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Municipal Solid Waste Management in Imphal Town, Northeast India: A Critical Analysis of Existing Management Practices and Proposed Action Plans

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Abstract

Rapid growth in urban population coupled with economic growth and rise in community living standards has resulted in generating huge amount of municipal solid wastes in various Indian cities. The present study evaluates the status of existing solid waste management (SWM) system in Imphal town of Northeast India and feasibility of SWM plan. It revealed that the present system of SWM is not appropriate and highly unsatisfactory based on Solid Waste (Management and Handling) Rules-2000. There are many shortcomings in the existing system of municipal solid waste management (MSWM). Imphal town generates about 120 tonnes/day of solid waste, and is projected to rise about 170 tonnes/ day by 2035. About 40-50% of that waste is collected by the management authorities while rest of it remains uncollected. In the absence of sanitary landfills, solid wastes (SWs) get dumped in the open places, creating nuisance and unhygienic conditions. This may resulted in a high risk of contamination to different environmental compartments including soils, groundwater/surface water, and air leading towards human health hazards. The newly proposed future strategies and action plans by Imphal Municipal Corporation to combat the deficiencies in the existing MSWM systems will prove to be satisfactory and feasible provided its immediate and successful implementation.

Keywords: Municipality; Imphal; Nambul river; MSW (Management and Handling) Rule 2000; Refuse

Introduction

Municipal solid waste management (MSWM) is an integral part of urban environmental management [1,2]. As the villages grew into towns and cities, it has been observed especially in developing countries to throw waste onto access ways, vacant plots and into waterways where they intermingled with excrement of communities [3]. Today's greedy human populations utilize more material than required to meet their daily needs. Hence, the excess materials and non-usable portions are discarded, known as solid waste or refuse. At every level of development, human beings produce domestic, agricultural, industrial, hospital wastes and some wastes at public places [3]. Such waste contains both solid and semisolid organic wastes, which may be biodegradable, non-biodegradable, or in part. Therefore, proper collection and subsequent disposal of solid wastes with minimum nuisance have assumed a great importance in community environmental sanitation programs. Improper disposal causes an adverse impact on all components of the environment and human health [4-6]. Improper management of SW has been well reported in different cities of developing countries [7-9].

In India, every year 30.3 million tons of municipal solid wastes (MSW) are generated, equaling to on an average nearly 350 gram of waste per person [10]. This amount is expected to increase in the near future with increasing population and industrialization [11-13]. According to the Central Pollution Control Board of India [13] estimates, the expected MSW generation rate will be believed to increase to 299.3 million tons by the year 2047, considering that urban population growth of India to 45% from the present growth of 28% [13,14]. This remarkable increase in the amount of MSW generation is due to change in lifestyles, food habits, and living standards of the urban population. Around 65% of India's population lives in class I town (population over 0.1 million), and 23 cities have become metropolises (population over 1 million) [1]. Presently, India with its seven megacities, 28 metro cities, 388 class I cities, and another 3,955 urban centers (populations less than 100,000) generates 7.70, 7.17, 15.56, and 7.35 million tons of MSW per year, respectively. This equates to 72.5% of the waste generated in India and 17.5% of the total waste generated in 3,955 urban centers [15].

In New Delhi (capital city of India), 13.9 million residents living in 2.96 million households generates approximately 2.56 million tons of SW per year and is projected to rise 6.21–9.13 million tons per year by the year 2021 [16]. The quantity of MSW generated in Chennai (population in 2010; 4.62 million) metropolitan city was around 1.28–1.75 million tons per year [17]. Allahabad Municipal Corporation (AMC; population in 2001: 1.22 million) estimated annual per capita growth rate for MSW generation to 0.15 million tons in 1997 and predicted to 0.51 million tons by the year 2026 [18]. Kolkata city (the capital city of West Bengal state, population in 2010: 5.14 million) generated approximately 1.07 million tons per year [19]. The total MSW generated in Kharagpur (West Bengal; population in 2001: 0.21 million) was 95 tons per day(TPD), but the waste collected by the municipality is about 50 TPD, which implies that almost 45 TPD of the solid waste generated remained uncollected [20].

In the light of above literature reviewed, it is evident that in spite of technological advancement, an effective management of MSW is plaguing in most of urban city of India. A systematic approach to deal

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effectively with the solid wastes is lacking in most of the Indian cities [16,19,21-24]. Imphal town (the capital city of Indian state of Manipur) with population of around 0.25 million (2011 Census) also facing problems of proper solidwaste management. Hence, present study aims to assess existing MSW management practices in compliance with MSW (Management & Handling) Rules, 2000 and to estimate the quantity and composition of MSW to categorize them suitable for waste recycling. Further, we intend to evaluate the feasibility and accomplishment of newly proposed MSWM plan by IMC.

