

Baseline report - Plastic waste management and upcycling low-value plastics interventions in Bhubaneswar.

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Table of Contents

Table of Contents.....	2
List of Tables	3
List of Figures	3
List of abbreviations.....	3
1. Introduction.....	4
1.1. About the Project.....	4
1.2. Technology Partners	4
1.2.1. Silica Plastic Waste Blocks.....	4
1.2.2. Resin-free plastic panel boards.....	5
1.3. About the pilot location – Bhubaneswar City	6
1.4. Objective of the report	6
2. Plastic Waste Management in Bhubaneswar City: Current Status and Challenges.....	7
2.1. Existing status of plastic waste management.....	7
2.2. Formal and informal value chains.....	8
2.3. Institutional framework	9
3. Stakeholder discussions.....	10
4. Stakeholder mapping.....	12
5. Policy and Infrastructure Gaps Analysis	14
6. Recommendations and Way-forward	15
6.1. Project stakeholders – Possible roles and responsibilities	15
6.2. Marketing plan for both technology partners	15
References	17

List of Tables

Table 1 The selected stakeholders for the interview.....	10
Table 2 Key findings of stakeholder discussion	11
Table 3 Gap analysis for plastic waste management in the city	14
Table 4 Marketing plan for Silica plastic waste blocks	16
Table 5 Marketing plan for Plastic panel boards	16

List of Figures

Figure 1 Silica Plastic Waste Blocks	4
Figure 2 Plastic Board Panel.....	5
Figure 3 Bhubaneswar City Map	6
Figure 4 Waste composition of Bhubaneswar City.....	7
Figure 5 Bhubaneswar City waste flow	8
Figure 6 Mapping the stakeholders for the project in the city.	13
Figure 7 Project Stakeholders' Role and Responsibility	15

List of abbreviations

B2B: Business to Business

BMC: Bhubaneswar Municipal Corporation

BWG: Bulk Waste Generators

EPR: Extended Producer Responsibility

H&UDD: Housing and Urban Development Department

HDPE: High-Density Polyethylene

IT: Information Technology

LDPE: Low-Density Polyethylene

MCCs: Material Composting Centres

MLP: Multi-Layer Plastic

MLPs: Multi-Layer Plastics

MRFs: Material Recovery Facilities

PET: Polyethylene Terephthalate

PPP: Public-Private Partnership

RDF: Refuse-Derived Fuel

SPWB: Sustainable Plastic-Waste Composite Blocks

TPD: Tonnes per Day

ULB: Urban Local Body

UN-Habitat: United Nations Human Settlements Programme

1. Introduction

1.1. About the Project

The eastern region of India is grappling with significant challenges in managing plastic waste, primarily due to the lack of adequate infrastructure for waste disposal in many areas. In response to this pressing issue, UN-Habitat has proposed a project to demonstrate effective upcycling interventions for plastic waste in Bhubaneswar, Odisha. This proposal has received support and assurance from city and state authorities, indicating their willingness to collaborate and showcase the sustainability and scalability of these pilot initiatives. The ultimate objective is replicating these interventions in other eastern and nationwide cities.

The project's primary focus is establishing public-private partnerships (PPP) and promoting social entrepreneurship while expanding market accessibility for upcycled products made from plastic waste. Currently, the market for recycled products, particularly those made from PET and other high-value plastics, is largely limited to the Business to Business (B2B) segment. Due to various market dynamics and barriers, this poses challenges to the acceptance of low-value plastics such as LDPE and MLPs. The project seeks to overcome these limitations by demonstrating two innovative technologies in Bhubaneswar, enabling upcycling of low-value plastics. This approach will yield tangible and intangible benefits over the project's implementation period.

The project is supported by Norwegian Retailers' Environment Fund, and by implementing the proposed interventions, the project aims to prevent approximately 20 tonnes per day (TPD) of plastic waste from reaching landfills or dumpsites. Furthermore, the daily plastic waste recovery will increase to 50 TPD by the project's third year. These measures will positively impact over 0.16 million beneficiaries, which accounts for at least 20% of the total population of the pilot city. By reducing plastic waste-related problems, the project will significantly improve the lives of individuals and communities in Bhubaneswar. Moreover, the successful implementation of this initiative will serve as a replicable model for other cities within the eastern region and the entire country.

1.2. Technology Partners

1.2.1. Silica Plastic Waste Blocks

Rhino industries have successfully developed a sustainable alternative to bricks – the Sustainable Plastic-Waste Composite Blocks (SPWB). These composite blocks utilise a combination of dust/sand from construction and demolition waste and waste plastics, resulting in a cost-effective and environmentally friendly building material. The SPWB consists of approximately 75% dust/sand, derived from construction and demolition waste, and 25% waste plastics, including low-value plastics (LVPs). The dust/sand serves as the primary component of the block, while the plastic functions as a bonding agent,



Figure 1 Silica Plastic Waste Blocks

eliminating the need for water or cement during production. The project has ingeniously combined foundry material handling technology with plastic extrusion technology to create this composite material.

