Poor People's Waste Management outlook in Dhenkanal Municipality, Odisha, India- From People's Perception

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Odisha, one of the least urbanized states in the India is marked by inadequate access to sanitation, high open defecation and over-reliance on onsite sanitation systems. In 2011, all 114 urban centers in the state, had very poor access to sanitation facilities and approximately 35 per cent of urban households lacked access to individual household latrines. The objective of the research to know about city sanitation situation, solid waste management practice, waste calculation and future plan for waste workers livelihood. In this study, total sample size was 390 households. Out of 390 HH, 130 each for slums, middle-income and higher income households. In each group 130 HH was surveyed through SurveyTO Go app. The Focus Group Discussions (FGDs) were conducted with different income groups living in the municipality area. As per the income standards of the households they were divided into three income groups such as LIG (low-income group), MIG (Medium income group), and HIG (High income group). as per the income of the households. The study outcome reflects that slum people are getting better service because of compact in size, so it is easy to collect the waste easily from their door. City is growing faster most of the affluent people are constructing house in city outskirt, it is very difficult for the municipality to provide service. Scientific way of Solid Waste Management is needed at this juncture and Waste pickers should be engaged in recycle process. So, it would be if there would be Solid Waste Plant at the city so the all resident and slum dwellers waste can be processed and slum people would get new livelihood opportunity. City life would be livable and lovable.
Key words: Slum, Solid waste, FGD, HIG, LIG and MIG

I.   Introduction:

Indian cities and towns generate enormous amounts of garbage every day. Mumbai, for example, produces 6,000 tons. Even in smaller cities garbage disposal is turning to be a major problem; there are more than 175 towns that generate more than 300 tons of refuse a day. One sample study showed that 70 per cent of Indian cities lack the capacity to collect and transport all the municipal solid waste (MSW) they generate. The uncollected waste poses health and environmental hazards. Most of the waste that is collected is dumped in landfills. Land-filling, unless done scientifically, allows toxic components to get into and pollute groundwater. Between 13 and 20 per cent of waste, comprising paper, plastic, glass, rubber, and metals, is recyclable. In1996 public interest litigation filed in the Supreme Court demanded hygienic and eco-friendly waste management in India's 300 Class-1 cities whose population is more than 100,000. The MSW Rules direct municipalities to "promote recycling or reuse of segregated materials" and "ensure community participation in waste segregation". Waste picking is an established urban survival tactic in India's megacities and recycling is a flourishing business in this informal sector. It supports up to 0.5 per cent of the population in cities of over a million inhabitants, and saves a city 10-15 per cent of its total waste management costs through reduction in waste volumes handled; it is also now attracting service providers in commercial areas. While the Government of India directive forced municipalities to address the issue, it has also stirred up interest in private players. Selecting a technology depends on where it is to be located. Urban waste handling is a nascent industry and the

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awareness level of its profitability is low. As urban populations grow, so will mounds of garbage. The sheer volume can make garbage processing a money-spinning enterprise. Investors are looking at using it to produce energy and compost while enhancing recovery of resources and improving the environment. Good-quality compost also has high market value and can even be exported. Once a commercially proven technology is established, it will also go a long way in dealing with energy problems in the country.

Odisha, one of the least urbanized states in the country is marked by inadequate access to sanitation, high open defecation and over-reliance on onsite sanitation systems. In 2011, all 114 urban centers in the state, had very poor access to sanitation facilities and approximately 35 per cent of urban households lacked access to individual household latrines.

2. Study Area: Dhenkanal district is one of the centrally located districts in Odisha. It lies between Longitude: 85° 58' to 86° 2' East and Latitude: 20° 29' to 21° 11' North. Dhenkanal Municipality was constituted on 18.04.1951 covering the village Nizigarh i.e. Dhenkanal Town vide Govt. Notification No.51/LSG Dated 03.01.1951. Subsequently 12 nos. more revenue villages were included vide Govt. Notification No. 33259/HUD dated 08.12.1975. The total area of the Municipality is 30.92 sq. kms and is divided administratively into 23 Municipal Wards. The total population of the municipal region increased from 57677 in 2001 to 67414 in 2011. There are 14,908 households residing in the Municipality area as per the Census 2011. There are 17 slums (notified) in Dhenkanal Municipality. The total number of households residing in these slums is 2059 with total population of 7821 out of which 3970 are males and 3851 are females (Census 2011). Faecal Sludge Treatment Plant (FSTP) Dhenkanal is the Odisha`s first FSTP to serve the purpose of completing the sanitation value chain supported by Practical Action, India. Fig-1 and 2 shows Dhenkanal municipality map and infrastructure map of the study area.

Fig- 1 and 2 Map of Study Area (Dhenkanal Municipality) and city infrastructure Mapping
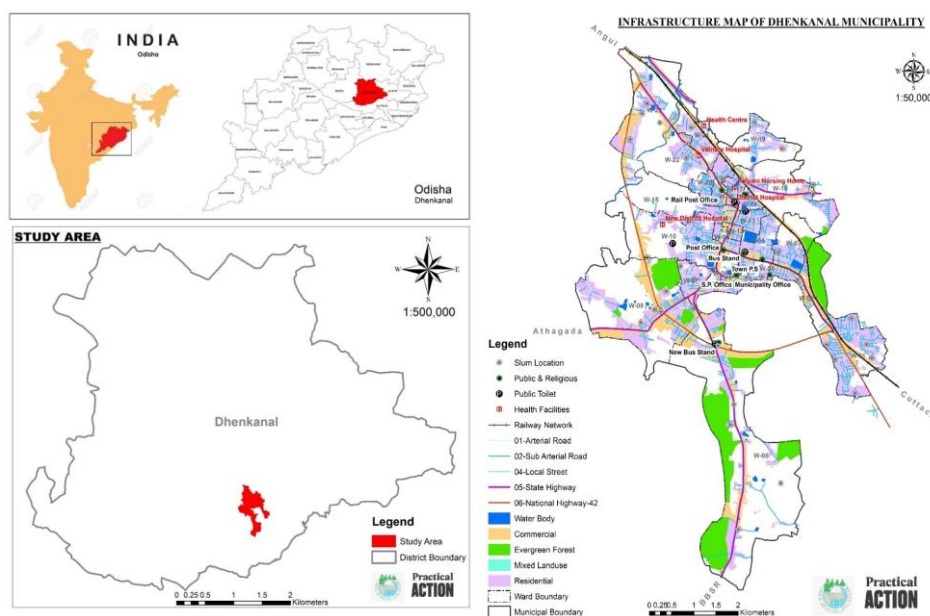
3.Objective and Methodology of the Study: The objective of the research is to know about city sanitation situation, solid waste management practice, waste calculation and future plan to handle the solid waste workers livelihood. Study team members took 2-days training by the Practical Action International team through virtual mode due to Covid-19 Pandemic, in the use of a comprehensive toolkit. This training combines methods and approaches from various international toolkits on waste management and on a variety of tools and techniques such as:

  ☐ Data Collection and survey tools (Survey2Go) using digital devices (phones or tablets)
  ☐ Mapping tools (e.g. GIS, Google Maps)
  ☐ Waste quantity and composition analysis

As per 2011 census total number of Dhenkanal Municipality House Hold (HH) was 14,980. Out 14,980 HH, Slum HH 3548. In this study, total sample size was 390 households. Out of 390 HH, 130 each for slums, middle-income and higher income households. In each group 130 HH was surveyed through SurveyTO Go app. In survey TO app three types of app was developed by Practical Action International Expert. In Menu it shows

HH survey, Mapping tool and Service Provider tool. The following table shows the details of HH survey sample taken into three groups.

Table-1

Ward number	SLUM Name	Number of HH interviews
1	ShyamacharanpurSabarSahi	9
1	KathagadaParbatiaSahi	9
2	Refuge Colony	2
3	Chandiasahi	4
5	ChandamariSahi	7
6	KalaraGada	7
7	MurdangiaSahi	10
8	BankualaSahi	7
8	GajamaraJuangaSahi	7
9	KantanaliKandhaSahi	8
10	SarjangaSahi	12
10	Colony Sahi	13
18	BhagabanpurSabarSahi	3
19	Similia SabarSahi	4
21	AlasuaSabarSahi	8
22	Hata Road Harijan Sahi	8
23	KorianSabarSahi& Harijan Sahi	6
23	KorianJuangaSahi	6

| Ward number	Middle income	High income
1	4	4
2	5	5
3	5	5
4	9	9
5	4	4
6	6	6
7	6	6
8	3	3
9	7	7
10	9	9
11	7	7
12	5	5
13	9	9
14	6	6
15	6	6
16	7	7
17	7	7
18	4	4
19	4	4
20	5	5
21	4	4
22	7	7
23	2	2

This study has a three-phase gradual approach, consisting of Review secondary report (Desk review), field and synthesis work. While a desk review exercise largely depends on project document and toolkit analysis of

secondary information. Field work was carried out to highlight the varying levels of waste management service that different communities enjoy, and the variety of formal and informal service providers who are working across various parts of the city.

- City-wide maps, showing:
    o Household survey results to illustrate the varying quality of the service provided
    o Mapping to show areas served by street cleaning/collection and by door-to-door services, and to highlight waste hot spots, sites of open dumping and the extent to which drains are blocked with rubbish.
- Household survey results analysing waste management service levels by household type, and across different neighbourhoods.
- Analysis of waste quantities generated and collected at the household level, and contribution of the informal sector to collection and recycling.
- Gendered findings from participatory focus groups with householders and waste collectors and recyclers.
- Use of the Waste Aware (http://wasteaware.org/) indicators to take an overall view of situation and in order to compare the situation between cities on the same basis
- Case studies and quotes from individuals: both individuals (living in different parts of the city) and case studies of waste enterprises.
- Photographs that capture core dynamics of waste management in the case study area

The following maps depicts about land use and land cover map, waste survey location, waste hot spot area, and city built up area.
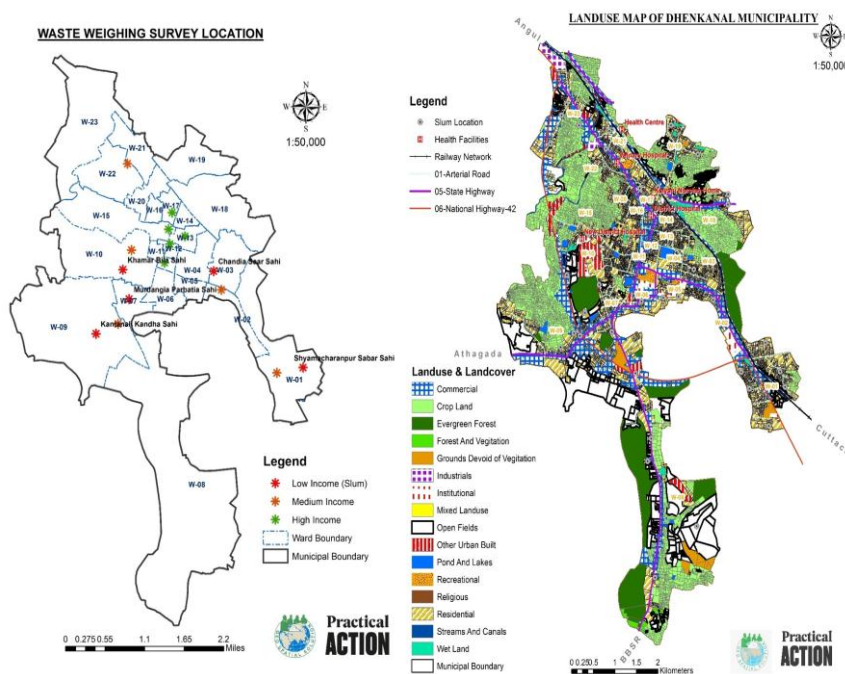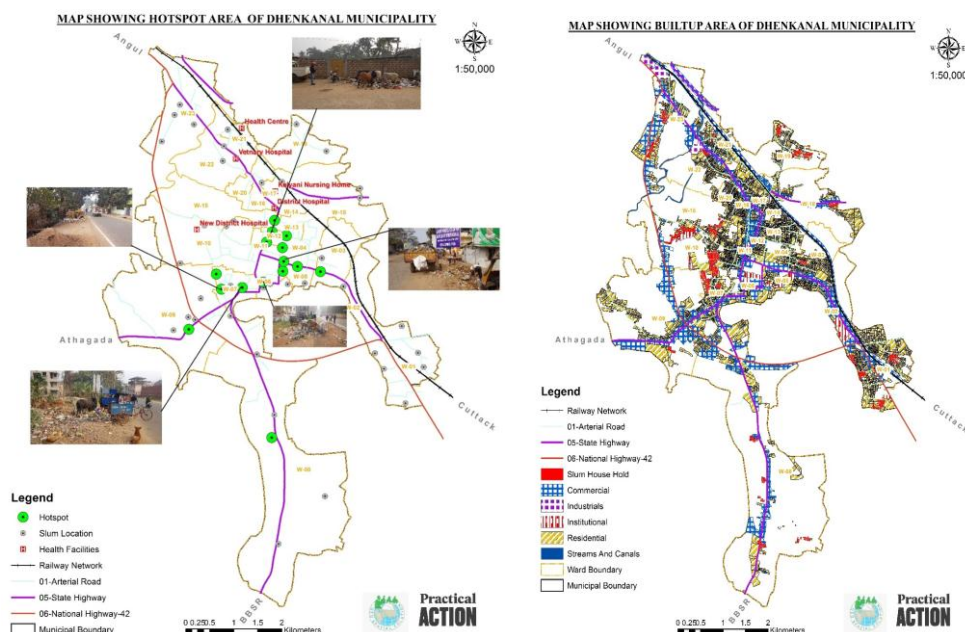
4. Study Outcome: The research team undertook interviews with individuals from the households, municipal authorities, and private waste management agencies to obtain their views on policy and practice priorities concerning household solid waste management in Dhenkanal municipality. The results of these interviews are summarized below.

