



SOLID WASTE MANAGEMENT IN URBAN AREAS; A CASE OF JCMC AREA, JALGAON, MAHARASHTRA, INDIA

Vishal L. Rane, Abhijit S. Thorat and Sanjaykumar R. Thorat

School of Environmental and Earth Sciences

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon, Maharashtra

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ABSTRACT

This study carried out within the Jalgaon City Municipal Corporation in Maharashtra State, India, concentrating on the prevailing practices, challenges, and strategies pertinent to solid waste management. Initial field assessments indicated that the average solid waste generation rate of household in the city stands at 0.25 kg per capita per day, culminating in an estimated total waste output of around 54 tons daily. A thorough examination was conducted to analyze the processes involved in the sourcing, quantity produced, collection, transportation, storage, treatment, and disposal of Municipal Solid Waste (MSW). Data pertaining to Solid Waste Management within the Municipal Corporation was gathered through the distribution of questionnaires, individual site visits, and interviews with pertinent municipal officials. Furthermore, photographic evidence and documentation were amassed to depict the various stages of generation, storage, collection, transportation, treatment, and disposal of Municipal Solid Waste.

The study's outcomes advocate for the adoption of sanitary landfills as a substitute for current open dumping practices, aiming to reduce reliance on waste incineration, notwithstanding the challenges and issues that may arise from this transition. The paper proposes an urgent shift from the existing waste collection and disposal methodologies employed by the government to a newly recommended framework that prioritizes waste-to-wealth or trash-to-treasure initiatives through recycling and community involvement, which are considered vital for attaining sustainability and effective solid waste management in the region under study.

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References: 18

Keywords: Municipal Solid Wastes, Jalgaon area, Landfill, Recycling Waste.

INTRODUCTION

Effective waste management is crucial for promoting sustainability in Jalgaon. The strategies employed for the disposal of solid waste, including landfill operations and recycling initiatives, play a significant role in minimizing environmental impact. By focusing on these key areas, Jalgaon can enhance its waste management practices and contribute to a more sustainable future. Municipal Solid Waste Management (MSWM) represents a significant challenge to public health and environmental sustainability in Indian urban areas. Despite

allocating 20-55% of their budgets to solid waste management, these cities manage to collect only 40-80% of the generated waste. Legislation mandates that each state and local government establish its own environmental protection agency to oversee the safeguarding and enhancement of the environment within their jurisdictions. The management of municipal solid waste and pollution is a primary obligation of these state and local environmental agencies, which are tasked with the responsibilities of handling, processing, disposing of solid waste, and mitigating pollution (Ogwueleka et. al., 2009). The

concept of municipal solid waste encompasses the solid refuse generated from residential areas, roadways, public spaces, commercial establishments, healthcare facilities, and administrative offices. This type of waste is frequently managed by municipal and governmental entities. In contrast, solid waste produced by industrial activities is typically not classified as "municipal." Nevertheless, it is essential to consider industrial waste in the context of municipal solid waste management, as it often inadvertently contributes to the municipal waste stream (Zurbrugg, 2003).

Improper management of waste including its handling, storage, collection, and disposal poses significant risks to both environmental integrity and public health. In urban areas with high population densities, the effective and safe management of municipal solid waste and pollution is crucial for fostering a healthy living environment for residents (Mosler et. al., 2006). Research indicates that between one and two-thirds of generated solid waste remains uncollected. Consequently, this uncollected waste, frequently contaminated with human and animal feces, is often disposed of haphazardly on land, leading to issues such as flooding, the proliferation of insect and rodent vectors, and the transmission of diseases. Even the waste that is collected is frequently disposed of in an uncontrolled manner at dumpsites or incinerated, resulting in the pollution of air and water resources as per the Zurbrugg, 2009. Recently, several developing nations have come to the realization that their existing policies regarding solid waste and pollution management do not align with the goals of sustainable development (Abhijit et.al, 2024). This recognition underscores the necessity for a fundamental shift in the approach to municipal solid waste and pollution management challenges (Agamuthu, 2003). Emphasis is placed on the technical dimensions of various collection and disposal methods. Effective management of municipal solid waste and pollution transcends mere technological concerns; it encompasses institutional, social, legal, and financial dimensions (Sonawane et. al., 2010). This complexity necessitates the coordination and management of a substantial workforce, as well as collaboration with numerous stakeholders and the broader community. Furthermore, it requires contributions from diverse academic disciplines and a thorough understanding of local conditions (Zurbrugg, 2009). The aim of this research study is to provide a comprehensive overview of the issues and challenges encountered in

