

Municipal Solid Waste Management and Public Health Risks: An Escalating Socio - Environmental Challenge in Jorhat, Assam

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ABSTRACT

With rapid pace of urbanisation, urban solid waste management has emerged as a growing threat in India, as the unscientific handling of municipal solid waste degrades urban ecology and poses public health hazards. Based on an analysis of seven wards in Jorhat municipality of Assam, India, the paper outlines concern regarding public health and environmental safety in relation to improper garbage disposal and highlights the current status of solid waste management practises by conducting interviews with the respondents recruited through Simple Random Sampling. Priorities for proper implementation of the national campaign, Swachh Bharat Mission (Urban) undertaken by the government of India for scientific waste disposal in Jorhat are discussed. The paper concludes by examining challenges and the best practices followed by Jorhat municipality. The study uncovers that unawareness and lack of active participation of urban residents in proper solid waste disposal is the primary cause of the problems.

Keywords: Municipality; solid waste; solid waste management; environment; public health risk; non-governmental organisation

Introduction:

In contemporary times, improper management of Municipal Solid Waste (MSW) has been one of the foremost environmental and social issues for all urban areas around the globe. (Pradhan, et al., 2012) Rapid economic development, industrialisation and population growth have accelerated the process of urbanisation in a dynamic way in developing countries. Simultaneously the rapid growth of urban areas and their huge population has given rise to many tenacious issues like inadequate solid waste management. Moreover, changes in life style due to fast rates of urbanisation, changes in consumption pattern and economic growth have resulted in increasing of per capita waste generation by about 1.3 per cent yearly. (Pradhan, et al., 2012). According to WHO (1991), compared to other developing countries, India is on the higher position in terms of per capita waste generation, where waste generation is accepted by people as one of the indicators of prosperity, consumerism, and standard of living style. (Venkateswaran, 1994)

Before we consider the relationship between solid waste management and its impact on

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environmental health, there is a need to define the idea of solid waste management and environmental health. According to Solid Waste Management rules 2016, municipal solid waste includes solid domestic waste, commercial waste, sanitary waste, catering and market waste, street sweepings, silt removed or collected from the surface drains, agricultural waste, horticulture waste, dairy waste, treated bio-medical waste, excluding e-waste, battery waste, radio-active waste and industrial waste generated in the area under the local authorities.(Ministry of Statistics and Programme Implementation ,2023). On the other hand, environmental health is a branch of public health which addresses the concerns through monitoring the factors associated with environment that affect health and well-being of people. Here the term ‘environmental health’ concentrates on the impact of improper solid waste management on human health and ecology in the urban environment.

To attain the ambition of sustainable development particularly in urban area, there is an urgent need to invest municipalities’ concern to reduce fast depletion of natural resources and environmental stress caused by improper management of solid waste, to promote public health and sanitation practices at households, commercial and landfill sites. In India, most of the urban centres have no requisite land and adequate facility for disposal of municipal solid waste. As per annual report on solid waste management (2020-21), Central Pollution Control Board, Delhi stated that in Assam there are 96 urban local bodies responsible for implementation of solid waste management rules, 2016, from where 88.5 per cent of waste was collected through door- to - door household collection and segregation was not practiced at all. As per the report, Assam got the position of 34th rank in terms of environmental performance (SWM) based ranking of states in India. (CPCB, 2021) Jorhat, as per the census 2011, is an urban agglomeration of Assam, North -East India with a total population of 1, 53,889 and now, in 2024 it is approximately 2,18,000. (Population Census, 2011-24)

Open dumping of solid waste system is widely accepted in India and it has several dangerous impacts on public health, socio-economic well-being of people and environment as a whole. (Swaminathan, 2018) Despite having many approaches and models to deal with the problem of waste management, it is still becoming a problematic task due to the main challenge of waste segregation at source. Central initiatives like ‘Swachh Bharat Mission’ and others are continuously trying to ensure proper waste disposal and universal sanitation. Otherwise, improper management of solid waste plays a major role in environmental degradation around the world and sanitary condition of urban areas are worsening daily with the increasing population density.(Dwivedi ,2023) Population explosion has a huge effect on waste generation that impacts the environment and its sustainability.(Franchetti, 2009) The composition of municipal solid waste depends upon a large number of elements such as relative standards of living, lifestyle of the people, general consumer patterns, the level of technological advancement and inventions, industrial growth etc. Alongside, solid waste management and its impact on urban sanitation is now rising as a burning issue for municipal administration especially in growing city of developing countries in terms of disposal of waste due to lack of skilled staff and limited financial resource. As a consequence, open dumping ground is affecting the ecology and public health adversely. (Choudhury, et al., 2018) The existing system of disposal points to the need for greater resource recovery through recycling and energy generation and it will help in terms of land availability for dumping and environmental

implications. (Venkateswaran, 1994) Besides, safe disposal of municipal solid waste is vital for the realisation of the right to sanitation. In this regard a healthy legal environment is necessary to articulate the right of the people and responsibilities of the authorities to ensure sustainable sanitation. (Bhullar, 2013) Corporate Social Organisation's (CSOs) should felicitate various innovations to encourage sustainable behavioural change among communities in solid waste management and promote the understanding of Swachh Bharat Mission -Urban. (Dasgupta et al. ,2023). In the context of behavioural change of people, United Nations International Children's Emergency Fund define it as research and consultation to promote the ideas of human rights, mobilise leadership, positive changes in different attitudes and social norms, and transforms behaviours of people for the well-being of communities. The term 'behavioural change' is defined as a set of approaches, strategies, tools and tactics that helps to promote positive as well as measurable changes in peoples' behaviour, environment and society as a whole. (UNICEF) Therefore, the current study attempts to describe the existing scenario of solid waste management and its impact on public health and environment as a whole in different wards under Jorhat municipality where the researcher seeks to reflect the practices of residents regarding solid waste management and how they perceive its importance that has been identified in the study. The paper also investigates the challenges and best practices followed by the municipality in the field of waste management.

