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So long a toilet! Deviations from a conventional design, level of latrine construction and use by rural households in Nyanga district, Zimbabwe

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Abstract

Background Building toilets and getting people to use them is critical for public health. When prescribed with a sanitation option, households may go with it, choose alternatives, construct its non-conventional designs or practise open defaecation. Non-conventional designs may compromise operational efficiency and safety. This study assessed the construction and use of the Blair ventilated improved pit (BVIP) latrine, a sanitation option of choice for rural Zimbabwe, southern Africa.

Methods A semi-structured questionnaire was administered to 191 rural households who own BVIP latrines or their upgradable designs in a cross-sectional study in 2022. Latrine characteristics were physically observed using a checklist. Households were selected from nine villages of Nyanga district, Zimbabwe. The association between socioeconomic demography and level of latrine construction were evaluated using Chi square test. Cross tabulations were used to show the level of latrine construction and design. Binary logistic regression was used to determine significant predictors of latrine construction. Statistical relationships were considered significant if $p \leq 0.05$.

Key findings Households self-reported adopting the BVIP latrine mainly due to government encouragement (42.07%) and for social reasons (34.49%) than for perceived health and hygiene benefits (4.71%). Some built latrines had wall openings, lacked roofs, vent pipes with fly screens and handwashing facilities. Latrine construction was significantly associated with household size, monthly income, number of cattle owned, latrine financier and the presence of a resident formally employed household member ($p < 0.001$). Some household members did not use latrines (40.84%) citing main reasons as unhygienic environment (39.75%), inconveniences (26.92%) and foul smell (17.95%). Increasing household size, income and the number of cattle, the presence of a resident formally employed household member and NGO financing latrine construction were more likely to complete ($p < 0.05$).

Conclusions Ongoing sanitation developments (outside specific interventions) need close monitoring for latrine construction and dissemination of sanitation behaviour change messages at a local scale. The mantra, *so long a toilet*, does not work when a conventional latrine design is prescribed.

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Keywords BVIP latrine design, Conventional design, Rural sanitation, Sanitation option, Zimbabwe

Introduction

Universal access to adequate sanitation is a fundamental need and human right [1], an important barrier to disease transmission [2] and critical to socioeconomic development [3]. However, in 2022, 3.5 billion people globally still lacked safely managed sanitation, including 419 million who practised open defecation [4]. The situation remains profound in low and middle-income countries [5]. Therefore, governments have been urged to formulate policies that tackle sanitation at a more local scale [6]. Rural communities in sub-Saharan Africa have always lagged behind in accessing adequate sanitation services [7]. Zimbabwe has been using a home-grown technology innovation, the Blair ventilated improved pit latrine (BVIP) latrine [8] since the 1980s as a sanitation option of choice for rural communities, and later, its upgradable designs [9]. This is the standard ventilated improved pit latrine named after Dr Blair who is behind its innovation in Zimbabwe (Supplementary File 1, picture b). The joint monitoring programme service ladder for sanitation defined *safely managed sanitation* service level, a global indicator on sanitation for sustainable development goal target 6.2, as the use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or removed and treated off-site [4]. The BVIP latrine is an improved sanitation facility. Despite four decades of its massive promotion, access to safely managed sanitation by rural communities in Zimbabwe remained low at 30% in 2022 [ibid].

A sanitation option may be adopted for privacy, protection, dignity, convenience, low-cost construction, operation and maintenance, and perceived health gains [10–12]. However, earlier studies have indicated that the presence of a sanitation facility may not result in its (hygienic) use [13–15]. The design and operation of a conventional BVIP latrine is that of a pit latrine (with a slab) installed with a ventilation pipe and fly screen for odour and fly control [16]. It has a roof that makes the interior semi-dark. However, the design has been considered not a pro-poor option as it is not affordable by many rural households [17]. Consequently, households may adopt it, construct alternative options or incomplete conventional latrines, consider deviations from the conventional design or practise open defecation. Here, we argue that deviations from the conventional design and incomplete construction (*so long a toilet*) compromise the design operation of the latrine and therefore its (hygienic) use by households. The current study assessed deviations, level of construction and use of (upgradable) BVIP latrines using Nyanga district rural communities in Zimbabwe as a case study.

