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Research Article

MANAGEMENT OF URBAN SOLID WASTE

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ABSTRACT

The municipal solid waste (MSW) management in Imphal is still infused with challenges owing to the predominant reliance on the conventional method of waste collection, transportation and disposal. Segregation of waste is not done at source even though the municipal laws stress the importance of it. The situation at present is alarming and requires improvement in the area of infrastructural up gradation, public-private partnership (PPP), public participation, awareness campaign and implementation of existing laws. The reliance on modern method of waste recovery and recycling in the present context of waste management is negligent. This paper stresses the need of material recovery, recycling and waste-to-energy technologies in the policy making pertaining to MSW. The paper also aims to understand the importance of PPP relationship in effective management of MSW in Imphal.

INTRODUCTION

India and the other developing countries share a common problem in terms of urban solid waste management. The municipalities are unable to manage the increasing generation of waste due to rapid growth of population, change in lifestyles, urbanization and industrialization. Many scholars have often directed our attention towards some of the common problems which includes financial constraints, inadequate infrastructure, poor implementation of policies and undesirable behavior towards disposal of waste. The other problems associated to this are non-segregation of waste at source, open dumping and the major portion of which are diverted to landfills. This method of waste disposal poses a threat to health and environment.

The release of greenhouse gases (methane, carbon dioxide, water vapour and so on) from the disposal site contributes to global warming and lecheate percolation, which pollutes the ground water. The epidemic outbreak pertaining to vector borne and water borne diseases are the direct impacts associated to unscientific and haphazard manner of waste dumping. Developing countries are hence compelled to spend a huge financial amount to neutralize these impacts. According to World Health Organisation (WHO) report 2016, India's expenditure on Malaria and Dengue was about $1.94 billion (Rs 11,640 crores) and $1 billion (Rs 6,000 crores) respectively with 95% of the people living in malaria-endemic areas (Times of India, 2016). Considering the amount spent on vector-borne diseases, the financial burden could be reduced and be utilized in other sectors of development if the urban solid waste is managed and tackled in sustainable manner.

In India, the per capita generation of MSW has increased from 0.44 kg/day in 2001 to 0.5 kg/day in 2011. The increase in purchasing power of urban Indians in addition to the growing population, urbanization and industrialization has resulted in 50% increase of MSW generated in the last decade. The urban cities of India generate about 68.8 million tons per year or 188, 500 tons per day of MSW. The steep increase of MSW generation has worsen the severity of stress on all available resources such as natural, infrastructural and budgetary (Annepu, 2011). The situation has alarmed NGOs, civil societies and other stakeholders to take part in effective management of MSW in various cities of India.

MATERIALS AND METHODS

The Imphal Municipality covers an area of 1,22,800

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hectares which comprises of Imphal East and Imphal West. The area extends between $24^0$33' N to $25^0$55'N latitudes and $93^0$42' E to $94^0$7' E longitudes. Imphal West has the highest population of 514,683 which comprises of 18.91% of the total population among the nine districts of Manipur. It is followed by Imphal East with a population of 452,661 which comprises of 16.63% of the total population. Imphal West has the highest population density of 992 persons per square kilometers (Khwairakpam, Singh and Naorem, 2015).

The Imphal Municipality generates 48 tons per day (TPD) of MSW in 2001 and which increased to 72 TPD in 2011. The per capita generation of MSW also increased from 0.190 kg/day in 2001 to 0.217 kg/day in 2011 (Annepu, 2012). The city observed an increase of MSW on an average of 50% daily and 14.2% on per capita generation in a decade.

The Imphal Municipality consists of 27 wards. It employs 100 staff and 22 vehicles for collection, transportation and disposal of municipal solid waste. The study includes field visit to landfill sites in Porompat and Lamdeng. The study also includes household interviews to understand the nature of waste collection system and problems related to non-segregation of waste at household level. The household survey was carried out in Tangkhul Avenue, Nagaram, Deulaland, Chingmeirong East and Singjamei.

