

CHAPTER -1

INTRODUCTION

In simple terms, waste is a material (solid, liquid, hazardous, biodegradable, non-biodegradable, etc.) that is unwanted and needs to be disposed off. For instance, Municipal Solid Waste (MSW) can be defined as discard or garbage generated from household or domestic, institutional and commercial establishments. It includes organic waste like food waste, yard waste and recyclables like paper, plastic, metal, glass, and inert material. It may include some hazardous waste like E-waste and biomedical waste like sanitary pads and discarded medicine. Effective waste management relies on a chain of systematic processes like collection, transportation, treatment and safe disposal. Different categories of wastes have different modes/procedures of treatment. Hence, segregation or sorting of waste at the source before the collection becomes crucial. Critically, the lack of segregation into basic categories like wet (organic waste) and dry (recyclables and inert) at the source or household level leads to the complete failure of the municipal solid waste management (MSWM) system. This problem is being faced by many cities in India and across the world. Mixed waste contaminates recyclables and hinders efficient processing (like composting and biomethanation) resulting in drastically increasing landfill volumes and lowering resource recovery efforts. This human element behaviour of non-segregation in individuals is identified as a fundamental barrier. Addressing this challenge requires people's capability, opportunity and motivation to adopt segregation behaviour, which is our target behaviour or focus of study. By accessing different models of behaviour, the COM-B (capability, opportunity, motivation and Behaviour) model is found to be the most

suitable and appropriate model that proves helpful in diagnosing specific barriers. i.e. lack of knowledge, inconvenience and low motivation can prevent segregation behaviour. The COM-B model is an integral part of the behaviour change wheel (BCW) framework, which can suggest the systematic implementation of suitable intervention functions like education, enablement, persuasion and environmental restructuring. These functions are helpful in the systematic conversion of barriers into enablers.

By applying a structured approach to behaviour change, which focuses on promoting segregation at the source, we can achieve the goal of effective municipal solid waste management through COM-B diagnosis and behaviour change interventions. We discuss them in detail in the following sections:

1.1 What is waste?

Waste encompasses whatever we throw away that we are unlikely to utilize again (Bhattacharjee et al., 2022). The Municipal Solid Waste Rules of 2016 (MOEF, 2016) broadly define what constitutes Municipal Solid Waste (MSW). MSW includes everything from food leftovers, yard trimmings, street-sweeping, trash and garbage generated by commercial area (Fig 1.1). This category includes treated medical waste (excluding fresh bio-medical and e-waste). To make matters even more complicated, MSW comes in various shapes and sizes; some, including paper and food waste, degrade naturally, but others, such as plastics and metals, might remain in place for an extended period (Devi et al., 2016). Our regular rubbish is a far greater issue than most people think. Municipal Solid Waste (MSW) encompasses various items, from yard and leftover food to commercial and medical waste. The bad news is that our rubbish

is rapidly increasing, and we are on track to outstrip population growth by a significant margin by 2050 (Gupta et al., 2015; Kolekar et al., 2016).

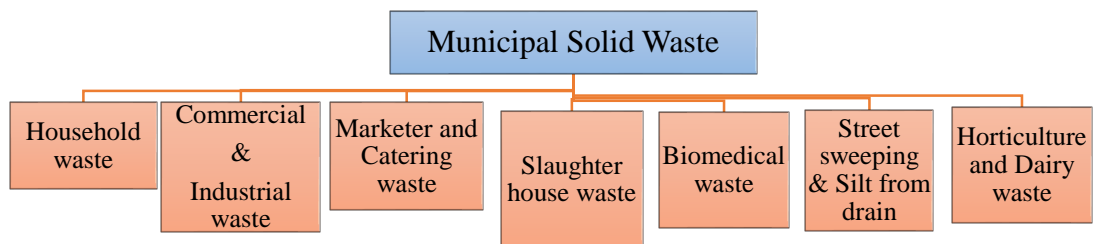


Figure 1.1: Composition of Municipal Solid Waste (MSW).

1.2 Waste throughout the world

Municipal solid waste is a worldwide issue, not just a local one, and handling all of this garbage sustainably presents a significant challenge for countries worldwide (Chatterjee, 2010). It is a complex issue that requires thoughtful solutions considering the environment, the economy, and what is fair to society (Sharma & Jain, 2020a). Waste management has become a crucial concern, particularly in developing countries, threatening health and the environment (Chatterjee, 2010).

Landfills are the most popular way we dispose of garbage worldwide, but an alarmingly big percentage (30-32% of waste) winds up in unclean dumps. Recycling and composting have a lesser percentage, around 22-24%, while thermal treatment, such as burning, is even less prevalent, at 10-12% (Fig. 1.2). These figures demonstrate an obvious need to enhance how we manage garbage (Sharma & Jain, 2020a).

