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Challenges and opportunities in Urban Solid Waste Management: The Case of Wolkite Town, Ethiopia.

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Abstract - *Urban solid waste management remains one of the most challenging environmental issues in rapidly growing Ethiopian towns. This study assessed the major challenges and emerging opportunities of solid waste management (SWM) in Wolkite Town, Ethiopia, with particular attention to household practices, institutional capacity, environmental impacts, and community participation. A mixed-methods research design was employed, using quantitative data from 380 systematically selected households and qualitative data from 45 key informants, focus group discussions, and field observations. Data were analyzed using descriptive statistics, thematic analysis, and GIS-based spatial assessment of waste disposal patterns. The findings reveal that only 30–40% of households receive formal waste collection services, while open dumping (35%) and open burning (17.1%) remain common disposal methods. Awareness and attitudes toward SWM are generally low, with 51.8% of respondents unfamiliar with proper waste management and 65% never practicing waste separation. Organic waste constitutes the largest proportion of household waste (60.3%), indicating strong potential for composting and waste-to-energy initiatives. Major challenges identified include inadequate service coverage, weak enforcement of regulations, limited infrastructure, low community participation, and poor institutional coordination. Despite these constraints, opportunities exist in the form of high household willingness to pay for improved services (55%), increasing urban expansion that supports market-based SWM solutions, and potential partnerships with private collectors and micro-enterprises. Overall, the study concludes that strengthening institutional capacity, enhancing public awareness, expanding collection infrastructure, and promoting resource recovery can significantly improve sustainable solid waste management in Wool kite Town.*

Key Words: **Solid Waste Management, Urbanization, Community Participation, Behavioral Change, Wolkite Town**

1. INTRODUCTION

Urban solid waste management (SWM) is one of the most pressing environmental challenges confronting rapidly growing towns in developing countries[1]. Population growth, urbanization, and shifts in consumption patterns have led to increased municipal solid waste, putting immense pressure on urban infrastructure and municipal services[2]. Ineffective SWM can result in environmental degradation, public health risks, and economic losses, while limiting opportunities for resource recovery[3]. Globally, low and middle-income countries face disproportionate challenges due to rapid urban expansion, insufficient infrastructure, and weak institutional capacity, underscoring the need for context specific solutions that integrate social, environmental, and economic dimensions[4].

In Sub-Saharan Africa, municipal solid waste management is often inadequate, with widespread practices of open dumping, uncontrolled burning, and unregulated disposal[5]. Such practices contaminate soil, water, and air, and create breeding grounds for disease vectors. Many urban centers suffer from low collection coverage, limited service delivery, and poor enforcement of waste regulations. Additionally, public awareness of proper SWM practices is generally low, reducing community engagement in recycling, composting, or waste reduction initiatives [6, 7]. The resulting environmental pollution, health risks, and loss of potential economic value embedded in waste highlight the critical need for sustainable, participatory, and institutionalized SWM systems.

Ethiopian towns, particularly secondary urban centers, face similar constraints. Despite national strategies and policy frameworks to improve SWM, implementation is limited by insufficient funding, technical capacity, and institutional coordination [1, 8]. Rapid urbanization in these towns has outpaced waste management infrastructure, resulting in widespread illegal dumping, open burning, and low levels of community participation. Inadequate collection coverage and irregular services exacerbate waste accumulation, leading to environmental pollution, vector-borne diseases, and declining urban living conditions[9]. These challenges demonstrate the importance of integrating awareness campaigns, infrastructural development, and institutional strengthening into local SWM strategies.

Wolkite Town, the administrative capital of the Gurage Zone in Central Ethiopia, exemplifies these challenges. The town is undergoing rapid urban expansion. Solid waste is managed through a combination of limited municipal collection, informal services, and self-disposal by households. The main disposal site, located in Gasore, is an unregulated open dump without leachate management or environmental safeguards. Many households, particularly in newly developing areas, lack access to formal collection

services, while enforcement of regulations for illegal dumping is weak. These structural and institutional gaps contribute to poor environmental conditions, including pollution, health hazards, and social vulnerability[10].

The social, environmental, and economic implications of inadequate SWM in Wolkite are substantial[11]. Environmentally, open dumping and burning degrade soil and water, release harmful gases, and create breeding grounds for pests. Socially, residents face increased health risks, while low participation in recycling and waste separation limits community engagement and civic responsibility. Economically, opportunities for resource recovery, income generation, and cost savings remain underutilized. However, the town also presents opportunities: the predominance of organic waste (60.3% of household waste) offers potential for composting and biogas programs, and over half of households (55%) are willing to pay for improved waste collection services. Public awareness, though limited, shows promise for targeted education and engagement programs.

The study concludes that the key challenges in Wolkite Town include insufficient formal waste collection coverage, weak enforcement of regulations, low public awareness, limited household participation in waste separation, and inadequate institutional coordination. The main recommendations emphasize expanding municipal collection infrastructure, promoting community-based waste separation and recycling programs, strengthening enforcement mechanisms, and enhancing public awareness through education campaigns. Partnerships with private collectors, micro-enterprises, and NGOs are also recommended to improve service delivery and support sustainable, economically viable, and environmentally sound SWM practices. By addressing these issues, Wolkite Town can transform its waste management system into a more resilient, participatory, and resource-efficient model, contributing to improved public health, environmental protection, and local economic development.