Extensive evaluations of the SPWB's properties have revealed compelling advantages over traditional red clay bricks. The composite blocks are approximately 2.5 times stronger while weighing only 75% as much as their conventional counterparts. These superior strength characteristics make SPWB a highly competitive option for construction projects, ensuring enhanced structural integrity and durability. Furthermore, SPWB offers environmental benefits, as by utilising construction and demolition waste and waste plastics, the project effectively tackles two significant waste management challenges. The upcycling of these materials reduces the burden on landfills and mitigates the environmental impact of improper disposal.

Additionally, eliminating water and cement requirements during production minimises resource consumption and lowers carbon emissions. It has comparable material properties and competitive production costs, positioning it as an attractive and economically viable alternative to traditional bricks. As a green building material, SPWB aligns with the growing demand for sustainable construction practices. Its unique strength, weight, and environmental advantages make it an appealing choice for various construction projects. This innovative technology effectively addresses waste management challenges while offering a high-performance, eco-friendly building material. With its commendable strength, reduced weight, and cost-effectiveness, SPWB has the potential to revolutionise the construction sector, promoting sustainability and driving the adoption of green building practices.

1.2.2. Resin-free plastic panel boards

The Bamboo House Technology presents an innovative solution for upcycling plastic waste. It harnesses the potential of shredded LDPE/HDPE plastic waste to create durable and sustainable building boards. The technology revolves around effectively utilising shredded LDPE/HDPE plastic waste. Through a meticulous process, the plastic waste is hot and cold pressed under a weight of 650 kg at temperatures between 160 and 170 degrees Celsius. This unique method does not rely on the use of resins, ensuring an eco-friendly approach to production. Depending on the desired board type, various plastic waste materials can be incorporated, including MLP, LDPE, LDPE + Aluminium, LDPE + HDPE, Post Industrial MLP, or post-consumer waste.

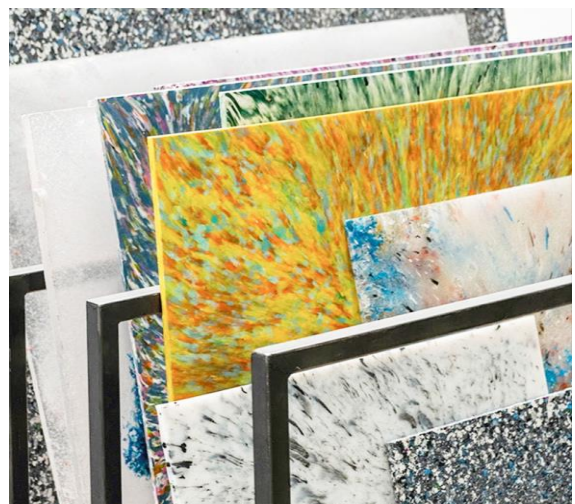


Figure 2 Plastic Board Panel

The resulting building boards exhibit good strength and versatility, making them suitable for various applications. By repurposing plastic waste, the Bamboo House Technology offers a cost-effective and environmentally friendly alternative to traditional construction materials. These boards find utility in developing low-cost shelter solutions and various other

construction projects. Moreover, the use of plastic waste materials reduces the environmental impact associated with plastic pollution and contributes to the principles of the circular economy. It addresses the critical issue of plastic waste management, significantly reducing the strain on landfills and minimising environmental pollution. By upcycling plastic waste into valuable building boards, this technology contributes to a cleaner and more sustainable future.

1.3. About the pilot location – Bhubaneswar City

Bhubaneswar is the capital city of the state of Odisha in eastern India. It is a rapidly developing city combining its rich cultural heritage with modern infrastructure and amenities. Bhubaneswar has a population of approximately 8.4 lakhs (840,000) people as of 2021 estimates. The primary language spoken in Bhubaneswar is Odia. However, due to its cosmopolitan nature, you can also find people speaking Hindi and English, especially in educational institutions, businesses, and tourism. Bhubaneswar has a rich cultural heritage influenced by the ancient kingdom of Kalinga.

