FINAL REPORT

ON

EVALUATION OF ECOSAN FACILITIES IN CHAISA COMPOUND OF LUSAKA

BY

LUSAKA WATER AND SEWERAGE COMPANY LIMITED AND CARE INTERNATIONAL ZAMBIA – WATER AND SANITATION FOR THE URBAN POOR

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EVALUATION OF ECOSAN FACILITIES IN CHAISA COMPOUND OF LUSAKA

EXECUTIVE SUMMARY

This document presents results of the review of EcoSan facilities in Chaisa Compound pilot project, a peri-urban area of Lusaka. The study focused on collecting information on the operation and maintenance from 45 household which benefited from the SIDA-CARE project with respect to being provided with EcoSan facilities in Chaisa Compound. Twenty four (24) households without the facilities but living in the vicinity of the facilities were also interviewed. Lastly, institutions with a stake in sanitation provision were also targeted. The instruments were semi-structured questionnaires for each of the three categories of respondents.

It was observed that acceptability of the facilities among the residents of Chaisa was very high. This was a result of unfavourable hardships people faced in accessing toilet facilities. Historically, initiatives of flying toilets and seeking access from neighbours and drinking places have caused a number of people to have high acceptance of the facilities because they are seen as a solution to their suffering in the past. But even then, there is more acceptances on the Double Vault as compared to the Sundome as they take relatively a much longer time to fill up. However, it was observed that less than 25% of the beneficiaries could use the human manure in agriculture which defeats the principle of ecological sanitation. There is also absence of policy and legislature on ecological sanitation in Zambia as the current policy does not provide for re-use but “safe disposal”. This compromises the viability of the sanitation option.

From the public health perspective, it was observed that the facilities have the potential to improve health as they address the hazard-host transmission routes though the current number of facilities does not have a big impact due to limited number.

In terms of operations and maintenance, the project had both successes and challenges. The system was solving the problem that was insurmountable in the past; that of not having facilities due to lack of space. The hygienic conditions associated with the systems are a fact appreciated by many. A number of challenges were also associated with the system, the prominent one being that of frequent desludging. This arose from the fact that designs of the vault sizes were based on standard assumption. In the project area, over 50% of the respondents had inhabitants in the excess of ten when the designs were based on about 6 people per household. A lot of sentiments were expressed on the suitability of the squatting slabs which presented big challenges to the physically disabled and the pregnant women. The opening on the slab was also viewed to be too big and hence a danger especially to children. The biggest challenge was on the harvesting of the

excreta with the Sundome proving to be very unsuitable in this respect. It was also clear that the design of the drain pipes from the urinals needed adjusting as there seems to be promotion of precipitation which resulted in blockages. This was because urine was allowed to stagnate in some sections of the urinal drain pipes.

It was observed that up-scaling of the EcoSan systems, especially in areas lacking even the basic sanitation infrastructure would be well received. However, as to whether the use of the systems would embrace the principles of ecological sanitation especially on the re-use aspect would depend on a number of aspects ranging from policy to awareness raising. It was also noted that the tenure arrangements would play an import role especially that most houses in per-urban areas are on rent. It was also noted that the disposal of the sludge might cause a big challenge at large scale.

Lastly, it was observed that EcoSan can be economically viable if awareness was there, not only among users but also among the farming communities and importantly to decision and policy makers. There is also need to create an enabling environment which starts with appropriate policy and legislature formulation which would be in support of this “new” paradigm.

The review recommended the following:

a) As EcoSan facilities are not ordinary toilets, there is need to include instructions on use to minimize misuse of the facilities. It is recommended that instructions are put on the door before one enters and also on the walls the user faces when entering and during the utilization of the facility. This is to minimize risks of first time users misusing the facilities due to ‘ignorance’;

b) Hand-washing is one of the most effective barriers in the faecal oral route of disease transmission. Almost all the EcoSan facilities that were evaluated did not have any provision for hand-washing. All future EcoSan facility designs should incorporate hand-washing facilities with the wastewater draining into the soakaway provided for the grey water and urine;

c) Awareness campaigns on importance of hand-washing should be an ongoing activity to initiate and sustain behavioural change among the residents in peri-urban to achieve positive results.

d) Many facilities had blocked urinal drain pipes resulting from formation of precipitates in the piping. The design of the drain pipes should therefore be revisited to make sure they do not promote stagnation of the urine which enhances precipitation and hence blockages.

e) To enhance good usage of the facilities, especially by the men folk, there should be compulsory provision of urinals in all the facilities.

f) To improve on the safety of the EcoSan facilities, the opening for the faecal matter should be reduced to a size that does not pose a danger of falling in to children.

g) It is necessary to have custom designed vaults to suit the situation for places where the facilities are to be implemented than to have standard designs for all households. This would enable all facilities attain the minimum desired retention time necessary for preliminary treatment before the vaults are emptied.

h) The EcoSan facility should be made user friendly to the disabled, pregnant women, elderly and men. This is in form of accessing the toilet and also the user interface. A person on a wheel chair can easily access a facility provided with an access ramp as opposed to stair cases. For all users, the pedestal type of interface is friendlier than the squat slab.

i) EcoSan toilets should be taken on a large-scale to address the sanitation problems in peri-urban areas as it is effective and efficient in the provision of on-site sanitation i.e. it does not require water to operate, can be built inside the house, the waste can be used as manure thus alleviating poverty by enhancing food security, ash is available locally which can be used to sprinkle on the faecal waste to enhance the dehydration, decomposition and odour reduction.

