

Research Article

Evaluating Water, Sanitation, and Hygiene (WaSH) Infrastructure and Behavioral Health Factors: A Community-Based Study in Mattu Town, Ethiopia in 2024

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Abstract

Inadequate Water, Sanitation, and Hygiene (WaSH) infrastructure remains a significant public health challenge in urbanizing Ethiopia, directly driving morbidity and mortality from enteric pathogens. This community-based cross-sectional study evaluated WaSH facility status, environmental sanitation practices, and health-related behaviors in Kolo Korma Kebele, Mattu Town, Southwest Ethiopia, to inform targeted municipal and public health interventions. A mixed-methods approach was conducted among 347 randomly selected households using structured questionnaires, focus group discussions, key informant interviews, and direct environmental observations. Quantitative analysis was performed using SPSS version 21.0, and qualitative data were integrated via thematic analysis. The results revealed that while household latrine coverage was high at 94.2% (primarily traditional pit latrines, 85.3%), functional hygiene components were critically lacking; only 38.0% of latrines were consistently clean, and handwashing stations with soap and water were severely scarce near toilet units. Water security emerged as a primary bottleneck: only 29.4% of households had access to piped municipal water, leaving the vast majority (70.6%) dependent on unprotected springs. Alarming, point-of-use water treatment was critically low, with 79.7% of households using non-piped water directly from the source without any treatment. Furthermore, solid waste management infrastructure was severely deficient; 79.5% of households lacked municipal collection services, compelling 52.1% to practice open-field dumping. Although health literacy was high—with 93.7% of respondents demonstrating a clear understanding of communicable disease transmission pathways—systemic economic constraints and inconsistent water supplies prevented this knowledge from translating into safe practices. This study concludes that high infrastructure coverage alone is insufficient without ensuring service quality, water safety, and waste infrastructure. It is recommended that the Mattu Town administration prioritize spring protection, decentralized waste collection, and that health initiatives transition toward fostering specific behavioral changes like household water chlorination and handwashing maintenance.

Keywords

WaSH, Mattu Town, Environmental Health, Urban Sanitation, Water Quality, Ethiopia, Public Health

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1. Introduction

The global public health landscape is inextricably linked to the quality and accessibility of Water, Sanitation, and Hygiene (WaSH) services. These three pillars represent the most fundamental requirements for human survival, dignity, and economic productivity. Trotz massive global milestones, billions of people worldwide remain underserved [1]. Inadequate WaSH services are not merely a matter of convenience; they are a primary driver of global morbidity and mortality, particularly in low- and middle-income countries where infrastructure development often lags behind rapid urbanization [2].

Globally, the scale of the sanitation crisis is staggering. It is estimated that approximately 2.5 billion people lack access to basic improved sanitation facilities, and over 748 million people do not have access to safe drinking water [3]. The consequences of these deficits are profound. Contaminated water and poor sanitation are linked to the transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid, and polio. Inadequate WaSH services in health facilities also contribute to the spread of healthcare-associated infections and increase the risk of antimicrobial resistance [4]. It is estimated that 58% of all diarrheal deaths in low- and middle-income countries—amounting to approximately 842,000 deaths annually—are caused by inadequate water, sanitation, and hygiene [5].

In the context of Sub-Saharan Africa, the challenges are even more acute. The region faces a dual burden: a lack of physical infrastructure and a high prevalence of infectious diseases that thrive in unsanitary environments. Rapid and often unplanned urbanization has led to the proliferation of informal settlements and densely populated urban kebeles (neighborhoods) where municipal services like piped water and waste management struggle to keep pace with demand [6]. In Ethiopia, while there has been commendable progress in reducing open defecation and increasing water coverage over the last two decades, significant disparities remain between urban and rural settings, and even within different sectors of the same city [7].

The Ethiopian government has prioritized WaSH through various strategic frameworks, including the Health Sector Development Program (HSDP) and the subsequent Health Sector Transformation Plans (HSTP). These policies emphasize the role of environmental health in preventive medicine [8]. However, national data often masks local realities. For instance, the 2014 Ethiopia Mini Demographic and Health Survey (EMDHS) revealed that only 4.5% of the population had access to improved, unshared toilet facilities, highlighting a massive gap in quality and privacy [9]. In urban centers like Mattu Town, the infrastructure designed decades ago is now being pushed to its limit by a growing population and evolving consumption patterns that generate more solid and liquid waste than the system can currently process [10].