2. Materials and methods

2.1 Description of the study area

This study was conducted in Wolkite Town, the administrative capital of the Gurage Zone in the Central Ethiopia Regional State. The town is located along the Addis Ababa–Jimma highway, approximately 158 km southwest of Addis Ababa, and lies at about 8°17′N latitude and 37°47′E longitude. Wolkite is one of the fastest-growing urban centers in the region, with expanding residential, commercial, and institutional areas[12]. According to the Gurage zone plan and Development Department projection 2025, Wolkite has a total population of approximately 120,368 residents, driven by both natural population growth and consistent rural-urban migration.

The town experiences a moderate subtropical highland climate. Analysis of 30-year data from the National Meteorology Agency (NMA) (1988–2018) shows that the average annual rainfall varies from 856 to 1600 mm and the mean yearly temperature is 19.1 ^{0}C with the maximum and minimum values of 22.5 and 6.7 ^{0}C, respectively (Ane-seyee et al. 2019). These climatic conditions affect waste decomposition rates, accessibility to certain areas during heavy rains, and the overall functioning of the municipal waste system.

Wolkite's infrastructure includes a developing network of asphalt, gravel, and cobblestone roads; however, newly expanding neighborhoods still face limited accessibility, which constrains effective solid waste collection and transportation. The town relies on a single main disposal site located in Gasore, which operates as an open dump without proper engineering or environmental protection measures. This has led to challenges such as leachate leakage, open burning, and exposure of nearby communities to health risks.

The study areas selected within the town include residential neighborhoods, commercial zones, institutional centers, and areas around the disposal site to capture a comprehensive understanding of waste generation and management practices. Wolkite was chosen for this research due to its rapid urbanization, increasing waste production, limited waste management capacity, and the urgent need to improve solid waste handling systems to protect public health and the local environment.

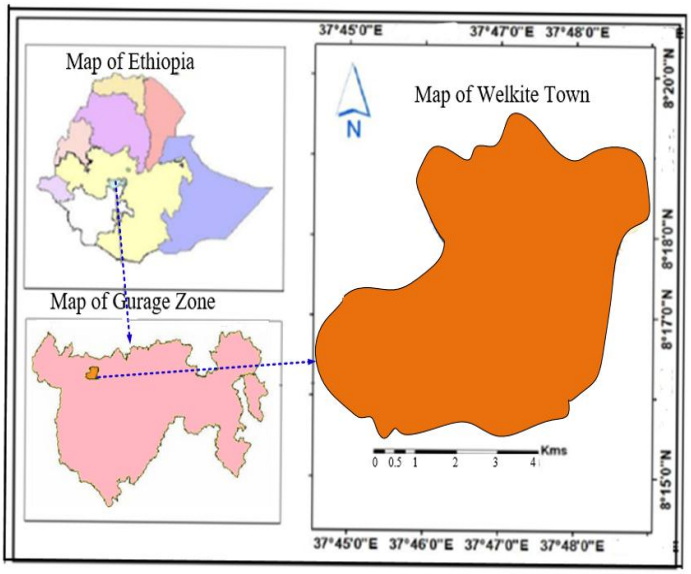

Figure -1: Map of study area

2.2 Approaches of data collection and analysis

2.2.1 Sample size and Sampling procedures

The study was conducted in Wolkite Town, which has a total population of 120,368. A sample of 380 households was selected from its two Kebele's Gubre01 and Adishiwot Kebele. The sampling process involved creating a sampling frame based on household lists obtained from each Kebele's, followed by a systematic random sampling technique to identify the specific households to be surveyed. This strategy was based on statistical techniques with a 95% level of confidence. The particular formula employed to determine the sample size was Cochran's formula for a finite population[13], as outlined in Eqs 1 and 2

$$n_0 = \frac{z^2 . p(1-p)}{e^2} \quad \text{---------- (1)}$$

$$n = \frac{n_0}{1+\frac{n_0-1}{N}} \quad \text{---------- (2)}$$

Thus 380 respondents were selected to participate.

Where the initial sample size (n_0) was calculated using Cochran's formula, where Z is the Z-score corresponding to the desired confidence level (1.96 for a 95% confidence level), p represents the estimated proportion of the attribute in the population (commonly assumed to be 0.5 when the true proportion is unknown to maximize variability), and e denotes the margin of error (±5%). Because the study population is finite (N=120,368), the initial sample size was adjusted using the finite population correction formula to obtain the final sample size (n). Where: n is the final sample size after finite population correction, and N is the total population size (120,368).

2.2.2 Data Types and Sources

This study employed an explanatory research design using both primary and secondary data. A mixed-methods approach integrated quantitative data from household questionnaires with qualitative insights from interviews, focus group discussions, and field observations. Primary data were collected from households, municipal officials, health professionals, NGOs, and private waste collectors. Secondary information was obtained from scholarly articles, municipal reports, and policy documents, providing context on existing SWM frameworks and challenges in Wolkite Town.

