Solid Waste Management in Bhubaneswar: Practices and Challenges

By

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ABSTRACT

This paper presents an overview of current Solid Waste Management (SWM) practices in Bhubaneswar (BBSR), India and identifies possible strategies for key problems that the city faces. The city generates about 500 Ton/day of solid waste within the Bhubaneswar Municipality Corporation (BMC) area. There are some visible deficiencies exist which are key elements for deficiency in the SWM system. The collection process is weak in terms of manpower and vehicle availability. Bin capacity provided is in-adequate and locations were found to be inappropriate. Untreated solid waste is dumped on open land after collection. With a population of 1 million, the per capita annual expenditure for SWM in 2016-17 was Rs. 670. In comparison to other cities in the country, this expenditure is insufficient for providing reasonable services. Besides political will, technological capability and management competence in all functional areas need intensive development to achieve the status of a smart and clean city.

Keyword: Solid Waste Management; Waste Collection; Waste disposal.

1. INTRODUCTION

The city of Bhubaneswar (BBSR), state capital of Odisha recently bagged the number one place in the Smart City Challenge among 100 cities in the country of India. According to many distinct elements for consideration of smart cities, some major indicators include [1]:

- Population of the city and regular collection of solid waste (residential)
- Per capita collected solid waste
- Percentage of solid waste that recycled

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Sanitation and effective Solid Waste Management (SWM) systems are the major prerequisite for making an initiative of the smart city [2]. With functioning of this ambitious project, the city is going to be become an attractive hub for sustainable assets and high competences.

According to the cleanliness survey conducted under Swachh Survekshan 2018, the city has been slipped to 245th position from the rank of 94 in 2017 among 4040 cities [4]. Also, the city was ranked in 331 positions out of 476 cities in the Swachh Bharat rankings conducted by the Ministry of Urban Development under the National Sanitation Policy of 2008 during 2014-15 where an open defecation and SWM indicators are the major criteria for consideration. This indicates the present situation of the city and undertaking of necessary intervention to meet Swachh Bharat Mission, a cleanliness drive to meet the target of zero waste approach in the city.

The modern city of BBSR was designed by the German architect Otto Königsberger in 1946 with a habitation of German. In 2015, the city has over 1.2 million populations and is growing at a rate of 24% per annum. BBSR has become a major urban centre of Eastern India, after Kolkata. BBSR which generates about 500 tonne of solid waste every day. Presently, the city employs a rudimentary waste collection and disposal system. BMC is responsible for management of total waste generated in the city. Administratively, the city is divided into 67 wards. SWM in the city is performed under three major heads: Collection, Transportation and Disposal (**Figure 1)**. The BMC has proposed to develop 985 acres as Bhubaneswar Town Centre District (BTCD), as a Smart City, where 'Smart Solutions' will be introduced. Presently, the city has been hired the services of private agencies such as Infra En Consulting and CRISIL Risk and Advisory Solutions Limited for integrated technical and commercial solution of MSW including up-gradation of waste collection system and establishment of modern waste transportation and processing infrastructure. The waste collection efficiency of the city is about 70%. Poor collection, inadequate transportation, absence of treatment facility, shrinking space for waste disposal, conflict with the periurban community, unhealthy socio-cultural and political factors are the major reasons for accumulation and inappropriate management of MSW at different parts of the city. The open dump disposal adopted by the city causes an adverse impact on all components of the environment and human health [5-6]. Households followed by both formal and informal are generating the largest source of solid waste in the city [7]. Informal sectors consists of individuals, groups and small businesses engaging in many activities which are not registered and formally regulated contributes generating of regular wastes. A latest assessment reveals, at least 36 per cent of the city population live in slums. Increase of population and rapid growth of urbanization have resulted in generation of huge quantity of MSW which is usually dumped in the open dumping sites.

