Municipal Solid Waste Management on In-depth Analysis for a Hilly area District of India

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ABSTRACT

Everyone on earth faces a serious threat from municipal solid waste (MSW), but it is especially hazardous in developing countries like India where urbanization and industrial expansion are rising swiftly. Urbanization is expanding quickly and the population is gradually increasing in Almora city located in Uttarakhand. The city provides sites for a range of administrative, educational, economic, tourism, health, and recreational pursuits. In the study area, solid waste collection and management services are mostly provided by municipal organizations. Despite being a crucial service, it does not get the attention that the city's fast growth requires. Solid waste management (SWM) and collection services are generally inadequate and lacking in this area. This situation has caused a number of problems for the urban environment and public health. Large-scale human interventions in the natural environment are the principal source of ecological and sustainability risks in the urban municipal region. Black carbon is produced during the incineration of MSW, and harmful toxins like sulfur dioxide, mercury, and carbon dioxide are also released. Particulate matter is also added to the urban environment. These elements are posing problems for people, wildlife, and vegetative plants. It is the goal of this research to identify the problems with the MSW repository, handling, and dumpsites in the chosen region so that we may work toward fixing them.

Keywords: *Almora City*, *Uttarakhand Region*, *Solid Waste, Urbanization, Waste Management*

Introduction

Waste is a result of all living things. It is customary to refer to the created non-liquid waste as "solid waste" since the first person to come into contact with it finds no value in it. Organic and inorganic items like yard clippings and product packaging, as well as commonplace items like furniture, clothes, bottles, and paper, make up solid waste (Tchobanoglous *et al.,* 1993). MSW management is a global issue, but it poses a specific challenge to India. Due to rapid urbanization and industrialization, Indian cities are seeing exponential population growth (Alam and Kulkarni 2016). In recent years, Indian cities' quality of life has greatly increased.

These elements contributed to a rise in MSW production in metropolitan areas. As per the Central Pollution Control Board (CPCB) of the country, the annual production of waste is more than 510 billion kg. Between 0.2 and 0.6 kg of garbage is produced everyday per person (Priti and Mandal, 2019). Solid garbage generation in Indian cities rose by 4.25 % yearly on average between 1947 and 1997, from 0.6 billion kg to 4.8 billion kg. The CPCB predicts that 300 million metric tons of waste will be generated yearly by 2047 (CPCB, 2004). In around 90% of India, MSW is dumped in a dangerous manner on land.

According to the world data bank, more than two-thirds of Indians (68%) and almost half (46%) of

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the global population live in rural regions (The World Bank, 2016). Homes are clustered together in Indian communities in a region that is a mixture of wooded, agricultural, and grazing areas. 5 to 6 people and 4-5 cows make up the average Indian family. A large portion of the garbage produced is deposited on the ground in an open yard, while household and agricultural wastes are utilized to create compost apart from residences (excreta and kitchen waste). Our communities' combined odor of decomposing human waste and incomplete biomass fuel burning is proof of better waste management.It is difficult for urban local bodies (ULBs) trying to maintain clean, sanitary cities in India to manage MSW since the majority of Indian ULBs neglect it. Due to a shortage of sufficient land for dumpsites, as well as capital and institutional restrictions, it is difficult to dispose of garbage which impedes the effectiveness of garbage collection, transportation, and disposal of scientific waste, ULBs may choose to disregard MSW management (Mani and Singh, 2016).

