Acceptance of EcoSan Concepts in Tanzania A Case Study of "Piloting Ecological Sanitation Majumbasita Dar Es Salaam"

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Abstract

Piloting Ecological Sanitation at Majumbasita Dar Es Salaam Tanzania particularly aimed at adaptation of Ecological Sanitation (EcoSan) as an option in combating sanitation problems in the country by recovering and recycles to the maximum extent the renewable resources present in human excreta.

EcoSan technology has drawn attention to many Majumbasita dwellers, international organizations, government line ministries, individuals and other stakeholders following the construction of 95 EcoSan Latrine units in household level and 6 stances School latrine in the project area. Two types of urine diversion toilets have been applied, the seat pan and squatting pan, the later is more acceptable to the community following the unplanned settlement in the area.

This paper provides insights and lessons learned from a piloting ecological sanitation project in Tanzania since November 2000. It includes findings of review as conducted to assess the operation and socio cultural pertaining the technology. It shows to what extent is the EcoSan is accepted in Tanzania. In addition, the paper explored community reactions towards the recycle of nutrients from human excreta and research on the recycling nutrients.

Public acceptability is promising following the PHAST (Participatory Hygiene and Sanitation Transformation) methodology carried out at all stages of project implementation.

Introduction

Unplanned settlements have kept increasing in many Tanzanian towns and there is no immediate plan to improve them. The problems of diarrhea and other faecal – related diseases remain highly endemic, despite enormous efforts over the past few decades to control them. The situation is even worse than sanitation coverage statistics depict. Coverage of sanitation facilities in Dar es Salaam (with approximate population of 3.4 million inhabitants, which is about 10% of the total population of the country) revealed that 79% of the inhabitant's uses pit latrines, 9% septic tanks and 12% uses conventional system Mato (2002).

Although a bigger number of people have access to some form of latrine, vast amounts of improperly managed faeces and untreated sewage contaminate the living environment. According to Haskoning and M Consult (1998) 50% of the pollution produced at domestic level per capita per day in Dar es Salaam was estimated to be received by pit latrines that have a pollution load to groundwater in kg/day estimated to be Biological Oxygen Demand (BOD_5) 15,282; Chemical Oxygen Demand (COD) 16,131; Suspended Solids (SS) 6,116; Dissolved Solids (DS) 97,857; Total Nitrogen 4,829 and total Potassium 915. The groundwater finally is used for water supply for domestic and industrial uses. The water users may suffer the consequences from the pollution.

Conventional forms of centralized and individual sanitation systems are not sustainable solution to sanitation problems in the country. In Dar Es Salaam City domestic sewage is collected by a sewerage system that was first constructed in the 1950's. The system serves only about 12% of the residents. The major part of the Dar es Salaam residents about 88% use on-site sanitation allowing its effluent to percolate into the soil representing a potential source of contamination of groundwater, which is an alternative source of water supply for the residents. (Piped water supply in the Dar es Salaam city supplies only 50% of water demand in the city by ration. To supplement piped supply more than 36 deep boreholes drilled in the city are supplied directly without treatment connected to the main water system Mato (2002). In addition, individual residents in the city are used to dug and drill shallow and deep wells to carter the problem of water supply in their respective residences).

Environmental Engineering and Pollution Control Organization (EEPCO) a Tanzanian Non Governmental organization recognized an urgent need to look into human excreta disposal option in the country that will not contaminate our environment.

EEPCO supported by UNICEF Tanzania pioneered and implemented a piloting of ecological sanitation project in Majumbasita Peri-urban area in Tanzania since November 2000.

Ecological Sanitation is a system that makes use of human waste and turns it into something useful and valuable, with minimum pollution of the Environment. In essence it consists of using latrines, which are safe and ecologically sound and designed in such a way the end products can be easily transferred into agriculture or forestry (Morgan, 1999).

Pilot Area

The piloting Ecological Sanitation Project in Tanzania have been implemented by EEPCO in unplanned settlements at the Peri-urban part of Dar Es Salaam called Majumbasita in Kipawa ward Ilala District. The current population is about 23,000 inhabitants.

The piped water supply from the city network caters for only a small proportion of the inhabitants in the project area and the source is in intermittent. Many people (85%) in the area depend on well water, which its quality is doubtful. According to Chaggu and John (2002), Escherichia coli (E-Coli) count for samples from boreholes with depths 1.8metres and 6.5metres were 3000 feacal coliform (FC)/100millilitres(mil) and 178FC/100mil respectively. The pollution is definitely due to seepage from pit latrines and septic tanks. These conditions have resulted into breakout of cholera and other faecal related diseases mostly during rain seasons.