MSW (Management and Handling) Rules, 2000

Considering the pathetic situation of solidwaste management practices being adopted by the urban local bodies (ULBs) in the country, in September 2000, Ministry of Environment and Forests (MoEF) notified the 'Municipal Solid Waste (Management and Handling) Rules, 2000. It was promulgated under Environment Protection Act, 1986, making it mandatory for ULBs to improve the systems of waste management as envisaged in the rules, within a given time frame of 31st December, 2003 [25]. MSW (M&H) Rules, 2000 is applicable to every municipal authority responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid wastes. There are four schedules in the rules which describe and layout procedures for waste collection, segregation, storage, transportation, processing and disposal of SWs in a scientific manner (Table 1). The silent feature of schedule-I is given in Table 2. It is imperative to note that even with the span of 10 years from the implementation deadline, municipal authorities and corporations of Indian urban cities failed to implement the SWM plan compliance in MSW (M&H) Rules, 2000 and very little has been improved compared to past 10 years. As per these rules, all the biodegradable MSW shall required to be processed by appropriate biological processing method, littering of waste on the streets should be prohibited, adopting of three bins (green for biodegradable, white for recyclable and black for other wastes) system, primary collection of wastes from the doorsteps, daily street sweeping, abolition of open waste storage sites, transportation of wastes in covered vehicles, processing of wastes by composting or power generation and disposal of non biodegradable waste only at sanitary landfill sites. The MoEF, Government of India, identified the Central Pollution Control Board (CPCB) as the agency to monitor the implementation of these rules.

Another serious concern pertaining to solidwaste in an urban area relates to the generation of bio-medical waste. These wastes, though are generated in small quantities, pose a great risk to the community due to their potential biohazard. Recently, Ministry of Environment and Forest, Government of India has drafted new Bio-Medical Waste (Management and Handling) Rules, 2011 under the Environment (Protection) Act, 1986 to replace the earlier Bio-Medical Waste (Management and Handling) Rules, 1998 and will be implemented soon. The disposal of non-hazardous industrial waste is also another problem area and is taken care through the hazardous waste (Management and Handling) Rules, 1989 and Amendment Rules, 2000 and 2003. Though these wastes have low components of hazardous components, the environment is threatened due to the volume of such waste generated in a city. Regulation of plastic waste, particularly manufacture and use of recycled plastic carry bags and containers, is being regulated in the country as per 'Recycled Plastics Manufacture and Usage Rules, 1999' and as amended in 2003. However, there are no specific environmental laws or guidelines for electronic waste management in India. None of the existing environmental laws have any direct reference to electronic waste or reference to its handling as hazardous in nature.

Materials and Methods

Imphal town is situated at 24.50° North latitude and 93.57° East longitudes, is a rapidly growing urban area (Figure 1). It is located in the Valley of Manipur River surrounded by the North-Eastern hills. It is the only class I city (population over 0.1 million) in the State. IMC area includes East and West Imphal districts spreading over 34.48 Sq. km, and has a total population of 0.25 million. Whereas, Imphal urban agglomeration comprised of IMC as well as fringe areas, known as Greater Imphal, with an areas of 104.54 Sq. km and 0.42 million as its total population. It is the center of all cultural, commercial and political activities in the state, and is an attractive tourist attraction center.

A total of 27 municipal wards (an administrative unit of the town: henceforth referred as ward) of Imphal town were surveyed for sampling purpose. Figure 1 shows the different wards of the Imphal town. The whole town was divided into five different zones such as higher income, middle income, lower income, slum areas, and commercial areas. MSW deposited in 10 dustbins (2 dust bins per zone) for the different population groups was selected and identified for present study. The waste from selected bins was thoroughly mixed and about 80 kg of waste samples were collected, thoroughly mixed, and reduced to 10 kg by Coning and Quartering technique. By utilizing the quartering technique, the total waste mass was raked into quarter and waste from two diagonally opposite portions was taken and mixed. The other two portions were discarded. Quartering the sample and mixing was continued until a representative sample of approximately 10 kg weight was obtained. Proper care was taken to avoid selection of larger sized particles to reduce sample biasness. The details about the sampling technique are described elsewhere [26]. Various components from 10 kg sample, such as plastics, paper, metal, organic fractions,

Schedules	Silent features
Schedule-I	Relates to implementation Schedule
Schedule-II	Specifications relating to collection, segregation, storage, transportation, processing and disposal of municipal solid waste (MSW)
Schedule-III	Specifications for land filling indicating; site selection, facilities at the site, specifications for land filling, Pollution prevention, water quality monitoring, ambient air quality monitoring, Plantation at landfill site, closure of landfill site and post care.
Schedule-IV	Indicate waste processing options including; standards for composting, treated leachates and incinerations.