The relationship between WaSH and health behavior is a critical focal point of this research. Providing hardware—such

as latrines or water points—is only half the battle; the "software" aspect, involving human behavior, hygiene practices, and community perception, determines the ultimate health outcomes [1]. Hand washing with soap, for example, is one of the most cost-effective public health interventions, capable of reducing diarrheal diseases by over 40%. Yet, the practice remains inconsistently applied due to factors ranging from water scarcity to a lack of ingrained habits [2]. Furthermore, the management of solid waste at the household level directly impacts the prevalence of vector-borne diseases. When municipal collection services are absent, residents often resort to open dumping or burning, which leads to soil contamination, clogged drainage systems, and respiratory issues [3].

Mattu Town, located in Southwest Ethiopia, serves as a vital economic and educational hub. However, its Kolo Korma Kebele presents a microcosm of the WaSH challenges found in many Ethiopian urban areas. The kebele is characterized by a mix of residential structures where access to the municipal water grid is inconsistent. Many residents rely on traditional springs, which, while appearing clean, are often vulnerable to contamination from runoff and poorly constructed latrines [1]. The geographical topography of Mattu, characterized by a high water table and frequent rainfall, further complicates the situation, as pit latrines can easily overflow or leach into the groundwater [4].

The persistence of communicable diseases in Kolo Korma Kebele is a clear indicator that the environmental health barriers are not yet sufficiently addressed. Previous reports have suggested that many households in this region suffer from recurring bouts of intestinal parasites and diarrheal illnesses, which are directly correlated with the quality of their physical environment [5]. Moreover, the lack of centralized waste management systems means that "environmental hygiene" is often left to the individual household, leading to fragmented and often ineffective practices that compromise the health of the entire community [3].

This study aims to fill a critical data gap. While general statistics for Mattu Town exist, there is a lack of granular, kebele-level data that integrates infrastructure status with behavioral assessments. Understanding why a household with a latrine might still practice poor hygiene, or why residents choose unprotected springs over treated sources, is essential for designing interventions that are culturally appropriate and logistically feasible [6]. By utilizing a mixed-methods approach—combining quantitative surveys with qualitative Focus Group Discussions—this research provides a comprehensive view of the WaSH landscape in Kolo Korma.

In conclusion, the urgency of addressing WaSH issues in Kolo Korma Kebele cannot be overstated. As the community grows, the environmental pressure will only increase. This research is not merely an academic exercise but a necessary diagnostic tool intended to inform the Mattu University Community-Based Education (CBE) program, local health offices,

and municipal planners. By identifying the specific bottlenecks in water supply, sanitation infrastructure, and hygiene behavior, we can move closer to a reality where every resident of Kolo Korma enjoys the health and dignity afforded by safe, sustainable WaSH services [1].

2. Materials and Methods

2.1. Study Area and Period

The study was conducted in Kolo Korma Kebele, located in Mattu Town, Ilu Ababora Zone, Oromia Regional State, Southwest Ethiopia. Mattu Town is situated approximately 600 kilometers from the capital city, Addis Ababa. Kolo Korma is one of the 12 administrative kebeles within the town. According to the 2021 kebele administrative records, the total population was 12,229, residing in approximately 2,046 households. The area is characterized by a tropical rainforest climate, receiving heavy rainfall for several months of the year, which significantly impacts its water table and sanitation drainage systems. The data collection phase was carried out from November 1st to November 30th, 2025, as part of the Developmental Team Training Program (DTTP) of Mattu University [1].

2.2. Study Design

A community-based cross-sectional study design was employed to assess the status of Water, Sanitation, and Hygiene (WaSH) and identify behavior-related health problems. To ensure a comprehensive understanding of the local context, a mixed-methods approach was utilized, integrating both quantitative and qualitative data collection techniques. This triangulation allowed for the validation of household survey findings through direct observation and the lived experiences shared by community members during discussions [7].

