INOPOL

INDIA-NORWAY COOPERATION PROJECT ON CAPACITY BUILDING FOR REDUCING PLASTIC AND CHEMICAL POLLUTION IN INDIA (INOPOL)

PILOT STUDY FOR PLASTIC AND BIOMEDICAL WASTE MANAGEMENT DURING THE COVID 19 PANDEMIC IN DELHI AND SURAT

Norwegian Embassy
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NIVA
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Toxics Link
for a toxics-free world

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Core authors

Satish Sinha (TL), Girija K Bharat (MGC), Hans Nicolai Adam (NIVA), Eirik Hovland Steindal (NIVA), Pallavi Gulati (MGC), Emmy Nøklebye (NIVA), Priti Mahesh (TL), Avanti Roy-Basu (MGC), Manisha Jain (MGC).

Contributions

Ecovision (NGO), Surat; Gulmeher (NGO), Delhi; East Delhi Municipal Corporation; South Delhi Municipal Corporation; Vinod Kumar (TL) and Aakanksha Mehrotra (TL)

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Paper Play, Delhi. E: care.paperplay@gmail.com.

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ADB	Asian Development Bank
BMWM	Bio Medical Waste Management
CBWTF	Common Biomedical Waste Treatment Facility
CPCB	Central Pollution Control Board
EDMC	East Delhi Municipal Corporation
EEE	Electrical and Electronic Equipment
HDPE	High Density Poly Ethylene
IFC	International Financial Corporation
INOPOL	India-Norway cooperation project on capacity building for reducing plastic and chemical pollution in India
ILO	International Labour Organization
LDPE	Low Density Poly Ethylene
MoEFCC	Ministry of Environment Forest and Climate Change
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
MT	Metric Ton
PET	Polyethylene Terephthalate
PPE	Personal Protective Equipment
RDF	Refuse Derived fuel
SDMC	South Delhi Municipal Corporation
SPCB	State Pollution Control Board
UNEP	United Nations Environment Program
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organization

Executive SUMMARY

The present study aims to analyze the effect of COVID-19 on the plastic and biomedical waste generation and management in the two Indian cities of Surat (in Gujarat) and Delhi. This relationship was explored because of concerns around COVID-19 related impacts on waste management systems, the informal sector and the global rise in use of single-use-plastics, which are part of PPE items whose use increased exponentially. Similarly, little primary information exists on these issues. The study provides a critical insight into the most stringent lockdown periods from March – July 2020, findings of which have been publicly presented and contextualized subsequently.

The India-Norway cooperation project on capacity building for reducing plastic and chemical pollution in India (INOPOL) is working towards building knowledge and capacity to tackle plastic and chemical pollution in India, with a focus on Gujarat state. The project team is collaborating with key industries, the public sector and civil society to achieve this aim. In the backdrop of the sudden societal changes triggered by COVID-19, the INOPOL project team saw the need for directing project attention to the pandemic, and provide knowledge on how the recent developments affect various stakeholders, including marginalized groups working with plastic waste management. Hence, in consultation with the project owner, the Royal Norwegian Embassy in New Delhi, the INOPOL project management group decided to direct attention to understand the scenario of plastic and biomedical waste management against the backdrop of COVID-19. The objectives of the study are to:

- Understand how the COVID-19 outbreak is impacting plastic waste management systems and the waste related informal sector workers in the study sites;
- Assess how the INOPOL project may support ongoing efforts to respond to the COVID-19 related impacts on waste management and the informal sector;
- Propose tentative measures that can assist the informal waste sector, and reduce risks from increased plastic pollution (e.g. caused by use of PPE).

The current study is not just an attempt to understand and document the isolated impact of the pandemic on plastic waste generation and its management, but also to assess how it has affected vulnerable people within the informal sector, who have been instrumental for plastic waste management in the country. The existing practices and change in practices of the affected sector were analysed, keeping in mind the socio-economic context. The target audience for this report includes policy makers, research fraternity, waste management sector and associated industry, funding agencies, and the wider public interested in this topic.

Over the initial, most severe lockdown period, millions of people employed in the informal sector left cities to head back to their native places

(mostly in rural areas). The informal waste sector had a slightly different story though, because waste generation continued even when most other economic operations may have shut down. The effects of COVID-19 did, however, lead to various supply and value chains to break down, including in the informal sector. In the informal waste chain for example, respondent waste pickers reported that the market for certain types of plastics, like polythene, reduced significantly and was not being accepted by most aggregators. One of the key reasons cited was a sharp drop in the price of plastic waste due to decreased prices on virgin plastics (a result of a sharp drop in global oil prices). This impacted the market for recyclable plastics, which declined. There were also limited physical places waste pickers and *kabadiwalas* could sell their collected waste due to restrictions imposed to limit social contact.

The **key findings** of the study are that the amount of total waste generation and waste segregation rates fell and that the income of informal waste collectors and recyclers reduced significantly (up to 87% with waste workers in Delhi and 53% in Surat). This further weakened several stages of the informal plastic recycling chain due to lack of income, fear of COVID-19, out-migration and lack of labour availability. The limited provision of adequate health and safety standards in waste management sectors were found to represent a health risk to individuals working with waste, and to urban residents by extension. It was also observed that the ongoing effort to ban single-use-plastics (SUPs) had been relaxed, because mixed wastes were emanating from households and communities.

The cities of Surat and Delhi were doing well in overall waste management (as per the *Swachh Survekshan*) and hence were better equipped to adapt to the new waste streams, and to the changes in type and quantities of waste. In terms of biomedical waste handling, the data shows that there was in fact a drop in generation of regular BMW in March and April 2020, with a subsequent, gradual rise in quantities in subsequent months. Common Biomedical Waste Treatment Facility (CBWTF) facilities in both these cities continued to have excess capacity at all times and the system did not appear to be overwhelmed.

However, in the initial months of the lockdown (March-June 2020), there was more mixed waste being generated from households, which was streamlined only in the later months. It took some time for the municipal corporations to learn, adapt and formulate new response strategies to the changing composition and quantities of waste.

The study gave valuable **insights** that the ongoing efforts by ULBs in source segregation of household solid waste (which was at a preliminary stage) has taken a backseat with the emergence of the COVID-19 pandemic, as the focus of awareness generation shifted from household waste segregation to dealing with the COVID situation. The national lockdown and curfew imposed suddenly on 24th March 2020, probably had a greater impact on the informal waste workers during the first phase of lock-down. This was followed by many migrant workers leaving Delhi (and to some extent from Surat also) for their native places. Some of the formal (and probably informal) plastic recyclers were trying to restart their business, but were unable to do so (as in July 2020) due to the unavailability of skilled personnel. States like Delhi and Haryana had made an interim announcement (when the COVID-19 cases were on steep rise and hospital beds were falling short) that in-State residents will be given priority in treatment and hospitalization (The Print, 2020). This contributed to the large-scale migration of city-based labourers to their respective villages. There is a need for better coordination between municipalities and health systems for efficient handling of infectious waste generated from households and flowing into the Municipal solid Waste (MSW) stream. A separate policy and detailed guidelines on waste management during a pandemic situation should be a starting point for future learning. This is a critical need and should take into account learning from current data from across the country and consulting with all stakeholders.

Plastic- and biomedical waste management systems are essential to acknowledge as tools to limit the spread of COVID-19. The pandemic has shown that access to appropriate safety measures to protect waste workers from direct exposure to COVID-19 contaminated waste is crucial. Social security and health care services need to be made available to informal sector workers, otherwise the waste management sector will continue to face aggravated vulnerabilities at several stages of the recycling chain. Particularly on the lowest levels of the plastic recycling sector, stakeholders have been severely affected. This has impacted their livelihoods, collection rates and recycling capacities. In turn, the COVID-19 induced fluctuations in the market for recyclables influence the amount of plastic waste being dumped into landfills or left unrecovered in environment and may become plastic pollution and increase the Marine Litter burden. It is critical to ensure that the recycling industry does not suffer from prolonged regulatory uncertainties or long-lasting closures. Interventions are thus necessary to ensure that the involved businesses, at various hierarchies, are not forced to close or go bankrupt because of the COVID-19 related situation and are supported in the interim.


ALCOHOL FREE WIPE
WARNING DO NOT FILL ABOVE THE LINE
SHARPSGUARD
DANGER
Cyclizine Lactate
50 mg/ml Injection
Mebeverine 135 mg
tablets BP
SINGLE USE ONLY
TERUMO

Chapter 1
INTRODUCTION AND BACKGROUND

1.1 Introduction

Waste Management has been an important agenda across the world. Waste continues to pose serious environmental and human health challenges across countries, more so in developing countries such as India, which face more serious challenges to efficient management of solid waste. India's vast population, growing economy and increasing consumption and production systems result in constantly increasing waste streams. Existing management systems are failing to adequately capture, treat and dispose the waste. The issues around waste have been part of various national and international dialogues and several interventions have been made on multiple fronts.

The Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). COVID-19 has led to disruptions in the formal and informal sectors of waste management, inducing changes in the quantities, generation, type, and accessibility of waste. The World Health Organization (WHO) guidelines recommend using personal protective equipment (PPE) to protect against infection from and limit spread of SARS-CoV-2. The main routes of spread of SARS-CoV-2 are through spread of respiratory droplets and human contact (World Health Organization, 2020). Protective public health guidelines thus led to a surge in production and consumption of PPEs including masks, gloves, etc. This potentially contaminated waste contributes significantly to the biomedical waste stream.

Biomedical waste generated from COVID-19 patients has increased at an alarming rate in most countries. This waste is highly infectious in nature and is generated over diagnosis, treatment and immunization of human and animals. Healthcare facilities and other centers providing treatment to patients are major sources, however, in the case of the current pandemic, infectious waste is expected to be generated from many other sources such as homes, quarantine centres, etc. Due to the nature of biomedical waste it requires a special protocol for handling and disposal to avoid spread of infection and create further public health concerns. Countries have varying capacity levels to safely handle this waste. As a result, any significant increase in volumes in countries with poor handling systems can pose serious challenges in its management. There are also reports indicating a surge in generation of plastic waste since citizens are seeking safe and sanitized supplies for various everyday consumer goods, necessitating the use of protective packaging materials and increasing the use of plastic. The pandemic has also led to a surge in use of single use plastics, with a relaxation observed in Indian States regarding the earlier ban on the same (Poovanna & Khanna, 2020). The use of PPEs such as mask and gloves are being mandated by many governments and increase the load of plastic in the waste stream and create an additional burden in managing such waste.

This report provides an overview of the existing management scenario of the plastic and biomedical waste streams and draws out lessons from the two

Indian mega cities Delhi and Surat. Data has been collected through a scoping study involving empirical research with key stakeholders in the waste management chain in the two cities.

1.2 Waste Generation during COVID-19 Pandemic: **Global Scenario**

The use of PPE has been vital to protect society and public health against the spread of COVID-19 however, its disposal remains a major challenge globally. Apart from PPEs, increasing demand for single use plastics in food delivery containers, online retail delivery systems etc. have also led to an upsurge in plastic waste generation globally (Duer, 2020). Some heavily COVID-19 affected cities like Wuhan (China) have seen a 40-fold increase in waste generated from hospitals, which overwhelmed the waste management system. The daily production of masks in China went up to 116 million in February 2020, which was 10-12 times higher than the previous month. Similarly, in Thailand, plastic waste more than quadrupled since pre-COVID time, which was mainly attributed to the increase in food deliveries and food take outs.

While some countries have been ramping up their waste management systems to meet the increased demand, others have struggled with broken waste handling chains and have seen a large amount of waste going into water ways and landfills (L.Patrício & TeresaRocha-Santos, 2020). Some municipalities have been better prepared to handle the pandemic related waste by having improved infrastructure and systems in place, such as a functioning common biomedical waste facility, incinerators and transport infrastructure to manage the biomedical waste. However, in many localities, biomedical waste has been inadequately disposed of in landfills and open dumps. For example, in Delhi's Sharan Vihar area, an open pile of biomedical waste (including discarded face masks, tunics, gowns, caps and syringes) was found and reported by an Indian newspaper agency on April 1, 2020. In Delhi's Ghazipur dumpsite, the waste collectors reported to have seen biomedical waste disposed openly. This included various types of PPEs and other hospital waste. This upsurge in single use plastics has resulted in plastic waste accumulating in urban drainage systems, increasing the risk of floods, spread of vector borne diseases, and causing soil degradation and water pollution (L.Patrício & TeresaRocha-Santos, 2020).

The plastic recycling industry, and the informal sector in particular, has been hit hard by the immediate and indirect impacts of COVID-19. As global outlooks display decreased prices for virgin plastics, informal plastic waste collectors and recyclers get significantly lower return prices for recycled materials (Waste & Recycling MVA, 2020). Moreover, national and local lockdowns have in many instances failed to recognize informal collection and recycling practices as essential services, resulting in lost income and livelihood opportunities for people working informally with plastic waste. This issue has been exacerbated by government relief efforts which tend to be inaccessible for workers in the informal sector (ICTD, 2020). In addition, since the informal sector often operates without PPE, and the recent growth in biomedical waste is significant, informal workers face increased risk of exposure to hazardous substances as recycling activities proceed. Beyond these immediate socio-economic concerns, the absence of informal recycling services has led to increasing amounts of recyclable plastic waste accumulating in urban areas, being inadequately burned, dumped in landfills and in water bodies.

1.3 Waste Generated during the COVID-19 Pandemic: **Indian Scenario**

Ever since waste management in India has been fallen under the responsibility of the Urban Local Bodies (ULBs), their functioning has included part

of the waste management being handled by the informal waste collectors. Due to heavy reverse migration because of a sudden lockdown and fear of COVID-19, certain links of this waste management chain weakened or got broken. It became an essential requirement of the system to protect the front-line workers in the waste management system. Formal workers were better off, backed by social security systems, whereas for the informal waste workers, the situation seemed to be much worse. Improvement of waste management systems has been one of the key focus areas of Swachh Bharat Mission (Clean India Mission), a national program, launched in 2014. A key inclusion in the program has been an annual ranking of cities on the parameters of cleanliness, called the Swachh Survekshan. Many cities have drastically improved their systems of sanitation and waste management to obtain a good rank in the Swachh Survekshan. The Central and State Governments have also incentivized the cities based on the annual ranking achieved.

The first case of COVID-19 in India was detected on January 30, 2020 in the State of Kerala and since then the number of positive cases has continued to rise exponentially resulting in significant increase in generation of infectious waste and posing challenges in its effective management. While India has in place a system of Biomedical waste management, the waste generated from the COVID-19 pandemic threw up additional challenges on account of inadequate information about its handling and treatment protocol. The information on the virus is constantly changing leading to apprehension in minds of health workers and waste handlers too. With increased usage of PPEs, every individual is a potential COVID-19 waste generator; in the form of using non-reusable masks, gloves and other protective gear that is being used and discarded.

COVID-19 waste is highly infectious and is covered under the ambit of the Bio-medical Waste Management Rules, 2016. However, its management has been strengthened further by issuance of guidelines by the Central Pollution Control Board (CPCB) in 2020. The guidelines have been revised four times (March 25, April 18, June 10 and July 17, 2020) according to contemporary understanding and waste management challenges at hand.
The guidelines have recognized and defined new generators and sources of bio-medical waste. It provides guidance for handling, treatment and disposal of COVID-19 waste at healthcare facilities with isolation wards, including temporary facilities like quarantine camps/quarantine homes/home care facilities, sample collection centers, and laboratories (CPCB, 2020). The CPCB has also created an app called “COVID19BWM”and mandated its use to track the generation, collection and disposal of COVID-19 Bio-medical waste, generated at various Health Care facilities/Hospitals (HCF), Quarantine Centers, Isolation wards, Testing Labs, COVID-19 Sample Collection Centers and ULBs involved in performing the duties of waste collection from Home Quarantine centers / homecare units. It requires generators to daily register and upload details related to waste generation, which requires usage of specific smartphones (i.e. specific versions of Android OS), thus potentially limiting its reach (CPCB, 2020).
In addition, the CPCB has shared an important list of “Do’s and Don’ts for Waste Management during COVID-19” for the general public as well as issued an Advisory on facilitating operation of Common Bio Medical Waste Treatment Facilities (CBWTFs) as an essential service under health infrastructure.

The Indian scenario depicted here is restricted by the availability of data on the pan-India situation, as a result of the novelty of the COVID-19 situation and rapidly changing circumstances and developments associated with the pandemic.

1.4 Impact of COVID-19 pandemic on PWM and BMW system and Informal sector

The informal waste sector generally consists of poor migrant workers, living under conditions of economic insecurity and socio-cultural marginalization. Individuals working informally with waste often lack proof of identity, a bank account, access to social welfare and government insurance schemes, and labor-regulated rights. Many are illiterate and live on the fringes and in the most polluted parts of city and subsist on very meagre earnings. Consequently, informal waste workers have faced exacerbated hardship whilst a prolonged national lockdown has prevented this societal group from earning a livelihood. As most migrant waste workers operate without official recognition for the services they provide and social support networks in the cities, lack of livelihood opportunities and access to government relief packages have forced many informal waste collectors and recyclers to re-migrate to their villages by foot (Deshingkar 2020).

