

Article

# Adopters and Non-Adopters of Low-Cost Household Latrines: A Study of Corbelled Pit Latrines in 15 Districts of Malawi

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**Abstract:** The Sustainable Development Goals will challenge low- and middle-income settings to look at new approaches for rural sanitation. In 2013, Mzuzu University, in partnership with United Nations Children's Fund (UNICEF) Malawi, started a low-cost latrine program in rural areas using the corbelled latrine design supported by locally owned sustainable businesses. The objective of this work was to trace customers (early household adopters) and non-customers through field observations and interviews in 15 districts of Malawi. The research team spent 193 personnel work days in data collection and found 21 households as adopters in 7 districts. Most respondents had a preference with regard to the design of the sanitation facility they would like to use. Although sharing of sanitation facilities was common, the corbelled latrine is promoted as a single household pit latrine design. Unfortunately, 8% (23/304) of non-adopters responded they practiced open defecation. Households were satisfied with the corbelled latrine design, and no latrine was found to have collapsed during field visits. To promote the corbelled latrine in Malawi, the following are recommended: (1) education of frontline government extension workers towards non-subsidized household latrines; (2) identification of rural low-income households as the best target for potential adopters; and (3) linkage of low-cost sanitation technologies to community mobilization campaigns led by the government, such as Community Led Total Sanitation.

**Keywords:** developing countries; household; Malawi; pit latrine; sanitation; sustainability

## 1. Introduction

In 2012 it was estimated the global diarrhea burden from inadequate sanitation resulted in 280,000 deaths, almost half of which were in Sub-Saharan Africa [1]. The Sustainable Development Goal (SDG) to “ensure access to water and sanitation for all” will challenge low- and middle-income settings to look at new approaches [2]. Chambers and Myers [3] note that to move towards Open

Defecation Free (ODF) status, technical knowledge is essential for policy and practice, and observe that “substructure is critical” for the sanitation facility.

In Ethiopia, low-cost latrine promotion has been found to dramatically improve latrine coverage in less than one year. Households with more education and larger families were more likely to be early adopters [4]. In addition, Jenkins and Curtis [5] found in Benin that to motivate latrine adoption, household drive was needed, with wide individual variations showing that changes in sanitation behavior have an individual preference. But sanitation promotion is part of an interconnected environmental and public health cycle. In rural India it has been found that on-site sanitation systems leaching excreta may impact groundwater drinking water supplies [6].

Malawi has a population of 17 million people, 85% living in rural areas. The nationwide prevalence of Open Defecation (OD) is 4% [7]. A regulatory framework supports the SDGs through both a National Sanitation Policy and National Open Defecation Free Strategy [8,9]. In rural areas of Malawi, Cole et al. [10] found a disconnect between the current supply and household demand for household pit latrines. To address the need for a model of affordable and desirable sanitation products supported by locally owned sustainable businesses, in 2013 Mzuzu University partnered with United Nations Children’s Fund (UNICEF) in Malawi. A low-cost latrine program was developed for rural areas using the corbelled pit latrine design. The design uses a substructure with a dome shape constructed with bricks below ground surface to reduce potential collapse. The design targets rural, low-income, households, with materials available throughout Malawi. The substructure uses no cement. A traditional superstructure using local materials is built on top of the corbelled substructure [11,12].

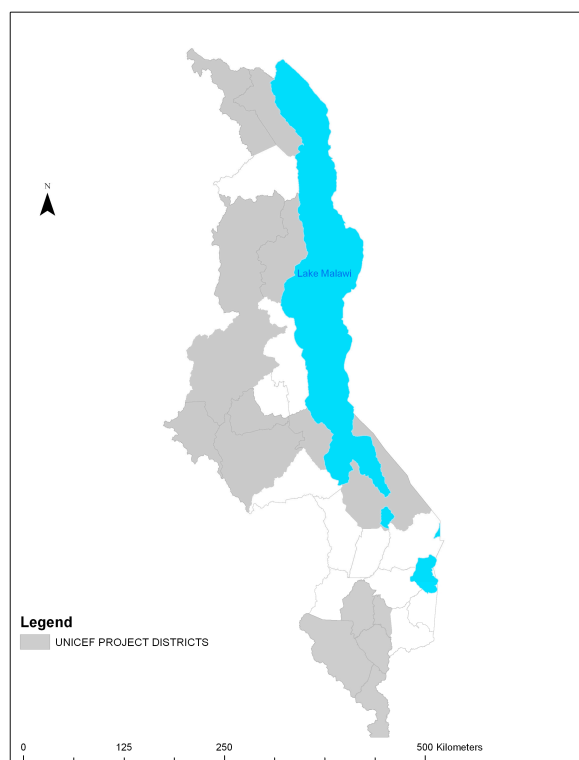
The study aimed to add to the existing body of knowledge to reduce OD by verifying the effectiveness of scale-up for a low-cost pit latrine design targeting rural households in 15 districts of Malawi by tracing customers (early household adopters) and non-customers. This paper is divided into four main sections: materials and methods, results, discussion, and conclusions.