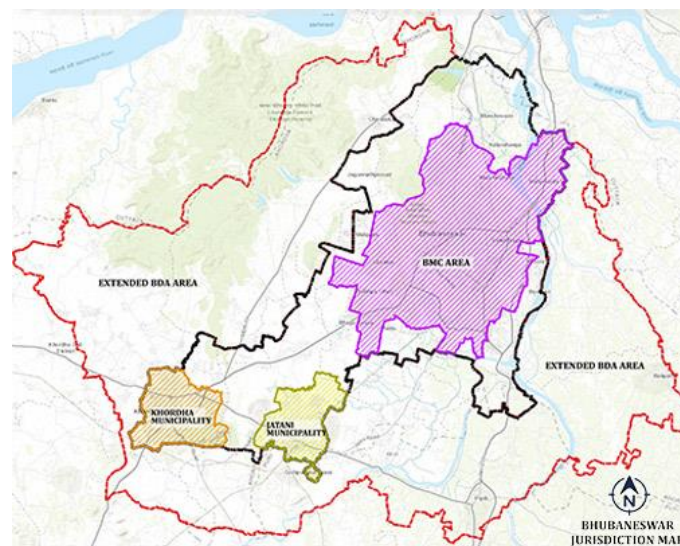


Figure 3 Bhubaneswar City Map

The city is known for its classical dance form, Odissi, which originated in Odisha. Festivals like Durga Puja, Rath Yatra, and Diwali are celebrated enthusiastically, bringing people from different communities together. Bhubaneswar is renowned for its educational institutions. It has numerous schools, colleges, and universities that attract students nationwide. The city has experienced significant economic growth in recent years. It serves as a major economic hub for Odisha, with a thriving service sector, including information technology (IT), education, healthcare, and tourism. Establishing IT parks and business centres have contributed to job creation and the city's economic development.

1.4. Objective of the report

The report is about the stakeholder mapping exercise carried out for the project. It focuses on collecting data on plastic waste management in the city, conducting the focused group discussion with various actors to understand better the need and status quo for plastic waste management, and positioning the project for smooth implementation.

2. Plastic Waste Management in Bhubaneswar City: Current Status and Challenges

Odisha's decentralised waste management model incorporates key highlights of household-level segregation, setting up decentralised recovery centres for all waste types, and including Swachh Sathis and sanitation workers that contribute to effective waste management practices.

2.1. Existing status of plastic waste management

Plastic waste management is a critical concern in Bhubaneswar City, with the need for effective strategies to address the substantial volume of plastic waste generated. The city's waste composition reveals that plastic waste accounts for 25% of the total waste generated (189 TPD), alongside other significant components such as kitchen, garden, paper-cardboard, metals, glass, WEEE, and miscellaneous waste.

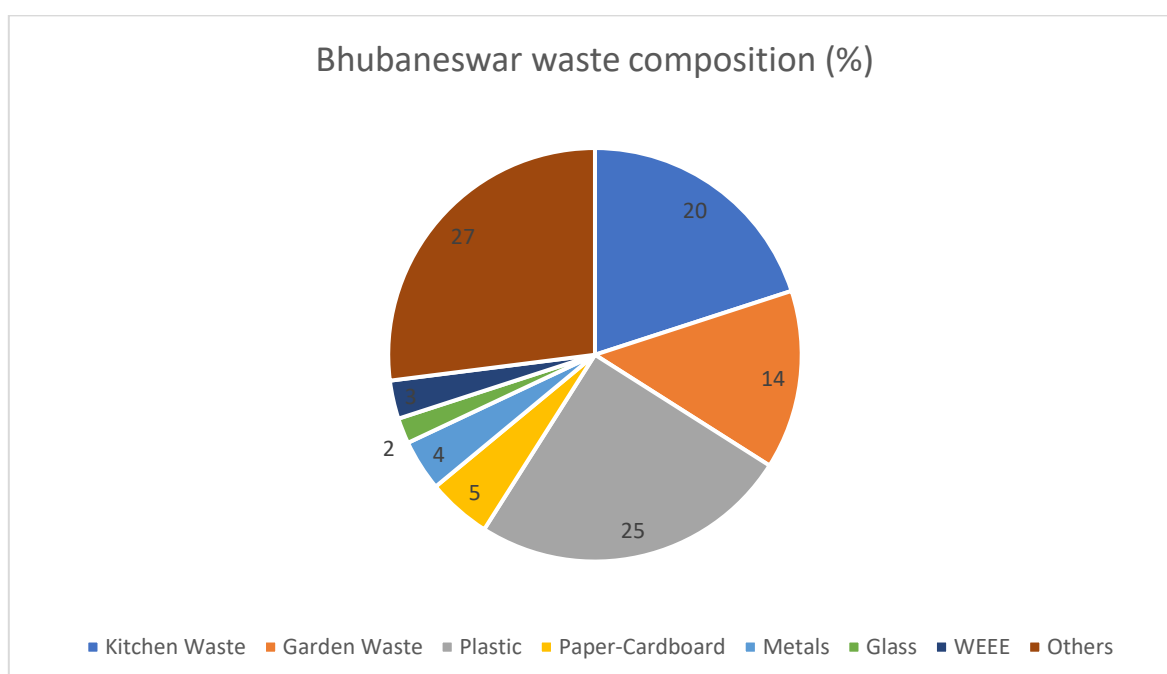


Figure 4 Waste composition of Bhubaneswar City

Regarding waste generation, Bhubaneswar City sees an average of 0.582 kg per capita per day, with a total household waste generation of 439 tonnes per day (TPD). Commercial waste contributes an additional 130 TPD, while Bulk Waste Generators (BWG) and the market (HAAT) generate 72 TPD and 116 TPD, respectively.