2.3. Population and Eligibility Criteria

Source Population: All households located within the administrative boundaries of Kolo Korma Kebele. **Study Population:** Randomly selected households included in the sample. **Inclusion Criteria:** Household heads or permanent residents aged 18 years and older who had lived in the kebele for at least six months were eligible for the interview. **Exclusion Criteria:** Individuals who were critically ill or unable to communicate at the time of the visit were excluded from the study.

2.4. Sample Size Determination

The sample size (n) was calculated using the single population proportion formula. Since there was no specific previous study on the exact prevalence of WaSH-related problems in this specific kebele, a p-value of 0.5 (50%) was used to yield the maximum possible sample size. The calculation used a 95%

confidence interval ($Z_{\alpha/2} = 1.96$) and a 5% margin of error ($d = 0.05$):

$$n = [(Z_{\alpha/2})^2 * p * (1 - p)] / d^2$$

$$n = [(1.96)^2 * 0.5 * (1 - 0.5)] / (0.05)^2 = 384$$

Since the total number of households in Kolo Korma Kebele ($N = 2,046$) was less than 10,000, a finite population correction formula was applied:

$$n' = [n * N] / [n + (N - 1)]$$

Where n' = Corrected sample size, n = Initial sample size (384), and N = Total population of households in Kolo Korma Kebele (2,046):

$$n' = [384 * 2046] / [384 + (2046 - 1)] = 323$$

Accounting for a 10% non-response rate, the final sample size was determined to be 355 households. (Note: The final analyzed data represented 347 completed household surveys).

2.5. Sampling Technique

A simple random sampling technique was employed. First, the kebele was divided into its existing administrative zones (Zone 1 [Kolo Korma gote], Zone 2 [Laga misomaa gote], and Zone 3 [Odda gote]). The total sample size was then proportionally allocated to each zone based on their respective number of households. A sampling frame was developed using the house numbering system provided by the kebele administration, and households were selected using a computer-generated random number table to ensure every household had an equal chance of being included [8].

2.6. Data Collection Instruments and Procedures

Quantitative Tool: A structured, pre-tested questionnaire was developed, initially in English and then translated into Afan Oromo and Amharic. The questionnaire covered socio-demographic characteristics, water source and handling, latrine ownership and utilization, and solid/liquid waste management practices. **Qualitative Tools:** Three Focus Group Discussions (FGDs) were conducted with 8–10 participants each, including community elders, women's group representatives, and youth. **Key Informant Interviews (KIIs)** were held with the Kebele Manager and Health Extension Workers. **Observational Checklist:** To verify reported data, an environmental observation checklist was used to assess the physical condition of latrines, the presence of hand washing facilities, and the cleanliness of the household compound. **Data Collectors:** The study was conducted by a multidisciplinary team of 13 Mattu University health science college students.

2.7. Data Quality Assurance

To maintain high data quality, the questionnaire was pre-tested on 5% of the sample in a neighboring kebele with similar socio-economic characteristics. Based on the pre-test, ambiguous questions were refined. Data collectors received two days of training on interview techniques and ethical protocols. On-site supervision was provided by team leaders, and all questionnaires were checked for completeness and consistency at the end of each day.

2.8. Data Processing and Analysis

Quantitative data were cleaned, coded, and entered into SPSS (Statistical Package for the Social Sciences) version 21.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to describe the findings. Qualitative data from FGDs and KIIs were transcribed, translated, and analyzed using thematic analysis. These findings were then integrated into the quantitative results to provide a holistic view of the WaSH situation.

2.9. Ethical Considerations

Ethical clearance was obtained from the Mattu University College of Health Sciences. Formal letters were submitted to the Mattu Town Health Office and the Kolo Korma Kebele Administration. Informed verbal and written consent was obtained from each respondent after explaining the purpose, risks, and benefits of the study. Participants were informed of their right to withdraw at any time, and confidentiality was maintained by using anonymized codes instead of names [1].