Project Activities

Main activities inputs to the piloting project included, community awareness creation and sensitization about sanitation improvement and introduction of EcoSan concept. This was achieved mainly by using Participatory Hygiene and Sanitation Transformation (PHAST) methodology. Another activity involved in the project was recruitment of local masons to be well acquainted with theoretical and practical aspects of EcoSan latrine technology so that they will be resource persons in the project for its sustainability. Another activity was construction activities of EcoSan latrines where by 95 units (double vault, urine diversion) were constructed in household (hh) level and 6 stances school latrine. Monitoring and evaluation is the other major and important activity in this project to measure project acceptability and sustainability.

To accomplish the activities some stakeholders were involved from the start of the project including the implementing agency (IA) EEPCO, UNICEF, local governments, community etc. The following sections discuss the main activities of the project, and achievements.

PHAST training to CORPs (Community Owned Resource personnel)

PHAST is one of the best working Participatory approach methodologies to address water, sanitation, hygiene, behavior and attitude change (PHAST training guidelines, 1998). The hygiene and sanitation promotion processes focuses on the linkages between water, sanitation,

hygiene and health in the areas of personal hygiene and its related water uses; safe and unsafe water; waterborne and excreta related diseases; environmental cleanliness; food handling and storage; specific behaviors such as hand washing practices; and latrine use and maintenance.

The project IA recognized the importance of applying PHAST methodology in implementing the project. To make sure that the PHAST methodology is equipped to the community in a sustainable manner, some members of the community were trained to be PHAST CORPs in their area, these are expected to train other people in the area. The number of PHAST CORPs with capacity to impart PHAST knowledge to others in the area is 22, trained by national PHAST trainers for a period of 10 days and also had one month on job training under national PHAST facilitators. The PHAST CORPs in the area has formed a community group aiming in facilitating community PHAST meetings to other members of the community.

Recruitment of masons/artisans

The exercise of recruiting masons was successfully done. To date12 masons have EcoSan technical skills. These are the ones who constructed the mentioned 95 EcoSan units in hh level and 6 stances school latrine. Methods used were lectures and lot of practices & demonstrations.

EcoSan Construction Activities

Constructions of EcoSan latrines in hh level were done in cost sharing. The table below shows cost sharing for constructing one EcoSan unit in hh.

Item	Project contribution US$	Hh/community contribution US$	Total US$
All materials for Substructure	80		80
Skilled Labor costs for substructure	12		12
Casual Labor costs for substructure		3	3
Construction site and water		Not valued	
Materials for Superstructure- walls and door		[1]Variable. Maximum 70	70
Roofing materials	15		15
Vent pipe	6		6
All Labor costs for superstructure		15	15
Total	113	88	201
Percentage %	56.2	43.8	100

Table 1: Cost For One Unit Double Vault hh EcoSan Latrine

Construction activities for all 95 hh units were carried out successfully and in time. Generally the community accepted the project, and their contribution and commitment in the construction activities was high and encouraging. This is due to the learnt benefits of EcoSan toilet including conserving the environment and water.

Ecological Gardens

Study gardens have been established at Karakata primary school compound and at individual households for trial purposes of recycling nutrients from EcoSan latrines in the project area. The plants in the gardens, which were fertilized, include eggplants, banana trees, cassava plants etc. The crops have been divided into two categories the one irrigated with urine and the other not. This is to determine the efficiency of urine as a fertilizer.

Observations.

The following were things observed during the implementation period.

[1] *Costs for superstructure varies depending on the materials used for construction. The maximum cost in the project area is where sand: cement blocks were used for superstructure construction.*

Sanitation Prospects

- The communities in the project area keep their home environment clean, use water for anal cleansing and use latrines.
- Latrine coverage is high in the area. However, most of the latrines are traditional pit latrines lacking privacy, doors, and roofs and characterized by poor dirty squatting slabs. In addition are characterized by high water table, and the situation is worse during rain seasons.
- Latrines are dug mostly shallow, because of the high water table and the soil are sandy and very collapsible in the wet seasons. The pits are mostly lined by sand: cement blocks
- The community uses ground water/well water as a reliable source of water supply in the area.

[2]Community Reactions

- EcoSan Technology though new has attracted many people. They found it to have many advantages in their living environment, and most of the people proved it to be permanent latrine by having a standby vault (being a double vault is an added advantage to them).
- The community also welcomed the EcoSan as a solution to latrines construction in their area as they found it permanent, simple, durable affordable, environmentally friendly and hygienically safe.
- Nutrient recycling was also found to be an added advantage to the community.