To address waste management, the city operates 34 Material Composting Centres (MCCs) for processing organic/wet waste and 19 Material Recovery Facilities (MRFs) for inorganic/dry waste. These facilities are crucial in diverting waste from landfills and separately processing organic and dry waste. MCCs process around 102 TPD of organic waste, while MRFs handle 95 TPD of dry waste. Additionally, a portion of the waste (140 TPD) is co-processed as Refuse-Derived Fuel (RDF) materials in a cement kiln at Rajgangpur, Odisha.

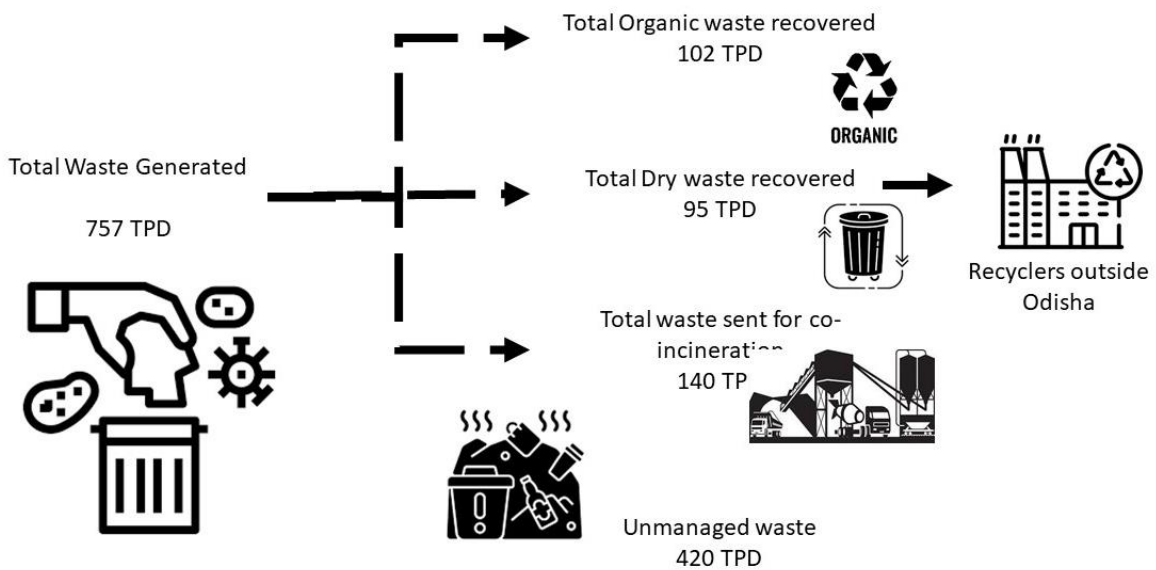


Figure 5 Bhubaneswar City waste flow

Source: Bhubaneswar Municipal Corporation

The current status of plastic waste management in Bhubaneswar City highlights several challenges. Limited recovery rates and the need to strengthen recycling infrastructure are significant obstacles. Raising awareness and promoting behavioural change among residents to reduce plastic waste generation is crucial to address these challenges. Furthermore, investing in innovative technologies and establishing robust recycling facilities can enhance recovery rates and maximise resource utilisation.

2.2. Formal and informal value chains

In Bhubaneswar City, waste management has transformed by integrating informal and formal value chains, promoting social equity and creating a more inclusive waste management system. The key players in this integrated approach include the Swachh Sathis, women's self-help groups, and transgender self-help groups. Swachh Sathis are the backbone of waste collection from households. These women, organised into self-help groups, actively collect waste and use battery-operated vehicles to transport MCCs and MRFs. MCCs, managed by women and transgender self-help groups, receive the organic waste collected by Swachh Sathis. At these centres, organic waste undergoes composting processes. This compost is sold through designated outlets, generating revenue and promoting sustainable agricultural practices.

Material recovery facilities, known as wealth centres, are managed by women and transgender self-help groups. These centres play a vital role in segregating and processing recyclable waste. Plastics, paper, and metals are sorted and sold to scrap dealers and recyclers through a tender-based system that ensures a fixed rate for recyclables, providing stability to the waste management value chain. One notable aspect of this integrated model is the fair distribution

of revenue generated from selling recyclables and compost. The revenue is distributed among the sanitation workers operating the wealth centres, ensuring equitable compensation and empowering those involved in waste management activities.