2.2.3 Socio-Economic Data Collection

Socio-economic and household-level data were collected using structured questionnaires administered to 380 households in the Gubre01 and Adishiwot Kebele's. The questionnaire captured key variables such as age, gender, education level, income, household size, and occupation, along with detailed information on waste generation, storage practices, collection frequency, disposal methods, and awareness levels. The tool was developed through a literature review, consultations with local officials, and pilot testing to ensure clarity and relevance. To improve accessibility and response accuracy, it was translated into Amharic, the local language. This quantitative dataset provided the foundation for assessing how socio-economic characteristics influence household waste management behaviors in Wolkite Town.

2.2.4 Focus Group Discussion and Key Informant Interviews

Qualitative data were gathered through focus group discussions (FGDs) and key informant interviews (KIIs) to complement the household survey and capture stakeholder perspectives. FGDs were conducted with private waste collectors, sanitation micro-enterprises, NGO representatives. Community members also involved in Gasore Kebele in local waste-handling activities and disposal methods. These discussions explored operational challenges, community participation, fee sustainability, and gaps in waste infrastructure.

In addition, semi-structured interviews were held with 45 purposively selected key informants, including municipal officials, environmental and health officers, sanitation workers, Kebele leaders, and representatives from the small and micro enterprise unions. The interviews focused on the effectiveness of current municipal solid waste management (MSWM) practices, institutional coordination, service delivery constraints, and potential improvement strategies. The flexible semi-structured format allowed for probing questions, enabling respondents to provide personal experiences, institutional insights, and context-specific recommendations. These qualitative data enriched the study by highlighting practical challenges, policy-level issues, and community attitudes influencing SWM performance.

2.3 Methods of Data Analysis

The study used both qualitative and quantitative analytical methods to interpret the collected data. Quantitative data from the household surveys were processed through editing, coding, entry, and cleaning before analysis in SPSS. Descriptive statistics such as frequencies and percentages, were used to summarize household waste generation, storage practices, collection frequency, disposal methods, and awareness levels. Qualitative data from interviews and FGDs were analyzed thematically. Responses were transcribed, grouped into thematic categories, and interpreted to identify recurring issues related to institutional performance, operational constraints, policy implementation gaps, and community behaviors. Field observations were triangulated with both qualitative and quantitative findings to validate results and enhance reliability. GIS tools were also used to providing spatial

assessment of waste disposal patterns and a spatial dimension to the analysis. Together, these analytical methods offered a comprehensive understanding of the challenges, practices, and opportunities within Wolkite Town's municipal solid waste management system.

3. Results and discussion

3.1 Household Knowledge towards on Solid Waste Management

3.1.1 Awareness of Composting, Recycling, and Waste-to-Energy Opportunities

The survey results in Figure 1 indicate that 47.6% of respondents in Wolkite Town are aware of composting, recycling, and waste-to-energy opportunities, while a slightly higher proportion (52.4%) remain unaware. This demonstrates a generally low level of public awareness of sustainable solid waste management options, which directly influences household waste handling practices[14]. Similar highlighted that fewer than half of households had adequate knowledge of composting and recycling practices in Hawassa city[15]. Likewise, Tadesse et al. (2018), in the African Journal of Environmental Science and Technology, reported low public awareness as a major constraint to effective waste segregation in Ethiopian secondary cities [3, 16].

Compared to earlier municipal assessments in Wolkite Town, the proportion of respondents aware of sustainable waste management options appears slightly improved, suggesting gradual progress in public exposure to environmental issues. However, awareness levels remain lower than those reported in Addis Ababa, where recent studies in Waste Management & Research indicate higher public familiarity with recycling initiatives due to pilot projects and NGO involvement[17]. This difference highlights disparities in access to information, infrastructure, and institutional support between large metropolitan areas and emerging towns like Wolkite.

From an environmental perspective, low awareness limits waste diversion practices such as composting and recycling, resulting in continued open dumping and burning, increased pollution, and higher greenhouse gas emissions. Socially, inadequate knowledge contributes to unsafe waste handling behaviors that negatively affect public health and neighborhood sanitation, a challenge similarly documented in Ethiopian urban health environment studies[18]. Economically, limited awareness constrains opportunities for resource recovery, including compost production, recycling enterprises, and potential waste-to-energy initiatives, thereby reducing employment and municipal revenue prospects[19].

Nevertheless, the fact that nearly half of respondents are already aware of these sustainable options represents a significant opportunity. Ethiopian studies emphasize that awareness-focused interventions such as community education, demonstrations, and local media campaigns can substantially improve participation in waste segregation and recycling[20]. Therefore, strengthening awareness programs is essential to enhancing the environmental, social, and economic performance of solid waste management in Wolkite Town, and to supporting the development of context-specific, sustainable waste management interventions.