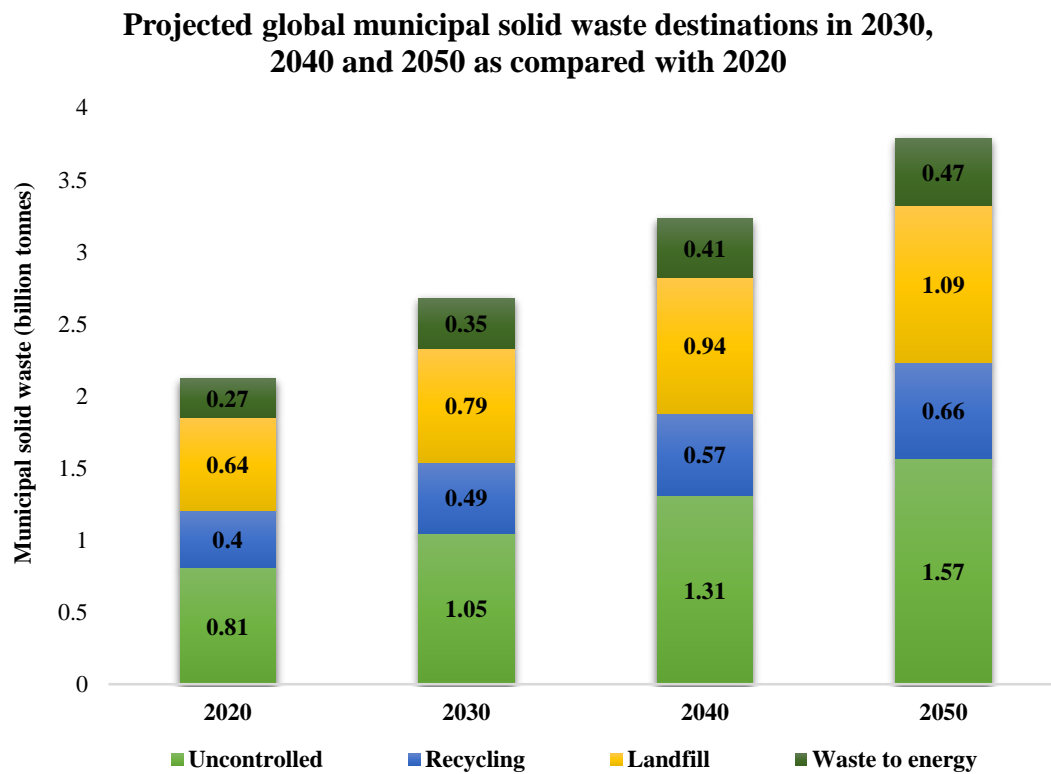


Figure 1.2: Projected global municipal solid waste destinations 2020-2050.

As urbanization grows, economic prosperity, higher living standards, and increased consumption of goods and services contribute to increased waste generation due to the demographic shift from rural to urban areas. In 1950, just 30% of the global population resided in cities. That figure has climbed to 55% today, and by 2050, over 70% of us are predicted to live in cities. This fast urbanization generates a complex waste management problem that necessitates novel solutions (Sharma & Jain, 2020a).

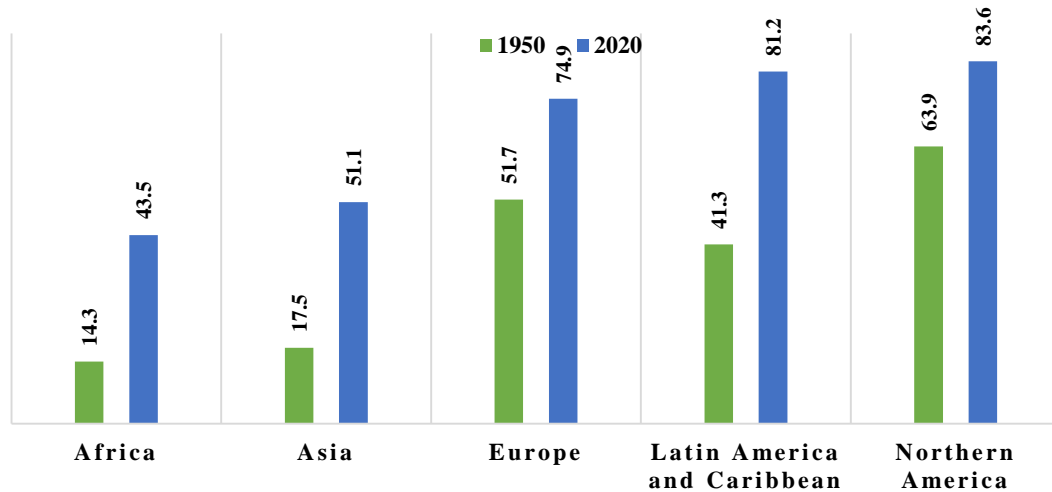
URBAN POPULATION WORLDWIDE (1950-2020)

Figure 1.3: Difference in the growth of urban population since 1950 to 2020.

Our planet is overflowing with waste. Every year, the globe generates a whopping 2.01 billion tonnes of MSW, with at least 33% not managed effectively. Per capita, waste generation amounts to a standard of 0.74 kilograms of garbage per capita per day, but the range is wide: some places produce as little as 0.11 kg/capita/ day, while others produce a massive 4.54 kg/capita/day. The problem is only projected to intensify, with forecasts indicating that worldwide garbage creation will reach 3.40 billion tonnes by 2050, surpassing the population growth rate (Fig. 1.4). Notably, there is a direct correlation between income and garbage creation, with wealthier countries producing significantly more trash.