j) Political will should be mobilized to help in speeding up the acceptance of the technology and also help in amending the gaps in the legislature on sanitation by putting up a deliberate policy to encourage the implementation of on-site sanitation technology options like EcoSan.

k) There is also need to share EcoSan experiences among stakeholders to enhance full scale implementation of EcoSan in the country. It should also be noted that unless the aspect of re-use is seriously addressed, the viability of ecological sanitation in Zambia will continue to exist but only in limbo.

l) There is need to introduce EcoSan in school curricular and also in colleges and universities so as to build capacity at all stages.

m) The media i.e. radio, television and the print media, needs to play a role in the sensitization of people about the EcoSan toilets and also the need to change the mindset and consider excreta management a topic of discussion like water.

n) Private sector participation should be encouraged in order to complement government efforts in the area of sanitation; specifically ecological sanitation.

o) Since the harvest from the facilities is expected to be in solid/dry form, there is need to design tools/equipment for removing the dry solid matter. To the inclusion of solid waste management, CBEs could be empowered to include in their responsibilities the aspect of sludge collection from the EcoSan facilities. Whereas the CBEs involved in the desludging would be paid per facility desludged, it was recommended that residents pay a monthly fee to the Water Trust who would then take up the financing of the desludging aspect when the facilities are due.

p) The CBEs should work with LWSC, LCC and ECZ on the aspect of collection and disposal. It was proposed that once collected, the sludge should be taken to the LWSC drying facilities without intermediate storage within the compounds. The sludge so disposed of at the LWSC drying facilities would then receive the required tertiary treatment (further dehydration) before being sold to customers together with the sludge from the conventional treatment plants.

q) Personnel who had been actively involved in desludging feacal matter previously be identified and brought to a round table with all relevant stakeholders to discuss business opportunities for better desludging methods to be improved. Training activities are an option for building capacity on better methods to be employed in the desludging of feacal matter; and

r) WDCs, LCC and ECZ to monitor the operations of the CBEs in the collection and disposal of the sludge

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LIST OF ACRONMYS

AIDS	Acquired Immune Deficiency Syndrome
BORDA	Bremen Overseas Research Development Agency
CBEs	Community Based Enterprises
CBO	Community Based Organisation
CMI	Community Managed Improvements
DANIDA	Danish International Development Agency
DTF	Devolution Trust Fund
DWA	Department of Water Affairs
ECZ	Environmental Council of Zambia
EU	European Union
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
HIV	Human Immune Virus
IEC	Information and Education Communication
LCC	Lusaka City Council
LWSC	Lusaka Water and Sewerage Company Limited
MACO - SIP	Ministry of Agriculture and Cooperatives – Small Irrigation Project
MDG	Millennium Development Goal
MLGH	Ministry of Local Government and Housing
MoH	Ministry of Health
NISSIR	National Institute for Industrial and Research
NWASCO	National Water and Sanitation Council of Zambia
PHAST	Participatory Hygiene and Sanitation Transformation
PPP	Public Private Partnerships
PPUSS	Promoting Peri-Urban Sanitation Services
SIDA	Swedish International Development Agency
SNV	Netherlands Development Organisation
SPSS	Statistical Package for Social Scientists
VIP	Ventilated Improved Latrine
WASAZA	Water and Sanitation Association of Zambia
WSUP	Water and Sanitation for the Urban Poor
WDCs	Ward Development Committees
ZDC	Zone Development Committee
ZMK	Zambian Kwacha

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1.0 INTRODUCTION

1.1 General

Ecological Sanitation or EcoSan is a new paradigm in sanitation that recognizes human excreta and household wastewater as a resource. The main underline principle is closing the loop between sanitation and agriculture for food security. EcoSan is based on three fundamental principles namely:

- preventing pollution rather than attempting to control it after we pollute;
- sanitizing the urine and faeces; and
- safe reuse of the resulting products for agricultural purposes.

Since, ecological sanitation is a closed loop in which all the waste is turned into a useful non-environmental polluting resource, its adoption on a large scale would help in a number of ways. Firstly, it would help protect our groundwater, streams, lakes and seas from faecal contamination as this system has literally no discharge. Secondly, the per capita water demand would go down as there would be no need of water for flushing of toilets. This would lessen the burden on water resources. If adopted on a larger scale, EcoSan would therefore result in improved water supply coverage by the utilities. Lastly, it would result in farmers utilising less commercial fertilizers, much of which is washed out of the soil into water bodies, thereby contributing to environmental degradation. This would also lead to increased food production. It has been shown that utilising processed faecal matter and urine increases food productivity by a factor of not less than two and in some cases to well over ten times (Morgan, 2003).

The concept of EcoSan has gained acceptance in many regions of the world. Apart from a number of organizations involved in promoting the concept of the paradigm in Zambia, CARE Zambia has been integrating EcoSan activities in its peri-urban governance programme since 2005 in the project known as Community Managed Improvements (CMI) funded by the Swedish International and Development Agency (SIDA) for two years in a settlement called Chaisa. The CMI project addressed five main key areas of needs of which Alternative Sanitation pilot (Ecology Sanitation) was one. The overall goal of the CMI project was to contribute to poverty reduction in the urban areas through creation of a healthier and more tolerable environment by promoting popular participation and democratic governance with special attention and focus on the most vulnerable among the poor and those affected by HIV/AIDS. Specifically, the alternative sanitation pilot aimed at promoting sanitation coupled with participatory health and hygiene education.

The EcoSan facilities have been piloted in Chaisa Compound by CARE for three years. This study was conducted to review and evaluate how effective the pilot EcoSan activities had been in order to chat the way forward. Furthermore, the review was in support of Lusaka Water and Sewerage Company's (LWSC) "Sanitation Marketing and Hygiene Promotion Strategy for peri-urban settlements in Lusaka" and specifically addressed the component "increased range of Sanitation Products".