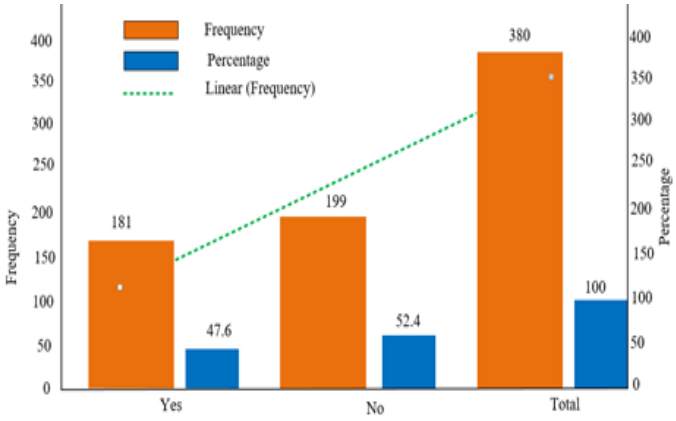

Figure-1: Awareness of Composting, Recycling, or Waste-to-Energy Opportunities

3.1.2 Familiarity with Solid Waste Management

The result in Figure 2 show that 51.8% of respondents are not familiar with solid waste management (SWM) systems in Wolkite Town, while 48.2% are familiar, indicating that public understanding of SWM remains limited. This lack of familiarity contributes to improper waste disposal behaviors, low participation in waste reduction efforts, and reduced community cooperation with municipal services, all of which negatively affect public health and living conditions. Environmentally, limited familiarity means residents are less likely to sort waste, participate in recycling, or support cleaner disposal practices, thereby increasing pollution and pressure on dumpsites [21]. Economically, the low level of familiarity restricts the adoption of cost-saving and income-generating alternatives such as composting, recycling enterprises, and waste-to-energy initiatives [22]. However, the nearly equal share of familiar respondents shows a significant potential for improvement if awareness campaigns, training, and community engagement strategies are implemented. Strengthening familiarity with SWM is therefore essential for achieving sustainable, environmentally sound, and economically beneficial waste management in Wolkite Town.

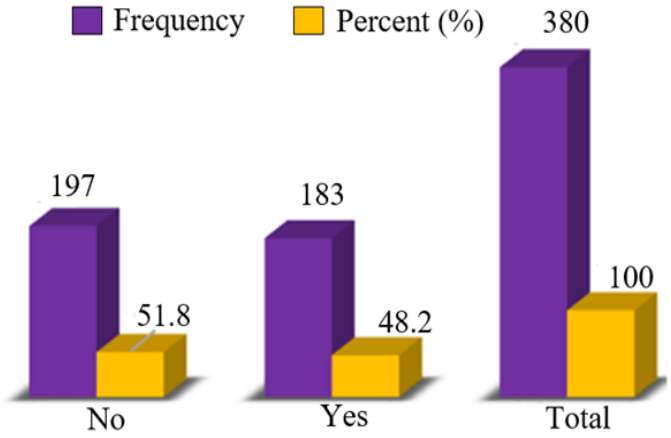

Figure- 2: Familiarity with Solid Waste Management

3.1.3 Formal Solid Waste Collection Coverage and Enforcement of Penalties

The findings indicate that formal solid waste collection coverage in Wolkite Town is limited, with 60% of respondents reporting that only 30–40% of the population receives municipal waste services, and 26.1% indicating coverage below 30%. Only 13.9% believe coverage exceeds 40%, highlighting substantial gaps in operational capacity, equipment, and workforce, particularly in peripheral and rapidly urbanizing areas. Similar low coverage has been reported in Ethiopian secondary cities that highlighted as municipal collection in medium-sized Ethiopian towns typically serves less than half of households [23]. Compared to Addis Ababa, where coverage exceeds 70% in most districts [24]. Wolkite Town clearly faces localized service limitations.

As a result of limited coverage, households adopt alternative disposal methods such as indiscriminate dumping, burning, or reliance on informal collectors, intensifying environmental pollution, clogging drainage systems, and increasing public health risks. This pattern mirrors findings from other Ethiopian towns, where inadequate municipal services have been linked to widespread illegal dumping and vector-borne diseases [25]. Economically, low collection coverage also reduces opportunities for efficient waste recovery and resource utilization, as waste is dispersed and mixed, complicating recycling and composting efforts.

Compounding this structural challenge, enforcement of penalties for illegal disposal is extremely weak. About 68.2% of respondents report that no penalties are enforced, while 23.9% indicate penalties exist but are weak, and only 7.9% observe strict enforcement. Weak regulation not only allows improper disposal to persist but also undermines municipal credibility, discouraging public cooperation and reducing motivation to participate in formal waste management systems. This finding is consistent with Ethiopian Studies that observed as ineffective enforcement in Ethiopian towns contributes to the normalization of illegal dumping behaviors [26].

The interconnection between limited collection coverage and weak enforcement creates a feedback loop: poor access to municipal services encourages illegal dumping, and weak penalties allow such behavior to continue unchecked, exacerbating environmental degradation, water contamination, pest proliferation, respiratory and gastrointestinal illnesses, and overall reductions in quality of life. However, this relationship also highlights an opportunity: strengthening enforcement can enhance proper use of existing collection services, while expanding coverage can reduce reliance on punitive measures. Addressing both gaps through infrastructure improvement, community-based collection models, and consistent enforcement is critical to advancing sustainable, socially responsible, and economically viable solid waste management in Wolkite Town.