Methods

Study design

A cross sectional study was conducted to 191 rural households from three wards of a district in Zimbabwe. A pre-tested questionnaire was administered at household level to collect data on socioeconomic demographyof participants and latrine construction and use. An observation checklist augmented the questionnaire in data collection on the characteristics of latrine construction and use.

Setting

The study was conducted in Nyanga district (18° 12' 36.00" S and 32° 44' 24.00" E) of Manicaland province in Zimbabwe, southern Africa, between May and September 2022. According to ZimStat [18], the district had an estimated human population of 146 282 in 31 wards and 39 368 households in 2022. There is one urban ward and the rest are rural villages and commercial farms. The major economic activities are mainly commercial farming of tea, apples, avocados, bananas and grapes, timber plantations and forestry reserves. Rural communities rely mainly on groundwater sources and simple pit and BVIP latrines for sanitation services.

Participants

The administrative boundaries in rural communities start with a village (collection of several households). Several villages form a ward, and wards form a district. A collection of districts form a province. Urban areas, forest reserves and commercial farms were excluded from the study. Access to safely managed sanitation is considered very low in rural Zimbabwe. Therefore, all households with BVIP latrines (various designs and at different levels of construction) in a selected village of a ward were eligible to participate in the study. Three rural wards of Nyanga district (1, 6 and 10) were randomly selected (picking from a hat with numbers of all rural wards) for the study. Similarly, three villages were randomly selected from a ward to give nine villages (Supplementary File 2). The household was the smallest sampling unit. A list of households with BVIP latrines was obtained from the local environmental health technician at a local rural health facility (clinic). This was purposively used for sampling. The female house head was the target participant. Although gender equality is promoted for access to sanitation, considerations for privacy, safety and convenience make the design of sanitation systems to be women and girl-friendly. Women are the principal managers for household water and sanitation needs in the African culture.

Variables

The questionnaire collected socio-economic demographic data. The variables included gender, age group, marital status, educational level, household size, monthly household income, number of cattle owned, presence of a formally employed household member resident at the home and the residence period of the household in the village. These were predictor variables for the level of latrine construction (dependent variable) which had two categories (completed and incomplete construction). The observation checklist collected data on the characteristics of the latrine as indicators of completion and deviation of construction. These were latrine design and operational features (e.g., presence of a concrete slab, vent pipe with fly screen and roof). Functionality of latrine and hygienic interior environment were indicators of latrine use.

Measurement

A 13-item semi-structured and self-administered questionnaire (Supplementary File 3) was developed from literature [17, 19]. A participant had to complete the questionnaire without outside help. It was piloted to 21 households from two villages of two non-participating wards. This was done to appropriately phrase questions to avoid embarrassing participants and take care of sensitive issues. Questions were revised for clarity of expression and intent. The questionnaire had two sections for respondents' socioeconomic demography (A) and latrine construction and use (B). It was evaluated by an independent sanitation specialist and a committee member from the rural district council WASH committee before use. A 13-item observation checklist (Supplementary File 4) augmented the questionnaire in data collection by observing latrine construction and use. The study protocol was approved by Bindura University of Science Education (Department of Environmental Science), Ministry of health and child care (district) and the local leadership (councillor and headmen).

The questionnaire targeted only households with BVIP latrines subsequent to notification from the local leadership. The female household head was the target respondent. However, if she was not available, the male house head or other adult person (above 18 years of age) was recruited to participate in the study. Informed consent was sought orally before the interview. The study was conducted considering applicable general principles and ethical standards for studies involving human subjects [20]. The questionnaire was administered by one of the authors in vernacular 'ChiShona' and responses converted into the English language.

Bias

Potential sources of bias for the study included interviewer and participant-response bias. To address these, the questionnaire was administered by one of the authors and an observation checklist was used to augment it to address reliance on self-reported data. The tool was piloted. It was evaluated by an independent WASH specialist and revised.