Informal waste workers are highly vulnerable since their livelihoods are not assured and they could be switching places of work depending upon the availability of waste and the opportunity to access waste. These are mostly men, but women are also part of the workforce and are more vulnerable as compared to their male counterparts. They are often paid less as compared to their male counterparts and are more vulnerable to exploitation (Muller & Schienberg, 2020). While the waste workers have played a very significant role during the current crisis, they have also faced the vulnerabilities on account of complete lockdown and little means to subsist in the cities. It was extremely difficult for the workers at the peak lockdown to even access sufficient food (or for their families), afford housing and they were therefore forced to return to their ancestral villages. Some who chose to stay back had to survive in the city and persisted on meagre incomes.

Beyond the socio-economic insecurities faced by informal waste workers, which has become particularly visible in the wake of COVID-19, the pandemic has highlighted the societal contribution of the informal recycling sector; its resilience has been significant to prevent plastic waste form piling up in the streets, being burned, dumped illegally or unsegregated in landfills (ICTD 2020). However, COVID-19 has also highlighted the challenge of informality with regard to waste handling standards and safety practices, or the lack of these, which becomes important when it comes to managing medical waste. Poorly managed waste poses an environmental threat and may be a potential source of re-emerging infection, creating prolonged and unwanted public health hazards (Rahman et al. 2020). Moreover, the use of PPE in informal recycling activities are essentially nonexistent, which makes informal sector workers particularly exposed to contaminated waste. Considering the unprecedented spread of COVID-19, such exposure risk is not only a concern to individual waste workers' health, but also to society as a whole.

1.5 National and State level responses

To control the transmission of the COVID 19 pandemic, the central government imposed a complete lockdown in the country on 24th March 2020 to reduce economic activities and social mobility. People, with even minor symptoms and a travel history were forced and later advised to stay in government/ home quarantine. Also, wearing of masks was mandated for the general public. In addition, the government body charged with ensuring proper solid waste management, CPCB along with Ministry of Health and Family Welfare issued guidelines on disposal and management of COVID-19 related waste in India (Central Pollution

Control Board, 2020). This was required as a shift in consumers' behavior was observed in the plastic industry which was impacting its waste management. At all levels, various preventive measures were imposed to stop the spread of the COVID-19 pandemic that had huge impacts on the plastic industry and the consequent waste management patterns and systems. There was a paradigm shift in consumer behavior that were mostly triggered by concerns related to hygiene management, and their growing feeling of need to stock up necessary food items that led to a huge rise in the demand for food packaging. Also, the growing apprehensions over cross-contamination that might be caused by reusable bags led to withdrawals or postponements of bans on single use plastics. Hence, the resultant increase on the use/consumption of single use plastics, PPEs and other plastic items during the pandemic led to a quantum jump in plastic waste generation, disrupting viable options of sustainable plastic waste management (Silva, Prata, Walker, & Campos, 2020). The regulatory efforts to manage the single use plastic by the city governments also saw a slow down, which further led to increase in the use of disposables and single use plastics manifold (Centre for Science and Environment, 2020).

Chapter 2
ABOUT THE STUDY

The present study aims to analyze the effect of COVID-19 on the plastic and biomedical waste generation and management in the two Indian cities of Surat (in Gujarat) and Delhi. This relationship has been explored because of concerns around the global rise in demand for single-use-plastics that forms the base material of most of the PPE items.

The INOPOL team is working towards building knowledge and capacity to tackle plastic and chemical pollution from important sources within key industries, public sector and civil society. In the backdrop of the sudden societal changes triggered by COVID-19, the INOPOL project team saw the need for directing project attention to the pandemic, and how the recent developments affect marginalized groups involved in plastic waste management. Hence, in consultation with the project owner, the Royal Norwegian Embassy in New Delhi, the INOPOL project management group decided to dedicate part of the project to understand the scenario of plastic and biomedical waste management against the backdrop of COVID-19.

2.1 Aim and Objectives of the study

The aim of the study is to assess how the COVID-19 outbreak is impacting the plastic and biomedical waste generation and management in selected Indian cities in the light of sudden changes in the current context. The objectives of the study are as follows:

- Understand how the COVID-19 outbreak is impacting the plastic waste management and the waste related informal sector workers in India;
- Assess how the INOPOL project may support ongoing efforts; and
- Propose tentative measures that can assist the informal waste sector and reduce risks from increased plastic pollution (eg. caused by use of PPE).

The study collected data to address the following research questions:

A. The informal sector, livelihoods and waste flows/network

What are the current impacts on livelihood and waste flows, as compared to pre-COVID-19 levels and composition?

B. Solid Waste/Plastic waste volumes

What are the changes in volumes and physical characterization of municipal solid waste and bio-medical waste in Surat and Delhi?

C. Changes in behavior among different socio-economic sections with respect to plastic usage/consumption

What are the behavioural shifts (like usage of particular items more and reduction in consumption of another), and what are its effects on plastic waste generation in the cities (with a particular attention on PPEs, and packaging materials at household level)?

2.2 Geographic focus

The geographical areas in focus for the study are Delhi, the national capital and Surat city (in the State of Gujarat) (Figure 1). For the purpose of the current study we accessed information on waste from two municipalities South Delhi Municipal Corporation (SDMC) and East Delhi Municipal Corporation (EDMC) covering 25% and 24% of the total Delhi population respectively.

The State of Delhi is spread over an area of 1483 sq. km with a population projected to be approximately 18 million in 2020 (Unique Identification Authority of India, 2020). Delhi is unique in its administrative and governance mechanism with both the National and State governments having responsibility for several facets independent of each other. Being the national capital, it enjoys several advantages since it houses the political elite of the country, receiving a lot of media attention and has good infrastructure facilities. On account of its economic strength and employment opportunities, the city also attracts many migrants, thus placing additional strain on its resources and infrastructure. South Delhi Municipal Corporation (SDMC) is spread over an area of 656 sq. km, divided into 104 wards and consists of the Districts: South East, South, South West and West.

EDMC consists of the three Districts North-East, Shahdara and East on the eastern side of river Yamuna river. It covers an area of 125 sq. km and is the most densely populated part of Delhi. It is divided into two zones, Shahdara North and Shahdara South and 64 administrative wards. East Delhi has a population of 1,709,346 (2011 census) and an area of 64 sq. km, with a population density of 22,639 persons per km. As per CPCB estimates (2016 data), Delhi produces 8700 MT of solid waste per day.

Surat is a port city in Gujarat, in western India located close to the Arabian Sea. The metro area population of Surat in 2020 is 7,185,000 (PopulationStat-Surat, 2020). Surat is especially known for two flourishing industries, textile and diamond. It also supports other ancillary businesses in the city's periphery, hence providing livelihood opportunities to a significant number of migrant populations. Most of the industries in Surat are based on textiles, as the city contributes to 40% of the nation's synthetic fibre production, chemicals and petrochemicals, rubber and plastics and paper mills, which majorly contributes to plastic waste

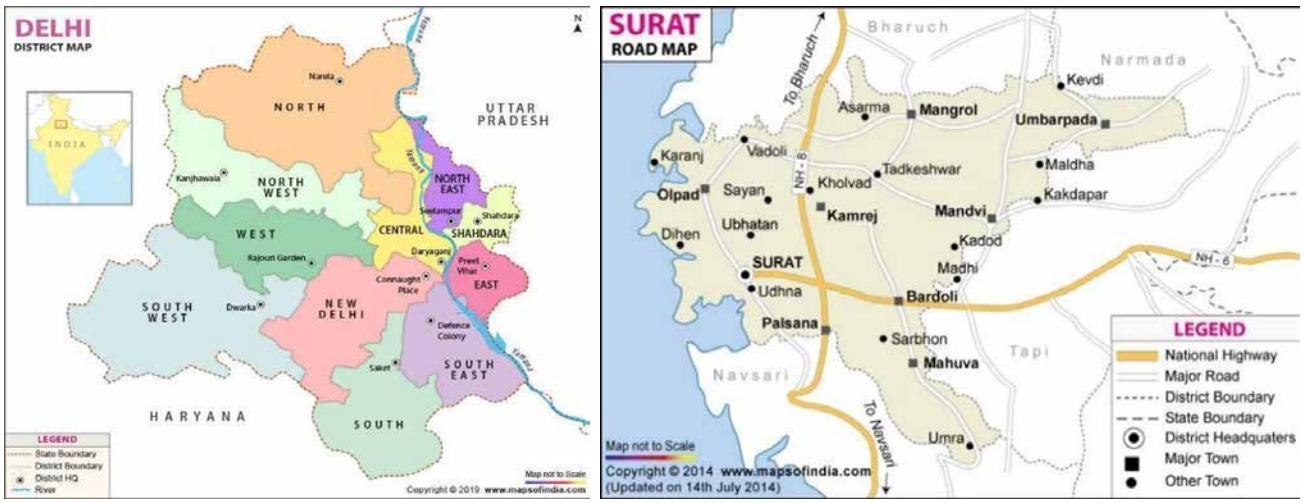

Figure 1 Map of Delhi (left); Map of Surat (right)

generation. As per Swachh India (2017), the city contributes more than 150 MT of plastic waste per day (Karelia, 2017).

2.2.1 Spread of SARS 2-CoV 2 virus in the project locations

The first case of COVID-19 infection in India was reported in Kerala on January 27, 2020. As noted, a complete national lockdown for 21 days was declared on March 24, 2020 in India. While there are geographic and regional hotspots (e.g the State of Maharashtra), more generally its densely populated megacities have been the hardest hit, including the national capital Delhi and Surat.

In Delhi, COVID-19 was declared as an epidemic on 12 March, 2020 with a handful cases. However, community transmission spread the disease soon after, despite lockdown restrictions. By May 2020, the total confirmed cases by government officials had crossed 15,000 and by June the number had crossed 80,000.

In Gujarat, the first few cases were seen in mid-March 2020, by June the number of cases had crossed 23,000 and 44,000 by July. By September 2020, as many as 1,14,834 total cases and 3,227 deaths occurred in Gujarat due to COVID-19 (September 15, 2020).

2.3 Methodology

The methodology for the study was designed to capture information regarding the effects of COVID-19 on waste management issues and practices, as well as impacts on key stakeholders such as informal sector workers. The research team started with conducting a thorough literature review that included reports, research papers, news articles and other publications. In addition, surveys were conducted in the study sites. Furthermore, stakeholder assessments were undertaken in the study areas to identify key actors involved in the chain of waste collection and management. The details of the identified stakeholders and the tools used to elicit information from them are given below.

A. **The informal sector:** waste pickers were identified with the help of grassroot NGOs/ partners (who had access to them). An interview guide was developed to ask questions to stakeholders on the impacts on their livelihoods, their knowledge about people who have shifted jobs, etc.

B. **Waste volumes:** Secondary information from State Pollution Control Boards (SPCBs) were gathered. Information on discarded PPEs in the biomedical waste sector were collected from **hospital data**. To understand the qualitative components of the study, specific groups of respondents who have a good overview of the situation (key informants) such as municipality officials, heads of NGOs were interviewed.

C. **Changes in behaviour/patterns of consumption at household level:** A short survey (online/telephonic) was conducted with members of households. Questions that allowed a certain quantified metric/ objective type analysis on changes in consumption/ behavior/ waste generation were asked.

An interview schedule was developed for the key stakeholders and was administered through telephonic medium with a sample of key stakeholders. Snowballing was a key technique used to identify them. The questions mostly included pre- and post-COVID scenarios, trend analysis, objective as well as subjective type questions to capture their socio-economic background including livelihood issues, response to COVID-19 related situations, financial effects of COVID-19. In total, close to 100 interviews were conducted to gather the information. In Delhi, 68 interviews were undertaken with the informal waste collectors, municipality officials, workers in the formal waste management systems,

waste traders etc. In Surat, about 30 interviews were conducted with informal waste collectors, formal waste management employees, association of waste workers, State pollution control board officials, and other key informants.

In addition, to analyse the pre- and post-COVID-19 situation, secondary data (of the past six months) was collected from relevant government bodies on municipal solid waste, plastic waste, biomedical waste generation, treatment and disposal. Qualitative and quantitative data collected through interviews and other sources was analysed by the research team in Microsoft Excel. The existing practices and change in practices were analysed, keeping in mind the respondents differentiated socio-economic contexts.

The first part of the survey and data gathering exercise was conducted among plastic waste pickers, who lived in the vicinity of the landfills in East and South Delhi, guided by a structured interview schedule. The waste pickers were selected purposively and interviewed to elicit information and get a general picture of their status and the impact of the lockdown, questions on various aspects such as gender, migration, quantity of waste collected per day, sale of the waste, monthly income, precautionary measures taken while collecting waste, and issues faced by them, were included in the questionnaire.

This study is not just an attempt to understand the isolated impact of the pandemic on plastic waste generation and its management, but also to assess how it has affected vulnerable people within the informal sector, who have been instrumental in plastic waste management in the country.

Limitations of study/research challenges:

1. *Telephonic interviews*: Due to the partial lockdown and difficulty in physically administering the questionnaires, telephonic interviews were conducted with waste pickers, recyclers, municipality officials, and other stakeholders in the waste management chain. Grassroot NGOs, directly working with the waste pickers and traders were reached out for support.

2. *Data availability*: The data availability from different sources was limited. For example, the grassroots NGOs worked in certain geographical areas, where the waste pickers were living and working, i.e. in East Delhi near the Ghazipur dumpsite in a colony called Ghazipur Dairy Farm, where most of the waste pickers were living. This led to data collection and interaction mostly from those specific clusters of waste pickers. The survey team attempted to overcome this by taking contacts from the surveyed waste pickers and expanding the number of participants to other geographic areas.

3. *Selection bias:* Given the ongoing COVID-19 pandemic situation in the country, the interviews for the study were conducted telephonically through purposive sampling and snowballing, hence a sampling/selection bias may exist.

4. *Sample size:* The sample size was limited given limited time availability for the study in addition to the difficulty to gain access to primary informants during the severe lockdown periods, with limited access to informants, and keeping in mind health and safety of all study participants physical contact was avoided.

Chapter 3
FINDINGS OF THE STUDY- PLASTIC WASTE MANAGEMENT

3.1 Different aspects of Plastic Waste Management

In the context of plastic waste accumulation in the pandemic scenario, there is an intensifying need to clearly understand the role of the informal sector in plastic waste management. The International Labour Organisation (ILO) defines informal sector waste workers as "individuals or small and micro-enterprises involved in the process of managing waste without being registered and without being formally charged with providing waste management services". In most cases, the groups dealing with waste comprise of the urban poor, whose livelihood opportunities in the city are limited. In the case of plastic waste handling, the operations down the waste management chain are generally carried out by poor, disadvantaged, vulnerable and/or marginalized social groups. The socio-economic and socio-demographic characteristics (level of income, gender, age distribution and cultural background) of the people engaged in informal plastic recycling can differ across locations, but the fundamental characteristic of not being recognized by any official agency remains unaltered.

The informal sector is characterized by small-scale, low-paid, unorganised, and unregulated work. Individuals and family groups within the sector do not usually possess trading licenses, do not pay taxes, and are not included in the government insurance, social welfare or funding schemes making them highly vulnerable to socio-economic shocks. Nevertheless, the informal sector plays a significant role for waste management due to some of its key strengths. In the case of plastic waste recycling, the informal sector has grown to develop a lucrative market for recyclables. Actors involved in the collection, sorting, segregation shredding and pellet-making of waste, are part of a larger informal plastic waste management chain. Despite not being formally trained, many workers have picked up skills by practice, through several years in the business, and have become highly efficient and knowledgeable within their specialized fields of extracting value from waste materials. Their operations are extremely low-cost involving low-end rudimentary technology, working on very small margins and inherent ability to subsist on meager earnings that make all their operations sustainable (Nizzetto and Sinha, 2020).

Data on the informal sector is limited, partly because the informal sector is not included in any census category, and its identification has not been a priority within official waste management strategies. Attempts to estimate the size of the informal waste sector are mostly based on case studies using different parameters and methodologies to calculate its scale. On a national scale, it has been estimated that waste collection, sorting and trading provides a source of income to 1.7 million people (Oates, et

al. 2018). Case studies from Delhi and Bangalore suggests that informal recycling structures prevents around 15% of waste from going to landfills (Aparcana, 2017). Activities within the informal sector are typically handled by individuals or groups that are identified by their nature of activities, as described in the following section.

3.2 Existing chain of plastic waste recycling in informal sector

In India, the identification, collection and recycling of plastic waste follows a hierarchical structure (Figure 2), where waste pickers and small *kabadiwalas* sell their collected items to scrap dealers. *Kabadiwala* is a junk or scrap dealer or a doorstep service provider in India who buys household junk and throwaway material from people, and pays money in return. Such materials finally reach industries for recycling and making new products. It has been widely accepted that the informal sector plays a big role in bringing back discarded plastic into the waste management chain.

Waste Management in the informal sector is highly segmented. There is a division in the entire process undertaken by different sets of persons, usually non-overlapping with each other. The typical plastic waste management stages in cities include collection, sorting, accumulation of volume, pre-processing, market intelligence and trading. Each stage is discussed in detail in Table 1.