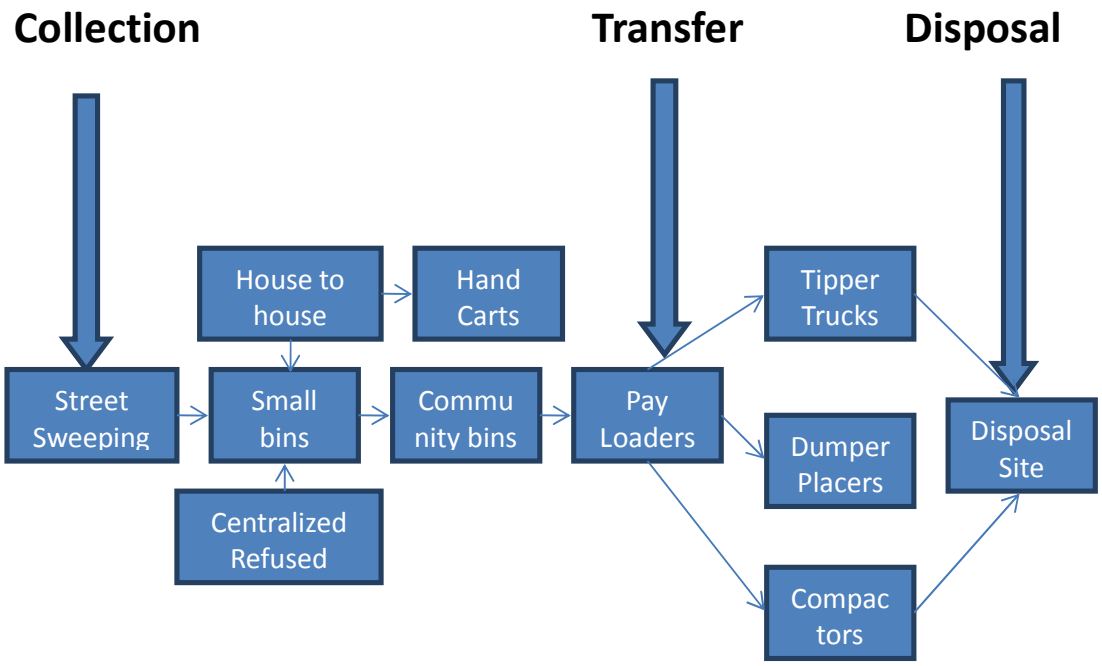

Figure 1: SWM System in Bhubaneswar

The effectiveness of SWM system depends upon the active participation of all the stakeholders and awareness of the citizens about the threat of solid waste and implementation. Many studies [8-10] also linked household participation and behavior are the major requirements for practicing of effective SWM. McDougall et al,; Bruvoll et al, 2008; and Clift et al, 2000 reported about role of economics assessments and feasibility of various socio-technological options needs to be realized [11-12]. Hence, the need for creating a stronger civic sense among the citizen is important for successful implementation and functioning of SWM system. Understanding the concept and context of waste segregation is vital for an effective SWM process. This level of effectiveness in implementing SWM system is only possible due to the prevalence of civic sense, as well as a clear understanding and acceptance of the concept of waste segregation. SWM is a four-tier process consisting of street sweeping, waste collection, waste transportation and waste disposal. All the four steps are considered as the core or prime pillars of an effective SWM process. The current scenario indicates that the core concepts of SWM need to be established among the people. The concept is still new and hence creating an effective awareness among citizen is of vital importance. The other major hindrance is the monitoring of land by disparate authorities. Ever expanding urban infrastructure demand is another major challenge for the smooth functioning of SWM system.

Disposing or recycling solid waste is a herculean challenge. The city needs to upgrade and adopt advanced waste recycling technologies.

In the current paper, the Municipal SWM system of BBSR, the capital city of Odisha, is analysed based on conceptual framework that considers the key stakeholders, their expectations and power to influence the decisions. Subsequently, the quantity, characterization, the pattern of primary collection, transportation, disposal, treatment facilities and organizational arrangement for MSW are discussed. Major factors affecting waste management in the city have been analysed.