Study size

A sample size of 191 households was used for the study from a multi-stage sampling procedure: district - ward - village - household (Supplementary File 2). Three rural wards were randomly selected in the district (picking from a hat). In each ward, three villages were similarly selected. All households with BVIP latrines (at any level of construction, any design) were selected for the study. This was done considering the low adoption of the latrine design.

Statistical methods

Collected questionnaires and observation checklists were checked for completeness and correctness before data entry into MS Excel and exported to SPSS version 22.0 for analysis. Descriptive statistics were used to show the distribution of variables across wards and to display observational data. The Chi square test was used to determine associations between socioeconomic demographic variables and the level of latrine construction. Binary logistic regression analysis was performed to assess the impact of predictor variables on the outcome variable. It was used because the dependent variable had two categories ("complete" and "incomplete" latrine construction. Relationships were considered statistically significant at $p < 0.05$.

Results

Descriptive data

Characteristics of participants

The response rate was 100%. The demographic attributes of the study participants are shown in Table 1. About two thirds of the participants were female (61.78%), married (65.97%) and had a residence period of greater than 10 years in their respective wards (66.49%). Most households (69.11%) had a monthly income of less than $US 100. About three quarters of them (76.44%) had completed secondary education.

Adoption of the BVIP latrine

The study recruited all households with various designs of BVIP latrines at different levels of construction. Figure 1 shows the main self-reported reason for a household to adopt the latrine design. It appears households in the three wards adopted the BVIP latrine due to government encouragement (Ward 1: 43.42%, $n = 76$; ward 6: 44.44%, $n = 63$; and ward 10: 38.36%, $n = 52$) and for social reasons that include privacy, protection, dignity and convenience

Table 1 Demographic characteristics of participants(*n* = *191*)

Variable	Category	Frequency n (%)
Gender	Male	73 (38.22)
	Female	118 (61.78)
Age group (years)	18–25	7 (3.66)
	26–35	39 (20.41)
	36–45	81 (42.41)
	Above 45	64 (33.51)
Marital status	Single	16 (8.37)
	Married	126 (65.97)
	Divorced	28 (114.66)
	Widow/er	21 (11.00)
Educational level	Primary	26 (13.61)
	Secondary	146 (76.44)
	Tertiary	19 (9.95)
Household size	≤ 3	54 (28.27)
	4–5	84 (43.98)
	> 5	53 (27.75)
Monthly household income (USD)	< 100	132 (69.11)
	100–200	46 (24.08)
	> 200	13 (6.81)
Number of cattle owned	None	102 (53.40)
	≤ 5	62 (34.46)
	> 5	27 (14.141)
Presence of a formally employed resident household member	Yes	37 (19.37)
	No	154 (80.63)
Residence period (years)	≤ 5	25 (13.09)
	6–10	39 (20.42)
	> 10	127 (66.49)

(ward 1: 35.53%, *n* = 76; ward 6: 33.33%, *n* = 63 and ward 10: 34.62%, *n* = 52). The government encourages the construction and use of the BVIP latrine as the rural sanitation technology of choice, a policy statement, without providing subsidies. Adopting the BVIP latrine for health and hygiene was considered a main reason by very few households (< 5% across the wards).

Construction of household BVIP latrines

Figure 2 shows that the construction of a BVIP latrine was financed mainly by the household (Ward 1: 90.79%, *n* = 76; ward 6: 80.95%, *n* = 63 and ward 10: 82.69%, *n* = 52). Overall, household financed latrines were 85.34%.

Table 2 shows observations made on the completion and deviations in the construction of 191 BVIP latrines and their upgradable designs. Most of the latrines were functional (97.38%) and had hygienic environments (74.87%). However, almost a third of them (26.70%) were not roofed and 70 (36.65%) did not have vent pipes. Further, some installed vent pipes had no fly screens (23.97%). Almost half of the latrines (45.03%) had no handwashing facilities built-on or within 3 m distance. Some observations that were made on the latrines are critical to their operation. They include (a) well-designed and built latrines but with wall openings, (b) no roofs, attached or detached handwashing facilities or vent pipes with fly screens, (c) not facing the windward direction and (d) had some trees around them.