Construction Materials

The design criteria for selecting construction materials for EcoSan were suggested which takes into consideration of the following: - Locally available, easily applied, Affordable and durable.

With these in mind it was suggested that sand: cement blocks to be used in substructure construction. For superstructure construction the following materials were suggested to be appropriate for walls construction sand: cement blocks, new or used/old iron sheets/tins, timber, thatch etc depending on what the household can afford, and it provide privacy in the latrine. For roofing, new or used/old iron sheets/tins and thatch were suggested. Timber, new or used/old iron sheets/tins and thatch were suggested for making a latrine door.

Masonry Thatch Used/old iron sheets

Figure 2: EcoSan latrines - superstructures by different construction materials – Majumbasita DSM. (Photos by EEPCO 2002)

[2] *These reactions of communities were collected during PHAST facilitation in community level. They are important towards the Successes of the lessons learned because it will help in spreading the technology to reach and benefit more people quicker.*

[3]EcoSan Pans Types and User's choices

A Survey conducted in the 43 household using EcoSan latrines 19(44.2%) prefers seating pan in their toilet and 24(55.8%) prefer squatting pan.

Among 95 households using EcoSan latrines 34 (35.8%) have seating EcoSan pans while 61(64.2%) has squatting EcoSan pans. Choice trend shows that more people in the project area prefer squatting pans than seating ones.

Figure 3a: EcoSan Latrine installed with squatting pan (Photos by EEPCO 2002)

Figure 3b: EcoSan Latrine installed with seating pan

EcoSan Toilets Usage Practice

The project management with assistance of community PHAST group carried a survey to the first constructed EcoSan latrines in 44 households in the project area. The survey took place between 27 November 2001 and 30 November 2001. The survey was aiming to check usage trend of the latrines and behaviour change among EcoSan latrine users and find some problems encountered in using the latrines. Below are the results & discussions.

	HH with EcoSan latrine surveyed	Latrines in use	[4]Latrines not in use	Latrines used in very good practice	Latrines used in good practice	Latrines used in poor/bad practice
No	44	28	16	18	9	1
%	100	63.6	36.4	64.3	32.1	3.6

Table 2: HH survey results for EcoSan latrine usage practice. (source: EEPCO final report for pilot project 2002)

Among the 28 hh using EcoSan latrines 21 hh (75%) said there is no problems in using the latrine. The remaining 9 hh (25%) has reported some problems such as smell, difficulty in urine separation, dislike of seating pan especially houses with many user including tenants and difficulties in washing seating pan. The project management with the users has solved the problems through participatory leaning and experiences from other users in the same area.

Furthermore, experience shows that after people have become familiar with these systems, no flies or smells occur, other people normally opt to install these toilets inside or adjacent their homes and most of their initial reservations are gone. Following this the number of EcoSan latrine users increases, and many has left their old pit latrine, and many has started using urine in gardens/plants to fertilize soil. (Charts below)

Table below shows the number and percentage of EcoSan Latrine users using urine in gardens/plants.

	HH with EcoSan latrine surveyed	Latrines in use	Latrines not in use	Hh using urine in gardens/plants	Hh not using urine in gardens/plants
No	44	28	16	13	15
%	100	63.6	36.4	46.4	53.6

Table 3: HH survey results - urine use in gardens/plants. (source: EEPCO final report for pilot project 2002)

[3] *EcoSan Pans are locally prefabricated using sand and cement for seating pan and aggregate for squatting pan, to be installed in EcoSan latrines.*

[4] *Latrines that are not in use were still under construction in the time of the survey.*

