morepannai village

The waste management activities in Morepannai panchayat are implemented by Kadalur panchayat and it has engaged 10 waste workers for all 6 villages. The vehicles for collection of waste are pushcarts and these are shared among all the 6 villages under the Kadalur panchayat. The study team was informed that there are 7 pushcarts and 1 tricycle for the panchayat,

33 Data was given by Kadalur Panchayat where Morepannai is one of the villages under the Gram Panchayat

34 Data was given by Kadalur Panchayat where Morepannai is one of the villages under the Gram Panchayat

35 https://cpcb.nic.in/uploads/plasticwaste/Annual_Report_2020-21_PWM.pdf

however, during field visits, only 2 push carts were observed in operation and the tricycle was in a dilapidated condition.

Figure 26: Interview with waste workers at Morepannai

Figure 27: DTD collection at Uppur Chathiram

6.3.2 Waste flow through formal stakeholders

In Morepannai panchayat there is no door-to-door (DTD) waste collection and the local residents resort to dumping their waste on the seashore and in nearby open areas. From the interviews with waste collection staff, the study team identified that, due to the substantial waste accumulation on the seashore in Morepannai, the Panchayat President allocated the 7 waste workers to clean up the seashore in Morepannai. However, during the time of visit, due to a local festival in Uppoor Chathiram (one of the 6 villages in Kadalur panchayat and located at a distance of 1.5 km from Morepannai) all the waste collection staff were deployed in Uppoor Chathiram and no clean-up activities were observed in Morepannai.

Figure 28: Plastic waste at seashore, Morepannai

Figure 29: Dumpsite at Morepannai

6.3.3 Waste flow through informal stakeholders

The study team observed that Morepannai does not have any L1 aggregators, but there are 4 L1 aggregators operating in Uppur Chathiram. Among these 4, only one aggregator is collecting high-value plastic waste from residents in Morepannai, while the other 3 abstain from collecting waste from these residents due to ongoing local disputes. The aggregator who collects plastic waste from Morepannai trades only with high-value plastics such as PET, HDPE and some types of LDPE. However, due to lack of financial viability, he does not deal with plastic types such as PP and PVC (which is traded by the informal sector in Rameswaram and Pamban). With respect to high value of plastic, he carries out the primary sorting based on resin type and thereafter, sells the sorted plastic waste to agents or recyclers located in Madurai.

However, it's important to note that itinerant buyers, (who come on two-wheelers or four-wheelers like Tata ACE) from nearby villages or districts such as Pudhukottai, Thoothukudi and Karaikudi, regularly visit Morepannai to collect high-value plastic waste from the residents. During the field visit, the study did not come across any itinerant buyers; hence, information regarding the disposal of plastic waste by itinerant buyers remains unclear.

Figure 30: L1 aggregator at Uppur Chathiram

The figure below depicts the flow of plastic waste through formal and informal stakeholders in Morepannai:

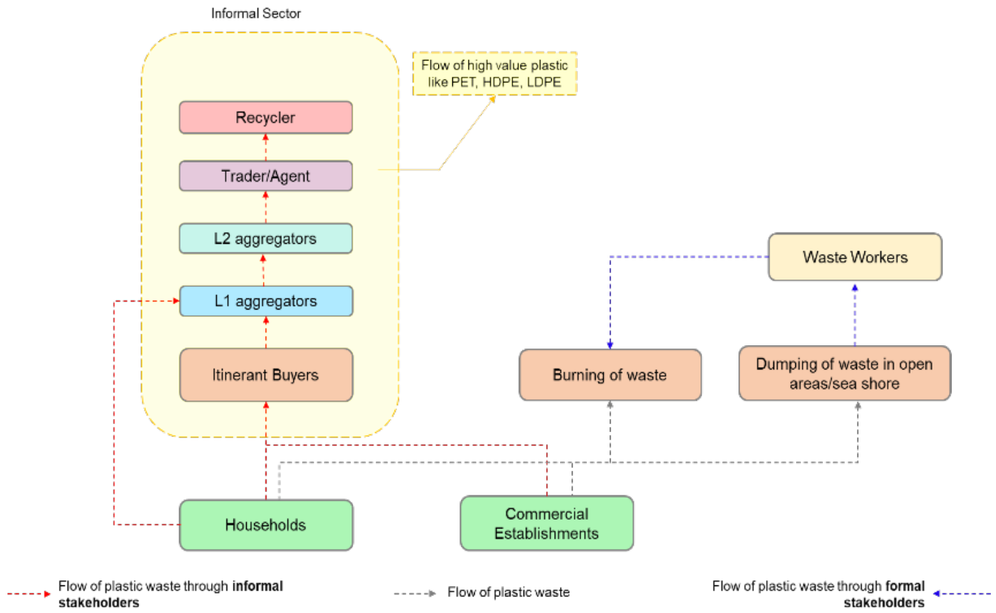

Figure 31: Flow of Plastics waste through formal and informal stakeholder in Morepannai

6.3.4 Gaps identified with respect to plastic waste management

(i) There is no door-to-door (DTD) collection system and infrastructure for collection of waste such as public bins, specific to Morepannai. This leads to dumping and burning of waste by the residents of Morepannai in open areas including the shoreline.

(ii) The waste workers who are assigned to clean the seashore in Morepannai, informed the study team that there are only 2 manual collection vehicles and the distance from the village to the common dumpsite is approximately 2 km. Therefore, given the lack of collection infrastructure and manpower, they collect the mixed waste dumped on the shore and burn the waste on the shore itself rather than taking it to the dumpsite.

(iii) There is inadequate manpower for collection from all waste generators in Morepannai village. As per the above-mentioned normative standards, there should be at least 5 workers for door-to-door collection only in Morepannai given that manual vehicles are used for waste collection.

(iv) Through interviews with the residents of Morepannai, it was observed that the practice of storing and selling high-value plastic waste is not prevalent in this village and 50% of the interviewed residents mentioned that they do not sell their plastic waste to the itinerant buyers. Several reasons contribute to this, including the relatively low financial returns for the effort required to keep the waste separately stored, and the negative perception

associated with receiving money from sale of waste. However, they sell fishing nets to aggregators because of the comparatively higher returns.

(v) Similar to Rameswaram and Pamban, there is no management or processing of plastic waste within the government infrastructure and any plastic that is being managed is done by the informal waste sector. Even within the informal sector, certain plastic types such as PP and PVC which is traded in Rameswaram and Pamban is not traded in Morepannai. Since the informal waste sector deals only with valuable plastic types like PET, HDPE, some types of LDPE, large quantities of other plastic types such as PP, PVC, MLP, plastic carry bags, etc are not managed and are likely to contribute to marine litter.

6.4 Quantification and characterization of plastic waste

6.4.1 Waste audits of the households

Waste audits were conducted at 85 households over 4 consecutive days in the Identified Locations. The figure below depicts the average plastic generation in households on a daily basis and its details are contained in Annexure II.

Figure 32: Waste audits at households

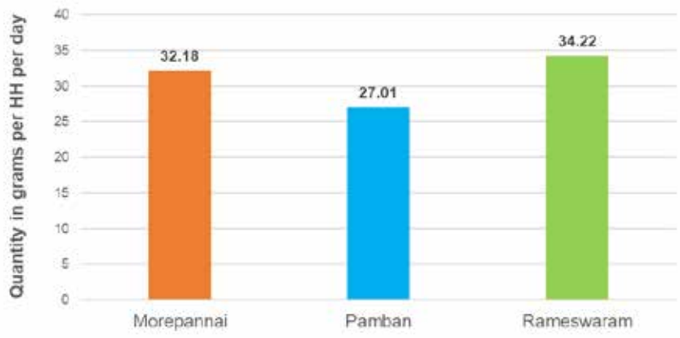

Figure 33: Plastic waste generation in HH on a per day basis

From the Figure 33, it can be assumed that households across the Identified Locations (and possibly, across Palk Bay) generate between 27 to 35 grams of plastic waste per day. Furthermore, it was observed that PET, LDPE and MLP are the most predominant types of plastic waste generated at households across all three Identified Locations.