2.0 BACKGROUND

The health of any community is invariably related to the state of sanitation in that area. Chaisa Compound is no exception hence it is not surprising that among the priorities of that community, appropriate sanitation was found to be one. Since water supply in Chaisa Compound is through standpipes, promotion of waterborne toilets is out of question. Promotion of Ventilated Improved Pit latrines (VIP) is also hampered by inadequate space around the houses. Because of the above reasons (lack of household water supply and space), CARE Zambia opted to pilot dry alternative sanitation as an appropriate on-site sanitation technology with the support of SIDA. The justification for choosing this method of sanitation was based on a number of factors as follows:-

- it does not require water to operate;
- It can be built inside the house;
- the waste can be used as manure and in the case of Chaisa, it can serve as a source of manure for the greening component of the project;
- the ash required to sprinkle on the faecal waste to enhance the dehydration, decomposition and odour reduction is readily available.

Prior to implementation of this technology, the community was accorded an opportunity to learn from similar sanitation systems locally and within the sub –region.

Through a snap assessment of the prevailing sanitation situation in Chaisa; it was established that most households lacked access to basic services. It was also established that the community did view sanitation as a priority. After a number of consultative meetings with stakeholders including the community, Water Trust, Chaisa community based organisations LWSC, Lusaka City Council (LCC) Ministry of Local Government and Housing (MLGH Department of Water Affairs (DWA), National Water and Sanitation Council of Zambia (NWASCO), Ministry of Health (MoH), etc., two options of EcoSan facilities were chosen for implementation. These included the Sundome and Double Vault Urine Separator.

The main activities to the piloting project included community awareness creation and sensitization regarding sanitation improvement and introduction of the EcoSan concept. This was achieved mostly by using Participatory Hygiene and Sanitation Transformation (PHAST) methodology. Having received positive reception from the community, 45 EcoSan facilities were constructed in Chaisa. These comprise 30 Double Vault- urine diversion and 15 Sundomes. All these units were constructed at households with only two (2) in public places.

The concept of ecological sanitation in Zambia is relatively new. It is a paradigm that may be in disagreement with some of the social and cultural beliefs. Because of this, monitoring and evaluation of the constructed facilities and measuring project acceptability and sustainability are cardinal activities in the assessment of the success of the pilot project. It is against this background that this review study was undertaken.

3.0 MAIN OBJECTIVE

The main objective of this review was to systematically assess the implementation, operation and maintenance of EcoSan facilities in selected peri-urban areas of Lusaka; specifically, Chaisa Compound.

3.1 Specific Objectives

In order for the main objective to be realized, the following were the specific objectives:-

i) To review the efficiency and effectiveness of EcoSan facilities and make recommendations on the design and operation of such facilities in the future;
ii) To assess the mechanisms and sustainability of operation and maintenance of EcoSan facilities taking into consideration all steps along the Sanitation chain from latrine to reuse or final treatment / disposal;
iii) To review specific aspects of implementation such as stakeholder involvement, community participation, utilization of facilities, user satisfaction, training on operation and maintenance and health information; and
iv) To make specific recommendations, based on the findings from the above, for the development of EcoSan at large scale and city wide.

Within the specific objectives outlined above, the review explored and tried to answer a number of questions some of which were the following:-

i) Was EcoSan accepted by the community/users?
ii) Was the EcoSan concept technically and financially viable at all levels in the context of peri-urban settlements in Zambia?

iii) What were the successes and challenges in operation and maintenance of EcoSan facilities?

iv) How could the EcoSan concept be promoted at large-scale?

v) What were the achievements of the training activities?

vi) What were the external factors that influenced the success of EcoSan facilities (environmental conditions, policies, local governance, and advocacy) and what was their effect?

vii) What other products and services could complement existing facilities in order to handle the waste such as transportation, disposal, treatment facilities of LWSC?

viii) What were the necessary local institutional arrangements and how were landlord/tenant agreements affecting EcoSan facilities?

ix) How could the concept of business, entrepreneurship and marketing in EcoSan be promoted?

x) What other design options and products could be added to the existing EcoSan facilities?

4.0 SCOPE

The review mainly concentrated on reviewing the EcoSan facilities in Chaisa Compound. The review also targeted CARE Zambia who were the project implementers together with LCC and selected Community Based Organisations (CBOs) in Chaisa. Other stakeholders included LWSC, MLGH, WASAZA, GTZ, Bremen Overseas Research Agency (BORDA), Zulu Burrow, Ministry of Health, Water Aid, NISSIR and many more.

5.0 METHODOLOGY

The execution of the review on EcoSan facilities was done at different levels and involved both qualitative and quantitative methods of research through interviews of institutions and individuals (Appendix A). It also involved workshops (Appendix B and C). The qualitative aspect of the review involved desk reviews and preparation of tools i.e. questionnaires [Appendix D (D1, D2, D3)] which were used when conducting household and institutional interviews. Questionnaires were developed and administered both at household and institutional level. The quantitative aspect involved coding and analyzing of data using the Statistical Package for Social Scientist (SPSS) software from which analyses was done to come up with some of the results presented in this report.

5.1. Literature Review

Documents were gathered from institutions and persons with past experience on the EcoSan facilities showing its initiation, challenges and prospects for future execution and how its implementation was done. The information reviewed was necessary to understand the concept of EcoSan in a wider perspective as it was a new concept in Zambia. In regard to the project area – Chaisa Compound, CARE international provided relevant literature on how the EcoSan project in Chaisa Compound was implementation. This information provided a foundation for the review work undertaken by the Consultancy Team.

