

Rural-Urban Disparities in Water, Sanitation, and Hygiene (WASH) Infrastructure in Primary and Secondary Schools: A Case of Iringa Region, Tanzania

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Background and study aim: Water, Sanitation, and Hygiene (WASH) infrastructure in schools is vital for students' health and educational outcomes. Access to safe WASH services is a fundamental human right emphasized by Sustainable Development Goal 6, which seeks universal access by 2030. This study assessed disparities in WASH infrastructure between rural and urban schools in the Iringa Region to improve conditions and support students' health and well-being.

Patients and Methods: This study was conducted in the Iringa, Kilolo, and Mufindi districts of Tanzania from July 4 to July 25, 2024. A total of 64 primary and secondary schools were selected through both purposive and random sampling techniques. The analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 26, which facilitated descriptive and comparative analyses to summarize and interpret the findings.

Results: This study revealed adequate availability of functional toilets (96.9%) and gender-separated toilets (95.3%). However, water filters or purification systems are only present in 23.4% of schools, and hand sanitizers are available in just 37.5%, showing gaps in hygiene resources. Overall, 64% of schools met adequate criteria, while a good number (87.5%) of urban schools had adequate infrastructure compared to rural schools (40.6%). A significant association was reported between school location and WASH adequacy ($p < 0.05$).

Conclusion: This study revealed significant disparities in WASH infrastructure between rural and urban schools in the Iringa Region. Schools from rural areas face more significant challenges. Tanzania should prioritize initiatives to improve WASH infrastructure in rural schools.

INTRODUCTION

Water, Sanitation, and Hygiene (WASH) infrastructure in primary and secondary schools is critical for promoting health and educational outcomes among students [1]. Access to safe water, sanitation, and hygiene services is a fundamental human right for school children [2-5]. The Sustainable Development Goal 6 (SDG 6) calls for universal access to safe water, sanitation, and hygiene services for all by 2030 [2]. The provision of essential Water, Sanitation, and Hygiene (WASH) services in schools is crucial for creating a safe, healthy, and clean learning environment. Furthermore, these services promote the development of positive hygiene practices that students can uphold throughout their lifetime [2-5].

According to the World Health Organization (WHO) and the United Nations International Children's Emergency Fund (UNICEF) 2020, approximately 50% of schools in low-income countries lack basic water services, and 50% also lack adequate sanitation facilities [6,7]. These deficiencies are particularly pronounced in rural areas, where infrastructure is often underdeveloped [7]. The lack of adequate WASH facilities can lead to increased absenteeism, the spreading of infectious diseases, and hindered academic performance [8,9]. The progress report on WASH services in schools by the WHO/UNICEF joint monitoring program (JMP) in 2022 revealed that numerous schools

globally, including those in low-income countries such as Tanzania, lack access to basic WASH facilities. The JMP report reported that only 71% of schools have access to basic drinking water services, 72% have access to basic sanitation facilities, and 58% have access to basic hygiene services [5].

The WASH study, conducted in rural educational institutions across six Sub-Saharan African countries, revealed that the availability of improved water sources on-site, enhanced sanitation facilities, and access to water and soap for handwashing varied significantly, ranging from 1% in Ethiopia and Mozambique to 23% in Rwanda. Additionally, fewer than 23% of rural schools fulfilled the World Health Organization's recommended student-to-latrines ratios for both boys and girls [10].

In Tanzania, access to safe water and sanitation facilities in schools remains a challenge. The importance of WASH infrastructure in schools cannot be overstated, as it directly influences student attendance, health, and overall learning experiences. A study by Jacob and Kazaura highlights that while there have been improvements in access to safe drinking water and sanitation, significant disparities exist between urban and rural areas, particularly affecting schools in low socio-economic regions [11]. This is corroborated by findings from the National Sanitation Campaign, which reported that only 50% of schools met the guidelines for sanitation facilities, with many lacking reliable water supplies and functional handwashing stations [12]. Such deficiencies not only hinder the ability of students to maintain proper hygiene but also contribute to the spread of waterborne diseases, which are particularly detrimental to children's health [13].