2. Profile of the City

BBSR, the capital of Odisha, is the 9th largest city by area and 11th largest by population among all cities of India. It has an area of 394 square kilometer and a population of 8.85 lakh in 2011 (Census of India) with decadal growth of 34%. The city is located on latitude 23˚15' 20" North and longitude 85˚ 5' 30" East, which is approximately 35 km far from the Bay of Bengal. **Figure 2** illustrates geographical map of the city showing of 67 wards. The city has an average altitude of 40m above sea level. The city is a hub for information Technology and considered as country's fastest-developing city. According to a study by Associated Chambers Of Commerce And Industry of India [13], the city is witnessing highest rate of employment growth among 17 Tyre-II cities of India. It is among top ten emerging cities [14] considering physical, Social, real estate, infrastructure, current level of economic activities and growth.

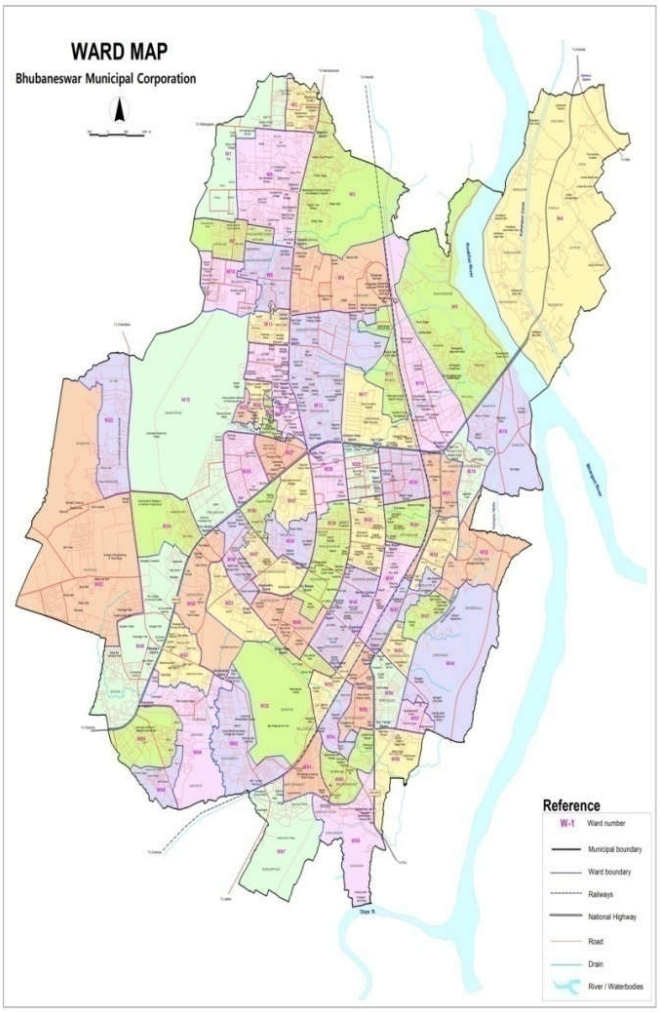

Figure 2: Geographical Map of Bhubaneswar (Source: http://bmc.gov.in/img/BMCWordMap_big.jpg)

The city is the centre of commercial activity providing employment opportunity which accounts booming of population and accelerating of urbanization. Around 32% of the population lives in slum areas, both authorized and unauthorized spread all over the city. The city is divided in to 67 Wards and each Ward divided into 7- 10 Blocks.

3. Current MSW System of the City

According to the Orissa Municipal Act, 1950 and the Orissa Municipal Rules, 1953 as stipulated in the 74th amendment of the constitution, BMC is the waste management authority of the city. This functions under administrative control of the state and urban development department (H&UDD) headed by the director of municipal administration 15 [13].Under the act, BMC is obliged to

provide directly or through contract, public cleansing services of acceptable quality, disposal of all collected waste in a sanitary manner. However, local authorities are facing several problems due to improper waste collection and transportation. There are number of legislations exist at national and state level which govern MSW management in BBSR such as Orissa Municipal Corporation act of 1950, municipal waste, (management and handling) 1989, biomedical waste management rules 1998, manual earn municipal solid waste management, 2000, plastic and other non bio-degradable garbage ordinance of July, 2000. Two departments under BMC involved in SWM are health and sanitation department which is responsible for waste management of 60 wards and engineering department which is responsible for maintenance of roads and vehicles etc. However, all the legislations and present act of BMC fails to provide zero waste management. Presently, city is sub divided in to five zones for administrative purpose. These five zones together have 60 wards and households and preferred sites have been identified for collection of waste. Random sampling technique has been applied for collection of waste from each household from different wards. **Figure 3** illustrates present waste collection to disposal system adopted by the City. The solid waste generation expected in BBSR would be 750 T/day as on 2030 [15]. The situation demands a comprehensive and sustainable SWM strategy for effective implementation.