Table 1 Stages of Plastic Waste Recycling in Informal sector (Wilson, Velis, & Cheeseman, 2006)

Informal Sector - Plastic Recycling	
Collection	Identification and picking of items or collecting mixed waste allows the sector to acquire the waste and turn it into a resource. Also, huge network means larger reach.
Sorting	Main process that increases the value of the waste recovered. The deeper the sorting differentiation, the higher the value of waste. For instance, if plastic is grouped into one major category, its value is lower than when it is further separated into sub-categories of hard and soft, then HDPE, PET, LDPE, etc. Sorting according to colour, size, shape and potential use or re-use of the materials etc. to meet the quality specifications of the end-users.
Accumulation of volume	Volume adds value. Larger volumes command higher per-unit prices. The greater the quantity, the better bargaining power the trader has.
Pre-processing	Washing, changing in shape-cutting, granulating, compacting. Low operational costs keep the overall material costs lower.
Market intelligence	Proximity to markets where informal recyclers and traders conduct business allows for the flow of information helps in decision making on accurate market prices, competitors etc.
Trading	In informal or formal markets, links to the secondary materials network are crucial. Has the forward and backward linkages that enable wastes to be recovered for recycling purposes.

Waste pickers (locally also called '*Kachrawala*') Waste pickers constitute the bottom layer of waste recycling and form the base of the large informal recycling pyramid. They pick up/collect waste from public places such as garbage dumps, streets or landfills and earn their livelihood by selling collected and sorted waste to higher levels in the recycling chain.

Plastic waste is a significant category amongst the recyclable materials found in municipal waste. It is important to note that informal sector workers only collect plastic waste with high market/resale value, resulting in less valuable plastic waste being left unrecovered. Unmanaged biomedical waste, such as PPE made from single use plastics, is therefore generally not collected by waste pickers for recycling. Nevertheless, these plastic wastes represent a direct health hazard for the waste pickers who may face direct exposure to these in their day-to-day work. Women are overrepresented at the manual collection and sorting stages of the informal recycling chain (Krishnan and Backer 2019) and are consequently increasingly exposed to the direct health hazards of dealing with mixed municipal and medical waste.

Waste Collectors (locally also called '*Kabadiwalas*') Waste collectors also operate within the lowest levels of the recycling pyramid but differ from waste pickers because they generally collect waste directly from the waste generators (i.e. households, residential compounds, small offices, and shops). The waste collectors purchase waste by paying cash to the households. Waste collectors are often seen travelling by hand pulled carts, tricycle or small trucks, and can therefore have a relatively higher spatial coverage and collection volume than waste pickers. They can also access small lanes and areas that are otherwise too congested for other motorized vehicles to traverse. In contrast to waste pickers, they require more capital investment to partake in its respective market.

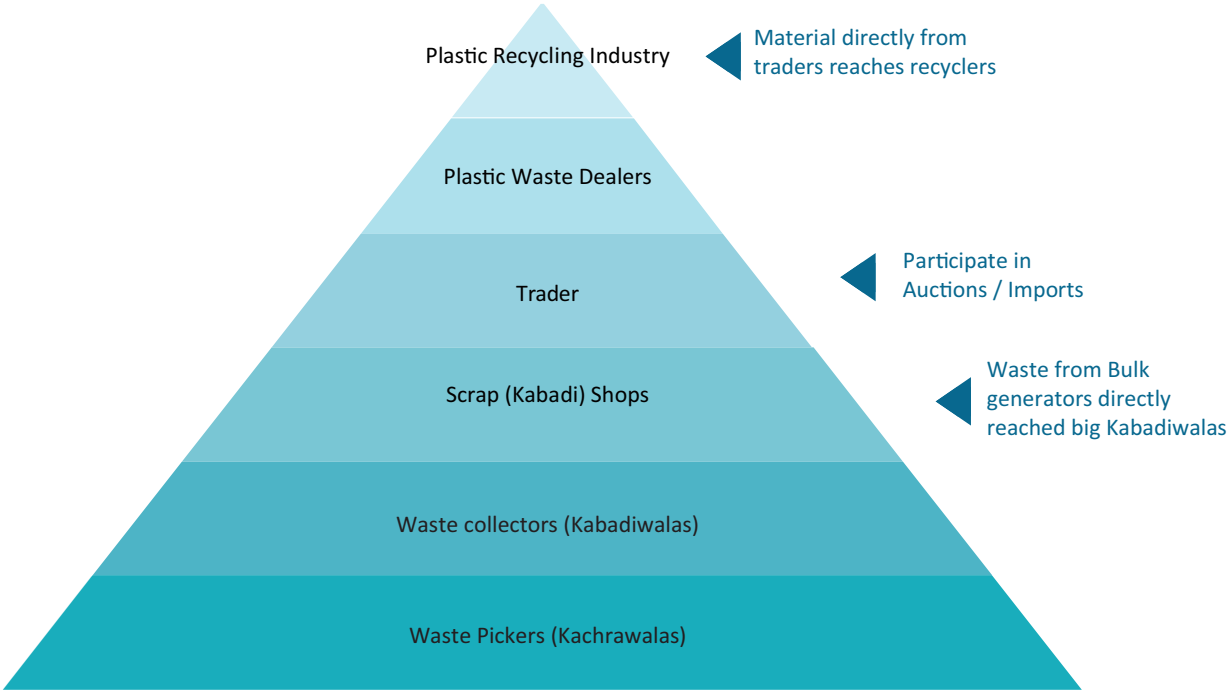

Figure 2: Waste Hierarchy in the Informal Sector for Plastic in Delhi

***Kabadi* or Junk shops** – There are two different levels of scrap shops or *Kabadi* shops, small and large. The small *Kabadi* shops are spread across the city and have a presence in almost all localities. They buy materials from many local *'Kabadiwalas'* and sell them further to a larger *Kabadi* shop. The larger *Kabadi* shops are limited in number and in addition to small *Kabadi* shops, also receive sorted waste from other sources. They also pick up waste directly from offices or establishments. From here, the waste is sold to plastic traders. There are around 4-5 workers in these kinds of junk shops who are mostly men.

Trader/Dealer/Wholesaler – Up to the level of *Kabadi* shops, all players deal with all kinds of recyclables. At the trader or dealer level, it becomes specialized. A plastic waste dealer purchases waste from junk shops, institutions, shops and industries. The trader also has direct linkages and can pick up material from imports or buy from auctions. At the level of plastic dealer, functions like sorting, cleaning, grinding and pellet making are undertaken,

Plastic Recyclers – The recycling chain of plastic consists of several traders, waste sorters, grinders, and pellet makers. After material trading at a commission basis (most times more than once), plastic usually ends up with waste sorters who separate different types of plastic, based on their experience and some locally developed methods. After sorting, these are sold to grinders who do a further segregation and cleaning before the cutting and grinding process. These are then channelized to pellet makers. The pellet makers receive waste from dismantlers and traders directly, and also from other cities where they have linkages. The sorted and grinded pellets then go through the extrusion process for making pellets. The recycled pellets are either sold directly to the moulding units in the city or are sold to traders in the city dealing in plastic. The recycled pellets are also sold to plastic traders in other cities.

3.3 Status of plastic waste management in Delhi

South Delhi: In the annual nationwide survey carried out on cleanliness of 4000+ cities (*Swachh Survekshan*), the city ranked 32 in 2018, slipped to 138 in 2019, and regained its position to 31 in 2020. Figure 3 shows the municipal solid waste

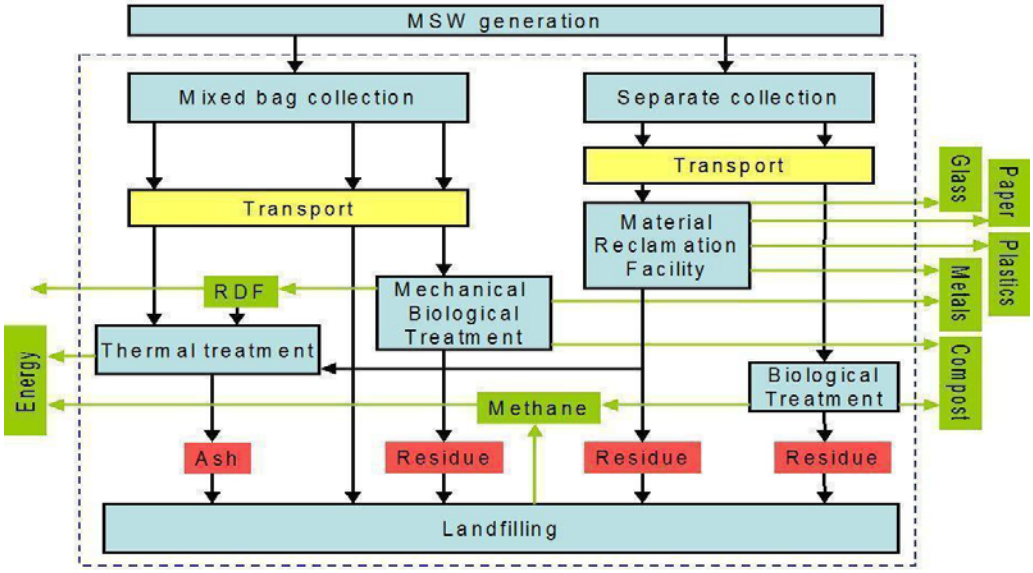

Figure 3: Municipal Solid Waste Management Lifecycle
Source: CITATION Kon11 \l 1033 (Abeliotis, 2011)

management lifecycle. In South Delhi, waste management is undertaken by the SDMC. As part of the informal collection system, waste pickers are involved in collecting municipal solid waste from households, commercial establishments and institutions, and sell it to *kabadi* shops (junk/scrap shops) who segregate this waste into different streams, which further get aggregated. These areas where aggregators assemble are called '*kabadi bastis*', where the plastic waste is further segregated and sold at different rates to small industries and waste recyclers. Some of the waste pickers skip the *kabadi* shops and sell their plastic waste directly to recyclers and industrial units, for better selling prices (by eliminating one layer of local aggregators).

Solid waste from households, commercial establishments and institutions is also collected through the formal waste collection services extended by the municipality, where the primary collection is done by small vehicles called auto-tippers. The auto-tippers deposit waste into municipal storage containers called '*Dhalaos*' from where it is collected and transported to either the treatment plant or the landfill.[1] At the treatment plant, the mixed waste is separated on ballistic separators. The segregated biodegradable waste goes for centralised windrow composting. Most of the other waste is incinerated at the waste-to-energy plant in Okhla. The remaining waste goes to the Okhla dumpsite.

The effects of COVID 19 have led to the chain breaking at certain points. In the informal waste chain, respondent waste pickers reported that the market for certain types of plastics, like polythene, reduced significantly and is now not being accepted by most aggregators. Hence, after segregation, this type of plastic has to be thrown into a '*dhalao*' (municipality bin). Some of the '*Dhalao*' in-charge also charge a bribe from these waste pickers to allow them to throw waste. This amount charged was reported to be Rs 500 per month. As a consequence, the most cost-effective and easy solution for the individual waste picker may be to throw the waste on the street or in the local environment.

Waste pickers in South Delhi have been receiving domestic biomedical waste (BMW) mixed with municipal solid waste (MSW). They dispose of the masks and gloves too, along with the other mixed MSW at the '*Dhalaos*'. Most of them reported to be handling 30-40 disposal masks and gloves on a daily basis, potentially exposing them to infection and disease.

East Delhi: East Delhi generates about 25% of Delhi's total waste (about 2500 MT/day of MSW). In the annual nationwide survey done on cleanliness called *Swachh Survekshan*, the city massively improved from rank 341 in 2018, 240 in 2019, to 46 in 2020.

As per the existing practice of EDMC, waste generated from households is collected either via door-to-door waste collectors or brought to waste collection points (*dhalao*/dustbins) by the waste generators. This primary collection of waste involves a large fleet consisting of small trucks, handcarts, rikshaws and e-rikshaws, undertaken by formal and informal waste collectors. During door-to-door collection, the waste collectors at many locations collect unsegregated waste and thereafter segregate recyclables like paper, plastics, metals and glass; and dispose the balance collected waste at the *dhalaos* (municipal bins).

The waste deposited at the *dhalaos* is loaded to trucks via loaders or lifted by mechanical means into the compactor truck and transported to processing/ disposal sites. In the instances where waste is processed via the Waste to Energy plant (located next to the Ghazipur dumpsite), the rejects are transported back to the disposal site. The informal

[1] The Dhalaos are ideally placed one in each cluster. The sizes of the bins placed are: Wet waste - green colour bin (capacity 1.1 m3), Street sweeping waste - brown colour bin (capacity 1.1 m3), Drain Silt - Black colour bin (capacity 5 m3) at the designated Dhalaos, Dry waste – blue colour bin (capacity 1.1 m3). Waste pickers do pick from these and also dispose the non-sellable waste in them.

waste pickers generally collect recyclables from the *dhalaos* as well as disposal sites. The remaining non-recyclable materials like organics, inert, and construction and demolition waste, drain silts along with rejects from processing plants are disposed of at the Ghazipur disposal site.

For the present study, workers engaged in plastic waste handling across East Delhi were administered a questionnaire and were also telephonically contacted for a structured detailed interview. The following sections have captured an analysis of the survey findings.

3.3.1 Total Waste Generation in Delhi

The total waste generated per month in East Delhi reduced February onwards and saw a sharp decline in April coinciding with the national lockdown. It slowly rose as economic activities resumed in the country as well as in the city.
A similar trend has been observed in South Delhi. The amount of solid waste generated in EDMC and SDMC is given in Figure 4.

3.3.2 Assessment of information elicited from Waste pickers

A Majority of the interviewed waste pickers possessed some sort of government identify cards like *Aadhar*[2] or *ration card*[3]. Only a handful of them had *Jandhan* account[4] linked to the *"Pradhan Mantri Jan Dhan" Yojana,* which was initiated to help the poor open bank accounts offering dual benefits of a debit card and life insurance cover.

3.3.3 Migration to Delhi by waste workers

Migrant workers make up a major part of the employment force in India in the informal sector. However, it is difficult to estimate the total number of migrant workers in India. Among the respondents, only 5% were from Delhi, and the rest of them were

[2] Aadhar is a 12-digit unique identity number that can be obtained voluntarily by residents or passport holders of India, based on their biometric and demographic data. It was launched in 2009 by the Government of India.

[3] Ration cards are an official document issued by state governments in India to households that are eligible to purchase subsidized food grain from the Public Distribution System under the National Food Security Act (NFSA). They also serve as a common form of identification for many Indians.

[4] A basic savings bank account for all are being opened under the Pradhan Mantri Jan-Dhan Yojana (PMJDY) can be opened in any bank branch or Business Correspondent (Bank Mitra) outlet, for persons not having any other account.

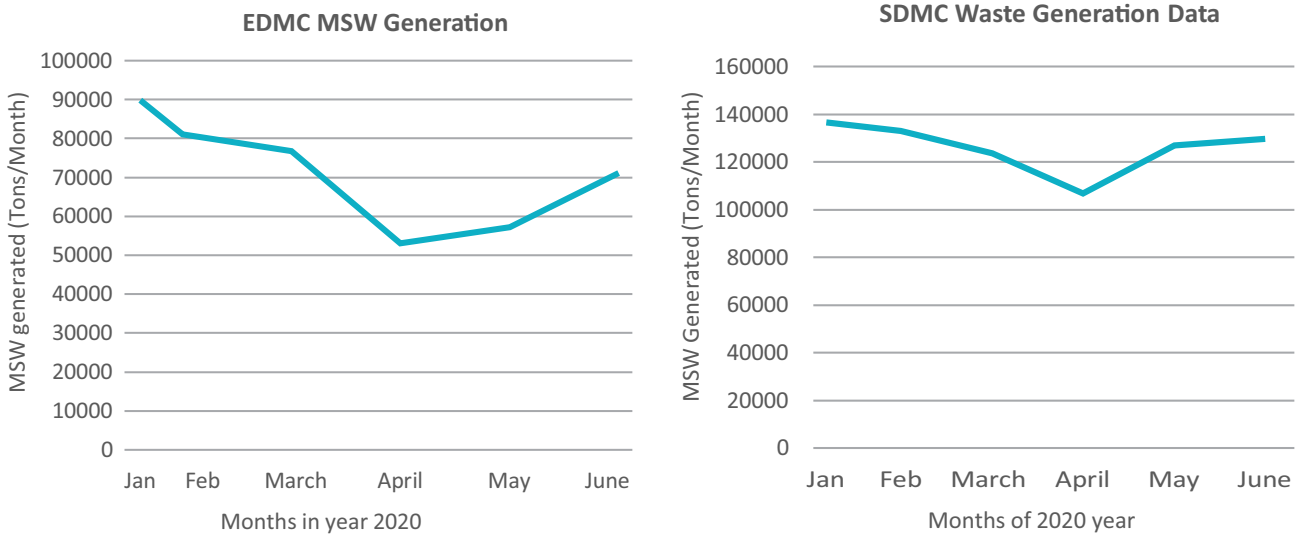

Figure 4 Solid Waste Generation in EDMC (A) and SDMC (B)

from different states, mainly from eastern states (Assam, West Bengal) (62%) (Figure 5). Most of them had been involved in the waste business for a long time, with some engaging in it for close to two decades. The survey clearly pointed towards involvement of migrant labourers in plastic waste picking and collection.