[a] Latrine functionality - signs of use e.g., wet slab/area around squat hole, faecal matter around inside parts of squat hole, odour, clear footpath to latrine etc [21].

[b] Hygienic environment means absence of faecal matter and houseflies around [14].

Figure 3. shows that out of the 191 latrines observed, only 72 (37.70%) were constructed meeting the conventional design in ward 1 (30.26%, *n* = 76), ward 6 (46.03%, *n* = 63) and ward 10 (38.46%, *n* = 52).

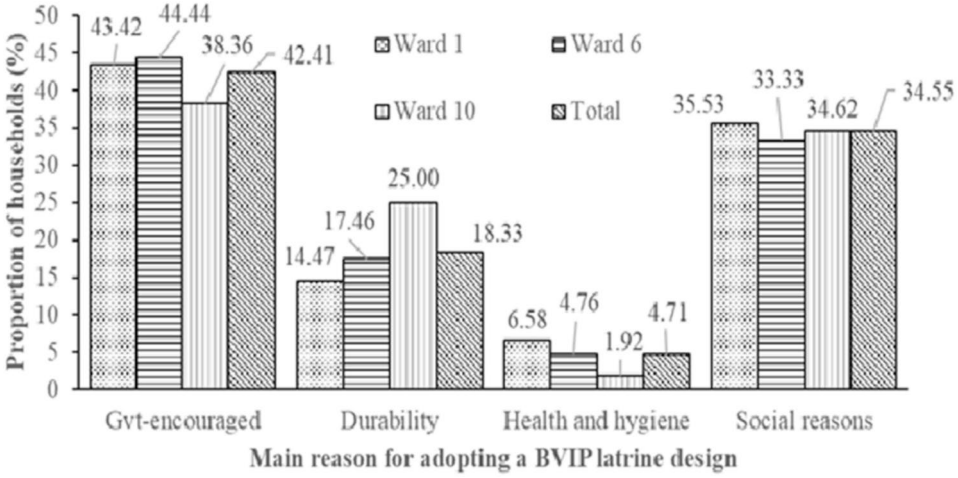

Fig. 1 Main reason for the household to adopt a BVIP latrine in different wards (*n* = *191*)

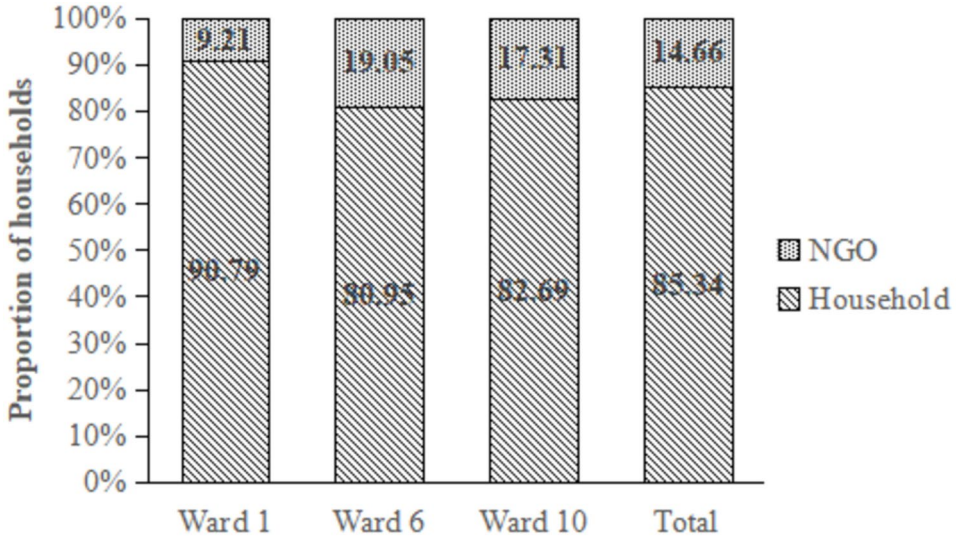

Fig. 2 Financing of household BVIP latrines in different wards (*n* = *191*)

Table 2 Observed completion and deviations of construction BVIP latrines (*n* = *191*)