the waste management sector, particularly concerning basic waste disposal and pollution control methods. Additionally, the study seeks to develop strategies that can be effectively implemented within the Jalgaon Municipal Corporation of Maharashtra State.

The recommendations derived from this study address various dimensions of municipal solid waste and pollution management, including institutional, political, social, financial, economic, and technical factors. Furthermore, it emphasizes the importance of information dissemination and training regarding innovative approaches such as waste-to-wealth and recycling, which are essential for achieving sustainability and enhancing solid waste management practices in the JCMC area of Maharashtra State.

MATERIAL AND METHODS:

2.0: Study Area: Jalgaon city is positioned at a latitude of $21^{\circ}00'77''\text{N}$ and a longitude of 75.5626°E , located on the right bank of the Girna River. It is strategically situated along the Dhule-Nagpur National Highway No. 6 and is connected by the Mumbai-Bhusawal-Delhi, Mumbai-Bhusawal-Kolkata, and Bhusawal-Surat railway lines. According to the 2001 census, the population of Jalgaon was recorded at 368,579 individuals, an increase from 242,193 in 1991, encompassing an area of approximately 62.29 square kilometers as shown in Fig. 1. It is estimated that around 72% of the urban population resides in informal or unplanned settlements. The management of solid waste is overseen by the city cleansing section within the Environmental Health Service department.

2.1: Data Collection: The data necessary for the current study was obtained from a variety of primary and secondary sources. This included information sourced from several government entities, such as the Census Bureau, Municipal Corporation, Town Planning Department, as well as from newspapers and academic journals. Additionally, data was gathered using questionnaires, fieldwork, and personal interviews. The collected data was systematically organized, classified, presented, compared, and analyzed using various suitable statistical techniques. Graphs, diagrams, and maps were employed where relevant, and their interpretations contributed significantly to the findings of this study. This research integrates both theoretical frameworks and empirical investigations, providing comprehensive insights into the issues and challenges associated with municipal solid waste and pollution management. Solid waste from diverse societal segments was collected, mixed, and a one-kilogram (1kg) sample was

prepared utilizing the quartering method. The waste was subsequently characterized, and the proportion of each component was calculated. Secondary data sources included municipal records, direct observations, photographs of selected sites, and personal interviews. A questionnaire was distributed to assess the involvement and collaboration of various ministries and agencies in Solid Waste and Pollution Management (SWPM) regarding solid waste collection services, disposal methods, and the generation of waste.

3.0: Solid Waste Generation Rates: The quantity of solid waste produced per capita daily in Jalgaon City Municipal Corporation (JCMC) was assessed to estimate the total volume of domestic solid waste generated each day. The measurement of waste generation in the city was conducted weekly on Fridays over a span of ten months, and the mean value was calculated. The results obtained from these studies are displayed in Graph-2, Waste Generation 305.66MT and Collection 298.82 and Uncollected 06.83 in Jalgaon City Municipal Corporation (JCMC) shown in Graph-3.

RESULTS AND DISCUSSION:

3.0: Solid Waste Generation Rates: The quantity of solid waste produced per capita daily in Jalgaon City Municipal Corporation (JCMC) was assessed to estimate the total volume of domestic solid waste generated each day. The measurement of waste generation in the city was conducted weekly on Fridays over a span of ten months, and the mean value was calculated. The results indicate that the waste generation rate in household in JCMC was approximately 0.25 kg/ca/day. The results obtained from these studies are displayed in Graph-2, Waste Generation 305.66MT and Collection 298.82 and Uncollected 06.83 in Jalgaon City Municipal Corporation (JCMC) shown in Graph-3 suggests that income level is a significant factor inducing domestic solid waste generation rates, as demonstrated by the high waste production rates observed in (JCMC) area.