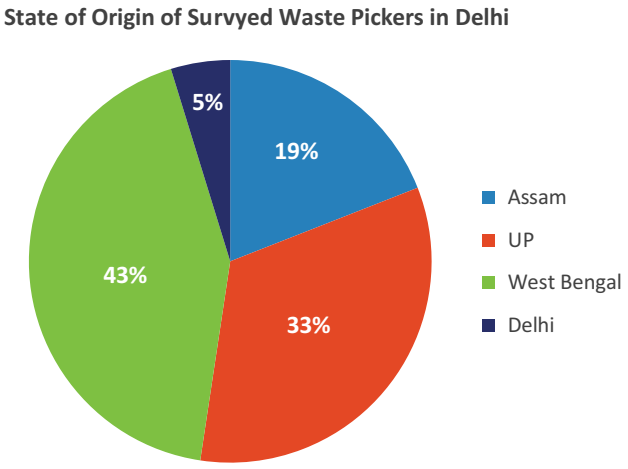

Figure 5: State of origin of surveyed waste pickers in Delhi

3.3.4 Waste Source

The study showed that 58% of the respondents were doing door-to-door waste collection from homes, 38% of the respondents were collecting waste from open dumping sites, and an equal percentage was sourcing it from the community bins or *Dhalaos* (Figures 6 & 7). It is commonly known that most of the them collected waste from roadside or drains as well. Since there is hardly any segregation at source, most waste pickers received mixed waste for free (Figure 8).

3.3.5 COVID-19 and its impacts

Regarding the change in composition of plastic waste during and after the lockdown, the survey findings revealed that opinions were divided, mostly based on the sourcing of waste. About 52% stated that plastic waste composition was the same as earlier

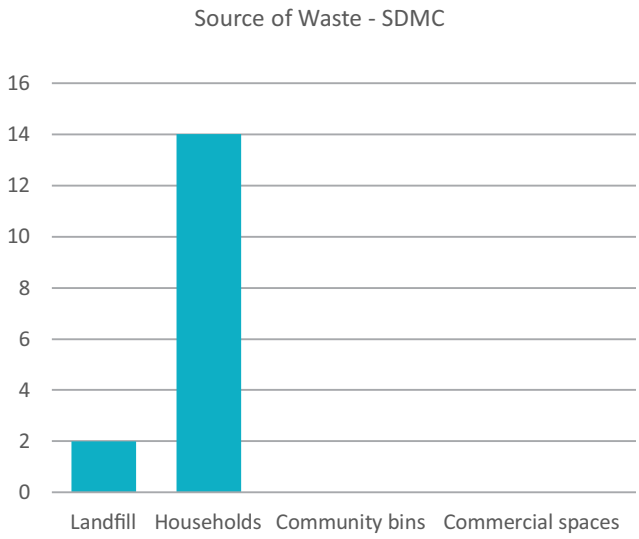

Figure 6: Sources of plastic waste in South Delhi

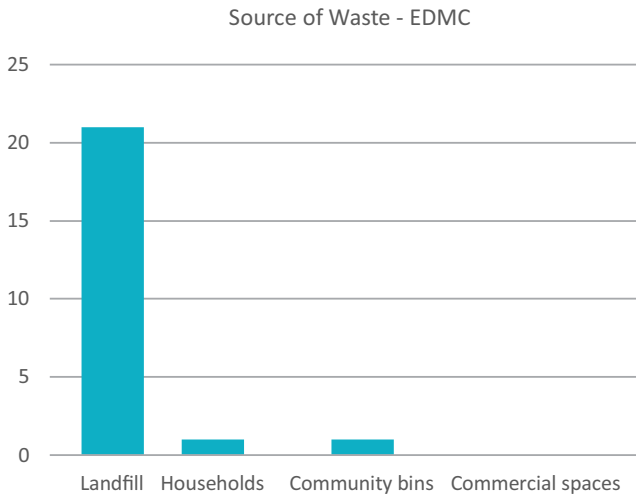

Figure 7: Source of Plastic Waste in East Delhi

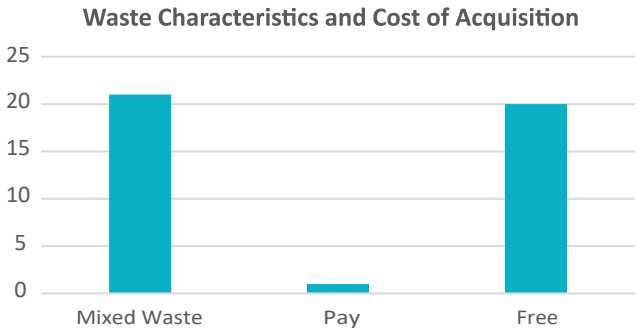

Figure 8 : Waste characteristics and cost of acquisition observed in Delhi survey

while 48% opined there was change in it (Figure 9). Some reported that good quality plastic had gone down. Others reported a sharp drop in PET bottles and cutlery plastic waste. Some also reported an increase in discarded gloves and masks. Some waste pickers also shared that polyethene (i.e. thin plastic sheets and food wrappers) have increased on the dumpsite, and PPEs are seen disposed openly on the dump as well (Figure 10). Overall, a general reduction in the amount of all types of plastic waste (recyclables and non-recyclables) was reported in both South and East Delhi for a couple of months (including lockdown period and 2 months post lockdown).

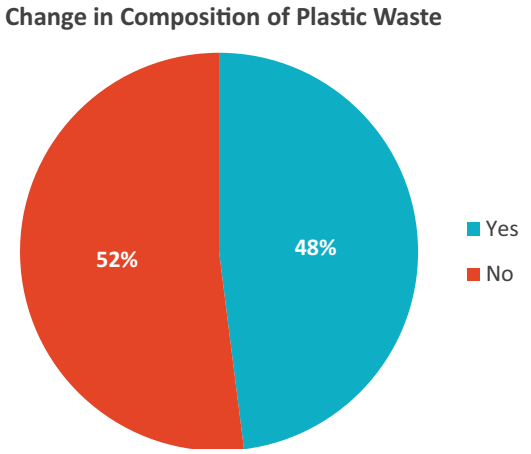

Figure 9: Change in plastic waste composition in Delhi due to COVID 19 Pandemic

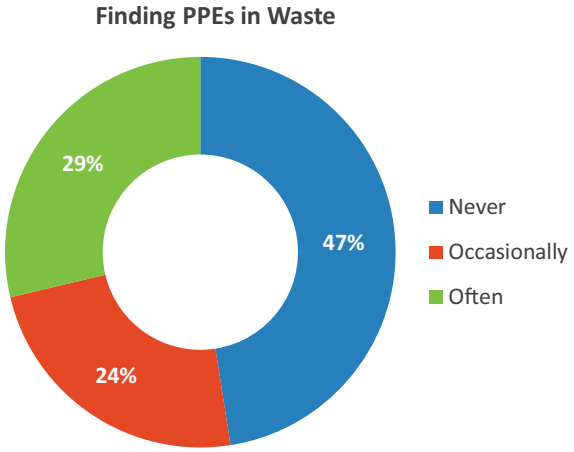

Figure 10: Presence of discarded PPEs in Municipal Solid Waste

"These days were are receiving a lot of plastic bags, some feel different as they tear easily; unlike the usual polythene bags, also there are a lot of milk packets in the waste"

*- **Prashant,** a waste trader from South Delhi*

Those who found PPEs in waste said that the occurrence differed from location to location and were not constant. Many of them stated that they threw the waste PPEs back into community bins/ *dhalaos*. Some of them also mentioned that they did not touch the material and were often warned by the households to not touch the discarded material. All of them mentioned that disposed masks and gloves were of no use to them, because these items have no resale value in the market for recyclables. On enquiring, almost 76% of them mentioned that they were scared of handling PPEs related plastic waste.

The series of lockdowns had a significant impact on informal workers. Workers in the informal economy need to earn each day to feed themselves and their families, as most of them have little savings and

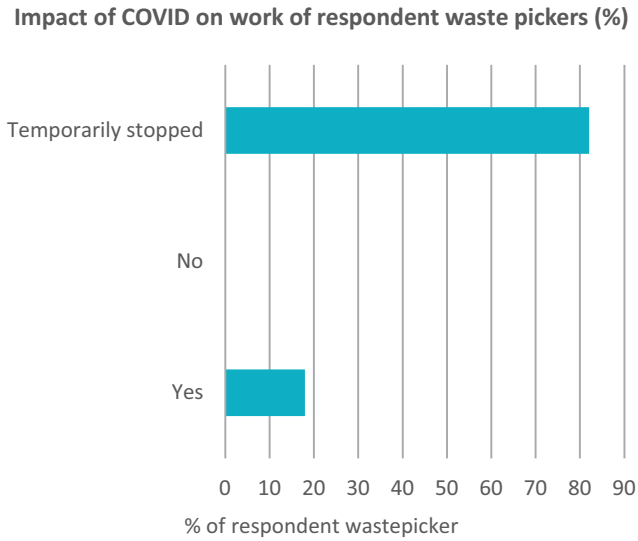

Figure 11: Impact of COVID-19 on working status of waste pickers in Delhi

cannot rely on those for sustenance. Not working and staying at home is therefore not an option, as many of them live from hand-to-mouth. The national lockdown put a break to waste workers' operations, as clear from our survey. Almost 81% of the respondents had temporarily shut down operations during the initial months of complete lockdown and have opened once the norms were eased (Figure 11).

Though during the complete lockdown, there was mass exodus of informal workers who left cities and headed back to their villages; the informal waste sector had a slightly different story, because of the fact that waste generation continued when other operations may have shut down. Only 19% of the waste pickers said that they knew some people who had left the city to move back to their villages during the lockdown. The reasons cited were primarily lack of employment and fear of illness. Some witnessed that waste workers who stayed under the lockdown, left the city after a few months, when savings were drying up and they were not anymore able to sustain themselves.

3.3.6 Change in waste quantities

Most respondents asserted that there has been a huge decrease in the amount of collected waste since pre-COVID-19 levels. Though many reported as high as 75% decrease, based on their perception, on an average the waste quantities went down by approximately 50% (Figure 12 & 13).

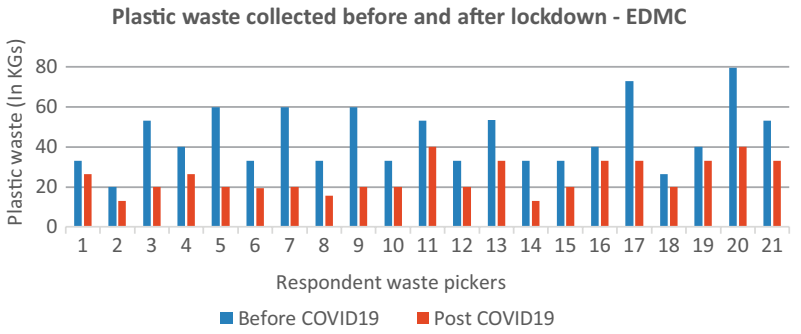

Figure 12: Amount of plastic waste collected before and after lockdown in East Delhi

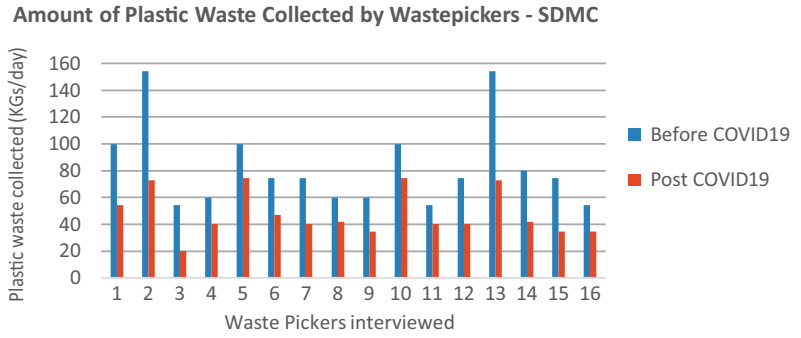

Figure 13: Amount of plastic waste collected before and after lockdown in South Delhi

Table 2: Amount of Plastic waste collected by waste pickers in Delhi before and after COVID-19 lockdown

Waste collected (Kgs/day)			Decrease (%)
Respondent	Before Lockdown	After Lockdown	
1	6 to 7 kg	4 to 5 kg	30.8
2	10-12	5-6	50.0
3	8-10	4-5	50.0
4	20	10-12	45.0
5	60-65	15-20	75.0
6	10-12	10-12	0.0
7	40-50	15	66.7

Waste collected (Kgs/day)			Decrease (%)
Respondent	Before Lockdown	After Lockdown	
8	10-12	5-6	50.0
9	10-15	5-6	56.0
10	15-20	5	71.4
11	10	5	50.0
12	5-7	5-7	0.0
13	15-20	4-6	71.4
14	12-20	10-12	38.9
15	5-10	2-3	66.7
16	5-6	2-3	54.5
17	15-20	5-7	65.7
18	10-15	5-6	56.0
	Average decline		49.9

3.3.7 Impact of COVID-19 on incomes of waste collectors

Overall, there is a significant reduction in the income levels of waste collectors. For most, there has been sharp decline in the range of 50-70%. For instance, a female waste picker shared that her collection before the COVID-19 lockdown was around 12000 Rupees, which had dropped to only 6000 Rupees, making it difficult to survive (Table 3). A small *kabadiwala* from South Delhi shared that the decrease in income has made it very difficult to survive in the city.

"These days I am only able to make Rs 15000 per month, of which 12000-13000 gets spent on groceries and rent. It is becoming very difficult to survive in the city"

*- **Siddik Sheikh,** a small kabadiwala based out of Mehrauli, South Delhi*

This needs serious attention as these declines might push many waste collectors further into economic hardship. An ILO report (International Labour Organization, 2020) has already warned that around 400 million workers employed in the unorganised economy are at a risk of falling deeper into poverty during the crisis. Our survey results clearly confirm these concerns in the context of the informal waste sector, where the impact of lockdown has significantly decreased the income levels of waste pickers in Delhi (Figure 14 & 15).

Table 3 Change in income of waste pickers in Delhi before and after lockdown (per month)

Respondent	Income before lockdown (INR)	Income after lockdown (INR)	Decrease in income (%)
1	20000	12000	40.0
2	15000	7500	50.0
3	15500	7500	51.6

Respondent	Income before lockdown (INR)	Income after lockdown (INR)	Decrease in income (%)
4	12000	6000	50.0
5	14000	8500	39.3
6	11000	8500	22.7
7	10500	6500	38.1
8	10000	7000	30.0
9	20000	7500	62.5
10	11000	6000	45.5
11	7500	4000	46.7
12	8000	8000	0.0
13	10500	10500	0.0
14	20000	9000	55.0
15	30000	9000	70.0
16	6000	6000	0.0
17	10000	5000	50.0
18	11000	5500	50.0
19	11000	6000	45.5
20	8500	11000	-29.4

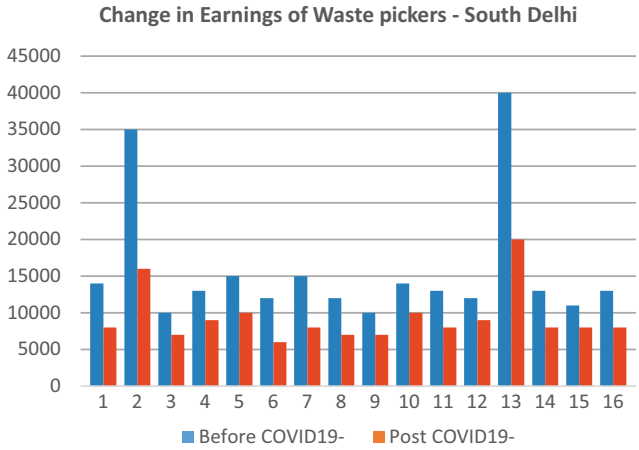

Figure 15: Earning of waste pickers before and after the COVID-19 lockdown in South Delhi

3.3.8 Commercial situation of the collected plastic waste

One of the factors behind the drop in income levels was waste pickers' inability to sell collected materials further. About 67% of the waste pickers interviewed during the survey said that they faced problems selling their collected waste (Figure 16).

One of the key reasons cited was a sharp drop in the price of plastic waste. For example, one collector mentioned that the price per kg for a type of plastic had dropped from INR 30 to INR 12. Also, it was reported that many plastic waste processing units were shut down because of imposed restrictions on non-essential businesses during lockdown. As a result, many workers from the waste processing industry picked up temporary 'essential' work. In combination with decreasing prices on virgin plastics, the market for recyclable plastics declined and there were limited places waste pickers and *kabadiwalas* could sell their collected waste.

