Research Paper

Moving up the sanitation ladder with the help of microfinance in urban Malawi

Richard Chunga, M. W. Jenkins, Jeroen Ensink and Joe Brown

ABSTRACT

We carried out a stated preference survey in Malawi to examine whether access to microfinance for sanitation would significantly increase the proportion of households upgrading to improved pit latrines or alternative improved sanitation technologies (urine diverting dry toilet, fossa alterna, pour flush). We presented a range of sanitation options at local market prices, initially without and then with a real microfinance option, to 1,300 households sampled across 27 low-income urban settlements in the two largest cities, Lilongwe and Blantyre. When we gave respondents a microfinance option, the proportion of households stating an intention to install improved and unimproved pit latrines decreased significantly, while the proportion stating an intention to upgrade to alternative improved sanitation technologies increased significantly. However, households in the lowest wealth quintile were more likely to state a preference for unimproved pit latrines, suggesting that the benefits of microfinance for sanitation may not accrue equally across wealth strata. Organisations seeking to improve access to safely managed sanitation by promoting alternative sanitation technologies would succeed if households have access to affordable alternative sanitation technologies and microfinance for sanitation. However, poorer households would need more affordable improved sanitation technologies, flexible microfinance options and possibly targeted subsidies to gain access to safely managed sanitation.

Key words | Malawi, microfinance, sanitation, urban sanitation

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INTRODUCTION

The Joint Monitoring Programme for Water Supply and Sanitation estimates that 2.3 billion people globally lack access to basic sanitation (use of improved sanitation facilities that are not shared with other households) and that 892 million people practise open defecation (WHO/UNICEF 2017). In 2012, it was estimated that 280,000 people, mostly children under five years old, died from diarrhoea caused by lack of basic sanitation (Prüss-Ustün *et al.* 2014). These deaths could be prevented, in part, by improving access to safely managed sanitation (Brown *et al.* 2013). Safely managed sanitation refers to the use of improved sanitation facilities that are not shared with other households and where excreta are safely disposed of *in situ* or transported and treated off-site (WHO/UNICEF 2017).

Supporting households in low-income and high population density urban settlements to gain access to safely managed sanitation presents several challenges. First, many households are not able to pay upfront the cost of upgrading to basic sanitation facilities because of poverty (Trémolet *et al.* 2015). Second, it is not always possible to dispose excreta *in situ* because of lack of space for constructing

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replacement pit latrines – the most common form of sanitation in these settlements (Chunga *et al.* 2016). Third, it is difficult for households to safely empty and transport excreta to wastewater treatment stations because of the poor design of pit latrines, lack of satisfactory pit emptying equipment and lack of access roads for vacuum trucks (Thye *et al.* 2011; Peal *et al.* 2014; Jenkins *et al.* 2015).

To support urban households to gain access to safely managed sanitation, non-profit organisations have introduced a range of alternative improved sanitation technologies in several settlements: pour flush toilet, urine diverting dry toilet (UDDT) and fossa alterna toilet (Morgan & Mekonnen 2013; Tilley *et al.* 2014). The advantage with the pour flush toilets is that they are more permanent and easier to empty than pit latrines (Tilley *et al.* 2014). The UDDT and fossa alterna toilets are known as 'ecological sanitation' or 'ecosan'. Ecosan facilities are designed to allow users to treat excreta on-site (by adding ash and soil/sawdust into the pits after defecating) and use the treated excreta as fertiliser for food crop production (Morgan & Mekonnen 2013). Proponents of these alternative sanitation technologies argue that they are suitable where space for constructing replacement pit latrines is limited and, if used correctly, could reduce health risks caused by the disposal of untreated excreta into surrounding areas (Werner *et al.* 2009; Morgan & Mekonnen 2013; Tilley *et al.* 2014). Although these technologies offer households several advantages, their adoption has been very slow, in part because they are too expensive for poor households (Tilley *et al.* 2014; Simiyu 2017).

Poor households often indicate that they cannot afford to pay upfront to purchase a latrine that meets their preference (Pedi *et al.* 2011; WSP 2014). Access to microfinance for sanitation could help many households to address this challenge (Trémolet *et al.* 2015). The concept of microfinance was developed in the 1980s and it refers to a range of financial services, including loans, savings and insurance available to poor entrepreneurs and small business owners who lack collateral to qualify for a formal bank loan (Robinson 2001). The purpose of microfinance is to provide individuals with money to invest in their business to help them to move out of poverty (Robinson 2001). Considering that many households cannot afford to pay upfront for a latrine of their preference, several organisations started offering poor households microfinance for sanitation. Microfinance for sanitation enables poor households to invest in sanitation because it allows them to pay for sanitation technologies of their preference in small amounts over a longer period (Mehta 2008). Research shows that households with access to microfinance for sanitation compared to households without access are more likely to adopt improved sanitation (Davis *et al.* 2008; Trémolet *et al.* 2015; Ben Yishay *et al.* 2016; Geissler *et al.* 2016).