Moreover, the impact of WASH on educational outcomes is profound. Research indicates that schools with inadequate sanitation facilities often see higher rates of absenteeism, particularly among girls who may lack access to menstrual hygiene management resources [14]. A study conducted in various Tanzanian schools found that cultural programs promoting hygiene and sanitation were effective in raising awareness, yet only a fraction of schools implemented these initiatives consistently [15]. The lack of proper facilities can lead to increased health risks, with studies showing that poor hygiene practices are associated with higher incidences of diarrhea and

other illnesses among school children [16].

Additionally, the role of hygiene education in schools is crucial. Educational interventions that incorporate hygiene practices can significantly improve health outcomes. For instance, the Participatory Hygiene and Sanitation Transformation (PHAST) model has been successfully implemented in Tanzanian schools to engage students in learning about hygiene and sanitation [14]. Such programs educate students about the importance of WASH and empower them to take action within their communities, fostering a culture of hygiene that extends beyond the school environment [14].

However, the success of such interventions often depends on community engagement and the availability of resources, which can be limited in rural settings [17]. A comprehensive approach that includes community involvement, adequate funding, and training for school staff is essential for the sustainability of WASH programs in Tanzanian schools [12].

In light of the limited and unequal distribution of resources to enhance Water, Sanitation, and Hygiene (WASH) reported in various studies, this research aimed to investigate the disparities in WASH infrastructure between rural and urban primary and secondary schools in the Iringa Region of Tanzania. The findings of this study, along with the conclusions drawn and recommended actions, will contribute to improving WASH conditions in Tanzanian schools, ultimately benefiting students' health and well-being.

METHODS

Area of study

This study was conducted in the Iringa, Kilolo, and Mufindi districts located within the Iringa region. The Iringa Region is situated in the Southern Highlands zone of mainland Tanzania, positioned below the Equator. It is delineated by latitudes 6° 55' and 9° 00' south, as well as longitudes 33° 45' and 36° 55' east of Greenwich. To the north, Iringa shares its borders with the Singida and Dodoma regions. The Morogoro region lies to the east, while the Mbeya region is to the west. Additionally, the Njombe region is situated to the south of Iringa [18]. Three districts were selected in this study due to their different economic, geographical, and population sizes. Iringa municipality from the Iringa district was selected to represent

schools from urban areas as it is predominantly urban. Kilolo and Mufindi districts were selected to present schools from rural areas as they are predominantly rural. Iringa district has 151 primary and 42 secondary schools, of which 50 primary and 30 secondary schools are from Iringa municipality, Kilolo district has 133 primary and 44 secondary schools, and Mufindi district has 162 primary and 48 secondary schools [19-22].

Study design

This study used a quantitative cross-sectional descriptive design to assess water, sanitation, and hygiene infrastructure in primary and secondary schools in all three districts. It was conducted from July 4 to July 25, 2024, and provided an overview of the state of infrastructure during data collection.

Study population

This study involved schools from rural and urban areas of the Iringa region, including public and private schools, day, boarding, mixed schools, and primary and secondary schools. In secondary schools, the study included both ordinary and high-level schools.

Sampling and sample size

An equal number of rural and urban schools were selected based on a proportionate distribution of private and public schools, primary and secondary schools, and boarding and day schools. Thus, rural and urban school strata were separated. Then, 32 schools were selected from rural schools in Kilolo and Mufindi districts, 16 schools from each, and 32 schools from Iringa Municipality, representing schools from urban areas, making a total of 64 schools. Further strata were formed based on private and public schools, primary and secondary schools, and day, boarding, and mixed schools. A simple random selection technique was used to select schools from each stratum.

Data collection

Data were collected using a structured checklist designed to assess WASH infrastructure in primary and secondary schools, based on WHO and UNICEF guidelines. The list included two main parts: water facilities, which assessed the availability and reliability of clean drinking water, and sanitation and hygiene facilities, which assessed the availability, functionality,

and condition of toilets, hand washing facilities, and menstrual hygiene management facilities.

Statistics

Data analysis was done using Statistical Package for Social Science (SPSS) version 26, where descriptive and comparative analysis summarized and interpreted the results. Frequencies and percentages regarding the availability and status of WASH facilities were summarized using descriptive statistics. Mean and standard deviation values were calculated for continuous variables, such as number of toilets. Based on a scoring system, schools were classified as having adequate or inadequate WASH infrastructures. Schools that achieved 60% or more of the WASH indicators were classified as adequate, while those that achieved less than 60% were classified as inadequate. Rural-urban WASH facilities in schools were compared using cross-tabulations. Also, Chi-square tests were used to assess the relationship between rural and urban schools' adequacy of WASH facilities.