It is no secret that basic services like water supply, sanitation, and the collection of municipal solid waste are severely lacking in Indian urban areas (MSWM). Because of the expanding Indian economy, MSW output has skyrocketed in recent years. According to Kumar *et al.* (2004), as urban residents' living standards rise, so does the amount of garbage they create. It is projected that in 2001, 46 million tons of waste were produced; by 2010, 65 million tons was produced. Even though municipalities get substantial sums of money for this purpose, the majority of the nation's urban areas do not have solid waste management (SWM) services. Ground and surface water are contaminated by solid waste, which also increases greenhouse gas emissions. Additionally, any substance that water filters through may cause its constituent parts to dissolve into the water. Leaching is the process, and the fluid that is produced is known as leachate (McMichael, 2000). According to Hoornweg and Thomas, (1999), one common activity is illegal garbage dumping in water bodies, which not only spreads chemicals into the environment but also coagulates water bodies and damages an area's entire ecosystem. The contends that secure waste management and disposal are essential for risk reduction, good hygiene practices, and safe working conditions (Blenkharn, 2007). In their study, Pant and Joshi, (2022) investigated that many environmental issues that tourism has caused and provide a variety of solutions. Solid waste origins, processing, management, and possible solutions are only a few of the issues covered in depth by Jagbir and Ramanathan edited book (Singh and Ramanathan, 2010). Most developing Asian countries continue to dump solid waste in landfills, according to a study (Dhokhikah and Trihadiningrum, 2012). The framework for waste management created by Cucchiella *et al.* (2014) has as its purpose the sustainability of MSW administration. MSW is a big problem in most cities of the country, despite the fact that considerable sum of municipal cash are set a side for it. An unprecedented amount of effort and concern have been made in response to worries about the inappropriate use of MSW on a worldwide scale (Read *et al.,* 1997). Rana (2006) looked at how neighboring rivers were affected by the improper dumping of various types of solid waste, such as garbage, waste, sewage sludge, and other items. Around the world, a great deal of research is being done to determine the best ways to manage solid waste.

The Clean India Mission (Swachh Bharat Mission) of the Indian Ministry of Housing and Urban Affairs has raised pressure on ULBs to act quickly to control MSW. As a consequence, solid waste management requirements for Indian cities must be met right away. Uttarakhand is one of the states of India with the greatest population growth, is a sizable mountainous area with a lot of religious monuments. Despite this, the literature on MSW creation and management only mentions a small number of Uttarakhand cities. Therefore, the primary objectives of the current research were to: (1) Identify the origins and causes of MSW in Almora city; (2) Examine Almora current solid waste management system; (3) Identify the MSW system inadequacies; (4) Determine the best practices for Almora MSW management.

Materials and Methods

This section is divided into two sub-section. The study site and data description used in this research will be explained in the first section, while the methodology followed in this study is described in the second section.

Study Site and data description

The Indian state of Uttarakhand has a district named Almora in its Kumaon Division. The district of Almora is located between latitudes 29°37'-29°62'

North and longitudes 79°40'-79°67' East. Above sea level, it rises to 1,638 feet. There are the nine tehsils of the Almora district. In 1864, the Almora Municipal Board was established. At 7.54 km2, Almora City is the seat of the Almora Municipality and the district administrative center. Pithoragarh, Chamoli, Bageshwar, and Nainital are the nearby districts. Located on a ridge of the mountain, Almora is the capital of the Almora region. Talifat is the eastern part of the hill, while Selifat is the western part. Talifat and Selifat intersect at the top of the hill, where the market is situated. Almora was also the location of Udai Shankar dance school, which educated a number of notable Indian and French dancers. Pine Lodge, a suburban townhouse complex, served as the site of the Almora Dance Academy (Ranidhara). The Himalayas and the city may be seen from the location. 622.506 people live in Almora district, according to the most recent census. There are 198 individuals living in the district per square kilometer. From 2001 to 2011, its population increased by 1.73 %. One in every eleven men in Almora is a woman, and the literacy rate is an impressive 81.06%. More than 90% of the district population speaks Kumaoni as their first language.

As of right now, the planned research would focus on Almora City, which is organized into 13 wards and a smattering of Mohallas. Based on census data from 2011, there are 38364 people in the study area, including 19730 men and 18634 females, with the majority of the population living on a ridge. Most people live in Baleshwar ward, which has 4619 residents, including 2374 men and 2245 women, while Sailakhola ward has 1437 residents, including 737 men and 700 women. The study site, which is located between the Kosi and Suyal Rivers, is characterized by steep, tall peaks as well as deep, narrow valleys, making it an excellent place for conducting research.

Applied methodology

During the investigation, researchers used both quantitative and qualitative approaches. Field surveys, questionnaires, and interviews were all part of this process.