Table 1: Four schedules of MSW (M&H) Rules, 2000.

SN	Implementation program	Deadline
1	Setting up of waste processing and disposal facilities	31 December, 2003 or earlier
2	Monitoring the performance of waste processing and disposal facilities	Once in six months
3	Improvement of existing landfill sites as per provision of these rules	31 December ,2001 or earlier
4	Identification of landfill sites for future use and making sites ready for operation	31 December, 2002

Table 2: Silent features of Schedule I of MSW (M&H) Rules, 2000.

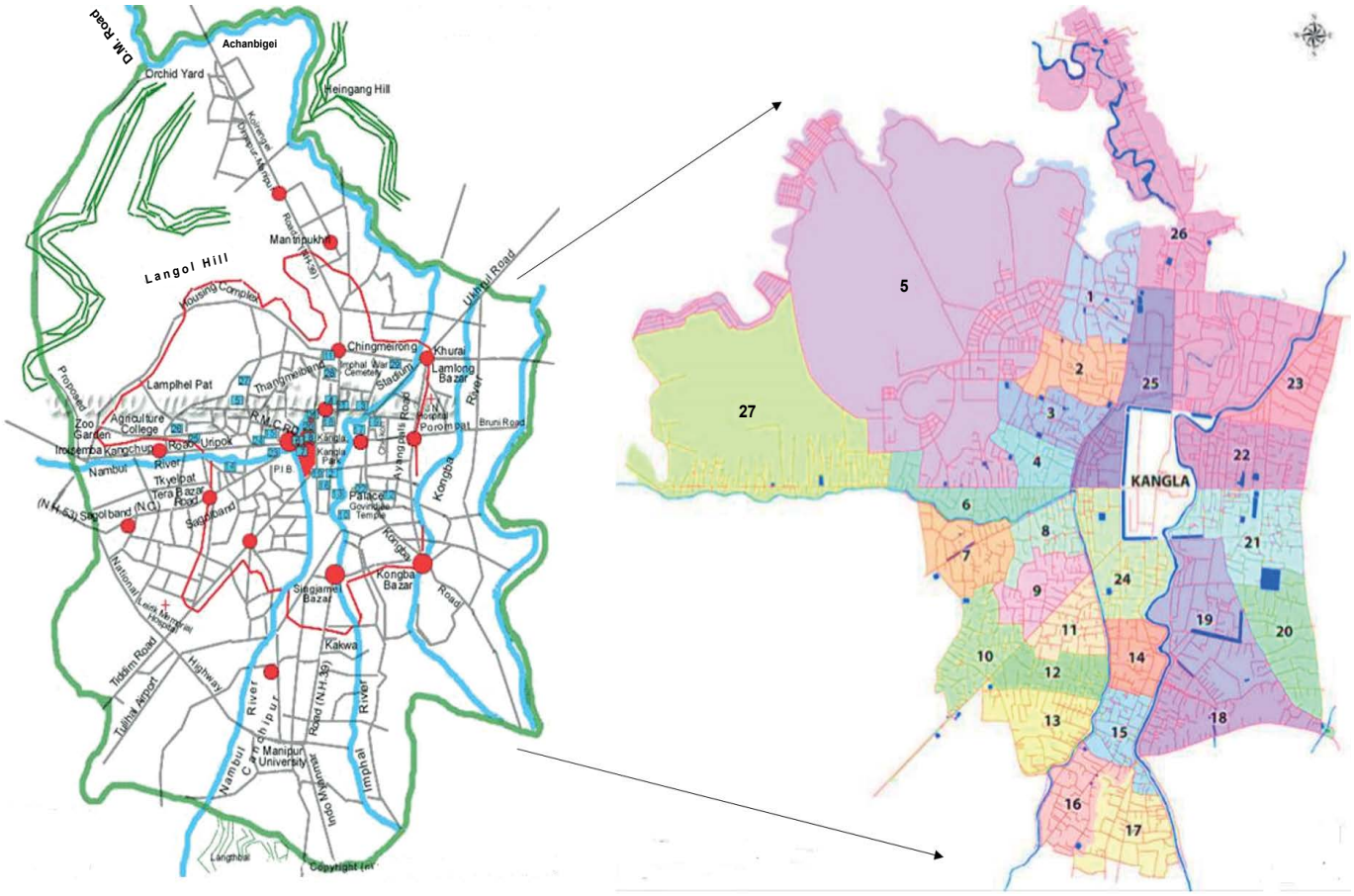

Figure 1: Location map of Imphal town showing sanitary wards.

etc., were segregated and weighed, and were expressed as a percentage of the total weight. The organic fraction was taken to the laboratory for chemical analysis. The characteristics parameters such as pH, moisture, nitrogen, phosphorus, potassium, loss on ignition, and calorific value were analyzed following Bureau of Indian Standard (BIS No. 9234) protocol (BIS, 1979).

Necessary secondary information/data were collected in consultation with Imphal Municipal authorities. Present MSWM systems in Imphal town comprising collection, storage, transportation, processing, and disposal was critically analyzed in compliance with provisions made under MSW (Management and Handling) Rules, 2000, and shortcomings in the systems were identified. Also, we assessed the new proposed MSWM action plan formulated by IMC to overcome the shortcomings in present MSWM system.

Results and Discussions

Physicochemical characteristics of SWs

The characteristics of waste depend on a variety of factors such as food habits, cultural traditions, lifestyles, climate and income, etc [27-29]. The pH value of analyzed wastes ranged from 6.4 to 7.7. The % moisture content of MSW in Imphal was 67.1. The C/N ratio was 26.37. The organic carbon content in waste was found 15.30%, total nitrogen 0.58%, phosphorus 