## 2. Materials and Methods

The study was conducted in 15 purposively selected districts (Blantyre, Chikwawa, Chiradzulu, Chitipa, Dowa, Karonga, Kasungu, Lilongwe, Mangochi, Mchinji, Mzimba, Nkhata Bay, Nsanje, Salima, and Thyolo) throughout Malawi. These districts were specifically selected to coincide with districts where UNICEF Malawi has been working on low-cost sanitation solutions (Figure 1). Data were collected from 76 masons, 325 households, and 24 frontline government extension workers (Health Surveillance Assistants (HSA)) between November 2015 and March 2016. Although the study aim was to trace household customers from each of the 100-total trained masons, it was not possible to re-visit missed masons or associated customers unavailable during the data collection period. In this study, the adopters were rural households who had purchased corbelled latrines from masons trained by Mzuzu University, while the non-adopters were those who did not own this type of latrine in the areas of trained masons and were surveyed for comparison. A corbelled latrine costs approximately MK 49,000 (USD \$75). In some districts, no early household adopters for the corbelled latrine could be found despite the presence of trained masons. Focus group discussions were held with the HSAs covering criteria that may impact early adoption of the technology. In all cases, data collection was through face-to-face field visits and interviews in the local languages of Chichewa or Chitumbuka in the geographical area where the trained mason resided. A detailed review of factors affecting the success of sanitation business associated with individual masons is not covered in this work.

Data analysis was conducted with SPSS version 16 (Armonk: New York, NY, USA) and Microsoft Excel. The quantitative data were summarized through frequencies and percentages, as represented in tables. Qualitative responses were coded and quotes were selected to illustrate themes.

This study and its informed consent procedures were approved by the Republic of Malawi National Commission for Science and Technology in Malawi (Protocol No. P.10/15/62).



**Figure 1.** Map of Malawi—study area (sampling districts).

### 3. Results

Inadequate research and documentation often surrounds scaling up of new technology. This study performed extensive ground surveys to assess adopters and non-adopters of the corbelled latrine design across difficult road conditions in rural districts. The research team spent 193 personnel work days in data collection and found 21 households as adopters. This section presents results on the household characteristics of the adopters and non-adopters for corbelled latrines under study.

#### 3.1. Demographic Attributes of Corbelled Latrine Adopters and Non-Adopters

The adopters comprise only 6% (21/325) of sampled households and were found in 7 districts (Blantyre, Chiradzulu, Dowa, Kasungu, Mangochi, Nkhata Bay, and Salima) out of the 15 districts studied. Adopters dominated in two districts: Nkhata Bay and Kasungu. Table 1 depicts the demographic attributes of adopters and non-adopters of corbelled latrines. The household member responsible for sanitation decisions was usually either the household head or the spouse in both adopters and non-adopters. A Chi-square test showed there were significant differences ( $X^2 = 17.325$ ,  $df = 2$ ,  $p = 0.000$ ) in the proportion of respondents between the head of households, the spouses, and the rest of the related respondents. In contrast, no significant differences were observed in the proportion of household heads and spouses among adopters and non-adopters. Education level for adopters was found to be higher than for non-adopters. More than three-quarters of adopters had at least some primary school education (Standard 1 to 8), compared to about half of non-adopters. Out of 21 respondents who were adopters of the corbelled latrine, 20 adopters (95%) had attended primary, secondary, or tertiary education, compared to 81% (245/304) of non-adopters. Subsistence farming is the major occupation in the 15 districts for adopters and non-adopters, and those in trade and salaried (paid) work were low for both adopters and non-adopters. Respondents married with one spouse dominated in both adopters and non-adopters. Widow/widowers in the overall survey comprised 8% (26/325), and it is important to recognize that this often-vulnerable group may have a limited income for the construction of an improved latrine. Also of importance is that polygamous

married respondents accounted for 5% (17/325), a group which may have higher household latrine users than households where the respondent is married with one spouse.