RESULTS

Demographic characteristics of schools

This study included 64 schools, evenly divided between rural and urban locations, with 32 schools (50%) from each area. Regarding educational level, primary schools comprised the majority, with 32 (50%) schools. Ordinary-level secondary schools accounted for 24 (37.5%), while high-level secondary schools comprised the smallest group, contributing only 8 (12.5%).

Public schools predominated, with 42 (65.6%) schools, compared to 22 (34.4%) private schools. The Iringa district had the highest representation, contributing 32 (50%) schools, while Kilolo and Mufindi each contributed 16 schools (25%). Additionally, there were more day schools, with 40 (62.5%) schools, whereas boarding schools were fewer, numbering only 6 (9.4%), as described in Table 1.

Availability and status of WASH facilities in schools

The highest availability of WASH indicators are functional toilets for students at 62 (96.9%) and separate toilets for boys and girls at 61 (95.3%). Additionally, 58 (90.6%) schools have educational programs for students on the importance of water conservation, and the same

number, 58 (90.6%), provide education on hygiene and sanitation practices.

On the other hand, the indicators with the lowest availability are water filters or purification systems, which were only found in 15 (23.4%) schools. The sufficient number of toilets to accommodate female students, as recommended by WHO (20 girls per toilet), is met in only 16 schools (25%). Furthermore, only 20 schools (31.3%) conduct regular water quality testing, and hand sanitizers are available in addition to handwashing stations in 24 (37.5%) schools, as detailed in Table 2.

Rural-urban comparison of availability and status of WASH facilities in schools

Significant differences were observed between rural and urban schools regarding the availability and maintenance of WASH infrastructure based on 23 indicators. Many (21) indicators showed higher availability in urban schools, while only 2 indicators were higher in rural schools. The only indicators observed as slightly more adequate in rural than urban schools include the sufficient number of toilets for female students, following WHO recommendations of 20 girls per toilet, which had 9 (28.1%) in rural schools compared to 7 (21.9%) in urban schools. Additionally, a designated staff member responsible for sanitation management was reported in 28 (87.5%) rural and 27 (84.4%) urban schools. Four WASH indicators exhibited substantial differences, exceeding 40% between rural and urban schools. Urban schools reported significantly better results in the following indicators: availability of designated drinking water stations for students (11 or 34.4% in rural vs. 26 or 81.3% in urban), sufficient water supply to meet the needs of all students and staff (17 or 53.1% in rural vs. 30 or 93.8% in urban), reliable sources of clean drinking water (18 or 56.3% in rural vs. 31 or 96.9% in urban), and regular maintenance of drinking water facilities (14 or 43.8% in rural vs. 27 or 84.4% in urban), as detailed in Table 3.

56.3% in rural vs. 31 or 96.9% in urban), and regular maintenance of drinking water facilities (14 or 43.8% in rural vs. 27 or 84.4% in urban), as detailed in Table 3.

The findings in Table 4 further highlight disparities in toilet status between rural and urban schools. The average number of female students per toilet was 34.4 ± 21.1 in rural schools and 35.3 ± 18.3 in urban schools. Additionally, the average number of male students per toilet was 60.5 ± 106.2 in rural schools compared to 34.2 ± 21.6 in urban schools.

The results described in Figure 1 show descriptive statistics of the adequacy scores for WASH elements in rural and urban schools. Rural schools had a maximum score of 91.3% and a mean of 54.6%, which is inadequate compared to urban schools, which had a maximum score of 100% and a mean of 74.5%.

Also, this study revealed that 64% of all assessed schools had adequate WASH infrastructure, while 36% had inadequate infrastructure. In comparison, only 40.6% of rural schools had adequate infrastructure compared to 87.5% of urban schools, as described in Figure 2.

Bivariate analysis of factors associated with adequacy status in schools

This study analyzed a significant association between demographic variables and school adequacy using bivariate analysis. Among the independent variables examined, only two (school location and school district) displayed a significant association with adequacy, all with a P-value ($P < 0.05$). In contrast, the rest of the independent variables showed no significant association, all with a P-value ($P > 0.05$), as illustrated in Table 5.