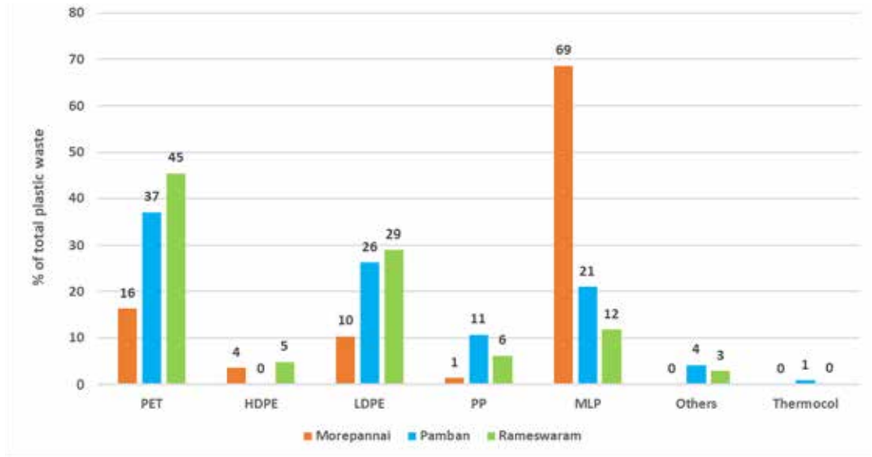

Figure 34: Composition of plastic waste in HH

6.4.2 Waste audit at dumpsites

Waste audits were conducted at both the dumpsite in Pamban and Morepannai over 3 consecutive days and the data from the audits conducted at each location are provided in Annexure III.

Figure 35: Waste audit at Pamban dumpsite

Figure 36: Waste audit at Morepannai dumpsite

It is important to note that, although the dumpsite is located in Morepannai, the waste dumped there is from the nearby village Uppur Chathiram because waste from Morepannai is not collected. Given the similarity in waste generators between Morepannai and Uppur Chathiram, it was assumed that the waste generation and characterisation patterns would also be similar. Similarly, the dumpsite in Pamban is also shared with the nearby Panchayat Thangachimadam. In order to obtain distinct data for Pamban, waste audit samples were directly collected in an area where the waste collection vehicles arriving from Pamban Panchayat were depositing waste.

As per the waste characterisation that was carried out, it was determined that plastic waste accounts for 10% and 26% of the solid waste at Uppur chathiram and Pamban respectively. Furthermore, approximately 91% and 68% of the plastic waste in Morepannai and Pamban dumpsites, respectively, consisted of low-value plastics[36].

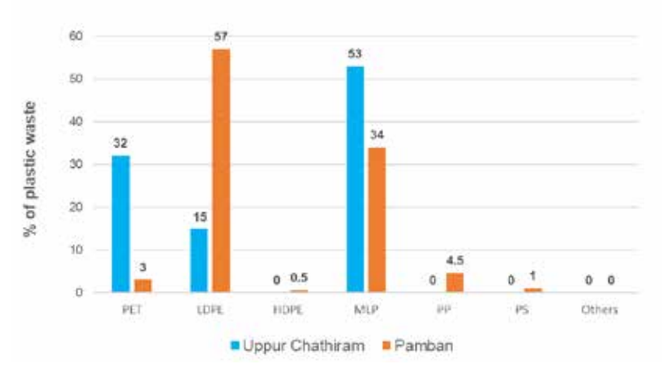

Figure 37: Plastic waste composition in Pamban and Uppur Chathiram

36 However, it should be noted here, in Uppur Chathiram, a significant number of residents do not sell their plastic waste to aggregators. Instead, the waste workers transport all plastic waste to the dumpsite, where they segregate the high value plastic for sale to L1 aggregators. Therefore, the dumpsite in Morepannai had high value plastic waste such as PET as well.

On the basis of the above audits, the following observations can be made:

(i) PET is one of the most common types of plastic that is generated at households and is rarely dumped given its economic value in the informal waste value chain.

(ii) LDPE and MLP are also generated in large quantities in households. However, given that certain types of LDPE and MLP are not handled by the informal sector, they are dumped or burnt in the open. This corroborates the analysis in sections 6.2 and 6.3 with regard to mismanagement of low value plastics and it being a part of litter in the open areas.

7. OVERVIEW OF THE PRICING OF PLASTIC WASTE ALONG THE VALUE CHAIN

This section presents a comprehensive overview of buying and selling prices for different types of plastic waste including PET, HDPE, LDPE and PP in the Identified Locations: Rameswaram, Pamban, and Morepannai. Additionally, it elaborates on the value addition process that occurs at each level of the plastic value chain and examines how these processes impact the rates of plastic waste. The purpose of analysing the plastic waste prices and value addition processes is to understand the existing system in the value chain and to explore how value addition can potentially improve and generate livelihoods based on plastic waste management.

Figure 38: Interview with L2 aggregator in Rameswaram

During the site visits, the study team identified one L2 aggregator in Rameswaram, and according to him, he is the only L2 aggregator in Ramanathapuram district who is engaged in pre-processing of plastic waste. He operates a facility equipped with both a grinder and a baler to preprocess the various types of plastic wastes such as PET, HDPE, PP, LDPE and PVC. This L2 aggregator plays a crucial role in Rameswaram and its surrounding areas by procuring plastic waste from L1 aggregators, sorting it based on type and colour, and subsequently pre-processing it through grinding or baling before selling it to recyclers, agents, or traders in Madurai.

7.1 Comparison of rates of high value plastics at L1 aggregator level

The pricing of plastic waste experiences constant fluctuations due to market dynamics driven by changes in demand and supply for recycled materials and products, geographies and oil prices. During the interviews with aggregators, the survey team gathered information regarding the rates at which the aggregators purchase and sell high-value plastic waste. Among the Identified Locations, the rates for different types of plastic in the plastic value change differed due to different local context which are included in the observations below. The consolidated data are provided in Annexure IV.

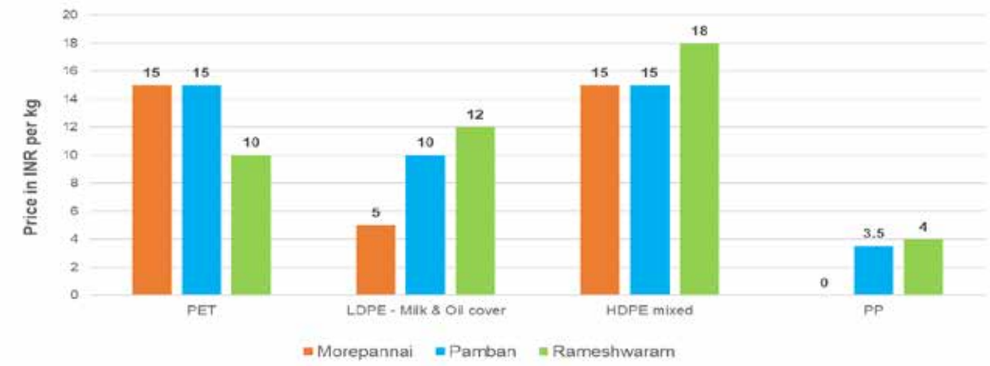

Figure 39: Difference in buying price of plastic waste by L1 aggregators across the Identified Locations

On the basis of the above, the following observations could be made:

(i) The buying price of PET (INR 10 per kg) in Rameswaram is lower when compared to other two locations (INR 15 per kg) which is likely due to the high supply of PET in the area because of the tourist inflow in the city.