3.1: Factors Affecting Solid Waste Management in JCMC, Jalgaon: In the realm of solid waste management and development, numerous factors that influence the process differ from one location to another and must be considered during the design phase. Among these factors are:

3.1.1: Waste Quantity and Composition: The domestic waste generated in industrialized nations typically contains a significant amount of packaging materials

such as paper, plastics, glass, and metals, resulting in a low density of waste. Conversely, in many developing countries, including Jalgaon city in India, the waste comprises substantial quantities of fillers like sand, ash, dust, and stones, along with elevated moisture levels due to the high consumption of fresh fruits and vegetables (Sonawane and Thorat, 2010). These characteristics contribute to a higher density of waste. Consequently, the weight and abrasiveness of the sand, coupled with the corrosive nature of the water content, can lead to the rapid degradation of equipment. In such circumstances, incineration is not an appropriate method; instead, recycling or salvage operations should be utilized to minimize the amount of combustible paper and plastic in the waste prior to its treatment stage.

3.1.2: Awareness and Attitudes: Public awareness and attitudes towards waste significantly influence the entire solid waste management system. Every aspect of solid waste management, from the storage of household waste to waste segregation, recycling, collection frequency, the prevalence of littering, the willingness to pay for waste management services, and the resistance to the establishment of waste treatment and disposal facilities, is contingent upon public awareness and engagement. Therefore, this issue is vital in determining the effectiveness or ineffectiveness of the solid waste management system within the Jalgaon City Municipal Corporation, Jalgaon.

3.1.3: Access to Waste for Collection: Numerous sources of waste may only be accessible via roads or alleys that could be unsuitable for certain transportation methods due to their width, slope, congestion, or surface conditions (Sonawane and Thorat, 2010). This situation is particularly critical in unplanned settlements, such as slums or low-income neighbourhoods within the Jalgaon City Municipal Corporation, Jalgaon, and it significantly impacts the choice of equipment used for waste collection.

3.1.4: Institutions and Legislation: Institutional challenges encompass both existing and proposed legislation, as well as the degree to which such legislation is enforced. Standards and restrictions may constrain the technological options available for consideration. Additionally, governmental policies regarding the involvement of the private sector, both formal and informal, must be considered. The strength and concerns of trade unions can also play a crucial role in shaping waste management practices.

3.1.5: Collection and Storage: The solid waste in Jalgaon City Municipal Corporation is gathered from

various sources and establishments through multiple methods. This process encompasses primary collection, which involves transporting waste from households to designated collection points, as well as secondary collection, which entails gathering waste from household levels, collection centres, open spaces, and illegal roadside dumps, ultimately leading to final disposal (Abhijit Thorat, et. al., 2024). Approximately 2,653 dust bins are strategically placed throughout Jalgaon City Municipal Corporation to facilitate primary collection. These bins come in cylindrical, semi-cylindrical, and rectangular shapes, with capacities ranging from 2 to 10 m³, and are located in various settings such as Hospitals, and Schools. The waste collection from these dust bins is organized based on the frequency at which the containers reach capacity, as noted during this study. Within the Jalgaon City Municipal Corporation, door-to-door waste collection is partially executed in affluent neighborhoods, while communal collection is also somewhat practiced. In this scenario, households dispose of their waste using handcarts to transport it either to the primary collection points or to the municipal collection sites from these locations, the waste is eventually transported to the two chosen garbage dump sites.