Variables	Frequency	Percent
Level of study		
Primary School (Standard 1-7)		50
Secondary school (Form 1-4)	24	37.5
High School (Form 5-6)	8	12.5
School Location		
Urban	32	50
Rural	32	50
Type of school		
Public	42	65.6

Private	22	34.4
School district		
Iringa	32	50
Kilolo	16	25
Mufindi	16	25
Living situation		
Boarding student	6	9.4
Day student	40	62.5
Mixed	18	28.1

Table (2). Availability and status of WASH facilities in schools (N = 64)

Questions on school WASH infrastructure	RESPONSE	
	YES n (%)	NO n (%)
Water infrastructure in schools		
Does the school have a reliable source of clean drinking water?	49 (76.6)	15 (23.4)
Are water storage facilities (like tanks or reservoirs) present in the school?	52 (81.3)	12 (18.8)
Is the water supply in the school sufficient to meet the needs of all students and staff?	47 (73.4)	17 (26.6)
Are the drinking water facilities regularly maintained and cleaned?	41 (64.1)	23 (35.9)
Does the school have water filters or purification systems in place?	15 (23.4)	49 (76.6)
Are there designated drinking water stations available for students?	37 (57.8)	27 (42.2)
Does the school conduct regular water quality testing?	20 (31.3)	44 (68.8)
Are there measures in place to ensure water conservation in the school?	40 (62.5)	24 (37.5)
Is there an established procedure for reporting and fixing water facility issues?	32 (50)	32 (50)
Are students educated on the importance of water conservation?	58 (90.6)	6 (9.4)
Sanitation and hygiene infrastructure in schools		
Does the school have functional toilets available for students?	62 (96.9)	2 (3.1)
Are there separate toilets for boys and girls in the school?	61 (95.3)	3 (4.7)
Does the school have handwashing stations with soap and water available?	33 (51.6)	31 (48.4)
Are the sanitation facilities regularly cleaned and maintained?	42 (65.6)	22 (34.4)
Is there adequate privacy in the toilets for students?	51 (79.7)	13 (20.3)
Are there toilets accessible for students with disabilities?	34 (53.1)	30 (46.9)
Does the school have a sufficient number of toilets to accommodate male students as recommended by WHO (25 boys per toilet)?	26 (43.3)	34 (56.7)
Does the school have a sufficient number of toilets to accommodate female students as recommended by WHO (20 girls per toilet)?	16 (25)	48 (75)
Are there hand sanitizers available in addition to handwashing stations?	24 (37.5)	40 (62.5)
Are there trash bins available in or near the sanitation facilities?	44 (68.8)	20 (31.3)
Does the school provide menstrual hygiene management facilities for female students?	53 (82.8)	11 (17.2)
Do students receive education on hygiene and sanitation practices?	58 (90.6)	6 (9.4)
Is there a designated staff member responsible for sanitation management?	55 (85.9)	9 (14.1)

Table (3). Rural-urban comparison of availability and status of WASH facilities in schools (N = 64)

