Hawassa University Journals

Volume V
Pages: 164-191
Article Number: 885-Article Text-4462-1-2-20230825

www.journals.hu.edu.et/hu-journals/index.php/ejet/index

Ethiopian Journal of Engineering and Technology

Perceptions of Households towards Urban Waste Management Challenges: Evidence from the Southern Ethiopia Urban Corridor

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ABSTRACT

Rapid urbanization in Ethiopia exacerbates critical waste management challenges, threatening public health and environmental sustainability. While infrastructural and policy analyses exist, a significant gap remains in understanding household perceptions, which are pivotal for effective policy implementation for which this study is undertaken. The study provides a comprehensive, perception-based analysis of urban waste management in the Southern Ethiopia Corridor. The primary objective was to assess household perceptions across the entire waste management spectrum, including sewerage, solid waste, pollution, and water supply. A mixed-methods approach was employed, collecting data from 1,419 households across four urban centers (Hawassa, Yirgalem, Butajira, Hossana) via structured questionnaires. Quantitative data were analyzed using descriptive statistics and chi-square tests. Results revealed that inadequate sewerage was perceived as the most severe challenge, with 71% of respondents agreeing it constrains sustainable development. Solid waste collection was seen as inconsistent, and control methods for pollution and noise were deemed highly ineffective. Critically, over 70% of households reported water insufficiency directly hindered their waste management practices. Significant inter-town disparities indicated uneven service delivery. The study concludes that infrastructural deficits are severely compounded by operational inefficiencies and a lack of community-responsive policies. These findings provide crucial evidence for municipal planners, emphasizing that sustainable waste management requires technical solutions integrated with household-level insights to foster equity, participation, and resilience, thereby supporting key sustainable development goals. The study calls for stronger infrastructure, fairer services, stricter rules, and active community involvement to build sustainable and equitable urban waste management in Southern Ethiopia.

Keywords: Urban waste management; Sewerage infrastructure; Solid waste collection; Pollution control; Water scarcity; Southern Ethiopia; Sustainable cities.

1. Introduction

Urbanization is a serious challenge for city authorities around the world. The problem is greater in low- and middle-income countries (LMICs). Population growth is very fast, and basic services cannot keep pace (United Nations Human Settlements Programme (UN-Habitat, 2022). Waste management is one of the most important services in cities. It affects public health, environmental safety, and the quality of life of the urban community (Kaza et al., 2018). The challenge is wide in scope. It includes the handling of liquid waste, the handling of solid waste, the control of pollution, and the supply of safe water for sanitation (World Health Organization (WHO) & United Nations Children's Fund (UNICEF), 2021). Ethiopia shows this problem clearly in its growing towns and cities (World Bank, 2020). This paper focuses on the problem and appropriate solution of waste management through the views of households in the Southern Ethiopia Corridor. This region is growing quickly. It faces weak infrastructure and poor service delivery (Adugna, 2023; Fereja, 2022). The problem is not only about technology. It is also about social and economic conditions, the capacity of municipalities, and the daily life of people. The way households think and act has a direct role. Their views and behavior often decide if management efforts succeed or fail (T. Alemu & Desta, 2022; Tadesse et al., 2023).

A serious problem in many Ethiopian towns is the poor sewerage and wastewater system. The system does not serve the growing population, and this creates health and environmental risks that affect daily life (Keraga et al., 2023). Adugna (2023) studied 14 towns in Southern Ethiopia and found that the system is underdeveloped. Only four towns had vacuum trucks to remove sludge, and no town had a proper place to dump wastewater. Because of this, households and businesses throw waste into open drains, rivers, and empty fields. The water is not treated, and this makes the environment unsafe and increases the risk of disease (Getahun et al., 2022).

This type of problem is not limited to Ethiopia. Other African cities also face similar issues. In Kampala, Uganda, about 60–70% of households release wastewater into open channels. This exposes people to waterborne diseases (Okello et al., 2021). In Nairobi, Kenya, most people use pit latrines. These latrines often overflow, especially during rain, and nearby water becomes polluted (Munyua et al., 2020; Otieno & Githiri, 2021). These examples show that the problem of weak sewerage systems is common in African cities. Most of these cities are growing quickly, but their governments do not have enough resources to provide strong sanitation systems (Nyenje et al., 2022).

In the Southern Ethiopia Corridor, the situation is worse because of low funding, poor upkeep of old systems, and little involvement of local communities in sanitation projects (Mekuria & Erko, 2023). In Dilla town, for example, rainwater and wastewater often mix during the wet

season. This mixture causes flooding and spreads disease (Fereja, 2022). People who live in these towns also share negative views about the system. Surveys in this study show that more than 70% of residents do not have regular service, and many are not connected to the town network. People see the sewerage system as unreliable and weak. This lack of trust makes them continue unsafe waste disposal and reduces their interest in joining sanitation programs (Abebe et al., 2022; Tadesse et al., 2023).

Concurrently, solid waste management (SWM) practices in cities like Hawassa, Dilla, and Wolaita Sodo are characterized by significant inefficiencies and gaps in service delivery (Gebrekidan et al., 2024). Rapid urbanization and changing consumption patterns have led to a surge in municipal solid waste generation, yet the municipal capacity for collection and processing has remained stagnant (Mihretie & Tadie, 2023; Yirdaw, 2022). The waste stream is predominantly organic, with food scraps and biodegradable materials constituting up to 73% of the total, followed by potentially valuable recyclables such as plastics, paper, and metals (K. Alemu et al., 2021). However, the potential for resource recovery remains largely untapped due to systemic failures at the collection stage (Adefris et al., 2023). Our survey data indicate that household-reported waste collection in Hawassa shows that only 25% of households receive daily service, while a further 30% report weekly collections. The remainder experience highly irregular service, often exceeding two weeks between pickups.

Studies in Addis Ababa show high PM2.5 levels near informal dumpsites. These levels are above the limits set by the World Health Organization (Dessalegn et al., 2023; Sisay et al., 2024). People living near these sites often have breathing problems, eye irritation, and constant coughing. These health issues show a clear link between poor waste management and community health (Adefris et al., 2023; Kumie et al., 2022). Waste piling in open areas also causes serious soil pollution. Hazardous materials such as batteries, chemicals, and plastics release toxins into the soil. These toxins lower soil fertility and can enter the food chain through urban farming. Urban agriculture is an important source of food and income for many people (Gebrekidan et al., 2024; Moges et al., 2021).