Integrating informal and formal value chains in Bhubaneswar's waste management system showcases a holistic approach that optimises resource recovery, minimises environmental impact, and fosters social equity. This model creates a sustainable and inclusive waste management ecosystem by harnessing the capabilities of Swacha Sathis, self-help groups, MCCs, MRFs, and Scrap dealers/Kabadiwala. This integrated waste management model addresses environmental concerns and uplifts marginalised communities by providing employment opportunities and promoting their active involvement in waste management initiatives. The success of this approach highlights the significance of collaboration, inclusivity, and empowerment in creating efficient and socially equitable waste management systems.

2.3. Institutional framework

Bhubaneswar Municipal Corporation (BMC) serves as the waste managing authority of the city, operating under the constitutional framework provided by the 74th Amendment of the Constitution, the Orissa Municipal Act of 1950, and the Orissa Municipal Rules of 1953. The overall administrative control of BMC lies with the State Housing and Urban Development Department (H&UDD), headed by the Director of Municipal Administration. The state government can request information, conduct inspections, give directions, dissolve the Urban Local Body (ULB), cancel orders, and rescind council resolutions under specific circumstances. The functions of BMC can be categorised into obligatory and discretionary functions. Obligatory functions include the maintenance of roads, street lights, sanitation, water supply, registration of births and deaths, public immunisation, and regulation of buildings. On the other hand, discretionary functions encompass activities such as constructing and maintaining parks, schools, hospitals, and libraries. BMC has separate departments responsible for these functions, including the administrative and finance departments. Solid waste management is one of the obligatory functions of BMC. Various national, state, and local legislations govern municipal solid waste management in Bhubaneswar. These include the Orissa Municipal Corporation Act of 1950, Hazardous Wastes (Management and Handling Rules) of 1989, Bio-Medical Waste (Management and Handling) Rules of 1998, Municipal Waste (Management and Handling) Rules of 1999, Manual on municipal solid waste management of 2000, and the Plastic and other non-biodegradable garbage—Ordinance of July 2000. Despite the existence of these legislations, financial challenges faced by local bodies and the overall status of municipal solid waste management, as well as hazardous and bio-medical waste management, remain a challenge.

BMC is administratively divided into 60 wards, each with varying sizes of population and geographical areas. The corporation comprises an elected body and an executive wing. The elected body consists of public representatives known as Councillors, one for each ward, who hold office for five years. The mayor heads the executive wing, and the council serves as the policy-making body, supported by various standing committees (such as finance, public health, hospitals and dispensaries, and public works) responsible for specialised functions. The administrative head of BMC is called the Municipal Commissioner.

3. Stakeholder discussions

The stakeholders, who are working in Bhubaneswar City, were identified through network resources and were interviewed. Table 1 lists the stakeholders interviewed. The interviews highlighted the major stakeholders and gaps in plastic waste management in Odisha. Bhubaneswar City has drastically improved waste management by focusing on collection and processing. However, the majority of collected waste is sent outside the state. The city must build its recycling capacity and maximise the collection of recyclables. The key findings from the discussion are highlighted in Table 2.

Table 1 The selected stakeholders for the interview

Organisation/Stakeholder interviewed.	About organisation and potential interest in the project
Recykal – Utkarsh Sahoo	<ul style="list-style-type: none"> • Recykal can also source plastics for the project. They can channel it at an agreed cost, Including logistics costs (around 1-2 Rs/kg). • Recykal is interested in the DRS system in Bhubaneswar too • They currently operate the Market Place – Connecting all aggregators, approx 30 from Odisha and 3-4 in Bhubaneswar; the major focus is PET in plastics.
CEIBA Green – Neelima Mishra	<ul style="list-style-type: none"> • They provide wet waste solutions for bulk waste generators • They also conduct drives for dry waste collection
UNDP – Abha Mishra	<ul style="list-style-type: none"> • UNDP has an overarching MoU with the state urban dept and one with the city
Ashima Bio Earth – Avilash Mohanandan	<ul style="list-style-type: none"> • They are working with the technology that binds plastics to make dust- and moisture-free lumps, which can be used for all plastic types (Except PET and MLPs). They are exploring nano additive technology for plastics from the US. They are exploring the implementation aspects and funds. • They send MLPs to Dalmia Cement. (No cost delivery) • They collect the dry waste from all the Wealth centres in Bhubaneswar
Odisha Urban Development Authority Rep – Sandipan Sarangi	<ul style="list-style-type: none"> • Responsible for decisions on waste management