Questions on school WASH infrastructure	RURAL (n = 32)		URBAN (n = 32)	
	YES n (%)	NO n (%)	YES n (%)	NO n (%)
Water infrastructure in schools				
Does the school have a reliable source of clean drinking water?	18 (56.3)	14 (43.8)	31 (96.9)	1 (3.1)
Are water storage facilities (like tanks or reservoirs) present in the school?	25 (78.1)	7 (21.9)	27 (84.4)	5 (15.6)
Is the water supply in the school sufficient to meet the needs of all students and staff?	17 (53.1)	15 (46.9)	30 (93.8)	2 (6.3)
Are the drinking water facilities regularly maintained and cleaned?	14 (43.8)	18 (56.3)	27 (84.4)	5 (15.6)
Does the school have water filters or purification systems in place?	7 (21.9)	25 (78.1)	8 (25.0)	24 (75)
Are there designated drinking water stations available for students?	11 (34.4)	21 (65.6)	26 (81.3)	6 (18.8)
Does the school conduct regular water quality testing?	6 (18.8)	26 (81.3)	14 (43.8)	18 (56.3)
Are there measures in place to ensure water conservation in the school?	14 (43.8)	18 (56.3)	26 (81.3)	6 (18.8)
Is there an established procedure for reporting and fixing water facility issues?	10 (31.3)	22 (68.8)	22 (68.8)	10 (31.3)
Are students educated on the importance of water conservation?	27 (84.4)	5 (15.6)	31 (96.9)	1 (3.1)
Sanitation and hygiene infrastructure in schools				
Does the school have functional toilets available for students?	30 (93.8)	2 (6.3)	32 (100.0)	0 (0.0)
Are there separate toilets for boys and girls in the school?	30 (93.8)	2 (6.3)	31 (96.9)	1 (3.1)
Does the school have handwashing stations with soap and water available?	11 (34.4)	21 (65.6)	22 (68.8)	10 (31.3)
Are the sanitation facilities regularly cleaned and maintained?	16 (50.0)	16 (50.0)	26 (81.3)	6 (18.8)
Is there adequate privacy in the toilets for students?	23 (71.9)	9 (28.1)	28 (87.5)	4 (12.5)
Are there toilets accessible for students with disabilities?	16 (50.0)	16 (50.0)	18 (56.3)	14 (43.8)
Does the school have a sufficient number of toilets for male students as recommended by WHO (25 boys per toilet)?	12 (38.7)	19 (61.3)	14 (48.3)	15 (51.7)
Does the school have a sufficient number of toilets for female students as recommended by WHO (20 girls per toilet)?	9 (28.1)	23 (71.9)	7 (21.9)	25 (78.1)
Are there hand sanitizers available in addition to handwashing stations?	10 (31.3)	22 (68.8)	14 (43.8)	18 (56.3)
Are there trash bins available in or near the sanitation facilities?	17 (53.1)	15 (46.9)	27 (84.4)	5 (15.6)
Does the school provide menstrual hygiene management facilities for female students?	23 (71.9)	9 (28.1)	30 (93.8)	2 (6.3)
Do students receive education on hygiene and sanitation practices?	28 (87.5)	4 (12.5)	30 (93.8)	2 (6.3)
Is there a designated staff member responsible for sanitation management?	28 (87.5)	4 (12.5)	27 (84.4)	5 (15.6)

Table (4). Rural-urban comparison of toilet status in schools

Descriptive Statistics	RURAL		URBAN	
	Min - Max	Mean ± Std	Min - Max	Mean ± Std
Total number of male students per school	79 - 620	286.8 ± 148.5	49 - 529	292.2 ± 130.3
Total number of male toilets per school	1 - 27	8.1 ± 4.6	3 - 24	9.9 ± 4.8
Average number of male students per toilet	9 - 557	60.5 ± 106.2	6 - 79	34.2 ± 21.6
Total number of female students per school	99 - 622	294.8 ± 152.1	53 - 900	339.8 ± 191.2
Total number of female toilets per school	2 - 33	9.8 ± 5.7	3 - 28	10.2 ± 5.0
Average number of female students per toilet	11 - 116	34.4 ± 21.1	5 - 74	35.3 ± 18.3

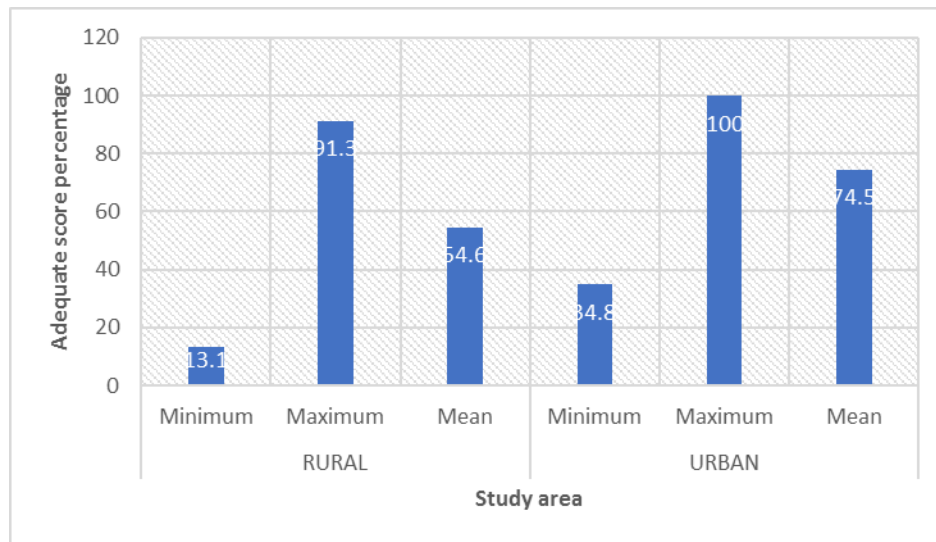


Figure (1). Descriptive statistics of adequacy score of WASH elements in rural-urban schools