Observed characteristic	Yes (*n*, %)	No (*n*, %)
Is the latrine functional? [a]	186 (97.38)	5 (2.62)
Is the interior floor hygienic? [b]	143 (74.87)	48 (25.13)
Are there openings/cracks on the superstructure?	29 (15.18)	162 (84.82)
Is there a concrete slab?	191 (100)	0
Is the pit built with fired bricks and cement?	191 (100)	0
Is there a roof (concrete/asbestos/zinc/thatch?	140 (73.30)	51 (26.70)
Is there a vent pipe (PVC/brick)?	121 (63.35)	70 (36.65)
Does the vent pipe have a fly screen?	92 (48.17)	99 (51.83)
Does the entrance face the windward direction?	172 (90.05)	19 (9.95)
Are there trees around the latrine?	38 (19.90)	153 (80.10)
Is the latrine interior semi-dark?	113 (59.16)	78 (40.84)
Is there a handwashing facility (attached/within 3 m)?	105 (54.97)	86 (45.03)

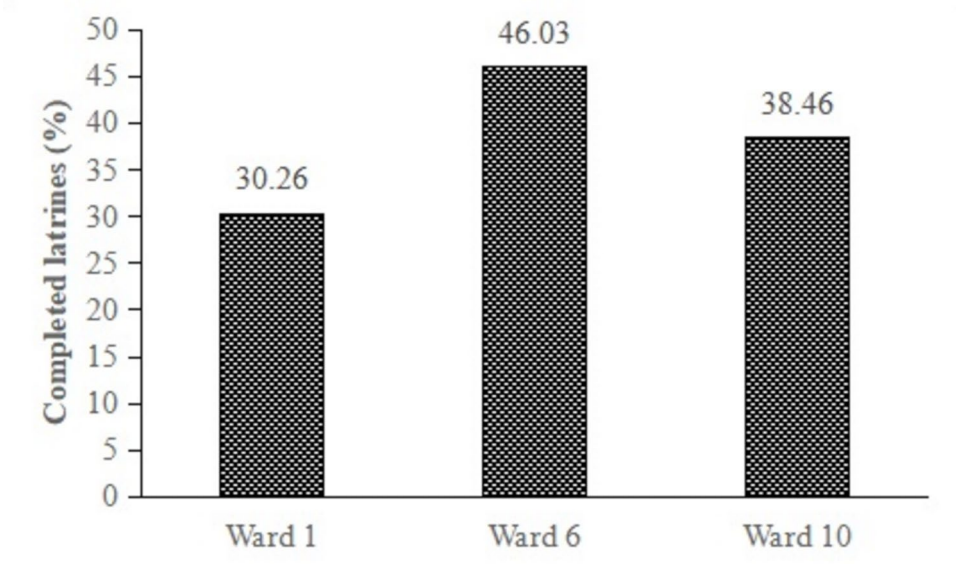

Fig. 3 Proportion of well-designed and completed BVIP latrines in wards 1, 6 and 10 (*n* = 191)

Table 3 Association between socioeconomic demographic data and the level of latrine construction

Socio-demographic variable	Pearson's Chi square value	*p* value
Ward (3 wards)	3.665	0.160
Gender (2 categories)	0.025	0.873
Age group (4 categories)	6.671	0.083
Marital status (4 categories)	5.629	0.131
Level of education (3 categories)	0.716	0.669
Household size (3 categories)	16.421	< 0.001*
Monthly household income (3 categories)	45.798	< 0.001*
Number of cattle owned (3 categories)	34. 100	< 0.001*
Formally employed resident member (2 categories)	41.502	< 0.001*
Resident period in the village (3 categories)	0.398	0.820
Latrine financier (5 categories)	42.506	< 0.001*