Methodology:

Study Area:

Assam is situated in the North-Eastern part of India, known as the gateway to North-East India. The state of Assam is divided into 35 administrative districts. The studied area of Jorhat is also known as the 'cultural capital of Assam'. Jorhat was the last capital of Ahom kingdom. Moreover, Jorhat is one of the oldest recognised and constantly inhabited urban centres in Assam constituted before the independence of India. The studied area Jorhat municipal board was established in 1909 as an urban administrative body. (Gattani, 2014) Currently, administratively Jorhat town is divided into nineteen (19) wards of municipality covering an area of 9.20 square kilometres.

Research Design and Data Collection:

The approach of the study is both qualitative and quantitative in nature. The study took place in Jorhat municipality in which Jorhat is the administrative headquarters of Jorhat district in Assam. Currently, there are nineteen wards under Jorhat municipality, where ward no 19, 1 and 15 are highly populated and ward no 18,11 and 10 are least populated among all wards. Therefore, these six wards out of nineteen wards are selected for the study based on the amount of population as per the Jorhat municipal board city population census 2011-2023, Assam. Moreover, ward no 6 is also selected which is commercial in nature, basically the area of *Garali* is the famous commercial destination of Jorhat town.

The study is based on descriptive research design where the researcher has adopted the simple random sampling method to select the respondents and a total of 138 respondents are chosen for the research. The respondents of the present study are of six types, these are: i. Head of the household and Shopkeepers (105) ii. Employees of the municipality (17), iii. Sanitation

workers (6), iv. Ward commissioner of selected wards (7), v. Litterateur (1) and vi. Businessmen (2) of the area of study.

Both primary data and secondary data have been collected for the research. The researcher has adopted the semi structured interview schedule and observation method for primary data collection. On the other hand, secondary data are collected from published books, research paper, newspaper, government report and websites related to the topic.

Objectives of the Study:

1. To study the present scenario of solid waste management practices adopted by the residents under Jorhat municipality.
2. To discuss about the impacts of solid waste management on environment and public health.
3. To highlight the best practices followed by Jorhat municipality and NGO (SAAHAS) working with the municipality to ensure proper solid waste management.
4. To examine the challenges associated with municipal solid waste management within the areas.

Solid Waste Management – Environmental Health Interface

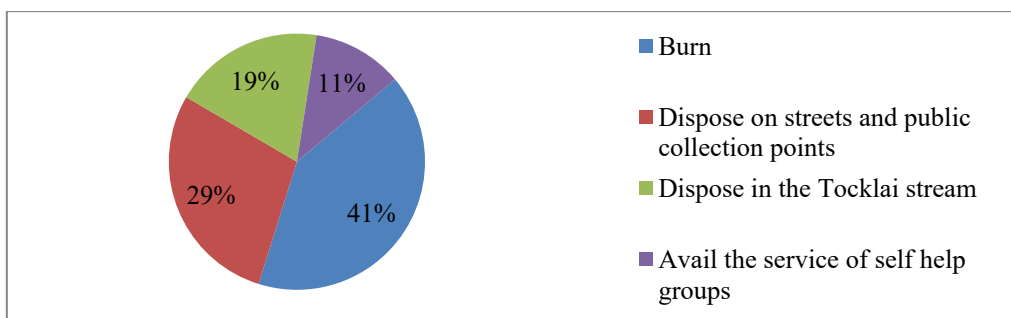
Safe disposal of municipal solid waste is imperative for the actualization of the right to sanitation, public health well-being as well as environmental safety. Inappropriate management of urban solid waste continues to pose a serious threat in India where rudimentary disposal of waste is very common. (Bhullar, 2013) It is apparent that, a huge number of people in India are still not adequately disposing their waste. Improper management of waste also means daily exposure to a troublesome environment. Despite the presence of several solid waste management methods, inadequate management of waste remains to be one of the constraints in terms of public health and environmental degradation faced by the urban dwellers. Inadequate and open dumping of municipal solid waste usually clog up the drains which results in water logging and creates stagnant water which serves as a breeding ground for insects and disease vectors such as flies, mosquitoes, cockroaches and rodents which are responsible for infectious diseases through the transmission of germs and zoonotic infections. Clogging of the drains also causes artificial flood during monsoon. Basically, insect and rodent vectors are attracted to the open dumping of waste and spread infectious diseases like cholera, dengue, malaria, typhoid and many more. (Alam and Ahmade, 2013) Discharge of untreated domestic and municipal waste water has resulted in the contamination of ground and surface water sources across the country. (Showkat, 2016) To solve the issues related to solid waste management and public health, one needs to take account of the various elements of environmental health, basically, in terms of solid waste management, generation of hazardous waste, drainage complication etc. That is why the atrocious state of municipal solid waste management in urban centres in India stands out as a highlighting area of study.

Solid Waste Management Practices

Similar to other public services provided by Jorhat municipality, solid waste management service is also not free of cost to the residents. The board imposes a waste

collection fee from residents with the aim to maximise collection and segregation of the waste. This waste management practice is widely practiced and accepted across nations today. The municipality of Jorhat town has a specific area earmarked as a landfill area named as *Garmur* is an open dumping site of waste disposal. The waste collection process begins with contractors from a particular Self- Help Group (SHG) under municipality, performing door to door collection of waste services. Self- Help Groups are trying to cover their respective designated wards including households, commercial establishments, institutions, temple and so on to collect solid wastes. In this regard, every household need to pay an amount of Rupees 50 per month to the Self- Help Group as a waste collection fee. Jorhat municipality conveys the responsibility of door- to- door waste collection and proper dumping of waste at the *Garmur* open dumping site to several Self - Help Group. The Self -Help Groups are requested to make people of their wards aware of the importance and challenges of waste management and the groups are asked to carry out their duties appropriately to ensure regularity and prompt service in a sustainable manner.