Physical composition of MSW in Imphal

The physical composition of MSW in Imphal has a maximum content of organic waste (60.59%) followed by plastic (11.06%) and paper (7.16%) as indicated in Table 1. The physical composition suggests that the adoption of technologies such as compost and recycling plant is imperative in the management of MSW in Imphal municipality. The existing laws do not promote "3R" policy which is a key tool for effective management of MSW in the contemporary world. "3R" policy means "reduce, reuse and recycle". Huge volume of waste can be reduced, reused and recycled to reduce the pressure on production of virgin materials.

Table 1. Physical composition

S. No	Parameters	Percentage (%)
1	Organic	60.59
2	Paper	7.16
3	Plastic	11.06
4	Glass	1.86
5	Metal	1.4
6	Leather	0.16
7	Rubber	1.75
8	Wood	0.49
9	Textile	1.68
10	Biomedical	0.78
11	E-waste	0.73
12	Miscellaneous	12.51

Source: Singh and Dey, 2015

RESULTS AND DISCUSSION

Present status of municipal solid waste management

The Imphal municipal corporation (IMC) collaborates with 6 NGOs namely, centre for research on environmental development (CRED), workers' union Manipur (WUM), seven security force (SSF), TACDEF solid waste management of Manipur, Khaba waste management system (KWAMS), and social upliftment and welfare organization (SUWO) to carry out the management of municipal solid waste in Imphal municipality. These six NGOs and their assigned wards for collection, transportation and disposal of MSW are given in Table 2.

Table 2. Name of NGOs and their assigned wards

S. No	Name of NGO	Wards Covered
1	Centre for research on environmental development (CRED)	4, 5 (part), 6, 14, 15, 16, 17, 24 and 27
2	Workers' union Manipur (WUM)	25 (part) and 26
3	Seven security force (SSF)	7, 8, 9,10,11,12 and 13
4	TACDEF solid waste management of Manipur	1, 2, 3 and parts of 4, 5, 25 and 26
5	Khaba waste management system (KWAMS)	18 and 22
6	Social upliftment and welfare organization (SUWO)	21 and 22

Source: Imphal Municipal Corporation

Collection

There are two system of waste collection in Imphal municipality. First, the residents assemble the waste in a plastic bag or cartoon box or jute bag outside the corridor of the house. Second, the NGOs or municipality vehicles would collect the assembled waste and dump them in the landfill sites. The vehicles used in collection of waste raises an alarm to alert the residents after which they drop their household waste into the vehicles. The collection of MSW is done randomly without any segregation. Door-to-door service of collection is also not practiced. Sometimes, the collection of MSW by NGOs or municipality vehicles is irregular due to regular events of strikes and blockades and sometimes floods in Imphal. Owing to this, a regular complaint by local residents was observed in the studied area.

CRED employed 9 vehicles, 40 workers and 30 sweepers for collection, transportation and disposal of MSW. The organization collects monthly fees of 100 rupees for residents, 250 rupees for commercial areas for other establishments like hospitals, hotels and clinic and so on, they are charged per volume or quantity. They collect wastes twice or thrice a week in all the assigned areas. The organization collects a monthly fee of 8000 rupees for waste collection at Langol View Charitable Clinic and Maternity Home, 2000 rupees at Iboyaima Hospital Research Centre and 4000 rupees at Manipur Secretariat with a frequency of thrice a week.

WUM employed 18 workers, 35 sweepers and 6 vehicles. The sweeping areas includes ward no. 4 (RIMS road Nagamapal to RIMS Traffic Corner, Uripok Hindu Hotel to RIMS Corner via RIMS Gate) and ward no.6 (Uripok Cheirap Machin to N.R.L Pump Traffic Point). The organization collects 200 rupees for major shops, 150 rupees for households and 100/50 rupees for small shop per month.

SSF employed 9 vehicles, 73 sweepers, 27 labourers and 9 drivers. It employs the highest number of workers and vehicles among the six NGOs. The sweeping extends from Keishampat junction to airport exit gate and Keishampat junction to Tera Bazar via Wahengbam Leikai traffic point.