* significant association between variables

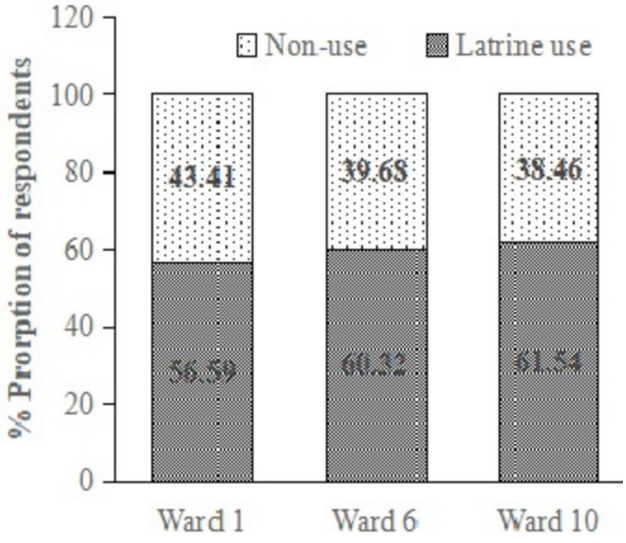

Fig. 4 Proportion of self-reported latrine use in wards 1, 6 and 10 (*n* = *191*)

Main results

Association between demographic data and level of latrine construction

Table 3 shows the results of a Chi square test of association between socioeconomic demographic factors of participants and the level of latrine construction at the household. Five factors were significantly associated with the design and construction of a household latrine ($p < 0.001$). They were household size, monthly income, number of cattle owned, presence of a formally employed resident member and financier for latrine construction.

Determinants for completion of latrine construction

Table 4 shows the results of binary logistic regression analysis to determine the predictors for completion of latrine construction. Having a family size of 4–5 persons was less likely than one with above five to complete latrine construction (AOR: 0.124; CI: 0.020–0.787; $p = 0.27$). Having an employed family member resident at the household had high odds than not having one of completing latrine construction (AOR 46 484; CI: 5.632–383.691; $p = < 0.001$). Similarly, having more less cattle than more than five, having a household income of less than $ 200 had lesser likelihood of completing latrine construction (Table 4).

Household latrine use

About 60% (113) of the participants self-reported that they used their household latrines in the way they were constructed (Fig. 4). The percentage mean of latrine use was 59.48 ± 2.58. Ward 1 had the highest proportion of self-reported non-use of latrines by some household members (43.41%).

Self-reported reasons by participants for some of the household members who did not use latrines (40.84%) were from wards 1 (42.31%), 6 (32.05%) and 10 (25.64%). Figure 5 shows that the most cited reasons for not using household latrines were unhygienic environment (39.75%), inconveniences (26.92%) and foul smell (17.95%).

Table 4 Predictors for the completion of latrine construction

Variable (reference category)	Category	Odds ratio	95% CI	*p* value
Household size (> 5) persons	4–5	0.124	0.020–0.787	0.027*
Household monthly income (> $200)	< $ 100	0.019	0.002–0.047	0.001**
Number of cattle (> 5)	None	0.023	0.020–0.787	0.001**
	≤ 5	0.028	0.004–0.217	0.028*
Presence of resident employed member (No)	Yes	46 484	5.632–383.691	< 0.001***
Financier of latrine construction (NGO)	Household	< 0.001	< 0.001–0.011	< 0.001***