(ii) The buying (INR 5 per kg) of LDPE (mostly milk and oil covers) in Morepannai is lower when compared to other two locations. Due to the low generation and receipt of less revenues from its sale, the costs of collection of the plastic waste by the itinerant buyer is high and therefore, its collection and pricing remains low. This could also explain the high percentage of LDPE in the Morepannai dumpsite. Therefore, in the context of this region, all types of LDPE could be considered low value plastic waste and therefore, not managed at scale by the informal sector.

(iii) The demand for PP is less when compared to other high value plastics in the recycling ecosystem across the Identified Locations. In addition, the informal sector in Morepannai does not deal with PP and PVC because of its limited generation and value in the informal market while the informal sector in Rameswaram and Pamban trade in these plastic types.

These observations highlight the variance in the operational and financial viability of collection and recovery of different plastic types across geographical locations in the Palk Bay region. Rigid plastics such PET and HDPE types of plastic remain consistently valuable in the informal waste value chain

while recovery of other plastic types depend on various factors such as quantum of generation, viable processing destinations and costs of operations

7.2 Comparison of value addition across different levels of aggregators

The below graphs depict the selling prices of high value plastics at different stages of the plastic value chain, including waste pickers, L1, and L2 aggregators in Rameswaram. This graph highlights a consistent increase in selling prices for all high value plastics at each stage of the value chain. These price fluctuations are a direct result of value addition activities, such as aggregation, sorting, grinding, and baling, that occur at various points within the plastic value chain. Although there are differences in price ranges between the minimum and maximum values across the identified locations, the overall trend of increasing value is observed in the Identified Locations.

Notably, the data reveals that the L2 aggregator in Rameswaram has a significant increase in the value of all plastic types compared to waste pickers and L1 aggregators. This underscores the potential for profit associated with value added processes, including colour and type sorting, baling, and grinding of plastic waste. These processes not only enhance the value of plastic waste but also enhance transport efficiency by reducing volume, resulting in higher profits from selling larger quantities in a single transaction.

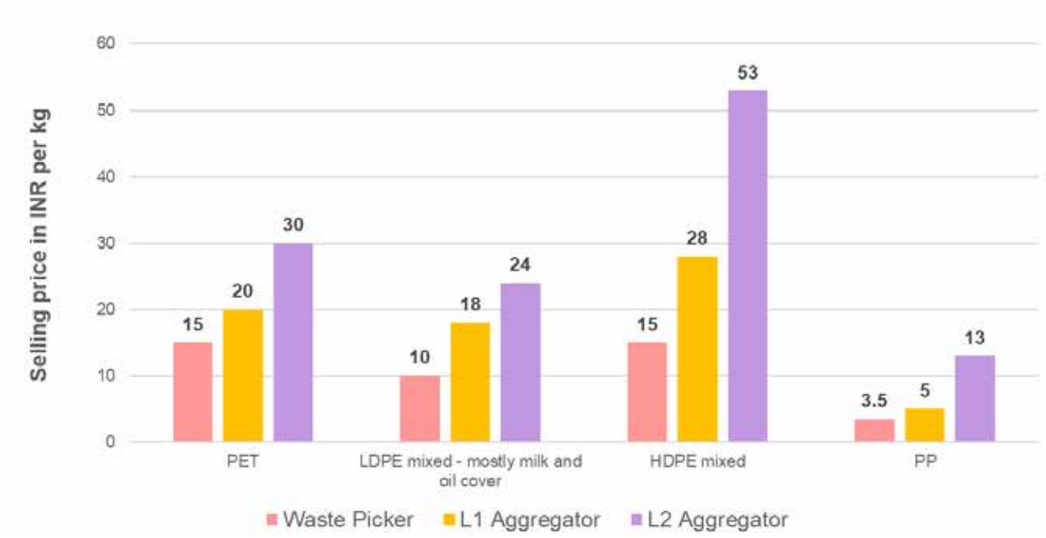

Figure 40: Selling price across the plastic value chain in the Identified Locations

The above graphs further indicate that if L1 aggregators in the areas like Morepannai and Pamban (where the L2 aggregator is absent) scale up their operations to the level of L2 aggregators and subsequently sell pre-processed plastic waste to recyclers, agents, or traders, they have the opportunity to significantly increase their profits. This increase could range from 1.5 to 4.5 times greater than the current profits earned by L1 aggregators when selling plastic to recyclers, agents, or traders. This increase in revenues also has considerable potential in terms of livelihood improvement because of additional manpower required for secondary sorting, baling and grinding of plastic waste.

JDK Plastics - L3 aggregator from Ayyankulam, near Rameswaram

JDK plastic was set up in 2021 to aggregate and handle various plastic types. While the setup is informal with a semi-constructed shed, the enterprise has equipment such as grinder, cutter, sharpener and baler and is the only facility which has such equipment in Rameswaram. JDK Plastics purchases approximately 3 to 5 MT of plastic waste per week from 10 scrap dealers from Rameswaram, 2 from Uchipulli and 2 from Pamban. In addition to the equipment, JDK is the only facility that carries out finer sorting of plastic waste by type and colour, bales certain types of plastic while grinding others. The enterprise engages 5 women and 2 men at INR 300 and 600 per day for different waste management processes such as sorting, grinding and baling. Some of the challenges he faces is the lack of continuous supply of electricity at his facility, lack of infrastructure and funds for scaling his operations. He was not aware of EPR obligations under PWM Rules and was willing to expand his operations to include low value plastics if funds and processing destinations are available for these plastic types.

JDK's ability to perform value-added processes such as grinding and baling sets it apart from L1 aggregators and significantly increases its profitability. For instance, HDPE plastic waste is purchased for Rs. 50 per kg by JDK and it is then sold at Rs. 194 per kg after sorting and grinding into chips. This value addition not only enhances recovery of resources from plastic waste but also improves financial viability of a plastic waste facility. If an L1 aggregator progresses to become an L2 aggregator, they stand to increase their profits, enabling them to procure more materials and expand their workforce, ultimately enhancing livelihoods within the community.

8. OVERVIEW OF MANAGEMENT OF OLD FISHING NETS

8.1 Old fishing net waste generation and challenges

Given that the Identified Locations are situated in coastal areas and one of the primary occupations being fishing in these areas, there is a high incidence of waste generation due to old fishing nets. The study team conducted visits to the fishing landing centres in Rameswaram and Pamban, where interviews with fishermen associations and individual fishers provided insights to waste generation and management of fishing nets. During the interviews, the study team was informed that a minimum of 200 kg of fishing net waste was generated per day in the Identified Locations[37]. The disposal of these nets is affected by various factors, including the age of the fishing nets, their overall condition, fishing seasons and the financial condition of the fishers.

37 Data shared by Fishermen Association in Morepannai and Pamban

Figure 41: Fish landing centre at Rameswaram

Despite the significant volume of fishing net waste generated, the ULB or the Gram Panchayats in the Identified Locations do not have a formal mechanism to collect or manage old fishing nets. Consequently, the collection and channelisation of these old fishing nets to recyclers, as is the case with plastic waste, are presently facilitated through the informal waste sector.

8.2 Flow of fishing net through informal sector

At the Identified Locations, the fishers sell the old fishing nets to itinerant buyers and/or L1 aggregators. These aggregators, in turn, sell the nets to either L2 aggregators in Rameswaram or recyclers/agents in Madurai. Subsequently, the L2 aggregator also sell the fishing nets to recyclers in Madurai and Gujarat, depending on their supply linkages.

During the field visits, the study team identified that there is only one L2 aggregator in the Identified Locations. The fishing nets are pre-processed by separating ropes and other materials such as plastic buoys and thermocol from the net and aggregating them before subsequently selling the nets to recyclers in Madurai and Gujarat.