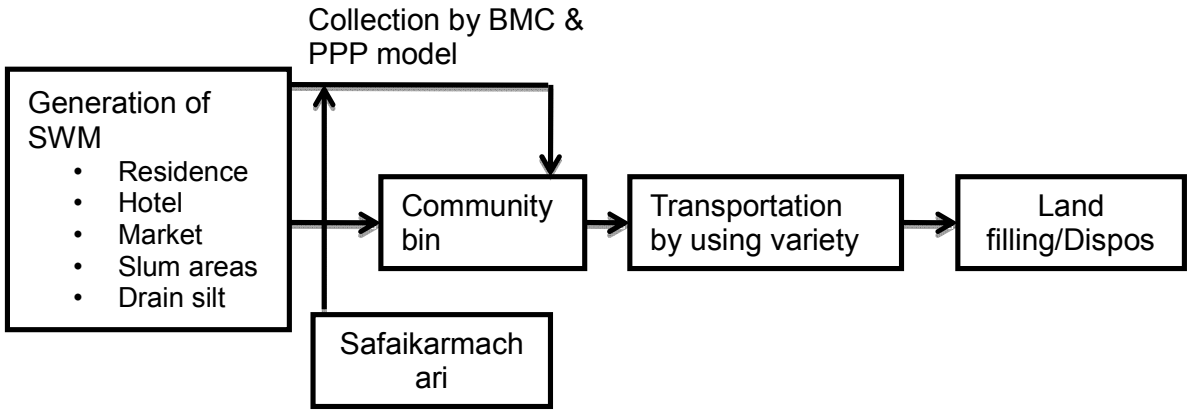

Figure 3: Present Scenario of SWM at Bhubaneswar.

BBSR city generates municipal waste, industrial waste and biomedical waste. The MSW consists of household and institutional waste, construction and demolition debris, sanitation residue and waste from streets. Major institutions that produce solid waste include commercial establishments, hotels and restaurants, temples, marriage halls, etc. The daily average solid waste generation of BBSR is about 350-400 tons (500gm/day/capita).In the city, average solid waste constitutes about 61.81% biodegradables, 27.15% inert material, 7.8% plastic

and leather, 1.25% metal and glass. There is no source segregation facility prevails in the city. The recyclable materials are segregated by rag pickers before reaching to the community bins.

Waste collection in the city in different Wards ranges from 30% to 80% and BMC spends between Rs 500 to Rs 1500 on collection of solid waste per tonnage. About 60 to 70% of total expenditure is spent on collection alone, 20% to 30% on transportation and less than 5% on treatment and disposal. On an average, sanitation contractors are charging BMC about Rs.2,500 per ton for shifting of MSW to the temporary transfer station (TTS) near Sainik School. Earlier, BMC, on an average, paid about Rs. 700 per trip for transportation of solid waste to TTS. In addition to that, the sanitation contractors reportedly charged an additional amount for transportation of MSW from TTS to the processing unit at Bhuasuni.

Only at few parts of the city, residents have been employed making source separation for composting and recycling purpose. However, most of residents do not conduct at source waste separation. Temporary storage sites named as depots are established near at Sainik School for reducing of transportation costs. Grabages as generated are collected from different community bins are initially transferred through tractors and trucks to the depots and stored there. At present, there are 1478 temporary storage sites available in BBSR from where waste is transferred to the depots. At the temporary storage sites, waste is transferred to waste trucks by either manual labor or shovel loader. There is no segregation or waste treatment facilities available at storage sites. According to the report, the temporary storage sites increase the effectiveness of collection vehicles from 1.7 to 3 trips per day. This efficiency is due to the fact that the waste is pooled at the temporary storage sites and is easily collected and transported to the disposal site. By contrast, collecting the waste from various points would reduce the efficiency of collection.