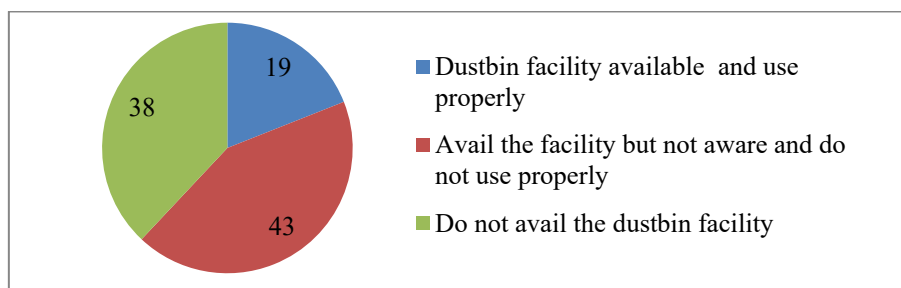
Figure 1: Primary research result on waste disposal



Source : Field Study, 2024

Regarding the waste disposal, majority that is 43(41%) numbers of the respondents have burnt wastes openly in their households. 30(29%) numbers of respondent dispose waste either on the streets or public collection points. Moreover, 20(19%) respondents of the study disclose that they have used '*Tocklai*' stream (which is a major stream of Jorhat that flows into the river Bhogdoi which is a tributary of the river Brahmaputra) as open dumping place of the solid wastes. The practice of handing over the segregated waste to the self-help group under municipality is comparatively very less which is around 12(11%) numbers of respondent and it clearly reflects that awareness of residents in terms of proper waste handling also is in a very preliminary stage.

Figure 2: Dustbin provision in wards



Source: Field Study, 2024

Among all the wards of the studied area, there are 20(19%) numbers of resident who avail and use the two-colour coded dustbin facility properly for waste segregation; the green one for wet or bio-degradable waste, another one is blue which is for dry or non-bio-degradable waste provided by the municipality under Swachh Bharat Mission (urban), followed by 40(38%) numbers of resident who does not avail the facility. Moreover, 45(43%) residents are not much aware and do not show their willingness to use dustbins despite availing the facility and they use to go to the public collection points for the purpose of garbage disposal.

The survey of this study, (figure: 1) has shown that only 12(11 %) household pay a fee amount of 50 Rupees per month to the Self-Help Group for door-to-door household collection of waste. Moreover, recyclable waste is sold to the recyclers that may fetch a market price and later transport all the remaining waste to landfills of Garmur. As a result, existing landfills of Garmur receives an unmanageable huge amount of waste. From the account of the respondents it has been interpreted that, the garbage collection service of self-help group is not regular anymore that is why residents do not want to avail the service and maximum of them (as shown in the figure: 1) used to rely on open burning of waste and using public collection points. Therefore, the cycle of waste collection, waste dumping and burning goes on infinitely. But the waste collection process of self-help group will actually help in increase collection rates of garbage and avoid illegal dumping. So, the collection rate of solid waste needs to be improved to avoid illegal dumping of waste and burning waste at household, street corners and unoccupied lands. (Swaminathan, 2018) In this process, there are three major stakeholders present as a chain system: the waste generator – the waste collection agent (sanitation worker) and other middleman in charge of fees collection and transportation – the final contractor assigned to dump the waste.

In the year 2016, the ministry of environment of India released the solid waste management (amendment) rules to govern municipalities' effective waste collection and disposal of municipal solid waste in India. As per the act, one of the key features of the solid waste management rules ,2016 is that, it is mandatory for all waste generators to segregate waste as dry and wet waste at source. In this regard Jorhat municipality have fulfilled this objective with a success rate of about 12(11%) across the selected wards. (See figure: 1). Moreover, as per the rules of the act, municipal body should order bulk generators to manage their waste on their own. From the observation of the field survey and opinions of public, it is seen that sometimes the bulk generators also use public collection points for disposal of their waste. Apart from these, one significant aspect of the solid waste management (amendment) act, 2016 is the promotion of Waste to Energy (WTE) plants. In this way, recently Jorhat municipality have started their works on legacy waste mining and plastics are being sent to local cement factory of Dima Hasao district of Assam.