Although several researchers have examined the effect of microfinance for sanitation on demand for improved sanitation, there is limited information about the indicators of demand for microfinance for sanitation and its effect on households' sanitation technology preferences. In this paper, we use data from a stated preference survey to examine the socioeconomic indicators of demand for microfinance for sanitation, and whether access to microfinance for sanitation would significantly increase the proportion of households upgrading to improved pit latrines or alternative improved sanitation technologies. We carried out the survey in Malawi. Our analysis focuses on ecosan and pour flush toilets because these were the alternative improved sanitation technologies non-profit organisations were promoting in the targeted areas at the time of the study.

MATERIALS AND METHODS

Study site

We conducted the study in 2012 in Lilongwe and Blantyre City, the two largest cities in Malawi. The national census report of 2008 indicated that Lilongwe City had a population of 669,021, an annual population growth rate of 4.3% and a population density of 1,479 persons per square kilometre, while Blantyre City had a population of 661,444 people, an annual population growth rate of 2.8% and a population density of 3,006 per square kilometre (NSO 2008). The Joint Monitoring Programme for Water Supply and Sanitation reports that 47% of the urban population in Malawi have access to basic sanitation (UNICEF/WHO 2015).

Sanitation promotion and access to microfinance for sanitation

In 2009, the Government of Malawi received a grant and a loan from the European Investment Bank to implement the

Malawi Peri-urban Water Supply and Sanitation Project. The project was implemented by the Lilongwe and Blantyre Water Board with technical support from two non-profit organisations (WaterAid and Water for People). These non-profit organisations supported the two water boards in promoting hygienic pit emptying services, improved pit latrines and a range of alternative improved sanitation technologies: UDDT, fossa alterna toilets and pour flush toilets. Households in the two cities were expected to fully cover the cost of installing a new pit latrine or any of the alternative sanitation technologies.

At the time of the study, there were two organisations that were offering households microfinance for sanitation. These two organisations had different approaches: The first organisation, Opportunity Investment Bank of Malawi (OIBM), was offering loans for sanitation in Blantyre City only. The bank was offering loans at 2% monthly interest rate and households were required to pay back their loan within one year. Households that were interested in obtaining a loan were required to join a group of other households that were also interested in obtaining a loan for sanitation. Although loans were given to groups, individuals within a group were free to select any sanitation technology of their choice. By 2012, the bank had offered finance for sanitation to 210 households and achieved a loan repayment rate of 88%. However, the bank stopped providing loans for sanitation in 2012 because the bank perceived these as high risk loans since they were not for productive purposes (Chatterley *et al.* 2013). The second organisation, CCODE, was offering loans for sanitation in the two cities. CCODE was offering loans at 2% monthly interest rate and households were required to pay back their loans over a period of two years. CCODE was offering loans for UDDTs only but households were not required to join a group. Between 2009 and 2012, CCODE had offered 1,320 loans for UDDTs (Hunga 2016).

DATA COLLECTION

Sample size

We sampled 650 households from each city. We calculated the sample to identify a representative sample of property owners that were concerned about space for constructing replacement pit latrines. We used a two-stage sampling technique to select survey respondents. In the first stage, we selected low-income urban areas to visit from a list of such areas prepared by the two cities under the Participatory Slum Upgrading Programme. We selected areas to visit based on probability proportion to population. In the second stage, research assistants sampled property owners randomly by starting from a central location and selecting every fifth house until they interviewed a pre-specified number of property owners. The survey targeted property owners only as they are usually the ones responsible for constructing sanitation facilities and deciding on the type of sanitation technology to install.

Examining sanitation technology preferences

We asked survey respondents to indicate what technology they would install when the technology they were using at the time of the survey filled up. Before we asked the respondents to indicate their sanitation technology preference, we showed them pictures and explained the estimated cost of the following options (*supporting file 1*): a pit latrine slab, lined pit latrine (this is an improved pit latrine – it has a slab floor but the walls of the pits that collect excreta are lined with bricks and mortar to prevent the pits from collapsing), UDDT, fossa alterna and a pour flush toilet. We explained the advantages and disadvantages of UDDT, fossa alterna and pour flush toilets in relation to pit latrines as these were new sanitation technology options in the two cities. We did not offer the estimated cost of constructing a pit latrine with a slab floor or unimproved pit latrine because households use a range of materials to construct pit latrines (e.g. cardboard, mud bricks, plastic, paper, tin roof) so it was difficult to come up with accurate estimates for these two options. We also did not offer septic tank toilets because non-profit organisations were not promoting septic tanks (they are very expensive) and there was no institution offering loans for the construction of septic tanks. However, we informed households that they were free to choose any sanitation technology of their choice including unimproved pit latrine or septic tank toilet.