5.2. Workshop with the community

A workshop for the community was organized by the Consultancy Team. The purpose of this workshop was to get views on EcoSan implementation, utilization and appreciation in Chaisa Compound from the residents' perspective. Participatory approaches were employed during the deliberations of the workshop involving both males and female. Participants of the workshop included community workers and representatives such as the Ward Development Committees (WDCs) and the Water Trust. Other participants included beneficiaries of the EcoSan facilities from different community zones.

5.3. Community interviews

Selection criteria for community interviews were purposive; focusing on households with EcoSan facilities on their properties. A household questionnaire was developed tailored to capture information from people who benefited from the pilot project and/or those using EcoSan facilities. Out of the 60 households using EcoSan facilities, 45 were beneficiaries of the pilot project while 15 households built the facilities using their own initiatives after observing what was pertaining with the funded pilot project of Chaisa Compound. Of the 45 households that benefited from the EcoSan facilities in Chaisa, 44 of them were interviewed. Interviews were not conducted for the 45th household in Chaisa because it was found that the household had not completed building the toilet facility and most materials for the building project were unavailable despite having been provided. Attempts were made to find and interview the 15 households who built EcoSan toilets with their own resources but proved futile because they were outside the proximity of Chaisa Compound and based in other compounds. Additionally, the households could not easily be identified and found because the actual locations were not recorded or mapped out. The questionnaire used during the interviews captured information from the users of the EcoSan facilities on the efficiency and effectiveness of the facilities in Chaisa Compound. Other issues addressed in the questionnaire included those of user satisfaction, suitability of the facilities, operations and maintenance of the

facility, stakeholder involvement and community participation and the achievement of training activities in the area.

Another questionnaire was developed for households without the EcoSan facilities but within the proximity of households with EcoSan facilities. A purposive sampling was also done to capture views from people in these households. A total of 24 people from different households were interviewed in this category. The idea was to get their views on the perceived achievements of the EcoSan facilities in Chaisa Compound and also what they perceived to have been challenges for use of such kinds of facilities. Additionally, it was important to understand views of people without the facilities on expansion prospects of the EcoSan facilities to other peri urban areas in Zambia.

5.4. Institutional Interviews

A number of institutions with relevant experience and involvement in the implementation of the EcoSan facilities in Chaisa were identified and interviewed. The objective of the institutional interviews was to get views of their involvement and prospects of the EcoSan projects in Zambia. 25 institutions were identified as relevant sources of information for the implementation of EcoSan facilities in Chaisa Compound to include, LCC, LWSC, Mandevu Health Centre, ECZ, African Ceramics, Edome Systems, Water Aid, WASAZA, MLGH, GTZ, DTF, NWASCO, SNV, Zulu Burrows Consulting Engineers, NISIR, DANIDA, SIDA, WDC – Chaisa, Water Trust – Chaisa, CBEs (Solid Waste Management Groups), Chaisa Cooperative Market, BORDA AND MACO – Small Scale Irrigation Project. Of these institutions 20 institutions were administered of the questionnaire and responses were obtained from only 11 institutions to include LCC, DANIDA, LWSC, BORDA/WASAZA, DTF, WATER AID, Chaisa Water Trust, Chaisa WDC, and MACO - Small Scale Irrigation Project, NISIR and ECZ.

5.5 Data Analysis and Report Writing

All the data collected from community and institutional interviews were coded in the SPSS databases developed and analyzed to derive inferences of the responses. Inferences drawn from the analyses culminated into part of the result presented in Section 7 of the report.

Other sections of the report were written based on literature reviewed from relevant documentation and researcher observations.

6.0 LITERATURE REVIEW

This section outlines findings from the literature reviewed relevant to the study.

6.1 General Introduction

Safe disposal and containment of waste, it be human excreta or solid waste has ever been a big challenge in most communities. The challenge has always been aggravated by the fact that there is no direct benefit in waste disposal systems as compared with, for example, water supply systems. It is therefore, not surprising that governments expend most of their resources on improving water supply systems and not on sanitation although the two are supposed to go hand-in-hand. The results have been degeneration in the sanitary conditions of communities and the environment resulting in higher incidences of environmental related diseases like diarrhea and malaria.

By definition, sanitation is the removal and safe disposal of waste that can be hazardous to health. Waste here can be liquid or solid. Liquid wastes are basically the various types of wastewater that are generated in homes, in trade establishments and in industries. Solid wastes are all kinds of refuse which may also be of domestic, trade or industrial origin. With this definition, we can envisage sanitation systems as engineered devices for the safe collection and/or disposal of waste. This is for the direct benefit of a community and the ecological balance of the environment.

In the context of this study, sanitation applies to excreta management, grey water management, solid waste management and drainage of rain or storm water. Excreta management is exclusively concerned with the management of faeces and urine. Grey water management refers to the management of waste streams from the bathrooms and the kitchen. Solid waste on the other hand refers to the management of refuse from domestic, industrial, commercial and public sources. Finally, storm water management refers to the collection and disposal of rain water. In this study, focus is on excreta management.

There are two types of sanitation systems with respect to wastewater/human excreta management. These are the off-site and on-site systems. Off-site systems refer to systems where waste is collected and transported from their place of generation. Transportation is usually through sewage conveyance systems. The destination of the waste so collected is ideally a treatment plant where the wastewater should be treated before final disposal. Two types of treatment exist; conventional and non-conventional methods. On-site sanitation systems are where the waste generated is stored and treated at or near their place of generation. It includes septic tanks, aqua privies, pit latrines and ecological sanitation systems.