Figure 3: Garmur open dumping ground

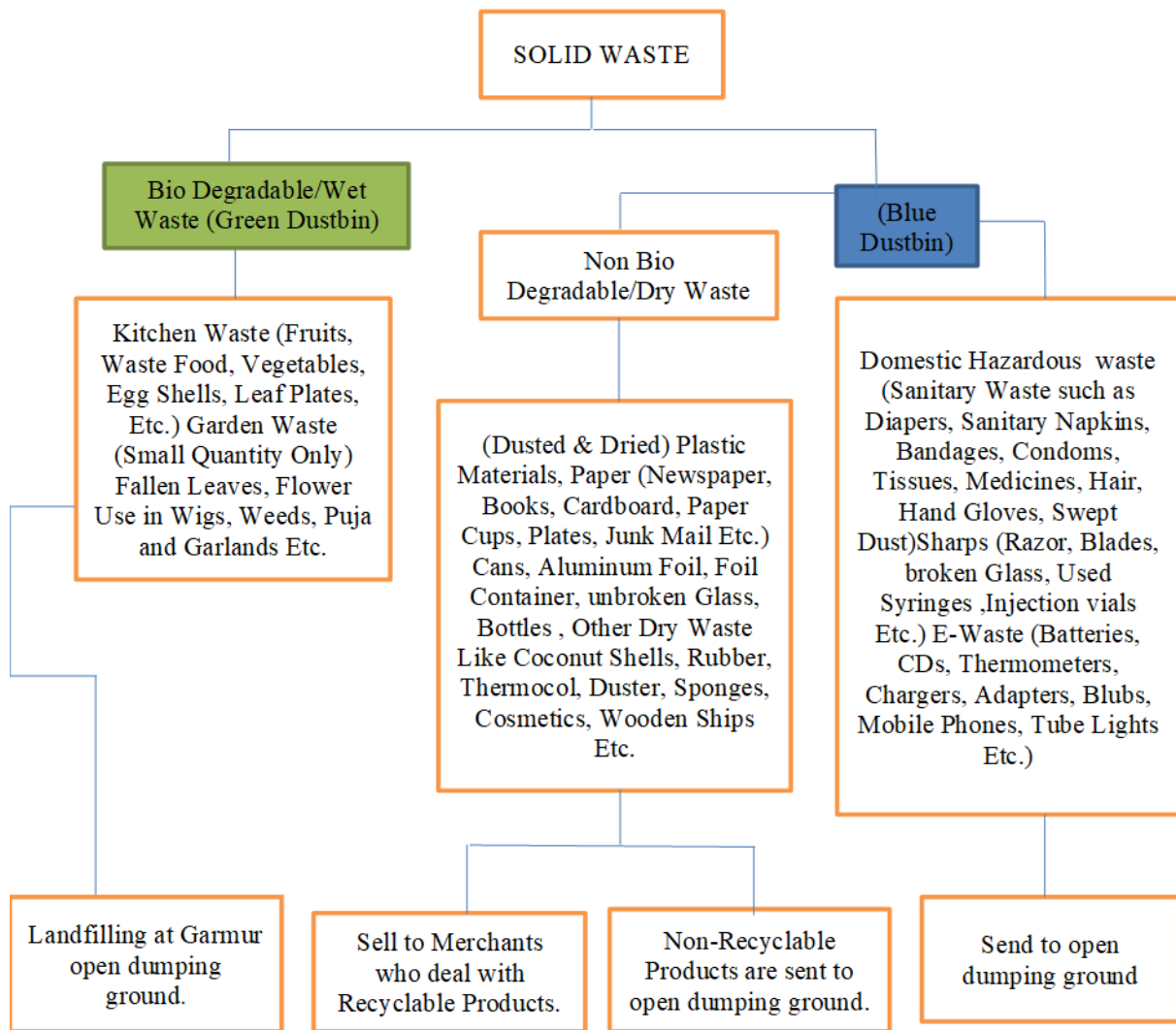


(Photo: First author, 2024)

Waste disposal has been a significant challenge in urban areas across the country and in Assam, Jorhat is no exception. The wastes collected and stored for years on any landfill site or any barren land is called as legacy waste. In Jorhat also, the legacy waste exceeded their capacity in the Garmur open dumping site of Jorhat municipality. To deal with the severe challenges of waste management in Garmur site, the role of bio-mining is considered as significant by the government. According to the central pollution control board (CPCB), “Bio-mining is the scientific process of excavation, treatment, segregation and gainful utilisation of municipal solid waste lying in dumpsites typically referred to as legacy waste.” (Yadav, 2022) Basically, bio-mining aims to convert old waste material of dumping sites into reusable resources. With heaps of waste accumulating in the open dumping ground of Garmur, the government of Assam is implementing a sustainable waste disposal action plan or project titled ‘legacy waste dumpsite remediation through bio – mining and disposal of residual waste’ by which the government with the help of Jorhat municipality makes a collective effort to solve the solid waste management problem at Garmur. Basically, the project aims to clear legacy waste that has been dumped at Garmur site for the past 55 years amounting to approximately 1.60 lakh metric tonnes.(The Hills Times, 2023).The bio-mining process separates organic and plastic materials of waste, from which organic substances are converted into fertilizers or organic manure and the plastic wastes are utilized as fuel in the cement manufacturing factory namely Dalmia located in Umrangso town of Dima Hasao district of Assam instead of coal. Besides, the remaining waste about 1 to 1.5 per cent of the total will be scientifically and systematically land-filled underground. This innovative process is already in a progressive way from where maximum mining waste has been transported to the cement factory. The concerned authority declares their ambitious target to complete this project soon. Further, plans are in motion to develop a park for recreational purpose at the Garmur site, to turn this place of source of pollution into a community asset. According to the respondents’ point of view, the projects primarily emphasise on two aspects: proper treatment of fresh waste and scientific remediation of existing legacy waste. In this context, to maintain a sustainable waste management system under this innovative project, concerned authority should try to disposed and treat daily collected wastes and remediated existing wastes in the landfills soon. Respondents said, problem arises when daily collected municipal solid wastes is partially treated and remaining is again added to the existing wastes. As a consequence, it becomes a never- ending process of

waste generation and remediation of legacy waste. But at this point local people of Jorhat feel very happy and optimistic about the initiative and of utilizing advanced technology for waste disposal that this sustainable approach can remarkably lessen their long-standing issues of waste management in the city.

Figure 4: A Simple Solid Waste Management Model of Jorhat Municipality



Source: Field Study, 2024

Role of Non - Governmental Organisation (NGO)

The role of non-governmental organisations has been growing steadily in India, basically focusing on urban issues. Their activities have covered lots of aspects in terms of solid waste management, such as, awareness campaign in residential localities, health and hygiene aspect of public, organising community engagement programme with the aim of proper garbage disposal through door-to-door garbage collection, train up people about recycling matter of solid wastes etc.

A non-governmental organisation namely ‘SAAHAS’ has been working with Jorhat municipality since June, 2023 in the field of solid waste management. NGO ‘SAAHAS’ was

started in 2001 with registration as a non-profit organisation under the Karnataka societies registration act, 1960. Founder Wilma Rodrigues, founded it (SAAHAS) to promote waste management practices. The headquarters of the NGO is located in Bangalore. The organisation has worked across multiple states of India, working both in rural and urban areas. The primary vision of this NGO is to enable India to become a leading circular economy where nothing is wasted. They believe in working towards creating long term solutions that achieve real outcomes. (SAAHAS)

In the year of June 2023, the organisation has started their work in Assam, North-East with a project of solid waste management in Jorhat district and Majuli district. They have worked on solid waste management under Jorhat municipality. The NGO 'SAAHAS' has valid certifications required to receive Corporate Social Responsibility (CSR) funds and has run its works with the help of CSR fund's project. Their projects are typically of the duration of 3-5 years.