Qualitative Method

For primary data collection, a standardized questionnaire was developed. To get a better knowledge of people lives, a questionnaire was given to people from various walks of life. Respondents were re-

quested to offer responses to questions in the form of closed-ended questions in the questionnaire. Officials from Almora municipal government and employees of the A2Z firm were questioned about the city waste management services and methods. Citizens' knowledge of SWM, Almora residents' desire for SWM, and Almora residents' fear of solid waste management are all addressed in the survey, which is broken down into three sections.

Quantitative Method

The key dimensions of the questionnaire were analyzed to obtain the data. The Nainital Municipal Corporation and the agency gathered secondary data on the creation, collection, and disposal of solid waste. The individuals as well as organizations engaged in solid waste management in Almora undertook on-site field visits to examine different elements of their operations. Waste creation, collection, transportation, transfer, and disposal were all part of the waste collecting chain that was covered. During the case study, there were two stages. There was an initial survey conducted in various places of Almora city. In the second phase, fieldwork and data analysis were carried out on-site.

Results and Discussion

The Almora Municipality's daily waste output is shown in Figure 1. Vegetables, fruit peels, newspapers, and other household waste generated in residential areas are included in this waste. The data shows that the Almora municipal region produces 10.57 tons of waste per day. Every day, 3.36 tons of garbage are recovered from the sewers, of which 5.8 tons are discarded as household waste. The daily production of garbage from hotels and restaurants is 0.114 tons that from commercial areas is 0.36 tons, that from roads is 0.621 tons, and that from vegetable and fruit markets is 0.32 tons.
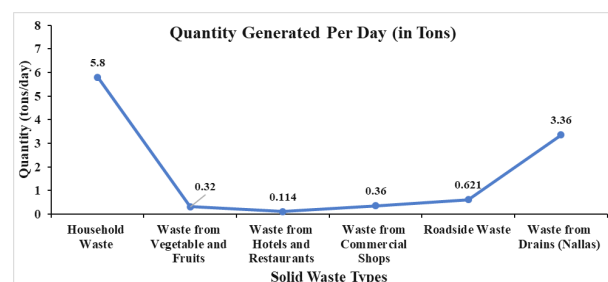

Fig. 1. MSW G production per day in study area

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Since the previous several decades, the majority of metropolitan areas have implemented solid waste management systems. However, these systems and coordinated procedures have yet to exist, despite the fact that the solid waste characteristics of metropolitan centers vary considerably. Figure 2 depicts a significant workforce shortfall in the Almora Municipality. Workers and sweepers may be seen sweeping, collecting, classifying, inspecting, and dumping of MSW in Almora. It can be seen in Figure 2 that 9 supervisors along with one chief officer as well as 179 municipal workers are engaged in the functioning of the local government.

From Figure 3 it can be perceived that there are just a few dustbins per capita in Almora, which has a population of 38364 as of 2011. Despite the fact that Baleshwar (4619 people) and Rajpura (3904 people) are the most populated wards in the study area, only 5 dustbins are allotted to each ward, and only 2 dustbins are provided to each ward. Local government bodies such as the municipal board are in charge of allocating dustbins to various wards in the city. The Railapali, Dugalkhola, Ramshila, and Tripurasundari wards each have three dustbins, but the Tripurasundari ward has just two. There are seven dustbins in Badreshwar ward, eight in Lakshmeshwar ward, seven in N.T.D. ward, and eight in Vivekanandpuri ward. According to municipal statistics from the year 2020, only 57 dustbins are allotted to the research area as a whole. As a re-
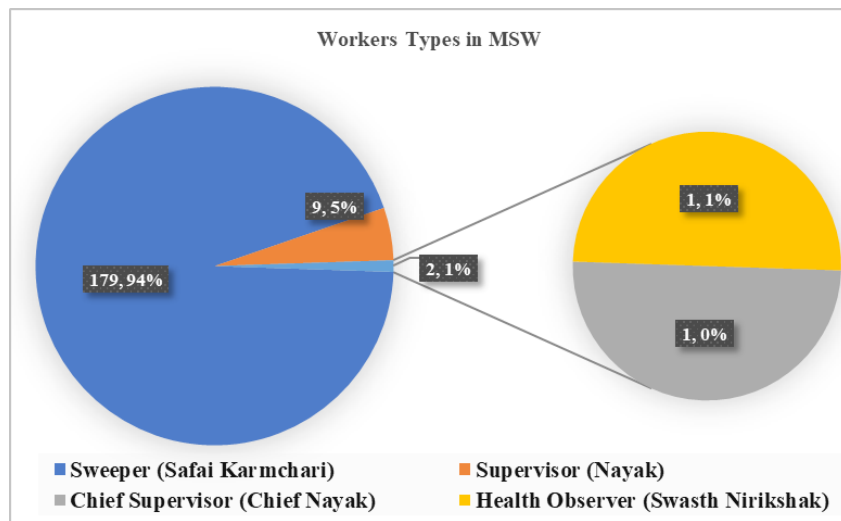