0.57%, potassium 0.68%, the compostable fraction was 42.31%, and total recyclables were observed to be 24%. High calorific value on a dry weight basis was observed to vary from 591 to 1008 kcal/kg. The compositional percentage of SWs with high compostable fraction suggests its suitability for composting (Figure 2). Hence, composting of SWs is proving to be most viable option for town like Imphal where suitable disposal facility is lacking.

The present MSWM system in Imphal

IMC is responsible for the management of MSW generated in the town. In total, there are 27 sanitary wards in the town. Complete operation of SWM is carried under four headings i.e. cleaning, collection, transportation and disposal of solidwaste. The inhabitants of Imphal town generate approximately 100-120 tonnes of MSW per day at the rate of 0.210 kg/capita/day (IMC 2004). Out of which, the IMC area generates about 40-45 tonnes/per day of SWs while remaining 80-100 tonnes/per day come from greater Imphal. A ward-wise SWs generation of IMC area is given in Table 3. Ward number 26 is found to generate highest quantity of SWs (5.9 tonnes/day). Major sources of SWs generated in the town comprise domestics (79.65%), constructions (14.03%) and agricultural (5.26%) activities. Thirty two hospitals/clinics also contribute biomedical wastes (1.06%) of the total waste generated in the town. The composition of MSW varies with cultural practices, economic status of the residents, urban structure, population density, extent of commercial activities and climatic conditions. SWs of IMC contain compostable wastes (60% by weight) as well as non-compostable wastes including construction waste (40%) (Figure 2).

Sweepers are deployed to collect the SWs from main roads as well as from other important streets covering total length of about

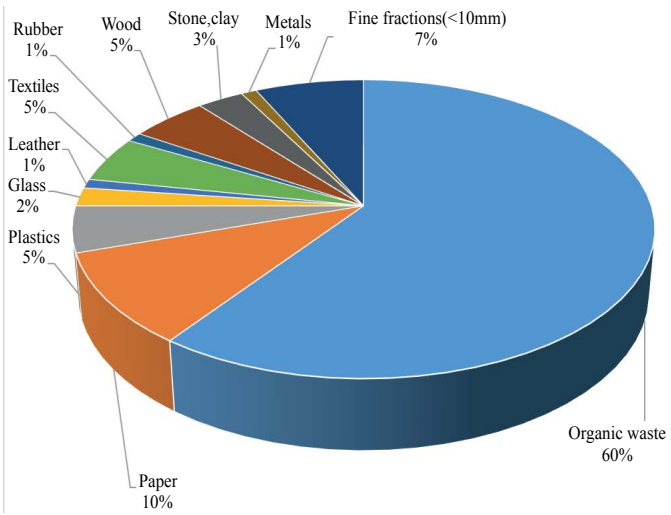

Figure 2: Percentage composition of MSW generating from various sources in Imphal.