For effective disposal of solid waste, BMC has allocated budgetary provisions which was around Rs 26 crore in the year of 2012-13 and increased up to Rs. 45 crore in 2015-16 *(BMC,2013*).It includes an expenditure of Rs.16 crore annually for transportation of solid waste from transfer stations to dumping yards. For the first time the corporation has proposed budgetary provision of Rs 7.5 crore for street sweeping. Presently only one sweeping machine is being used in the city. Proposals are made to privatize some wards and to use mechanized sweeping machine. Also the corporation has proposed allocation of nearby Rs 121.52 crore for improving roads, drainage system and street lights.

Table 1 depict about allocated budget and existing practices for managing of SWM by BMC. Housing and Urban Development Department of Government of Odisha (HUDD) proposed regional MSW processing and landfill facility at Bhuasuni covering an area of 61.485 acres. Around 300 Tonnes of daily collected solid waste is dumped at Bhuasuni. For making of an effective SWM, BMC has opened a cell to ensure hassle-free management of solid waste The primary activities of the cell includes monitoring of solid waste collection activities at primary level, disposal at the designated dumping site and processing.Other activity of the cell includes registering of complaints pertaining to solid waste. The cell has been created in accordance with SWM and Handling Rules, 2000. BMC has made rule for imposing a fine for Rs. 50 a month for individual household, having built-up area up to 1000 sq ft. Also, a weighbridge at the garbage dumping yard has been placed to take stock of the waste collected and dumped every day. Presently, about fifty lorries are been engaged for collecting of garbage's from 52 wards.

Presently, SWM has implemented process of storage, collection, transportation, processing and disposal of solid refuse residuals. Major sources of solid waste includes households (Kitchens and yards), commercial areas (shops, hotels, and restaurants),industries (raw material and packaging), institutions (schools, hospitals, and offices), parks (fallen branches, leaves from trees) and streets (sand, silt, clay, concrete, bricks, asphalt, residues from air deposition and dust). At present, nearly 300 waste collection points and two dump yards, one near at Sainik School and the other in Bhuasuni exists in the city. Different types of vehicles are been engaged such as trucks, tipper trucks and tractor trailers for transportation of the waste to dump wards. Also, BMC has privatized the cleaning service in about 40 of its 67 wards. BMC partners with different private partners for waste collection and transportation and currently using around 80 types of transport vehicles. Around 400 tonnes of waste generated from the City per day takes the route of a temporary transfer station near Sainik School before being dumped at Bhuasuni yard. The waste includes plastics, bio-degradable and construction materials.

Table: 1. SWM practices and allocated budgets for SWM in BBSR.

Waste Scenario at BBSR	Fund Flow (In Crores) Budget provision for last 05 years	The ongoing Process
• BBSR generates nearly 500 tons of waste/day. • Civic body has more than 300 collection points • Nearly 125 vehicles engaged for transportation of waste • BMC has one health officer, two sanitary inspector,30 supervisors and 1,186 sweepers engaged in cleaning jobs	• 2016-17 57 • 2015-16 45 • 2014-15 45 • 2013-14 45 • 2012-13 26	• Segregation of waste at sources • Door-to-door collection of waste • Cleaning roads • Night cleaning at busy rods and markets

4. **Challenges faced of MSW in Bhubaneswar**

Presently, the city does not have proper action plan for implementation of the MSW Rules. Waste collection is observed only 70% of total waste generation and the remaining 30% lost in the urban environment. House-to-house collection and segregation not been implemented. There is a large gap exists in between Waste collection and processing. For all its claims as a smart city, the BMC has not yet been able to fix the SWM system, one of the basic requirements of good municipal governance. A city that generates more than 500 tonne of garbage daily does not even have a single solid waste treatment plant nor a proper waste disposal system in place. The capital is also struggling to manage its ever-increasing population, particularly the exponential growth in slums over the last decade.