Ultimately, the efficiency of waste collection and the integration of disposal methods determine the final environmental outcome (Kaza et al., 2018). The current state in the Southern Corridor points to a fragmented system with low integration (Gebrekidan et al., 2024). As previously noted, collection efficiency is highly variable and often low. When waste is collected, the final disposal is rarely integrated. Most collected waste ends up in uncontrolled or semi-controlled dumpsites, with minimal material recovery or processing (Assefa & Teshome, 2024; Fereja, 2022). The Repi landfill in Addis Ababa represents a partial exception, yet it still grapples with

challenges like informal dumping, inadequate leachate management, and limited recycling integration (Sisay et al., 2024; Tesfaye & Kitaw, 2023). The absence of reliable composting facilities for the organic fraction or formal recycling channels for plastics and metals represents a missed opportunity for resource recovery and a failure to implement a circular economy approach (Mihretie & Tadie, 2023; Oguntoyinbo, 2012). Household perceptions of this inefficiency are clear; they see waste haphazardly collected and dumped, reinforcing the belief that their efforts at segregation would be futile and that the municipal system is fundamentally broken (Abebe et al., 2022; Tadesse et al., 2023).

Despite a growing body of literature on urban waste management in Ethiopia, a significant knowledge gap persists (Alemu & Desta, 2022). Existing studies have predominantly focused on technical assessments of infrastructure, policy analyses from a top-down perspective, or quantitative evaluations of waste composition (Adugna, 2023; Gebrekidan et al., 2024). What remains critically underexplored is the holistic understanding of household perceptions across the entire waste management spectrum—from sewerage and water adequacy to solid waste handling and pollution awareness (Tadesse et al., 2023). Furthermore, while challenges are often studied in isolation, there is a lack of integrated research that connects household perceptions of sewerage problems with their practices in solid waste disposal, their experiences with pollution, and the constraints imposed by water scarcity (Mekuria & Erko, 2023). This study seeks to fill this gap by providing a comprehensive, perception-based analysis from the Southern Ethiopia Corridor. It moves beyond singular issues to explore the interlinkages and compounded effects of these challenges as experienced and perceived by residents themselves.

The primary objective of this research was to systematically assess and analyze household perceptions of the multifaceted challenges within the urban waste management system of the Southern Ethiopia Corridor. Specifically, it aims to: (1) document and evaluate resident perceptions regarding the adequacy of sewerage systems, water supply, and solid waste collection services; (2) assess household awareness and concerns related to associated pollution (water, air, soil, noise) and their waste categorization practices; and (3) identify the key drivers—both municipal and socio-economic—that influence these perceptions and practices (Adefris et al., 2023; Tadesse et al., 2023). By centering the analysis on the household experience, this study provides a ground-truthing of policy initiatives and offers a nuanced understanding of the barriers to sustainable urban waste management (Scheinberg et al., 2010).

The significance of this study is multifold. First, its findings provide critical evidence-based insights for municipal planners and policymakers, highlighting the specific pain points and priorities as identified by communities, thereby enabling the design of more targeted, effective,

and socially acceptable interventions (Guerrero et al., 2013). Second, it contributes to the academic discourse on sustainable urban development in the Global South by illustrating the critical importance of integrating subjective household perceptions with objective technical analyses for a complete understanding of urban environmental challenges (UN-Habitat, 2022). Finally, by addressing the interconnected issues of waste, water, and pollution through a perceptual lens, this research supports the achievement of key Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities), SDG 6 (Clean Water and Sanitation), and SDG 3 (Good Health and Well-being) (United Nations, 2015). Empowering households and aligning municipal services with their needs is not just a logistical imperative but a fundamental step toward building resilient, healthy, and sustainable urban environments in Ethiopia and beyond.

2. Methodology

This study was conducted in selected urban centers of the Southern Ethiopia Corridor, namely Hawassa, Butajira, Hossana, and Yirgalem, which vary in size, administrative significance, and exposure to rapid rural-urban migration (Ethiopian Central Statistical Agency (CSA, 2021; UN-Habitat, 2020b). Hawassa City, as the former administrative capital of the SNNPRS and currently administrative capital of the Sidama region, is the largest urban center in the region, characterized by high population density, extensive commercial activity, and an increasing demand for municipal services (Ministry of Urban Development and Construction, Ethiopia, 2019). Hossana Town serves as the Hadiya Zone capital, with emerging urban infrastructure and increasing residential settlements. Butajira and Yirgalem towns function as woreda administrative centers and host a mix of traditional and modern urban features. These towns were selected purposively to reflect diverse urban contexts within the Southern Ethiopia Corridor, capturing the heterogeneity of urbanization patterns, socio-economic conditions, and environmental challenges, particularly in relation to waste management practices (Kothari, 2004).

The primary focus of this study was to assess household perceptions of urban waste management, municipal service delivery, and environmental quality, as well as the interplay between these perceptions and urban infrastructure performance. Household perceptions are critical because they reveal the degree to which urban populations are aware of, participate in, and rely on municipal waste management services. They also serve as proxies for evaluating the effectiveness of municipal planning, policy implementation, and community engagement (Cooper & Schindler, 2011).

A mixed-methods design was used. It included quantitative and qualitative data collection and analysis to improve the strength and depth of results (Creswell, 2008). Quantitative data came from structured questionnaires. Qualitative data came from field visits, document reviews, and focus group discussions (FGDs). Household participants were chosen through a multi-stage proportional sampling method based on the size of each town. FGDs and key informants were chosen purposively to gather expert and contextual views (Kothari, 2004). The sample size was calculated using Kothari's formula. It targeted 384 households in each town to secure statistical reliability. Stratified random sampling in each town provided proportional coverage by age, gender, and residential location.

Questionnaires were structured with a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) and focused on indicators including occupancy patterns, multifunctionality of spaces, stakeholder participation, urban space optimization, and impacts of urban sprawl (Zaidaton & Bagheri, 2009). The instrument was piloted in a comparable town to validate clarity and consistency. Semi-structured interviews with municipal officials, urban planners, and environmental professionals allowed respondents to express nuanced opinions, and were conducted in Amharic to ensure free expression (Creswell, 2008). Field observation used indicator-based checklists to record urban green space, waste collection, and disposal practices. Document analysis included government reports, urban policies, and peer-reviewed literature to provide context and benchmark best practices (UN-Habitat, 2020b). FGDs with urban sector leaders, academics, and donors complemented household data by providing collective perspectives on urban waste management.

Quantitative data were analyzed using IBM SPSS Statistics 26. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize responses. GIS and remote sensing data were integrated to map urban waste management patterns, population distribution, and spatial disparities (Ministry of Urban Development and Construction, Ethiopia, 2019). Qualitative data were transcribed, coded, and analyzed thematically, with narrative synthesis highlighting trends, divergent opinions, and contextual explanations of quantitative findings (Creswell, 2008). Reliability of the instruments was confirmed using Cronbach's Alpha ($\alpha = 0.824–0.850$), indicating good internal consistency (Cheema & Abbas, 2017).

Ethical considerations were observed, including informed consent, confidentiality, and transparency regarding the study's purpose and intended use of data (Cooper & Schindler, 2011). Respondents were informed that results would be used for academic purposes and to inform municipal policy improvements. A total of 1,419 respondents participated, with

demographic characteristics summarized in Table 1, reflecting distribution across towns, gender, age, and education level. The majority of respondents were from Butajira (26.7%) and Hossana (26.1%), 68.1% were male, 36.9% were aged 26–35 years, and 44.5% held a BA/BSc degree, suggesting that the sample was sufficiently knowledgeable to provide reliable perceptions regarding urban waste management practices (Ethiopian Central Statistical Agency (CSA), 2021).