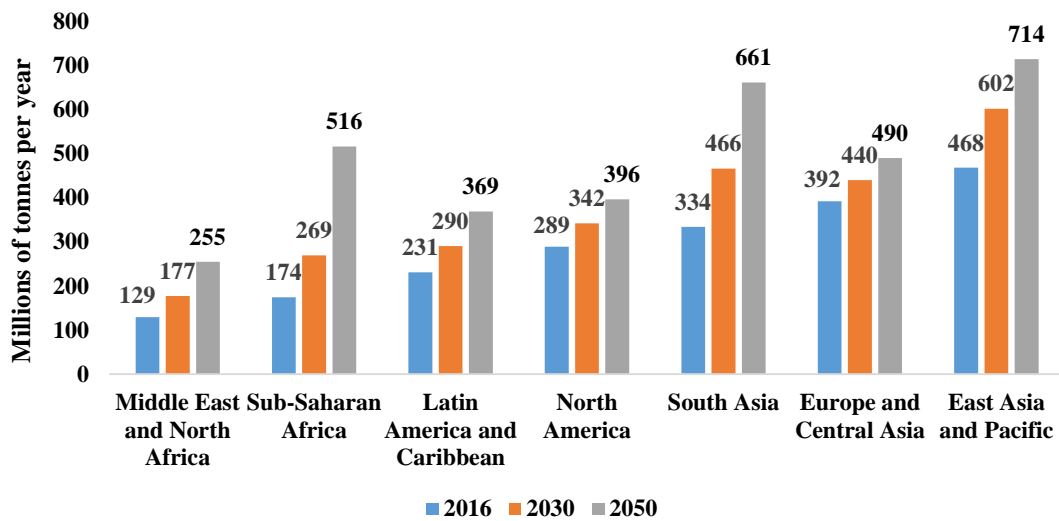


Figure 1.4: Trends in SWM across the world.

1.3 Condition of MSW in India:

Municipal solid trash is becoming increasingly pressing in India's thriving civilization. Factors such as population growth, increased industrial activity, and large-scale urban migration have all contributed to a significant increase in waste output. This emphasizes the importance of developing new, long-term solutions for properly managing India's garbage (Sharma & Jain, 2020a). India produces a substantial amount of municipal solid garbage, reaching 160,038.9 tons per day. While the collection is impressive at 95.4%, with 152,749.5 tons collected daily, only half is processed (79,956.3 tonnes). The rest of MSW 29,427.2 tons will be disposed of in landfills. Worryingly, a significant amount, 50,655.4 tons, or 31.7% of total garbage, remains unaccounted for. The fluctuation in per capita waste generation is recorded too small between 2015-2021 (Fig. 1.5). This emphasizes India's need for better waste management systems (Lingan et al., 2007; CPCB, 2022). The population explosion in India is a major contributor to the rising flow of municipal solid waste (Sharma & Jain, 2020a). The quantity and type of waste varies substantially between cities. The environment, geographical position,

and the population's economic condition are all important considerations. Inevitably, densely populated cities create the greatest MSW, which presents a substantial challenge to waste management systems (Giusti, 2009).

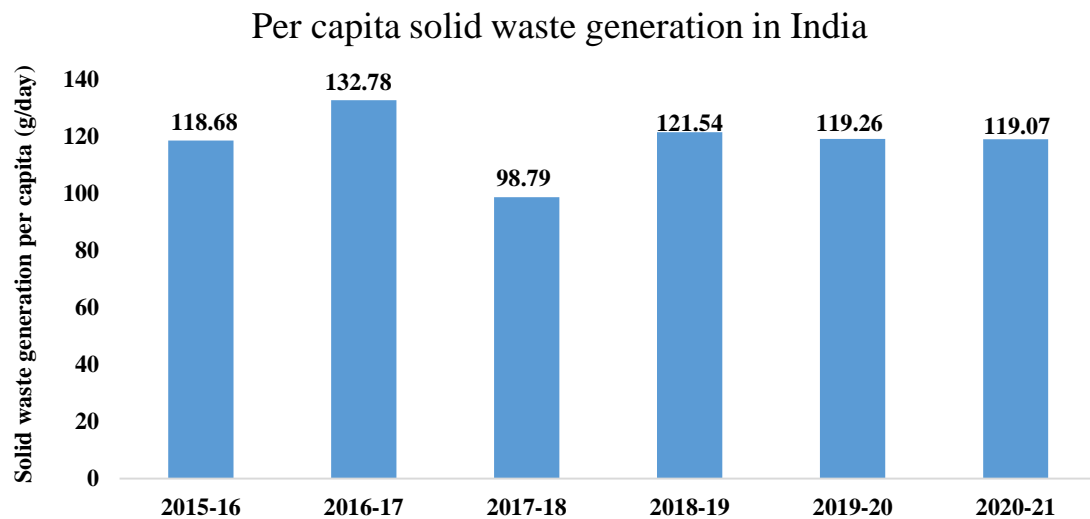


Figure 1.5: Per capita solid waste generation in India (2015-2021).