A waste picker from East Delhi

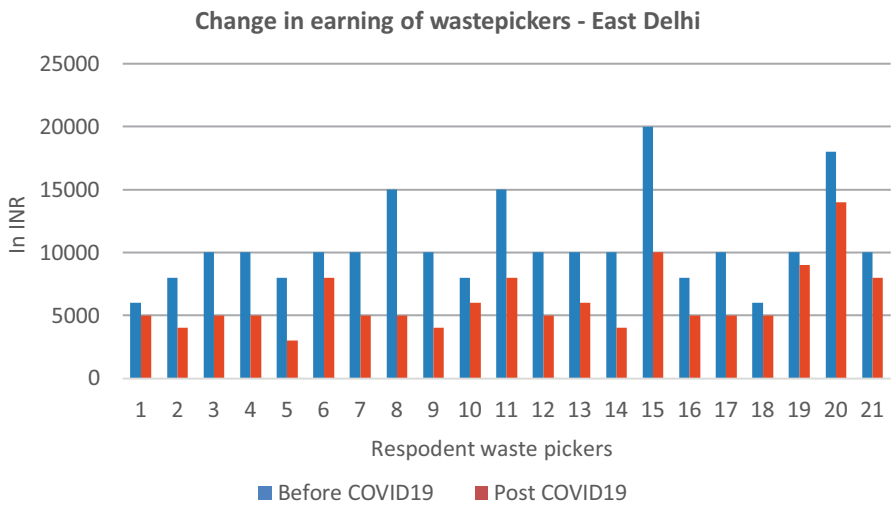

Figure 14: Earning of waste pickers before and after the COVID-19 lockdown in East Delhi

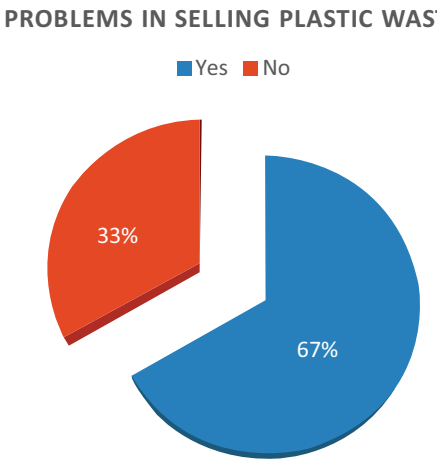

Figure 16: Problems in selling plastic waste during COVID-19

explained how people in his situation are forced to sell collected plastic waste to the low market price, because they need the money to feed their families.

As mentioned earlier, many waste pickers had temporarily stopped working during the lockdown period. It was important to understand the ways they supported themselves and each other during this period - 33.33% of the respondents said that they had utilized their deposits, and 23.81% of them asked for help from relatives/friends. A large number of them got food from different religious institutions and NGOs. There were also others (such as scrap dealers) who offered assistance in terms of food and cash etc. to their support staff for several months. Notably, the reports suggest that the sector was only to a limited degree supported by the state, one reason being that many informal workers didn't have their social security IDs like Aadhar and JanDhan account. The government twice sent direct transfers to everyone with a Jandhan account. So individuals and other non-state actors played a crucial role of reaching out to many people needing assistance. Many of the respondents also changed their occupations and became vegetable and fruit vendors to support themselves and their families during this period.

"Earlier we were able to sell polythene for 5 Rs/kg, now no one wants to buy it, and the bottle we were selling for 22Rs/kg is now bought at 13Rs/kg. We have to sell at whatever price they pay, because we have to buy food for our family"

'A lot of medical waste is now seen on the dumpsite' *("Bimari wala kooda boht arha h khatte pe")*

*- **Saddam,** waste picker from East Delhi*

3.3.9 COVID-19 Precautions

The overwhelming majority of workers in the informal economy have higher exposure to occupational health and safety risks, lack appropriate social and physical protection, and are more likely to suffer from illness, accident or death (International Labour Organization, 2020). These risks are particularly high for informal workers who are in direct contact with waste and have become intensified in the wake of COVID-19.

As expected, masks were the most used PPEs, but a small number of respondents were using gloves as well (Figure 17). Some of them also mentioned that they were not using the conventional mask but would use *dupatta* (ladies' scarf) or *gamcha* (towel) to cover their faces to protect themselves. Some of them added that they were also using sanitizers and social distancing measures to guard themselves from the disease.

3.3.10 Waste Traders and Processors

Delhi is one of largest plastic waste trading and recycling centres in India. While waste pickers at the bottom of the waste hierarchy have been amongst the most economically impacted during COVID-19, lockdown restrictions on movement has most

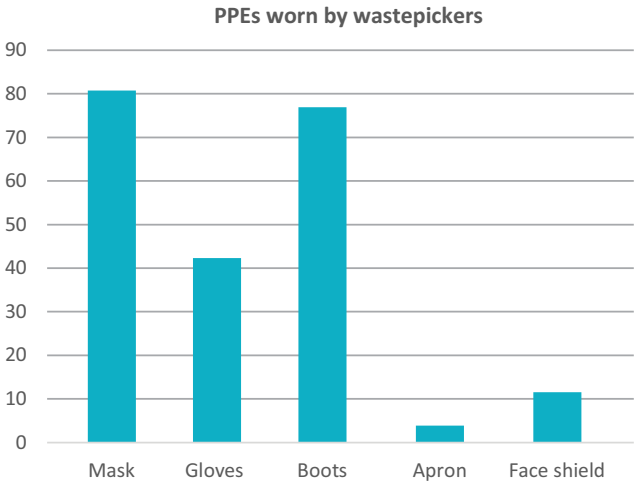

Figure 17: PPEs used by waste collectors in Delhi

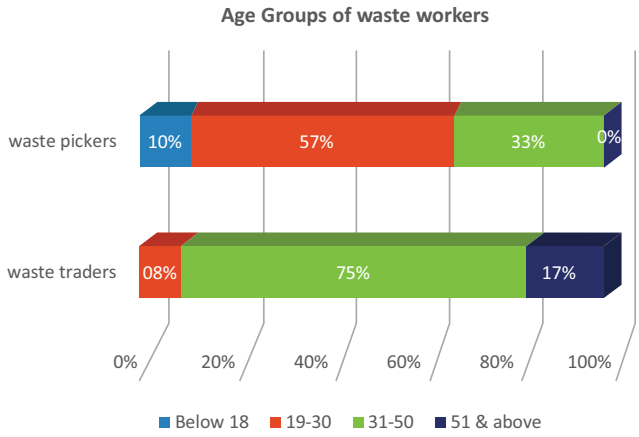

Figure 18: Distribution of age groups of respondent waste traders and waste pickers in Delhi

certainly had an impact on the trading and plastic recycling community as well.

The plastic waste processing community in Delhi has people from all over the country. But unlike the waste collectors, who were mainly from the eastern states (West Bengal and Assam), the traders were mainly from the heartland of Uttar Pradesh, Rajasthan
and Haryana.

Also, the age group involved in trading and processing was much older than in waste picking (Figure 20). Though most waste pickers (57%) were between 19 and 30, the ones in the trading and processing business were in the age bracket of 31-50. Some waste pickers were below 18 years of age. On the other hand, though there were many in trading and processing who were above 50, there were no waste pickers of that age group. This is probably an indication that the waste pickers start at an early age, but do not continue beyond a certain age, possibly due to the physically straining nature of the profession. Most of the traders and processors interviewed during the survey had been in this business for many years, some for more than 30 years. Though 50% of them had their kins involved in this business, a large number were working individually without their family's involvement.

3.3.11 Waste Types

The study findings showed that the sources for plastic waste were from landfills, households, community bins, small waste dealers. Collections from commercial establishments had almost stopped. Though 50% of them handled all kinds of plastic resin, an equal percentage specialized in specific types such as PVC, LDPE, HDPE, PP, PET bottles and Acrylics. This was also hugely dependent on the kind of operation. Though the traders and most segregators were taking in mixed waste, extruders or those in moulding business took in specialized resins. Post the complete lockdown period, some units recorded a decrease in packaging waste, while others reported an increase. Very few units received plastic masks or gloves, and most of them did not know how to handle them.

The group interviewed during this survey was mixed and interviewees were involved in segregation, extrusion, moulding, as well as pure trading (Table 4).

Table 4 Nature of business of respondent waste

traders in Delhi

Nature of Business	
Segregation	11
Extrusion	5
Moulding	3
Trading	6

3.3.12 Impacts of COVID-19 pandemic on plastic waste management

COVID-19 had a major impact on the plastic trading and processing business in Delhi, especially in terms of operation. In the initial months of the lockdown, nearly all the waste traders had shut down their units. Once the lockdowns were partially eased, 79% of them have restarted the operations. Also, almost 80% of them stated that a significant number of labourers left during the lockdown due to which the whole plastic waste recycling market was impacted. Reasons behind laborers leaving the city, roughly 20% as estimated by this study, included lack of employment during the complete lockdown phase and fear that COVID patients from outside the State (who do not have a valid ID proof of Delhi) will not be treated in Delhi hospitals. Reduction in business as well as the migration of labor has resulted in massive reduction in the number of workers employed in these units. Some of the large units were affected severely. A large plastic segregation unit, which employed almost 70 labourers before the pandemic, was left with only 15 at that point. A plastic moulding unit, which was providing livelihood to 30 people was now down to 1. A large number of units also reported a decrease in the wages they pay the workers, especially the ones engaging in trading (Figure 19). However, not all of these workers had left state, some did not go to work in fear of infection, others were fired by employers or taken on other types of work.

There is a massive decline in the amount of plastic waste being handled in these units, with some units who were collecting as much as 3 MT everyday

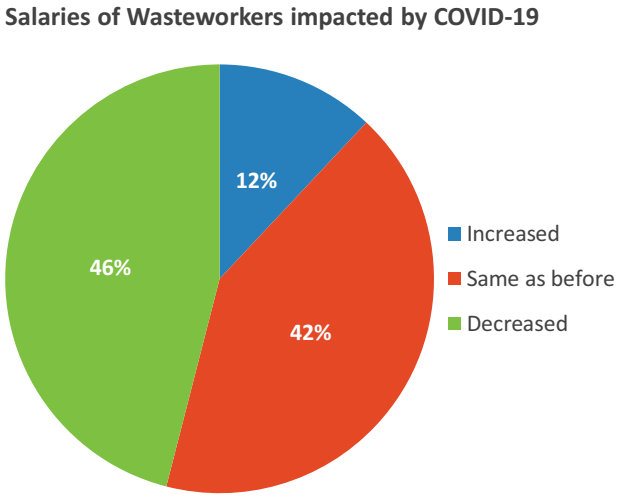

Figure 19: Impact of COVID-19 on waste workers' salary

> **"I had shut shop during the lockdown because of which my workers went back to their hometowns in Haryana. When I wanted to restart, I could just find two new workers and hence I have started small again".**
>
> *- **Saikh Anish,** a recycler based out of Surat*

being down to zero after the reopening. About 87% of respondents mentioned that they were either highly or severely impacted due to the COVID situation (Figure 20). On an average, there was a 68% decline in the amount of waste being traded and processed, while more than half of the units included in the survey were impacted severely and the waste flows were down by more than 70%.

Decrease in material flow has also led to change in the informal economy. A vast majority of the units (87.5%) had lowered the buying price as well as selling price (Figure 21). This was primarily because the respondents were finding it difficult to sell the

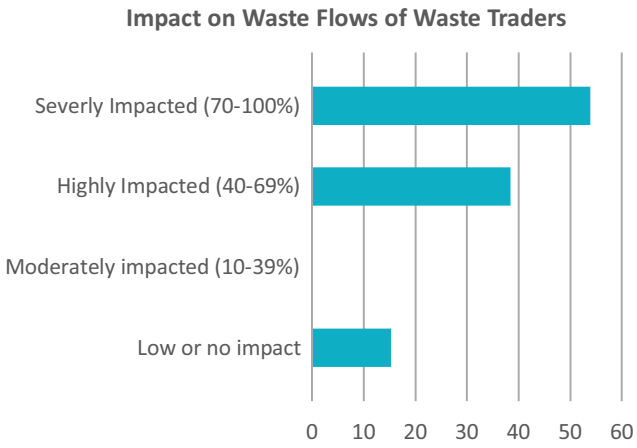

Figure 20: Impact on Waste flows of waste traders

material further or there was no demand from their vendors. Our study shows that 87.5% of the respondents said that there was a problem in selling the plastic waste at that time.

The problems listed included lack of money flow in the market, reduced or no labour workforce, rejection of plastic by recyclers, or an absence of recyclers, suppliers and buyers (Figure 21). There is also a delay in payments, which affected their cash flows. Almost 42% of the units also shared that they were having financial concerns because of the lockdown and its impact on the plastic waste flows and prices.

3.3.13 Awareness on COVID-19

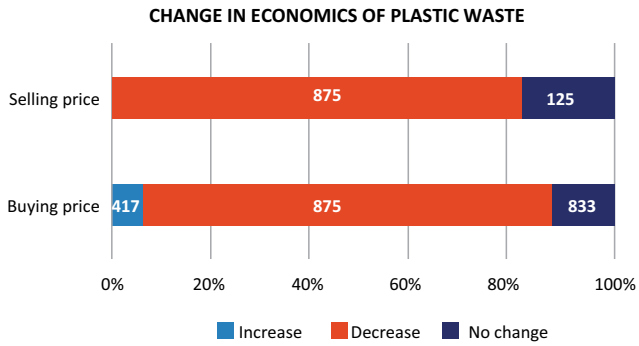

Figure 22: Change in selling and buying prices of plastic waste in Delhi

The trader community seems to be well-aware of COVID-19 and its spread, and a large majority is taking precaution to safeguard themselves (Figure 23). But, 12.5% of the respondents said that they had not received any instruction or directive from the Municipality on handling of COVID-19 related waste.

3.4 Status of plastic waste management in Surat Municipal Corporation

In the recent years, Surat has been working towards efficient management of their solid waste streams, to adhere to the *Swachh Bharat* Mission guidelines. Surat was declared as a zero-waste city in 2020. It had also banned the use of single use plastics below

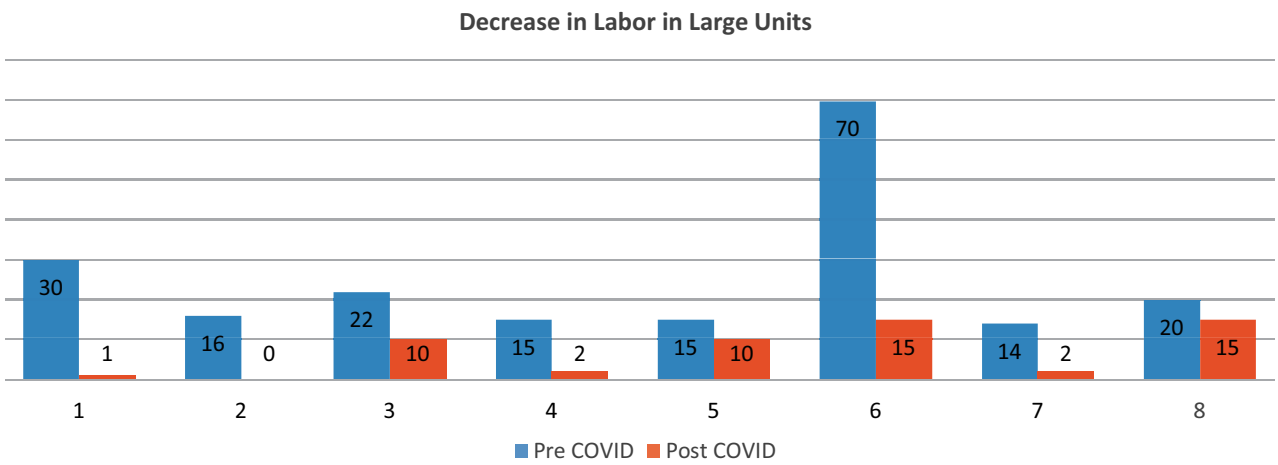

Figure 21: Decrease in labour in large units

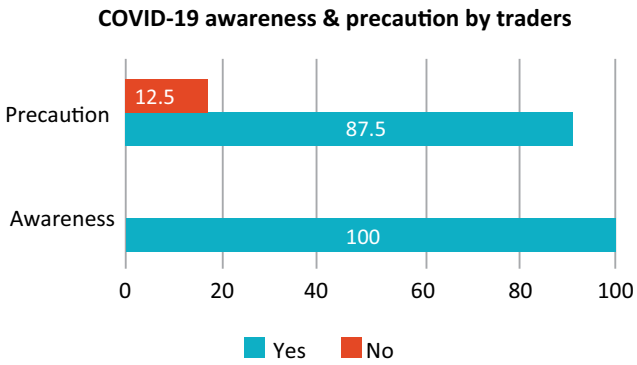

Figure 23: Awareness and precautions regarding COVID-19 by waste traders in Delhi

40 microns. The city's waste management system is considered to be one of the best in the country. In the annual nationwide survey done on cleanliness, the city ranked 14 in 2018 and 2019, and 2 in 2020.

The city's waste collection is primarily undertaken by Surat Municipal Corporation (SMC) and it implements a 100% door-to-door collection of all waste streams. Over the pandemic period, special vehicles dedicated for biomedical waste collection, and collection from COVID containment areas had been put in place to avoid mixing of domestic BMW and MSW. Plastic waste management has been outsourced to an NGO named Ecovision. A Special Purpose Vehicle of Envision group of companies is deployed for plastic waste collection, segregation, treatment and disposal of Surat under the guidance of SMC.

