Ecological sanitation in Mozambique: baseline data on acceptability, use and performance*

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Abstract

Households using ecological sanitation ("ecosan") latrines in Niassa province, Mozambique, (n=76) were surveyed regarding the factors contributing to the adoption, acceptability, use, and maintenance of these latrines. Neighbors without ecological sanitation latrines were also surveyed, for comparison. Biosolid samples taken from in-use latrine pits had a mean temperature of 23°C (16.1°C–30.4°C), pH of 8.3 (5.7–10.2) and moisture content of 48% (13-88%). Most users learned of ecological sanitation through the non-governmental organization (NGO) WaterAid and its partner organizations. Households chose ecological sanitation for a variety of reasons, including the design, construction, maintenance, and health benefit of the latrines. Users found ecosan latrines very satisfactory, and were following maintenance directions. Based on the low average temperature and varying moisture contents of the latrine samples, we recommend prolonged storage (1-2 years) and that precautions be taken when using the biosolids for agriculture.

Introduction

Prompted by the educational outreach work of the international NGO WaterAid and its Mozambican partner organizations, households in the province of Niassa, Mozambique, are rapidly adopting ecological sanitation ("ecosan") technology in which human wastes are stored until safe and then reused as fertilizer for agriculture. ESTAMOS, a community organization that promotes food security, HIV/AIDS prevention, and safe water and sanitation, is the partner organization that works in the districts of Lichinga and Mandimba, where this study was conducted. Lichinga is the provincial capital of Niassa, Mozambique's poorest and most remote province, and Mandimba is a large district capital within the province.

The primary ecosan design promoted by WaterAid through ESTAMOS is the "fossa alterna," which consists of two permanent, partially lined, shallow (1.25 – 1.75 meter) pits and a movable concrete latrine slab. This slab covers the pit that is in use, and a wooden cover protects the pit that is not in use. Thatched straw walls surround the two pits and a private bathing area, which is attached (fig. 1). Fresh excreta are covered with a mixture of ash and soil. When the first pit is full-after approximately one year of use-it is covered and its contents are allowed to decompose. The second pit is then used until it is full, at which point the first pit is prepared for reuse: its

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contents are removed and are further decomposed or used immediately as fertilizer. Since the spring of 2001, communities throughout Niassa have requested assistance with constructing more than one thousand fossa alterna ecosan latrines, and more than three hundred of these have already been built.

This study highlights the attitudes and behaviors of ecosan users as they begin to use ecological sanitation. At the time of the study, few households had begun using the second pit. This study therefore does not address the impact of ecosan latrines after the decomposed excreta have been removed. Instead, building on WaterAid's regular monitoring and evaluation of Niassa's fossa alterna latrines, this study documents baseline information on 1) latrine preference and ecosan acceptability, 2) the use and maintenance practices of ecosan latrines, and 3) selected physical and chemical characteristics of the biosolids in the latrines.

Figure 1: Fossa Alterna Latrine

Methods

Eligible population

This June 2002 to July 2002 study investigated all households known to have fossa alterna latrines in the peri-urban towns of Lichinga and Mandimba and in the surrounding rural communities. Latrines that had been completely built but which were not in use because they lacked a concrete slab were included in the study. Also included in the study were the one or two closest households neighboring each household with an ecosan latrine. Eligible respondents in all households were people who were over 18 and were responsible for latrine maintenance (if applicable).

Field survey

In June and July 2002, interviewers fluent in local languages (Portuguese, Nyanja, Macua, and Yao) conducted surveys of households with fossa alterna latrines (n=76) and of their closest neighbors (n=110). The in-depth surveys asked up to 338 questions. The type of latrine owned (if any), the number of latrines owned, and whether the owned latrines were in use determined which questions were asked in each household.

The research team visually inspected latrine construction and maintenance and noted evidence of use. Using PVC pipe of 3.8 cm diameter, the team took core biosolids samples from 48 in-use and two full (dormant) pits. Ambient and sample temperatures were taken on-site, and the samples were taken to the lab in plastic bags.

Physical and chemical measurements

Moisture content of the core samples was determined by comparing the initial weight of a 20-60 gram sample with the weight of the same sample after the sample was dried. Samples were dried in the sun in metal weighing dishes, on a concrete slab covered with black plastic. Samples were covered with plastic overnight and during inclement weather. The pH of the

sample was measured with a standard pH probe. If necessary, the sample was diluted with small amounts of neutral water until the pH could be measured.

Analysis

Two households with ecosan latrines are omitted from analysis because their respondents were younger than 18 years. In order to reduce the potential bias of a varying sample size, direct comparisons between households with ecosan latrines and their neighbors used only one comparison neighbor, even if two comparison neighbors were surveyed.