Economic progress frequently results in better waste management methods. However, it is a two-edged sword (Sharma & Jain, 2020a). While wealthier countries often have better SWM systems, increased urbanisation and population growth provide new issues in managing the increasing volume of collecting waste, disposal, and treatment. The garbage problem is evident in India's highly populated regions, where cities account for approximately 70-80% of total trash production (MNRE India, 2018). India's solid waste problem is increased by urbanisation and economic expansion. (Balasubramanian, 2018a; Mandpe et al., 2022; Mohd et al., 2019; Sharholy & Ahmad, 2007). Rapid industrialisation, population growth, and improved living standards significantly increased garbage creation (Sharma & Jain, 2020a). The waste management problem is mainly concentrated in cities, where growing urbanisation, financial prosperity, and consumption habits contribute to increasing rubbish

production. India's rapidly growing population, the world's second-biggest, is a major contributor to the country's increasing waste management difficulties (Kaza et al., 2018). Cities are experiencing an increase in solid waste production as their populations quickly urbanise, owing to causes such as limited rural possibilities and the allure of urban occupations (Gerdes, 2010; Vij, 2012). The combination of factors pressurises municipal waste handling and disposal capacity, stressing the need for new waste management solutions in India (Kumar & Agrawal, 2020b; CPCB, 2022).

1.4 Importance of technical advancements in municipal solid waste management (MSWM)

Ineffective waste management endangers public well-being and the environment. When an extensive and successful program is not in place, rubbish from diverse human activities, ranging from houses to industries, is disposed of. This produces unclean circumstances that can spread disease and damage the environment, causing harm to people and ecosystems (Deswal & Laura, 2014). Efficient SWM is a multi-step process. It all begins with collecting and transporting rubbish. Then, to reduce overall volume, procedures such as recycling are used. Finally, any remaining garbage must be disposed of correctly. However, implementing these steps alone will not produce a robust SWM system. It necessitates in-depth trash knowledge, from composition and economic potential to efficient storage and collection techniques. The ultimate goal is to establish reliable and cost-effective methods for garbage disposal in landfills (Deswal & Laura, 2014).

The kind of waste we generate significantly impacts how it is managed. Wealthier populations generate more packaging waste, including paper, plastic, glass, and metals

(Sridevi et al., 2012). This is very different from the garbage generated by low-income groups. Municipal Solid garbage (MSW) may contain hazardous elements such as residual paint, outdated medications, pesticides, technological garbage, and even old batteries (Kumar & Agrawal, 2020). To develop efficient and environmentally friendly waste management methods, it is critical to determine the overall quantity of waste generated and the exact mix of components it includes. The massive amount of solid waste produced in India needs careful consideration in allocating resources and technological skills for proper disposal (SUD et al., 2008). Recognising this difficulty, the country is looking into novel approaches such as composting (conventional and vermicomposting with worms) and waste-to-energy solutions. These energy-generating processes include incineration, which burns garbage to generate power; palletisation, which converts waste into fuel pellets; and bio-methanation, which degrades organic matter to produce biogas (Sharma & Jain, 2020a).

1.5 Behaviour as social aspect and municipal solid waste management.

Behaviour, particularly judgement and decision-making. Nudges, "an intervention, from either private or public institutions that affects people's behaviour while fully maintaining their freedom of choice," are relevant to waste segregation in this literature. Nudge instruments try to change behaviour without changing options or economic pay-offs. Choice architecture, a structured environment that elicits desired behaviour, affects judgement and decision-making gradually and automatically. For instance, making organ donation the default option in the driving and motor vehicles form increases organ donation, and small buffet plates reduce food waste. Including nudges for behaviour change automatically guides behaviour and may spill over. Environmentally friendly behaviour triggered by behavioural interventions is more

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likely to be repeated. Nudges are cost-effective because they do not require constant surveillance, fines, or levies. Nudges encourage desired actions and behaviours, not just positive attitudes or intentions.

Environmentally friendly nudges are called "green nudges." Green nudges are helping policymakers worldwide implement sustainable practices. With help from their Behavioural Insights Team, the UN Environment Programme (UNEP) developed 'Green Nudges' strategies for university campuses to mobilise the Sustainable Development Goals (SDGs) and protect the environment. University College Cork, Ireland's Cup washers encouraged reusable cups and reduced disposable cups.

The following approach makes nudges effective, according to nudge theory:

- 1) Choosing the target behaviour,
- 2) Understanding the context,
- 3) Designing the nudge,
- 4) Testing its effectiveness,
- 5) Reflecting and redesigning.