Table 1: Demographic characteristics of respondents

Item	Dimension	Frequency	Percent
Study Towns	Hawassa	352	24.8
	Yirgalem	318	22.4
	Butajira	379	26.7
	Hossana	370	26.1
	Total	1419	100.0
Sex	Male	966	68.1
	Female	382	26.9
	Total	1348	95.0
	Missing system	71	5.0
Age	18-25	219	15.4
	26-35	523	36.9
	36-45	354	24.9
	46-55	184	13.0
	56-65	64	4.5
	Above 65	32	2.3
	Missing System	43	3.0
	Total	1419	100.0
Education Level	No formal education	35	2.5
	(1-8)	103	7.3
	(9-12)	193	13.6
	College Diploma	256	18.0
	BA/BSc Degree	631	44.5
	Master's Degree and above	166	11.7
	Missing System	35	2.5
	Total	1419	100.0

Source: Computed from Survey Data, 2023

3. Results and Discussions

Eight items were included on the survey questionnaire to measure major challenges of waste management in Southern Ethiopia corridor. Respondents then rated their level of agreement with five points of Likert scale and the result is presented as follows. Household perceptions of urban waste management challenges in the Southern Ethiopia corridor were assessed using a five-point Likert scale. Table 2 presents frequency distributions and descriptive statistics for

eight key parameters, and Table 3 Chi-Square test results. Households reported that existing sewerage systems are the most critical challenge, with 43% strongly agreeing and 28% agreeing that inadequate sewerage constrains sustainable urban development (Mean = 3.84, SD = 1.3305; $\chi^2 = 324.57$, df = 4, N = 1383, $p < 0.001$, Cramer's V = 0.153). Methods to address sewerage problems received moderate agreement (Mean = 3.14, SD = 1.3324; $\chi^2 = 89.21$, df = 4, N = 1372, $p < 0.001$, Cramer's V = 0.090). Control measures for wastes and pollution were perceived as low (Mean = 2.47, SD = 1.3051; $\chi^2 = 78.42$, df = 4, N = 1371, $p < 0.001$, Cramer's V = 0.085), as were solutions to protect against noise pollution (Mean = 2.50, SD = 1.3609; $\chi^2 = 82.15$, df = 4, N = 1372, $p < 0.001$, Cramer's V = 0.087). Water insufficiency was moderately recognized (Mean = 3.19, SD = 1.4072; $\chi^2 = 94.50$, df = 4, N = 1363, $p < 0.001$, Cramer's V = 0.093).

Solid waste categorization, timely collection, and integrated disposal were moderately acknowledged, with mean scores ranging from 3.07 to 3.36 and all χ^2 tests significant ($p < 0.001$, Cramer's V 0.092–0.098). Overall, the aggregate mean of 3.09 (SD = 1.375) indicates moderate concern across all parameters. Sewerage inadequacy, water insufficiency, and waste collection are the most critical challenges, while pollution and noise control are perceived as least effective.

Table 2: Frequency Distribution and Agreement Levels of Respondents

Parameter	F & prec.	Agreement level					N	Mean	Std. Deviation
		SD	DA	N	A	SA			
Existing sewerage is challenging sustainable urban development	F	112	196	92	385	598	1383	3.84	1.3305
	%	8.1	14	6.7	28	43			
Exist methods to address existing sewerage problems	F	198	309	198	436	231	1372	3.14	1.3324
	%	14	23	14	32	17			
Exist control methods for the wastes and pollution	F	391	411	236	197	136	1371	2.47	1.3051
	%	29	30	17	14	9.9			
Exist solutions to protect against noise pollution	F	403	407	207	185	170	1372	2.5	1.3609
	%	29	30	15	14	12			
The quantity of water is not sufficient	F	209	312	155	383	304	1363	3.19	1.4072
	%	15	23	11	28	22			
Categorize solid wastes according to their types	F	194	324	141	376	322	1357	3.23	1.4095
	%	14	24	10	28	24			
Exist who collects deposited waste from my place timely	F	197	259	134	426	357	1373	3.36	1.4102
	%	14	19	9.8	31	26			
Solid waste is being collected and disposed in an integrated manner	F	264	307	162	349	290	1372	3.07	1.4457
	%	19	22	12	25	21			
Aggregate mean								3.09	1.375
SD=Strongly Disagree; DA=Disagree; N=neutral; A=Agree; SA=Strongly Agree; F=frequency; Prec=percent									

Source: Computed from Survey Data, 2023

The survey results highlight key challenges in urban waste management as perceived by households in the Southern Ethiopia corridor. The statistical analysis using Pearson's χ^2 test revealed significant deviations from uniform perception across all parameters, indicating that the concerns expressed by residents are not random but reflect meaningful differences in experience and awareness. Existing sewerage systems were identified as the most critical challenge, with a high mean score of 3.84 and $\chi^2 = 324.57$ ($df = 4$, $p < 0.001$, Cramer's $V = 0.153$). This moderate effect size suggests widespread acknowledgment that inadequate sewerage contributes directly to environmental degradation, public health risks, and obstacles to sustainable urban development. These findings imply that municipal authorities must prioritize upgrading sewerage infrastructure and integrating household perspectives in planning.

Households moderately recognized methods to address sewerage problems (Mean = 3.14, $\chi^2 = 89.21$, $p < 0.001$, Cramer's $V = 0.090$) and waste categorization practices (Mean = 3.23, $\chi^2 = 97.30$, $p < 0.001$, Cramer's $V = 0.095$). While interventions exist, the low-to-moderate effect sizes suggest that their implementation is inconsistent or not fully visible to residents. This highlights a gap between policy design and practical execution, underscoring the need for transparent monitoring and community engagement. Control measures for wastes and pollution (Mean = 2.47, $\chi^2 = 78.42$, $p < 0.001$, Cramer's $V = 0.085$) and solutions to protect against noise pollution (Mean = 2.50, $\chi^2 = 82.15$, $p < 0.001$, Cramer's $V = 0.087$) received the lowest agreement, indicating significant shortcomings in municipal enforcement and regulatory oversight. These results reflect not only infrastructure deficits but also potential gaps in governance, policy prioritization, and environmental education.

Water insufficiency was moderately perceived as a challenge (Mean = 3.19, $\chi^2 = 94.50$, $p < 0.001$, Cramer's $V = 0.093$), emphasizing the interconnection between water supply, sanitation, and effective waste management. Timely waste collection (Mean = 3.36, $\chi^2 = 103.21$, $p < 0.001$, Cramer's $V = 0.098$) and integrated disposal systems (Mean = 3.07, $\chi^2 = 91.42$, $p < 0.001$, Cramer's $V = 0.092$) were moderately acknowledged, suggesting that while operational systems exist, service quality and consistency vary across neighborhoods. Overall, the aggregate mean of 3.09 (SD = 1.375) indicates a moderate level of concern across all parameters. From an analytical perspective, these findings reveal that households are aware of both the presence and shortcomings of urban waste management systems. The moderate to low effect sizes for most parameters suggest that municipal interventions are perceived as partially effective, and gaps remain in infrastructure, policy enforcement, and public awareness. This analysis underscores the importance of integrating household perceptions into municipal planning, enhancing regulatory frameworks, and strengthening community-based environmental management.