Given that there is only one L2 aggregator, the L1 aggregators and itinerant buyers are left with only two viable options for the sale of old fishing nets – they can either opt to collaborate with the L2 aggregator, or they may choose to sell the nets to recyclers or agents located in Madurai. The determining factor in this decision-making process often revolves around the entity offering the most competitive prices and the costs associated with transportation of the aggregated nets.

Figure 42: L2 aggregator at Rameswaram

Moreover, the team observed that there are no L1 or L2 aggregators in Morepannai collecting old fishing nets in the village area. Instead, itinerant buyers (in two or four-wheelers or Tata ACE), from the neighbouring districts such as Pattukotai, Pudhukotai, and Karaikudi, visit Morepannai regularly to collect old fishing nets from the fishers.

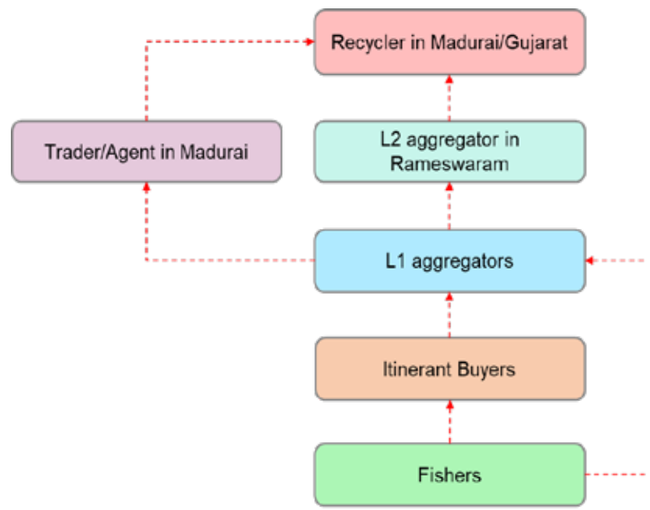

Figure 43: Flow of old fishing nets waste through informal stakeholders

Furthermore, from the visit to the landing centres in both Rameswaram and Pamban, the study team observed that old fishing nets are aggregated by individual fishers, with the intention of selling them as needed, especially during the ban on fishing (due to breeding seasons). This practice is primarily driven by the need to replace old fishing nets and the need for a source of income for fishers when fishing activities are temporarily halted due to the ban.

Figure 44: Fishing nets stored at fish landing centre at Pamban

8.3 Current practices and initiatives

8.3.1 Reuse of old fishing nets

During the study, it was noted that in the Identified Locations, there are instances of reusing old fishing nets for various purposes such as nets for different sports such as cricket, badminton and volleyball, external netting/fence, bundling multiple nets to function as speed breakers etc. These practices reflect a creative and sustainable approach to utilising old fishing nets in alternative ways beyond their original purpose.

Figure 45: Reuse of old fishing nets

8.3.2 Fishers' plastic waste collection drive

An initiative commenced by the fishermen association in Pamban in 2022 involved providing bins to each boat to facilitate the collection of plastic waste generated by the fishers during their expeditions as well as the plastics that become entangled in their nets. Initially, fishers followed the practice of bringing the collected waste back to the shore and depositing it in the bins provided at the landing centre. However, this practice was shortly discontinued over time due to the absence of an effective disposal system for the accumulated plastic waste and lack of financial incentives.

Figure 46: Bin provided in fish landing centre at Pamban

8.4 Pricing analysis of old fishing nets rates

The data presented in the graph below highlights the selling prices of various types of fishing nets, including "Blue nets/Oodha nets" and "Gill nets/Narambu nets", at different stages of the value chain across the Identified Locations.

At the L1 aggregator level, the primary value addition process entails only aggregating and selling to the next stakeholder in the value chain. L1 aggregators purchase the fishing nets only if they are separated from materials such as ropes, plastic buoys and thermocol. On the other hand, the L2 aggregator buy both separated and unseparated fishing nets as they undertake the separation of different materials in their units through manual labour. As a result of the costs, they incur due to the manual labour, L2 aggregators purchase unseparated nets at a lower price compared to the separated fishing nets.

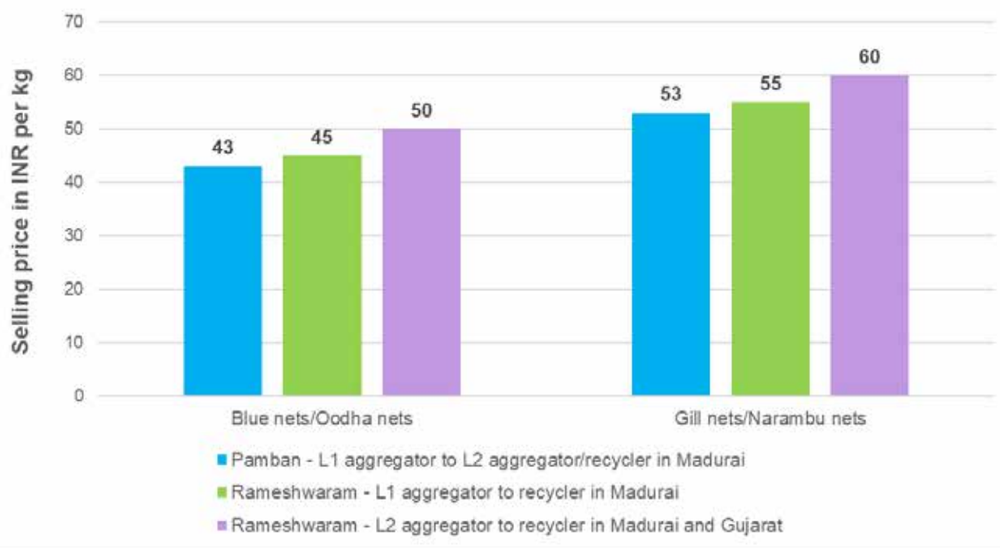

Figure 47: Selling price for the fishing nets across waste value chain in the Identified Locations

From the graph, it is evident that the L2 aggregator in Rameswaram attains a higher profit margin compared to the L1 aggregators in Rameswaram and Pamban. This advantage is primarily attributed to well-established business connections cultivated by the L2 aggregator, whose family has engaged in this business for several generations. Additionally, the volume of fishing nets processed by this aggregator amounts to approximately 10-15 MT per month, significantly higher than other L1 aggregators who handle smaller quantities (1.5 - 2.5 MT per month). This scale of operations allows the L2 aggregator to optimise costs such as transportation and also fetch a higher price from the recyclers and agents.

9. GOVERNMENT FUNDING OF PLASTIC WASTE MANAGEMENT

The following central and state schemes can be availed by the GPs and ULBs for implementing sanitation and solid waste management activities:

Table 7: Government funding sources for solid waste management (SWM) activities.

Sl. no	Source of funding	Amount of funding	Activities it can be used for
1	Swachh Bharat Mission (Grameen)	1. For solid waste management in village size upto 5000 population: Upto Rs. 60 per capita[38] 2. For solid waste management in village size above 5000 population: For solid waste management: Upto Rs. 45 per capita[39] 3. For plastic waste management unit, one in each block: Rs. 16 lakhs per unit	Capital expenditures like purchase of vehicles or setting up of waste management units (including labour costs for such construction)
2	Swachh Bharat Mission (Grameen)	5% of the total programmatic funding under SBM(G) where 3% is at the state/district level and 2% at the central level	IEC and capacity building activities in rural areas
3	Swachh Bharat Mission (Grameen)	1% of the total programmatic funding under SBM(G)	Administrative expenses such as salaries of consultants, travel expenses, monitoring & evaluation activities
4	Swachh Bharat Mission (Urban) 2.0	The central government's contribution for SWM activities: 1. 25% for other 10 lakh plus ULBs 2. 33% for other ULBs with 1 lakh to 10 lakh population (both included) 3. 50% for other ULBs with less than 1 lakh population 4. On this basis, Rs. 807.4 Crores has been allocated by the central government to Tamil Nadu.	Setting up MRFs, transfer stations and waste processing plants including plastic waste
5	Swachh Bharat Mission (Urban) 2.0	A total of 5% of the total allocation for project components of the overall budget On this basis, Rs. 251 Crores has been allocated by the central government to Tamil Nadu.	IEC & Behaviour Change initiatives in urban areas