Table 2 Key findings of stakeholder discussion

Topic	Key findings
Major Stakeholders in Plastic Waste Management	<ul style="list-style-type: none"> • The municipality is leading most of the activities. • Organisations active: CORE, SEBA GREEN, Recykal • CIPET is promoting technology for upcycling • SHG groups are major stakeholders in the operation of waste management • Cuttack is a twin city to Bhubhaneshwar; something can be explored to work jointly with both ULBs in the expansion phase.
Status on MLP and Low-Value Plastic waste management	<ul style="list-style-type: none"> • Only municipality MRFs receive them from the MSW collection. The private sector is not engaging in their recovery as they do not get value.
Recycling activities in Odisha	<ul style="list-style-type: none"> • No major recycling happens in Bhubaneshwar; most recyclables are collected and transported outside the state. • ULB has a rate card for plastics and recyclables, revised yearly based on the tender system. However, there is a price difference between scrap dealers and authorised recyclers. Scrap dealers pay more (double approx) • Operations of MRF and training and capacity building are done with the Urban Management Centre (UMC) • The low rate of materials reaching MRFs for SHGs also influences their segregation economics. • Some plastics are used in road construction. • Plastics (RDF) are also forward-linked with cement companies, but the transportation cost is not covered, which is an issue in the continuity of the model.
Potential Companies for CSR	<ul style="list-style-type: none"> • A local water bottle company, Bubble, has been active with CSR for waste-related projects. • L&T has developed a composting plant in Bhubaneshwar
Informal sector status	<ul style="list-style-type: none"> • The informal sector is present, and most informal sectors are from Bangladesh. • The informal sector organised with the SHG group is part of the collection in some areas and for the facility's operation. They are paid from sales of recyclables.

4. Stakeholder mapping

Stakeholder mapping enables identifying and analysing the various stakeholders involved in the project. In the context here, mapping the stakeholder below helps to understand the different individuals, organisations, and groups that have an interest or influence in the waste management process. It also provides insights into their roles, interests, and power dynamics, enabling effective engagement and collaboration for better outcomes. Figure 6 highlights the stakeholder map in the context of the project. The identified stakeholders are below,

1. Government Authorities
 - Bhubaneswar Municipal Corporation (BMC)
 - State Housing and Urban Development Department
2. Informal Waste Pickers
 - Swachh Sathis: Informal waste pickers from women Self Help Groups actively collect household waste. They play a vital role in the initial stage of plastic waste management.
3. Waste Management Facilities
 - Material Recovery Facilities: These centres segregate and recover recyclable materials from the waste stream.
4. Self-Help Groups (SHGs)
 - Women and Transgender Self-Help Groups: These groups manage the wealth centres and are responsible for the overall operations and revenue generation from the sale of compost and recyclable materials. Also, the state's priority is to have a socially inclusive model for waste management projects.
5. Scrap Dealers and Recyclers
 - Individuals and organisations engaged in buying and recycling recyclable waste materials.
6. Residents and Community
 - Households and Commercial Establishments: They generate waste and directly impact waste management practices through segregation and responsible disposal.
7. Civil Society Organizations (CSOs)
 - NGOs and Environmental Groups
8. Private Sector
 - Construction Companies: They generate construction and demolition waste and can contribute to waste reduction through proper disposal and recycling practices.
 - Industries: for the buy-in of output materials
9. Research and Academic Institutions
 - Universities and Research Institutes: These entities can contribute to the project through research, innovation, testing and knowledge sharing.