The related literature identifies six heuristics or shortcuts for effective influence or persuasion. Two are particularly important to Waste Segregation at Source:

1. **Authority:** Convincing messages come from trusted sources. When shown the opinion of a distinguished economist on an economic problem, participants followed it without considering other evidence.
2. **Social Proof:** Similar people influence behaviour. For instance, British tax officials increased tax revenues by stating on tax recovery letters that most people pay their

taxes on time. Home energy reports reduce energy consumption by 2% by providing households with past and neighbouring energy consumption data. We recommend intuitive products, packaging, Dustbin design, and text-based nudges for effective Information Education & Communication (IEC) messaging based on nudges-oriented literature.

1.6 Challenges in effective MSWM

Our rising population and fast urbanisation are significant factors in the global garbage problem. As the population grows, so does the demand for products and services, resulting in increased consumption and, eventually, waste. Urbanisation adds another level of difficulty. Cities require effective land use management to support infrastructure and expansion, implying reduced tolerance for inappropriate trash dumping in residential neighbourhoods. The growing population necessitates implementing efficient waste management strategies (Sharholly & Ahmad, 2007; Momodu et al., 2011; Oseghale, 2011). The expanding population and urbanisation are causing an additional challenge for garbage management in India. These factors not only cause people to consume more and produce more garbage but also alter the makeup of that waste. With its changing composition, this swelling stream of rubbish is putting enormous strain on India's urban local bodies (ULBs) and the municipal governments in charge of waste collection and disposal. Unfortunately, recent research has shown that many ULBs struggle to stay up. Wealthier communities and urban centres often have higher collection rates than rural locations. This imbalance emerges since waste management is sometimes seen as primarily an urban service, ignoring the requirements of rural populations (Vij, 2012). Financial constraints and institutional

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deficiencies impede their ability to manage these growing volumes of complicated garbage efficiently.

The Indian government recognises that urban local bodies (ULBs) struggle to comply with solid waste treatment and disposal rules. To deal with this, they have collaborated with key parties to discuss and build methods and procedures that will help ULBs achieve compliance. This collaborative project is intended to enhance waste management techniques across the country (Mani & Singh, 2016).

Unfortunately, India has a big issue in managing municipal trash. A shocking 80-90% is thrown in uncontrolled landfills or burned openly. This reckless disposal hurts the ecosystem by polluting the air, water, and soil. The daily data show the situation even more: India generates over 160,000 tonnes of MSW but only collects around 152,000 tonnes and treats only 80,000 tonnes. The significant gap between garbage generation and effective management requires immediate action (CPCB, 2022). A study from the CPCB expresses alarm about India's expanding trash problem. The analysis shows a significant increase in daily waste creation per person, rising from 118.68 grams in 2015 to 119.07 grams in 2021. The exponential rise in garbage generation underscores a critical issue requiring urgent attention. (Kumar & Agrawal, 2020b; CPCB, 2022).

Waste segregation at source offers clear benefits, and numerous policy directives are in place to promote it. Despite its apparent simplicity, numerous obstacles still hinder Waste Segregation at Source from achieving widespread adoption. Primary waste generators, including households, street vendors, consumers, and commercial establishments like restaurants and shopkeepers, often lack adequate awareness regarding waste management practices. There could be a lack of necessary

infrastructure, a low prioritisation of the issue, or an overwhelming focus on other tasks that prevent engagement in source segregation. This understanding requires a nuanced approach considering the Indian socio-cultural context, as psychological tendencies often manifest within this framework. The socio-cultural environment frequently offers both affordances and barriers to socially desirable actions. Any policy necessitating public engagement and civic action will struggle to take shape at the grassroots level if it does not align with the perspectives and behaviours of social actors.

Cities are growing for more reasons than only to accommodate more people. India's thriving urban areas are dealing with a complex trash problem. Economic expansion promotes a consumerist lifestyle, leading to an increase in the disposal of disposable items. As cities grow, authorised trash disposal places become strained. Moreover, new technology brings in new garbage, adding to the already-filled bins. This combination of variables quickly makes MSW a significant concern in Indian cities (Devi et al., 2016). Overflowing garbage bins and debris piles are an alarming sight in Indian cities. The issue of handling solid waste has reached a crucial point for most metropolitan local governments, necessitating bold solutions. Even in Uttar Pradesh's KAVAL (Kanpur, Allahabad, Varanasi, Agra & Lucknow) cities, which are known for their emphasis on sanitation, the State Pollution Control Board (SPCB) says that garbage collection coverage is only between 50% and 90%, illustrating the significant disparity between efforts and the expanding problem.

1.7 Future of MSWM in India

India is in grave condition due to its waste. A large fraction is discarded improperly in landfills or contaminates aquatic bodies. This reckless disposal causes devastation to

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the environment. Eco-friendly waste-to-energy technologies hold great promise as a solution. These technologies provide an effective method for recycling garbage before it ends up in landfills. One particularly appealing option is waste-to-electricity, offering a sustainable means to dispose of enormous amounts of MSW while producing clean energy. While some regard waste-to-energy (WtE) as a way to manage waste and generate energy, there are rising worries about its natural and health effects. This technique, which uses MSW to generate power or heat, is relatively new. Its rise correlates with the recent instability of fuel costs, prompting governments to investigate other cost-effective and environmentally friendly energy forms. However, concerns about WtE's safety have outweighed the potential benefits. With growing worries about landfills and demand for renewable energy sources, researchers are looking at the possibilities of WtE as an answer. WtE provides double advantages: it redirects waste from landfills while generating clean, steady electricity. This form of clean energy can help lessen our reliance on fossil fuels, which contribute significantly to greenhouse gas emissions. However, because research emphasizes human and environmental benefits, WtE facilities must be ensured to be safe and efficient (Singh et al., 2023).