TACDEF solid waste management of Manipur employed 30 workers and drivers, 40 sweepers and 5 vehicles. The organization collects waste daily from MLA Hostel, DMC College Road including ABC Go down, Lamphel Sanakeithel Main Road, Thangal Bazaar Area and Khongnang Karak Area. It collects waste from bulk generator such as Classic Hotel, Imphal Hotel, Classic Grandee, Raj Medicity, Maipakpi Maternity and Child Hospital, City Hospital and Research Centre and IBSD Takyel, SHIJA Hospital, Sky Hospital and Padma Diagnostic centre. The sweeping area includes Khongnang Karak to Khoyathong Traffic point, Khoyahtong Traffic Point to Nitaipat Chuthek, Khongnang Karak to Khoyathong Pukhri, Khongnang Karak to High Court, Khoyathong to Kasturi Thong and SSS Hotel to SBI (Gandhi Avenue). The collection is usually done twice or thrice a week in an allocated area.

KWAMS employed 15 labors and drivers, one inspector/supervisor, 32 sweepers and 3 vehicles. The sweeping area includes Waikhom Leikai Leirak, Kakwa Bazaar up to MU Main gate, Chingamakhong, Pisum Thong, Keisham Thong Bazaar up to Keishampat Thong khong. It collects waste from bulk generator such as Babina Diagnostics, Porompat and Imphal East.

SUWO employed three drivers and 5 labors and two vehicles.

Transportation

The transportation of MSW is done by varied number of vehicles. The vehicles used for transportation of MSW includes TATA truck, tractor, dumper placer, JCB, TATA 407, TATA ACE HT, canter truck, TATA tipper and others as indicated in Fig. 1.

Fig. 1 (A) Earth cover at Porompat landfill; **(B)** Compost plant at Lamdeng landfill; **(C)** Compost at Lamdeng landfill; **(D)** Layer sheet below solid waste at Lamdeng landfill.

Disposal and compost

At present, the MSW is dumped in Porompat and Langol landfill site. Landfill in Lamdeng is closed due to complaints by nearby village about the emanation of foul smell from it. The compost plant at Lamdeng constructed by Department of Municipal Administration Housing and Urban Development under Jawaharlal Nehru national urban renewal mission (JnNURM) became non-functional after a trial period of three months. After talking to the supervisor of the plant, Robindro Singh, it was revealed that there was no willing company to take over the plant.

There is no method implanted for lecheate recovery in both the landfill sites. Regular complaints by passerby and residents staying nearby landfill sites are noticeable owing to filthy and smelly environment. Earth filling was done in some parts of Porompat landfill site to shun the smell as indicated in Fig. 2. However, this method is not eco-friendly as it contains many non-biodegradable substances buried inside the soil which will instead create more disturbances to nutrients cycle and pollutes the ground water.

Fig. 2 (A), (C) and **(D)** Vehicles are used for collection, transportation and disposal of waste; **(B)** Vehicle used for loading/unloading of waste in landfill.

Incineration

Incineration with energy recovery is one of the most desired and viable option often used in industrialized nations. It is an appropriate technology for reducing the volume of MSW before dumping them to landfill sites. It also reduces the potential environmental risk and potentially converts MSW into recoverable energy. The other major advantage of incineration is that it minimizes the burdensome cost on land disposal (Liu and Liu, 2005). However, this technology should be procured based on the composition of MSW and economic aspects of a country.

Incineration plants are installed in most of the hospitals, research institutes and clinics in Imphal with a purpose of burning bio-medical waste. The concept of producing energy through incineration technology is absent in Imphal.

Household survey

Household survey was carried out in five areas namely Tangkhul Avenue, Nagaram, Deulaland, Singjamei and Chingmeirong of Imphal Municipal area. In all these areas, same method of waste storage, collection, transportation and disposal were observed. Segregation of waste is not done in all the households. While talking to respondents, it was revealed that the IMC lacks adequate infrastructure and awareness activities for segregation of waste at source.

The studied household generated an amount of 1 kg to 2 kg of waste daily depending upon the size of the family. The household of Elda Zimik and Dorendro Laishram generates 1 kg of waste daily with a family size of three persons. They use organic waste for pig rearing while the rest of the waste was left for collection by NGOs vehicles.

Each household deposit waste in plastic bags, cartoon box, bucket and so on and leave them outside the household compound. Door-to-door collection was not done in the studied area. The NGOs vehicles collects these waste twice or thrice a week as per their agreement with IMC but several complaints was made by public due to the irregularity in collection of waste.