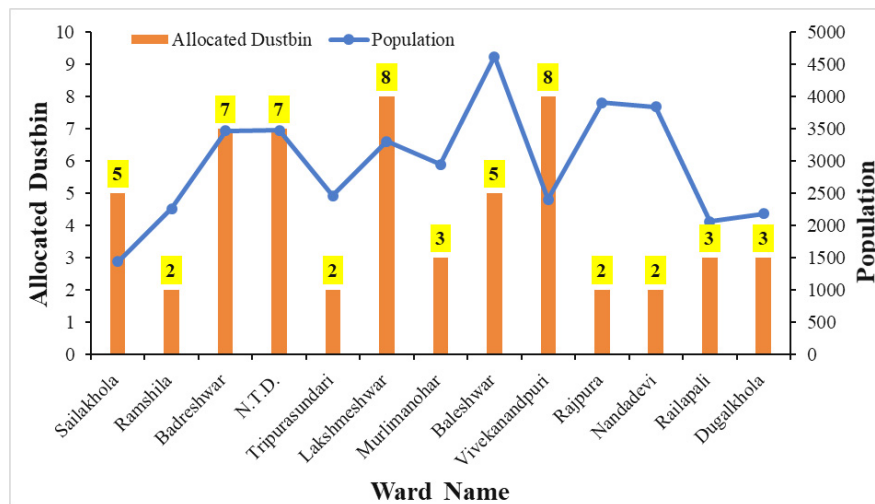
Fig. 2. Types of employees Work in MSW

Fig. 3. Allocation of Dustbin in study region

sult, the Almora municipal area streets, roads, and drains are littered with garbage because there aren't enough trash cans in most wards to keep up with the city population. Due to the tiny size of dustbins, garbage is often dumped outdoors and in close proximity to them.

Figure 4 shows that a larger proportion of respondents i.e. 77 emptied their garbage bin after four days, thirty-five people after three days, 21 people after two days, 39 people evacuating their bins after seven days while only twenty-three people emptied trash bin on daily basis.
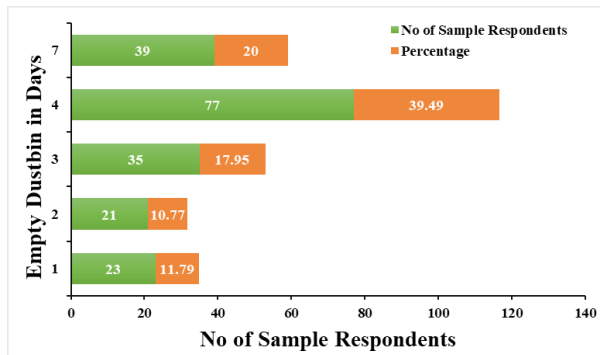
Fig. 4. Duration of Emptying Dustbins in Almora city

Figure 5 shows that there are not a lot of public restrooms compared to the population. There are no public restrooms in the wards of Dugalkhola, Railapali, Sailakhola, or Tripurasundari. Where public restrooms are present, they are in poor condition from a lack of upkeep. Only six of Almora 13 wards have septic tanks, with the other seven dependents on open drainage for waste disposal. The research area sewage disposal infrastructure is in poor condition, as can be seen. Only Tripurasundari, Baleshwar, and Rajpura wards in the whole Almora
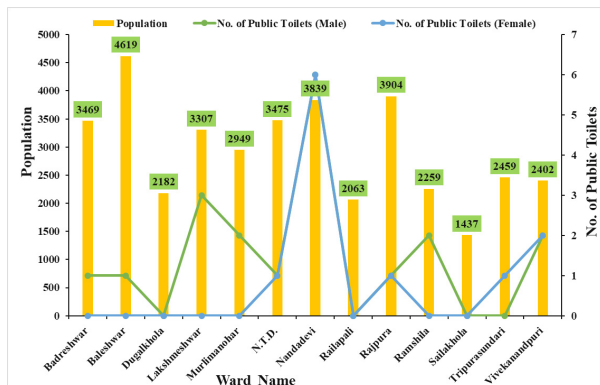