Ward No.	Area (sq.km.)	Population	SW generation (tonnes/day)
1	0.50	9,243	3.23
2	0.92	8,889	3.11
3	0.42	7,152	2.50
4	0.75	6,218	2.17
5	9.88	15,239	5.33
6	0.50	7,663	2.68
7	0.73	6,674	2.33
8	0.38	7,016	2.45
9	1.06	7,888	2.76
10	0.83	7,111	2.48
11	0.43	7,229	2.53
12	0.47	7,065	2.47
13	0.66	9,678	3.38
14	0.50	6,693	2.34
15	0.56	7,414	2.59
16	0.60	7,390	2.58
17	0.78	8,691	3.04
18	1.00	7,825	2.73
19	1.00	8,563	2.99
20	0.75	7,158	2.50
21	0.90	11,301	3.95
22	0.79	11,889	4.10
23	0.66	7,190	2.51
24	0.41	5,992	2.09
25	0.33	5,325	1.86
26	1.73	10,971	5.93
27	3.19	14,000	4.90

Table 3: Ward-wise generation of SW in Imphal town.

145 km. Sweepers collect the wastes from the roads and carried to the nearest collection point (designed or ingenuous bins) while SWs from residential, institutional and other localities are collected through the street corner masonry bins. The residents of the Imphal town usually dump their household wastes in the bins placed at designated locations by IMC, which are manually loaded onto the trucks and transported to the disposal site. In lack of sufficient bins, there are many locations without bins where residents dump their wastes in open place which later get collected by IMC. No segregation of SWs is done either at source level or prior to disposal.

In absence of storage facility for SWs in Imphal town, SW gets deposited either in community bins or thrown to the streets/drains/rivers. Thus, creating nuisance in the surrounding area and hazardous to the public health. Approximately, 55 dust bins have been placed in and around the town to collect the SWs [30]. However, most of the bins placed around the town are in dilapidated condition and often the SW gets spread around the bins. SWs from designated and undesignated locations are collected, manually loaded onto trucks and transported to the disposal sites. The IMC has four trucks, each with 12 m^3 capacities for transporting SWs from collection points to disposal sites. In addition, four tractors with trailers have also been deployed for SW transportation. All these vehicles can only collect around 40-45 tons SW/day, with 22-24 trips/day of the total waste generated in the town. Rest of the wastes remains unattended on roads and streets. Trucks are often overloaded, and are not covered while transferring the SW from collection to disposal sites, hence, resulting in spilling of SWs on either sides of the road.

Processing of SWs is not done prior to disposal of MSW. Sanitary landfill for proper disposal of SWs is missing in Imphal town. In dearth of sanitary landfill, SWs collected from the town get haphazardly dumped in an open land at Lamphel (spread over 6 acres area). Lamphel is located near Langol housing complex, about 5 km from Imphal town (Figure 3). Till date, IMC is not able to have its own dumping ground for disposal of SWs. As a result, the wastes get dumped at unspecified places in unscientific manner which leads to unhygienic conditions. The drains on either side of existing roads in the town often overflow, and are open. The amount of SWs generated in a day is about 70 to 80 tonnes. Around 2.5 tonnes of SWs is being dumped daily directly into the Naga stream /Nullah within the stretch (less than a km) between Khuyathong and Maharanithong. Similarly, around 1.8 tonnes of SWs is being thrown into the Nambul River between Naoremthong and Keisamthong. Stinking garbage heaps and over-flowing refuse bins attract numerous rodents and insects, leading to an open invitation to many diseases. It was observed that there is severe chance of surfacewater and groundwater contamination at Lamphel due to leaching of hazardous chemicals from biomedical waste especially during rainy season. Imphal town also generates around 1 ton/day of biomedical waste and is generally mixed with MSW. Though, an incineration plant for burning the biomedical wastes has been set up

Figure 3: Open dumping site at Lamphel.

at Regional Institute of Medical Sciences, Lamphel (with handling capacity of about 80 kg/hr), still much more biomedical waste is left unburned due to limited handling capacity of incineration plant, thus resulting in open dumping of biomedical waste nearby incineration plant. The Government hospitals, health centers and private nursing homes and clinics dispose the wastes according to their convenience. However, there is no regular system of disposal of biomedical wastes in the town which threatens the health of the people.