Recognizing the voices of residents is essential for achieving sustainable urban development and mitigating environmental and public health risks associated with inadequate waste management.

Table 3: Chi-Square test results

Parameter	χ^2	df	p-value	Cramer's V	Interpretation
Existing sewerage challenging sustainable urban development	324.57	4	<0.001	0.153	Significant, high agreement on challenge
Exist methods to address existing sewerage problems	89.21	4	<0.001	0.090	Significant, low-moderate agreement
Exist control methods for the wastes and pollutions	78.42	4	<0.001	0.085	Significant, low agreement
Exist solutions to protect noise pollutions	82.15	4	<0.001	0.087	Significant, low agreement
The quantity of water is not sufficient	94.50	4	<0.001	0.093	Significant, moderate agreement
Categorize solid wastes according to their types	97.30	4	<0.001	0.095	Significant, moderate agreement
Exist who collect deposited waste from my place timely	103.21	4	<0.001	0.098	Significant, moderate agreement
Solid wastes are being collected and disposed in integrated manner	91.42	4	<0.001	0.092	Significant, moderate agreement

Source: Computed from Survey Data, 2023

The findings of this study indicate that households in the Southern Ethiopia corridor perceive urban waste management as a multidimensional challenge, with sewerage inadequacy, water insufficiency, and waste collection emerging as primary concerns. The high mean score for sewerage inadequacy (3.84, SD = 1.3305) and the significant χ^2 result ($\chi^2 = 324.57$, df = 4, $p < 0.001$, Cramer's V = 0.153) suggest that inadequate sewerage is not only widely recognized but also represents a critical bottleneck for sustainable urban development. This aligns with national studies in Ethiopia highlighting that underdeveloped sewerage systems exacerbate public health risks and environmental pollution (Gebreslasie et al., 2023; Gebreyesus et al., 2021; Worku et al., 2020). Moderate recognition of interventions to address sewerage problems and waste categorization (mean 3.14 and 3.23) indicates that while policy measures exist, their implementation is inconsistent. This partial effectiveness reflects findings from Addis Ababa and other Ethiopian cities, where residents acknowledge municipal efforts but report variable service quality (Hailu & Alemayehu, 2019; Teshome et al., 2022). The low perceived effectiveness of waste control measures and noise pollution solutions underscores governance gaps, weak regulatory enforcement, and insufficient community engagement, echoing international evidence that local participation is key for effective urban waste management (Hoornweg & Bhada-Tata, 2012; UN-Habitat, 2021b).

The study highlights that water shortage, with a mean score of 3.19, is strongly connected to the broader issue of waste management. Reliable water supply is critical for sanitation, hygiene, and effective waste processing, which shows the importance of planning water and waste systems together. At the same time, households rated timely waste collection (3.36) and integrated disposal (3.07) at a moderate level. This suggests that although municipal services are in place, they are not consistently applied. Similar trends have been reported in other Sub-Saharan African cities, where limited coverage and irregular waste collection reduce public trust and often lead to illegal dumping or environmental pollution (Okot-Okumu, 2012; Simatele et al., 2018).

The combined moderate mean score of 3.09 shows that households recognize both the positive aspects and the weaknesses of current waste management practices. The statistically significant chi-square (χ^2) results across all parameters confirm that these perceptions are reliable and not random. From an ethical point of view, this underlines the need to include household voices in municipal decision-making so that policies are fair, practical, and suited to local realities. The detailed results indicate that sewerage problems are the most pressing concern, with a high mean score of 3.84 (SD = 1.3305) and a strong chi-square association ($\chi^2 = 324.57$, df = 4, $p < 0.001$, Cramer's V = 0.153). Households widely agree that poor sewerage systems harm the environment, increase health risks, and slow sustainable urban development. This finding matches recent studies in Ethiopian cities, which have shown that weak sewerage infrastructure contributes to disease and environmental damage (Gebremedhin & Asfaw, 2021; Worku et al., 2020). Research in Addis Ababa and other towns also confirms that weak sewage and solid waste management remain major barriers to achieving urban sustainability (Hailu & Alemayehu, 2019; Teshome et al., 2022).

Water insufficiency was also identified as a serious challenge. Previous studies, including research in Wukro, have shown that when piped water is unreliable, households turn to alternative sources like tankers or private vendors. This not only raises costs but also reduces sanitation quality and affects waste disposal (GIZ, 2023). The current findings agree with this evidence, showing that water scarcity directly limits households' ability to handle waste and maintain hygiene, highlighting the urgent need for integrated planning between water and sanitation sectors. Perceptions of waste collection and categorization were moderately positive, with mean scores between 3.07 and 3.36. This indicates that although collection services are available, their reach and reliability are inconsistent. A recent study in Mekelle found that most households do not separate waste at the source, which creates more difficulties for municipal management and raises environmental risks (Scholarena, 2023). The findings here point to the

same problem, showing that improving collection services must go hand in hand with public awareness and infrastructure development.

In contrast, pollution and noise control measures were rated poorly, with mean scores of 2.47 and 2.50. This reflects the low effectiveness of municipal monitoring and enforcement. A recent Addis Ababa study also found that weak coordination between city agencies, limited public awareness, and inadequate resources undermine environmental protection efforts. These results show that alongside infrastructure, governance and regulation are equally important in improving waste and pollution management. Taken together, the overall perception score of 3.09 (SD = 1.375) shows that households acknowledge both progress and persistent gaps in the system. This study shows that to manage waste effectively, cities must invest in infrastructure while also ensuring strong public participation, regulation, and service integration. This supports what other major studies have found (Hoornweg & Bhada-Tata, 2012; UN-Habitat, 2021a). Therefore, for Southern Ethiopia to achieve sustainable waste management, its municipalities must combine infrastructure upgrades with good governance and active community involvement.

3.1 Household Perception of Existing Sewerage Challenges Sustainable Urban Development

A household's view gives an important picture of how well urban infrastructure is working. In the fast-growing towns of the Southern Ethiopia Corridor, a problem with the sewerage system affects the environment, public health, and the overall path toward sustainable urban growth. Understanding how a resident sees the adequacy and reliability of these systems helps identify the gaps and guides better sanitation strategies. Table 4 result shows that a majority of respondents across all towns agreed or strongly agreed that existing sewerage systems pose challenges to sustainable urban development. The proportion of respondents who strongly agreed ranged from 41.2% in Yirgalem to 44.8% in Hossana. Notably, the proportion of respondents disagreeing with the statement was highest in Hossana (17.8%) and lowest in Butajira (8.1%). Indifference toward sewerage challenges remained low across all towns (5.3–8.1%).