A. Household Prospects: Household solid waste management is primarily done by the Dhenkanal municipality. Each household is provided with two waste bins (green and blue colored) so that they can keep wet waste in the green bin and dry waste in the blue bin. Every day the household waste is collected using BOVs which has two chambers to keep wet and dry waste separately. According to the Quantity Survey undertaken by the municipality in January 2019, the city generated an estimated volume of 25 metric tonnes (MT) of waste per day. The total waste is consists of 15 MT of wet waste and 10 MT of dry waste.

Waste generation varies as per the locality and income level of the households. High-income groups generate nearly double that of low-income groups. Waste collected from the low-income groups contains a large proportion of wet/ organic waste. On the other hand, rich people contribute to more dry waste. Out of 23 wards, municipal sweepers clean the streets of 8 wards. The rest wards are cleaned by the sweepers engaged by PRTYUSH.

Although the waste management drive was somehow affected the waste collection from the household was done regularly. In addition to that sanitation of houses was done throughout the city. According to the Municipal Engineer "*During the COVID time, we had to keep the household areas clean and maintain high levels of sanitization as part of the government direction*. During the COVID period, the amount of waste generated from the households and the city as a whole was drastically reduced. But the MMC and MRF were operational.

The participant's perception varies across different levels of households (high, medium, and low). It was found that solid waste management is happening differently as per the income groups. The reasons are quite evident from the way people perceive household waste and their attitude towards it. The households feel that the facilities provided by the municipality are better in HIG areas than MIG and LIG areas. The municipality is collecting waste with better frequency in better-off areas. The pubic waste collection points are more in HIG and MIG areas than LIG areas. In HIG areas municipality is collecting waste on daily basis and in MIG areas it is being done either daily or on alternate days. But in LIG areas it is being done in 2-3 days.

The main waste generation point across all types of households in the households themselves. Most of the waste generated in the households is organic. Of course, the amount of organic waste generated varied from LIG to HIG households. Food waste is more in higher-income groups by volumes but percentage-wise it is more in LIG households.

Disposal of waste is mainly done by wise wives/ women folks. The reasons behind this are that women deal with the kitchen in all types of households. Most of the households dispose of their waste to the collection agents engaged by the municipality. But a small part of the waste is still disposed of in public waste bins placed by the municipality in different localities. The municipality is not collecting waste in its entirety. There is still scope for improvement in waste collection.

The collection of waste has drastically improved in the last 2 to 3 years. The frequency of collection has been increasing. The municipality is also collecting waste separately. The aim is to segregate waste at the source. The

municipality has undertaken awareness generation drives across the city through different modes and methods. As the municipality has provided two bins (for wet and dry wastes) to each household people are gradually adopting them. Previously they used to throw away most of the waste in their backyard or along the streets.

Waste collected from the households is disposed of to MCC and MRF centers set up by the municipality. Wet waste is being converted into organic manure and dry waste is recycled wherever possible.

Although there has been improvement in HH waste management in Dhenkanal, still there are areas of improvement. Till now the collection is not 100 percent. Although the municipality is claiming it to be around 90 percent still it could be less. The municipality has set up open public large-sized waste bins across the residential areas. But it was found that these bins are mostly full and sometimes overflowing. The residents are still encountering different problems like the issues of smell, rodent growth, and littering around the public waste. They are also facing aesthetic and other issues. Sometimes the overflowing waste from public bins causes groundwater pollution and poses health hazards.

The municipality is collecting a user fee toward HH door-to-door waste collection. The amount is fixed as the plinth area of the households. But it is not correct always. The fees could be collected based on waste quantity not by plinth area. A small HIG household can generate more waste than LIG households. Then the number of family members in the family plays a vital role. These aspects should be relooked upon.

Table-2 Household Mixed waste generation data finding

			Household classification			
			Slum	Middle income	High income	Total
What do you do with your bulk mixed waste generated in the household?	It is collected from my home	Count	142	125	129	396
		% within Household classification	100.0%	94.7%	97.7%	97.5%
	Burn It	Count	0	5	2	7
		% within Household classification	0.0%	3.8%	1.5%	1.7%
	Dispose outside the home: please specify where?	Count	0	2	1	3
		% within Household classification	0.0%	1.5%	0.8%	0.7%
Total		Count	142	132	132	406
		% within Household classification	100.0%	100.0%	100.0%	100.0%

In HH survey three groups opinion about bulk mixed waste generated in household collected by municipality. It reflects that municipality and local are concern about waste harmful effect and impacts. Probably, this is year Dhenkanal municipality will get SWACHA SARVEYKHYAN award.