After respondents made their initial choice, we gave them a microfinance option at a 2% monthly interest rate

to be paid back over a period of one or two years, terms that corresponded to actual sanitation microfinancing options that were available in the study communities at the time of the study. We advised survey respondents that they could take any loan amount depending on the sanitation technology of their preference. We showed the respondents loan amounts ranging from MK10,000 to MK100,000 (22–122 USD), corresponding interest and how much a household would be expected to pay back every month to pay back their loan plus interest within 12 or 24 months (*supporting file 2*). We recorded their stated willingness to take a loan and the technology they would install with the loan.

Survey questionnaire

We trained a team of seven research assistants for 2 days to collect data using a semi-structured questionnaire. The questionnaire captured the following data: sanitation technology preference, whether a household was concerned about space for replacing pit latrines, the number of households at a plot and access to a garden for food crop production. The questionnaire also captured information concerning households' ownership of a television, radio, mobile phone; and dwelling characteristics including: source of drinking water, access to electricity, type of sanitation facility, and type of floor in the respondent's house. Regarding microfinance, the questionnaire captured the following information: whether a household had taken a loan before, household intention to take a loan for sanitation, and whether a household preferred to pay back the loan within one or two years. In the second city (Blantyre), we also asked households to indicate whether they had ever wanted to take a loan for sanitation and the barriers preventing them from taking a loan for sanitation.

Data analysis

We carried out the following analyses: (1) we used McNemar's test to compare sanitation technology preferences households made before and after we gave them an option for microfinance; (2) we used a binary logistic regression model to identify socioeconomic factors associated with demand for microfinance for sanitation as measured by the odds ratio (OR); (3) we used a multinomial logistic regression model to examine differences in sanitation technology preferences between wealth groups and between households that accepted and rejected the microfinance option. To identify wealth groups, we assigned each item owned by the households and their dwelling characteristics a factor score generated through principal component analysis. We then used the scores to create wealth quintiles: lowest quintile, second lowest, middle, fourth and highest quintile.

We conducted a series of univariable analyses to select variables to include in regression models we developed. Variables that had a p-value of 0.20 or less were selected for inclusion in the final models (Hosmer *et al.* 2013). Results were considered significant at the 5% level. We analysed the data using Stata version 12.

Weaknesses

In this study, we examined households' stated sanitation technology preferences. Stated preferences may differ significantly from actual preferences, demand, and behaviours. Other stated preference surveys give respondents time to think about their options, which can have advantages. Due to the limited time and resources of this large sample, survey respondents were not given extended time to think about their options, though interviewers did take time to explain the sanitation technology options, remind respondents to select an option they would be able to pay for and consider that they also needed money for other household needs.

We used stated preferences for the following reasons: first, not all households in the two cities had an option of microfinance when they were installing the sanitation facilities they were using at the time of the study; second, not all households in the two cities were offered all the alternative sanitation technologies under this study when they were installing the sanitation technology they were using at the time of the study. This is because not all the builders working in the two cities were trained to construct these alternative technologies. Under these circumstances, a stated preference survey was the best option for studying the effect of microfinance for sanitation on sanitation technology preferences.

Ethics approval

Ethical approval was obtained from The London School of Hygiene and Tropical Medicine and from the National

Health Research Council in Malawi. Survey respondents provided written informed consent consistent with approved study protocols.

RESULTS

Descriptive statistics

We interviewed 1,300 households from 27 low-income and high population density urban settlements across the two cities. Table 1 presents the descriptive statistics of the sampled households. Only 26% of the households had access to basic sanitation. Household heads were predominantly male (75%) and most had primary and secondary school education.

Access to microfinance for sanitation

When we asked households to indicate whether they had taken a loan before, 23% (301) indicated that they had. Only 13% (39 households) of the households that had taken a loan before took the loan to improve sanitation. Thus, access to microfinance for sanitation was available to only 3% of the sampled households. The results showed that 72% (28 households) of the households that took a loan for sanitation installed a UDDT and the remaining 28% (11 households) installed a pit latrine with a slab floor. This suggests that microfinance for sanitation was available mainly for UDDTs.

Barriers preventing households from accessing microfinance for sanitation

When we asked respondents in the second city (Blantyre) whether they had ever wanted to take a loan for sanitation, 29% (188 households) indicated that they had. When we asked these households to identify barriers that were preventing them from taking a loan for sanitation, they identified 11 barriers (Table 2). Households failed to take a loan for sanitation mainly because they did not know where to get a loan for sanitation or they feared that they would not be able to repay the loan.