The status of sanitation and hygiene facilities for adopters and non-adopters is shown in Table 2. The study revealed 9% (27/304) of non-adopters did not have any household sanitation facilities, and further probing during the study showed they resorted to using neighbors' facilities, the surrounding bush (i.e., OD), or nearby public sanitation facilities belonging to institutions such as primary schools, market places, and/or trading centers. Most (19/21) adopters reported they were happy and satisfied using the corbelled latrines, and there were no reported latrine collapses.

**Table 1.** Demographics of early adopters and non-adopters of the corbelled latrine.

Variable	Description of Variable	Early Adopter (n = 21)	Non-Adopter (n = 304)	Total (n = 325)
Education level	Standard 1–5	19% (4)	24% (72)	23% (76)
	Standard 6–8	57% (12)	32% (96)	33% (108)
	Form 1–2	5% (1)	12% (37)	12% (38)
	Form 3–4	5% (1)	12% (37)	12% (38)
	Tertiary	10% (2)	1% (3)	2% (5)
	None	5% (1)	19% (59)	18% (60)
Primary occupation	Farming	81% (17)	76% (230)	76% (247)
	Fishing	0	0	0
	Trade	14% (3)	13% (40)	13% (43)
	Piecework	0	5% (15)	5% (15)
	Funded by children	0	1% (3)	1% (3)
	Salaried employment	5% (1)	4% (13)	4% (14)
	No employment	0	1% (3)	1% (3)
Household marital status	Single/never married	0	5% (16)	5% (16)
	Married (one spouse)	95% (20)	77% (235)	78% (255)
	Married (polygamous)	0	6% (17)	5% (17)
	Widow/widower	5% (1)	8% (25)	8% (26)
	Divorced/separated	0	4% (11)	3% (11)

**Table 2.** Status on sanitation and hygiene facilities for early adopters and non-adopters of the corbelled latrine.

Variable	Description of Variable	Early Adopter (n = 21)	Non-Adopter (n = 304)	Total (n = 325)
Sanitation project in the area?	Yes	76% (16)	67% (205)	68% (221)
	No	24% (5)	33% (99)	32% (104)
Type of sanitation facility currently at household	Pit latrine with slab	0	16% (50)	15% (50)
	Pit latrine without slab	0	70% (213)	66% (213)
	Corbelled latrine	100% (21)	0	6% (21)
	Ventilated improved pit latrine	0	0.3% (1)	0.3% (1)
	Flush/pour flush	0	4% (11)	3% (11)
	Composting latrine	0	0.3% (1)	0.3% (1)
Is household sanitation facility shared with neighbors?	No facility at household	0	9% (28)	9% (28)
	Yes	24% (5)	29% (87)	28% (92)
Is a handwashing facility currently at household?	No/not applicable	76% (16)	71% (217)	72% (233)
	Yes	43% (9)	52% (158)	51% (167)
Is a dish rack currently at household?	No	57% (12)	48% (146)	49% (158)
	Yes	62% (13)	53% (162)	54% (175)
Is a rubbish pit currently at household?	No	38% (8)	47% (142)	46% (150)
	Yes	57% (12)	70% (212)	69% (224)
Is a clothes line currently at household?	No	43% (9)	30% (92)	31% (101)
	Yes	86% (18)	86% (261)	86% (279)
Is a separate kitchen space currently at household?	No	14% (3)	14% (43)	14% (46)
	Yes	86% (18)	84% (256)	84% (274)
Is a bath shelter currently at household?	No	14% (3)	16% (48)	16% (51)
	Yes	95% (20)	92% (279)	92% (299)
Is a bath shelter currently at household?	No	5% (1)	8% (25)	8% (26)
	Yes	95% (20)	92% (279)	92% (299)

Sharing of sanitation facilities is common: about a quarter of respondents for both adopters and non-adopters engaged in this practice. However, the corbelled latrine is promoted as a single household pit latrine design. Shared sanitation facilities are considered unimproved, based on the WHO/UNICEF [7] guidelines. Unfortunately, 8% (23/304) of non-adopters responded that they practiced OD in the study areas.

### 3.2. Preferred Sanitation Facilities

Awareness of the link between sanitation and improved health was shown in one HSA from Mzimba District who reported, “We civically educate people by teaching them that poverty reduction can only happen if sanitation is promoted, failing which all their resources will be used to care for diseases”. Yet another HSA in Chikwawa District had the idea of exchange visits among community leaders to expose village leadership to different household low-cost sanitation facilities in nearby areas. Additionally, most household respondents reported that education was the best intervention for promoting sanitation and hygiene practices.