6.2 Ecological Sanitation

Human excreta, if disposed of in the “traditional manner”, always put a strain on the ecological balance of the environment. Traditional manner here refers to either the “drop or store" and the "flush and discharge" systems which are commonly called on-site and off-site sanitation respectively. In both systems, ecological balance is not preserved. In the case of the drop and store systems, the contents might leach out and thereby pollute the underground aquifers. In the case of the flush and discharge system, surface water bodies are the most vulnerable. In most cases, the wastewater will be discharged into surface water bodies with inadequate or no treatment at all.

Ecological sanitation technologies take the principle of environmental sanitation a step further: Environmental sanitation means keeping our surroundings (the environment) clean and safe and preventing pollution. It includes wastewater treatment and disposal, vector control and other disease-prevention activities. Ecological sanitation, on the other hand, is structured on recycling principles. It means keeping the eco-cycle in the sanitation process closed. It is also a low-energy approach that uses natural processes.

Conventional approaches to sanitation misplace the nutrients in the excreta, dispose of them and break the ecological cycle. The very idea that excreta are waste with no useful purpose is a modern misconception. It is at the root of pollution problems that result from conventional approaches to sanitation. In nature there is no waste – all products of living things are used as raw materials by others. Recycling sanitized human urine and faeces by returning them to the soil serves to restore the natural cycle of life-building materials that has been disrupted by our current sanitation practices.

6.2.1 Reasons for Provision of Sound Sanitation Systems

Sanitation systems aim at forming a barrier against the spread of diseases caused by pathogens in the human excreta. In fresh faeces, there are four main groups of organisms of concern to humans. These are:-

i. Bacteria;
ii. Protozoa;
iii. Viruses; and
iv. Helminths.

These organisms once excreted may:-

- be immediately infectious;
- require a period of time outside the body before they become infectious; or

- require an intermediate host before becoming infectious.

When a person excretes a pathogen that is not contained or destroyed, the environment becomes contaminated. A contaminated environment puts people at risk of exposure to the pathogens which may lead to infection and diseases. Newly infected people then excrete into the environment and there is a repeated cycle of infection, contamination and infection.

The spread of pathogens can be prevented by using barriers to prevent them moving from one place (e.g. ground) to another (e.g. hands). An effective primary barrier would have to safely retain human excreta in one place so that other places are not contaminated thereby ensuring prevention of the spread of pathogens. A dry system based on eco-san principles is one such type of a barrier.

6.2.2 Key Features of Ecological Sanitation

Ecological sanitation is a cycle, or closed-loop system, which treats human excreta as a resource. In this system, excreta are processed on site until they are free of pathogenic (disease-causing) organisms. Thereafter, the sanitized excreta are recycled by using them for agricultural purposes. Key features of eco-san are therefore:

i. Prevention of pollution and disease caused by human excreta;
ii. Treatment of human excreta as a resource rather than as a waste product; and
iii. Recovery and recycling of the nutrients that are contained in the excreta.

6.2.3 Treatment Mechanism

Ecological sanitation preserves the environment by providing conducive environment for the

i. safe storage of excreta making sure the environment is not contaminated
ii. quick destruction of pathogens

In an ecological sanitation system safe storage is ensured through provision of what we may call a water-tight tank (processing vault) similar to a septic tank. Examples would be the dehydrating vault or a Composting Chamber. The difference of eco-san systems from the other on-site sanitation systems is that there is completely no discharge of the waste into the environment. The design of the tank into which the excreta is deposited and stored depends on how it is intended to treat the waste. There are principally two types of treatment. One is based on dehydration and the other is based on composting. Both these two systems destroy pathogens by creating very unfavorable conditions for the survival and multiplication of pathogens. Environmental factors speeding up the death of pathogens are summarised in Table 6.1.

Table 6.1: Environmental conditions speeding up the death of pathogens

ENVIRONMENTAL FACTORS	HOW
Temperature	Increase in temperature
Moisture	Decrease in moisture
Nutrients (organic matter)	Decrease in nutrients
Microorganisms (including other pathogens)	Decrease in organisms
Sunlight	Increase in sunlight
pH	Increase in Ph

6.2.4 Ecological Sanitation Systems Based on Dehydration

In a dehydrating system, the contents of the processing vault are dried in as short a period as possible. This is done with the help of heating, ventilation and addition of dry material. The quick reduction of moisture results in pathogen destruction.

As the contents should be as dry as possible, specialised collection devices (squatting slabs or seat risers) with a urine deviation system have to be used. This allows the faeces to be dehydrated fairly easily. The urine collected in some cases is used as fertilizer. In cultures that do not permit the use of urine as a fertilizer, it is evaporated in evaporation pans or allowed to seep into the ground. Usually, the processing vaults have partitions so that when one vault is in use, the other is not. This allows for complete treatment of the excreta before it is finally taken out. The time the excreta is taken out, it will have stabilized and in most cases is used as a fertilizer or soil conditioner.

6.2.5 Ecological Sanitation Systems Based on Decomposition (Composting)

Composting is a biological process in which under controlled conditions, bacteria, worms and other types of organisms break down organic substances to make humus, a rich stable media in which roots thrive. In a composting toilet, human excreta, together with other additional bulking agents such as vegetable scraps, straw, wood shavings etc are deposited into a processing vault where soil based organisms decompose the solids - just as eventually happens to all organic materials in the natural environment. Temperature, air flow and other factors are controlled to varying degrees to promote optimum conditions of composting.