Table-1: Formal Solid Waste Collection Coverage and Enforcement of Penalties in Wolkite Town

Indicator / Response	Frequency	Percent (%)
Population receiving formal solid waste collection		
< 30%	99	26.1
30–40%	228	60.0
> 40%	53	13.9
Enforcement of penalties for illegal dumping		
Yes, strictly	30	7.9
Yes, but weakly	91	23.9
No	259	68.2
Total respondents	380	100.0

3.2 Household Attitude towards on Solid Waste Management

3.2.1 Willingness to Separate Waste for Recycling

The results in Figure 3 show a very low level of willingness to separate waste for recycling among residents of Wolkite Town. Only 5% of respondents "always" separate their waste, while 30% do so "sometimes," and an overwhelming 65% "never" separate waste. This pattern highlights a major behavioral and awareness challenge in the town's solid waste management system. The high percentage of households who never separate waste suggests that most residents lack knowledge about the benefits of recycling, are not provided with separate bins or designated collection points, or do not receive incentives for resource recovery

practices. This low willingness also reflects the absence of a functional recycling system, inadequate municipal communication, and limited community engagement, which collectively discourage households from adopting sustainable waste practices [1, 27].

The implications of these findings are significant across the social, environmental, and economic dimensions of the study. Socially, the lack of waste separation contributes to unhygienic household environments, mixed waste accumulation, and increased exposure to health risks such as pests, pollution, and contaminated surroundings. Environmentally, the failure to separate waste means that recyclable materials such as plastics, paper, glass, and metals end up in dumpsites or in open spaces, increasing pollution, clogging drainage systems, and contributing to land and water contamination[28]. Organic waste mixed with recyclables creates unpleasant odors and accelerates the decomposition of materials that could otherwise be reused or converted into compost. Economically, the low level of separation undermines opportunities for job creation in recycling, reduces the potential for small enterprises to recover value from waste, and increases the operational costs of disposal, since all waste must be collected together and dumped rather than sorted and sold[29].

Overall, the findings indicate that weak public awareness, a lack of incentives, and absent infrastructure are key barriers to waste separation behaviors in Wolkite Town. However, the 30% who practice separation "sometimes" represent an important opportunity showing that with targeted awareness programs, provision of sorting facilities, school and community-based education, and municipal support, household participation in recycling could greatly improve. Strengthening this intermediate group could serve as a foundation for expanding recycling programs, reducing waste volumes, and promoting sustainable waste management practices throughout the town.

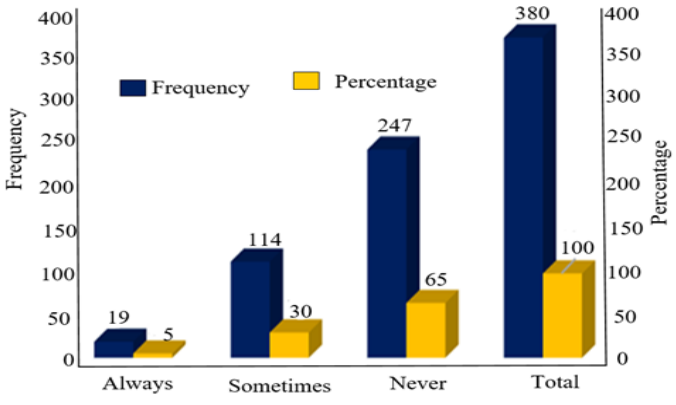

Figure- 3: Willingness to Separate Waste for Recycling

3.2.2 Participation in Community Clean-Up Programs

The Figure 4 reveals that community participation in clean-up programs in Wolkite Town is relatively low. A majority of respondents, 65%, reported not participating in such initiatives, while only 35% actively take part. This indicates that most residents are not engaged in organized efforts to maintain neighborhood cleanliness, which reflects broader challenges in social mobilization, civic responsibility, and public awareness regarding the benefits of collective waste management. Low participation can be attributed to factors such as insufficient awareness campaigns, limited municipal coordination, lack of incentives or recognition, and competing livelihood priorities among residents.

From a social perspective, low participation reduces the effectiveness of community-driven approaches to solid waste management and limits opportunities for fostering a culture of environmental responsibility [30, 31]. It also diminishes the potential for social cohesion, since collective efforts in clean-up programs can strengthen neighborhood networks and civic engagement. Environmentally, low engagement leads to the persistence of littering, illegal dumping, and accumulation of waste in public areas, which increases pollution, contaminates water sources, clogs drainage systems, and creates habitats for disease vectors such as mosquitoes and rodents. The limited involvement of residents also hinders the reduction of municipal waste management costs, as uncollected waste must be handled solely by the municipality.

Economically, low participation restricts the community's ability to contribute to cost-saving initiatives and resource recovery programs. Clean-up programs often provide opportunities for waste sorting, recycling, and composting, which can generate small-scale income and reduce municipal expenses [32]. The 35% of residents who do participate, however, represent a critical entry point for scaling up community-based waste management strategies. Their involvement demonstrates that with effective awareness campaigns, training, structured programs, and incentives, participation rates can improve significantly. Targeted programs, including school-based campaigns, local associations, and collaboration with NGOs, can enhance community engagement, strengthen environmental stewardship, and reduce the burden on municipal services.