Fig. 5. Available Public Toilets in study area

municipal boundaries are serviced by wastewater management and sewage treatment. Only 656 houses have access to sewage pipes (Almora Municipal Board, 2020). As shown in Figure 5, user fees and grievance procedures have not yet been implemented on land under the control of building owners, alongside busy roads in remote areas, and in other municipal wards of Almora.

Figure 6 demonstrates that there are just seven trucks of differing sizes, each having a capacity of 268 quintals, which is a small compared to the amount of garbage created in Almora.
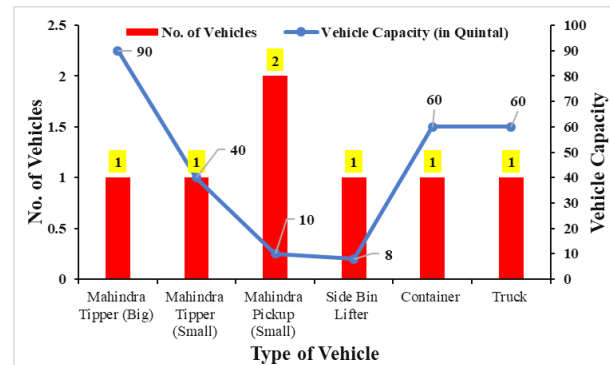

Fig. 6. Waste Transportation Infrastructure

Figure 7 depicts the answers of a representative sample of respondents about the quality and sufficiency of public trash cans. It is evident from the Figure that the majority of respondents are dissatisfied with the state of trash cans. Approximately 54 people confirmed that the dustbins are rusted, and 23 people admitted that they dump household garbage in broken dustbins, causing the garbage to escape and remain scattered on the streets and roads. Only 12 people acknowledge that public trash cans in their vicinity are in excellent shape.

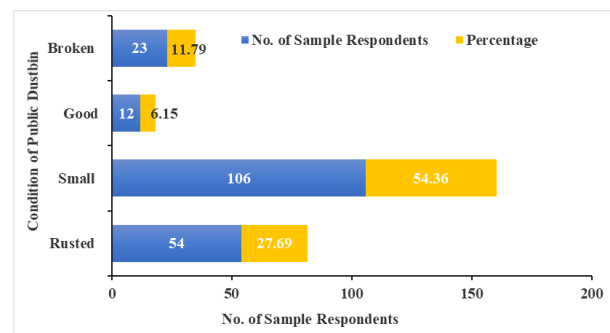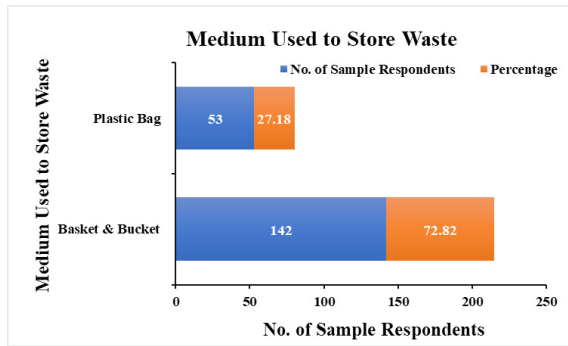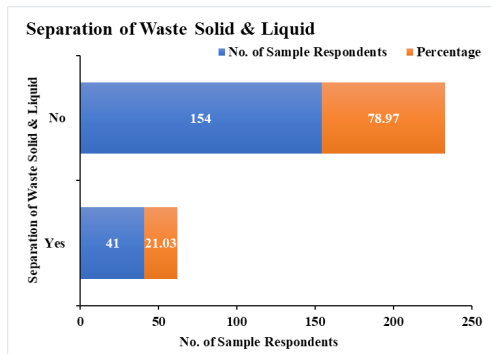Figure 8 indicated that Only 41 people segregate