Few Imphal based local NGO such as Thangmeiban Assembly Councilor Development Forum (TACDF), Seven Security Force (SSF), Center for Research on Environment Development (CRED), and Workers Union (WU) is actively helping IMC in managing SWs in the city. Altogether, they collect and process around 20-30 tons /day of SWs generated.

Major shortcoming in present SWM system

We assessed the present SWM system in Imphal town based on MSW (M & H) Rule, 2000 implemented by Government of India and found not appropriate and highly unsatisfactory. There are several shortcomings in every step of SWMS (from generation of SWs to the final disposal systems) which need to be utterly addressed for proper management of SWs in town. IMC is responsible for managing SW in Imphal town. However, they don't have separate solid waste management department for managing/dealing with the SWs. In lack of SWM department in the IMC, the Engineering division compels to look over the management operations of SW which don't have trained professionals. The cleaning and collection of MSW from the streets of the town is done through tricycle and are manually loaded onto trucks for transportation to disposal site. IMC spends about Rs 37 million every year on SWM which is about 2% of its total budget [31].

Manual disposal of wastes in surface is the most widely practiced system of waste disposal in Indian cities including Imphal town. It has been found that established system for collection, transportation, treatment, disposal and complete networking is lacking. The IMC which is responsible body for managing SWs are over-burdened with other responsibilities of much higher priorities such as street cleaning, construction and maintenance, building licensing, water supply etc. and waste disposal receives less attention. Imphal being a small town, it is likely to establish a proper waste management system; however, these are not being operated and maintained practically. Some of the possible reasons behind its poor operation and maintenance may be due to lack of adequate funds; inadequate trained personnels, multiplicity of agencies for operation and maintenance; lack of performance monitoring; inadequacy in preventive maintenance and lack of management and coordination within IMC.

Provision of MSWM in proposed action plan

Many developing nations including India, collection and transportation accounted most of the MSW budget. Despite high expenditure, only small fraction of waste generated gets collected and processed [32]. Mostly, Asian countries lack well formulated guidelines and policy structure regarding waste management services. In lack of this, municipal authorities also have not been performing satisfactorily their tasks. Another reason for poor management of SW in Asian countries is lack of complete source of data on major wastes streams. The same is the case with India too, because many factors such as institutional, financial, technical, regulatory knowledge and public participation influence the SWM system [33].

MSW (M&H) Rules 2000 through litigation has made, SWM is the sole responsibility of ULBs (city corporations and municipal corporations). It solicits for segregation at source level, clean composting and recycling of wastes. Further, the Supreme Court of India has directed that all urban local governments must have its own SWs treatment plant for managing it scientifically. In compliance to the notification of the Ministry of Environment and Forest (MoEF), Government of India; Government of Manipur proposed a concrete SWM plan in 2005 to have better SWM for the coming years. The plan comprises three stages: immediate phase (2005-2015), intermediate phase (2015-2025) and ultimate phase (2025-2035). IMC and government of Manipur intended to implement the proposed SWM plan considering 2005 as the base year and 2035 as the ultimate year with 30 year design period for the solid waste disposal system. At present the SWM plan is in immediate phase.

According to 2001 census, the total population of Imphal town is around 0.25 million with decadal growth rate of 26.04%. Figure 4 is showing the projected population of IMC, which is estimated to cross around 0.33 million by 2031. It is worthy to note that though the projected population is not high but considering the area under the corporation and expected growth in business development, it will generate huge quantities of SW in the near future. The estimated quantity of waste generation in Imphal is given in Figure 5. These estimates are based on the per capita (0.210 kg/person/day) generation of SWs. However, the present waste generation quantity is likely to increase much more in the coming decades owing to spurt in consumerism facilitated by expected improvement in socio-economic conditions and income pattern.