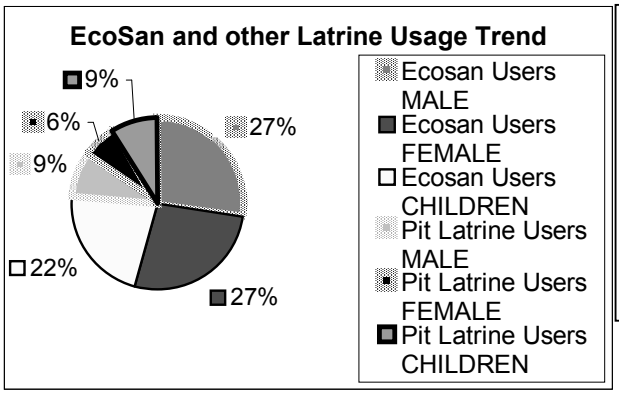

Figure 4: EcoSan and other latrines usage trend

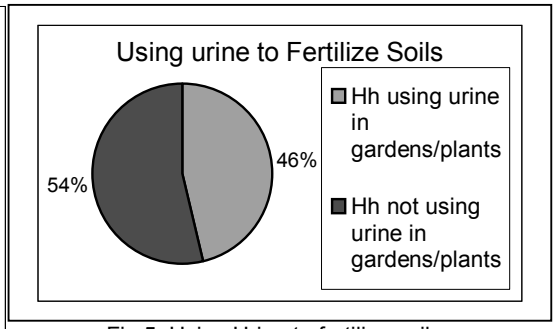

Fig 5: Using Urine to fertilize soils

Figure 4 Shows that, 76% of the total population in the hhs with EcoSan latrines has left their old latrines, and start using EcoSan. The number of EcoSan users in the hhs increases with time, depending on the experiences and knowledge given to the hhs occupants by the project management and first users.

Figure 5 Shows that 46% of hhs using EcoSan latrine has started using urine as a soluble fertilizer in their gardens/plants. The number of hhs Using urine in gardens/plants is increasing with time depending on the experiences and knowledge given to the hhs occupants by the project management and first users.

[5]Research & Laboratory Analyses

A research that included Laboratory analyses and field-testing of urine and dry sludge were carried in the department of Civil Engineering department, Water Section in the University of Dar Es Salaam. Analyses were supposed to be done in both urine and feaces for nutrient levels feacal pollution and heavy metal contents. The main reason being to observe that the excreta had or had not any nutrient to support plant life as fertilizer or soil conditioner and to check the level of contamination by both feacal and/or heavy metals.

Due to time and resources constraints only few Solid Feaces samples were taken on the 4th December 2001 for analysis to obtain baseline data that will be compared with the data to be obtained from Sanitized feacal matter, that will be analyzed when the latrine are filled and covered to allow complete sanitized. In addition analysis for heavy metals was dropped.

Enough urine samples were taken and analyzed from 4th December 2001 to 26th February 2002. The summary of results is given below.

Sampling pt	PH	COD (mg/L)	TSS (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	[6]TKN (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Faecal Coliform (No/100 ml)	Total Coliform (No/100 ml)
1	8.8	3850	2060	180.5	7.04	616	6.72	173.4	70	180
2	8.76	3620	1980	141	9.12	319.2	5.14	71.6	60	150
3	8.88	3300	1660	165.8	5.42	442.4	10.93	85.6	90	210
4	8.85	3580	1950	170.4	8.53	302.5	10.54	167.3	70	180
5	8.82	3560	1900	168.2	5.4	285.6	7.03	49.5	60	170
6	8.9	3780	2010	195	10.12	518	15.74	54	80	140
7	8.47	3300	3300	160.4	5.26	228.5	6.82	180.2	60	140
8	8.78	3520	3520	175	7.44	320.1	3.24	65.8	60	130

[5] *Research was very important to determine levels of nutrients in both urine and sanitized faecal matter.*

[6] *TNK = Total Kjeldahl Nitrogen (Sum of Organic Nitrogen and Ammonium and Ammonia Nitrogen). Total Nitrogen (TN) = TKN +Nitrite (N)+Nitrate (N)*

Sampling pt	PH	COD (mg/L)	TSS (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	[7]TKN (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Faecal Coliform (No/100 ml)	Total Coliform (No/100 ml)
9	8.8	3450	3450	170.5	6.35	298.2	3.67	78.5	80	180
10	8.66	3380	3380	186.2	6.24	314.5	9.12	143.6	70	160
11	8.84	3420	3420	165.8	5.46	298.6	8.54	98.2	90	200
12	8.74	3550	3550	186.5	6.93	386.2	10.22	63.4	70	190
13	9	4200	2400	125.6	4.75	596.4	24.5	330.8	60	160
14	9.23	5350	2680	208.5	26.815	1760	75.65	176.5	70	180
15	9.2	4830	1960	185.2	11.44	1366	47.8	184.3	40	120
16	8.52	3680	2100	190.4	13.1	967	28.4	104.6	20	100
17	8.98	5600	2900	235.3	26.25	1580.6	92.3	392.8	190	340
18	9,02	4950	2460	195.8	10.56	1220.2	67.5	204.4	130	310
19	9.05	3860	1350	148.3	9.76	783.7	52.9	192.5	170	370
20	8.93	4800	2160	180.5	15.62	1670.5	70.3	187.9	110	350
21	8.88	4500	1990	173.9	11.18	982.1	85.6	195.2	150	390
22	9,21	4150	2080	210.5	16.43	976.5	69.7	148.9	170	390