Results

Background demographics

Communities that are farther than a 30 minute walk from the administrative centers of Lichinga and Mandimba were classified as rural (n=32); others are classified as peri-urban (n=42). Thirty study households were in Lichinga, and 44 in Mandimba. The mean household size was 5.5 people in houses with ecosan latrines and 5.1 in houses without ecosan latrines. About 61% of households were Muslim, and 39% were Christian. The materials used to construct houses indicate poor economic status: 79% of ecosan households had roofs made of straw, 81% had walls made by free hand, and 81% had dirt floors. Regarding property, 55% had bikes, 56% had radios, 4% had televisions, and 15% had access to electricity. Households with ecosan latrines did not differ significantly from their neighbors by socio-economic indicators.

Seventy-six percent of households with ecosan latrines grow food in machambas (agricultural fields that are away from the home) or in home gardens. Research on agricultural practice, conducted in Mandimba only, found that all of the ecosan households that grew food used fertilizer, thought that their land was not fertile, or thought that fertilizer would help their land.

In terms of health, 18% of respondents from households with ecosan latrines thought they had worms, 18% thought that their youngest child had worms, and 24% reported that their youngest child had had diarrhea in the past week.

Knowledge, preference and acceptability

When asked how they heard of ecosan, 63% of people with ecosan latrines identified ESTAMOS as the source of their introduction to ecological sanitation. Ten percent reported having heard of ecological sanitation from a community leader (such as a chief, secretary, or sanitation activist), and 10% reported having heard of ecosan on the radio. When asked directly regarding whether they had heard about ecosan on the radio, 36% of households with ecosan latrines and 35% of their neighbors responded affirmatively.

Among owners of fossa alterna latrines, 23% chose this type of latrine for its structural aspects (design and construction), and 14% chose ecosan for aspects relating to its use or outcome (maintenance, health, or fertilizer, for example). A substantial proportion of all ecosan owners, 41%, reported not having chosen this type of latrine for themselves (table1).

Why ecosan owners chose ecosan latrines (n=70)	**%**
design	17
construction	5.7
maintenance	7.1
health	5.7
fertilizer	1.4
generally attractive/other	19
did not choose ecosan latrine	41
don't know	2.9

Table 1: Factors in latrine choice

The majority of ecosan owners reported that their hands felt dirty after defecating (88%), that they were accustomed to washing their hands when they didn't feel dirty (95%), that feces were dangerous (85%), and that latrines improve health (82%). For these attitudes, there were no significant differences between ecosan owners and their neighbors. Ecosan owners were significantly more likely to think that using composted feces and urine from a latrine on agriculture would improve health ($p = 0.0098$).

Ecosan users, but not their neighbors, most commonly identify fossa alterna latrines as the healthiest type of latrine and as the type of latrine they hoped to have in two years (fig.2). Both households with ecosan latrines and their neighbors viewed traditional pit latrines as the hardest to maintain. Improved pit latrines are defined by their concrete slabs, whereas traditional pit latrines have platforms made of poles.

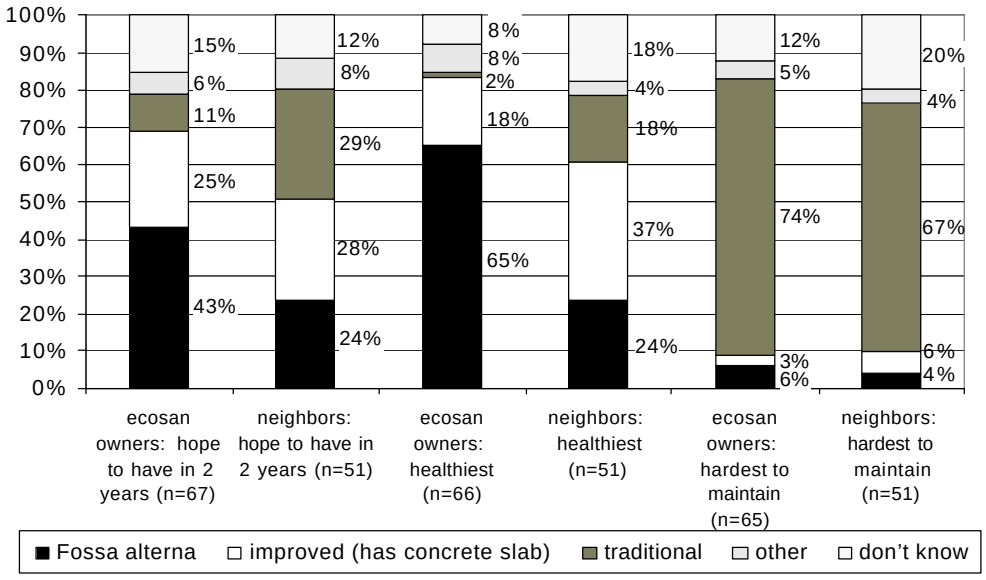

Figure 2: Perceptions of latrine types

All respondents reported receiving assistance in ecosan latrine construction, but only 18 percent of households with ecosan latrines reported that they would have built the same latrine without assistance. Ninety-one percent reported having received help with materials, 83% with construction advice, and 61% with construction labor, and none reported having received monetary assistance. In contrast, although the sample size was smaller, no owners of other types of latrines reported having received any construction assistance. Few people knew the cost of constructing their latrine (table 2)[1].