3.1.6: Disposal System: In India, like many developing nations, waste is frequently discarded in open dumps, which are uncontrolled landfills where waste collection services are organized. These dumps are typically situated along or adjacent to major roadways (Ogwueleka et. al., 2009). Within the Jalgaon City Municipal Corporation in Jalgaon, Maharashtra State, there exist two (2) dumpsites located 3 km from the city along the City Municipal Corporation, Jalgaon road and City Municipal Corporation, Jalgaon Road, with disposal operations commencing in 1991; currently, these sites are either filled or exhausted. The practice of open dumping cannot be regarded as a sustainable environmental disposal method. Furthermore, refuse often spills onto roadways, obstructing traffic and culverts within the urban area, and waste is frequently burned openly at the roadside. Various methods exist for waste disposal; however, sanitary landfills represent the sole land disposal option that allows for the control and effective mitigation of severe emissions and contamination of surface and groundwater. Sanitary landfills necessitate significantly higher initial investments and, consequently, incur greater operating costs compared to controlled dumps (Abhijit et.al, 2024). Although sanitary landfills are not implemented in

Maharashtra State, open dumping remains the predominant practice. There is an absence of landfill regulations or standards that establish a framework for compliance and monitoring. Waste in open dumps is often burned to reduce its volume. By considering each fundamental element separately, it is possible to: Identify the essential components and when feasible, establish measurable relationships to facilitate engineering comparisons, analyses, and evaluations.

3.1.7: Characteristics of Solid Waste: The amount and characteristics of solid waste differ across various locations. Factors that affect both quantity and composition include average income levels, sources of waste, population dynamics, social behaviors, climate conditions, industrial output, and the market for waste materials. Research has linked waste generation to the economic status of society by examining the volume of domestic solid waste produced across three socio-economic categories: Low Income Group (LIG), Middle Income Group (MIG), and High-Income Group (HIG). A positive correlation was noted between higher income levels and increased waste generation. Individuals in the HIG category tend to dispose of significantly more plastic, metal, and glass waste, as well as hazardous materials, which constitute 25.3% of the solid waste in Jalgaon City Municipal Corporation, Jalgaon. The studies indicated that the composition of solid waste in Jalgaon City Municipal Corporation, Jalgaon consists of 28% organic materials, followed by 12% rubber and leather products, and 2.6% textiles and rags. This suggests that the municipal solid waste in Jalgaon City Municipal Corporation, Jalgaon contains a substantial proportion of biodegradable materials. The typical composition of municipal solid waste generated in percentage is shown in Graph 4. Conversely, the percentage of non-biodegradable waste, such as metals and plastics, is notably high, indicating significant consumption of packaged plastic and rubber/leather products (Abhijit et.al, 2024).

3.1.8: Transport and Transfer: In recent years, the implementation of small transfer stations in various cities across developing nations has gained traction (Moghadam et. al., 2008). Currently, due to advancements in technology, there are only a limited number of transfer stations within the Jalgaon City Municipal Corporation, Jalgaon. The primary objective of establishing a transfer station is to mitigate the incidence of open dumping in proximity to residential areas and commercial hubs, which are characterized by narrow streets and aged alleys

(Abhijit Thorat, *et.al.*, 2024). The specific type of transfer station utilized in Jalgaon City Municipal Corporation is a direct load system. Waste collected by smaller vehicles (e.g., vans) is unloaded into different categories of collection dumper trucks, which are equipped with specialized mechanisms for the removal and disposal of waste at designated sites.

Environment Problems Resulting from Solid Wastes
Traditionally, the government served as the exclusive provider of nearly all essential services, including water supply, electricity, road infrastructure, and health services, with solid waste management being part of this framework. This reliance on a conventional model has resulted in insufficient infrastructure and service delivery (Kyessi, and Victoria, 2009). Despite the implementation of various intervention strategies since the early 2000s, such as collaborations with private contractors and civil society organizations, numerous challenges persist in the realm of solid waste management within the Jalgaon City Municipal Corporation, Jalgaon (JCMC), which include: Insufficient service coverage (some individuals not receiving service); Lack of authority to make financial and administrative decisions; Insufficient financial resources; Shortage of trained personnel; Deficiency of vehicles and equipment/existing ones frequently break down; Inability to maintain/repair vehicles and equipment; Absence of legislation to enforce measures and capabilities.; Rapid urbanization exceeding service capacity; Uncontrolled growth of squatter settlements; Challenges in locating and acquiring landfill sites; Poor public cooperation; Shortage of qualified private contractors; Difficulty in managing contractual services.