Table -3 HH Transport Waste data analysis

			Household classification			
			Slum	Middle income	High income	Total
What do they use to transport the waste?	Manual collection – carry bags	Count	7	0	0	7
		% within Household classification	4.9%	0.0%	0.0%	1.8%
	Manual collection – hand cart	Count	6	39	19	64
		% within Household classification	4.2%	31.2%	14.7%	16.2%
	Animal power – animal pulled cart	Count	2	0	0	2
		% within Household classification	1.4%	0.0%	0.0%	0.5%
	Mechanised – small vehicle	Count	0	1	1	2
		% within Household classification	0.0%	0.8%	0.8%	0.5%
	Non-motorised	Count	127	85	109	321

	tricycle van	% within Household classification	89.4%	68.0%	84.5%	81.1%
Total		Count	142	125	129	396
		% within Household classification	100.0%	100.0%	100.0%	100.0%

Mostly wastes are transferred through non-motorized tricyle van in slum-, middle- and high-income group.

Table-4 HH waste reliably data collection

			Household classification			
			Slum	Middle income	High income	Total
.Is your waste reliably collected as scheduled?	Almost all the time	Count	140	120	128	388
		% within Household classification	98.6%	96.0%	99.2%	98.0%
	Most of the time	Count	2	5	1	8
		% within Household classification	1.4%	4.0%	0.8%	2.0%
Total		Count	142	125	129	396
		% within Household classification	100.0%	100.0%	100.0%	100.0%

Collection waste by the municipality in all sections of people are highly commendable job. More than 95 percent agreed about the HH collection of waste by the municipality.

Table-5 HH solid waste management services for your mixed waste

			Household classification			
			Slum	Middle income	High income	Total
Are you satisfied with your access to solid waste management services for your mixed waste?	Yes	Count	141	121	125	387
		% within Household classification	99.3%	96.8%	96.9%	97.7%
	No	Count	1	4	4	9
		% within Household classification	0.7%	3.2%	3.1%	2.3%
Total		Count	142	125	129	396

People are highly satisfied with the HH collection of waste by the Dhenkanal Municipality. Slum residents were more likely to appreciate that the service was affordable, reliable and with good customer service. While middle-income and higher income residents focused on convenience, reliability and good customer service.

Table-6 service improved in the last 5 years

			Household classification			
			Slum	Middle income	High income	Total
.Has the service improved in the last 5 years?	Yes – it's improved	Count	139	111	110	360
		% within Household classification	97.9%	88.8%	85.3%	90.9%
	No-It's the same	Count	3	13	18	34

			Slum	Middle income	High income	Total
		% within Household classification	2.1%	10.4%	14.0%	8.6%
	No – it's got worse	Count	0	1	1	2
		% within Household classification	0.0%	0.8%	0.8%	0.5%
Total		Count	142	125	129	396
		% within Household classification	100.0%	100.0%	100.0%	100.0%

There is no doubt, waste services have been increased/improved in tremendous manner in Dhenkanal Municipality. As the city is also extending/growing fast, out skirt part of the city are lagging behind the waste services.

Table-7 clear up solid waste from open spaces/streets/drains in Dhenkanal Municipality

			Household classification			Total
			Slum	Middle income	High income	
Are any efforts made to clear up solid waste from open spaces/streets/drains in this neighborhood?	Yes	Count	139	18	12	169
		% within Household classification	97.9%	13.6%	9.1%	41.6%
	No	Count	3	114	120	237
		% within Household classification	2.1%	86.4%	90.9%	58.4%
Total		Count	142	132	132	406
		% within Household classification	100.0%	100.0%	100.0%	100.0%

As slum areas are the vote bank of political people, corporates are giving more emphasis on slum areas for their neat and cleanness.

Table-8 carries out waste service system

			Household classification			Total
			Slum	Middle income	High income	
Who carries out this service?	Neighbourhood residents	Count	0	2	2	4
		% within Household classification	0.0%	11.1%	16.7%	2.4%
	Local government	Count	139	16	10	165
		% within Household classification	100.0%	88.9%	83.3%	97.6%
Total		Count	139	18	12	169
		% within Household classification	100.0%	100.0%	100.0%	100.0%

Local government is sole responsible for carry out waste management system in the city.

Table-9 frequency of waste service

			Household classification			
			Slum	Middle income	High income	Total
What is the frequency of this service?	Daily	Count	139	8	3	150
		% within Household classification	100.0%	44.4%	23.1%	88.2%
	Weekly	Count	0	2	0	2
		% within Household classification	0.0%	11.1%	0.0%	1.2%
	Monthly	Count	0	3	3	6
		% within Household classification	0.0%	16.7%	23.1%	3.5%
	Irregularly	Count	0	5	7	12
		% within Household classification	0.0%	27.8%	53.8%	7.1%
Total		Count	139	18	13	170
		% within Household classification	100.0%	100.0%	100.0%	100.0%

Table-10 Number of items separated by households

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	327	80.0	80.0	80.0
	1.00	3	.8	.8	80.8
	2.00	72	17.6	17.6	98.4
	3.00	5	1.3	1.3	99.7
	4.00	1	.2	.2	99.8
	5.00	1	.2	.2	100.0
	Total	408	100.0	100.0	

Slum communities were less likely to source separate their waste than non-slum communities. This was particularly the case for paper/cardboard and organics. This is for selling purpose to kawadiwala.

Table-11 Waste Separation

			Household classification			
			Slum	Middle income	High income	Total
Number of items separated by households	.00	Count	128	98	107	333
		% within Household classification	89.5%	74.2%	81.1%	81.8%
	1.00	Count	4	0	0	4
		% within Household classification	2.8%	0.0%	0.0%	1.0%
	2.00	Count	3	34	24	61
		% within Household classification	2.1%	25.8%	18.2%	15.0%

			Slum	Middle income	High income	Total
3.00		Count	6	0	1	7
		% within Household classification	4.2%	0.0%	0.8%	1.7%
4.00		Count	1	0	0	1
		% within Household classification	0.7%	0.0%	0.0%	0.2%
5.00		Count	1	0	0	1
		% within Household classification	0.7%	0.0%	0.0%	0.2%
Total		Count	143	132	132	407
		% within Household classification	100.0%	100.0%	100.0%	100.0%

Table- 12 Types of Waste Segregated at Home

			Household classification			
			Slum	Middle income	High income	Total
Tick Which of these types of waste you segregate at home? (Paper/cardboard)	0	Count	129	98	107	334
		% within Household classification	90.8%	74.2%	81.1%	82.3%
	Paper/cardboard	Count	13	34	25	72
		% within Household classification	9.2%	25.8%	18.9%	17.7%
Total		Count	142	132	132	406
		% within Household classification	100.0%	100.0%	100.0%	100.0%

For both plastics and organics, households said that the material was collected from their home by the Local Government or Formal Waste Service provider service. Most said that no-one else was prepared to take this type of waste. A minority (16% of those who have paper/cardboard collected) said they paid for the service, but this could mean through their general waste collection charges.