Finally, linking participation with awareness, willingness to separate waste, and willingness to pay through cross-tabulation and chi-square analysis can provide deeper insights. Households that are more aware of recycling and composting or willing to pay for improved services are likely to participate more actively in clean-up programs, suggesting that integrated awareness and incentive strategies could simultaneously improve multiple aspects of solid waste management in Wolkite Town.

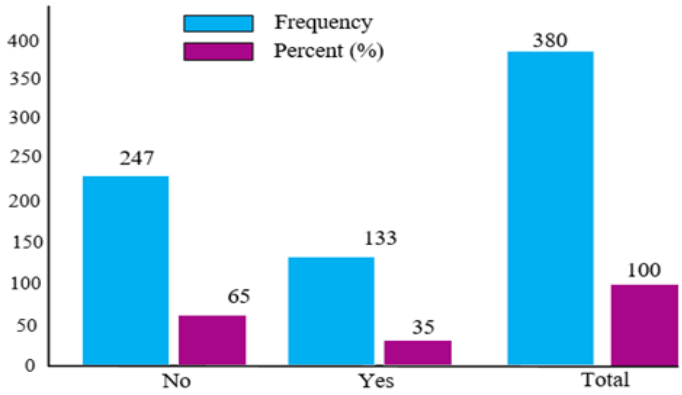

Figure- 4: Participation in Community Clean-Up Programs

3.2.3 Willingness to Pay and Satisfaction with Solid Waste Services

The survey results in Table 2 show that a majority of households in Wolkite Town, 55%, are willing to pay for improved solid waste collection services, while 45% are not willing. This indicates a positive potential for community-supported financing of SWM improvements. Despite this willingness, satisfaction with current services is low, with nearly 59% of respondents reporting being very dissatisfied or dissatisfied, 25% neutral and only 15.8% satisfied. This highlights a gap between residents' readiness to contribute financially and their perception of current service quality.

From a social perspective, low satisfaction reflects challenges in public health and quality of life. Irregular collection, illegal dumping, and waste accumulation expose residents to environmental hazards and reduce neighborhood cleanliness. However, the fact that 55% are willing to pay demonstrates that household's value improved services and could support initiatives that enhance cleanliness, reduce disease risks, and encourage civic participation. Awareness campaigns and community engagement programs could harness this willingness to foster more active participation in sustainable waste management [33].

The environmental implications of low satisfaction are significant. Dissatisfied households are more likely to engage in improper disposal practices, including open dumping and burning, which contribute to air, soil, and water pollution [23]. Conversely, the willingness to pay presents an opportunity for households to support environmental improvements such as regular collection, recycling, composting, and potentially waste-to-energy programs. Linking financial contributions to tangible improvements could incentivize better household waste behaviors and reduce environmental degradation.

Economically, the willingness to pay represents a valuable source of revenue for the municipality to expand service coverage, improve collection efficiency, and invest in resource recovery initiatives [34]. However, dissatisfaction may limit financial participation unless residents perceive real improvements. Cross-tabulation and chi-square analysis could confirm whether satisfaction significantly influences willingness to pay, helping policymakers design targeted interventions.

In conclusion, while dissatisfaction with current solid waste services is high, the majority willingness to pay provides an opportunity to improve SWM in Wolkite Town. Strategic measures that combine reliable service delivery, awareness programs, and transparent financial management can leverage this willingness to pay, thereby enhancing environmental protection, social well-being, and economic sustainability.

Table- 2: Willingness to Pay and Satisfaction with Solid Waste Services in Wolkite Town

Indicator / Response	Frequency	Percent (%)
Willingness to pay for improved solid waste collection		
No	171	45
Yes	209	55
Satisfaction with current waste services		
Very dissatisfied	45	11.8
Dissatisfied	179	47.1
Neutral	96	25.3
Satisfied	60	15.8
Total respondents	380	100.0

3.3 Household practice towards on Solid Waste Management

3.3.1 Types of Solid Waste Generated Most

The results presented in Figure 5 indicate that organic waste is the dominant component of household solid waste in Wolkite Town, accounting for 60.3% of the total waste generated. This is followed by plastic waste at 20.8%, paper and cardboard at 8.4%, and metal and glass at 3.9%. The remaining 6.6% consists of other materials such as textiles, ash, and miscellaneous household residues. Overall, the findings confirm that biodegradable materials constitute the largest share of household waste in the study area. This is consistent with evidence from other Ethiopian urban centers reports, where organic waste typically represents 55–65% of total household solid waste [15, 35]. The high proportion of organic waste in Wolkite Town reflects prevailing consumption habits, limited food preservation practices, and the dominance of fresh food preparation at the household

level, which are common characteristics of rapidly urbanizing towns in Ethiopia.

From an environmental perspective, the predominance of organic waste poses significant management challenges. When collection services are inadequate, decomposing food waste contributes to unpleasant odors, leachate formation, and the proliferation of disease vectors such as flies and rodents. However, this high organic fraction also represents a major opportunity for composting, which could reduce the volume of waste disposed of at open dumping sites while improving soil fertility for urban and peri-urban agriculture.