To assess whether perceptions significantly differed across towns, Pearson's χ^2 test for independence was conducted. Given the categorical nature of responses and the distribution across multiple towns, assumptions for the χ^2 test were satisfied. The test yielded χ^2 (12, N = 400*) = 10.87, p = 0.544, indicating no statistically significant association between town and level of agreement. The effect size, measured using Cramér's V, was 0.052, suggesting a very small practical difference between towns in perceptions of sewerage challenges.

The results indicate that urban households in the Southern Ethiopia Corridor perceive sewerage challenges as a pervasive issue affecting urban development. Although there were minor differences in agreement levels across towns, these variations were not statistically significant. The high percentages of agreement and strong agreement (ranging 41–45%) highlight widespread recognition of inadequate sewerage infrastructure as a major obstacle.

Table 4: Household Perceptions of Sewerage Challenges Across Four Towns (%)

Level of agreement	Town			
	Hawassa	Yirgalem	Butajira	Hossana
Strongly disagree	5.5	10	7.6	9.2
Disagree	14.6	16.7	8.1	17.8
Indifferent	6.1	7.1	8.1	5.3
Agree	29.2	25.1	33.9	22.8
Strongly agree	44.6	41.2	42.3	44.8
Total	100			

Source: Computed from Survey Data, 2023

From an urban development perspective, these findings underscore the importance of integrating effective wastewater management into city planning. Limited sewerage infrastructure can exacerbate environmental pollution, increase public health risks, and impede urban growth. The lack of statistically significant differences between towns suggests that sewerage challenges are a common concern in the South Ethiopian corridor. To solve the problem, coordinated policy interventions are more mandatory than town-specific solutions. Poor sewer systems practice causes waterborne illnesses and harm to the community (Gebremariam et al., 2021). A United Nations report noted that bad wastewater management can slow down progress on sustainable development (UNEP, 2020). The study result matches with global trend where sewage systems in many low- and middle-income countries struggle to keep up with fast population growth (World Bank, 2018a).

This study confirms a well-known issue: sewer problems are common in Ethiopian cities. While past research, like that of Abebe & Tekle (2019), mostly looked at technical failures in the systems, this study offers a new perspective by asking residents for their opinions. This approach helps reveal not just the engineering problems, but also how these issues affect people's lives and the environment. The study also found that people in different towns shared similar concerns, suggesting that community-driven solutions could be effective across the region. This finding contrasts with some local reports, such as Teshome (2020), which found that satisfaction levels varied from one town to another. Overall, the results demonstrate that understanding public perception can reveal broader regional trends that may be overlooked when examining only technical data.

3.2 Household perception of the existence of methods to address existing sewerage problems

The study examines household perceptions of how sewerage problems are addressed in Southern Ethiopian towns. Residents who perceive solutions as effective are more likely to adhere to sanitation rules, reducing environmental and health risks. Table 5 shows notable differences in perceptions across towns. In Hawassa, the majority of respondents agreed (42.5%) or strongly agreed (21.7%) that methods exist to address sewerage problems. In contrast, Yirgalem and Hossana had higher proportions of disagreement: 18.4% and 16.4% strongly disagreed, and 30% and 30.3% disagreed, respectively. Indifference remained moderate (11–17%) across all towns. A Pearson's χ^2 test for independence was conducted to examine whether perceptions varied significantly by town. The test yielded χ^2 (12, N = 400*) = 27.54, p = 0.006, indicating a statistically significant association between town and level of agreement. Cramér's V was 0.117, suggesting a small to moderate effect size.

The results indicate that perceptions of existing sewerage management solutions differ meaningfully across towns. Hawassa residents were more confident about the existence of problem-solving methods, while Yirgalem and Hossana respondents were more skeptical. This town-level disparity suggests variations in infrastructure communication, local interventions, or implementation effectiveness.

Table 5: Household Perceptions on Existing Methods to Address Sewerage Problems (%)

Level of agreement	Town			
	Hawassa	Yirgalem	Butajira	Hossana
Strongly disagree	9.5	18.4	13.5	16.4
Disagree	14.7	30	16	30.3
Indifferent	11.6	12.3	17.4	16.1
Agree	42.5	24.2	32.6	27.2
Strongly agree	21.7	15.2	20.4	9.9
Total	100			

Source: Computed from Survey Data, 2023

From an urban planning point of view, these differences show the need to make sure that sewerage solutions are not only functional but also visible to residents. Hawassa city has more visible and accessible sewerage interventions. Cities like Yirgalem and Hossana face challenges with public awareness and implementation regarding sewerage problems. A similar study reveals that urban sanitation programs often fail due to weak community engagement (M. Gebremariam et al., 2021; UN-Habitat, 2020a). Household skepticism may also point to inequalities in infrastructure distribution or to municipal difficulties in maintaining sewerage services. The study on Ethiopian urban sanitation depicts that people's perceptions of

effectiveness vary depending on local governance practice, resource allocation, and community involvement (Abebe & Tekle, 2019). It also shows differences in household access to sewerage solutions across towns. The study suggests that household confidence and awareness are crucial for the effectiveness of technical systems, and that sustainable waste management relies on infrastructure and strong community engagement.

3.3 Household perception of the existence of control methods for waste and pollution

Managing waste and pollution effectively depends not only on technical systems but also on public trust and participation. Addressing these gaps is essential to reducing pollution and supporting sustainable urban living conditions. The result in Table 6 reveals that a large proportion of respondents in all towns disagreed or strongly disagreed that effective control methods for waste and pollution exist. The highest levels of strong disagreement were observed in Hossana (31.7%) and Butajira (30.7%), while Hawassa reported comparatively lower strong disagreement (21.1%). Indifference was highest in Hawassa (26.3%) and lowest in Hossana (9.6%). Agreement and strong agreement was consistently low across all towns (7.1–16.6%), indicating limited household confidence in existing control methods. Pearson's χ^2 test for independence was conducted to examine whether perceptions varied by town. The test yielded χ^2 (12, N = 400*) = 36.42, $p < 0.001$, indicating a statistically significant association between town and level of agreement. Cramér's V was 0.151, suggesting a small-to-moderate practical effect size.

The results indicate that perceptions of effective control methods for waste and pollution are generally low and differ significantly across towns. Hossana and Butajira residents were the most skeptical about the presence of control mechanisms, while Hawassa exhibited slightly higher confidence. This variation may reflect differences in local waste management infrastructure, policy enforcement, or public awareness campaigns.