In slum communities, there was a slightly wider range of products separated for recycling (paper/cardboard, organics, but also plastics, and glass). This service also seemed to be through the formal / local government system, rather than through informal providers. But the proportion of people separating waste remains lower than in non-slum households. Most of the HH waste are collected by municipality. Also people are not aware about the waste value. **WASTE is no more Waste it is Wealth**

Very few people said they had difficulty disposing of waste such as medical items, diapers or sanitary products. However, particularly in slum communities, there was a recognition that some people dispose of items in the toilet (81% of people in slums said that this happens). Here people are not much aware about bad effects of medical waste items.

Table-13 Sanitation disposal facility

			Household classification			
			Slum	Middle income	High income	Total
.Do you, or people who share your facility, dispose of any solid waste in this sanitation facility?	Yes	Count	115	6	3	124
		% within Household classification	81.0%	4.5%	2.3%	30.5%
	No	Count	27	126	129	282

	% within Household classification	19.0%	95.5%	97.7%	69.5%
Total	Count	142	132	132	406
	% within Household classification	100.0%	100.0%	100.0%	100.0%

The most common reasons given were **convenience** and **privacy**. People are not much aware about the toilet fill up more quickly.

Table- 14 Indiscriminate solid waste disposal causing an impact in your locality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Significant impact	247	60.6	60.6	60.6
	Moderate impact	154	37.7	37.7	98.3
	Small impact	4	.9	.9	99.2
	No impact	3	.8	.8	100.0
	Total	408	100.0	100.0	

In **non-slum** communities who are the most likely to say the impact is 'significant" because city has open drain in most places. Most the toilets raw water pass to drains. It has environmentally significant impact.

Table- 15 Indiscriminate solid waste disposal causing an impact in your locality

			Household classification			
			Slum	Middle income	High income	Total
Is indiscriminate solid waste disposal causing an impact in your locality?	Significant impact	Count	1	105	102	208
		% within Household classification	0.7%	79.5%	77.3%	51.1%
	Moderate impact	Count	135	25	30	190
		% within Household classification	94.4%	18.9%	22.7%	46.7%
	Small impact	Count	4	1	0	5
		% within Household classification	2.8%	0.8%	0.0%	1.2%
	No impact	Count	3	1	0	4
		% within Household classification	2.1%	0.8%	0.0%	1.0%
Total		Count	143	132	132	407
		% within Household classification	100.0%	100.0%	100.0%	100.0%

The top reason for a significant impact mentioned by all was that rubbish **blocks drains**. Second and third reasons included encouraging flies and mosquitoes and rodents, and creating bad smells. Mostly people through their waste to drains.

In Dhenkanal musicality, most of the markets are near the road side. People sit at the morning time, sell their product. All the waste dump in that location. Though few designated market places are located that happen once weekly or twice weekly. Market places have significant waste generation sites.

When asked about the **types of activity that generate the most significant waste** in the neighbourhood, the overwhelming response was **Local Markets**, followed in non-slum areas by complaints about indiscriminate household disposal, and the role played by hotels and cafés.

Almost everyone in non-slum communities said the impact was worst during the rainy season. In Slum communities, almost everyone said there was no difference in the impact throughout the year.

Table- 16 Impact of poor solid waste management worse at particular due to weather or festivals

			Household classification			
			Slum	**Middle income**	**High income**	**Total**
60.Is the impact of poor solid waste management worse at particular times of the year e.g due to weather or festivals	Yes – dry season	Count	4	0	0	4
		% within Household classification	2.8%	0.0%	0.0%	1.0%
	Yes – rainy season	Count	4	128	124	256
		% within Household classification	2.8%	97.0%	93.9%	63.1%
	Yes – festivals	Count	1	0	1	2
		% within Household classification	0.7%	0.0%	0.8%	0.5%
	No	Count	133	4	6	143
		% within Household classification	93.7%	3.0%	4.5%	35.2%
	Other -please specify	Count	0	0	1	1
		% within Household classification	0.0%	0.0%	0.8%	0.2%
Total		Count	142	132	132	406
		% within Household classification	100.0%	100.0%	100.0%	100.0%

The majority are sympathetic to the work of informal waste pickers. They don't mind them. However, there is very little recognition of the importance of recycling.

Table- 17 opinion of informal waste pickers

			Household classification			
			Slum	**Middle income**	**High income**	**Total**
65.What is your opinion of informal waste pickers?	They create more mess - they are a nuisance	Count	1	0	2	3
		% within Household classification	0.7%	0.0%	1.5%	0.7%
	I don't mind them. They are just trying to make a living.	Count	136	131	129	396
		% within Household classification	95.8%	99.2%	97.7%	97.5%
	They are doing a good job for us by helping recycle material	Count	5	1	1	7
		% within Household classification	3.5%	0.8%	0.8%	1.7%
Total		Count	142	132	132	406
		% within Household classification	100.0%	100.0%	100.0%	100.0%

Attitudes to littering are quite poor. Many people don't mind about it, and in slum areas, the majority of people say that it's fine and it's someone else's job to pick up the litter.