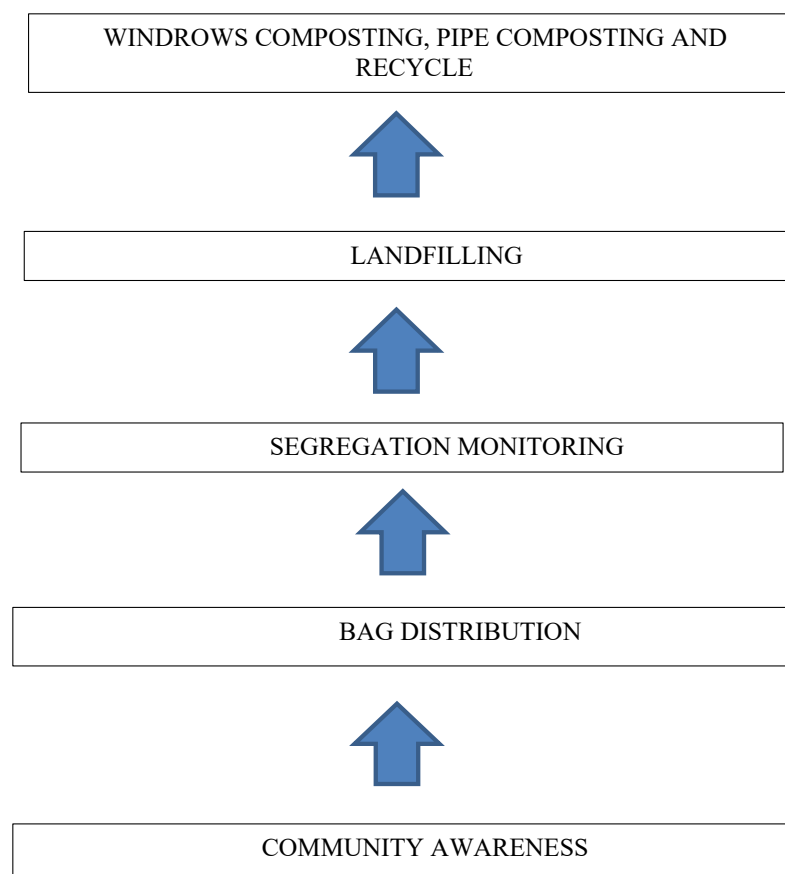
SAAHAS works in Jorhat municipal area to assist the self-help groups of Jorhat municipality engaged with residents, business community, educational institutions and so on to set up a sustainable solid waste management system through generating massive awareness, attitudinal and behavioural change of people from different ward regarding scientific waste disposal. Also, focusing on the functional aspect, SAAHAS makes an effort to train sanitation workers and aims at providing identity cards and uniform dresses to all the workers engaged in solid waste management.

The NGO 'SAAHAS' also undertakes baseline survey assessment of 5 per cent of the households in each ward to measure the weights of waste at door-to-door level using a digital weighting scale across a span of four days to take account of the variations in food consumption and waste generation in the holidays or weekend. The members of the NGO are very conscious about segregation of solid waste and have taught residents how to segregate solid waste separately as dry and wet waste on spot of waste collection because they are monitoring the process of waste collection daily at household level. 'SAAHAS' recognises the significance of engaging with the youth of the country to enhance the idea of sustainability. They run several awareness programmes on waste management in wards and different educational institutions basically in lower and upper primary schools and colleges in town area of Jorhat. They often try to train people about recycle and reuse of waste material through making various eco-friendly products and recycled products such as eco board chair, eco board outdoor seating, roofing sheets that are made of recycled multi-layer single use plastics, different home accessories like upcycled bells, photo -frame, tissue papers, napkins, toilet paper roll, stationary products like pen stand, hardbound diary, recycled paper, bags as part of their interventions. Even they demonstrate these products in different exhibition and public meeting, awareness programme etc. They believed that waste properly managed at source becomes a resource. Along with, they strive to make solid waste management effective with the help of community involvement focusing on the model of 'Information, Education and Communication - IEC' of Swachh Bharat Mission, through which they create awareness about critical issues related to waste management, information regarding health, sanitation and any other aspects that directly affect the community and communities attitudinal change regarding the waste disposal ways

through communication in terms of open defecation, hygiene practice etc. Members of ‘SAAHAS’ have revealed that to succeed in the waste collection process of self-help groups under Jorhat municipality, they will assist the self-help groups financially so that their waste management system can bring change in terms of irregular visit to wards for household solid waste collection. The NGO ‘SAAHAS’ will pay half expenditure every month required to complete the whole collection process.

Integrated solid waste management is one of the most widely practised proposals of solid waste management. The notion is also followed by ‘SAAHAS’ to reduce waste and manage waste in a handy way. ‘SAAHAS’ has given more emphasis on eliminating waste that is ‘zero waste’ concept. According to United States Environmental Protection Agency (EPA), the concept of zero waste includes maximise recycling of waste material, minimise waste, reduce consumption and it ensures that products are made to be reused, repaired, and recycled back into the nature or the market. So, by this concept of ‘zero waste’ the NGO ‘SAAHAS’ intends to emphasises on systematically avoid and eliminate the volume and toxicity of waste materials by minimising excess consumption and maximising the recovery of solid waste basically through reuse and recycling. (EPA) Their approaches strive for a massive change in behaviour of people in different wards through disseminate the concept of zero waste in which they believe that nothing is waste. By this way, the NGO stimulates a guiding design for reducing waste at household level and all public collection points.