38 30% of this amount will be borne by GPs from their 15th Finance Commission grants

39 30% of this amount will be borne by GPs from their 15th Finance Commission grants

Sl. no	Source of funding	Amount of funding	Activities it can be used for
6	Swachh Bharat Mission (Urban) 2.0	A total of 3% of the total allocation for project components of the overall budget On this basis, Rs. 126.1 Crores has been allocated by the central government to Tamil Nadu	Capacity building of different stakeholders in urban areas
7	Costs under Convergence with MGNREGS		Construction of capital/infrastructure assets for SLWM projects such as conversion of single pit toilets, construction of dry waste storage unit and compost pits Employment of waste workers
8	Funds under 15th Central Finance Commission that are earmarked for cleanliness and solid waste management for rural (gram/block and district levels) and urban areas (ULBs)		1. Wages for waste workers 2. Setting up waste management units and purchase of collection vehicles
9	Funds by the State Finance Commission for rural (gram/ block and district levels) and urban areas (ULBs)		Salaries of existing waste management personnel
10	Revolving funds and loans available under National Rural Livelihood Mission (NRLM)		Credit facilities for SHGs especially, women SHGs
11	Members of Parliament Local Area Development (MPLAD) scheme	Limits as per the Guidelines issued for MPLAD on April 01, 2023	Providing garbage collection and disposal systems in the constituency
12	Member of Legislative Assembly Constituency Development Scheme	The current allocation of funds is Rs. 3 Crores per constituency per annum	As per the works approved under the scheme
13	Shyama Prasad Mukherji Rurban Mission (SPMRM) for cluster-based development activities including waste management.	Convergence and funding as per the provisions of the scheme	Solid waste management as per provisions of the schemes in a cluster of villages
14	Special funds such as development grants from state, NITI Aayog etc. awards, performance-based incentives	Depend on the fund guidelines	Depend on the fund guidelines
15	Funds from corporate social responsibility of companies and private donations through Swachh Bharat Kosh or otherwise.		Operating and capital expenses of waste management units in urban and rural areas.

It is evident that government funding is predominantly available for the capital infrastructure/assets for solid (including plastic) waste management while the ULBs/GPs are required generate funds for operations and maintenance from its own revenues. One of the biggest challenges in long term sustainability of solid waste management systems is the lack of consistent financial resources to operate waste management systems. Therefore, it is critical for ULBs and GPs to generate revenues that will partially or totally cover the operational costs of SWM systems. This is discussed in greater detail under "Recommendations" under Section 11.

10. RECYCLING OF PLASTIC WASTE

Plastic waste can be recycled in a variety of ways and the ease of recycling varies among polymer type, package design and product type. For example, rigid containers consisting of a single polymer are simpler and more economic to recycle than multi-layer and multi-component packages. Thermoplastics, including PET, PE and PP all have high potential to be mechanically recycled. While, plastic packaging that frequently uses a wide variety of different polymers and other materials such as metals, paper, pigments, inks and adhesives that increases the difficulty of recycling[40].

It must be noted that a major challenge for producing recycled resins from mixed plastic waste is that most different plastic types are not compatible with each other because of inherent immiscibility at the molecular level, and differences in processing requirements at a macro-scale[41]. As a result, recycling units tend to be separate/different for specific plastic types.
The following fundamental factors affect the setting up of recycling facility using mechanical recycling method

10.1 Availability of space:

A minimum of 3000 square feet of space preferably in an industrial area is required for setting up of a recycling unit that has the capacity to recycle 2 MT per day. The location should be in an industrial area given that plastic recycling is an orange category industry (as categorised by CPCB) which means that it is significantly polluting in terms of air and water[42].

10.2 Pricing analysis of old fishing nets rates availability of water:

Plastic recycling units typically have a washing line to remove impurities/contamination such as adhesives, residual waste and labels etc and/or for finer sorting of plastic waste. Therefore, having access to fresh water for the washing line/equipment is important. Given that Ramanathpuram is a highly drought prone area[43], regular access to fresh water will be a challenge.

10.3 Equipment:

Depending on the plastic type and process, several equipment such as equipment for pelletising, dust remover machines, cutting, shredding, washing, extrusion etc. are required for the recycling facility.

40 Plastics recycling: challenges and opportunities, at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2873020/

41 Plastics recycling: challenges and opportunities, at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2873020/

42 Final Document on Revised Classification of Industrial Sectors Under Red, Orange, Green and White Categories, February 29, 2016, CPCB

43 https://tnenvis.nic.in/files/RAMANATHAPURAM.pdf

10.4 Other utilities:

Given the equipment and processes involved in plastic recycling, utilities such as regular electricity is critical for the optimal operations of the recycling unit.

10.5 Authorisations:

Necessary licenses and permissions for plastic recycling business from TNPCB, Factories Department need to be in place before starting operations in the plastic recycling unit. In the event the location of the recycling unit is in an ecologically sensitive area, obtaining such permissions can be challenging given the polluting nature of plastic recycling.

10.6 Regular supply of plastic waste:

Plastic recycling units require plastic waste that are of a specific type and quality and this supply needs to be consistent. The quality of the plastic could be dependent on the thickness, colour, size, free of residual waste among others. This consistent supply of good quality of plastic waste is possible only if the area has good segregation levels and the infrastructure and systems for secondary sorting of plastic wate is available.

10.7 Market for the recycled plastic:

The price of virgin plastic is influenced by the price of oil, which is the principal feedstock for plastic production. While good quality recyclate typically requires additional sorting and processing steps compared to lower-quality recyclate, resulting in higher costs[44]. Given the fluctuating oil prices, the price differentials between virgin and recycled materials are uncertain. In this context, a steady market for recycled plastic is possible if the gap between the value of recycled plastic resin and virgin resin is reduced and recycled resin remains cheaper than virgin plastic.

11. RECOMMENDATIONS

There are diverse challenges and gaps that have been highlighted during the scoping study. Therefore, in addressing the complex issue of plastic waste management in the Palk Bay region, it is essential to adopt a strategic and phased approach. While the overarching goal is to develop a comprehensive plastic waste management solution, it is often impractical and resource-intensive to tackle all challenges simultaneously. Therefore, in the following section, the recommendations are specifically tailored to livelihoods from plastic waste management, with the understanding that they are not intended to solve all the challenges associated with plastic waste in the Palk Bay region.

11.1 Infrastructure and manpower for collection of waste

Rural areas: From the baseline assessment of Pamban and Morepannai, it is evident that there is inadequate collection infrastructure and that the number of personnel deployed for door-to-door

44 Understanding Business Requirements for Increasing the Uptake of Recycled Plastic: A Value Chain Perspective at https://www.mdpi.com/2313-4321/7/4/42

waste collection is below the recommended number of workers. Employing an adequate number of waste workers as per typical normative stands across municipalities and gram panchayats for waste management activities creates additional employment opportunities and therefore, livelihoods from solid (including plastic) waste management. While the government orders require engagement of one Thoomai Kaavalar for every 150 households, this does not seem to be implemented at all for the village panchayats in the Identified Locations. In addition, given that no user/service fees are collected from the residents, there is no source of revenues except for the sale of recyclable waste. One of the approaches for ensuring manpower and generating revenues can be through creation of self-help groups for door-to-door collection, similar to Haritha Karma Sena in Kerala, where women self-help groups collect dry waste from households upon payment of a service/user fee[45]. A similar model can be replicated in gram panchayats in Palk Bay, particularly in areas with insufficient collection systems, and this can significantly contribute to improved waste management and employment generation. Door to door primary collection of waste could also be supported and/or facilitated by community-based organisations and non-profits.