Since the onset of lockdown, the overall waste generation had reduced as according to the waste collectors and recyclers interviewed and the price of selling plastic waste and *dana* (pellets) had gone down marginally. The waste from COVID-19 containment zones was taken to a specially dedicated landfill area, where waste pickers were strictly prohibited from entering by the on-duty guards. Many waste pickers and recyclers had migrated back to their villages due to reduced work in Surat. These waste pickers were generally picking up waste from four sources, namely, commercial spaces, community bins/*dhalao*, households and

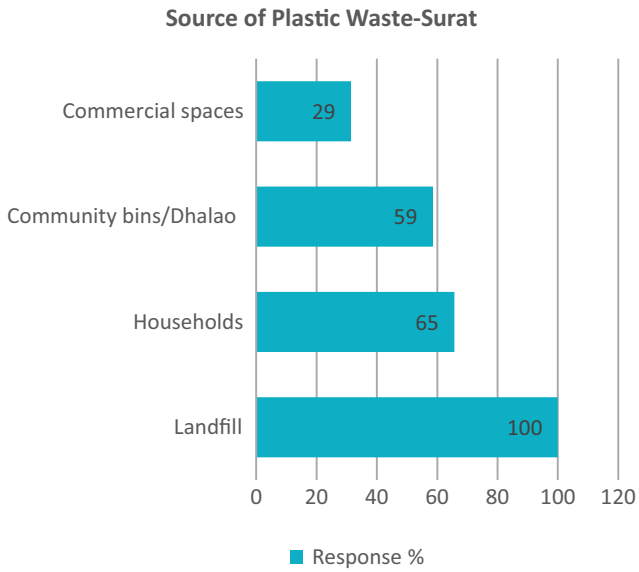

Figure 24: Source of plastic waste for waste pickers in Surat

landfills (Figure 24).

All of the waste pickers and recyclers reported to be wearing masks while working. They said that they

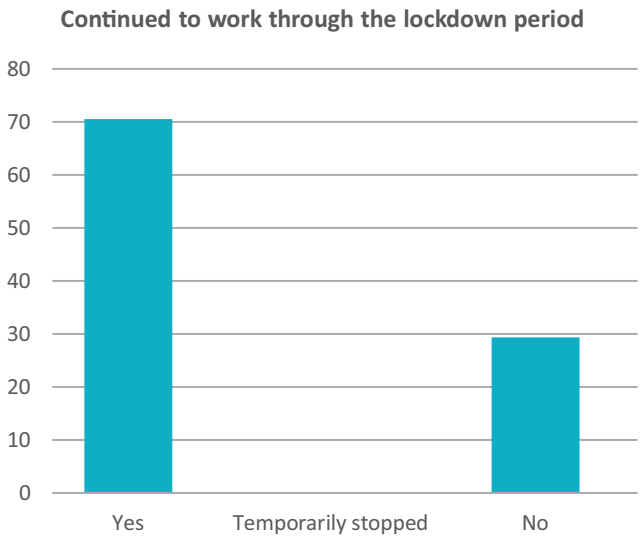

Figure 25: Impact on work status of waste workers during COVID-19 in Surat

are all aware of the disease and tried to keep safe to avoid contracting it by wearing masks, gloves, and using hand sanitizers.

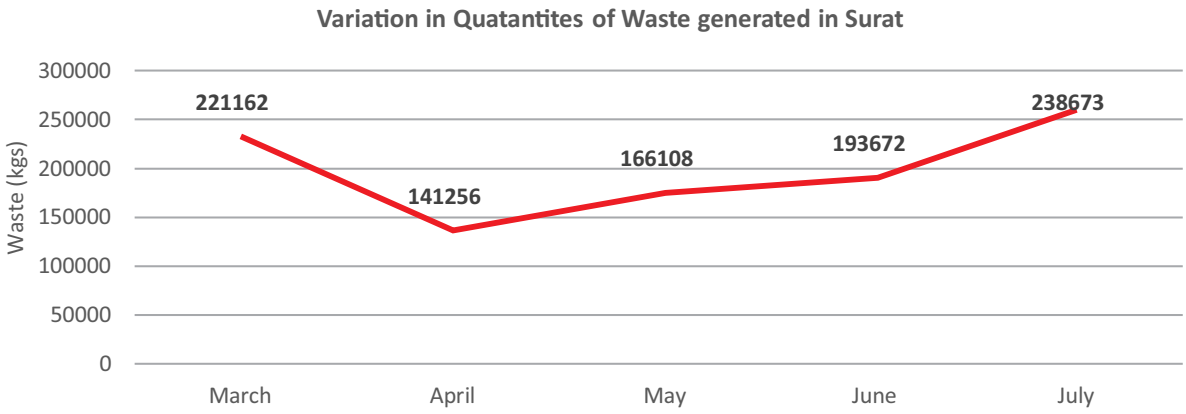

Figure 26: Variation in quantity of waste generated in Surat
(***Source:*** Ecovision, Surat city)

"I had shut shop during the lockdown because of which my workers went back to their hometowns in Haryana. When I wanted to restart, I could just find two new workers and hence I have started small again".

*- **Saikh Anish**, a recycler based out of Surat*

Five out of 17 respondents had temporarily stopped working in Surat during the lockdown. This was due to inadequate work available in the city (Figure 25).

In pre-COVID-19 times, average plastic waste collected per day was 40 kg/person and it ranged from 13-60 kgs. During post COVID-19 times, the average plastic waste being collected dropped to 30 kg/day/person showing a reduction of 25%. The range is 10-50 kgs (Figure 26). The waste pickers reported that the quantities are getting back to normal with industries and shops starting to open again gradually.

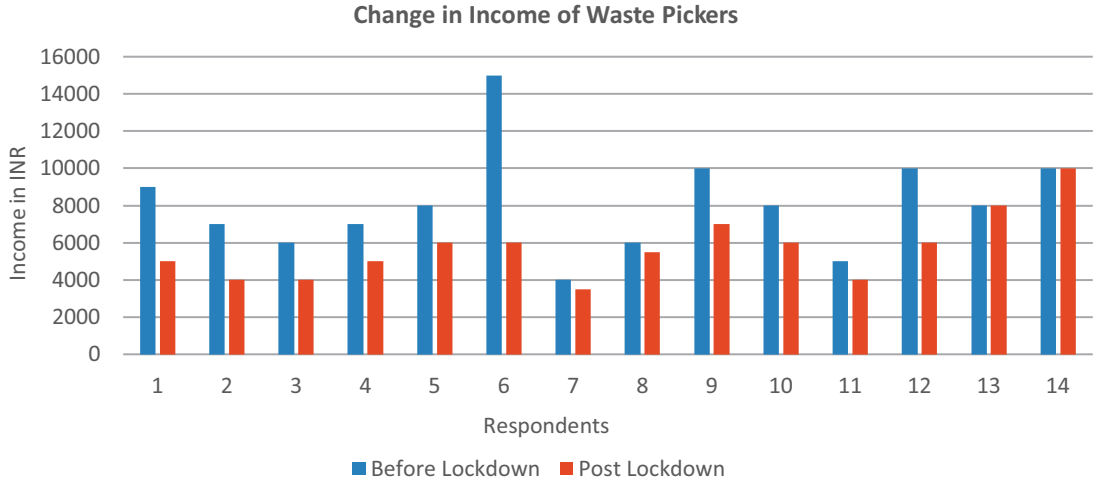

Figure 27: Change in income levels of waste pickers in Surat during pre and post Lockdown period

The earnings, as reported by the waste pickers during pre-COVID times were about Rs 7000/ month. The average earning post-COVID had reduced to about Rs 5300. The average reduction has been 25%. About 30% of the waste pickers reported no reduction in earnings (Figure 27).

About 53% of the waste pickers reported a setback/problem in selling their plastic waste due to reduced selling prices, lack of demand and non-availability of market for certain types of plastics like polythene. 24% of the respondents reported a change in the type of plastic waste picked (Figure 28). The majority of the waste comprised polythene waste and milk packets.

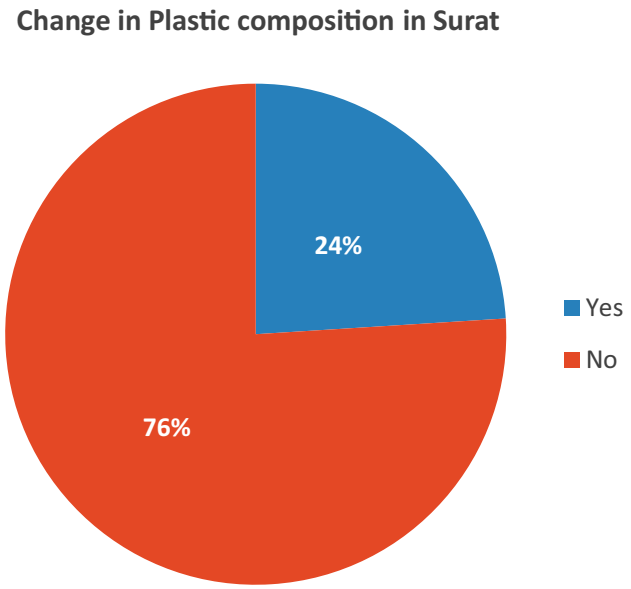

Figure 28: Change in plastic composition in Surat

Chapter 4-
FINDINGS OF THE STUDY:
BIO MEDICAL WASTE MANAGEMENT

4.1 Introduction

Today, the country is confronted with rising volumes of infectious waste generated due to the ongoing pandemic, requiring highly specialized protocol and technology to handle this since it can potentially spread infection and further add to public health concerns. The use of masks and gloves by citizens has further added to the waste volumes, in addition to what was being generated earlier by the healthcare facilities. Most of the masks that flooded the market are single-use in nature (Economic Times, 2020), hence their sale and usage has only led to increased waste generation. These single-use masks are generally produced from non-woven material containing polypropylene (PP), constituent of plastic (Economic Times, 2020) therefore adds to waste flow of single-use plastic stream, which has been an ongoing global environmental concern.

4.2 Background

The current population of India being approximately 130 million is distributed over 28 States and 8 Union Territories that are responsible for providing healthcare services to their citizens. The current status of healthcare infrastructure and capacities are at varying levels of preparedness and efficiency throwing up multiple challenges in managing COVID related issues. There are serious apprehensions about increased volumes of COVID waste generation and the capacity of the states to effectively manage this waste. The country has had long experience of over 20 years in dealing with biomedical and infected waste and has since built deep institutional capacity with varied experiences. However, the unpredictability of the pandemic gives rise to serious apprehension among key functionaries and related stakeholders that the existing systems could get overwhelmed with increased volumes of waste hence, a need to take stock of the situation, identify all gaps, and create mechanisms to adapt to the new and emerging situation.

4.3 Bio-medical Rules and Guidelines in India

Biomedical waste encompasses any waste generated during the diagnosis, treatment and immunisation of human beings or animals, or research activities pertaining thereto. This waste is largely generated by healthcare facilities, diagnostic centers, veterinary hospitals, clinics, health camps and facilities engaged in production of drugs. It is important to note that the BMW rules largely cover all institutions and facilities treating and providing healthcare service to patients but does not explicitly cover infectious waste generated from homes, hence posing some real challenge in managing COVID waste generated from patients in home care. Bio medical waste in India is to be handled and treated as per a defined protocol stated in the Biomedical Waste (Management &

Handling) Rules, 1998. These Rules have since evolved and been revised in 2016 and later in 2018. The rules are further amplified through issuance of Guidelines by the CPCB on various aspects with an aim to enhance its effectiveness and compliance. In the current situation also the CPCB has issued Guidelines on COVID waste management for the benefit of all concerned.

The Biomedical waste management rules drawn up by the Ministry of Environment Forest and Climate Change (MoEF&CC) are essentially aimed at improving infection control in healthcare settings, thus protecting health of patients, healthcare workers, community at large and the environment. The fundamental principle for management of this waste is centered on segregation of waste at the point of generation and later treatment of such segregated waste with the best available technology that has the least environmental footprint. Currently, there are four separate colour-coded bins designated for segregation with clearly defined treatment and disposal options for waste in each colour coded bin. The Rules have also devised and incorporated well-defined business models to drive and sustain the waste management system. It has made provision for a third party to set up and operate a facility, commonly termed as CBWTF (Common Bio Medical Waste Treatment Facility), private sector companies that collect, transport and treat this waste as per the standards prescribed and charges a fee from generators of the waste. The waste flow is thus strictly controlled between generators and the third party.

The complete process of waste management is regulated and overseen by the CPCB and the State Pollution Control Boards (SPCBs) or Pollution Control Committees. While the SPCBs are responsible for effective implementation of the rules and oversee operations on ground, it also maintains records of waste generation and treatment and submits annual report and returns to the CPCB. The CPCB acts as the apex standard setting body and regulator of these Rules. The current Rules cover the entire country and is applicable to both bedded and non-bedded healthcare facilities, apart from other bio medical waste generating agencies, thus bringing almost all waste generators under the ambit of the law.

Figure 29: Improperly discarded BMW in Delhi

4.4 Biomedical waste segregation practices in India

The four categories of biomedical waste, as defined in the Rules, are given in Table 5 (Ministry of Health & Family Welfare, 2016):

Table 5: Categories of biomedical waste for segregation as per Biomedical Waste Management Rules 2016

Category	Type of waste	Colour and Type of Container
Yellow Category	➲ Human Anatomical Waste ➲ Animal Anatomical Waste ➲ Soiled Waste ➲ Discarded or Expired Medicine ➲ Microbiology, Biotechnology and other clinical laboratory waste ➲ Chemical waste (yellow-e) ➲ Chemical Liquid waste	Yellow Coloured non-chlorinated plastic bags

Category	Type of waste	Colour and Type of Container
Red Category	Contaminated waste (recyclable)	Red coloured non-chlorinated plastic bags (having thickness equal to more than 50 μ and containers.
White Category	Waste sharps including metals	White coloured translucent, puncture proof, leak proof, temper proof containers.
Blue Category	Glassware Metallic body implants	Puncture proof, leak proof boxes or containers with blue coloured markings.

These Rules were brought into effect in 1998, and the processes in implementation have evolved and improved over time. The waste management infrastructure has also grown substantially, and the country currently has approximately 200 CBWTFs and treats approximately 519 MT of waste per annum. Though these facilities are spread all over the country, there are seven states that do not have a single CBWTF established (Press Information Bureau, 2020). Even with more than 20 years of regulation in the country, the efficacy of the Rule is still a matter of concern highlighted by several reports that point to the gaps in the system.

In addition to the existing rules and guidelines on BMW management, the Central Pollution Control Board issued fresh guidelines in March for effective management of COVID waste. The guidelines have been revised from time to time adapting to the evolving situation, and its key features are highlighted in Table 6.

4.4.1 Segregation of waste at different levels

Table 6: Segregation of Biomedical Waste at various levels in India

Area of Operation	Segregation	Handling	Treatment
COVID-19 Isolation wards[5] and Sample Collection Centers and Laboratories for COVID-19 suspected patients	Separate colour coded bins (with foot operated lids)/bags/containers as per BMWM Rules, 2016 - Double layered bags ***Yellow bag-*** Used mask, head cover/ cap, shoe-cover, disposable linen Gown, non-plastic or semi-plastic coverall, used masks, tissues and toiletries, of COVID-19 patient. ***Red bag-*** Used PPEs such as goggles, face-shield, splash proof apron, Plastic Coverall, Hazmet suit, nitrile gloves into Red bag. Pre-treated viral transport media, plastic vials, vacutainers, Eppendorf tubes, plastic cryovials, pipette tips	- Collection bin/ bags/ containers labelled as "COVID-19" and stored separately - Dedicated and labelled trolleys and collection bins in COVID-19 isolation wards- to be disinfected with 1% sodium hypochlorite solution daily. - No segregation of biomedical waste and solid waste at temporary waste collection / storage area of Healthcare Facility.	COVID-19 waste should be disposed-off immediately upon receipt at facility. Vehicle should be sanitized with sodium hypochlorite or any appropriate chemical disinfectant after every trip. At Material Recovery Facilities (MRFs), discarded PPEs containing plastic should be shredded and sent to SPCB authorised plastic waste recyclers, or may be converted into refuse derived fuel (RDF) for co-processing or energy recovery or for road making.