Regrettably, at the site, scavengers informally collect valuable components of municipal solid waste (MSW). Furthermore, various animals such as dogs, goats, sheep, and cows consume organic components of the waste (Akinwale, 2005). These inadequate disposal methods and practices result in issues that negatively affect both human and animal health as per Sheet one pictures figure 1: Picture of a dumpsite at Jalgaon city municipal corporation (JCMC) area; figure 2: Dumpsite along Jalgaon city municipal corporation main road; figure 3: Chandu annanagar dumping site; figure 4: Dumping site solid waste segregation building; figure 5: Samta nagar road Jalgaon.; figure 6: 100 feet shiv-colony road, Jalgaon.; figure 7: Krushna marble store road Jalgaon; figure 8: Dumping ground in chandu anna nagar, Jalgaon; figure 9: Hari-Vithal nagar, shiv-colony Chau fully Jalgaon.; figure 10: Wagh

nagar stop area, Jalgaon. Environmental issues arising from MSW include Lack of action to control insects, rodents, and other vectors; no measures for leachate control; unpleasant odors at sites; air pollution due to waste burning, etc. Ultimately, the accumulation of garbage on streets, in open spaces, and on private properties presents another challenge associated with municipal solid waste management (MSWM). Despite some initiatives aimed at enhancing solid waste management in various areas of the metropolis, there remain significant levels of uncollected solid waste.

In Jalgaon today, it is a frequent occurrence to observe piles of decaying waste in our neighborhoods. The peripheries of residential buildings, drainage systems, highways, and the corners of both major and minor streets, as well as undeveloped land, have all transformed into waste repositories for numerous households. This situation results in waste accumulation increasing at a geometric rate, while collection and disposal occur at an arithmetic rate (Sonawane, *et.al.*, 2010).

3.1.9: Solid Waste Reduction and Recovery: There exist a few formal systems for material recovery in Jalgaon. Nevertheless, there is extensive reuse of plastics, bottles, paper, cardboard, and cans for domestic applications. This practice is particularly prevalent among the economically disadvantaged in the city. The primary challenge lies in the absence of local or national markets for recyclable materials (Yhdego, 1995; Abhijit Thorat, *et. al.*, 2024). The waste generated in developing nations contains a significant amount of moisture, necessitating the addition of fuel to initiate and sustain combustion. This results in a low calorific value and combustible components of solid waste in India, rendering incineration economically unfeasible, especially when considering the high costs associated with construction and maintenance (Ogwueleka *et. al.*, 2009). Therefore, it is suggested that composting could serve as a highly viable recovery alternative that is practically implementable within the Jalgaon City Municipal Corporation (JCMC). Most rural regions in Maharashtra State utilize household food waste to feed livestock, where the waste is composted at home and subsequently used to enrich the soil. The composted material can serve as fertilizer. It has been noted that composting programs are not well established in Maharashtra, including within the Jalgaon City Municipal Corporation; instead, backyard composting is more commonly practiced. Composting involves the decomposition of organic materials under

controlled conditions of temperature, humidity, and pH through an aerobic biological process.