Urban areas: Currently, the manpower in Rameswaram does not take into account the tourist inflow which on some religious occasions crosses the resident population. Therefore, it is critical that the ULB accounts for additional waste workers to manage the waste generated by this floating population. This measure will also lead to additional employment opportunities for the local population.

11.2 Operationalisation of existing waste management infrastructure

There is existing waste management infrastructure across the Identified Locations which are non-operational and/or operating at sub-optimal levels. These include dry waste aggregation and sorting centres in Vadaku, Ayyanthoppu and Morepannai. Reviving operations in these centres will generate employment for local communities and lead to improved management of waste including low value plastic waste. The initial operations of these facilities will require viability gap funding from the government, corporates and/or non-profits because the cost of operations are likely to exceed the revenues generated from sale of waste. However, by scaling up operations (where the centre manages a specific quantum and type of waste) along with funds from EPR, plastic credits and OBP (as discussed below), these centres can achieve financial sustainability.

11.3 Infrastructure for aggregation of non-biodegradable waste (including plastic waste)

Processing of non-biodegradable waste is not advisable at village, GP or small ULB level due to lack of its economic viability. Therefore, with respect to non-biodegradable waste including plastic waste, the handling should be limited to aggregation and if possible, sale of recyclable non-biodegradable waste. Every GP or a group of GPs or ULB (depending on waste quantities, distance, density of population, space availability etc.) should provide one dry waste storage unit as an aggregation point for dry waste. This is also supported by Tamil Nadu government orders which require identified village panchayats to have a segregation cum storage shed[46]. This could be an old or unused building in the village/GP/ULB. If there is no such structure, the village/GP/ULB should construct a dry waste storage unit. In the event there are scrap dealers and a market for recyclable non-bio-degradable waste

45 https://www.kudumbashree.org/pages/347

46 G.O. (Ms) No.10 issued by Rural Development and Pancha vat Rai (CGS.1) Department on 20.01.2016

at the village/GP/ULB, such recyclable materials can be sold from this dry waste storage unit. The non-recyclable non-biodegradable waste which has a high calorific value should be stored at the dry waste storage unit and transported to the block/district level aggregation centre at intervals as may be determined by the village/GP/ULB. Efficient operations of such dry waste (including plastic waste) collection centre will aid in management of plastic waste and employment of local persons.

11.4 Setting up plastic pre-processing units for high value plastic

As highlighted above, pre-processing of high value plastic waste is financially viable and critical to ensure the availability of suitable feedstock for plastic recycling units. In addition, the capital investment required to establish these pre-processing units is comparatively less than plastic recycling units. Currently, in the entire Ramanathapuram district, there is only one aggregator which carries out pre-processing of plastic waste. With training by government and incentives such as provisions of land, tax rebate etc., additional pre-processing facilities where plastic waste is categorised by type and colour and other processes such as baling and grinding can be established up by private entities and/or the government. These facilities also have the potential to create employment opportunities, for example, a scaled-up L2 aggregator, which has a capacity of handling 500 kgs of plastic waste per day, could potentially employ 7 to 10 persons. Therefore, pre-processing of high value plastic has the potential for financial gains, increased resource recovery and generation of local employment opportunities.

11.5 Processing of low value plastic

Resource, technology, and capital-intensive waste management processes for low value plastics such as RDF plants, co-processing in cement kilns, waste to energy projects, sanitary landfills etc. are best planned and executed at the district and/or regional level because they can benefit from economies of scale and for easy management and environmental monitoring. Therefore, until the block or district level, the units should be limited to dry waste collection centres (as described above) which can aggregate low value plastics. Once facilities such as RDF plants, kilns, waste to energy projects have been set up, district authorities should devise a strategy to link the processing of non-recyclable dry waste including low value plastic generated at ULBs and GPs.

In the absence of such facilities, the low value plastics can be channelised to the nearest cement plants and/or incineration units using the funds under EPR and OBP as described below:

11.5.1 Extended Producer Responsibility

PWM Rules, 2016 places the responsibility on producers, importers and brandowners (PIBOs) that use plastic packaging to manage the end-of-life of such packaging as well. In practice, PIBOs typically engage with waste management agencies, plastic waste processing facilities and local governments to facilitate the collection and proper channelisation of plastic waste. This engagement involves the payment of service fees, which subsequently generates much needed funds for the management of low-value plastic waste, such as flexible plastics and MLP, commonly used for product packaging. As highlighted above, currently this category of plastic waste remains unmanaged across the Identified Locations and most likely, across the Palk Bay region.

In addition, the local municipalities, gram panchayats and informal waste sector in the Identified Locations are unaware of EPR requirements and are therefore unable to leverage it for securing funds for managing low value plastic within their jurisdiction. To address this issue, the district administration can consider the following steps:

(i) Conduct training and capacity-building initiatives aimed at ensuring that relevant government officials understand the EPR requirements outlined in the PWM Rules. This equips them with the knowledge and skills necessary for effective implementation of EPR obligations within their respective jurisdictions.
(ii) Provide training for waste collection staff and the informal sector operating in their jurisdiction on EPR under PWM Rules, 2016. This training will enable them to initiate the collection, aggregation, and sorting of low value plastics and the documentation associated with these activities.
(iii) Collaborate with PIBOs, waste management agencies, and plastic waste processing facilities to establish systems that facilitate the collection of low value plastic waste from the Ramanathapuram district and the wider Palk Bay region.

The implementation of these measures is likely to create several livelihood opportunities as set out below:

(i) The informal waste sector is expected to start collecting and aggregating flexible plastic waste and MLP because it will have a market value through the EPR mechanism. This will lead to additional employment opportunities within the informal waste sector given that there will be additional workers who will now collect, sort, and transport flexible plastic waste and MLP along with other plastic types that are already getting managed.
(ii) In addition, EPR can incentivise the development of small private businesses that specialise in plastic waste collection and sorting. These businesses can become sources of additional employment, contributing to local economic development.
(iii) The government infrastructure which was aggregating only low value plastic will have EPR funds as an additional source of revenues. This would bring in revenues required for operations of the facilities and could also lead to additional employment within the government infrastructure.

11.5.2 Plastic Credits and OBP

With plastic offsetting through plastic credits (which can also be through OBP certification), individuals and businesses have the opportunity to offset their plastic footprint and neutralise it. By paying a given sum, a certain amount of plastic waste is intercepted from the environment on behalf of the company/individual, and then recycled. This money can be paid directly to organisations that are collecting and processing plastic waste on the ground.

In this context, local bodies, waste management organisations, community-based organisations or the informal sector players in the Palk Bay region can be registered with entities that are certified under different plastic credits and OBP certification programs and supply the plastic waste (including fishing nets) that are required by them. The supply of plastic waste will be upon payment of monies which cover the costs of collection as well as other margins and this ensures the financial sustainability of the supply chain. This is likely to lead to enhancement

of livelihoods in the informal sector due to increased revenues and additional employment opportunities due to increase in quantum and type of plastic waste managed. Some examples of organisations working with plastic credits and OBP in South India are Repurpose Global, Plastics for Change and CleanHub.

11.6 Enabling collection of user fee and introduction of tourist fees

While the existing government funding provide for capital costs for SWM infrastructure and initial manpower salaries, one of the biggest expenditures for SWM systems are the recurrent costs to maintain SWM facilities and manpower salaries. Therefore, all ULBs and GPs in the Palk Bay region need to consider the following for preparation of annual budgets for (i) the capital costs required for initial investment in waste management infrastructure and facilities; (ii) the recurrent costs/revenues required to operate and maintain the facilities; and (iii) the programme costs for activities such as training, IEC and BCC activities.