The proposed Regional MSW Management facility at Bhuasuni on outskirts of the Capital City continues to be a major headache for the HUDD department. Besides facing undue delay, the facility is now bogged down by technology and processing methods of solid waste. Presently, the concept is at proposal stage and a suitable 'processing technology' is highly required for treating of bio-degradable, combustible and recyclable contents of the solid waste. This indicates that before the waste goes for treatment, the three categories of waste should be segregated and treated separately [16-17].

The SWM Rules, 2016 states that the waste has to be segregated at source into three parts wet (biodegradable), dry (plastic, paper, metal, wood, etc) and domestic hazardous (diapers, napkins, empty containers of cleaning agents, mosquito repellents, etc). The generators should hand over segregated wastes to authorized rag-pickers or waste collectors or local bodies. BMC does not have taken any steps towards segregation of waste either at source or temporary transit stations or the dumping yard. The collective treatment of different categories of waste is not only unscientific but also high on pollution. Odisha State Pollution Control Board (OSPCB) does not follow any clear picture on where and by whom the segregation of wet, dry and hazardous substances should be done. The Design Built For Operate Transfer (DBFOT) project has been changed from ROCHEM technology to HITCHI Zosen technology to be used for treating solid waste and generating energy from it. Meanwhile, the budget estimate has gone up by five folds upto `250 crore. On the other hand, the residents of Daruthenga panchayat, nearby locality of the proposed dumping ward have moved the Orissa High Court (HC) for challenging the disposal of solid waste at the dumping site in Bhuasuni. The BMC has also led a caveat for searching an alternative site for solid waste disposal. The challenges of SWM as faced in BBSR city are broadly categorized under the heads of Collection, Transportation and Disposal:

5.Problems Related to Collection

Collection of waste in the city of BBSR is being badly affected due to the improper organization, lack of awareness and financial resource crunch. The scientific and systematic collection has been not practiced at the source. The city has 4500 dustbins and has planned to procure 500 more. Considering to the size of the city, it is highly inadequate. Inappropriate placement of dustbins contributed to unorganized waste collection. This method has a major disadvantage of littering the wastes over the road and thereby reduces public hygienic condition as well as aesthetical view of the place. Shortage of manpower adds to the problem. As a result, in many wards, 60-70% waste is never collected. Acute problem exist in the slum area and low and middle income areas which

contributes about 20% of total population of the city. Presently, BMC is collecting only 440T of waste per day out of total 590T generated [13]. Although, the city has a number of sensitization and awareness programs, the effect has not been spectacular. Primary collection is managed by community based organizations. The rag pickers are working in an unsystematic manner and take away recyclable wastes only. There are 348 collection points in the city from which waste has been collected which is not adequate for the city.

6. **Transportation**

Waste generated each day from the city takes the route of a TTS near Sainik School before being dumped at Bhuasuni yard. Presently, city is adopting manual method for Loading of waste from waste bin or containers into trucks or trailers or using pay loaders. It requires manual cleaning since pay loaders could not collect all the waste from storage enclosures and results spilling of waste. Further, waste while being transported by low height open trucks spills on the roads and has to be re-collected manually or often remains scattered. Inadequate transport capacity requires two trips per day per vehicle. Due to operational inefficiency, the available volume is not adequate even at four trips per day per vehicle is required. Additionally, some of the vehicles are old and their availability is poor. Also loaders fail to clean waste storage depot fully and damage the flooring and screen walls, very often, necessitating frequent repairs. It is often seen that concrete bins are not completely emptied, leading to purification of left over garbage and foul smell. There is no separate system of collection and transportation of wastes available from Hotels, Restaurants, Hospitals, Construction Sites, etc. It leads to waste accumulation and consequent nuisance and unhygienic conditions.

Typically, handcarts have been used in the city for discharge of their loaders onto the ground. Further, these wastes are reloaded in to the trailers that take at least five minutes. Garbage from two wheeler tractor emptied manually which takes around 20 minutes and further reloading of this waste needs four labors and around one hour for fully loading into the trailer. BMC needs to optimize vehicle productivity by selecting the appropriate vehicle size, routing, crew size and shift duration.