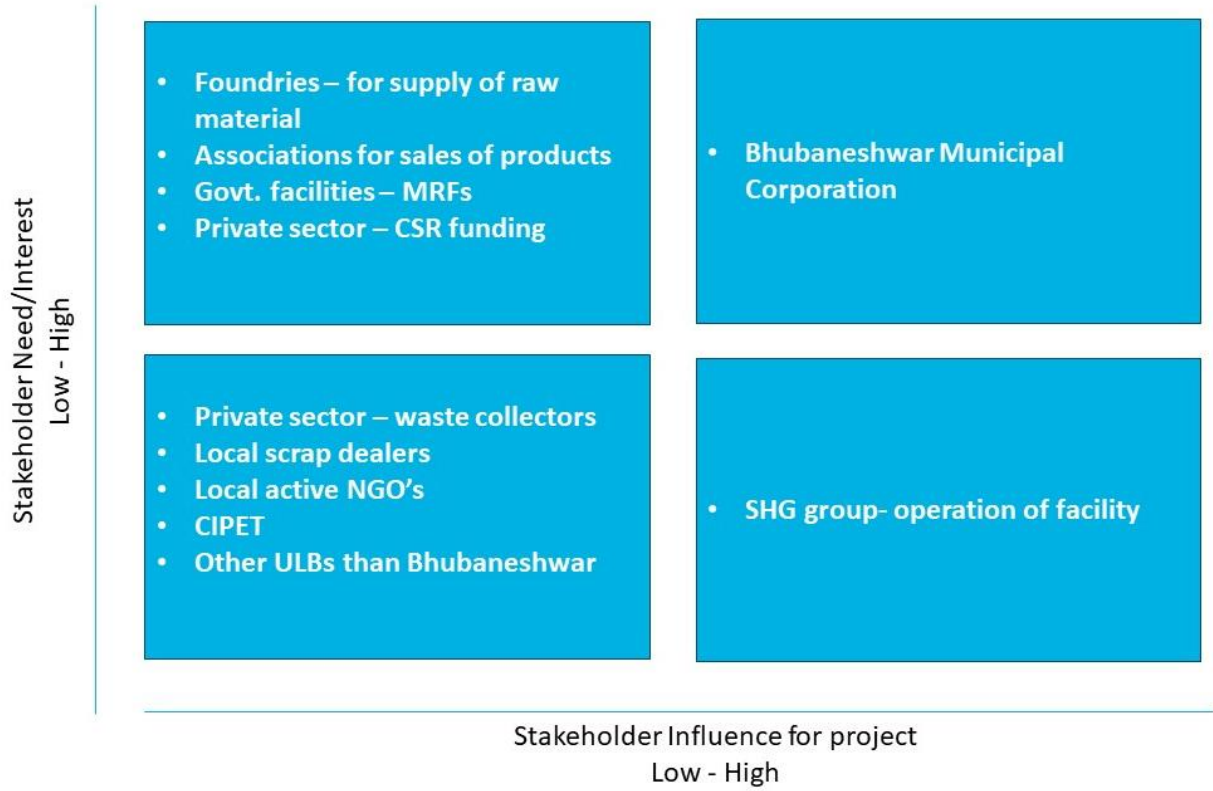


Figure 6 Mapping the stakeholders for the project in the city.

5. Policy and Infrastructure Gaps Analysis

Bhubaneswar City has made significant progress in waste management, including waste separation at the source and collection coverage. However, legal and infrastructure gaps must be addressed to enhance plastic waste management practices and maximise recovery.

Legal Gap Analysis

- a. **Source Segregation Improvement:** Although Bhubaneswar has supportive legal measures for waste separation at the source, there is a need for further improvement in implementing and enforcing these regulations. Awareness campaigns and educational initiatives can help raise public participation and compliance with source segregation practices.
- b. **Ban on Single-Use Plastics:** While waste collection coverage is generally good, interventions are required to address the issue of single-use plastics. Implementing a ban on single-use plastics in collaboration with resident welfare associations (RWA) groups, bulk waste generators, and market areas can significantly reduce plastic waste generation at the source.

Infrastructure Gap Analysis

- a. **Recyclable Collection Enhancement:** Bhubaneswar City must focus on enhancing the recyclable collection, particularly for plastic waste. Targeted interventions, such as dedicated collection bins and awareness campaigns, can encourage waste generators to separate and dispose of recyclable plastics appropriately. Collaborating with informal waste pickers can also improve the collection of recyclable materials.
- b. **Local Recycling Capacity:** A significant infrastructure gap exists regarding local recycling capacity for plastic waste. Most plastic waste is sorted and sold to recyclers outside the state. Establishing local recycling facilities within the city can reduce transportation emissions and create a local market and job opportunities in the recycling sector.

Table 3 Gap analysis for plastic waste management in the city

Bhubaneswar City			Prioritisation need (1-high, 3-low)
SWM stage	Policy / Legal	Infrastructure / Intervention	
Waste separation at the source	Yellow	Orange	2
Waste collection coverage	Yellow	Yellow	3
Waste collection	Yellow	Yellow	3
Material recycling	Orange	Red	1
Waste disposal	Orange	Red	1
Informal sector (incl. integration)	Orange	Orange	2
Waste financing, including user fees	Orange	Red	2
Local SWM plan/strategy	Yellow	Yellow	3