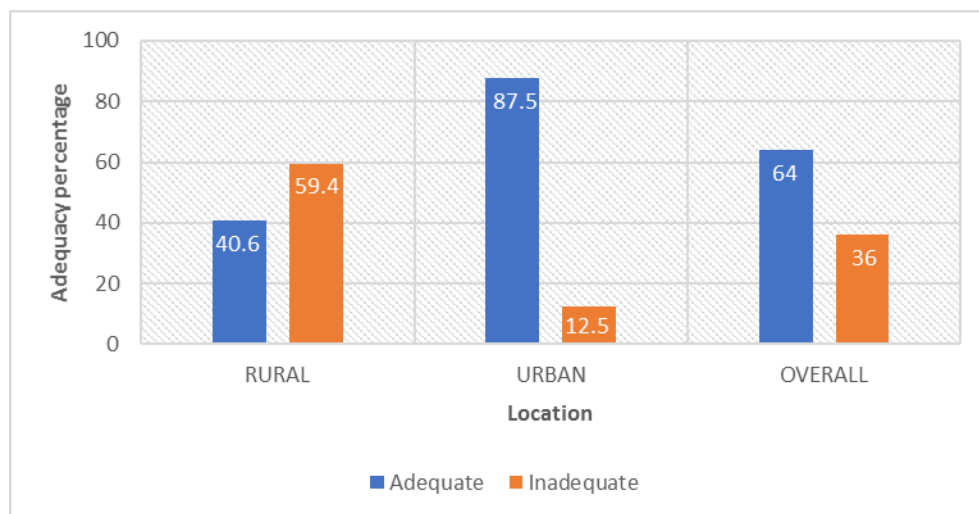


Figure (2). Rural-urban comparison of overall adequacy status of WASH elements in schools

Table (5). Bivariate analysis of factors associated with adequacy status in schools (N = 64)

Variables	Infrastructure status		Chi-square	P-value
	Adequate	Inadequate		
	n (%)	n (%)		
Level of study				
Primary School (Standard 1-7)	19 (29.7)	13 (20.3)		
Secondary school (Form 1-4)	16 (25.0)	8 (12.5)	0.792	0.673
High School (Form 5-6)	6 (9.4)	2 (3.1)		
School Location				
Urban	28 (43.8)	4 (6.3)	15.27	< 0.001*
Rural	13 (20.3)	19 (29.7)		

Type of school				
Public	24 (37.5)	18 (28.1)	2.541	0.111
Private	17 (26.6)	5 (7.8)		
School district				
Iringa	28 (43.8)	4 (6.3)		
Kilolo	4 (6.3)	12 (18.8)	18.664	< 0.001*
Mufindi	9 (14.1)	7 (10.9)		
Living situation				
Boarding student	6 (9.4)	0 (0.0)		
Day student	26 (40.6)	14 (21.9)	4.927	0.085
Mixed	9 (14.1)	9 (14.1)		

* P<0.05 is statistically significant

DISCUSSION

The high availability of functional toilets (96.9%) and gender-separated toilets (95.3%) in schools suggests a commendable commitment to WASH infrastructure. This study is consistent with research from rural schools in Serbia indicated that over 90% of school toilets met basic service criteria, including functionality and accessibility and 80% of schools have single-sex toilets located in separate toilet rooms [9]. Conversely, this study contrasts with a study conducted in Lagos, Nigeria, which found that only 40% of public schools surveyed had single-sex toilets, while another assessment in Jos North Local Government Area revealed that 45.3% of toilet facilities were not segregated by sex [23].

The limited availability of water filters or purification systems, found in only 23.4% of the schools, which is similar to other studies conducted in Tanzania, found that many schools lacked adequate point-of-use (POU) water filtration systems, which are essential for providing clean drinking water to students [24, 25]. The limited availability of hand sanitizers in schools (37.5%) also highlights a gap in accessible hygiene resources. This study aligns with another study in Uganda, which indicated that many private and public schools did not provide soap and water for handwashing near toilets, which correlates with poor hand hygiene practices among students [26]. However, this finding contrasts with the study from Nigeria during the COVID-19 pandemic, which found that many schools had made significant improvements in providing hand sanitizers and promoting their use as part of broader hygiene education initiatives [27]. This reflects a growing recognition of the importance of hand hygiene in

preventing the spread of diseases, particularly in the wake of the COVID-19 pandemic.