Figure 5: An integrated solid waste management model of ‘Saahas’ in Jorhat



Source: Field study, 2024

If we go through the figure 5, at present SAAHAS is working in the third stage, that is segregation monitoring and later they will proceed with the support of municipality. It is noteworthy to mention that by this integrated model of solid waste management and initiatives of NGO 'SAAHAS', people from different ward feel benefited a lot in terms of their waste disposal problem. People said, the service of NGO 'SAAHAS' is more dedicated, sincere and systematic than that of municipal waste collection service, therefore, they want their collaboration for a sustainable waste management system. People expressed gratitude towards NGOs service and feels optimistic that their activities can solve their longstanding issues of waste disposal by attitudinal change of people in Jorhat with the support of Jorhat municipal authority.

Impact on Environment and Public Health

The impact of the open dumping of solid waste system that is considerably prevalent today in most of the urban centres across the country is menace to public health, ecology as well as the socio-economic well-being of waste picker families live off the dumping grounds. Many studies on solid waste management and public health issues indicate that several human diseases are linked to open dumping of waste and its poor management including cholera, malaria, diarrhoea, dengue, typhoid, dysentery etc. Besides all of these, asthma, heart attack, emphysema, bronchitis etc. are linked to daily burning of the garbage. Human waste (faeces) is also often found in municipal waste. Along with this, improper decomposed waste often attracts rodents and that later causes infection and transmits diseases.

Many a time dump yards catch fires - the one at Ghazipur landfill site, country's one of the largest garbage dumping site located in India's capital Delhi, caught fire in April, 2024 which holds at least 8.4 million tonnes of waste which emitted tonnes of cancer-causing smoke into the air and India's capital choked on toxic fumes that day, and caused dangerous heat and methane emissions, adding to India's growing climate challenges. (Singh, 2024; The Times of India, 2024)

In Jorhat, Bhogdoi river (a major tributary of the Brahmaputra passing through the Jorhat city) and *Tocklai* rivulet has the very close proximity to the Garmur open dumping ground. Two major streams of Jorhat, one is the *Tocklai* stream flows into Bhogdoi river and passes through the Jorhat city and another one is *Tarajan* stream which flows into the river Brahmaputra on the north-western outskirts. *Tocklai*'s water level plummeted after a part of it merged with Bhogdoi river during the flood of 1987. It has now become an easy dumping zone or dirty drain for the residents. (The Telegraph Online, 2013) *Tocklai* rivulet has been blocked over the years as most of the people of Jorhat town reside near the rivulet throwing away their household garbage into the rivulet openly. Respondents of the study revealed their disappointments by saying that they feel very disheartening when they imagine that the stream may be disappear in just next two to three years if people of its nearby areas do not stop to throwing away or dispose their wastes in the stream directly. During the field study, respondents shared that earlier they went to enjoy picnic in the nearby areas of *Tocklai*, used its water for household activities, even in the activities of *Macharhat Namghar* (A local temple located in the ward no 1). At present one cannot even pass through near this stream without facing its foul smell. In the monsoon season, due to high rainfall, the instances of flood occur

near the areas of dumpsite basically due to the narrowing of *Tocklai* rivulet that led to run-off of the wastes into the Bhogdoi river. The residents of Jorhat also raised serious concern about the problem of foul odours and menace of stray animals in the area occurred as a result of open dumping of wastes in the stream.

There are some squatters residing at the bank of the river Bhogdoi and the numbers of squatters are increasing day by day on both sides of the river. Most of them are naturally draw water from the river for everyday household activities. It is observed in the field study that people basically dispose and burn their household waste near the river Bhogdoi and most of the inhabitant's pipe of toilet, bathroom pipe and drainage system are directly connected to the river Bhogdoi from where people use water for basic household activities. Bhogdoi's water is not actually fit for direct consumption by human, about which majority of the people of its nearby areas are not aware and they consume it without proper filtration. Therefore, the residents of Jorhat are much tensed and worried about the improper disposal of garbage in the bank of the river Bhogdoi due to which the river has become polluted day by day. In this context, it is come out that Jorhat municipality with the help of self- help groups often tries to organised awareness camp on Swachh Bharat Mission and hygiene maintenance. In such camp municipal authority went for inspection of their waste disposal practices and they have focus on various team work on wards cleanliness basically during holiday. In such campaign ward commissioner of the respective wards have tried to make people concern about the necessity of proper garbage disposal. We find that most of the residents are not interested to join such meeting and camp, rather they have tried to avoid it by showing some personal excuses every time.

During the field work one young man from ward no1 expresses his disappointment and narrates –

Most of the people here do not use dustbins and public collection points, they used to go to the Tocklai stream and bank of the river Bhogdoi to throwing away all their household waste on a daily basis....even they do not want to avail the solid waste collection service of municipality because they do not want to pay for it....as a result, Tocklai stream is now become a small dirty drain and if this mismanagement of waste will continues for years, then the river Bhogdoi will also be the next Tocklai few years later.

Apart from these, sanitation workers of municipality said, people are basically less aware about the waste disposal and segregation process due to which they have face difficulties every day in terms of garbage collection both at household level and public collection point. They also do not get adequate materials and equipment for regular sweeping of streets, garbage collection and proper waste disposal. Although some of them got the equipment from municipality such as hand gloves, mask, rain coat, shoes and others, the quality of these products is not satisfactory at all. Moreover, sanitation workers are not well aware about the municipal solid waste management act and its rules implemented by the ministry of urban development, India. As slum areas under Jorhat municipality are situated at the bank and nearby areas of the Bhogdoi river, it is seen that most of the houses are like huts where many large families and joint families are residing and due to the huge amount of garbage disposal of the households and its open dumping in *Tocklai* rivulet as well as at the bank of river

Bhogdoi, water pollution keeps on occurring during monsoon basically as the water of Bhogdoi is being affected to a great extent by the household waste materials and waste water as well. As a result, the stinking garbage creates a hellish atmosphere around the areas.

Moreover, the inadequacy of proper drainage system and its irregular cleaning play a major role in public health problems. In the main town area of Jorhat, drainage system is very poor and not cleaned regularly. Most of the existing drainage systems are blocked with plastic waste, these are uncovered in slum area and the waste water accumulates in the streets, for which children are primarily vulnerable to disease through direct contact.