7. Waste Disposal

The city does not have any facility for treatment of MSW and all waste is openly dumped in the allocated dumping site in an uncontrolled and unhygienic manner. This acknowledges the dangers

to the environment and to public health derived from uncontrolled waste dumping. There is a possibility of ground water contamination because of leachate production. There is no proper segregation facility is available at dump sites. The poorly maintained landfill sites in BBSR accommodating about 300 Ton of solid waste after collection from 60 wards under the control of BMC and private agencies and being dumped at Bhuasuni covering of land area about 62 acre.There is no adequate space available to accommodate total quantity of waste generated from the city. The dumping yard is a betting example of unscientific and unhealthy disposal of solid waste. Though the State Government had allotted 62 acres of land to BMC for dumping waste in 2005 and an additional 12 acres in 2014 for MSW processing facility, the progress of the ambitious 'Waste-to-Energy' project has been tardy. The decomposition of bio-degradable material and burning of plastic lead to contamination of surroundings. Stray animals including cattle venture into the dumping yard and feed on the waste which exposes them to the risk of severe diseases.

Lack of coordination among the various agencies and BMC led the city with depositing of heap of garbage at one place. Civic body suspends collection of all waste near at Gadakana claiming that it's a temporary dump-yard which is presently running out of space. The municipal corporation has come up with an alternative site for the relocation of the controversial Bhuasuni dumping yard at Daruthenga village on the outskirts of the city. The agitation by villagers at the Bhuasuni dumping yard made the disposal of waste difficult with municipal corporation authorities unable to lift garbage in the absence of an alternative site. Moreover, the area behind Sainik School, which is used as the lifting point of garbage, had garbage piled up high and overflowing. The dumping ground at Sainik School was already creating an unhygienic environment for all.

Waste is disposed of by deposition in low-lying areas like other major urban centers [19], and uncontrolled land filling is practiced. Soil cover is not provided and provision of gas control and leachate do not exist. The available disposal site is not properly controlled and waste picking is commonly practiced, is posing problem for controlled operation of the sites. Landfills create an unhygienic environment and causes pollution to the environment. In rainy seasons, rain water percolates through the waste and soil and creating pollution to the ground water.

The corporation also currently does not involve any waste processing facility for recycling and reutilization of waste. Little waste processing that takes place due to informal recyclers operating in the city. About 60-70 small waste dealers who collect the recyclable waste (glass, paper, metal, plastics, and electronics) either use their own network of people going to door-to-door or buying it from waste pickers. This acts as an incentive for the waste generator to segregate and store the

waste and for the waste picker to scavenge the waste dumps. A very rough estimate is about 30-40 kg of recyclable waste is presently collected per dealer per day. **Figure 4** shows a picture of dumping site of BBSR.

Figure 4: Dumping site at BBSR.

8. Sources and Quantities of Waste: BBSR

The waste generated from various sources in BBSR is shown in **Table 2** [20]. Major sources of solid waste are house hold; street sweeping; commercial areas including shopping complex and market offices, hotel and restaurants; and construction sites. The composition of solid waste varies according to location, standard of living, seasons and energy resources (**Table 3**). There is a large gap between solid waste generation and that is collected by the BMC, resulting in city remaining unclean (**Table 4**).

Table 2: Source-wise Collection of MSW in BBSR

Source	Quantity (Ts/Day)	Contribution (%)
Households	229	57.4
Institutions	24	6
Commercial Establishments	28	7
Hotels, Restaurants and Food Stalls	20	5
Temples	6	1.4
Marriage Halls	9	2.3

Street Sweeping	2	0.5
Construction and Demolition of waste	16	4
Hospitals	4	1
Dairies	62	15.5
Total	400	100

Source:(CPCB, 2004)

Table 3.Source and Types of MSW in BBSR

Source	**Type of waste generators**	**Components of solid waste**
Residential	Flats, Slums, Single & multifamily dwellings	Food waste, papers, cardboards, plastics, textiles, textiles
Commercials	Markets, Office buildings, Hotels, Stores, Restaurants	Food wastes, plastics, ceramics, papers, cardboards
Institutional	Schools, hospitals, Colleges	Cardboards, plastics, papers, waste electronics
Municipal Waste	Street cleaning, landscaping, Parks, dump yards	Plastics, food wastes, vegetables, trees, Construction wastes