Significant rural-urban disparities in WASH infrastructure emerged, with urban schools scoring much higher adequate mean (74.5%) than rural schools (54.6%). This study is consistent with the study from Guatemala and the Democratic Republic of Congo, which found that while urban schools had better access to water and sanitation services, rural schools struggled with inadequate infrastructure, which adversely affected students' health and educational outcomes [1, 28]. A notable example is the ratio of male students per toilet, averaging 60.5 in rural schools compared to 34.2 in urban schools. However, a study by T'Seole et al, highlighted the benefits of increased investment in WASH infrastructure in South Africa, noting that rural schools have seen improvements in access to sanitation and hygiene facilities due to these investments [29].

The study found that 64% of schools met the adequacy criteria for WASH infrastructure, with urban schools exhibiting significantly higher adequacy (87.5%) than rural schools (40.6%). This finding aligns with Tanzanian studies, which found inequities in the availability of improved sanitation facilities and hygiene services between urban and rural schools in Tanzania. The study noted that while urban areas have made significant strides in improving WASH infrastructure, rural areas continue to struggle with inadequate facilities, which can adversely affect students' health and educational outcomes [11, 30]. On the other hand, this study contrasts with reports from Cambodia, where nationwide efforts to standardize WASH infrastructure in rural and urban schools had

reduced rural-urban disparity levels. Overall improvements in investments in rural WASH programs showed an impact on health and educational outcomes in both urban and rural settings [31].

The study revealed a significant association between school location and WASH adequacy with $p < 0.05$, which aligns with other studies that identify geographic location as a determinant of WASH quality in schools. This study is consistent with many studies in Africa and outside Africa, which reported significant associations in WASH access between urban and rural facilities, with a $p < 0.05$, demonstrating that urban schools had better access to WASH services than rural schools [32-35].

The disparities identified in this study, in conjunction with findings from related research, underscore the imperative for immediate investment in Water, Sanitation, and Hygiene (WASH) programs, particularly in rural regions of Tanzania and other developing nations characterized by resource constraints. The significant impact of these disparities highlights the critical need for sustained efforts to address the deficiencies in WASH infrastructure and services, which are foundational to public health and community well-being.

To address the significant disparities in water, sanitation, and hygiene (WASH) infrastructure between rural and urban areas, Tanzania must prioritize initiatives to enhance these essential services in rural regions. Inadequate WASH infrastructure in rural schools often leads to higher illness rates, negatively impacting attendance and academic performance. By investing in developing and maintaining robust WASH systems, Tanzania can create a healthier environment that supports education and encourages students to thrive, ultimately closing the rural-urban gap and fostering a brighter future for the nation's youth.

CONCLUSION

This study contributes valuable insights into WASH infrastructure in schools in the Iringa Region, highlighting critical disparities between rural and urban settings where rural areas faced more significant challenges in WASH infrastructure than urban counterparts. A significant association reported between rural and urban schools (P -value < 0.05) identified a

clear relationship between location and adequate WASH facilities.

Ethical approval:

Ruaha Catholic University (RUCU) granted ethical clearance for this study under reference number RU/PC/PC/2024/14. Permission to conduct the research was obtained from the office of the regional education officer, the relevant district education officer, and the heads of schools and administrators. All collected data were handled with strict confidentiality, ensuring that no information was disclosed.

Conflict of Interest Statement: There are no conflicts of interest in this study.

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HIGHLIGHTS

- Water, Sanitation, and Hygiene (WASH) infrastructure in primary and secondary schools is essential for establishing a safe, healthy, and clean learning environment and fostering good hygiene behavior that students can maintain throughout their lives .
- This study revealed that 64% of schools met adequate criteria, while a good number (87.5%) of urban schools had adequate infrastructure than rural schools (40.6%). A significant association was reported between rural and urban schools (P -value < 0.05).
- To address the significant disparities in water, sanitation, and hygiene (WASH) infrastructure between rural and urban areas, Tanzania must prioritize initiatives to enhance these essential services in rural regions.

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