Given the substantial costs in sustaining waste management system they need to be made financially sustainable by ensuring cost recovery of operation, maintenance and asset depreciation costs through (i) external sources such as allocation of funds from government grants, viability gap funding from the government and any other schemes; and (ii) GP/ULB's own/internal sources of revenues such as property tax, license fees, levy of user fees on the beneficiaries, sale of recyclable dry waste, as detailed in paragraphs below.

The SWM Rules mandate local authorities to collect user fees from waste generators to finance the solid waste management activities within their jurisdictions. The user fees are a significant source of revenue for the local authority to fully or partially cover the operational costs associated with running their waste management systems. However, at the Identified Locations, neither the municipality nor the gram panchayats are currently collecting user fees, resulting in limited revenues for these authorities to fund their waste management operations. This has resulted in irregular door-to-door collection of waste, inadequate manpower for different waste management activities, insufficient number of collection vehicles and non-functional aggregation and processing facilities. Therefore, to address these gaps in waste management, it is recommended that the local authorities notify user fees for waste management services (including management of plastic waste). These could be collected along with property tax, trade license fees, electricity and/or water bill. When establishing the user fee structure, the following factors could be considered:

(i) The rate of use fee could be based on the area of the waste generator and/or follow a "pay as you throw system" i.e., depending on the amount of waste generated.
(ii) Variable rate should be prescribed for residential, non-residential, households, commercial establishments and bulk waste generators where the highest rate of user fees could be prescribed for bulk waste generators and commercial establishments while the lowest rates could be prescribed for slums and/low-income households. For example, it was found during the study that hotels generate a significant amount of plastic waste. Therefore, they should be charged a higher amount of user/service fees for waste management and/or should be made responsible for management of plastic waste through their own arrangement.
(iii) Capital and operational and maintenance costs of the SWM services and use fee should be structured such that a certain percentage or the entirety of these costs should be recoverable through user fees.

In addition, areas within the Palk Bay which have a high tourist footfall can consider introducing tourist fees. These fees can support additional waste management infrastructure, services and facilities required to handle waste generated by tourists. This multi-pronged approach not only ensures a sustainable revenue stream for waste management but also ensures employment of personnel for different waste management activities, which will lead to increased livelihoods in the region.

Given the possible reluctance to pay user fees for waste management services, the ULB and GPs could consider providing the service for a nominal fee which could be increased gradually with increased acceptance among the communities and improved level of services.

11.7 Collection and larger aggregation centres for fishing nets

While recycling of fishing nets is economically viable, the collection and transportation of such nets from distant villages add substantial costs, thereby diminishing the overall financial attractiveness of recovery of nets. Therefore, it is important that collection centres are established at appropriate locations for aggregation of fishing nets, allowing for bulk transportation which is cost efficient. In addition, given the increased financial returns due to trading and handling in fishing nets at scale, areas in Palk Bay where L2 aggregators are absent, the administration could consider establishing larger aggregation centres for fishing nets. This cost-effectiveness and scale of operations not only streamlines the logistics but also enables the collection agency to provide fair compensation to fishers who bring the damaged nets to the collection centres. In light of these considerations, it is recommended that various stakeholders, including government authorities, private enterprises, and non-profit organisations, collaborate in the establishment of collection centres within each gram panchayat and aggregation centres at a cluster level. Subsequently, transportation of these aggregated nets to the next level in the value chain such as larger aggregation centres, agents or recycling units, can be undertaken in a cost-effective manner. This opens up the potential to substantially increase revenues from recovery of fishing nets and create additional employment opportunities in the region.

11.8 Livelihoods through eco-friendly alternatives to single-use plastics

Under current Indian regulations, the manufacture and use of single use plastic items such as plastic cutlery, plates, cups, glasses, straws, sticks and thermocol for decorative purposes, plastic carry bags with thickness of 120 microns among others have been banned. In this context, the Government of Tamil Nadu has issued a G.O. (Ms) No. 116 of Environment, Climate Change & Forest (EC.2) Department dated 27.11.2021 notifying 4 strategies to be adopted to fight plastic pollution and eliminate single use plastics. In order to prevent single use plastic pollution and to revive traditional cloth bags, "Meendum Manjappai" campaign was launched in December 2021 by the government where an appeal was made to the public to use cloth bags and to avoid single use plastics. The Government of Tamil Nadu has also constituted a State Level Special Task Force (STF), under the Chairmanship of Chief Secretary, District Level Task Force under the Chairmanship of District Collector and the Chairmanship of the Commissioner for Greater Chennai Corporation area (vide G.O. Ms. No. 25 ECC&F Department dated 07.02.2022) for monitoring the implementation of Single Use Plastic (SUP) ban[47]. Therefore, in this context, there are opportunities to create livelihoods through the promotion of alternatives to these plastic items. Some of these options include:

47 https://tnpcb.gov.in/pdf/Annual_Report/AnnualRpt_Eng2022.pdf

(i) Establishing and managing cutlery banks that can maintain and rent out reusable plates, glasses and cutlery for festivals, events, ceremonies etc. This initiative not only promotes sustainability but also generates employment.
(ii) Converting textile waste to cloth bags and other functional products, especially in Rameswaram due to its high generation of textile waste, offers a sustainable substitute for plastic carry bags. This process not only reduces plastic usage but also provides employment through the production of these cloth bags.
(iii) Installing and operating water dispensers in main public areas not only reduces use of packaged drinking water but also provides job opportunities for individuals managing the dispensers.

11.9 IEC and behavioural change activities

For any program to be successful, it requires significant participation, perceived need of the program and acceptance from communities. Demand creation is the first key step to ensure the success of SWM systems in the villages and cities. Information, Education and Communication is an important tool in creating awareness and ensuring community demand for sustainable waste management practices. While effective dissemination of IEC plays a key role in generating awareness, behavioural change campaigns (BCC) take it to the next level of enabling action and ensuring involvement and ownership of the SWM practices by community on the ground.

There is large-scale dumping and burning of waste in the Identified which do not have proper waste management collection and processing, both by residents and waste collection staff. One of the primary reasons for this is lack of waste management options for the residents and lack of awareness with respect to harmful effects of burning and dumping plastic waste in the open. Therefore, IEC and BCC initiatives should be considered in parallel with other recommendations with respect to infrastructure and processes such that communities are in a position to support them through source segregation, handing over segregated waste through door-to-door collection, no dumping/burning and payment of user fees etc. The awareness and behavioural change strategy could focus on the following three focus areas:

(i) The Who - IEC target audience and stakeholders:

The primary target group for creating awareness regarding plastic waste management issued and solutions include fishers, school going children (critical for BCC because they are receptive to new ideas and they could also help influence their parents to adopt good sanitation practices), women, youth, Panchayat/ULB members especially members of Solid Waste Management Committees, community leaders, waste workers, Anganwadi and health workers and community-based organisations

(ii) The What – the content of the information:

Considerable evidence shows that trying to change too many behaviours does not work and therefore, the IEC strategy should focus on the following critical areas:

(a) Importance of source segregation
(b) No open dumping or burning waste
(c) Impact of mismanagement of plastic waste on public health and the environment.

(d) Prevention and minimising of waste at a generator level through implementation of ban on SUP

(e) Waste management program details and the need to pay for waste management services through user fees.

(iii) The How – Communication strategy

A well-planned communication strategy is necessary so that information is disseminated effectively and the following IEC activities could be used to convey the information are given in the table below:

Table 8: Overview of IEC strategies and target audiences.