India has an additional threat from its existing mode of waste disposal, which involves open dumpsites. Burning garbage in these unregulated situations emits dangerous pollutants into the air, such as fine particles and smog. These contaminants have been linked to respiratory problems, cancer, and higher mortality rates (Ghosh, 2016; Azar & Azar, 2016; Ahamed et al., 2020). Rapid urbanization generates municipal solid waste, which causes long-term concerns for both individuals and the environment. Air pollution is the world's most significant environmental hazard, jeopardizing public health and killing 7 million people yearly (WHO, -- 2013). MSW represents a

significant threat to human health and the environment, primarily through pollution from poorly managed disposal sites, significantly impacting surrounding communities' health. Continuous inhalation of particles such as dust, smoke, mist, and fumes leads to lung damage and respiratory disorders (kumar & Srimuruganandam, 2021a). Long-term exposure to air pollution poses a serious hazard to public health. Fine particles in the environment (PM_{2.5}) have health impacts, even in low quantities. PM_{2.5} can penetrate human airways and induce short- and long-term effects, including hospitalization and early death (Lingan et al., 2007). PM_{2.5} exposure can lead to cancer, renal illness, and DNA damage, depending on the concentration, chemical composition, and individual factors (e.g. age, gender) (Alam & Ahmade, 2013; kumar & Srimuruganandam, 2021b).

A more sustainable approach to managing India's municipal solid waste is urgently required (Birgitte & Reichel, 2013). Selecting the appropriate waste treatment technology is critical for sustainable waste management and behaviour change policymaking. With so many different technologies accessible, each having its own set of advantages and disadvantages, it is critical to understand their impact on the environment. Rapid urbanization and population increase continually alter the landscape of garbage generation, making measuring the volume and type of waste created even more important. This information enables local governments to choose the best SWM technology for their current needs and prepare for future waste management demands. As a result, a detailed study of waste quantity and composition, as well as a comparison of various treatment alternatives, is an essential decision-making tool for developing effective waste management strategies (Sharma & Jain, 2020a).

1.8 COM-B model and Behaviour change wheel framework

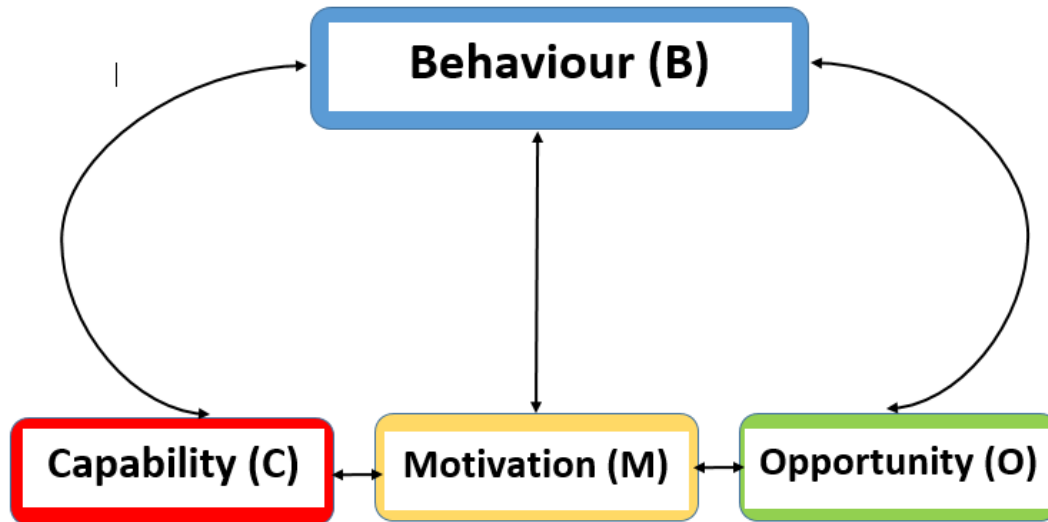


Figure 1.6: COM-B model.

The COM-B model proposes three components to any behaviour (B): Capability (C), Opportunity (O) and Motivation (M). The COM-B model synthesises various aspects of behaviour, including capability (both physical and psychological), opportunity (encompassing physical and social factors), and motivation (reflective and automatic), into a cohesive framework (Fig. 1.6). This framework facilitates a comprehensive understanding of the factors influencing waste management behaviours, including sorting, recycling, and composting. It considers both internal factors, such as knowledge, skills, and attitudes, and external factors, including infrastructure and social norms, thereby demonstrating significant adaptability to various contexts.