2.10. Operational Definitions

Improved Water Source: Defined as a water source that, by the nature of its construction or through active intervention, is protected from outside contamination, particularly from fecal matter. In this study, this includes piped water into a dwelling, plot, or yard; public taps or standpipes; protected dug wells; and protected springs [1]. Unimproved Water Source: Sources that do not protect the water from contamination. This includes unprotected dug wells, unprotected springs, cart-provided water, and tanker trucks [1]. Improved Sanitation Facilities: Facilities that hygienically separate human excreta from human contact. These

include flush or pour-flush toilets connected to a piped sewer system, septic tanks, or pit latrines; ventilated improved pit (VIP) latrines; and pit latrines with slabs [4, 9]. Unimproved Sanitation Facilities: Facilities that do not ensure the hygienic separation of human excreta from human contact. This includes pit latrines without slabs or open pits, bucket latrines, and hanging toilets or latrines [4, 9]. Latrine Coverage: The proportion of households that have access to a latrine facility (whether improved or unimproved) out of the total number of households surveyed [6]. Latrine Utilization: The consistent use of the available latrine facility by all members of the household, as verified by observational indicators such as a clear path to the latrine, lack of feces in the compound, and signs of recent use (e.g., damp floor or absence of spider webs over the pit) [1]. Safe Water: Water that is obtained from an improved source or water from an unimproved source that has been treated at the household level (e.g., boiling, chlorination, or filtration) to make it fit for consumption [3, 5]. Solid Waste: Any non-liquid, non-gaseous waste generated from household activities, including food waste, paper, plastic, and sweepings [3]. Solid Waste Management: The process of collecting, storing, and disposing of solid waste in a manner that does not pose a threat to human health or the environment [3]. Liquid Waste: Wastewater generated from household activities, including sullage (from kitchens and bathrooms) and sewage [3]. Knowledge of Communicable Diseases: Defined as the ability of the respondent to correctly identify at least one transmission route and one prevention method for common environmental diseases (e.g., diarrhea, typhoid, or malaria) [1]. Cleanliness of Latrine: A latrine is defined as "clean" if the floor is free from feces, urine, and mud, and the superstructure provides adequate privacy [1].

3. Results

3.1. Socio-Demographic Characteristics

A total of 347 households participated in the study, yielding a response rate of 97.7%. The mean age of the respondents was 35.35 years (SD ± 11.5). A majority of the respondents were female (64.6%) and married (68.9%). Regarding educational attainment, 31.7% had completed primary education, while 18.2% had no formal schooling. The occupational distribution showed that 30.8% were housewives and 23.3% were self-employed. Ethnically, the population was diverse, with Oromo (51.0%) and Amhara (16.1%) being the most prominent groups.

Table 1. Socio-demographic characteristics of respondents in Kolo Korma Kebele, 2024 (n=347).

Variable	Category	Frequency	Percentage
Sex	Male	123	35.4
	Female	224	64.6
Marital Status	Married	239	68.9

Variable	Category	Frequency	Percentage
Education	Single	66	19.0
	Others (Divorced/Widowed)	42	12.1
	No formal education	63	18.2
	Primary (1–8)	110	31.7
	Secondary (9–12)	98	28.2
	Higher Education	76	21.9
Religion	Muslim	165	47.6
	Orthodox	134	38.6
	Protestant	48	13.8

3.2. Water Source and Quality

Access to safe water remained a significant challenge. While 88.1% of households utilized sources they perceived as protected, only 29.4% had access to piped municipal water. The vast majority (70.6%) relied on unprotected springs for their daily needs. Furthermore, the practice of household water treatment was critically low; 79.7% of respondents reported using water directly from the source without any treatment such as boiling or chlorination.

3.3. Sanitation and Hygiene Practices

Latrine ownership was high at 94.2%, with traditional pit latrines being the most common type (85.3%). However, functionality and hygiene were identified as gaps. Observations revealed that only 38% of latrines were consistently clean, and a significant portion lacked hand washing facilities (soap and water) in close proximity to the toilet unit.

Table 2. Sanitation and Waste Management Practices among Households (n=347).