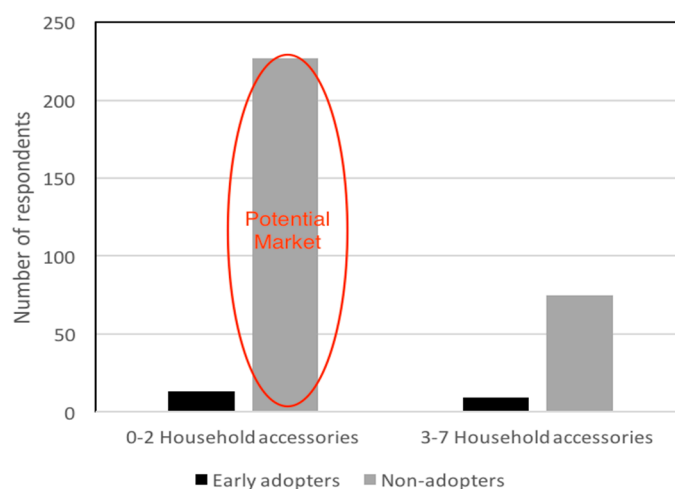
During focus group discussions, 7 out of 24 HSAs noted the need for subsidies of building materials, which runs counter to the aim of promoting preference for a low-cost latrine affordable to rural households. However, two HSAs, when asked about interventions to promote improved sanitation and hygiene in the district, suggested “competition amongst villages with prizes including building of latrine facilities”, which is in support of sanitation marketing principles. Both of these HSAs were working in areas of northern Malawi with less non-governmental organization influence than other districts, and neither of them talked about the need for subsidy.

Respondents’ preference for the type of sanitation facility was also assessed during the study as an open-ended question, with 296 of the 325 households responding to this question. This shows most respondents had an individual preference for the design of sanitation facility they would like to use within their communities. 15% (43/296) of respondents preferred the ventilated improved pit latrine design, an improved latrine design that is higher in local cost and higher on the sanitation ladder. 5% (15/296) of respondents wanted iron sheets for a roof despite being a costly construction material. This shows that even with the low-cost corbelled latrine substructure, households want a range of superstructure options. Over half (163/296) of the respondents preferred the corbelled latrine design, showing that although adoption is low, there is strong interest in the design. Only two households surveyed stated they wanted a composting toilet, which may be due to the barriers of low awareness of human waste as a soil conditioner for agricultural production, or cultural issues.

### 3.3. Willingness to Pay

In every district there were households surveyed who were not willing to pay (cash) for a low-cost pit latrine constructed by a mason contractor. But in the 15 study districts, 80% (259/325) of households interviewed indicated a willingness to pay. The maximum a household was willing to pay for a latrine was MK 200,000 (USD \$308); this, however, was an outlier of one respondent, who further commented what the household really wanted was a flush toilet, not a pit latrine. While MK 200,000 (USD \$308) will not cover the cost of a flush toilet at local prices, this response does show a willingness of an individual within the study area to pay more for a higher quality facility on the sanitation ladder. The median willingness to pay was MK 5000 (USD \$8) ( $n = 325$ ). One HSA noted that “since the poverty levels of villagers are high, people are not willing to pay. People prioritize other basic needs above latrines”, which is likely a core reason for low levels of adoption. Yet another HSA in Dowa said, “Some households have the capacity to pay masons as they do commercial farming”. Interestingly, one household in the study indicated a non-cash value of one chicken to purchase a latrine, valued at MK 2500 (USD \$4). Further analysis shows that the four lakeshore districts of Karonga, Nkhata Bay, Mangochi, and Salima did not have a higher willingness to pay as may have been expected, where environmental conditions of sandy soils make household pit latrine collapse more frequent.

Figure 2 shows that more corbelled latrine adopters were lower income households. The market potential for corbelled latrines is represented by low-income non-adopters, specifically those characterized by limited household accessories.



**Figure 2.** Number of respondents reporting ownership of any of seven household accessories (bike, cell phone, radio, television, cook stove, refrigerator, and/or car). Respondents were grouped into two contingency categories (0–2 and 3–7 accessories) to represent lower and higher levels of household income, respectively. Respondents were further grouped into early adopters or non-adopters, respectively.

#### 4. Discussion

Adopters of the corbelled latrine in Malawi were more likely to have had some education, which is supported by similar findings in latrine users in Ethiopia by O’Loughlin et al. [4]. Similarly, a study in Malawi of treadle pump adoption, a low-cost water supply technology, found those with more education slightly more likely to adopt treadle pumps [13]. This could imply that low-cost technology promotion in rural Malawi should target adult education literacy groups and use community posters to increase adoption.