Topographical variations of Imphal (Plain terrain with broad and flat pathways) facilitate the deployment of non-motorized vehicles for SW collection. Tricycles mounted with plastic bins have been proposed for door-to-door waste collection from individual households and institutional/commercial establishments. Similarly, wheel barrows can be used for wastes collection from street/road sweepings. Additionally, around 71 secondary collection points have been proposed for better management of SW of which, 56 collection points will be at the existing locations with masonry bins/undersigned locations and the remaining 15 at newly proposed locations. At each secondary collection point, two dumper placer bins will be provided, one for biodegradable waste and other for non-biodegradable wastes. The waste is proposed to be collected through dumper placer having tipping facility and hydraulic

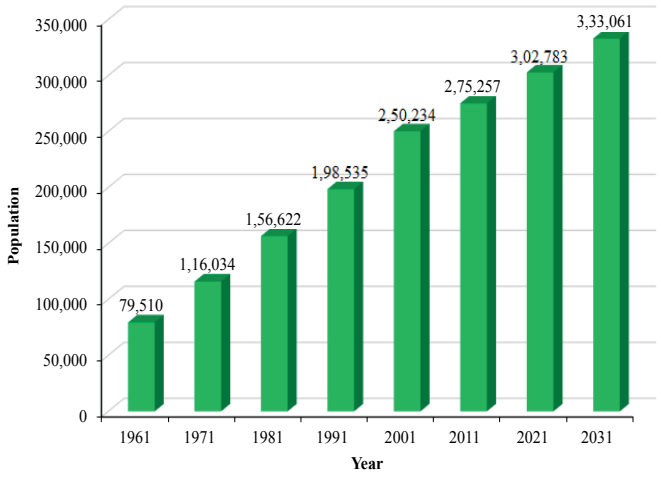

Figure 4: Projected urbanization of Imphal town.

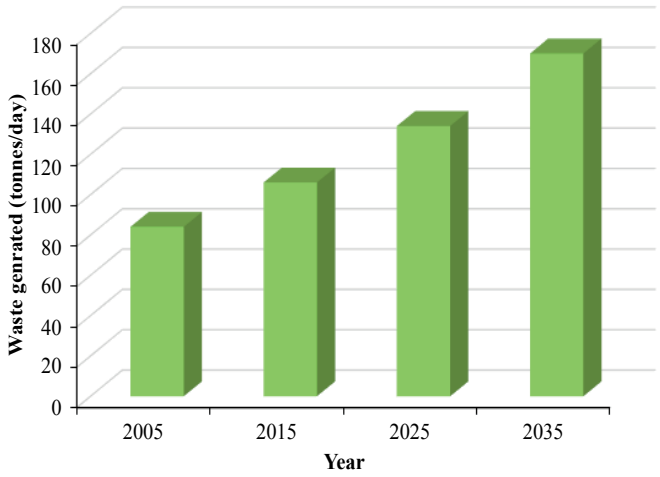

Figure 5: Estimation of waste generation 2035 (TPD).

accessories, which will lift the bins and place it on to the dumper placer. The dumper placer will then move to the disposal site and tip the waste at the waste receiving station within solid waste disposal facility (SWDF). The waste unloaded at the waste receiving station will further undergo through several treatment steps such as composting, bio-methanation, waste to energy, refuse derived fuel (RDF), incineration and pyrolysis before final disposal. The proposed SWDF plan for Imphal town comprises with the following units in conformity with the SWM manual and guidelines of the Government of India. Some of the silent feature of the SWDF are i) SWDF will have waste receiving station cum weighing area, fully mechanized composting unit with bagging facility for compost, sanitary landfill unit along with all infrastructure facilities, ii) it will also have incineration facilities for managing carcass and biomedical wastes, and iii) site development works such as approach road, internal roads within SWDF, fencing, guardroom, landscaping, store cum workshop area, street lighting etc.

Presently, IMC has specified and acquired 60 acres of land for SWDF, which is sufficient for next 10-12 years. However, an additional land requirement for SWs disposal in Imphal town would increase to 171 acres by 2035 (Figure 6) which create severe problem on SWM system. Since, significant percentage of MSW in Imphal town are organic in nature, an alternative waste management options such as source separation into organic and inorganic fractions followed by either composting or anaerobic digestion with accompanying biogas production proved to be best option for management of MSW. Treatment of MSW through composting is increasing in many European countries [34,35] and in United States [36] and United Kingdom [37,38].

The human resource development (HRD) and capacity building program is also an important aspect of MSWM. This includes identification of the training needs, development of training modules and imparting training (financial, economic, administrative and legal aspects) to sanitary engineering staff of the town committee. The training shall encompass both at the campus of the training institution and also at the concerned town or a combination of both. Study tours for the sanitary staff to other municipal corporation within India to showcase best managed systems/practices and their benefits will help to cater the need of unskilled manpower in MSWM. Also, the success of any SWM scheme can be assessed and assured through co-operation of people, effectiveness of the proposed system and operational efficiency. Effectiveness of the system and operational efficiency can be improved through human resource development and capacity building. The co-operation of people can be achieved through information, education and communication techniques. Therefore, strategies for waste reduction, reuse and recycling (RRR) should be necessarily propagated by organizing campaigning program in the town for deriving long term benefits. Details of target groups for IEC and action plan for creating the public awareness proposed in the SWM plan of the Imphal town have been illustrated in Table 4.