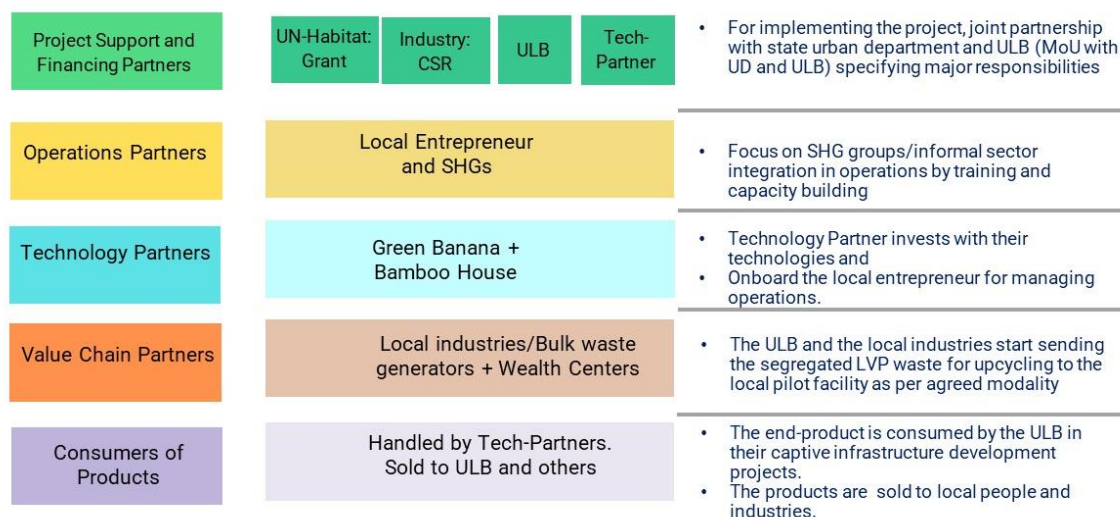
Priority	
High	1
Medium	2
Low	3

Gaps	
Large	Red
Medium	Orange
Low	Yellow

6. Recommendations and Way-forward

6.1. Project stakeholders – Possible roles and responsibilities

The possible arrangement of stakeholders for the project is shown in Figure 7. The project implementation must consider the involvement of SHG groups as it is the state's priority and builds up on the socially inclusive model adopted in the city. Further, a local entrepreneur shall be needed for the facility's operations.



23

Figure 7 Project Stakeholders' Role and Responsibility

6.2. Marketing plan for both technology partners

To create a marketing plan, the Business Model Canvas focused on the key elements and their marketing relevance. The Business Model Canvas consists of nine building blocks, each representing a different aspect of the business, of which ones related to the marketing plan were detailed.

Customer Segments: Identify the target customer segments for the product or service. Understand their needs, preferences, and behaviours to tailor the marketing efforts effectively.

Channels: Identify the channels the business will reach and engage with target customers. This includes traditional and digital channels such as social media, websites, email marketing, advertising, partnerships, and direct sales.

Customer Relationships: Determine the type of relationship the business will build with the customers. It is based on personal assistance, self-service, or community engagement. Define strategies to foster customer loyalty and retention.

Revenue Streams: Outlines the pricing strategy and revenue model. It explores the sales of products for both the technologies and the Extended Producer Responsibility (EPR) modality, as per the Guidelines of EPR for Plastic Packaging.

Table 4 Marketing plan for Silica plastic waste blocks

Customer Relationships	Customer Segments
<ul style="list-style-type: none"> Quality product: Testing and verifying products per Govt. standards and adding specifications to their purchase based on available test reports. Established use cases and use of references for further sale Collaboration with Panchayats and Cities 	Government infrastructure development projects - Pavements Parks Anganwadis Parking spaces Building and Construction industry – Pavements Parking spaces Wall cladding Table-tops Benches
Channels	
<ul style="list-style-type: none"> GEM portal for government tenders (B2G) Builder and architectural associations for the private sector (B2B) The retail supply chain for construction materials that would supply to customers (B2B) 	
Revenue Streams	
Sales <ul style="list-style-type: none"> Customers are paying for the equivalent of what they buy and can also get sustainable green products. The average realised selling rate has been about Rs 15 per kg for Paver Blocks or Tiles. EPR <ul style="list-style-type: none"> Depending on the market rate, approx. 1-2 Rs/kg of plastic used 	

Table 5 Marketing plan for Plastic panel boards

Customer Relationships	Customer Segments	
<ul style="list-style-type: none"> Quality product: Testing and verifying products per Govt. standards and adding specifications to their purchase based on available test reports. Established use cases and use of references for further sale Environment centric marketing Online Marketing 	Government projects – Public benches Dustbins Toilets Low-cost shelters Bus shelters School infra projects	Shelter needs of individual buyers and corporates – Parking spaces, Garden furniture Internal wall cladding, Kitchen Cupboards Benches etc.
Channels		
<ul style="list-style-type: none"> GEM portal for government tenders (B2G) Builder Group The retail supply chain for construction materials that would supply to customers (B2C) Government buyback for internal use. Example - Kiosk Online platforms 		
Revenue Streams		
Sales <ul style="list-style-type: none"> Customers might have to pay a slightly higher cost compared to equivalent products. EPR <ul style="list-style-type: none"> Depending on the market rate, approx. 1-2 Rs/kg of plastic used 		

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