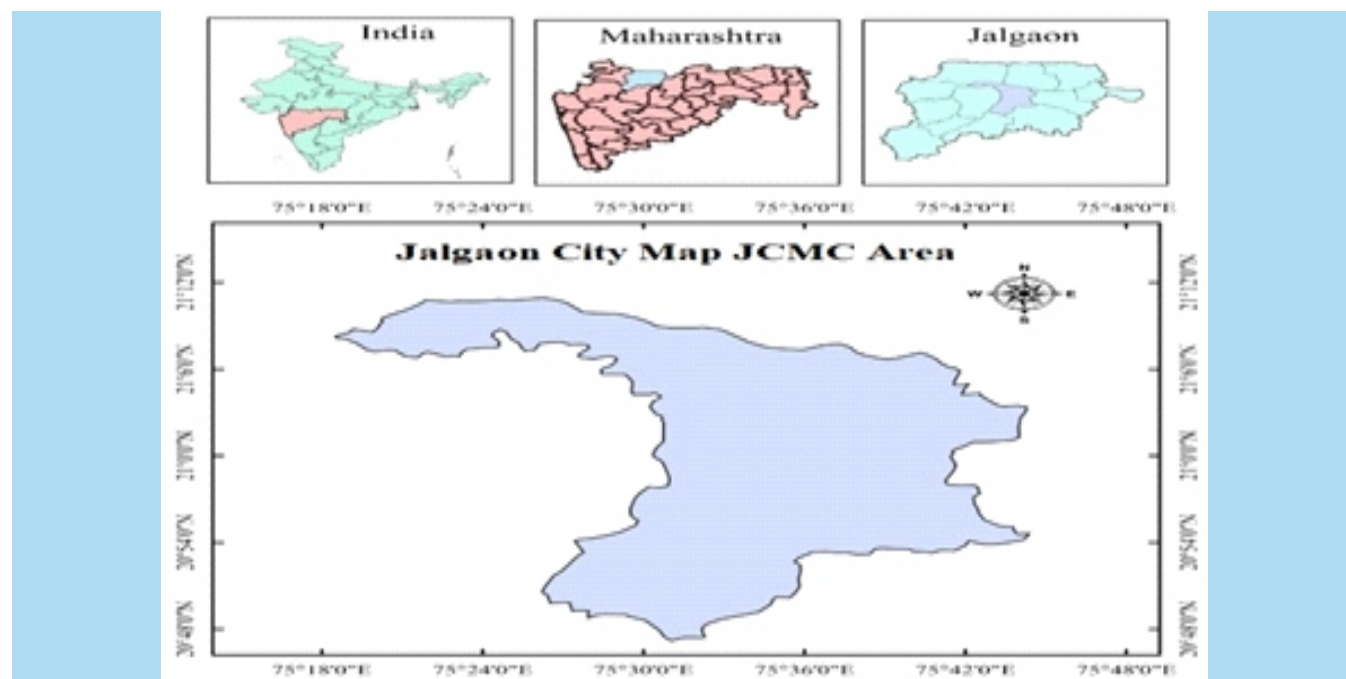
3.2: Challenges in Solid Waste and Pollution Management: The difficulties encountered by waste management departments, particularly in municipal waste and pollution control, are a global phenomenon. This assertion is substantiated by evidence such as the rise in global population, financial constraints, and the scarcity of resources and land, all of which significantly affect the necessity for and the extent of waste minimization within waste management practices. To effectively tackle the backlog in waste services, several issues must be addressed, including: Political commitment; Increasing volumes of waste; Institutional challenges; Financing and fees for waste services; Education and public awareness; Illegal dumping and littering; ; Legislative measures and enforcement; Waste minimization strategies; The involvement of the private sector in waste management services; Data collection and information dissemination; Inefficient collection systems and fleet management; Scavenging activities at landfill; Source separation and Insufficient land for new landfills; Emergence of new waste streams from innovative products and processes.

These challenges further amplify the necessity for enhanced environmental management and greater resource protection at an integrated level. Collectively, this demands ongoing innovation in waste management technologies, waste minimization