Areas in which sanitation projects already existed were more likely to adopt corbelled latrines in Malawi. This also shows there is some sustainability among different sanitation programs working in certain areas, provided these garner firm awareness. In Ethiopia, O’Loughlin et al. [4] also showed “community mobilization can be an effective, low-cost way to increase latrine ownership”. Community Led Total Sanitation (CLTS) is the primary sanitation community mobilization strategy in Malawi [8,9], but implementation does not reference technological design solutions such as the corbelled latrine. Currently, corbelled latrine promotion is by individual masons to household customers; it is not necessarily linked to government community mobilization campaigns. Additionally, O’Loughlin et al. [4] found that latrine access grew faster in rural areas closer to towns. Thus higher adoption would have been expected in Lilongwe and Blantyre Districts, which was not the case in this study. The two most successful districts in the study were Nkhata Bay and Kasungu, both of which have a major nationwide road crossing in the area. Kasungu District is also characterized by commercial tobacco farming and Nkhata Bay District by commercial fishing. These commercial activities may make more household cash available.

Study findings emphasize that major decision-making on whether to adopt the corbelled latrine was effected by either the household head and/or the spouses. As such, both household heads and spouses are critical for the adoption and up scaling use of the corbelled latrine in the study districts and should be targeted by masons and educational programs. Another issue not often discussed in sanitation research is household sanitation facilities for polygamous families. There may be a need

to promote criteria of the number of users per pit latrine, instead of the one latrine per household approach, in areas with a higher number of polygamous families and in similar global contexts.

Willingness to pay for sanitation solutions compares to a previous study showing households in the Nkhata Bay District of Malawi, where it was recorded to be up to MK 12,132 [14]. In rural Senegal, Hall et al. [15] found a household preference for the ventilated pit latrine, and for which households may be willing to pay up to 54,261 FCFA. Though willingness to pay is difficult to compare, each of these studies pertinently shows a willingness by rural households to pay something for improved sanitation, a demographic with limited formal income.

About half of adopters and non-adopters did not have a handwashing facility available near the latrine. Adoption of the corbelled latrine did not necessarily lead the household to adopt handwashing facilities, rubbish pits, clothes lines, and/or a kitchen shelter. Pertinently, it also shows that a bath shelter may be available in a household even if its members practice OD. There should be a promotion of a suite of household sanitation facilities, inclusive of latrines, handwashing stations, and rubbish pits.

A major challenge affecting adoption of the latrines is poverty in the rural areas of low-income countries, and available cash to pay a mason. This study also showed that frontline government workers perceived the need for a subsidy, which might be part of the problem in the low rate of corbelled latrine adoption. Although salaried work was reported by limited respondents, a general willingness to pay was found in the study. There is a need to promote the benefits of the corbelled latrine through HSAs as an affordable design for rural households and distinct from the need for subsidy. Most respondents in this study reported a preference for which sanitation facility they desired (whether corbelled latrine or not), indicating that social response to being satisfied with the corbelled latrine design might be one of the best approaches for scaling up. This also complements other findings that personal drives motivating latrine adoption in rural Benin includes satisfaction with the latrine designs [5]. Study response indicated that households did not demand composting latrine designs. However, the benefits of composting latrines are high and well-documented [3], and the design is promoted by several non-governmental organizations in Malawi; moreover, subsistence agriculture was the dominant occupation. This is an important finding, and practitioners must not force latrine designs despite their being a technical solution.

## 5. Conclusions

The study was designed to verify the effectiveness of scale-up for a low-cost pit latrine design targeting rural households in 15 districts of Malawi. Monitoring and sustainability studies are essential with any new technology, including the corbelled latrine design. To achieve the SDG in Malawi, low-cost latrine design promotion in rural communities must involve masons, households, and government officials in the solution. After piloting, the corbelled latrine design was scaled-up but is still having limited success, as it was only found in a few households. Households were satisfied with the corbelled latrine design, and just as important, no latrine was found to have collapsed. Preference for a sanitation facility can be key criterion in ending OD, and the corbelled latrine in the rural study areas was clearly preferred by households and showed consumer demand. The value of a tracer study allows for a program evaluation. To promote a higher uptake of the corbelled latrine in Malawi, the following are recommended:

- Education of frontline government extension workers towards non-subsidized household latrines,
- Identification of rural low-income households as the best target for potential adopters,
- Linkage of low-cost sanitation technologies to community mobilization campaigns led by the government, such as CLTS.

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the experiments; Rochelle Holm, Mavuto Tembo, Dalo Njera, Victor Kasulo, Mphatso Malota, Willy Chipeta, Wales Singini, and Joshua Mchenga analyzed the data and wrote the paper.

**Conflicts of Interest:** The authors declare no conflict of interest.

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