The COM-B model (Capability, Opportunity, Motivation - Behaviour) is gaining preference in municipal solid waste management (MSWM) compared to other behavioural models, such as the Theory of Planned Behaviour (TPB) and the Norm

Activation Model (NAM), due to its comprehensive, flexible, and practical framework for understanding and influencing behaviour.

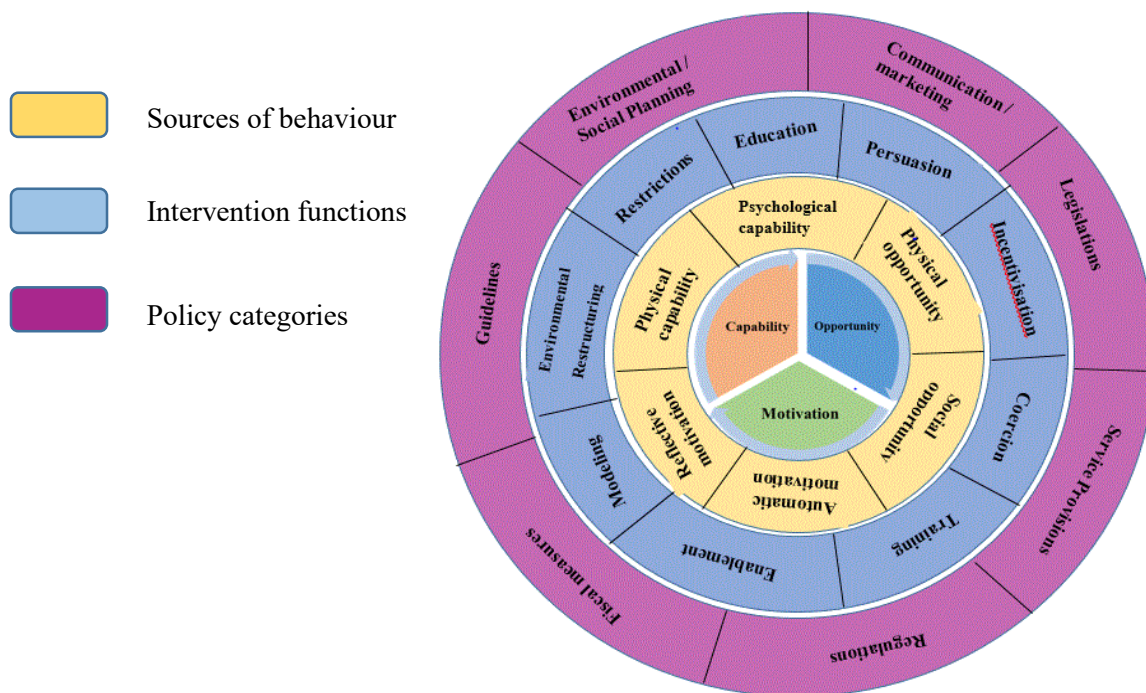


Figure 1.7: Behaviour change wheel (BCW) framework*.

Source: Michie et al. (2011)

The Behaviour change wheel (BCW) Framework comprises three layers: the COM-B model at the centre, nine intervention functions, and seven policy categories. The COM-B model asserts that behaviour (B) is determined by Capability (C), Opportunity (O), and Motivation (M). Capability comprises psychological (knowledge, skills) and physical abilities; Opportunity includes social and physical environmental factors; and Motivation involves reflective (conscious intentions) and automatic (emotional, habitual) processes. Intervention functions include education, persuasion, and environmental restructuring, which are supported by policy categories such as legislation, fiscal measures, and communication/marketing (Fig. 1.7).

The framework was initially utilised for public health concerns such as tobacco control and obesity, as indicated by Michie et al. (2011) in *Implementation Science*. However, its relevance also encompasses social issues, evidenced by its application in environmentalism and education.

1.9 Problem Statements

- Many Indian cities struggle with solid waste challenges not because of lack of infrastructure but because of ineffective public participation and limited understanding of behavioural drivers.
- Traditional MSWM studies focus on technical or administrative issues but ignore the behavioural component, leading to sub-optimal outcomes.
- There is no such application of behavioural models like COM-B and BCW in urban waste studies, especially in comparative, city-level analysis.

Thus, our research fills this gap using a behaviourally informed approach to study the issue.

1.10 Research Objectives

- To identify and analyse behavioural determinants of household and institutional waste segregation practices by applying the COM-B model (Capability, Opportunity, Motivation & Behaviour) in order to understand the cognitive, contextual, and motivational drivers influencing segregation-at-source.
- To compare behavioural profiles and MSWM practices between two contrasting urban Cities, Indore and Varanasi, by assessing differences in

waste handling behaviours, socio-demographic influences, infrastructural resources, and cultural norms.

- To evaluate existing municipal interventions, governance approaches, and policy frameworks using the Behaviour Change Wheel, thereby identifying alignment or gaps with behavioural science principles for waste management strategies.
- To generate behaviourally informed recommendations for policymakers, urban local bodies, and practitioners that align with local socio-cultural contexts, in order to strengthen segregation-at-source and advance sustainable, circular MSWM systems in Indian cities.