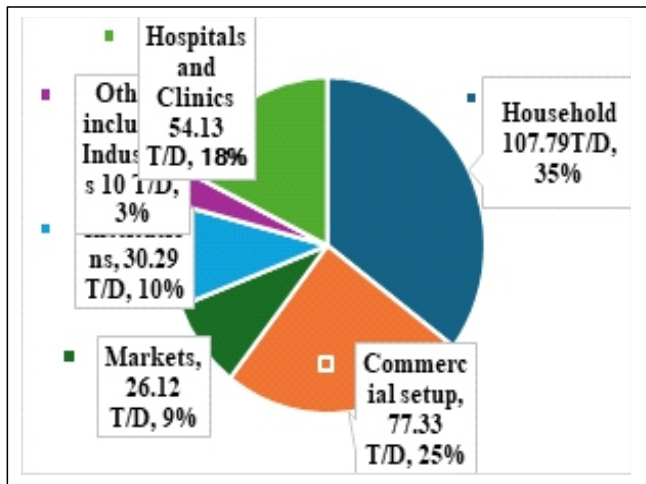
strategies, and resource management to maintain a balance between costs both direct and indirect to society, service providers, and environmental impacts, alongside the imperative for sustainable development (Coetzee, 2006). Thus, the challenges confronting the waste sector or department of the state can be succinctly summarized as: Modifying consumption habits to minimize waste production, adjusting behaviors to promote waste segregation at the source, incorporating recycling systems into both current and future waste management frameworks, disassociating economic growth from the environmental consequences of waste, exploring alternative waste treatment methods to lessen reliance on landfill disposal. The volume of solid waste generated has been on the rise due to an increase in population, particularly over the past 15 years.

3.3: Insufficient Funding, Human Resources, and Equipment: Household hazardous waste, such as paint, used batteries, and pesticide containers, is not collected separately. Plastic waste, particularly thin plastics used for packaging and PET bottles, has become a significant challenge in waste management across nearly all areas of the Jalgaon City Municipal Corporation, Jalgaon.

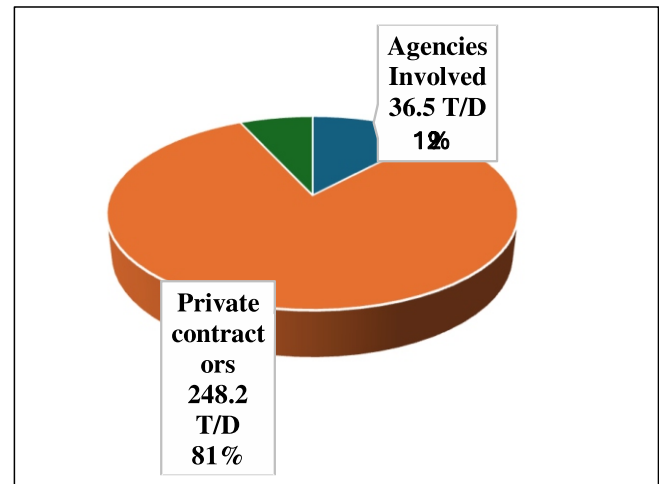
In many developing countries, regulations have been established or are being formulated. Nonetheless, there is a pressing need for stringent controls and enforcement mechanisms to ensure effective implementation (Sonawane and Thorat, 2010).



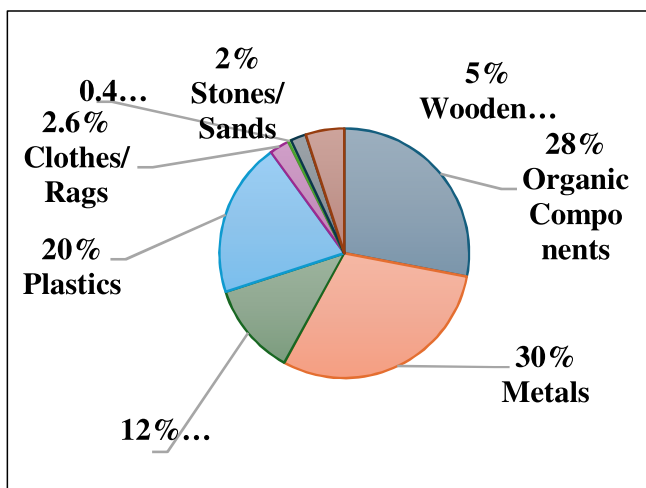
Graph 1: Detailed Map of Jalgaon City Municipal Corporation, Jalgaon.