Table 1 | Descriptive statistics ($n = 1,300$)

Variable	Percent
Access to sanitation	
Access to basic sanitation	26
Access to limited sanitation	45
Access to unimproved sanitation	28
No sanitation facility	1
Took a loan to improve sanitation	3
Household uses ecological sanitation	2
Household concerned about space for sanitation	25
Ownership and dwelling characteristics	
The house had a cement floor	82
Toilet floor had a slab floor	71
Piped water on the yard	34
Access to electricity	48
Household owns a television	52
Household owns a radio	75
Household owns a mobile phone	83
Owns a garden for food crop production	34
Education status	
No education	5
Primary school education	42
Secondary school education	45
College education	8
Gender of household head	
Male	75
Female	25

Indicators of demand for microfinance for sanitation

When we gave households in the two cities an option for microfinance, 48% stated that they would take a loan for sanitation, 46% declined the option, and 6% were unsure whether they would take a loan or not. Regarding preference for a loan repayment period, 49% of the households that accepted the loan option preferred to pay back their loan within one year while 51% preferred to pay back their loan within two years. We did not observe any significant differences in preference for a repayment period between wealth quintiles.

Table 3 presents a binary logistic regression model which identifies the indicators of demand for microfinance

Table 2 | Barriers preventing households from accessing a loan for sanitation ($n = 188$[a])

Barriers to access to a loan for sanitation improvement	Frequency	Percent
Barriers associated with lending to groups		
It was difficult to find people to join the loan group	2	1
Some members within my group failed to raise the deposit required	2	1
I did not want to join a loan group	3	2
Barriers associated with loan conditions/terms		
The interest was too high	3	2
The toilet technology offered under the loan was too expensive	3	2
I was not able to raise the deposit required	6	3
I felt that I would not be able to pay back if I took a loan	36	19
Information and process related barriers		
Did not know where to get a loan for sanitation	122	65
Did not have adequate information about the conditions of the loan	6	3
The process of acquiring a loan was too long	4	2
Other barriers		
Did not have adequate space for the sanitation technology I desired	1	1
Total	188	100

[a]The data from households that ever wanted to take a loan for sanitation in Blantyre City.

for sanitation. In this model, households that were unsure about taking a loan were considered to have rejected the microfinance option. The model shows that a household's decision to accept or reject the microfinance option was significantly associated with wealth status, type of pit latrine in use, concern about space for constructing a replacement pit latrine, access to a garden for crop production and experience in taking a loan.

Microfinance and sanitation technology preferences

Table 4 compares household stated sanitation technology preferences without and with the microfinance option. In this table, households that had intention to empty their sanitation facility (14% of the sampled households) were considered to have preferred the sanitation technology they were using at the time of the study. The table shows that the proportion of households stating a preference for alternative improved sanitation technologies increased significantly when we gave the households an option for microfinance. On the other hand, the proportion of households that stated a preference for pit latrines decreased significantly.

Figure 1 compares sanitation technologies households were using at the time of the study in all the wealth quintiles (from the lowest quintile (Q1) to the highest quintile (Q5)) and their sanitation technology preferences before and after we gave them an option for microfinance. When we gave the households an option for microfinance, the proportion of households that stated a preference for unimproved and improved pit latrines decreased in all the wealth quintiles, while the proportion of households that stated a preference for the ecological sanitation increased significantly in all the wealth quintiles. However, the proportion of unimproved pit latrines remained highest among households in the lowest wealth quintile.

When we compared the stated sanitation technology preferences between households that accepted the microfinance option and households that declined the option (Table 5), we observed that households that accepted the microfinance option were 21.2 times more likely to select ecosan technology over improved pit latrines ($p < 0.001$) and they were 12.3 times more likely to state a preference for the water-based technologies over improved pit latrines ($p < 0.001$). The results also showed that households in the lowest wealth quintile (Q1) compared to households in the middle wealth quintile (Q3) were 3.3 times more likely to select unimproved pit latrines over improved pit latrines ($p < 0.001$).