Table- 18 opinion of people who throw waste on the street

			Household classification			
			Slum	**Middle income**	**High income**	**Total**
66.What is your opinion of people who throw waste on the street?	It's fine – it's someone else's job to keep things clean	Count	96	1	1	98
		% within Household classification	67.6%	0.8%	0.8%	24.1%
	It's not advised, but I don't mind much	Count	34	77	98	209
		% within Household classification	23.9%	58.3%	74.2%	51.5%
	It's bad. We should all take responsibility for keeping our	Count	12	54	33	99
		% within Household classification	8.5%	40.9%	25.0%	24.4%
Total		Count	142	132	132	406
		% within Household classification	100.0%	100.0%	100.0%	100.0%

Table-19 Waste Aware Indicators summary:

Indicator	Score	Explanation
1.1 Waste collection coverage	90%	Although the ULB is claiming to collect 100% waste but in reality they cover only around 90% add the household waste.
1.2 Waste captured by the system	90%	The HH waste collected by the system is around 90%,
1C Quality of waste collection service. Will be calculated as a composite of 1C.1-1C.6 below.		
1C.1 appearance of waste collection points	90%	The appearance of waste collection points is 90% as they are placed in appropriate locations. In the areas covering LIG households the collection points should be relooked upon.
1C.2 Effectiveness of street cleaning (presence of litter / overflowing bins)	90%	The street cleaning is happening very effectively. But as a few households are not keeping and handing over waste properly, there are few incidences of litter and overflowing bins.
1C.3 Effectiveness of collection in low-income districts	90%	Collection of HH waste in LIG HHs is satisfactory. However, there is need for daily collection and placing of more public waste bins in these areas.
1C.4 Efficiency and effectiveness of waste transport	100%	Waste collected from the households is being transported efficiently and effectively. The role of PRAGATI, the private waste management agency engaged by the municipality is commendable.
1C.5 Appropriateness of service planning and monitoring	100%	The overall service planning and monitoring is happening up to satisfaction.
1C.6 Health and safety of collection workers	80%	The municipality and the engaged private agency are looking after the health abd safety issues of collection workers. But there is scope for improvement. The collection workers should be provided with gumboots, gloves, and masks regularly.

Indicator	Score	Explanation
4U. User inclusivity	90%	The user inclusivity is nearly hundred percent. But the municipality should involve waste pickers.
4U User inclusivity. Will be calculated as a composite of 4U.1 to 4U.6 below.		
4U.1 Equity of provision	90%	The provision is equally available for all residents of Dhenkanal municipality. But there is very little biasness towards middle- and high-income groups.
4U.2 The right to be heard	90%	Although there is scope of regular public hearing, the ULB is still not able to get the views of all stakeholders regularly. The waste pickers and other left out stakeholders should be increasingly involved.
4U.3 Level of public involvement	80%	The public involvement is quite encouraging. But there is scope to involve more stakeholders fro the public. Waste scavengers need to be included in the process.
4U.4 Public feedback mechanism	80%	There is public feedback mechanism in place. However, there is need for improvement.
4U.5 Public education and awareness	80%	Public education and awareness campaigns has been happening regularly. But there is enough scope to educate HHs especially the LIG people.
4U.6 Effectiveness in achieving behaviour change	80%	The behavioural change towards the management of HH waste is happening among the households. But there is need for more campaigning as around 10% people still need to be educated.

B. Service Providers Perspectives: Considering this, the Dhenkanal Municipality has partnered with PRATYUSH, a sanitation improvement, and waste management private sector company. The tie-up has started to reap good results within a span of the last eighteen months. The major tasks for PRATYUSH are as given below:

- Street Sweeping
- Supervising the collection in all 23 wards
- Supervising the operation at MCCs/ MRFs

Waste generation varies as per the income level of the households. High-income groups generate nearly double that of low-income groups. Waste collected from the low-income groups contains a large proportion of wet/ organic waste. On the other hand, rich people contribute to more dry waste. Pratush is in charge of sweeping and supervision of HH waste collection.

In eight wards municipal staff is engaged for the collection whereas in the rest of the wards PRATYUSH has its manpower. But the overall supervision of the collection process lies on the private agency. PRATYUSH has employed staff to supervise door-to-door waste collection in all 23 wards.

PRATYUSH is also in charge of the supervision of MMCs and MRFs. The company has engaged Supervisors in different MCCs and MRFs. There are 7 MCC cum MRF centers and 4 exclusive MCC centers operating in Dhenkanal. Eleven personnel from the ULB and 5 supervisors from PRATUSH are working at these center

The partnership between the ULB and PRATYUSH has successfully managed the solid waste generated at the household level in the city. Together, they have achieved nearly 90% of their targets in the volume of waste collection, segregation at the source, minimizing open dumping/ littering, disposing of waste, composting, recycling. The effort is not only proved to be beneficial in regards to HHSWM but also help in generating review for the municipality and livelihood opportunities for many. The greatest benefit is the positive impact that the initiative has on the environment as a whole.

The disposal facilities have a clear-cut management plan to deal with the collected waste. Previously, most/ some part of waste was disposed of indiscriminately. But in the last one year or so the target is to collect, treat, and dispose of 100 percent of household waste.

As a part of the initiative, the civic body set up six micro composting centers (MCCs) and three material recovery facilities (MRFs) at a cost of `3.51 crore. The women are in charge of the whole thing, from collecting waste to segregation and composting. They are also creating awareness among people about the need to compost waste than landfill it. The municipality has provided them battery-operated vehicles (BOVs) for collecting garbage from different wards and transporting it to the big tractors which take the waste to the MRFs and MCCs.

Data related to waste collection, transportation, processing, recycling, composting, etc. is kept. The data is organized at the Municipality and available to analyse and take necessary actions. The data is also used to make annual/ monthly plans and budgets. Records are kept in computers and hard copies are available to the decision-makers. Monthly MCC 187ntons and MRF 50.810 tons

The importance is given to separate the household waste at the source. The separation is mostly done at the household level. Still, around 20 percent of the households sometimes mix the waste that needs to be separated. Again, the municipal waste collected from market places and other sources is often mixed. So the collected waste when reached the disposal facilities are separated and accordingly sent to MCC or MRF centers. Wet waste is used for composting at the MCC whereas recyclable waste is sorted according to the type of material which is later sold to different companies. In the month of Dec MCC 63 tons and MRF 50.810 tons. Out of 187 tons MCC-63 tons sold and 102 tons are stock available.