Level of significance: * ≤ 0.05; ** 0.001; < 0.001 ***

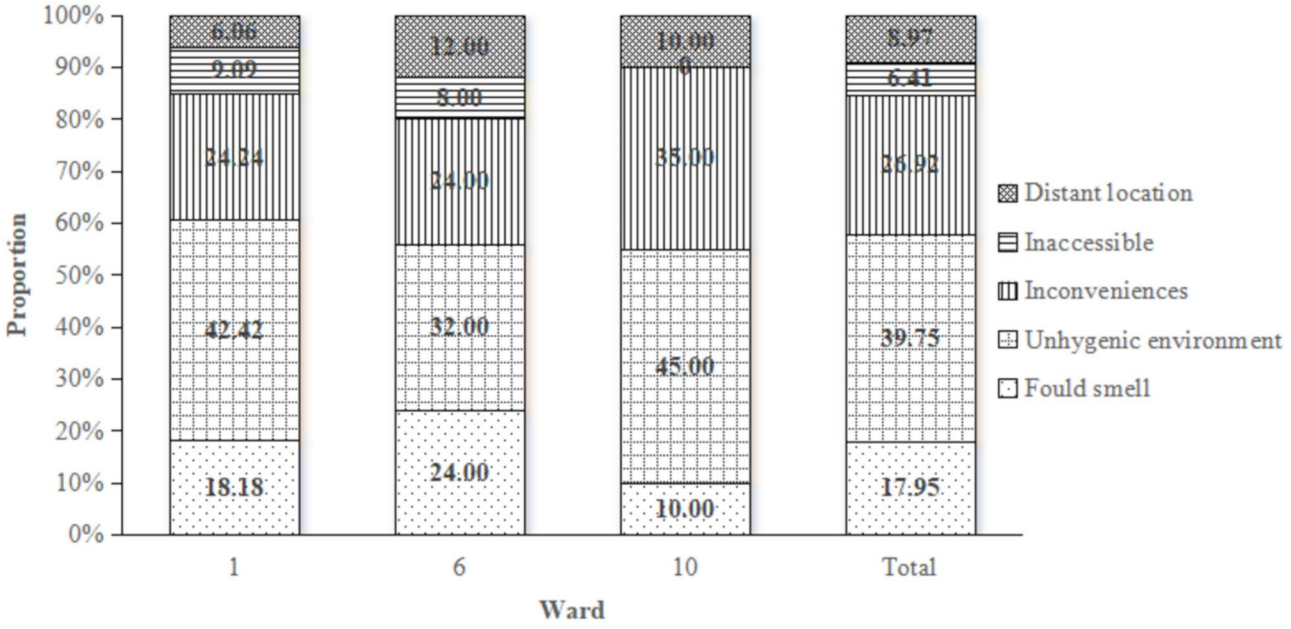

Fig. 5 Self-reported reasons for non-use of latrines by some household members

Relationship between predictor variables and the level of latrine construction

Discussion

Key results

Results indicated that most households were constructed by households (85.34%) due to government encouragement (42.41%). Only 37.70% were constructed meeting the conventional design requirements. Household size, monthly income, number of cattle, presence of a resident formally employed member and the type of latrine financier were significantly associated with the completion of latrine construction ($p < 0.05$). These factors were predictors for completion of latrine construction ($p < 0.05$). Results indicated mean latrine use of 59.48 ± 2.58 which was reported to be a result of unhygienic environment (39.75%).

Limitations

Findings of this study may not be interpreted without some important limitations. The low sample size corresponds to the low adoption of the BVIP latrine although an effort was made to sample all households with various designs of the latrine. This, together with the case study nature of the study, may limit generalisation of findings to other wards in the district. Self-reported data on latrine adoption and use may have response bias. However, observations were made on the physical characteristics of the latrines. Nevertheless, observational studies limit establishing cause-effect relationships.

Interpretation

The study setting represents a typical rural setting in Zimbabwe without near-urban neighbour effects, with very low access to safely managed sanitation services, relying on small-scale agricultural activities mainly for subsistence, and with a household monthly income of less than $US 100. Bearing in mind that household income is associated with latrine adoption [22], promoting sanitation and hygiene to improve public health and social development may be difficult at very low levels of access to sanitation services [23] due to poverty.

Results indicated that participants self-reported that they adopted the BVIP latrine because it was government-encouraged and for social reasons. Zimbabwe has encouraged the construction and use of the BVIP latrine at rural households for the past four decades. Every rural health centre (clinic) in Zimbabwe has an environmental health extension worker (Environmental health technician) and every village has a village health worker who directly work with communities at household level to encourage the construction and use of the BVIP latrine. The conventional latrine design provides for privacy, dignity, security and convenience (social reasons) to users. The adoption of latrines for social reasons has been reported (23,24]. The health and hygiene consideration in adopting a BVIP latrine was not a major self-reported reason. However, access to improved sanitation and adequate hygiene services prevent the transmission of pathogens [25]. These findings underscore the importance of participatory health and hygiene education where households are made aware of the importance of adequate sanitation services to prevent the transmission of pathogens.