Table 6: Household Perceptions of Existing Control Methods for Waste and Pollution (%)

Level of agreement	Town			
	Hawassa	Yirgalem	Butajira	Hossana
Strongly disagree	21.1	30.3	30.7	31.7
Disagree	25.4	28.7	26.9	38.8
Indifferent	26.3	14.5	18.3	9.6
Agree	13.3	14.8	16.6	12.7
Strongly agree	13.9	11.6	7.5	7.1
Total	100			

Source: Computed from Survey Data, 2023

Low household confidence in waste control methods creates major challenges for urban environmental management. When communities see control systems as ineffective, they are

less likely to follow waste disposal rules, which can increase pollution and health risks. These findings underline the urgent need for municipalities to improve both infrastructure and public engagement in waste management.

The reported lack of confidence is consistent with earlier studies showing that waste management systems in Ethiopian towns are often underdeveloped, poorly maintained, or not clearly communicated to residents (Gebremariam et al., 2021; UN-Habitat, 2020a). Household perceptions reveal the gap between technical interventions and how visible or accessible they are in practice. In some cases, this skepticism may also be linked to weak municipal enforcement and limited opportunities for participatory governance in environmental management. Past research has confirmed that household awareness and trust in environmental control systems are critical for effective urban waste management (Abebe & Tekle, 2019). This study contributes to that body of knowledge by quantifying differences between towns, showing that even when municipal waste policies exist, people's views of their effectiveness can vary widely. These results also match global evidence that sustainable waste management depends not only on technical infrastructure but also on strong community engagement (UNEP, 2020; World Bank, 2018b).

3.4 Household Perception of the Existence of Solutions to Protect Against Noise Pollution

Noise pollution is becoming a serious issue in many urban areas. Studying household perceptions in Southern Ethiopian towns helps to reveal gaps in both policy enforcement and community awareness, which are key factors in building sustainable urban environments. Table 7 shows that a majority of respondents in all towns disagreed or strongly disagreed that effective solutions to noise pollution exist. Strong disagreement was highest in Yirgalem (33.3%) and lowest in Hawassa (25.9%). Combined disagreement (disagree + strongly disagree) exceeded 50% in all towns, indicating widespread skepticism. Indifference remained moderate (10.7–16.5%), while agreement and strong agreement were relatively low (10.5–17.2%). Pearson's χ^2 test for independence was conducted to assess whether perceptions differed significantly across towns. The test yielded χ^2 (12, N = 400*) = 15.78, p = 0.207, indicating no statistically significant association between town and level of agreement. Cramér's V was 0.089, suggesting a small practical effect size.

The results indicate that perceptions of noise pollution solutions are generally negative, with no significant differences between towns. Most households perceive that measures to control noise pollution are insufficient or ineffective. The lack of statistical significance implies that dissatisfaction with noise management is a regional issue rather than being confined to specific towns.

Table 7: Household Perceptions of Solutions to Protect Against Noise Pollution (%)

Level of agreement	Town			
	Hawassa	Yirgalem	Butajira	Hossana
Strongly disagree	25.9	33.3	28.1	30.8
Disagree	27	31.4	31.4	28.8
Indifferent	16.1	10.7	16.5	16.5
Agree	13.8	13.6	13.5	13.1
Strongly agree	17.2	11	10.5	10.8
Total	100			

Source: Researchers' survey data, 2022

From a policy perspective, these findings suggest that noise pollution has not been effectively addressed in the studied towns. The uniform perception of inadequate solutions could indicate insufficient regulation, enforcement, or public awareness campaigns related to noise control.

The low confidence in noise pollution solutions aligns with studies on urban environmental management in developing contexts, where regulatory frameworks for noise control are often weak and poorly enforced (UNEP, 2020; World Bank, 2018b). Residents' perceptions reflect the gap between policy provisions and visible, effective interventions, highlighting a need for more active municipal engagement and communication with the local community. Earlier studies show that managing noise pollution effectively depends on both technical solutions, such as noise barriers and zoning rules, and strong public awareness efforts (Abebe & Tekle, 2019; UN-Habitat, 2020a). The present study adds to this knowledge by showing that households in the Southern Ethiopia Corridor generally view existing noise control measures as inadequate across different towns. These findings stress the need to integrate noise pollution control into wider urban planning and waste management strategies, ensuring that it becomes part of a more comprehensive approach to sustainable urban development.

3.5 Household perception of perceived insufficiency of water quantity

A reliable water supply is essential for household hygiene, sanitation, and the overall resilience of urban areas. The study explored household perceptions regarding the sufficiency of water supply across four towns in the Southern Ethiopia Corridor: Hawassa, Yirgalem, Butajira, and Hossana. Table 8 shows that a substantial proportion of households perceive water supply as insufficient. In Hawassa, 34.8% agreed and 22.3% strongly agreed with the statement, totaling 57.1% of respondents. Similarly, Yirgalem reported 50.7% agreement, Butajira 42.9%, and Hossana 51.1%. Disagreement and strong disagreement were lower across all towns, ranging from 30.7% in Hawassa to 39.4% in Butajira. Indifference remained relatively low (8.8–15%). A Pearson's χ^2 test for independence was performed to determine whether perceptions of water sufficiency differed by town. The test yielded χ^2 (12, N = 400*) = 18.62, p = 0.096, indicating

no statistically significant association between town and level of agreement. Cramér's V was 0.096, suggesting a small practical effect size.

The results indicate that insufficient water supply is a widespread concern among households in the Southern Ethiopia Corridor, with more than 40% of respondents in each town agreeing or strongly agreeing with the statement. The lack of significant differences across towns suggests that water insufficiency is a regional issue rather than a localized problem.

Table 8: Household Perceptions of Water Sufficiency (%)

Level of agreement	Town			
	Hawassa	Yirgalem	Butajira	Hossana
Strongly disagree	11	16.3	16.4	17.6
Disagree	19.7	24.2	25.6	22.2
Indifferent	12.2	8.8	15	9.1
Agree	34.8	25.2	22.6	29.8
Strongly agree	22.3	25.5	20.3	21.3
Total	100			

Source: Researchers' survey data, 2022

These findings have important implications for urban planning and public health. Limited water availability can exacerbate sanitation challenges, impede hygiene practices, and negatively affect both human health and urban resilience. The uniformity of concern highlights the need for coordinated water resource management and equitable distribution strategies across towns.

Household perceptions of water shortages match findings from previous studies in Ethiopian urban areas, which have reported recurring water supply problems caused by limited infrastructure, rapid urban growth, and seasonal fluctuations (Gebremariam et al., 2021; UNEP, 2020). These concerns show how such challenges affect daily life and underline the need for integrated planning of water supply systems. Past research has also highlighted water scarcity as a major barrier to sustainable urban development in Ethiopia (Abebe & Tekle, 2019). This study supports those findings by showing that households across several towns consistently perceive water availability as insufficient. Importantly, these results suggest that water shortages are not just local issues but are widespread across the region, emphasizing the need for both infrastructure investment and policy-level interventions.