The aim of this research is to investigate the behavioural, contextual, and policy-related factors shaping waste segregation practices in Indian households and institutions, using behavioural science frameworks to generate evidence-based, context-sensitive recommendations for effective municipal solid waste management in Indian cities.

1.11 Research Questions

- What are the main capability-related challenges (e.g., knowledge, skills) in waste segregation across both cities?
- How do opportunities (social, physical, systemic) affect behavioural choices regarding waste management?
- What motivations (habitual, emotional, and reflective) drive or hinder waste segregation behaviour?

- How do existing interventions in both cities map onto the BCW intervention functions?

1.12 Rationale and Significance

- Theoretical contribution: This study applies and expands behavioural theory (COM-B, BCW) in an Indian municipal setting—an under-researched area in environmental governance.
- Policy relevance: Offers actionable insights for urban local bodies (ULBs), municipal planners, and behaviour change practitioners.
- Comparative lens: Studying two culturally, administratively, and spatially different cities enriches the generalizability of the findings and helps refine policy tailoring.
- Practical impact: Helps design more effective, evidence-based interventions for waste segregation.

1.13 Scope and Significance

The thesis explores the barriers and enablers of municipal solid waste (MSW) management through the COM-B model, focusing on the dynamic interplay between social behaviours, technological tools, and institutional structures. This perspective highlights how these interconnected components collectively influence the effectiveness and sustainability of waste management systems. By examining these interactions, the study aims to comprehensively understand the factors driving or hindering effective waste management in urban settings.

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The findings of this research are aimed at fulfilling multiple objectives. First, they aim to offer actionable recommendations for policymakers and practitioners, enabling them to implement evidence-based strategies for improving MSW management. Second, the study seeks to contribute to the growing knowledge of waste management in developing countries, where the challenges are often unique and require context-specific solutions. Lastly, the research enhances the understanding of how socio-technical approaches can foster sustainable urban development by addressing both social and technical dimensions in a balanced manner.

By comparing the MSW management systems of Varanasi and Indore, the study identifies scalable practices that have proven successful in Indore while acknowledging the contextual challenges specific to Varanasi. This comparative analysis provides valuable insights for other cities facing similar waste management issues, offering guidance on adapting and implementing practical solutions. Through this approach, the research contributes to academic discourse and supports practical advancements in sustainable urban waste management. First, they aim to offer actionable recommendations for policymakers and practitioners, enabling them to implement evidence-based strategies for improving MSW management. Second, the study seeks to contribute to the growing knowledge of waste management in developing countries, where the challenges are often unique and require context-specific solutions. Lastly, the

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1.14 Methodology Overview

This study employs a methodology that comprehensively examines the socio-technical aspects of MSWM in Varanasi and Indore, using the COM-B model alongside the Behaviour Change Wheel (BCW) framework. The research employs a comparative study approach, combining qualitative and quantitative methods to explore each city's waste management systems' unique characteristics, challenges, and best practices. This mixed-method approach ensures a holistic understanding of the subject, enabling detailed and broad insights.

1.15 Comparative Study Approach

The study adopts a comparative study that diagnoses the MSWM systems of two culturally and demographically distinct Indian cities via the COM-B Model and suggests intervention through the application of the Behaviour Change Wheel (BCW) framework. This approach allows us to explore each city's socio-technical barriers and

enablers for designing effective municipal solid waste management strategies by focusing on Varanasi and Indore. The researcher benefits from contrasting waste management systems—one rooted in traditional practices and the other known for its modern, innovative solutions. The comparative framework facilitates the identification of city-specific challenges, shared issues, and transferable best practices.

1.16 Structure of this Thesis

This thesis is organized into six main chapters:

1. Introduction: we have already presented a brief overview of municipal solid waste, the status of MSWM in India and around the globe, opportunities and challenges in MSWM, the relevance of behaviour study in waste management, outlines the research problem, objectives, and questions.
2. Literature Review: Examines theoretical frameworks and existing literature on technical, social aspects of MSW management, behaviour insight in waste management, timeline and history of the evolution of behaviour studies in MSWM
3. Conceptual framework: Integrated municipal solid waste management, National Behaviour Change Communication Framework, the COM-B model, its component, the Behaviour change wheel framework and Theoretical Domain framework.
4. Research Methodology: Describes the study design, data collection methods, and analysis techniques.
5. Results and Discussions:

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- (a) Study area I (Indore): general overview of city, existing MSWM condition, application of COM-B model of behaviour for identification of barriers and enablers in MSWM & suggested intervention.
- (b) Study area II (Varanasi) general overview of city, existing MSWM condition, application of COM-B model of behaviour for identification of barriers and enablers in MSWM & suggested intervention.
- (c) Comparative Analysis: Analysis of barriers and enablers in municipal solid waste management between the two cities using the COM-B model and Behaviour change wheel framework for intervention function and behaviour change technique adoption.

6. Conclusion:

A summary of key findings, a reflection on the research objective, policy and practice implications, suggested interventions for Indore and Varanasi, future research scope and broader significance.