Plastic waste, which constitutes 20.8% of household waste, represents the second-largest component and an emerging concern for Wolkite Town. Although earlier Ethiopian studies published in the African Journal of Environmental Science and Technology reported lower plastic shares ranging between 15% and 22%[36]. Municipal field observations suggest that plastic waste is increasing due to the widespread use of single-use plastic bags and packaged goods, particularly in market and commercial areas. Environmentally, improperly disposed plastics contribute to drainage blockage, visual pollution, and long-term environmental degradation.

From a social and public health perspective, the combined dominance of organic and plastic waste has direct implications for sanitation conditions in residential neighborhoods. Field observations revealed that mixed waste accumulation in poorly serviced areas attracts insects and rodents, increasing the risk of waste-related diseases. Similar findings have been documented in Ethiopian urban studies, which highlight low awareness levels and limited household participation in waste separation as key contributing factors. Economically, the waste composition of Wolkite Town reveals considerable resource recovery potential. The large share of organic waste supports the feasibility of community-level composting initiatives, while plastics, paper, metals, and glass offer opportunities for recycling and income generation through both formal and informal sectors [37]. Previous studies have shown that diverting recyclable materials from disposal can reduce municipal waste management costs while supporting local livelihoods.

Overall, the predominance of organic waste in Wolkite Town mirrors national urban waste generation trends while highlighting both challenges and opportunities. Although improper handling of biodegradable and non-biodegradable waste particularly plastics poses environmental and public health risks, these materials also represent valuable resources. Strengthening household-level waste segregation, promoting composting, enhancing recycling systems, and increasing community participation can transform existing waste management problems into environmental improvements, social benefits, and economic opportunities tailored to the local context.

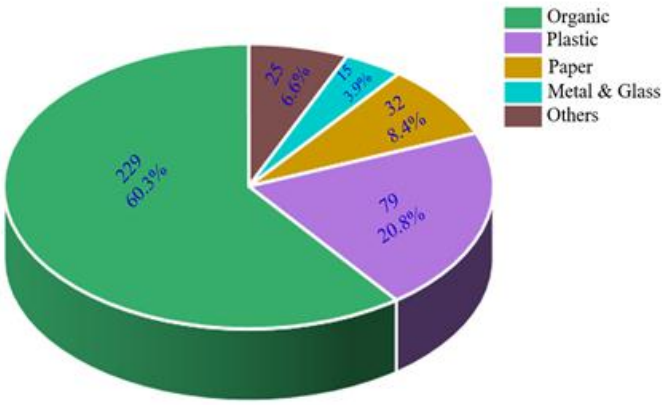

Figure- 5: Types of solid waste generated most

3.3.2 Methods of Household Solid Waste Disposal in Wolkite Town

The data presented in Figure 6 show that households in Wolkite Town employ a variety of solid waste disposal methods. The majority of households (38.9%) use municipal collection services, indicating some reliance on formal waste management systems. However, a significant proportion of households continue to engage in improper disposal practices, with 35% dumping waste in open areas and 17.1% burning waste openly. Only a small fraction of households, 8.9%, practice reuse or recycling, highlighting limited engagement in sustainable waste management practices at the household level.

From an environmental perspective, the prevalence of open dumping and burning is concerning. Open dumping contributes to soil and water contamination, blockage of drainage systems, and attraction of disease vectors, while open burning releases harmful air pollutants, including particulate matter and greenhouse gases [38]. These practices exacerbate environmental degradation and pose direct risks to community health. In contrast, households using municipal collection services and practicing reuse or recycling contribute to better environmental protection and resource recovery.

The social implications of these disposal patterns are significant. Communities relying on improper disposal methods are exposed to higher health risks, such as vector-borne diseases, respiratory problems from smoke, and contamination of local water sources [39]. Limited participation in recycling or reuse activities reflects gaps in public awareness and behavioral practices, emphasizing the need for targeted education and community mobilization to promote responsible waste handling.

Economically, the low level of reuse and recycling suggests untapped opportunities for resource recovery and income generation. Municipal collection services, if

efficiently expanded, can provide revenue through user fees, while organized recycling programs can create jobs and reduce disposal costs [40]. Encouraging households to separate and recycle waste would not only improve environmental outcomes but also enhance the economic sustainability of solid waste management in Wolkite Town.

Finally the analysis of household waste disposal methods underscores the interconnected environmental, social, and economic challenges in Wolkite Town. While municipal collection services are utilized by some households, the widespread practice of open dumping and burning demonstrates the need for improved service coverage, public awareness, and community engagement to achieve sustainable solid waste management.