Fig. 7. Condition of Public Dustbins by Sample Respondents

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(a)

(b)

Fig. 8. Separation of Household Solid Waste by Sample Respondents

Fig. 9. Employee response about MSW law awareness
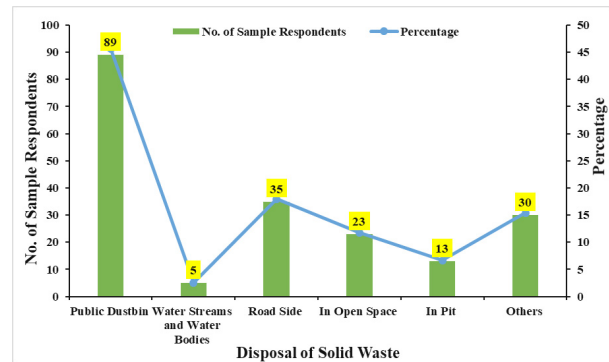
Fig. 10. Methods Used to Disposal of Household Waste

solid and liquid trash, while 154 people do not. 142 people utilize old baskets and buckets to toss rubbish, whereas 53 people use plastic bags. In addition, Figure 9 shows employee response about awareness of laws for MSW. It can be perceived that only 40.51% employee have proper knowledge about MSW laws. On contrary, a large number of employee (59.48%) were unaware from MSW laws.

Figure 10 reveals that out of 195 people dispose to waste public dustbins, while 5 people dispose to water streams like near Dharas, Naulas, 35 people dispose road side streets, 23 people dispose in open space, only 13 people dispose to self-made pits, and 30 people dispose to other side dispose to solid waste dustbins.

Conclusion

Almora city is now plagued by poor solid waste management, inadequate infrastructure, and a deficient labor force. Markets, streets, and roadways are littered with garbage; no systemic approach to dis-
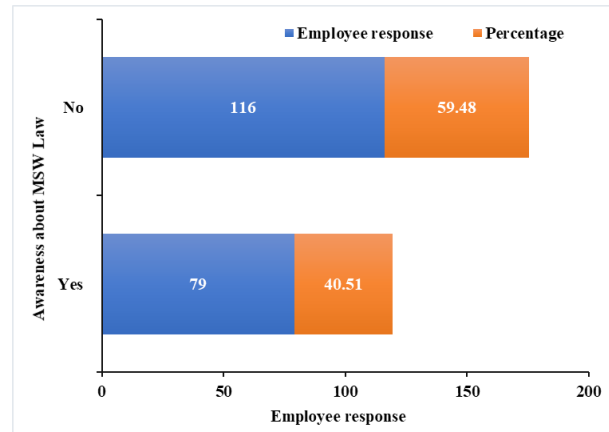
posing of it has been implemented. People are also unaware of the negative environmental, health, and social consequences of municipal solid garbage. Modern city life creates a pollution issue that grows in amount and varies in composition with each passing day. There has been a lack of attention paid to MSW management in this region due to a lack of sufficient knowledge of the problem infrastructure needs and social components. In many cases, urban health concerns may be traced back to the rapid growth of cities and the resulting accumulation of solid waste.

Future Recommendations: There is a need for appropriate MSW management in the research region due to rapid urbanization and an increase in the amount of SWM per capita. It is essential that Almora city be equipped with the most up-to-date technology and equipment. The collection should be done using containers and tools that are well-designed. MSW collection system can be used regularly to make sure that the collection process is good for the environment. Non-biodegradable garbage is placed in a

separate dumpster from biodegradable trash. Separate the garbage based on its origin and characteristics. MSW Municipality should organize awareness campaigns to ensure that the community participates in waste segregation, and citizens should support this effort. Transporting MSW requires the use of well-designed trucks. Almora City Municipality shall attend regularly to empty trash cans and containers, wherever they are located, and clean them before they overflow. It is necessary to use sanitary landfill methods for waste disposal. To properly implement SWM, all metropolitan local governments must have sufficient infrastructure and equipment. Capacity building includes a number of crucial elements, including education, awareness, and community engagement. Put restrictions on the disposal of items that cannot be recycled, repurposed, or converted into energy.

Acknowledgement

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