The benefit monitoring and evaluation (BME) of the solid waste management scheme can be accessed through the monitoring of the BME indicators such as performance evaluation of the solid waste collection and transportation system, ambient air quality monitoring, odor monitoring and ground water quality monitoring in and around the SWDF, performance evaluation of the composting operations and assessment of the leachate from SWDF. The BME will aid to identify the deficiencies within the system such as the amount of SW generated, collected, composted and dumped with or without any treatment. This will also aid in optional utilization of the resources for solid waste collection, transportation and disposal. SW characterization shall also be done both at the composting site and the waste receiving station of disposal site to assessing the efficiency of the composting and disposal operations, respectively.

Based on silent features laid down in proposed MSWM plan for better management of SW Imphal (is also in compliance with the MSW (M&H), 2000), the proposed SW plan is found to be satisfactory and feasible. It will help to curbs the problems and issue related with MSW in Imphal town provided that its successful implementation.

Conclusions

The present study conducted in Imphal town from India, revealed that the existing SWM practice is not appropriate and is highly unsatisfactory. There are many shortcomings in the existing practices followed for the management of MSW. These relate mainly to inadequate manpower, financial resources, and implements/machinery required for effectively performing MSWM activities in the town. Facilities for collection and disposal of SWs are inadequate leaving a substantial proportion uncollected. Segregation and storage of SW generally absent. Future strategies and action plan proposed by Imphal Municipal Corporation to combat the deficiencies in the

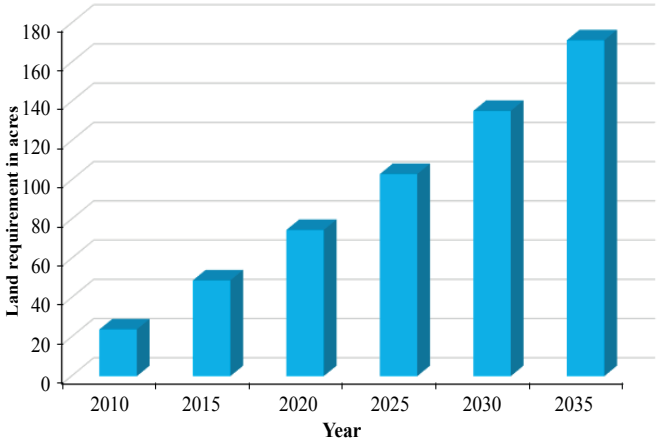

Figure 6: Land requirements for SWDF development 2035.

SN	Target group	Action plan
1.	Local influential/ community leaders	Holding of locality wise meetings and group discussions with local influential, where by the extent of societal problems of solid waste, related physical and humane factors, the consequent health hazards and the possible remedial measures are highlighted through the talks and technical presentations by the experts and social workers.
2.	Local NGOs	Motivating and advising local NGOs to participate in outlining execution and follow up efforts of community action plans for ensuring a clean and healthy, community life through litter free town.
3.	School teachers and students	Promoting schools as models of clean leaving and healthy environments and training school teachers and students as motivators and informal change agents for involving families and communities in segregation of waste at source and strategies for waste reduction, reuse and recycling (R-R-R).
4.	Elite group and organizations like rotary clubs, lions club, associations and forums of writers and artists etc.	Motivate the local influential people like leading businessmen, industrialist, office bearers of elite clubs like rotary, lions, junior chamber of commerce, local chapter of FICCI/CII, to undertake or sponsor such activities as solid waste management services through an effective strategy of public private partnership for improving sanitation conditions.
5.	Political/religious leaders	Motivate local MLAs and MPs and leaders or political parties to participate actively in the promotional efforts of community involvement for solid waste management scheme against the hazards of pollution, efforts, which shall pay them abundantly through the building of positive public opinions.
6.	Representatives of media viz. editors/ local correspondent of press/ key functionaries of radio/ TV stations.	Launching of mass campaign for educating and motivating local community and families about the need to have on-site sanitation facility like community toilet complexes at the public places and households toilets at the family level.

Table 4: Target group and action plan for public awareness campaign.

existing MSWM systems are found satisfactory and feasible provided its immediate and successful implementation.

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