Table 4: Quantity of Waste Generated and Collected in Bhubaneswar (Source: State Pollution Control Board. BBSR 2004 [20])

Year	**Generation (T/day)**	**Collected (T/day)**
2002	350	250
2005	400	250
2009	460	360
2011	590	440

9.Waste Characteristics

The MSW comprises of 30% to 55% of biodegradable organic matter, 25% to 35% inert material and 30% of miscellaneous material (bricks, rubber, wood, leather etc). In 2015, the city is generating more than 450T of solid waste per day, out of which 40% polythene based materials. The percentage of recyclable materials (glass, paper, plastics) in the city is around 10 to 20%. **Table 5** shows quantity of recyclable solid waste in BBSR. Recently, efforts are being taken to popularize waste segregation and composting. The high organic content of MSW indicates that a self-sustaining combustion reaction cannot be obtained from a majority of MSW, and auxiliary fuel would be required to aid waste combustion [21].

Table 5: Quantity of recycle solid waste in BBSR. Source: (BMC, 2011)

Sl. No	Types	Total Quantity (TPM)
1	Metal Scrap	250-300
2	Glass	100-150
3	Plastic/Polyethylene	40-45
4	Waste Paper/Card Board	80-100
5	New Print	16
6	Miscellaneous	---

10. Waste Disposal

There is no specific treatment facility for solid waste in the city. The waste processing is performed through a chain of informal recyclers. There are about 60-70 waste dealers in the city to collect and recyclable waste (glass, paper, plastics, metals and electronics). They either uses own network of people for door to door collection or buy from waste pickers. Each dealer collects about 30-40 kg/day of recyclable waste. The dealers further sale the wastes to recyclers.

BMC is working on public private partnership (PPP) with three private organizations, such as Ramkey Environment Engineers Limited (REEL), Jagruti Welfare Organizations and PMIR Consortium. These private agencies are responsible for placing dustbins at appropriate places and collection of waste from their assigned wards. They carry the waste to the transit transfer station. The partnership arrangement has the provision for performance based incentive based on their waste collection. The basic process of segregation at source, scientific collection and ecological treatment are yet to be implemented in the city.

For treating and disposing the MSW collected, HUDD department proposed to develop a Regional MSW Processing and Landfill Facility through the PPP mode over an area of approximate 61.485 Acres at Bhuasuni. BMC is signed an agreement with a Mumbai based company for setting of regional MSW processing plant and land fill facility on the outskirt of the city. Essel Infra Projects Limited and Rocken Separation System India Pvt Limited will set up solid waste treatment plant within two years with investment of Rs. 200 core. The project has provision for separation of biodegradable and non-biodegradable waste and generation of 11.5 MW electricity. The plant aims to use nearly about 350T of solid waste and will charge about Rs. 324 per ton from BMC. No recyclable and reusable waste will be transported to the landfill site. The city aims move for zero recyclable waste towards achieving “SWACH BHARAT”. The project has proposed to adopt innovative & proven waste processing technologies (combination of waste to energy and composting) that are environment friendly and aims to contribute in developing a pollution-free environment. The project aims dispose of the ramnant materials in a scientific manner.

11. Conclusion

With an ever increasing population and a rapid pace of urbanization in the city, waste management approach is not adequate and up to the mark which results an adverse effect to the environment and human health. The study concludes that the present policy and infrastructure are inadequate in dealing with the enormous quantity of MSW generated by the city of BBSR. With fast increase in MSW generation, reduction in generation and treatment at source, scientific transportation and comprehensive treatment of MSW is need of the hour. BMC has taken step towards improving MSW management practices by privatizing the collection, segregation, transportation and disposal of waste. The increase of service demands combined with the lack of resources for municipalities are putting a huge strain on the existing MSWM systems. Based on the experience with private partners, it has to rethink the strategy and move towards decentralized system, active participation of key stakeholders, designing financially, organizationally and ecologically sustainable system and follow a technology led path.

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