IEC activities	Target audience and suitability
Street plays, folk songs, folk artists	One of the most impactful tools for awareness generation among primary target group where language and literacy are major barriers
Door to Door awareness including interpersonal communication	Thooimai Kaavalars and other trained manpower can carry out interpersonal communication with different types of waste generators regarding SWM activities. This is an extremely critical component of IEC/BCC strategy and the GPs/ULB should use this as one of its primary mechanism for awareness and behavioural change.
Wall Painting/writing	An appealing message displayed through wall paintings can serve as an impactful tool targeting almost everyone in and out of the village and the floating population as well
Festivals/Melas/ group meetings	To be conducted at ULB/GP level
Awareness and training workshops, exposure visits to locations of best practices	To be conducted at all the levels by identifying the need and type of training required.
School programmes like formation of eco-clubs, organising competitions based on solid waste management	Target audience is school children, who can help in propagating the campaign

IEC activities	Target audience and suitability
Award presentation to villages, GPs/ ULBs or people performing well in the field of solid waste management	Target audience can be rural population, officials at ULB/ GP/ district/state level. This promotes healthy competition among GPs and impetus to perform better.
Mass media	Use of audio-visual on TV, audio messages through radio, community radio or public announcement in villages/GP/ ULBs including short films on success stories.
Print media such as pamphlets, hoardings, banners, posters etc.,	Target audience where literacy is not a barrier.
Social media and digital platforms	Use of social media campaigns is also an effective tool to generate awareness on SWM. This should be used in districts where majority of the GP/ULBs has access to mobile phones and internet facility
Celebrity endorsements	Community influencers to promote various SWM programs /projects
Celebration of major occasions (e.g. Environment Day etc.)	Helps in promoting engagement of primary and secondary target group
Walk of Pride	Helps building pride in residents who have attained successful milestones in the implementation of sanitation plan

ANNEXURE I: LIST OF STAKEHOLDERS

S.no	Stakeholders	Designation	Department/Organization
1	A. Kannan	Municipal Commissioner	Rameswaram Municipality
2	Thyagaraj	Sanitary Inspector	Rameswaram Municipality
3	Sathya	SBM Supervisor	Rameswaram Municipality
4	Maheshwari, Lingavalli, Ponnipechu, Nitesh and Colington	5 Animators, SBM	Rameswaram Municipality
5	Kathiresan	Panchayat Secretary	Pamban Gram Panchayat
6	Pushpa	Motivator	Pamban Gram Panchayat
7	Balan	President	Kadalur Gram Panchayat (Morepannai is one of village under Kadalur Panchayat)
8	Shridhar KS	Project Coordinator	Hand in Hand is a private agency responsible for waste management in Rameswaram.
9	Ravi Kumar	Project Coordinator	Hand in Hand is a private agency responsible for waste management in Rameswaram.
10	Kanakaraj	Supervisor	Hand in Hand is a private agency responsible for waste management in Rameswaram.
11	Ramesh	Project Head	Green Rameswaram
12	Anbuarasan	Founder	HVA Chemical Solution Private Limited, Plastic waste recycling unit in Ramanathapuram district
13	Waste collection staff		Rameswaram Municipality, Pamban and Kadalur Gram Panchayat
14	Staff working in the waste processing facilities		Rameswaram Municipality, Pamban and Kadalur Gram Panchayat
15	Residents in the Identified Locations		
16	Commercial Establishments		
17	Bulk Waste Generators (Hotels): 1. KNP Nest 2. Hotel Star Palace 3. Queen Palace 4. SS Grand 5. Aalayam 6. Just Sarang		
18	Fishers		
19	L1 and L2 aggregators of plastic waste and fishing nets: 1. Karthik - JDK Plastics 2. Sathish - Methagu Steels 3. Vishwanath and Murugan - VV Irumbu Kadai 4. Sathiyaraj Irumbu Kadai 5. Shankar 6. Vijayaraj - Senthilvel Irumbu Kadai 7. Mugesh and Shankar - SS Irumbu Kadai 8. Anthony Rajan Irumbu Kadai 9. Anthony Irumbu Kadai 10. Somu - Sozha Vinayaga Pathira Kadai 11. Palchami - Muthukaliamman irumbu kadai 12. Murugayya Irumbu Kadai 13. Sanjay – Itinerant buyer		
20	Johnson	Union Leader	Mechanised boat fishermen association in Pamban
21	Kalidas	Secretary	Fishermen association in Morepannai
22	Members of the SHGs (Self Help Groups)		

ANNEXURE II: PLASTIC WASTE GENERATION IN HOUSEHOLDS ACROSS THREE IDENTIFIED LOCATIONS

Plastic types	Rameswaram - Plastic waste generated per HH# per day (in grams)	Pamban - Plastic waste generated per HH# per day (in grams)	Morepannai - Plastic waste generated per HH# per day (in grams)
PET	15.55	10.00	5.26
HDPE	1.64	0.00	1.13
LDPE	9.91	7.11	3.33
PP	2.10	2.89	0.41
MLP	4.02	5.69	22.06
Others	0.98	1.11	0.00
Thermocol	0.02	0.21	0.00
Total	34.22	27.01	32.18

#Household that consist of 5 persons

ANNEXURE III: RESULTS OF CONING AND QUARTERING AT PAMBAN AND UPPUR CHATHIRAM

Description	Pamban	Uppur Chathiram
Sample size in kg	8	12.5
Quantity of plastic waste present in the sample size in kg	2.07	1.27
% of plastic waste in sample	25.87	10.16
Bifurcation of different type of plastic in the plastic waste		
PET in grams	55	404
LDPE in grams	1183	194
HDPE in grams	10	0
MLP in grams	707	672
PP in grams	95	0
PS in grams	13	0
Others in grams	7	0

ANNEXURE IV: PRICING DETAILS FOR HIGH VALUE PLASTIC ACROSS THREE IDENTIFIED LOCATIONS

Type of plastic	Price rates from L1 aggregators in INR per kg						Price rates from L2 aggregators	
	Pamban		Morepannai		Rameswaram		Rameswaram	
	Minimum Buying price	Minimum Selling price	Minimum Buying price	Minimum Selling price	Minimum Buying price	Minimum Selling price	Minimum Buying price	Minimum Selling price
PET	15	20	15	20	10	20	20	30
LDPE - Milk and Oil cover	10	18	5	10	12	20	18	24
HDPE mixed	15	25	15	25	18	27	28	53
PP	3.5	5	0	0	4	6	5	13

ANNEXURE V: UPDATED INFORMATION

Dakshin Foundation conducted meetings with the Rameswaram Municipality, Pamban Panchayat and Kadalur Panchayat. The team met with the Kadalur Panchayat President in November 2024, and Rameswaram Municipal Commissioner and other members and Pamban Panchayat President in January 2025. The Panchayat and Municipality members provided certain updates to the information that was included in this study. The updates are as follows:

1. The study mentions that Rameswaram Municipality has 34 waste workers (Page no. 26). The number has increased to 36 municipal waste workers.

2. Rameswaram Municipality conducts awareness sessions in public areas like schools, bus stands, Municipality office every month on 2nd and 4th Saturdays. The schedule for IEC activities is sent by the Rural Development Department. Every week a new ward is visited for IEC activities.

3. Pamban Panchayat has procured a new tractor, and 2 new BOVs in place of the non-operational ones. They have also sent a proposal for a Tata Ace.

4. The study mentions that Pamban Panchayat has 6,500 households (Page no. 31). The number has increased to nearly 8,000.

5. The study mentions Pamban Panchayat as employing 26 waste workers (Page no. 32). During the meeting in January 2025, the President mentioned that the Panchayat employs only 15 waste workers and not 26. The 15 workers are being given a higher salary than prescribed by adjusting for 26.

Every year an estimated 9-14 million tonnes of plastic waste enters the oceans, with most of it finding its origins on land. For a crucial biodiversity spot such as the Palk Bay region, this can cause indelible damage. Done in collaboration between Dakshin Foundation and Saahas Zero Waste, this study captures the type of plastic waste generated in this region, the flow of waste and gaps that exist, and the potential for livelihood creation. It highlights the structural challenges and opportunities that exist, presenting a call to turn the tide on the growing problem of plastic waste.