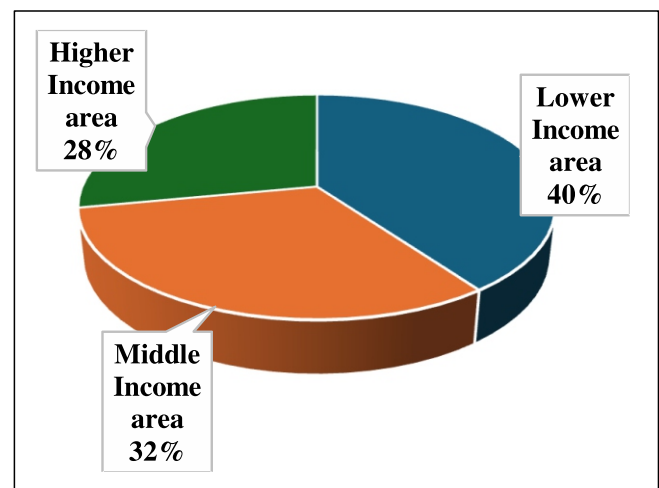
Graph 2: Solid Waste Generation in (JCMC) Jalgaon City Municipal Corporation, Jalgaon.



Graph 3: Waste Collection and Disposal by Ministry of Environment and Urban Development.



Graph 4: Composition of Municipal Solid Waste in Jalgaon City Using Quartering Method of 1kg.



Graph 5: Solid waste generation percentage at Jalgaon City (JCMC) Area.

The Jalgaon City Municipal Corporation, Jalgaon also contends with legal requirements concerning environmental matters, particularly in solid waste management (Moghadam et al., 2008). The operational efficiency of solid waste management relies heavily on the active involvement of both the municipal agency and the community. Given the low social regard for solid waste management in many developing nations, there is a pressing need for increased awareness. Therefore, there is a pressing need for significant apathy towards the issue, as evidenced by the accumulation of uncollected waste in numerous locations and the decline in both aesthetic and environmental standards at uncontrolled disposal sites (Shekdar and Tanaka, 2004). Fortunately, public engagement in Maharashtra, particularly concerning municipal solid waste, has seen improvements over the past decade due to the efforts of NGOs and media involvement.

CONCLUSION

The rise in solid waste production within the metropolis can primarily be attributed to population growth and various commercial and industrial activities. The recorded generation rate of 0.34 kg/capita/day is nearly equivalent to the 0.39 kg/capita/day reported by Kaseva and Gupta (1996) and falls within the range of 0.4-0.6 kg/capita/day for developing nations as noted by Smith (1997). An analysis of waste management by the Jalgaon City Municipal Corporation indicates a significant enhancement in solid waste collection efforts over the last ten years. This improvement is largely due to the active participation of government agencies and citizens in the waste collection process within the metropolis. However, the primary obstacles to effective municipal solid waste management include a lack of resources, inadequate infrastructure, insufficient planning, leadership deficits, and low

Sheet 1: Pictures showing present scenario of Jalgaon City Municipal Corporation (JCMC), Jalgaon area.

Figure 1: Picture of a dumpsite at Jalgaon city municipal corporation (JCMC) area; figure 2: Dumpsite along Jalgaon city municipal corporation main road; figure 3: Chandu annanagar dumping site; figure 4: Dumping site solid waste segregation building; figure 5: Samta nagar road Jalgaon.; figure 6: 100 feet shiv-colony road, Jalgaon.; figure 7: Krushna marble store road Jalgaon; figure 8: Dumping ground in Chandu anna nagar, Jalgaon; figure 9: Hari-Vithal nagar, shiv-colony Chau fully Jalgaon.; figure 10: Wagh nagar stop area, Jalgaon.

public awareness. In light of the study's findings, the following recommendations are proposed to effectively address the current challenges faced by the Jalgaon Municipal Corporation (JCMC) in managing municipal solid waste: The establishment of enclosed community depots or secondary collection centers in remote locations, the encouragement of recycling and composting programs, the formulation of appropriate policies, legal frameworks, and financial management strategies for municipal waste management, the execution of landfill liners, leachate collection systems, roll-on/roll-off control systems, final covers, groundwater monitoring systems, and gas collection systems, as well as the proper fencing of waste. The government should embrace innovative methods for waste collection and disposal, such as Waste-to-Wealth or Trash-to-Treasure, which are collectively referred to as Integrated Solid Waste Management (ISWM).

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