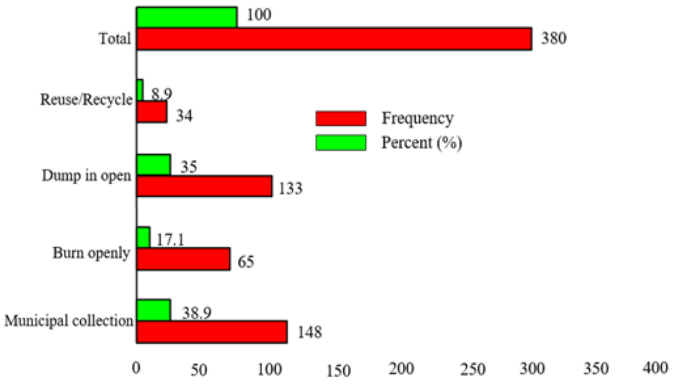

Figure-6: Methods of Household Solid Waste Disposal

3.3.3 Household Solid Waste Generation and Collection Frequency

The results presented in Table 3 show that most households in Wolkite Town generate 1–3 kg of solid waste per day (57.4%), indicating that moderate daily waste production is the most common pattern. The table further indicates that 21.8% of households generate 4–5 kg, reflecting a considerable number of households producing relatively high waste volumes. Meanwhile, 16.3% generate less than 1 kg daily, and 4.5% report producing more than 5 kg. These patterns illustrate that while the majority produce manageable amounts, a notable proportion contributes higher waste volumes, which may require closer attention by municipal authorities.

Regarding waste collection services, Table 3 shows that collection every three days is the dominant practice, covering 63.4% of households. Only 8.4% receive daily collection, which is relatively low considering the number of households producing 4 kg or more per day. Additionally, 24.8% of households report weekly collection, while 3.4% state that waste is rarely collected. This distribution reveals that although most households receive collection at least every three days, a significant share still relies on weekly or irregular services, which may not be adequate for higher waste-producing households.

The environmental implications derived from the table data indicate that households generating 4–5 kg or above are likely to experience waste accumulation when collection occurs only every three days or weekly. Such buildup increases the risk of environmental pollution, including improper disposal, open dumping, and burning. These practices can contaminate soil and water bodies, create foul odors, and encourage the spread of disease vectors, highlighting the need for more responsive waste management schedules.

Socially, the table suggests that households with higher waste output particularly those producing above the 3 kg per household may resort to unsafe disposal practices when collection frequency does not align with their waste generation rates. This underscores the importance of strengthening community awareness on waste reduction, segregation, recycling, and composting, especially in areas served weekly or rarely. Improved awareness can help households better manage waste while reducing dependency on municipal collection [41].

From an economic standpoint, the data in Table 3 highlight that aligning collection frequency with actual household waste output can enhance municipal efficiency [42]. Adjusting collection routes for neighborhoods with higher waste generation could reduce operational costs and improve service reliability. Additionally, encouraging recycling and composting could reduce the volume of waste requiring collection, creating opportunities for income generation and contributing to a more sustainable local waste management system [1, 43].

As shown in Table 3, the relationship between daily waste generation and collection frequency emphasizes the need for a more flexible and demand-driven waste management strategy in Wolkite Town. Ensuring that collection services match household waste production levels, while promoting community awareness and resource recovery practices, is essential for improving environmental health, social well-being, and economic efficiency in the town's solid waste management system.

Table-3: Household Solid Waste Generation and Collection Frequency

Indicator / Response	Frequency	Percent (%)
Daily household solid waste generation		
< 1 Kg	62	16.3
1–3 Kg	218	57.4

4–5 Kg	83	21.8
> 5 Kg	17	4.5
Frequency of solid waste collection		
Daily	32	8.4
Every three days	241	63.4
Weekly	94	24.8
Rarely	13	3.4
Total respondents	380	100.0

4. Conclusion and Recommendation

4.1 Conclusion

This study examined urban solid waste management in Wolkite Town using a *mixed-methods* design based on household surveys, field observations, key informant interviews, and a review of municipal records. Data were collected from a representative sample of 380 households and analyzed using descriptive statistical techniques to assess waste generation, composition, service coverage, and household knowledge, attitudes, and practices, and GIS-based spatial assessment of waste disposal patterns

The results indicate significant challenges in both household behavior and institutional performance. More than half of households lack awareness of sustainable waste management options such as composting and recycling, leading to improper disposal practices, including open dumping and burning. Municipal waste collection services cover only a limited portion of the town, while weak enforcement of existing regulations intensifies environmental pollution and public health risks. The dominance of organic waste, accounting for approximately 60.3% of the total waste stream, alongside plastics and other recyclables, highlights both the severity of current management problems and the potential for resource recovery. Overall, inadequate awareness, limited service coverage, weak governance, and low community participation continue to undermine environmental quality, urban sanitation, and economic opportunities in Wolkite Town.

4.2 Recommendation

To improve solid waste management in Wolkite Town, integrated interventions are required. Public awareness and behavior change programs should be strengthened through community-based education, schools, local media, and religious institutions, focusing on waste segregation, composting, and recycling. Municipal waste collection services should be expanded to underserved areas and collection frequencies adjusted to match household waste generation. Regulatory enforcement must be strengthened and applied consistently, alongside awareness efforts to ensure public understanding and compliance. Promoting household-level waste separation, supporting recycling cooperatives, and encouraging community participation through regular clean-up campaigns can enhance system efficiency. Sustainable financing mechanisms, including transparent user fees and public–private partnerships, are essential to support service expansion and resource recovery initiatives, particularly composting and small-scale biogas programs.

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