Despite few households adopting the conventional BVIP latrine or its upgradable designs, they appeared to struggle to complete its construction. Observations indicated latrines without roofs, vent pipes with fly screens and handwashing facilities. Incomplete latrine construction was also reported for government-subsidised latrines in coastal Odisha, India [13] and rural communities of Mbire district, Zimbabwe [17]. Further, of the few BVIP latrines constructed, some deviations from the conventional design were observed e.g., latrine entrance not facing the windward direction and openings (small windows) on the walls of the superstructure which devoid a semi-dark interior. The operational design of a BVIP latrine requires that there is a roof on the superstructure and no openings on the walls of the superstructure to have a semi-dark interior. This excludes houseflies. The vent pipe exits odour and houseflies out of the pit. The fly screen traps houseflies from the pit and prevents entry of those from the outside. Facing the windward direction allows air into the pit though the entrance. If these operational design features are not there, it compromises odour and fly control, critical features of the ventilated improved pit latrine [26]. These findings underscore the importance of adherence to a conventional design, making sure that those who adopt it do not have construction limitations. Upgradable latrine designs were not completed to the conventional design.

The level of latrine construction was significantly associated with household size and monthly income, number of cattle, latrine fancier and the presence of a formally employed resident household member ($p < 0.001$). These are household-level factors. Poverty, cost of latrine construction and availability of materials were flagged in qualitative studies in Zimbabwe [27] and Ethiopia [28] influencing latrine construction. These are directly linked to our findings of the number of cattle owned (wealth), income and the presence of a resident formally employed household member. The number of cattle has traditionally been seen as to correlate with household wealth in African culture [29]. Contrary to our findings, a study by Nunbogu and others [30] in northern Ghana did not find socio-demographic differences of a household to be significantly associated with level of latrine completion. However, their study was based on the community-led total sanitation where several sanitation options are used. In other reports, education, age and gender were reported to influence latrine construction [31, 32].

An overall latrine use of 60% was reported in this study. This value indicates that some available household latrines were not used. This finding is comparable to values reported elsewhere irrespective of the type of sanitation option used e.g., 60.7% in the district of Hulet Ejju Enessie Woreda, Amhara region, Ethiopia [21], 52.7% in western Ethiopia [33] and 55% for improved latrines pooled across 15 studies in a household-level sanitation systematic review [24]. Self-reported reasons for some household members not to use latrines were due to human behaviour (hygienic environment) and design and operational shortcomings (foul smell, inconveniences, inaccessibility and distance from the house). These have been reported as barriers to latrine use in similar studies [19, 34, 35]. An unhygienic environment refers to the presence of faecal matter on the latrine slab and many houseflies around [14]. Inconveniences included lack of social security, dignity, privacy, comfort and gender considerations. Therefore, the social context should not be overlooked in order to understand and bring about sanitation behaviour change [36]. The finding that some latrines were not used underscores the challenge that having a latrine does not translate into its consistent and sustained use. It is noteworthy that human behaviour (unhygienic environment) can be addressed to influence latrine use, e.g., by frequent latrine cleaning [37]. However, the completion of latrine construction may be a long-term challenge as long as households remain poor and are not able to finance it. Affordable, yet viable sanitation options may be considered.

Conclusions

The study identified household-level factors that are associated with completion of latrine construction. Our findings indicated that households constructed different designs of the conventional BVIP latrine and used incomplete latrines. Such designs do not promote user needs such as security, safety and convenience. Public health campaigns may be needed to let households know that incomplete latrine construction and deviations from the conventional design influence its use, and the belief that the use of any latrine (*so long a toilet*) is not good for human health. Additionally, public health campaigns can include alternative option to reduce flies and smell by promotion market-based sanitation such as installation of SATO pan, a device with a trap door fitted on the aperture.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-23020-8.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

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Author contributions
SS: Conceptualisation, data collection, data analysis, manuscript draft, final draft. AK: Conceptualisation, data collection, data analysis, supervision, final draft review.

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Data availability
Datasets analysed are included in the manuscript. any special requirements are obtainable through the corresponding author.

Declarations

Ethics approval and consent to participate
Approval was obtained from the Ethics Committee of Bindura University of Science Education through the Department of Environmental Science. The procedures used in this study adhere to the tenets of the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the study.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

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