The humus produced by the process is an excellent soil conditioner, free from human pathogens when the right conditions are achieved and adequate retention time is allowed. Odour, if any, can be extracted directly above the roof through a ventilation system.

A composting toilet tries to achieve the optimum conditions for biological decomposition. This means that sufficient oxygen should be able to penetrate the compost heap to maintain the aerobic conditions. Secondly, the material in the composting vault should have a moisture content of about 50-60%. The carbon nitrogen ratio should be in the range 15:1-30:1 and the temperature of the composting vault should be above $15^{O}C$.

6.2.6 Advantages of Eco-Sans

Since, ecological sanitation is a closed loop in which all the waste is turned into a useful non-environmental polluting resource, its adoption (on a large scale) would

i. Protect our groundwater, streams, lakes and seas from faecal contamination as this system has literally no discharge.
ii. Lessen water consumption as there would be no need of water for flushing of toilets. This would lessen the burden on water resources.
iii. Farmers would require less commercial fertilisers, much of which is washed out of the soil into water bodies, thereby contributing to environmental degradation.

6.2.7 Fertilizer Content of Urine and Faeces

Both urine and faeces are rich in nutrients and are comparable to chemical fertilisers as outlined in subsequent sections.

i) Composition and plant availability of nutrients in urine

The urine is filtered by the kidneys and contains only low molecular weight substances. At excretion, the pH of urine is normally around 6, but can vary between 4.5 and 8.2.Of the N, 75-90% is excreted as urea and the remainder mainly as ammonium and creatinine In the presence of urease, urea is quickly degraded to ammonium and carbon dioxide and the hydroxide ions produced normally increase the pH to 9-9.3. Normally urease accumulates within the urine piping system and therefore the above transformation is very swift, usually within hours.

Ammonium is directly plant-available and an excellent N fertilizer, which is verified by the fact that urea (which is degraded to ammonium by urease in the soil) and ammonium are two of the most used N fertilizers in the world. Many crops prefer nitrate to ammonium, but this is not a problem. Ammonium applied to arable soil is transformed within a few days to nitrate. In soils with very low microbial activity, these transformations take longer since they are performed by microbes.

The plant availability of urine N is the same as that of chemical urea or ammonium fertilizers. This is to be expected, as 90-100% of urine N is found as urea and ammonium and has been verified in fertilizing experiments.

The P in the urine is almost entirely (95-100%) inorganic and is excreted in the form of phosphate ions. These ions are directly plant-available and thus it is no surprise that their plant availability has been found to be at least as good as that of chemical phosphate. K is excreted in the urine as ions, which are directly plant-available. This is the same form as supplied by chemical fertilizers and thus their fertilizing effect is the same. S is mainly excreted in the form of free sulphate ions, which are directly plant-available. This is the same form as the S in most chemical fertilizers and thus, the fertilizing effect of S in urine and that in chemical fertilizers is the same.

ii) Composition and plant availability of nutrients in faeces

As shown above, the major proportion of the nutrients excreted is found in the urine, which has an extremely low contamination of heavy metals. The faeces fraction also contains a lot of relatively uncontaminated nutrients. Compared with the urine, which has water-soluble nutrients, the faeces contain both water-soluble nutrients and nutrients that are combined in larger particles not soluble in water. Still, about 50% of the N and the majority of the K in faeces are water soluble. P is mainly found as calcium phosphate particles, only slowly soluble in water

The K is mainly found as dissolved ions. The plant availability of the nutrients in the faecal matter is lower and slower than that of the urine nutrients. This is due to the fact that the main proportion of the P and a large proportion of the N stem from undigested matter and this matter needs to be degraded in the soil to become available to plants. However the organic material in the faeces degrades and its content of organic N and P then becomes available to plants. The calcium phosphates also dissolve and become plant-available and these calcium phosphates ought to be as available as those supplied by chemical fertilizers. The K in faeces is in ionic form, which is directly plant available.

Thus, it is only for N that the availability of faecal nutrients is considerably lower than that of chemical fertilizers or urine. The high concentrations of P, K and organic matter in faecal matter can give substantial yield increases, especially on poor soils. The organic matter contributes in several ways: by improving the soil structure, increasing the water-holding capacity and the buffering capacity, and by supporting the soil microorganisms by serving as an energy source.

iii) Facts about fertilising effects of urine and faeces

a) The fertilising effect of urine

The fertilizing effects of urine are highlighted in Table 6.2. Table 6.2 shows that use of urine in agriculture can boost production by a factor of at least 2. This then would contribute to the attainment of the Millennium Development Goals (MDGs) on eradication of hunger.

Table 6.2: (Grams fresh weight) in plant trials with urine as a fertiliser to vegetables in Zimbabwe (Morgan, 2003)

Plant, growth period and number of repetitions (n)	Unfertilised plants (g)	Fertilised, 3:1 water/urine application 3X per week (g)	Relative yield fertilised to unfertilised
Lettuce, 30 days (n=3)	230	500	.2.2
Lettuce, 33 days (n=3)	120	345	2.9
Spinach, 30 days (n=3)	52	350	6.7
Covo, 8 weeks (n=3)	135	545	4.0
Tomato, 4 months (n=9)	1680	6084	3.6

b) The fertilising effect of excreta compost

Results from experiments on the use of faecal manure as a fertiliser are presented in Table 6.3. Table 6.3 shows that use of excreta boosts production in some cases by a factor of over ten times.