	ecosan latrines	non-ecosan latrines
received assistance in building latrine	95% (69/73)	0% (0/23)
would have built the same latrine without assistance	18% (12/66)	not applicable
know cost of constructing latrine	0% (0/72)	15% (4/26)

Table 2: Assistance in constructing latrines

Ecosan users nearly universally reported satisfaction with their ecosan latrines, and many reported that they would recommend this type of latrine to someone else (tab.3)[2]. Comparing ecosan users in Lichinga with their neighbors who had functional latrines, ecosan users were significantly more likely to report latrine satisfaction ($p<.0001$) and willingness to recommend their type of latrine ($p<.0001$). When given the response options of improved health, worsened health, and health that has not changed, 86% of ecosan latrine users reported that their family

[1] The numbers in brackets indicate the number of positive responses divided by the total number of households interviewed."

[2] "The numbers in brackets indicate the number of positive responses divided by the total number of households interviewed."

had experienced improved health since the construction of their latrine. Upon probing, people elaborated with comments like, "we do not have diarrhea problems" and "we are not frequently sick." Users of non-ecosan latrines also reported similar improved family health since latrine construction.

When asked to identify latrine aspects they liked, 56% of ecosan users mentioned construction in general or some specific construction aspect, such as the walls, the concrete latrine slab, or the roof. Thirty-one percent of users also specifically noted liking the latrine's two pits. When specifically asked to identify what they disliked, 43% declined and responded simply that they liked the latrine. Despite the overall affinity towards ecosan latrine construction and design, 11% of ecosan owners disliked the depth of the pits, and 14% identified the walls as problematic. They described the walls as weak, and some explained that they would prefer walls of brick.

	ecosan latrines	non-ecosan latrine
satisfied with latrine	98% (65/66)	80% (33/41)
would recommend this type of latrine to someone else	88% (53/60)	51% (18/35)
problem with smell*	17% (10/59)	33% (5/15)
problem with flies*	16% (9/58)	71% (39/55)
health improved since latrine construction*	86% (51/59)	87% (13/15)
more flies before construction of latrine*	13% (7/56)	40% (6/15)

*among households whose latrines are in use

Table 3: Acceptability of ecosan latrines

Use and maintenance practices

Ecosan users most frequently reported reducing latrine-related smell and flies by adding ash and dirt and by covering the latrine. Users of other types of latrines also reported adding hot or boiling water and hot ash. Although users of other types of latrines reported adding ash to reduce smell, only ecosan users reported adding a mixture of ash and dirt.[3]

The majority of ecosan users follow the instructions given by WaterAid to regularly add dirt, ash, or a mixture of ash and dirt: 83% reported doing so (tab.4)[4]. Upon inspection, 85% of all in-use latrines had ash, dirt, or a mixture available inside the latrine. 82% of all ecosan owners thought they should add dirt, ash, or a mixture. Only 3.4% of ecosan users add grass, straw, and/or kitchen scraps to their latrines, and 2.7% of all ecosan owners thought that these substances should be added to a fossa alterna latrine. No ecosan users reported adding trash to their latrine, and only 1.6% of all ecosan owners thought that trash should be added. 91% of ecosan users had handwashing sites with evidence of use.

	ecosan latrines
add dirt, ash, or mixture*	83% (49/59)
think dirt, ash, or mixture should be added	82% (61/74)
add trash*	0% (0/39)
think trash should be added	1.6% (1/64)
add grass, straw, or kitchen scraps*	3.4% (2/59)
think grass, straw, or kitchen scraps should be added	2.7% (2/74)
has hand washing site with evidence of use	91% (50/55)

*among households whose latrines are in use

Table 4: Maintenance attitudes and actions

Physical and chemical characteristics

Samples taken from the in-use pits of fossa alterna latrines had temperatures similar to the ambient temperature, with a mean

[3] On average, 3.2 adults and 1.8 children use each ecosan latrine, and all household members use the ecosan latrine in 89% of ecosan households. Among ecosan households, 26% have more than one latrine. Before constructing ecosan latrines, 6% reported defecating in the open; others reported using their neighbors' latrines.

[4] "The numbers in brackets indicate the number of positive responses divided by the total number of households interviewed."