Furthermore, from the piled –up garbage of the streets and dustbins of Jorhat town area, basically in market area, the flies, mosquitoes and several insects have been carrying the germs to the nearby roadside shop of meat, fish, milk, sweet, vegetable and so on. The odour of rotten garbage forced everyone to close their nostril while crossing the roadside garbage heap in commercial areas that regularly witness crowd since morning to mid night. People from different wards have expressed their serious concern over such negligence towards public health and hygiene.

Figure 6: (a) Open dumping of waste at public place by residents, (b) Present condition of Tocklai, (c) Nearby residential place of Garmur dumping site



(a)



(b)



(c)

(Photo: First author,2024)

Waste burning is considered as one of the biggest factors of greenhouse gas emission in India. Along with human health, its effect on land, water, and air pollution is a matter of great concern for the country. (Swaminathan,2018) India emits more methane (6%) from landfill sites than any other country, according to Greenhouse gas emission monitoring Satellites (GHG,SAT). (The Times of India ,2024) Moreover, leachate from garbage contains toxic liquid and later it is either absorbed by the soil or it flows into ground water bodies. Consequently, this process can affect entire food chain if the contaminated water is used for agriculture and consumption purpose. (Swaminathan, 2018)

The survey reveals that the stagnant water of *Tocklai* stream serves directly as a host to the vector borne diseases such as mosquitoes transmitting malaria, dengue, Japanese encephalitis etc. and during artificial flood several diseases like diarrhoea, cholera, typhoid and so on break out among slums and its nearby areas as transpired by ASHA (accredited social health activist) workers of the wards of the studied area.

Best practices for solid waste management

Indian government launched the Swachh Bharat Mission (Urban) on 2nd October, 2014. The primary vision of the mission was to make India clean or at least free from open defecation and to scientifically process all municipal solid waste generated in the country. After that, to carry forward the progress of the mission, Swachh Bharat Mission- Urban (2.0) has been launched on 1st October, 2021 for the next five years, up to 1st October, 2026 with the vision of achieving zero waste (aims to reduce waste by recycling and reusing the waste material and preventing waste from going to landfills) status for all urban centres through 100 per cent source segregation, door-to-door collection of waste, systematic and scientific management of all fraction of waste and safe disposal in scientific land-filling sites. The mission also aims at remediation of all legacy waste dumpsite and conversion of these areas into green zones. Therefore, highlighting the efforts of the Indian government towards sustainable waste management, Swachh Bharat Mission - Urban (2.0) is a shining example of concerned authorities' green vision in terms of sustainable method adoption as well as proper service

delivery. In terms of solid waste management, solid waste processing has witnessed a significant level of success from 17 per cent in 2014 to more than 77 per cent in 2024 in India as a whole. Concerning this, Ministry of housing and urban affairs has advised all urban local bodies to promote separation of waste at source. (PIB, 2024)

Focusing on the objectives of Swachh Bharat Mission, Jorhat municipality works for innovative ideas for recycling of waste and takes the initiative of 'RRR -Reduce, Reuse and Recycle' centre opening under Swachh Bharat Mission – Urban (2.0) in different wards. 'RRR' centre refers to reduce, reuse and recycle of waste, in which town dwellers are asked to submit their unused materials such as books, newspapers, cloths, shoes etc. of their house in their respective 'RRR' centre with the motive of maintain cleanliness across the city and awakening people towards recycle and reuse of waste. Moreover, to disseminate awareness and bring behavioural changes, Jorhat municipality organises awareness campaign in the form of making green zone in wards, street play, mahalla meet up, chai adda, open mic, occasionally school workshop for several times on waste management in footpath, schools and colleges in association with NGO such as 'SAAHAS', 'Dix', 'Aamar Jorhat', Self Help Groups etc. NGO 'SAAHAS' tries to bring awareness amongst people through distribution of bags for dry waste segregation, demonstrate charts, documents of primary knowledge on types of waste and basic segregation method through door-to-door visit and spot segregation of waste etc. NGO 'SAAHAS' have shared a comprehensive plan on pipe composting on a lower primary school of Jorhat town as a model work to recycle mid-day meal waste as fertilizer and also try to make students aware about the waste management through practical workshop and visits in dumping ground. The NGO also tries to make students aware and courageous about the significance of scientific waste management through organizing practical workshop in a few lower primary and higher secondary school of Jorhat and visits in open dumping ground of Garmur. This innovative idea of NGO SAAHAS brings to us the famous theory of 'Sociological Imagination' by C. Wright Mills where it can be interpreted how the sociological imagination fosters critical thinking skill of students and how it works to get hand on experience through their involvement in the issue of garbage management by practicing sociology. The workshop on garbage exercise as a useful tool helps students to critically evaluate the waste disposal habit and behaviour of others. Moreover, from the childhood stage the students can have at least the basic idea of waste disposal and its importance. That is why, Jorhat municipality often strive to disperse awareness among children and youth about sanitary solid waste management through organised slogan writing competition, rally of youth, marathon, providing opportunity of internship to the graduate students on waste management etc. Besides, many a time municipality have tried to motivate hardworking and dedicated sanitation labourers by felicitating them publicly. NGO 'SAAHAS' also makes an innovative effort to propagate community awareness and motivate people by providing 'monetary reward' to those residents who properly give their wastes to Self Help Group through segregation at source. As the members of the NGO said, till now they have provided this award to a few women of their working wards.

Problems of Solid Waste Management :

In order to achieve the vision of solid waste management directed by Swachh Bharat

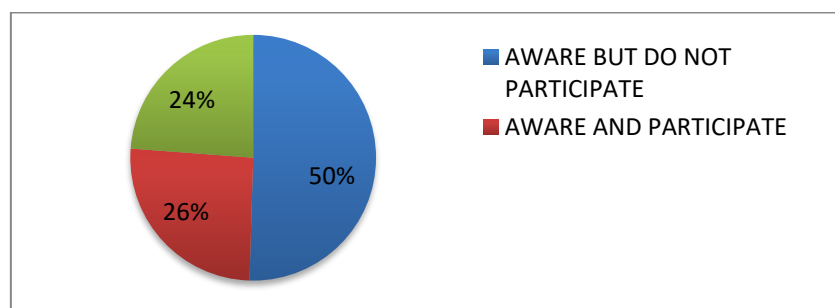
Mission and urban development authority there are some challenges that must be addressed.