Table 6.3: Average yields (grams fresh weight) in plant trials comparing growing in poor topsoil only, with growing in a mixture consisting of 50% topsoil and 50% Fossa alterna compost (Morgan, 2003)

Plant, soil type and number of repetition	Growth period	Fresh weight top soil only (g)	Fresh weight 50/50 top soil/FA* soil (g)	Relative yield fertilised to unfertilised
Spinach, Epworth soil (n=6)	30 days	72	546	7.6
Covo, Epworth soil (n=3)	30 days	20	161	8.1
Covo 2, Epworth soil (n=6)	30 days	81	357	4.4
Lettuce, Epworth soil (n=6)	30 days	122	912	7.5
Tomato, Ruwa Soil	3 months	73	735	10.1

*Fossa alterna soil.

From the above reviewed literature, it should be clear that if properly implemented, ecological sanitation has the potential to significantly contribute to the MDGs. Table 6.4 summarises how the EcoSan would contribute to some of the MDGs.

Table 6.4: How EcoSan can contribute to the attainment of the MDGs

ITEM	MDG GOAL	POSITIVE IMPACT FROM ECOSAN
1	Eradicate extreme poverty and hunger	Increased income from fewer sick days, less money spent on medication; improved yields from more fertile soils
2	Achieve universal primary education	Better school attendance: fewer sick days, less malnutrition – better ability to learn
3	Promote gender equality and empower women	
4	Reduce child mortality	Improved nutrition; less diarrhoea diseases and intestinal worms
5	Improve maternal health	Improved nutrition, less diarrhoea diseases
6	Combat HIV/AIDS, malaria and other diseases	Reduction in enteric diseases, Improved diet
7	Ensure environmental sustainability	Reduction of downstream and groundwater pollution, recycling of nutrients, less water use; more people connected; slum dwellers' lives improved

7.0 RESULTS OF THE STUDY

The information presented in this section is based on field observations by the Consultancy Team and views obtained from the residents of Chaisa Compound and also strategic persons in stakeholder institutions. Residents from Chaisa Compound comprised 44 with EcoSan facilities and 24 without but in the vicinity of the EcoSan toilets. As already pointed out in Section 3, the objective of this review was to systematically assess the implementation, operation and maintenance of EcoSan facilities in selected peri-urban areas of Lusaka. This involved reviewing the efficiency and effectiveness of EcoSan facilities; assessing the mechanisms and sustainability of operation and maintenance of EcoSan facilities; reviewing specific aspects of implementation such as stakeholder involvement, community participation, utilization of facilities, user satisfaction, training on operation and maintenance, and health information; and making recommendations, based on the findings from the above, for the development of EcoSan at large scale and city wide. For easy presentation, the findings are presented under sections each dealing with a specific aspect of the EcoSan system as presented under objectives namely Efficiency and effectiveness; Mechanisms and suitability of operation and maintenance of EcoSan facilities; Stakeholder involvement and community participation, Utilization of facilities and user satisfaction; Training on operation and maintenance and health information; and Other products and services complimenting implementation of sanitation strategy by the local authority.

7.1 Efficiency and Effectiveness

A number of aspects were looked at in assessing the effective and efficient use of EcoSan facilities in Chaisa Compound. These are presented in the subsequent sections.

7.1.1 Factors Influencing the Success of EcoSan Facilities

The study revealed that a number of factors influenced the success of EcoSan facilities in Chaisa Compound. Among the identified factors included the environmental conditions, policies, the local governance in the area and advocacy.

a) Environmental conditions

Environmental conditions in Chaisa had a high influence on the success of implementation and use of EcoSan toilets. The lack of space to construct permanent toilet structures had a high driving force in ensuring acceptability of the type of facility that was being introduced for the first time. The realization that having new facilities that were permanent and which did not require relocating to new sites when the old facilities were full was welcomed by the users because it was seen as a lasting solution of lack of toilet facilities.

The hydrogeology of the area is another factor that influenced the success of the EcoSan facilities. Chaisa Compound has a high water table. This made the Sundome facility less favourable as water easily got into some of the vaults. Secondly, households that had Sundome facilities faced problems with collapsing of the facilities. It was observed that this was as a result of a not so stable foundation base for the vault which resulted in sinking of the facility when the ground got soaked with water. Apparently, the Double Vaults were not as susceptible to this effect as the Sundomes which made the Double Vaults a more viable option for the area.

b) Policies

There is no deliberate policy that talks directly about EcoSan facilities in Zambia. The current legislature on water and sanitation has not included in its recommendations the re-use of the faecal matter for productive purposes. However, favourable conditions were made available with regard to the implementation of EcoSan facilities in Chaisa Compound by cooperation among stakeholders such as LCC, LWSC and the WDCs.

c) Local governance,

The involvement and willingness of the local leadership in spearheading the implementation of the EcoSan facilities in Chaisa Compound improved the acceptability of the facilities by the users. The trust and confidence placed on the local leadership was sufficient to help with acceptability among the intended beneficiaries in Chaisa Compound. Local leadership was also actively involved in the sensitization campaigns to help people understand on the use and maintenance of the toilet facilities.

d) Advocacy)

The implementation of the EcoSan facilities in Chaisa Compound started with the impartation of knowledge to the recipients of the facilities through training and community awareness campaigns. To a large extent, this exercise improved people's knowledge on the toilet facilities. However, other newer users were not captured in the training activities of the EcoSan facilities and hence still naturally lack knowledge on the operation and maintenance of the facility hampering the success of the EcoSan toilets in some cases.

7.2 Mechanisms and Suitability of Operation and Maintenance of EcoSan Facilities

The review of mechanisms and suitability of operation and maintenance of EcoSan facilities looked at the successes and challenges faced in using and implementing the EcoSan facilities. Further, a number of design options and products were proposed to the existing EcoSan facilities.