DISCUSSION

The debate about microfinance for sanitation has focused on how microfinance increases demand for improved sanitation. However, improved sanitation includes a range of sanitation technology options which demand different excreta management systems. This paper expands the debate about microfinance for sanitation by examining

Table 3 | Indicators of demand for microfinance for sanitation ($n = 1,198$[a])

Variable	n	Odds ratio	p-value	95% conf.int
Household income category				
1st Quintile (lowest) (ref)	235			
2nd Quintile	275	1.2	0.35	0.8–1.7
3rd Quintile	214	2	0.001	1.4–3.1
4th Quintile	243	1.2	0.47	0.8–1.8
5th Quintile (highest)	231	1.2	0.34	0.8–1.9
Had taken a loan before				
No loan before	930			
Had taken a loan before	268	2.1	<0.001	1.6–2.7
Type of pit latrine in use				
Pit latrine with a slab floor – pit lined (ref)	220			
Pit latrine with a slab floor – pit not lined	633	2	<0.001	1.4–2.7
Pit latrine without a slab floor (unimproved pit latrine)	345	2.2	<0.001	1.4–3.3
Concern about space for sanitation				
No concern (ref)	891			
had concern about space for sanitation	307	1.4	0.02	1.0–1.8
Access to a garden for food crop production				
No access (ref)	792			
Had access to a garden	406	1.3	0.05	1.0–1.7
Knowledge of ecosan technology				
No prior knowledge (ref)	392			
Prior knowledge	806	1.3	0.06	1.0–1.6
Constant		0.2	<0.001	0.1–0.4

[a]Data in Table 3 excludes the following: (i) Households that owned ecosan (32) because ecosan facilities are designed to be emptied and all households with ecosan preferred to empty their sanitation facility, (ii) households without a sanitation facility (19) because we were interested in understanding the relationship between a household's current sanitation facility and their sanitation technology preference, (iii) households whose choices were rejected because of inconsistency of their data (51) and (iv) households with pour flush toilet (1).

the socioeconomic indicators of demand for microfinance for sanitation, and whether access to microfinance for sanitation would significantly increase the proportion of households upgrading to improved pit latrines or alternative improved sanitation technologies. Our results suggest that access to microfinance for sanitation would significantly reduce the proportion of households using unimproved and improved pit latrines and significantly increase the proportion of households upgrading to alternative improved sanitation technologies. Our results have important implications for the design of microfinance for sanitation programmes and access to safely managed sanitation in low-income and high population density urban settlements.

Indicators of demand for microfinance for sanitation

Our results showed five socioeconomic indicators of demand for microfinance for sanitation: household wealth status, availability of space for constructing replacement pit latrines, type of pit latrine in use, experience in taking a loan and access to a garden for food crop production.

Household wealth status

A key obstacle to improving access to improved sanitation through the promotion of microfinance for sanitation is that microfinance for sanitation fails to reach very poor households (Davies & Tinsley 2013; Trémolet & Kumar

Table 4 | Stated sanitation technology preferences before and after households were given the microfinance option ($n = 1,198$)

	Preferences before microfinance option		Preferences after microfinance option		
Stated sanitation technology preferences	***n***	**%**	***n***	**%**	**Chi- square**
Pit latrines					
Improved pit latrine					
Pit latrine with a slab floor – pit not lined	495	41	309	26	<0.001
Pit latrine with a slab floor – pit lined	320	27	294	24	<0.01
Unimproved pit latrine					
Pit latrine without a slab floor	174	14	97	8	<0.001
Subtotal – pit latrines	***989***	***82***	***700***	***58***	***< 0.001***
Alternative sanitation technologies					
Water-based technologies:					
Septic tank	16	1	17	1	0.32
Pour flush	43	4	103	9	<0.001
Ecological sanitation:					
UDDT	66	6	179	15	<0.001
Fossa alterna toilet	84	7	199	17	<0.001
Subtotal – alternative improved sanitation	***209***	***18***	***498***	***42***	***< 0.001***
Total	**1,198**	**100**	**1,198**	**100**	

2013). Our results support this observation. We observed that households in the middle wealth quintile compared to the households in the lowest wealth quintile were two times more likely to accept the loan option ($p = 0.001$). However, we did not observe a significant difference in the decision to accept the microfinance option between households in the lowest wealth quintile and households in the fourth and highest wealth quintiles. We think that this is because most households in the fourth and highest wealth quintiles had access to a lined pit latrine, which can safely be emptied (Jenkins *et al.* 2015; Chunga *et al.* 2016), so they declined the loan option as they did not need to construct a new sanitation facility.