Table 4. [8]Table of Results for Urine Samples (Source: EEPCO & University of Dar es Salaam research report 2002)

Feacal & Total Coliform levels in Urine

Research results revealed that, the urine samples contained a few number of feacal coliform and total coliforms. The microorganisms' definitely originates from feacal matter, and is caused by the latrine users unexpectedly. However, the highest number of feacal coliforms found in one sample was 190 No/100ml is allowable for irrigation when compared to receiving water standards category 3 (maximum permissible concentration is 250 No/100ml). However, effort is required to prevent any possible ways, which allows the microorganisms to emerge and contaminate the urine. In addition further research is require to see improvements in controlling the cross contamination

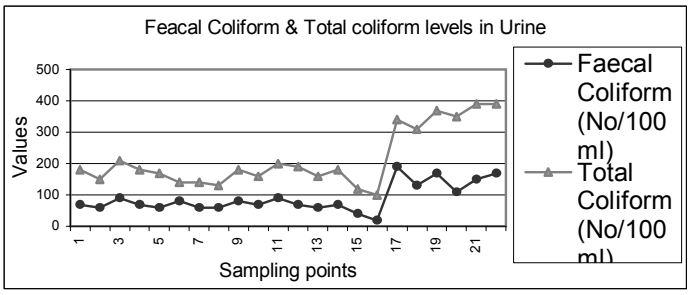

Figure 6: Feacal Coliform & Total Coliform levels in urine

NPK Values

According to Johnson (2002), 25-50 kg of faeces is produced per person per year; which contain up to 0.55 kg of Nitrogen, 0.18 kg of Phosphorus and 0.37 kg of Potassium. Furthermore, an adult may produce ~400 liters of urine per year containing 4.0 kg of nitrogen, 0.4 kg of phosphorus and 0.9 kg of potassium. Taking these figures into consideration, it means that, in Majumbasita per annum, they will produce 550 x 10^3 - 1100 x 10^3 kg of faeces with 88 x 10^3 kg of N, 8.8 x 10^3 kg of phosphorus and 19.8 x 10^3 kg of potassium. Comparing to the data obtained it suggested that there is a great potential in "human waste".

[7] *TNK = Total Kjeldahl Nitrogen (Sum of Organic Nitrogen and Ammonium and Ammonia Nitrogen). Total Nitrogen (TN) = TKN + Nitrite (N)+Nitrate (N)*

[8] *Source: Joint research report between EEPCO and University of Dar Es Salaam*

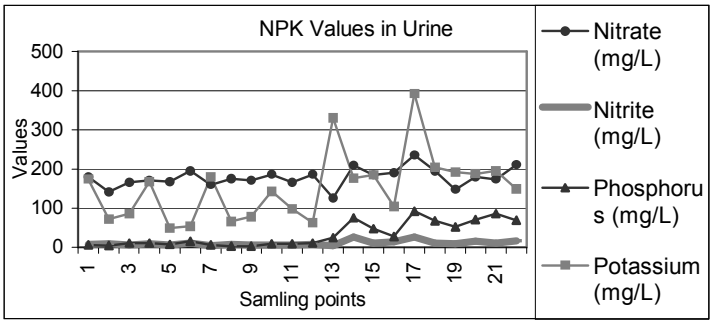

Figure 7: [9]NPK Values in urine

Future Plan

It is the aim of EEPCO to promote and spread the technology in Tanzania. Initially, EEPCO in its action plan has included a future plan to Promote Ecological Sanitation in Tanzania including Follow up of the piloting project in Majumbasita Dar Es Salaam, EcoSan promotion in schools, Organize National Workshop on Ecological Sanitation, Continuation of research on urine and sanitized feacal matter, Promotion of Ecological sanitation in Mara region and Mwanza City and Promotion of Ecological Sanitation in Hai District in Kilimanjaro region.

Conclusion

Ecological Sanitation toilets are very suitable for the Tanzanian environment especially in urban and peri-urban areas experiencing high water table problems, rocky and collapsible soil. Acceptability of the technology in Majumbasita Dar Es Salaam is promising, and people's uncertainties about EcoSan toilets faded away when they observe workable EcoSan latrines in their area. The pilot project was therefore vital in introducing EcoSan technology in Tanzania.

Communal acceptability, affordability, and political determination are very important in promoting EcoSan technology in Tanzania. Community involvement from the beginning onwards using Participatory approaches such, as PHAST methodology is vital for the success of EcoSan technology.

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[9] *NPK = Nitrogen + Phosphorus + Ammonium*