All the service providers are included in policy and decision-making, including informal providers. But it was observed that the informal waste businessmen (Kawadiwallas) are still not included in the waste management process formally. The kawadiwallas are not consulted or called for by the municipality. There is a feedback mechanism in place for the private sector to the public sector. The service provisions are demarcated by the personnel engaged by the public and private sector,

There are around 16,000 households that pay holding tax. There is another newly constructed 2,000 (non-assessed) houses in the city. The use fee is collected since August 2019. The user fee for HHSW is levied upon all 18,000 households. In the financial year 2018-19, INR the total holding tax collection was INR 22 million. For the same period, the user fee and MCC income together were accounting for INR 25 million. Income from holding tax-84 lakh per year , Income from sales from MCC-2 lakh 67 thousand per year

Income from MRF 2lakh 9000 thousand per year , Expenditure on SWM by municipality- 1 lakh 75 thousand per year

Table- 20 Summary of Waste Aware Indicators on Provider Inclusion

Indicator	Score	Explanation
4P. Provider inclusivity	90	The provider inclusivity is quite satisfactory. But there is need for improvement in few aspects.
4PProvider inclusivity. Will be calculated as a composite of 4P.1 to 4P.6 below.		
4P.1 Legal Framework	90	The legal framework is in place. However, there is need for inclusion of all waste business men and waste pickers.
4P.2 Representation of the private sector	90	The private sector is included in the HH waste management. But there is need for more inclusiveness inn this regards.
4P.3 Role of the informal and community sector	90	All waste pickers and waste business men should be identified and included in the pro cess.
4P.4 Public feedback mechanism	90	There is public feedback mechanism in place. But it need to be improvised.
4P.5 Balance of public vs private interests in delivering services	80	There is need for more inclusion of private players so that he balance could be made.
4P.6 Bid processes	100	The bid progress is quite transparent.

C. Waste Quantity Calculation: The fieldwork for waste quantity and composition study was carried out from 18th January to 25th January 2021. The objective was to collect household waste from 30 households across different economic groups (LIG, MIG, and HIG) in the study area, i.e. in Dhenkanal Municipality.

The rationale behind choosing households from different income groups was the amount of waste generated is often linked with income. In India, households are generally divided into these kinds of groups as per their income. Governments and other institutions take up/target developmental activities considering these three groups. Income pattern has a direct link with the kind of lifestyle that a household maintains.

To choose the households, a stratified random sampling method was used. Accordingly, each household was supplied with two bins (dry and wet) having separate colours (green and blue) meant to collect dry and wet waste respectively. The waste bins were provided by the Dhenkanal municipality for free of cost. The households were intimated that they would keep the bins with them even after the fieldwork is completed.

Before the collection of waste was made, a thorough orientation of the households was carried out to make them understand the spirit of the study. They were asked to keep all of their dry and wet wastes generated in their household separately each day for 8 days. They were also asked to keep waste in the provided bins and not to throw any waste outside/ backyard. They were requested to repeat the act for 8 days without missing any day in between.

It is noteworthy here that values for waste quantity and composition were taken from the 2nd day to the 8th day. The data for the 1st day was not taken into consideration. The 1st day was spared to ensure all households are putting waste separately and correctly.

During the fieldwork, the target was to collect waste from 10 households each from LIG, MIG, and HIG households. Eventually, waste was collected from 30 households from all economic groups. The households were divided into three groups as per their income levels. Families having an income of rupees 1 to 2 Lacs (INR 100,000 to INR 200,000) per annum were considered as LIG (Lower Income Groups). Those having an income level of rupees 3 to 4 Lacs (INR 300,000 to INR 400,000) per annum were considered as MIG (Middle Income Groups). The third group was HIG (High Income Groups) who have an income of rupees 4 to 6 Lacs (INR 400,000 to INR 600,000) per annum.

Table- 21 Total HH members from all economic groups

Total HH members from all economic groups	155.0
Total Weight (HIG + MIG + LIG) of waste in 7 days	307.1
Average waste per HH per day	1.0
Average waste per person per day	0.2

As mentioned above, stratified random sampling was used to identify the households that are chosen for the purpose. The chosen households were located across the city and different localities/wards were represented.

The prime emphasis was to collect waste from the sample households and to weigh that on daily basis for 8 days. Waste from each household was collected separately using bags and bins were remained with the households. The weighing was done at the source (households) itself.

The challenge was to ensure each household put all their waste separately in designated waste bins continuously for 8 days. If any of the households don't follow this then the result of the study would have been affected.

The 1st day was spared especially to know whether each household is putting all their waste that too separately in the bins. It was found that 3 LIG households didn't put all their waste in the bins rather threw part of the waste in their backyard. Again, 2 households from LIG and MIG groups didn't separate waste properly.

These households were further oriented and requested to collect waste as per the norm set for the study. From the 2nd to 8th day all households kept waste as per the instruction given to them.

Before shedding light on the findings of the waste quantities study, profiles of the households need to be discussed.

Waste was collected and weighed from 30 households in total from across 3 groups (LIG, MIG, and HIG). Ten households from each income group were chosen for the study. The total number of members from all households was 155. The average household member is highest (6.3) in LIG families and lowest (4.5) in HIG families.

Table- 22 Waste calculation from 30 HH

Income Group of HHs	Household identification	HH 1	HH2	HH3	HH4	HH5	HH6	HH7	HH8	HH9	HH10	Total	Avg. HH member
LIG	Household Sizes (Members)	5	4	7	6	6	2	11	9	8	5	63	6.3
MIG	Household Sizes (Members)	3	4	9	4	6	4	4	3	3	7	47	4.7
HIG	Household Sizes (Members)	3	4	4	6	8	6	4	3	3	4	45	4.5
TOTAL NO. OF MEMBERS FROM ALL HHs AND ALL INCOME GROUPS												**155**	**5.2**

The study on waste quantity and composition reveals the following important data about household waste in Dhenkanal city.

Table-23 Waste quantity and composition

Particulars	LIG	MIG	HIG	TOTAL	AVG. For all HHs
No. of HHs	10	10	10	30	NA
No.of Members	63	47	45	155	NA
Avg. No. Of Members in HHs	6.3	4.7	4.5		5.2
Total Waste in 7 days	88.3	91.9	126.9	307.1	102
Total Waste/day	12.6	13.1	18.1	43.9	14.6
Avg Waste Per HH Per day	1.3	1.3	1.8		1.5
Avg Waste / Person / day	0.2	0.3	0.4		0.3

During the waste quantity survey, it was found that the average weight of solid waste per household per day varies widely among different income groups. The figure for LIG is

The average weight of waste per household per day is 1.5 Kg in the study area. But it varies as per the economic level of the households. The average weight of waste per household per day for LIG, MIG, and HIG is 1.3 Kg., 1.3 Kg, and, 1.8 Kg. So it is evident that HIG households generate more waste than the other groups.