While interviewing Anthony Rimai, aged 40, graduate who hail from Tangkhul Hundung, it was found that the respondent segregate waste at home. The organic waste are segregated and then dumped at home in traditional compost pit made in front of their house. The waste such as plastic, paper and others were burnt in the open. When asked about the open burning of waste, he said that he had no other option for disposal. The respondent household generates about 2 kg of waste daily.

Policy

Appropriate policy with proper implementation is a key ingredient for success management of MSW. At the state level, Imphal Municipal Corporation has legislated "The Imphal Municipal Council (Cleanliness and Sanitation) Bye-Laws, 2011". According to this law, IMC is responsible for collection, transportation and disposal of municipal solid waste in 27 wards of Imphal. The concerned authority is also responsible to provide adequate infrastructure for segregation of waste, composting and recycling.

The law makes a mandatory provision with penalties to every household and vendors/hawkers for non-segregation of waste at source. However, the existing law severely suffers from poor implementation. CH Maneka, Assistant Engineer, Imphal municipal corporation (IMC) said that it was once implemented in some areas. However, with the ongoing time the municipal authority was unable to control the situation. The respondent blames the public for non- segregation of waste at source and littering of waste on the streets and drains.

The Imphal municipal council (Cleanliness and Sanitation) Bye-Laws, 2011 impose penalties on littering of municipal solid waste, spitting, open defecation and urination and others. The details of penalties are given in Table 3.

Table 3. Schedule of fines. The Imphal municipal council (Cleanliness and Sanitation) Bye-Laws, 2011

S. No	Description	Rupees
1	Littering on road/streets/public places	200
2	Spitting	100
3	Creating bathing nuisance	100
4	Urinating	200
5	Defecting	100
6	Feeding animals/birds in non-designated areas	200
7	Washing vehicles	500
8	Washing utensils/any other object	200
9	For not maintaining clean public courtyard	
	a) For owner/occupier or single premises	400
	b) For more than one owner/occupier	500
10	For delivering waste that is not segregated and stored as specified in separate bins	
	a) Individual	100
	b) Bulk generator	500
11	For not delivering bio-degradable waste in a segregated manner as specified	100
12	For not delivering “dry” waste in a segregated manner as specified	100
13	For not delivering garden waste and tree trimmings as specified	100
14	For disposal of waste by burning	100
15	For not delivering (non-household) fish poultry and meat waste in a segregated manner as specified	f 1000
16	a) For a vendor/hawker without a container/waste bucket	10
	b) For a vendor/hawker who does not deliver waste in segregated manner as specified	10
17	For not keeping the house-gully clean	500
18	For littering by pet owned animal	200
19	For not cleaning-up after public gathering/events within 4 hours	Forfeiture of the cleanliness deposit
20	Uncleanliness due to car/vehicles parking at the sweeping	500
21	Sticking of posters banners, hoardings	500

Source: Imphal Municipal Council

CONCLUSIONSANDRECOMMENDATIONS

The effective management of MSW is determined by joint action of appropriate technology and policy coupled with stringent implementation and desirable behavior of the society. It is also determined by the responsive functioning of the duties assigned to different stakeholders in public-private partnership (PPP) of a region. The study on MSW management in Imphal reveals that the technology is still not at par to handle the amount of MWS generated daily. The existing compost plant in Lamdeng is not functional. IMC would require setting up more compost plant and recycling units to manage generated MSW in sustainable manner. This will generate employment as recycling and compost is a lucrative business in other metropolitan cities of India. Eventually, it would also reduce pressure on natural resources and the negative impacts on health and environment.

To achieve environmental sustainability, integrated solid waste management is imperative where technologies, policies, PPP and more importantly the public participations are the key ingredients.

The existing policy pertaining to MSW in Imphal lacks holistic approach. Segregation of waste at source should be made mandatory and laws should be enacted to impose penalties on those violating the law. More awareness campaign is necessary to highlight the ill impacts pertaining to open dumping and improper management of MSW. A loophole in public-private partnerships was observed with frequent complaints from the public due to irregular collection of waste. The present situation of MSW management in Imphal is still at its natal stage with the need to improve in areas of technological up gradation, policies, public-private partnerships, public participation and behavioral perspectives.

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