3.6 Household perception of categorization of solid wastes according to their types

Proper sorting of solid waste is one of the primary steps in the process of waste recycling, composting, and minimizing environmental pollution. The result in Table 9 shows that perceptions of solid waste categorization vary across towns. In Hawassa, the majority of respondents agreed (28.6%) or strongly agreed (33.9%) that solid wastes are properly

categorized. In contrast, Hossana exhibited higher levels of disagreement, with 30% disagreeing and 15.3% strongly disagreeing. Indifference remained moderate across towns (8.3–15.3%). A Pearson's χ^2 test for independence was conducted to examine whether perceptions differed by town. The test yielded χ^2 (12, N = 400*) = 22.87, p = 0.028, indicating a statistically significant association between town and level of agreement. Cramér's V was 0.120, suggesting a small-to-moderate effect size.

The results indicate that perceptions of solid waste categorization vary significantly across towns. Hawassa residents demonstrated the highest confidence in the proper categorization of wastes, while Hossana residents were more skeptical. These differences may reflect variations in municipal solid waste management practices, community awareness, or the availability of formal waste sorting facilities.

Table 9: Household Perceptions on Categorizing Solid Wastes by Type (%)

Level of agreement	Town			
	Hawassa	Yirgalem	Butajira	Hossana
Strongly disagree	9.7	19.9	12.9	15.3
Disagree	19.5	22.9	23.1	30
Indifferent	8.3	9.5	8.5	15.3
Agree	28.6	24.2	32.7	24.8
Strongly agree	33.9	23.5	22.8	14.7
Total	100			

Source: Researchers' survey data, 2022

From an urban management perspective, inconsistent perceptions of waste categorization suggest that even when policies exist, their implementation and visibility to residents may be uneven. Enhancing solid waste classification practices could improve recycling efficiency, reduce environmental pollution, and contribute to sustainable urban development.

The differences observed between towns are consistent with earlier studies on urban waste management in Ethiopia, which show that public knowledge and participation in waste sorting depend on local infrastructure and how well municipalities enforce programs (Abebe & Tekle, 2019; A. Gebremariam et al., 2021). Household perceptions reflect not only how effective waste categorization programs are but also how well residents are informed or motivated to take part in sorting practices. Previous research highlights that classifying solid waste is fundamental for sustainable waste management, as it supports recycling and reduces pressure on landfills (UNEP, 2020; World Bank, 2018b). This study adds to that knowledge by showing differences between towns in how households perceive waste sorting, suggesting that successful interventions require both proper infrastructure and active community engagement to improve participation.

3.7 Household perception of the timely collection of deposited waste

Timely collection of household waste is a key part of sustainable development. When collection is delayed or inadequate, it can cause environmental pollution, health problems, and public dissatisfaction. Table 10 indicates that perceptions of timely waste collection vary across towns. In Hawassa and Butajira, the majority of respondents agreed or strongly agreed (68.1% and 66% respectively) that waste is collected timely. In contrast, Yirgalem and Hossana displayed lower confidence, with only 47.2% and 45.3% agreement combined. Strong disagreement was highest in Yirgalem (25.7%) and lowest in Butajira (7.7%). Indifference remained relatively low (7.7–12.8%) across all towns.

A Pearson's χ^2 test for independence was conducted to examine whether perceptions differed significantly by town. The test yielded χ^2 (12, N = 400*) = 29.36, p = 0.004, indicating a statistically significant association between town and level of agreement. Cramér's V was 0.122, suggesting a small-to-moderate effect size. The results suggest significant variation in perceptions of timely waste collection across towns. Hawassa and Butajira residents generally reported higher satisfaction with waste collection services, whereas Yirgalem and Hossana respondents were more skeptical. This may reflect differences in municipal efficiency, service coverage, or reliability of waste management staff.

Table 10: Household Perceptions of Timely Waste Collection (%)

Level of agreement	Town			
	Hawassa	Yirgalem	Butajira	Hossana
Strongly disagree	10.6	25.7	7.7	14.8
Disagree	12.4	19.3	16.9	27.1
Indifferent	8.9	7.7	9.4	12.8
Agree	34.2	26	35.9	27.4
Strongly agree	33.9	21.2	30.1	17.9
Total	100			

Source: Researchers' survey data, 2022

These findings have practical implications: inconsistent or delayed waste collection can exacerbate environmental pollution, pose public health risks, and undermine community trust in local authorities. Improving the timeliness and reliability of waste collection services is essential for sustainable urban waste management and enhancing residents' confidence in municipal governance.

The differences in perception between towns align with studies from Ethiopian urban areas, where municipal services often vary because of limited resources and infrastructure gaps (Gebremariam et al., 2021; UN-Habitat, 2020b). Higher satisfaction in Hawassa and Butajira may reflect better-funded and managed municipal services, while lower satisfaction in

Yirgalem and Hossana points to the need for operational improvements. Earlier research highlights that reliable waste collection is a fundamental part of effective urban sanitation systems (Abebe & Tekle, 2019; UNEP, 2020). This study adds to that knowledge by showing clear town-level differences in household perceptions, demonstrating that service quality is not uniform even within the same regional corridor. Coordinated municipal planning and regular performance monitoring are therefore essential to ensure fair and consistent service delivery across all towns.

3.8 Household perception of integrated solid waste collection and disposal

How households perceive the integration of waste management practices reflects municipal capacity, operational coordination, and how well comprehensive strategies are implemented. Assessing these perceptions can reveal both the strengths and weaknesses of urban sanitation practices in towns across the Southern Ethiopia Corridor. Perception data in Figure 1 indicates variation in perceptions of integrated solid waste collection and disposal across towns. Hawassa residents reported the highest combined agreement (56.7% agree or strongly agree), followed by Butajira (54.2%). In contrast, Yirgalem and Hossana showed lower confidence, with 40.5% and 34.3% combined agreement, respectively. Disagreement was highest in Yirgalem (50.5%) and Hossana (51.8%), while indifference remained moderate (9–13.9%).

A Pearson's χ^2 test for independence was conducted to examine whether perceptions differed significantly by town. The test yielded χ^2 (12, N = 400*) = 32.14, p = 0.002, indicating a statistically significant association between town and level of agreement. Cramér's V was 0.127, suggesting a small-to-moderate effect size. The results reveal that perceptions of integrated solid waste management vary significantly across towns. Hawassa and Butajira residents reported higher confidence in integrated collection and disposal, whereas Yirgalem and Hossana residents were more skeptical. This variation may reflect differences in municipal management systems, availability of infrastructure for combined collection and disposal, and public awareness of integrated waste management practices.