The average weight of waste per person per day is 0.3 Kg in the study area. But it varies as per the economic level of the households. The average weight of waste per household per day for LIG, MIG, and HIG is 0.2 Kg., 0.3 Kg, and, 0.4 Kg. So it is evident that the per capita waste generation increases as the income level of households increase.

The average number of members decreases as the income level increases. The average family size for LIG household was 6.3. The figure is 4.7 and 4.5 for MIG and HIG households. The average family size of households from all income levels s 5.2. There is a direct correlation between the level of income and household waste generation.

The average waste generation per household per day increases as the income level increases. Similarly, the average waste generation per person per day is more when the income of a household is more.

The average weight per household per day and person per day for the different *waste fractions* – for the different types of households (LIG, MIG, and HIG) are given in the table below.

Table-24 Waste Fraction for the different types of households (LIG, MIG, and HIG)

WASTE FRACTION	Total weight of Waste Per Category (in Kg) in Seven Days			% Per Category		
	Income Levels of HHs					
	LIG	*MIG*	*HIG*	*LIG*	*MIG*	*HIG*
Kitchen/canteen waste	51.6	52.7	52.1	58.4	57.2	41.1
Garden/park waste	0.0		20.3	0		16.03
Paper/Card	13.3	11.1	16.3	15	12	12.86
Plastic-film	3.1	1.2	6.6	3.4	1.32	5.18
Plastic-dense	15.0	22.5	22.6	16.9	24.52	17.84
Metals	1.1		3.4	1.2		2.66
Glass	4.1	4.1	5.2	4.6	4.42	4.1
Textiles/shoes	0.0	0	0	0	0	0
Wood (processed)	0.0	0	0	0	0	0
Waste electric and electronic equipment	0.0	0	0.1	0	0	0.08
Hazardous household waste	0.0	0	0	0	0	0
Other…(Dust)	0.2	0.4	0.2	0.24	0.39	0.12
Total weight of waste per day (kg)	88.3	92.0	126.9	99.74	99.92	99.97%

The total amount of waste (kg) generated by households was 307.2 kg. Out of the total amount of organic waste that goes for composting (Kitchen waste + Garden waste) accounts for 50.9%. The percentage of inorganic waste was 48.8% of the total generated waste. Around 0.3 % of the waste consists of dust collected from floors and moisture.

The good part of the study finding is that 100% of waste generated was collected and sent to the disposal sites and then 100% recycling is done. All collected organic waste sent for composting plants and all recyclable items are sent to MRF centers. Around 10% of the HH waste is not being collected for different reasons. We have to understand that the Kawadiwalla's are not getting waste from the streets or outsides. Rather a majority part of their waste comes directly from households to them. The agents of kawadiwallas purchase those waste from the households at their doorsteps. They are getting waste from HHs not from thrown away waste. Of course, they get a smaller part of waste from the thrown away waste that is collected by the scavengers and sell to them.

60% of people who opined that waste left in the environment that causes 'significant' impact is from particular areas of Dhenkanal not from the whole city.

Table-25 Waste disposal system

What happens to wastes	*LIG*	*MIG*	*HIG*	*Total*
Total waste generated (7 days) in kg	88.3	92.0	126.9	307.2
% of organic waste goes for Composting (Kitchen waste + Garden waste)	58.4	57.2	57.1	50.9
% of Inorganic waste	41.1	42.3	42.7	48.8
Other (dust, moisture)	0.5	0.5	0.15	0.3
Total (%)	100	100	100	100
% taken to a disposal site	100	100	100	100
% of Recyclable waste	100	100	100	100

% of Remainder left in the environment	0	0	0	0

Summarize conditions at final disposal site – and overall of environmental protection, using indicators from Waste Aware 2 and 2E on 'Environmental Control – waste treatment and disposal'.

Table-26 Environmental protection in waste treatment and disposal

Indicator	Score	Explanation
2. Percentage of the total municipal solid waste destined for treatment or disposal in either a state-of-the-art, engineered facility or a 'controlled' treatment or disposal site.		
2EDegree of environmental protection in waste treatment and disposal. Will be calculated as a composite of 2E.1-2E.6 below.		
2E.1 Degree of control over waste reception and general site management	90%	Around 90 percent of the HH waste is being collected, transported and treated. The MCC/MRF sites are well managed.
2E.2 Degree of control over waste treatment and disposal	90%	The municipality has total control over the waste treatment and disposal. However, around 10 percent of the HH waste is being eithercollected by the private waste pickers or thrown outside.
2E.3 Degree of monitoring and verification of environmental controls	90%	The municipality has monitoring wings that looks alter the waste collection, dispose, and treatment.
2E.4 Efficiency of energy generation and use	n/a	Not applicable – relates to waste-to-energy
2E.5 Degree of technical competence in the planning, management and operation of treatment and disposal	95%	The municipality is equipped with efficient technical staff for planning, management, and operation f treatment and disposal, But few more staff is required.
2E.6 Occupational health and safety	90%	The municipality is taking care of this aspect. But there is scope for improvement.

5. Conclusion: SWM problem for case study area is irregular/ slowness in waste collection by the municipality people, need more private player to intervein in collecting the waste. In this study area slum people are getting better service because of compact in size, so it is easy to collect the waste easily from their door. City is growing faster most of the affluent people are constructing house in city outskirt, it is very difficult for the municipality to provide service. It is very difficult for municipality to give the service in new expanding area. Very negligible contribution of informal waste workers to solid waste management in the city because most of the waste are recycle within the city. Scientific way of Solid Waste Management is needed at this juncture and Waste pickers should be engaged in recycle process. So, it would be if there would be Solid Waste Plant at the city so the all resident and slum dwellers waste can be processed and slum people would get new livelihood opportunity. City life would be livable and lovable. This paper would be helpful to academician, researcher, Planners and Decision makers for future city planning and management.

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