The challenges that solid waste management sector of India is facing are basically related to the low priority on scientific waste management accorded by municipal bodies and lack of awareness of the public. Municipal solid waste management poses a major environmental and social challenge for Jorhat municipality as existing waste dumping ground has surpassed the capacity. Additionally, the municipal authorities of urban local bodies are unable to deliver proper services due to the lack of funds, manpower, adequate technology of waste segregation as well as accountability of the system. Even a very basic and easy task of source segregation of waste is not being practiced by most of the residents in selected wards due to lack of awareness about its implications. Along with it, there is no such extra facility for transporting hazardous waste to the dumping site. It has been observed that the transportation facilities of waste collection and dumping are very limited, due to which a huge pile of waste is gathered in the streets every day. It is found that there is no such facility of separate dustbin for sanitary hazardous waste separation in municipal wards. In the vehicle also, there is no such facility of waste separation even though Swachh Bharat Mission has asked for waste segregation at source.

Residents have been facing the trouble of irregular garbage collection from household, even from public collection points also. However, residents are also responsible for irregularities of waste collection as they do not clear their monthly fees of collection to them. Moreover, residents and shopkeepers are very unsatisfied with the prevailing dustbin facility of their wards provided by municipality as it is insufficient and causes shortage of space for waste disposal as per requirement. It is noteworthy to mention that medical waste from different hospital under Jorhat municipality should be treated separately either by disinfection or incineration before dispatching into land-filling for disposal. It should be kept away from general waste and transported separately as well.

Although government of India has introduced Swachh Bharat Mission - Urban (2.0) to ensure proper solid waste management and improving sanitation practices, lack of awareness is the root cause of all its related issues. Peoples' priority on sanitary garbage disposal and hygiene is very low and they are not aware about its inherent linkages with public health.

Figure 7: Respondents awareness towards Swachh Bharat Mission (urban) campaign and their participation



Source : Field Study, 2024

From the studied area and figure :7, it is clearly visible that majority of the residents that is 53(50%), are aware of the campaigns initiated by Jorhat municipality to change attitude

of the public towards proper solid waste management but they have not participated in any such awareness programmes. On the other hand, 27 (26%) numbers of respondents are aware and willingly participated in different awareness programme such as 'Swachhata hi seva', 'Street play', 'Swachhata yatra', 'Rally of youth' 'Viksit Bharat sankalp yatra' etc organised under Swachh Bharat Mission-Urban by Jorhat municipality. In addition to that, 25(24%) of the household revealed that they do not know anything about the central initiative of Swachh Bharat Mission and its activities. It is evident that most of the people under Jorhat municipality lack proper knowledge on the objectives of garbage disposal as well as of the harmful effects of mismanagement solid waste in relation to Swachh Bharat.

Social and occupational aspects of sanitation practices are also highlighting factors. Despite appropriate legal policy of urban sanitation and Swachh Bharat Mission initiatives, there is a very low level of attention that has been paid towards the occupational hazard faced by sanitation workers, who works for garbage collection, street and drain cleaning, and those who works in the dumping grounds. Workers revealed objection in terms of quality of sanitary equipment that the materials are not satisfactory anymore. Moreover, there is a considerable gap between municipal authority and public pertaining to the matter of active participation and active communication in urban affairs due to which, in terms of proper implementation of Swachh Bharat Mission, concerned official body of Jorhat municipality has faced the problem of lack of public co-operation in the way of smooth running of Swachh Bharat Mission.

Conclusion:

The current practice of municipal solid waste management in Jorhat municipality of Assam is insufficient to fulfil the objectives of Swachh Bharat Mission and sustainable development. Urban areas of Jorhat need more innovative works and ideas of solid waste management to ensure scientific and sanitary waste disposal. Urban local bodies along with the help of NGOs, Self Help Groups and educational institutions should make a strong institutional framework to educate people, basically in slum areas about sanitation, hygiene and waste management through Swachh Bharat Mission. There is a great need of special attention of government and NGOs towards slum improvement programme, basically in terms of their livelihood improvement which can settle the problem of waste management and sanitation as a whole.

In terms of non-compliance of the door-to-door waste collection service and segregation of waste, both household residents and collectors need to be instructed strictly by municipal authority. For residents, municipality should impose fine for generating non - segregated waste and collectors should be made accountable for only collecting segregated waste from the source. The state government should create an appropriate framework to ensure the process of door-to-door waste collection more effective to maintain the waste management sector in a sustainable way where residents attitudinal change in terms of solid waste segregation and disposal, active participation and engagement of urban dwellers in the process are the key factors. Building suitable institutional framework along with policy level directions from concerned authority can definitely support the necessary changes. Above all, we need strong political will to bring modern amenities and public health education to the door steps of people. Thus, to achieve the sustainable development goals in the right direction, addressing

the issue of waste management, drainage, public health and sanitation all together is very important for overall development of the nation as public health well-being and environmental sustainability is now become a greater concern for all over the world.

Additionally, the waste management authority of Jorhat municipality needs to address the root causes of the problems with respect to solid waste management, environment and public health in a concise way. Jorhat municipal board authority along with government and non-governmental organisation should looking forward to solve the critical condition of Tocklai rivulet which has been blocked due to continuous waste dumping by the residents of its nearby areas. It is one of the visible problems that affects entire ecology of Jorhat town, public health and sanitation. Moreover, there has been limited involvement of private sector of India in waste management service. In this regard, government should encourage Public Sector Undertakings (PSUs) to contribute towards solid waste management and environmental sanitation.

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