[5] Healthcare Facilities having isolation wards including temporary Healthcare Facilities like rail coach wards, COVID Care Centers etc

Area of Operation	Segregation	Handling	Treatment
	General solid waste collected separately as per SWM Rules, 2016. In order to minimize waste generation, as far as possible, non-disposable items must be used for serving food- cleaned and disinfected. If use of disposable items is inevitable, use bio-degradable cutlery.	The wet and dry solid waste bags to be tied securely in leak-proof bags, sprayed with sodium hypo-chlorite solution and handed over to authorized waste collector of ULBs on daily basis.	In case of unavailability of CBWTFs, the existing captive facilities of any hospital may be identified for disposal of COVID- 19 waste. Permit hazardous waste incinerators to be used in case of any shortfall in capacity of CBWTF.
Quarantine Centers/Camps/ Home Quarantine or Home- Care facilities	**Bio medical waste -** (Used masks, gloves and tissues or swabs contaminated with blood / body fluids of COVID-19 patients, including used syringes, medicines, etc.)-collected separately in yellow bags. **General solid waste -** Waste generated from kitchen, packaging material, waste food material, waste papers, waste plastics, floor cleaning dust, etc. including left-over food, disposable utensils, water bottles, tetra packs, used by suspected quarantined persons. Left-over food, empty juice bottles or tetra packs, empty water bottles, packaging material, and any other items, generated or handled by COVID-19 patient.	**Biomedical waste - Hand over the yellow bags** -to authorized waste collectors at doorsteps engaged by local bodies; or -Deposit biomedical waste in yellow bags at designated deposition Centres established by ULBs; or - Handover the biomedical waste to waste collector engaged by CBWTF operator at the doorstep. Masks and gloves used by persons other than COVID-19 patients - kept in paper bag for a minimum of 72 hours prior to disposal as general waste **General solid waste -** segregated separately and disposed as per provisions under SWM Rules, 2016.	

4.5 Increased burden of biomedical waste

Globally, it has been reported that there has been an increase in the quantum of biomedical waste generated during COVID-19 (Figure 30). A report by International Finance Corporation (IFC) reported an increase in biomedical waste generation by 40% in volume during this time (IFC, 2020). The epicentre of the COVID-19 disease, Wuhan (China) experienced a massive increase in the biomedical waste generation from 40 and 50 tons per day to 247 tons per day in March 2020 (You, Sonne, & Ok, 2020). Many other cities (Manila, Kuala Lumpur, Hanoi and Bangkok) also experienced a similar increase, ranging from 154 MT to 280 MT of biomedical waste generation per day as compared to pre-pandemic levels (ADB, 2020). In India, the biomedical waste scenario prior to the pandemic suggested functioning of "2,60,889 healthcare facilities generating about 608 MT per day of biomedical waste, out of which 528 MT of

Figure 30: Heaps of biomedical waste in LNJP Hospital, New Delhi

biomedical waste was being treated and disposed through either CBWTF or Captive disposal facility" (Press Information Bureau, 2020). As per the report of the Central Pollution Control Board, submitted to the National Green Tribunal, the total volume of BMW generation had increased by 101 MT per day post the pandemic, which is in line with global trends of increasing waste generation (National Green Tribunal, 2020).

4.6 Mismanagement of the waste stream

The issues around compliance to the BMW Rules has been raised and discussed in various fora; even the courts have constantly been passing orders and directions in this regard. Several systemic gaps have been brought out by experts and stakeholders engaged on the issue, and improvement in BMW systems appears to be work in progress. Sights such as "Sacks full of used syringes, masks and gloves along with expired medicines dumped in water bodies and riverbanks" have been noticed in several states (Viswanath, 2019).

"Lack of proper segregation at healthcare facilities, inadequate collection & treatment is still common in many parts of the country" (Toxics Link, 2019). (Figure 31).

These issues get further complicated since the COVID-19 related waste is being generated at the household level, since many patients are being advised to be quarantined at home. This has led to infectious waste being generated and disposed of through the municipal waste stream and it's a matter of concern that the municipalities are not geared up to handle such infectious waste. The municipal waste workers are not adequately aware or trained to handle infectious waste, hence this poses new challenges to the waste workers in municipalities. The households across cities do not have any awareness or information on how to handle infectious waste as such are unable to practice any CPCB-defined protocol for segregating COVID-19 waste resulting in all waste being mixed and getting infected (Figure 32).

Figure 32: PPE being mixed with General waste (***Source:*** The Times of India 2020)

Figure 31: Used PPE discarded in the open at Ring Road, Delhi (Source: India Times 2020)

Most municipal workers do not wear appropriate safe PPEs and have not attended training or awareness sessions, which might put them at a higher risk. These workers who operate without any PPEs increase their risks of being exposed to the SARS-CoV-2, as these discarded materials function as carriers of the virus (The Hindu, 2020). The role of municipal workers and their capacity to handle COVID-19 waste generated from homes is a challenge that is also evidenced in the nature of waste being dumped by households in municipal dumps. The MSW Rules did have a provision of handling hazardous household waste, which had not been acted upon seriously by the municipal staff. Hence, in the current situation, the generation of infectious waste and its handling by municipal staff without any training and preparation, adds another dimension to the problem. Wastes such as used gloves and masks generated from households both from COVID positive patients and healthy citizens are expected to follow separate protocols but if the infected waste is handled without adequate care, it can pose health risk to waste workers. It is also important to mention that gloves and masks arising in the municipal waste system are accessed by the informal waste workers at some point during the process of secondary segregation and a potential threat to their safety too.

One of the ways that many cities and countries attempted to reduce and to control the spread of infection was to enforce lockdowns in partial or full measures, thus reducing the spread of infection, lowering visits to hospital for routine procedures, and as a result reducing waste generation. This further impacted the waste collection services due to shortage of workers (due to restricted movement or their own fear of contracting the virus) (UNEP, 2020). The lockdowns created a piquant situation in many large cities since many waste workers found it extremely hard to survive in cities due to loss of livelihood and started migrating to their homes in rural areas. The lockdown on one hand triggered reverse migration of the informal waste workers. On the other hand, it created a situation where municipal waste volumes reduced while at the same time it led to increased generation of new kinds of biomedical waste, such as masks, gloves and single use plastics. Some of the common observations on BMW and COVID-19 waste management in India and other countries are summarized below:

- Many cities across the world have reported an increase in waste generation.
- Masks and gloves are commonly found in waste streams.
- India too reports an increase in biomedical waste generation by about 100 tonnes.
- CPCB issues a new series of guidelines for safe management of COVID-19 waste
- Several instances of COVID-19 waste are found in municipal dumps.
- Municipal workers are not adequately trained to handle infectious waste in India.
- There is a lack of awareness on the method of handling PPE and other COVID-19 related waste.
- A sense of fear and anxiety exists among waste workers.

4.7 Biomedical Waste Management in Delhi

Delhi has a large number of healthcare facilities, perhaps some of the best in the country, and has a total bed capacity of approximately 57,000 spread over both public and private sectors. The city is known to generate approximately 850-900 tonnes of biomedical waste per month.The biomedical waste generated by the city is currently being handled and serviced by two separate waste treatment facilities, SMS Water Grace BMW Pvt. Ltd. (serving South West, Central and East Delhi facilities) and Biotic Waste Solutions (serving North West, North, New Delhi, South and South East Delhi areas). Both the facilities are equipped with requisite technologies and have

adequate capacity to handle the quantum of waste generated in the city.

To understand the impacts of COVID-19 on waste generation and the capacity of the city to handle such waste, it will be extremely important to gather sufficient data on waste generation volumes for the city and compare it with the capacity of the waste treatment facilities. The study therefore found it necessary to obtain data for pre- and post-COVID-19 scenarios (attached at A). This comparison between pre- and post-COVID-19 data will indicate the extent of increase / decrease in waste generation and also the nature of waste generated. In this attempt, we have obtained data for the months of January and February 2020 (recognized as pre COVID-19 months in India) as well as for March, April, May and June 2020 (post the onset of COVID-19). Some other important facts have also been obtained through interviews with CBWTF operators (B).

In **January** 2020, the city of Delhi generated approximately 884 tonnes of regular BMW that was further sub-categorized under different colour codes that suggest its material constitution. The BMW Rules stipulate the waste segregation into yellow, red, blue and white coloured plastic bags, which suggest its material composition as described in Table 5. In **February 2020**, the total BMW generated and received at these two facilities was reported to be 840 MT, which is a slight drop as compared to the previous month. Waste generation in both January and February represent almost a similar trend and can be used as city baseline data in normal situations. The first case of COVID-19 was reported from Delhi on March 2nd by a 45-year old man who had travelled back from Italy (Kumar, 2020). At the end of the month, there were 120 cases of COVID-19 (Figure 36).

The total COVID waste generated in **March 2020** by 120 patients was 33 MT. At the same time, a decline in total BMW generation from healthcare facilities was observed. The total BMW generation for March was approximately 789 MT as compared to 840 MT in February, thus registering a drop of about 6% in relation to pre-COVID-19 month (Figure 33).

In April 2020, despite strict implementation of lockdown, Delhi reported a surge in COVID-19 cases rising to 3515 cases (Figure 34). At the same time, the total amount of COVID-19 waste generated from the hospitals, testing centers and quarantine centers had risen to 237 MT. As compared to the previous

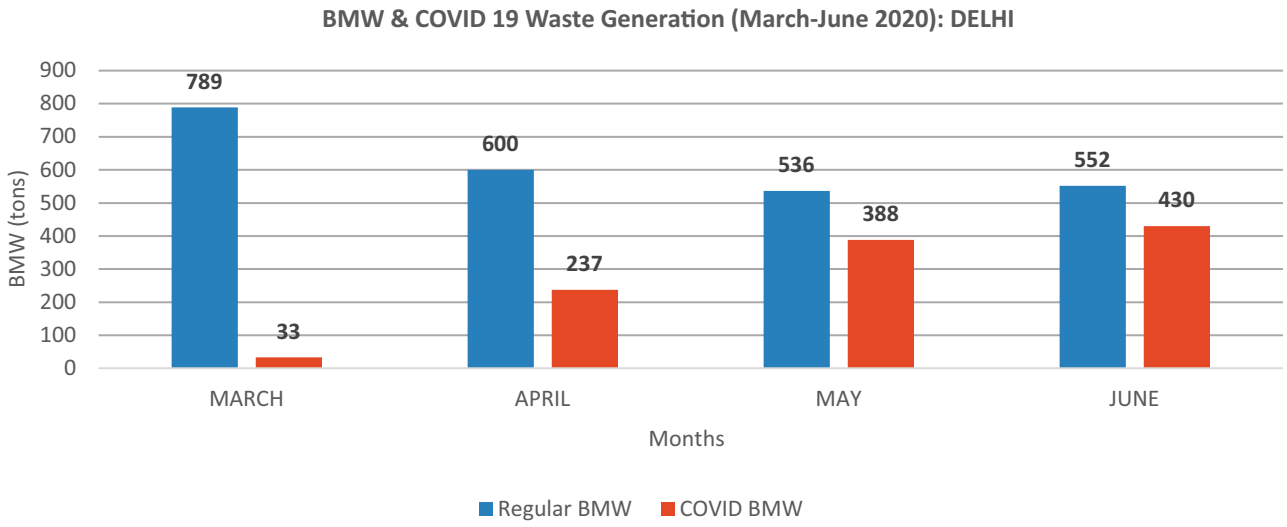

Figure 33: Generation of BMW and COVID-19 waste in Delhi

month, regular BMW generation had reduced by about 24% equivalent to 600 MT. It is significantly important to note that for both post-COVID-19 months of March and April, there is a downward trend in biomedical waste generation, and an upward trend of COVID-19 waste. On interviewing the facility operator, it was learnt that the COVID-19 waste received at the facility largely constituted of PPE and a mix of general waste (including food waste, disposable cutlery, paper and other materials) in yellow colored bags thus resulting in huge rise in waste volumes that required to be treated by incineration. This posed serious problems in handling at the CBWTF. As a result of the emerging situation, the CPCB in consultation with CBWTF reviewed the guidelines and mandated for moving plastics waste into Red bags to be treated by autoclaving, thus reducing the load on incineration. It also emphasized separation of waste such as packaging, paper, cans bottles, etc. to be treated as general waste and to be handed over to the municipality. The overall observations of BMW and COVID-19 waste management in Delhi in April 2020 are as follows:

- Waste data of April clearly indicated a drop in generation of BMW
- Increase in total number of COVID-19 patients to 3515
- Total COVID-19 waste generation increased to 237 MT.
- The decline in total BMW generation was attributed to low occupancy in hospitals because patients were not willing to visit hospitals for ailments other than COVID-19.
- The CPCB revised waste management guidelines.

In **May 2020**, India was still in lockdown condition though there were a few relaxations for the revival of the economy. The general population continued to be confined to their homes while those on essential duties started to move out. The COVID-19 cases continued to rise steadily, and the total number of new cases stood at 16329 (Figure 34). The COVID-19 waste generated during May showed a very significant jump, totaling to 388 MT, which was an increase of about 64% as compared to April. The BMW generation continued a downward trend and reported a total of 536 MT. In May, the total waste generation (BMW + COVID-19 waste) was approximately 924 MT, which was slightly higher compared to January (884 MT). The guidelines by CPCB were amended for the third time in May 2020. The overall observations of BMW and COVID-19 waste management in Delhi in May are as follows:

- COVID-19 waste jumps to 388 MT, an increase of 64%, as compared to April 2020
- The total waste generation was 924 MT that was slightly higher than January 2020 (884 MT)

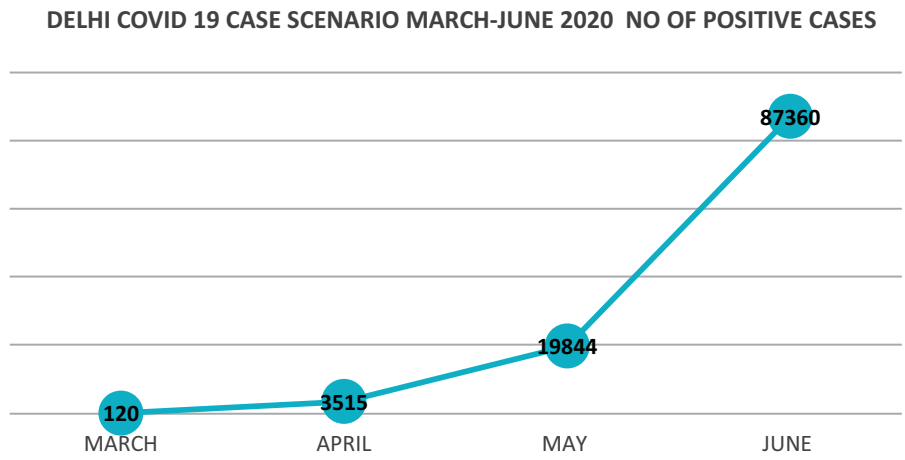

Figure 34: COVID-19 Scenario: March-June 2020 in Delhi

- BMW generation maintained a downward trend and an improved segregation of waste was observed from generators

In **June 2020**, 67516 cases of COVID-19 were reported which rose the state's tally of the total cases to 87360 (Figure 34). The waste data also reflected an increase (11%) in comparison to the previous month. On interacting with the CBWTF operators in Delhi, it emerged that the amendments in CPCB guidelines helped in improving waste segregation and channelized general waste to the municipal waste stream. Eventually, this resulted in reduced waste load being received at CBWTF which improved the overall waste management scenario. The BWM generation status in June has registered a very marginal growth, and therefore presents a steady trend.

- Total number of COVID-19 cases increases to 67516
- Slight increase in volume of COVID-19 waste generation
- Slight increase in BMW generation

Figure 35 represents the total capacity of both plants in Delhi and their capacity utilization. It can therefore be summarized that both plants have enough residual capacity to handle more waste.

4.8 Biomedical Waste Management in Surat

The Surat city has a developed healthcare facility spanning across both private and public sectors. It enjoys a good reputation in solid waste management, being placed in second position in the country as per the 2020 ranking by the *Swachh Survekshan*. Gujarat currently has 20 CBWTFs catering to the waste generated by various health facilities across the state. En-Cler BMW Pvt. Ltd., which has set up a facility in Surat caters to all the BMW waste generated by the city. This CBWTF has all necessary technologies and equipment, as stipulated in current regulations including one incinerator of 4800kg /day (4.8 MT/day) capacity and an autoclave of 3000Kg/ day (3 MT/day) capacity. The total plant capacity is 7800 kg/day or 7.8 MT/day.

In Surat, the first case for COVID-19 was reported on **March 19th 2020** from a student visiting from New York, USA. Since then, the number of cases has been on the rise. Data on the number of COVID-19 cases and waste generation from Surat was extremely difficult to obtain.