Variable	Category	Frequency	Percentage (%)
Latrine Availability	Yes	327	94.2
	No	20	5.8
Type of Latrine	Traditional Pit	279	85.3
	Flush/Pour Flush	48	14.7
Solid Waste Disposal	Open dumping	181	52.1
	Burning	111	32.0
	Pit/Burying	55	15.9
Waste Container Access	No storage container	242	69.7
	Has storage container	105	30.3

3.4. Environmental Sanitation and Health Knowledge

Solid waste management was poorly structured. Approxi-

mately 79.5% of households reported that there was no municipal waste collection service in their area. Consequently, 52.1% practiced open dumping. Regarding health literacy, 93.7% of respondents were aware of communicable diseases, correctly identifying contaminated water and poor hand hygiene as primary transmission routes. However, the qualitative

data from FGDs highlighted that economic constraints and inconsistent water supply were the primary barriers to translating this knowledge into practice.

4. Discussion

The findings of this study highlight a significant disparity between the availability of WaSH infrastructure and the quality of services in Kolo Korma Kebele. Although latrine coverage was high at 94.2%, exceeding the national urban average of 82.5% reported in previous health surveys [6, 9], the functional reality is concerning. Most facilities were traditional pit latrines that lacked essential hygiene components, such as hand washing stations and proper slabs. This "coverage-utility gap" suggests that while the community has embraced the physical structure of a latrine, the behavioral integration of hygiene—specifically hand washing with soap—remains secondary [1].

Water security is the most critical bottleneck identified. The reliance of 70.6% of the population on unprotected springs for domestic use poses a severe public health risk. This figure is significantly higher than findings in other urban parts of Ethiopia, where piped water coverage is typically more robust [7, 10]. The lack of household water treatment (79.7%) further compounds this risk. As noted in existing literature, the use of untreated water from open sources is a primary driver of enteric pathogens and trachoma in Ilu Ababora Zone [5]. The qualitative data from FGDs confirmed that residents perceive spring water as "natural" and therefore safe, indicating a clear need for targeted health education regarding groundwater contamination.

Environmental sanitation practices were found to be inadequate due to systemic failures. The absence of municipal waste collection for 79.5% of households has forced a reliance on open dumping (52.1%) and burning. Such practices not only create breeding grounds for vectors but also contribute to the "urban health penalty," where high population density combined with poor waste management accelerates disease transmission [3, 6]. These results emphasize that individual household efforts are insufficient without the supporting municipal infrastructure required to maintain a clean urban environment [1].

5. Conclusion and Recommendations

5.1. Conclusion

Kolo Korma Kebele faces a paradoxical WaSH situation: high latrine ownership but poor sanitary quality and acute water insecurity. The heavy reliance on unprotected springs and the total absence of a structured solid waste management system represent major environmental health hazards. While community knowledge of disease transmission is high, the

lack of infrastructure and point-of-use water treatment prevents the translation of this knowledge into health-protective behaviors.

5.2. Recommendations

- 1) Infrastructure Expansion: The Mattu Town Water and Sewerage Authority must prioritize extending piped water connections or protecting existing springs to prevent contamination.
- 2) Waste Management: The municipality should establish communal waste collection points (skip bins) and implement a regular collection schedule to discourage open dumping.
- 3) Hygiene Promotion: Health Extension Workers should shift focus from "latrine construction" to "sanitation quality," emphasizing the installation of hand washing stations (Tippy Taps) and the necessity of boiling or treating water.
- 4) Policy Integration: Local authorities should integrate waste management into kebele level urban planning to ensure sustainable environmental hygiene.

Abbreviations

AA	Addis Ababa
CBE	Community-Based Education
CSA	Central Statistical Agency
DTTP	Developmental Team Training Program
EDHS	Ethiopia Demographic and Health Survey
EMDHS	Ethiopia Mini Demographic and Health Survey
ENDA	Environmental Development Agency
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
HSDP	Health Sector Development Program
HSTP	Health Sector Transformation Plan
KII	Key Informant Interview
MDG	Millennium Development Goal
MOH	Ministry of Health
MTU	Mattu University
NGO	Non-Governmental Organization
ODK	Open Data Kit
SDG	Sustainable Development Goal
SPSS	Statistical Package for the Social Sciences
VIP	Ventilated Improved Pit (Latrine)
WaSH	Water, Sanitation, and Hygiene
WHO	World Health Organization

Author Contributions

Dagim Dagne: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing – original draft, Writing – review & editing

Data Availability Statement

Data are available upon reasonable request from the corresponding author.

Conflicts of Interest

The author declares no competing interests.

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