When we examined sanitation technology preferences between wealth quintiles, we observed that 8% of the sampled households (mostly households in the lowest wealth quintile) preferred to install unimproved pit latrines and when we compared sanitation technology preferences

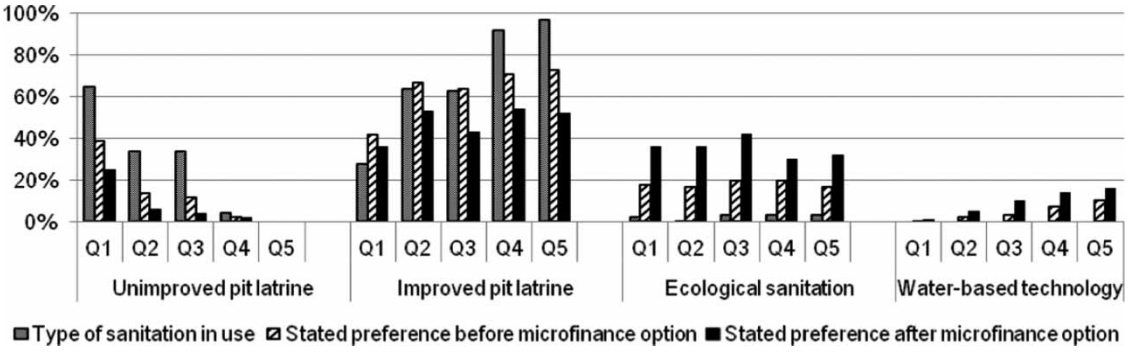

Figure 1 | Stated sanitation technology preferences by wealth quintile ($n = 1,198$).

Table 5 | Multinomial logistic regression model using improved pit latrine as the reference category ($n = 1,198$)

		Water-based technologies			Ecological sanitation			Unimproved pit latrine		
Variable	***n***	**RRR**	***p*-value**	**95% conf.int**	**RRR**	***p*-value**	**95% conf.int**	**RRR**	***p*-value**	**95% conf.int**
Accepted/rejected the loan offer										
Rejected the loan offer (ref)	615									
Accepted the loan offer	583	12.3	<0.001	7.5–20.2	21.2	<0.001	14.6–30.8	0	0.969	0.000
Household wealth status										
Quintile 3 (ref)	214									
Quintile 1 (lowest)	235	0.4	0.07	0.2–1.1	1.1	0.81	0.6–1.8	3.3	0.01	1.3–8.0
Quintile 2	275	0.4	0.01	0.2–0.8	0.8	0.26	0.5–1.2	0.8	0.72	0.3–2.2
Quintile 4	243	1.5	0.23	0.8–2.9	0.8	0.32	0.4–1.3	1.1	0.90	0.3–4.4
Quintile 5 (highest)	231	1.4	0.36	0.7–3.1	1.2	0.67	0.6–2.2	0	0.99	0.000
Type of pit latrine in use										
Unimproved pit latrine (ref)	345									
Improved pit latrine	853	1.3	0.43	0.7–2.6	1.1	0.79	0.7–1.6	0.0	<0.001	0.01–0.1
Concern about space for sanitation										
No concern (ref)	891									
Concerned about space for sanitation	307	1.0	0.95	0.6–1.6	1.1	0.62	0.8–1.6	0.5	0.15	0.2–1.3
Number of households at a plot										
One household (ref)	376									
2–3 households	410	0.7	0.19	0.4–1.2	0.8	0.29	0.5–1.2	1.4	0.37	0.7–2.9
Over 3 households	412	0.6	0.08	0.4–1.1	0.7	0.10	0.5–1.1	0.7	0.33	0.3–1.5
Access to a garden for food crop production										
No access to a garden (ref)	792									
Had access to a garden	406	0.7	0.19	0.4–1.2	1.2	0.23	0.9–1.7	0.9	0.65	0.5–1.6
Knowledge about ecosan										
No prior knowledge (ref)	392									
Had prior knowledge	806	0.8	0.28	0.5–1.2	1.8	0.00	1.2–2.5	0.5	0.03	0.3–0.9
Source of drinking water										
Communal water kiosk	777									
Had piped water on the yard	421	0.7	0.33	0.4–1.3	1.3	0.33	0.8–2.0	1.6	0.33	0.6–4.3
Constant		0.1	<0.001	0.03–0.2	0.1	<0.001	0.03–0.1	0.9	0.80	0.2–3.0

between wealth quintiles, we observed that households in the lowest wealth quintile compared to households in the middle wealth quintile were 3.3 times more likely to state a preference for unimproved pit latrines over improved pit latrines ($p = 0.01$).

Our results suggest that the current design of the microfinance for sanitation programme in urban Malawi would not lead to equitable access to safely managed sanitation. Households in the lowest wealth quintile would need more affordable sanitation technologies, flexible microfinance options and possibly targeted subsidies to gain access to safely managed sanitation.

Availability of space for constructing replacement pit latrines

As urban populations increase, availability of space for constructing replacement pit latrines is one of the key

challenges facing many households (Isunju *et al.* 2011; Chunga *et al.* 2016). In this study, we found that 25% of the households were concerned about space for constructing replacement pit latrines. Where there is concern about space for constructing replacement pit latrines, households adapt by seeking solutions to reduce the frequency of digging new pits. Improvements include purchasing a slab, lining the pits that collect excreta with bricks and mortar, roofing latrines, or adopting an alternative sanitation technology (Chunga *et al.* 2016). Households need money to make these adjustments, often substantial expenses at short notice.