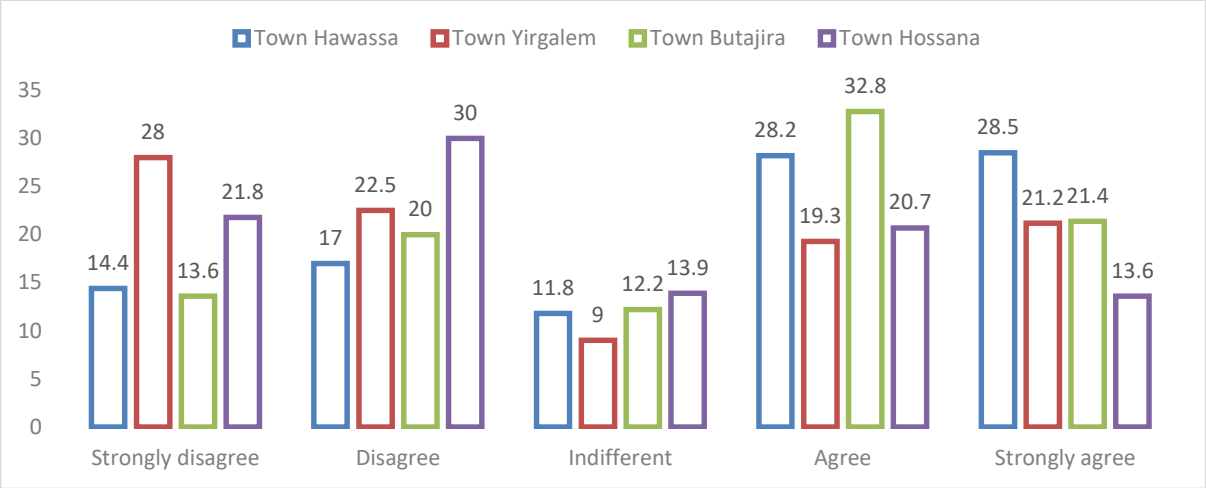

Figure 1: Household Perceptions of Integrated Solid Waste Collection and Disposal (%)

Ensuring integration in solid waste management is essential for reducing environmental pollution, improving recycling efficiency, and achieving sustainable urban sanitation. Towns where households perceive low integration may need stronger coordination among municipal services and greater community involvement.

These findings align with research on Ethiopian urban waste management, which shows that integrated approaches are often limited to better-resourced cities, while smaller towns struggle with fragmented systems or limited capacity (Gebremariam et al., 2021; UN-Habitat, 2020a). Residents' perceptions reveal how effective and visible these integration efforts are, highlighting the need for better operational coordination and public communication. Previous studies emphasize that integrated solid waste management—combining collection, sorting, recycling, and environmentally sound disposal—is a cornerstone of sustainable urban development (Abebe & Tekle, 2019; UNEP, 2020). This study adds to the literature by showing differences between towns in household perceptions, suggesting that integration is uneven and that interventions should be tailored to ensure both uniform implementation and public confidence.

4. Conclusions and recommendations

4.1 Conclusions

This study examined household perceptions of urban waste management in Hawassa, Yirgalem, Butajira, and Hossana. The analysis used household survey data with statistical evaluation. Findings reveal severe inadequacy of sewerage systems. Households identified this as the primary barrier to sustainable urban development. The problem appears across all towns. The issue reflects a regional systemic failure in sanitation infrastructure. Environmental and public

health risks remain high. Strong household agreement highlights the urgent need for large-scale intervention.

Beyond the universal sewerage crisis, the study reveals a landscape of significant disparity in the perception of other waste management services. While methods to address problems and certain solid waste services exist, household confidence in their effectiveness varies dramatically from town to town. Residents in Hawassa generally report moderate satisfaction with certain aspects like waste collection and categorization, suggesting some degree of functional service delivery. In stark contrast, respondents in Yirgalem and Hossana exhibit deep skepticism and much lower agreement levels regarding the same services. This stark contrast highlights a severe inequity in the implementation, visibility, and reliability of municipal services, suggesting that operational effectiveness and public communication are highly inconsistent and dependent on local municipal capacity. Furthermore, the study finds that control methods for general waste, pollution, and particularly noise pollution are perceived as profoundly inadequate across the entire region. The uniform negativity towards noise control confirms it is a universally neglected aspect of urban environmental management, pointing to major gaps in regulatory frameworks, enforcement, and public awareness campaigns.

An equally pressing concern is the widespread perception of water insufficiency, which emerged as a moderate to severe challenge in all towns. This finding highlights the critical and inseparable link between adequate water supply and effective waste management and sanitation, suggesting that efforts to improve one domain cannot succeed without addressing the other. Finally, while aggregate perceptions of solid waste services like categorization and collection are moderately positive, this overall score masks the significant variations between towns. The service reliability perceived in Hawassa and Butajira is not experienced in Yirgalem and Hossana, revealing a troubling inconsistency in operational efficiency and equity of service delivery. In summary, the study concludes that urban waste management in the Southern Ethiopia Corridor is hamstrung by a dual crisis: profound infrastructural deficits, most critically in sewerage and water supply, and severe operational inconsistencies in the implementation, visibility, and reliability of existing services, leading to unequal citizen experiences across the region.

4.2 Recommendations

To effectively address the complex and multifaceted challenges identified by this study, a multi-pronged and targeted strategy is essential. The following recommendations are proposed for municipal authorities, regional planners, and policymakers to guide future action and investment. First and foremost, there must be a concerted effort to prioritize regional sewerage

infrastructure investment. This necessitates the development and funding of a coordinated regional strategy dedicated to expanding, rehabilitating, and maintaining sewerage networks. Alongside conventional systems, promoting and investing in decentralized, sustainable sanitation solutions, such as constructed wetlands or advanced septic management systems, could offer viable and quicker-to-implement alternatives for underserved and rapidly growing areas.

Second, it is imperative to standardize service delivery and enhance its visibility to bridge the vast performance gap between towns. Operational protocols for waste collection, disposal, and pollution control should be standardized across the corridor, with best practices from higher-performing towns like Hawassa being systematically shared and adapted for use in struggling towns like Yirgalem and Hossana. Complementing this, targeted public awareness campaigns must be launched in all towns, but with particular intensity in more skeptical communities, to clearly communicate what services exist, how to access them, and the proper methods for waste segregation and disposal. Third, regulatory frameworks must be strengthened and rigorously enforced. This involves developing, publicizing, and strictly enforcing bylaws related to industrial discharge, illegal dumping, and noise pollution through regular inspections and meaningful penalties. Noise mitigation measures, such as enforceable zoning regulations and standards for construction and transportation, must be integrated into urban planning decisions.

Fourth, planners must adopt an integrated water-waste management approach that acknowledges the critical nexus between the two sectors. Water supply projects and conservation initiatives must be planned and evaluated with their impact on sanitation needs firmly in mind. Furthermore, fostering community participation and accountability is crucial for building sustainable systems. Establishing formal feedback mechanisms, such as dedicated hotlines or community committees, allows residents to report issues like missed collections or sewerage overflows, while participatory monitoring programs can enhance transparency, build public trust, and hold service providers accountable for their performance. Finally, to ensure future interventions are precisely targeted, subsequent research should integrate these perceptual findings with technical audits of the physical infrastructure to create a comprehensive baseline. Conducting detailed town-specific diagnostics will be essential for understanding the root causes of performance disparities and designing the highly targeted interventions needed to achieve equitable and sustainable urban waste management across the Southern Ethiopia Corridor.

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