In March, Surat reported eight COVID-19 positive cases, whilst generating 101.2 tonnes of BMW and a

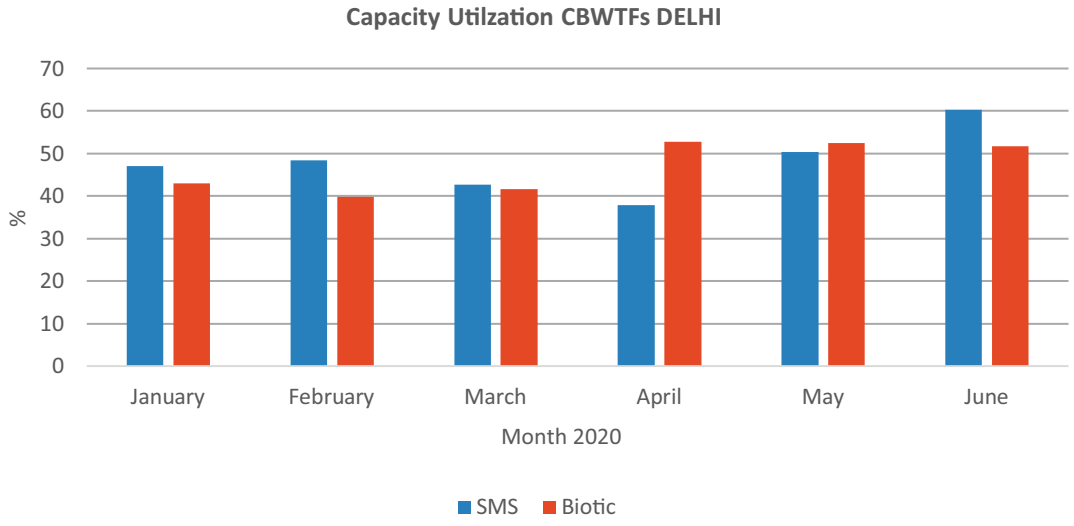

Figure 35: Capacity utilization of the biomedical waste treatment plants in Delhi

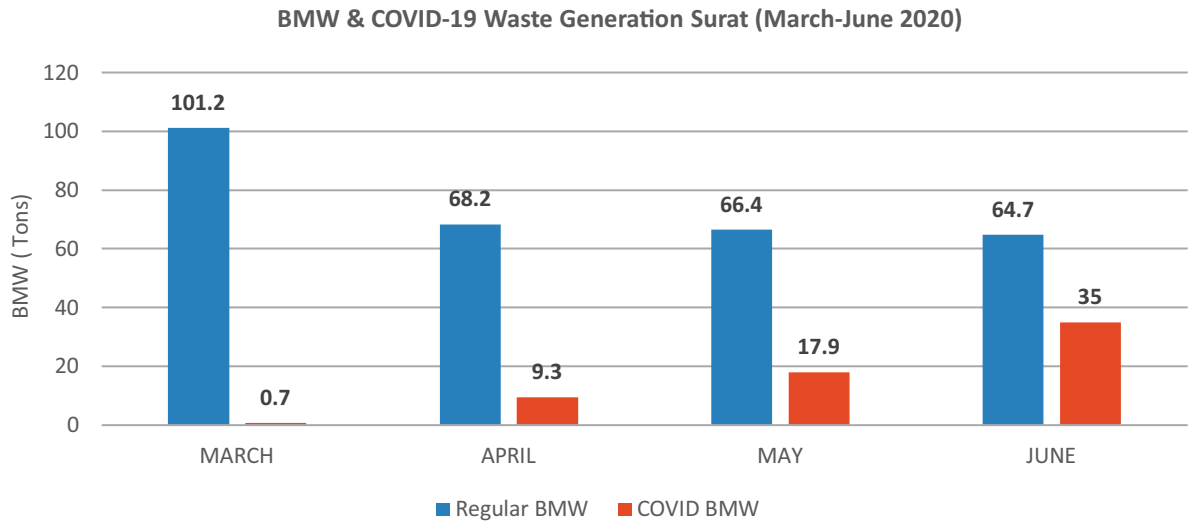

Figure 36: BMW and COVID-19 waste generation in Surat

mere quantity of 0.7 tonnes of COVID-19 waste (Figure 36). Data for January and February 2020 for Surat could not be obtained as we had in the case of Delhi. However, since Surat had only 8 COVID-19 positive cases in March, it will be appropriate to treat the figures of BMW waste generation for March as a baseline or regular BMW generation for the city.

In **April 2020**, after a month of implementation of lockdown, the total number of cases reported increased to 594 (Figure 37). Considering the demographics of Surat, it was a huge surge in the number of COVID-19 positive cases. Regular BMW generation came down to 68.2 MT, which is 33% lower as compared to March 2020. There was an increase in the generation of COVID-19 waste this month (9.3 MT) as presented. The total waste generation (mix of COVID-19 waste and BMW) in April amounted to 77.5 MT, which is a sharp decline compared to March. Reduction in BMW generation in Surat is similar to Delhi, which can be attributed to low number of regular patients in hospitals. The state of lockdown restrained people from seeking medical treatment for most normal ailments as people visited hospitals only in case of emergency.

- Total number of COVID cases rise to 586
- COVID waste rises to 9.3 tonnes. BMW generation drops to 68.2 as compared to 100 tonnes in previous month
- Total waste generation (COVID +BMW) stands at 77.2 tonnes

In **May 2020**, with the commencement of lockdown 3.0, cumulative positive cases of COVID-19 rose to 1567, with 973 cases being reported in May. With this escalation in cases, growth in COVID-19 waste generation jumped by 93%, totaling to 17.9 MT, which is almost double in relation to the previous month. There was no significant change noticed in the amount of regular BMW generated. In terms of total waste (BMW and COVID-19 waste) generated, an increase of 9% was observed compared to April indicating that the total waste generation was not moving up sharply but reflecting a very marginal growth and a steady trend. The overall observations of BMW and COVID-19 waste management in Surat in May 2020 are as follows:

- With the increase in COVID-19 patient load, the waste generation increased sharply.
- BMW generation continued a downward trend
- The total of BMW and COVID waste generation maintained a very small but steady growth trend. Waste generation had not overwhelmed the trends in May.

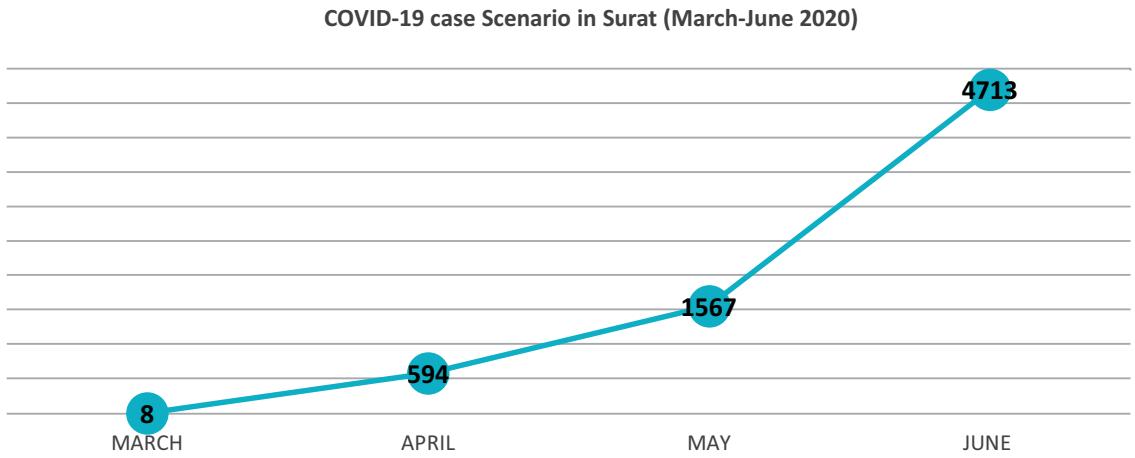

Figure 37: COVID-19 Scenario March to June 2020 in Surat

In **June 2020,** as many as 3146 positive cases were registered, ascending the cumulative count to 4713 cases. The generation of COVID-19 waste followed the same trend as the previous month, it reflected a very sharp growth and an increase by 95%, totaling to 35 MT. Similarly, regular BMW generation did not show any significant change but it reduced by mere 3% in relation to the previous month, thereby maintaining a steady trend. However, the total amount of BMW and COVID waste in June stood at 99.7 MT generation, which was still lower as compared to March. The overall observations of BMW and COVID-19 waste management in Surat in June are as follows:

- BMW generation maintained a steady trend and was similar to the previous month.
- Number of COVID-19 positive cases continued to rise exponentially.
- A sharp growth of COVID-19 waste generation reported.

The total waste generation (BMW +COVID) for June 2020 is lower than pre-COVID-19 period (March 2020).

Figure 38 represents the waste flow to capacity utilization of the plant, and it clearly represents that for the months of March to June, the plant had adequate residual capacity to handle more waste.

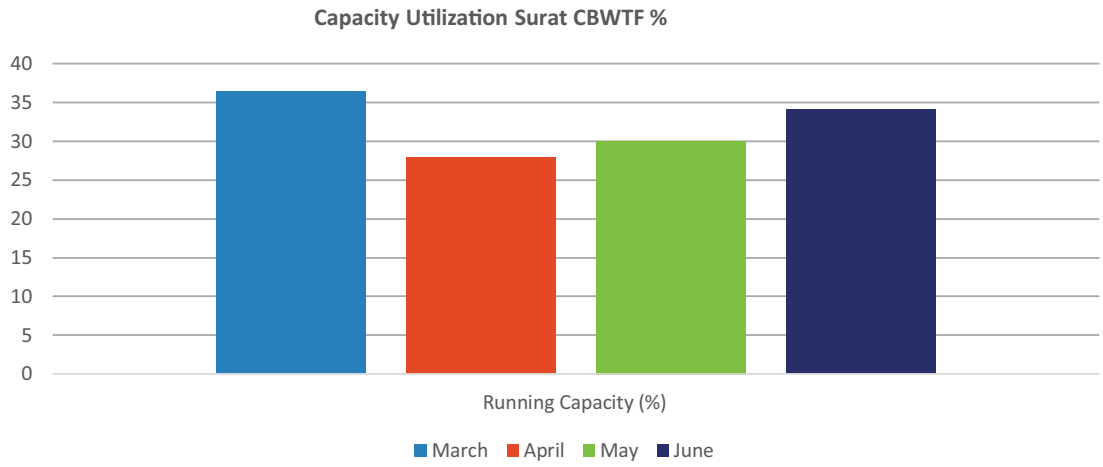

Figure 38: Capacity utilization of BMW treatment plant in Surat


RED
YELLOW

Chapter 5
CONCLUSION

The waste management systems in India have been greatly impacted by the COVID-19 pandemic. Several small-scale recyclers have closed shop or wound up temporarily or even permanently due to their inability to sustain in the face of falling incomes and turnover. The cash-flow issues in the market were pronounced. This resulted in reduced wages for the informal sector laborers, who were living on meagre earnings before COVID-19. Limited economic capacity and alternative livelihood opportunities, coupled with lack of access to social security and health care services amongst waste pickers and *kabadiwalas*, exacerbates vulnerabilities at the lowest level of the recycling chain. Without adequate bio-medical and waste handling training, and accessible information on how to protect oneself against contaminated waste, waste pickers are at higher risk of exposure to COVID-19. Added to these livelihood insecurities, the fear of not being eligible for treatment in Delhi if they contracted COVID, resulted in migration attempts by approximately 20% of workers back to their native villages.

Even when some of the recycling units started to operate, they faced a major issue of lack of qualified manpower. The Government of India announced loans for MSMEs and a stimulus package of INR 20,000 Crores, but the general public was either not aware how to access this support, nor having the means of access, i.e. such as a valid ID card. All these have contributed to many links in the waste management sector being broken down.

5.1 Key Findings

5.1.1 Municipal Solid Waste and Plastic Waste

The important findings from the study on solid waste and plastic waste management in Delhi and Surat are as follows:

1. The amount of total waste generation and waste segregation rates went down during the pandemic.
2. National lockdown restrictions have severely impacted the income of informal waste collectors and recyclers. In Delhi, about 87% of the waste workers reported that they were highly impacted by COVID 19 and the lockdown, while in Surat 53% waste workers reported the same.
3. Lack of livelihood opportunities, fear of COVID-19, and consequent re-migration patterns of informal labourers has weakened several stages of the informal plastic recycling chain.
4. Lack of adequate health and safety standards in both formal and informal waste management sectors represent a health risk to individuals working with waste and to society as a whole.
5. The ongoing effort on banning single-use plastic items seems to have been reduced, as is evident from the mixed wastes emanating from households and communities.
6. Cities such as Surat and Delhi were doing well in overall waste management (as per the consistent

improvement in ranking during *Swachh Survekshan*) and hence were better equipped to adapt to the new waste stream, and to the changes in type and quantities of waste. However, in the initial months (March-June 2020), there was mixed waste coming out of households. This got streamlined in the later months as the municipal corporations learnt and constantly evolved in managing the wastes.

7. The increased use of PPE is a cause of plastic pollution, but is also essential to protect the lives of frontline workers in waste management sectors. There must be an increased focus on education and awareness raising amongst waste workers on how to protect oneself against COVID-19, including making PPE financially and practically available to informal sector workers.

5.1.2 Biomedical Waste management

The pandemic has had deep impacts on economic growth and development on account of reduced pace of production and consumption patterns, this has also impacted the waste generation patterns. However infectious waste generation has witnessed a significant surge across the globe as a direct impact of increased load of patients being infected by the pandemic. While India has infrastructure and previous experience of managing infectious waste, this new situation of increased volumes of hazardous/biomedical waste and the pandemic situation is expected to pose new challenges. Hence, it is critical to study the changing situation and initiate measures to plug current gaps and plan for future needs.

The important findings from the study on biomedical waste management in India in general, as well as Delhi and Surat in particular, are as follows:

- India has in place a system for biomedical waste management and has practiced it for over 20 years.
- The country had no previous experience in handling waste during pandemic situations and did not have specific policy/regulation to address such an emergency.
- Many cities across the globe report high generation of COVID-19 waste and there is apprehension about this in the Indian scenario as well.
- Data obtained from both Delhi and Surat clearly indicate a drop-in generation of regular BMW in March and April 2020, and subsequently reflect a gradual rise in quantities in subsequent months.
- The data obtained for COVID waste generation for both Delhi and Surat indicate a rise in COVID waste generation post- March 2020 and shows an increasing trend month on month.
- Infectious waste generated on account of patients being placed in home care poses challenges in its handling since municipal workers are not adequately trained.
- The CBWTF facilities in both cities continued to have excess capacity at all times and the system did not appear to be overwhelmed.

5.2 Insights

a. The ongoing efforts by ULBs in source segregation of household solid waste (which was in a preliminary stage) has taken a backseat with the emergence of the COVID-19 pandemic, as the focus of awareness generation shifted from household waste segregation to dealing with the COVID situation.

b. The study findings revealed that about one-fifth of interviewed migrant labourers had exited the cities during April-June 2020 and this has affected the waste recycling process by breaking/ weakening both formal and informal waste management chains. The national lockdown and curfew imposed suddenly on 24th March 2020, probably had a greater impact on the informal waste workers during the first phase of lock-down. This was followed by many migrant workers leaving Delhi (and about 18 % from

Surat) for their native places in Uttar Pradesh, Bihar and other States from where they hailed.

c. Some of the formal (and probably informal) plastic recyclers are trying to restart their business, but were unable to do so (as of July 2020) due to the unavailability of skilled personnel.

d. States like Delhi and Haryana had made an interim announcement (when the COVID-19 cases were on steep rise and hospital beds were falling short) that in-State residents will be given priority in treatment and hospitalization (The Print, 2020). This resulted in mass migration of city-based labourers to their respective villages.

e. The *Swachh Survekshan* (an annual ranking of cities based on solid waste and sanitation parameters) under the Swachh Bharat Mission seems to have streamlined the waste management system in many Municipal Corporations, towns and cities of India. This was evidenced from the Surat case study.

f. There is a need for better coordination between municipalities and health systems for efficient handling of infectious waste generated from households and flowing into the MSW stream.

g. The need for a separate policy and detailed guidelines on waste management during a pandemic situation. This is a critical need and should take into account learning from current data from across the country and consulting with all stakeholders.

h. The need for a comprehensive study on aspects of waste management and lessons learnt from the pandemic.

Without improvements in the existing system, a whopping 12 billion metric tons of plastic litter can end up in the dumpsites by 2050, contributing about 15% to the global greenhouse gas emissions (Geyer, Jambeck, & Law, 2017). It may be stated that there is a need for scaling up of innovative and sustainable solutions like green plastics and other materials to replace single use plastic in the health care and PPE categories (L.Patrício & TeresaRocha-Santos, 2020).

The plastic- and biomedical waste management systems need to be acknowledged as important tools to limit the spread of COVID-19. Mismanaged municipal and biomedical waste does not only represent a threat to the environment but is now posing an urgent and direct threat to the people working with waste and to the urban residents. The pandemic showed that access to appropriate safety measures to protect waste workers from direct exposure to COVID-19 contaminated waste is crucial. Social security and health care services need to be made available to informal sector workers, otherwise the waste management sector will continue to face aggravated vulnerabilities at several stages of the recycling chain. Particularly on the lowest levels of the plastic recycling sector, stakeholders have been severely affected. This has impacted the livelihoods, collection rates and recycling capacities. In turn, the COVID-19 related fluctuations in the market for recyclables influence the amount of plastic waste being left dumped into landfills or left unrecovered in environment and may become plastic pollution and increase the Marine Litter burden. As such, national and regional efforts to increase resource efficiency, building a circular plastic economy, and limiting plastic pollution could be hampered by the short and long-term impacts of COVID-19.

The importance of empowering the informal waste management sector and raising awareness about their role in the waste management needs to be acknowledged. There is an opportunity for the government to join hands with the private and public sectors and support formalizing the informal sector as well as revival of the recycling chain by relief support. It is critical to ensure that the recycling industry does not suffer from prolonged regulatory uncertainties or long-lasting closures. Interventions are thus necessary to ensure that the involved businesses, at various hierarchies, are not forced to close or go bankrupt because of the COVID-19 related situation and are supported in the interim.

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