The results showed that households that were concerned about the availability of space for constructing replacement pit latrines compared with those reporting no space concern were 1.4 times more likely to accept the loan option ($p = 0.02$). This suggests that microfinance for sanitation is particularly important among households that are concerned about the availability space for constructing replacement pit latrines. We think that pressures associated with increasing urban population density have the potential to drive sanitation technology preferences and choices (Chunga *et al.* 2016). We therefore expect demand for microfinance for sanitation to increase significantly as urban population densities grow and space for constructing replacement pit latrines declines.

Type of pit latrine in use

Research in Malawi and in Dar Es Salaam has shown that households using improved lined pit latrines are more likely to maintain using lined pit latrines by emptying them when they fill up (Jenkins *et al.* 2015; Chunga *et al.* 2016). This possibly indicates the satisfaction households have on improved lined pit latrines. The results showed that households that were using improved pit latrines that were not lined compared with households using improved lined pit latrines were two times more likely to accept the microfinance option ($p < 0.001$). The results also showed that households using unimproved pit latrines compared to households using improved lined pit latrines were 2.2 times more likely to accept the microfinance option ($p < 0.001$).

The results suggest that access to microfinance for sanitation is less useful to households that have already upgraded to a lined pit latrine than it is to households that have not yet upgraded to an empty-able option, such as a lined pit latrine or one of the alternative sanitation technologies examined in this study. We conclude that, in this setting, microfinance has the potential to accelerate progress among households at the lower end of the sanitation ladder (e.g. from unimproved to improved pit latrine or alternative improved technologies).

Experience in taking a loan

Households that have experience in borrowing tend to borrow more (Schicks 2014). This possibly reflects the value they put on microfinance and their ability to take a loan and pay back. We found that households that had experience in borrowing compared to households that did not were 2.1 times more likely to accept the microfinance option ($p < 0.001$).

We think that households that have experience in borrowing are potential customers for microfinance for sanitation improvement. However, microfinance institutions are unlikely to know the potential demand for microfinance for sanitation or innovative sanitation products that are on demand, without support from non-profit organisations (Chatterley *et al.* 2013). It is therefore important that non-profit organisations should support microfinance institutions in developing suitable microfinance for sanitation options.

Access to a garden for food crop production

Ecosan toilets are alternative sanitation technologies that allow users to treat excreta on-site and use the treated human excreta as fertiliser for food crop production. They offer users an opportunity to have access to a sanitation facility they can use for many years, since they have been designed to be emptied (Morgan & Mekonnen 2013; Tilley *et al.* 2014). The prospect of owning a permanent sanitation facility and using excreta as a fertiliser attracts households to upgrade to this technology (Abraham *et al.* 2011; Uddin *et al.* 2012).

The results showed that households that had access to a garden for food crop production compared to households that did not were 1.2 times more likely to accept the microfinance option ($p = 0.05$). We think that access to a garden

for food crop production would drive demand for microfinance for the adoption of ecosan facilities. However, access to a garden for food crop production alone is unlikely to be a major driver of demand for microfinance for sanitation since only 34% of the households had a garden.

Stated demand for alternative improved sanitation technologies

The debate about microfinance for sanitation has focused on how it (microfinance) significantly increases the adoption of improved sanitation facilities (Trémolet *et al.* 2015; Geissler *et al.* 2016). However, improved sanitation covers a range of sanitation technology options that demand different excreta management systems. For example, fecal waste from pour flush or septic tanks must be collected and transported to wastewater treatment stations while ecosan toilets are designed to allow users to treat their fecal waste on-site and use it as fertiliser. As the sanitation sector seeks strategies for improving access to safely managed sanitation, it is important to understand the potential impact of microfinance for sanitation on sanitation technology preferences.

Our results suggest that access to microfinance for sanitation would significantly increase the proportion of households upgrading to alternative improved sanitation technologies. When we gave households an option for microfinance, the proportion of households that stated a preference for pit latrines reduced from 82 to 58%, while the proportion of households that stated a preference for alternative improved sanitation technologies increased from 18 to 42%. These results suggest that non-profit organisations promoting alternative improved sanitation technologies in low-income urban settlements would significantly increase the market share of the alternative sanitation technologies if they link households to microfinance institutions. However, the market share of the alternative technologies in this study would increase to a limited extent because of the challenges associated with their operation and maintenance. Research shows that ecosan facilities are difficult to operate, particularly when shared among multiple households (Roma *et al.* 2013; Chunga *et al.* 2016; Simiyu 2017). With regard to the pour flush toilets, lack of a constant supply of water for flushing is a key barrier (Simiyu 2017). In this study, only 34% of the sampled households had piped water on their yard.

The design of the microfinance for sanitation programme in Malawi

It has been observed that many microfinance institutions offer customers highly standardised microfinance products or 'one-size fits all' loan terms and conditions (repayment period, size of loans) to simplify decision-making for field staff and hold down operational costs (Meyer 2002). However, the policy of offering highly standardised microfinance terms and conditions does not always work in favour of poor households (Meyer 2002). Microfinance institutions that offer highly standardised microfinance products are likely to exclude poor households from taking loans, force customers to over-borrow and consequently struggle to meet their weekly or monthly loan repayment conditions and default (Meyer 2002; Schicks 2014).

We think that the microfinance for sanitation options that were available to the households at the time of the study were not flexible enough to encourage many poor households to take a loan to improve their sanitation. Although many households (48%) stated that they would take a loan to improve their sanitation, only 3% of the sampled households had actually managed to improve their sanitation through a loan from a microfinance institution.

At the time of the study, the organisation that was offering microfinance for sanitation in the two cities (CCODE) was offering microfinance for UDDTs only (Hunga 2016). The UDDTs were costing from 155 to 200 USD. In contrast, a cheaper ecosan technology – fossa alterna toilet – was available at about 66 USD and a slab for the construction of a pit latrine was about 11 USD. Our results showed that households needed the loan not for UDDTs only, but also for cheaper sanitation technology options including a pit latrine with a slab floor. We think that the policy of offering microfinance for UDDTs only excluded many households from taking a loan for sanitation and forced many households to take a loan for the most expensive sanitation technology option when cheaper options were available. We also think that this policy contributed to the high default

rate CCODE experienced in some areas (up to 72% in some areas) between 2009 and 2012.

The second organisation (OIBM) was offering microfinance for a range of sanitation technologies but households were required to join a loan group and pay back their loans within one year (Chatterley *et al.* 2013). Our results showed that some households had problems accessing loans for sanitation through a group, either because they did not want to join a group, found it difficult to find other households to join a loan group or some members in a group failed to raise the deposits households were required to pay to access a loan. Other researchers have found that some households prefer individual loans to group loans (WSP 2014). Regarding loan repayment period, our results showed that many households (51%) preferred to pay back their loans for a period of two years. Paying back a loan for two years means lower monthly payments which can be suitable for households struggling to find adequate cash to pay back their loan within one year.

To encourage more households to take loans to improve their sanitation, non-profit organisations will need to form partnerships with microfinance institutions and support the microfinance institutions in mobilising communities and developing affordable and flexible microfinance options (Chatterley *et al.* 2013).

Implications of the results of the study on demand for hygienic pit emptying services

We think that access to microfinance for sanitation would increase demand for hygienic pit emptying in the long-run. At the time of the study, non-profit organisations in Malawi were promoting pour flush toilets with a single pit. Households adopting pour flush toilets with a single pit would need to empty them as soon as they fill up, either by using a vacuum truck or manually operated pit emptying equipment and transferring the fecal waste to a treatment station (Tilley *et al.* 2014). Regarding ecosan, users are expected to empty their facilities every 6–12 months and use the excreta as fertiliser. However, results of a study on the use of ecosan in Malawi showed that households that do not have gardens for food crop production fail to dispose excreta from the ecosan facilities safely (Morgan & Mekonnen 2013). For households without gardens, organisations should consider offering them the double ventilated improved pit latrine as it allows households to treat excreta for longer periods of 1–2 years (Tilley *et al.* 2014).

Unless organisations improve and increase access to hygienic pit emptying services, for excreta from pit latrines, pour flush and ecosan facilities, access to microfinance for sanitation may actually threaten and not improve public health in the long-run if rates of unsafe emptying increase.

CONCLUSIONS

Our results suggest that access to microfinance for sanitation would significantly reduce the proportion of households using unimproved and improved pit latrines and significantly increase the proportion of households upgrading to alternative improved sanitation technologies. Our results also suggest that demand for microfinance for sanitation is strongly associated with household wealth status, concern about space for constructing replacement pit latrines, type of pit latrine in use, access to a garden for food crop production and experience in taking a loan from a microfinance institution. Organisations seeking to improve access to safely managed sanitation, through the promotion of alternative improved sanitation technologies, would significantly increase the market share of the alternative sanitation technologies if households have access to affordable alternative sanitation technologies and microfinance for sanitation. However, poorer households would need more affordable improved sanitation technologies, flexible microfinance options and possibly targeted subsidies to gain access to safely managed sanitation.

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