7.2.1 EcoSan Facilities - O & M Successes and Challenges

The successes and challenges of the EcoSan facilities were captured from both the field observations and responses from the administered questionnaires.

i) Successes

EcoSan toilets have scored successes in Chaisa Compound. Its design which promotes separation of urine from faecal matter and the provision of vent pipes makes the system relatively odour free. This in turn reduces the nuisance of flies. Just this aspect made these facilities more odourable over the traditional pit latrines. This fact had been appreciated by households provided with these systems.

The systems had in a way proved to be a solution to provision of sanitation facilities in areas with limited space. Over 85% of the population with EcoSan facilities interviewed indicated that they preferred EcoSan toilets to traditional pit latrines. The main reason for this preference was that the facilities were permanent. Just about 9% indicated that they preferred the pit latrines. Similar results were obtained from interviewees without the facility (Figure 7.1).

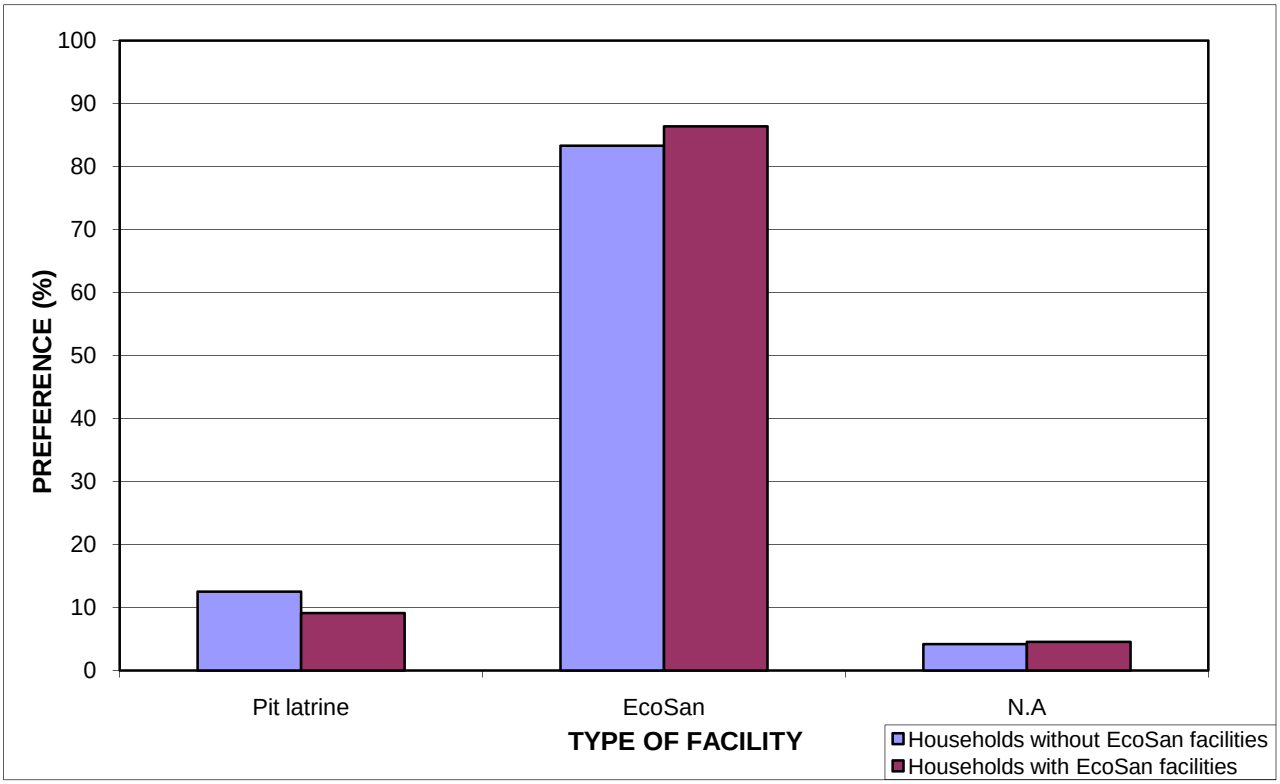

Figure 7.1: Preference on type of facility by respondents with and without EcoSan facilities (Preference for EcoSan was over 80% for both types of respondents)

All respondents who said they preferred the traditional pit latrines owned Sundome types of toilets and cited frequent desludging requirements for the Sundome as the main discouraging factor. Not a single respondent owning a Double Vault facility preferred a pit latrine. For the respondents without the facility, about 83% indicated that they would prefer the EcoSan system over the pit latrine. Among those who said they would prefer the pit latrine justified their preference by citing problems they had noticed those with the facilities faced. In terms of numbers, it was 3 out of the 24 of those who were interviewed. Two of them, living in the proximity of Sundomes, cited emptying and disposal problems as the reasons for their preference of an ordinary pit latrine over a Sundome. The other one who was in the proximity of the Double Vault did not prefer the systems because the facility in their vicinity had a leaking urinal drain pipe and apparently her children played with the leaking effluent from the facility.

Respondents indicated that the provision of EcoSan facilities has in a way contributed to the decline incidences of enteric diseases out breaks in the community. From the consultants' perspective, the number of units provided is too low to result in noticeable impacts. Most likely, other intervention measures were contributing significantly. However, it indeed is true the facilities can significantly result in improved health as it reduces the spread of diseases by preventing pollution and breaking the transmission route. Both these measures break the faecal oral route

which is the main route for enteric diseases infections (Figure 7.2). This is because the system does not promote leaching which is the cause of groundwater pollution and which in turn, is a pathway for the transmission of enteric diseases. Reduced smell reduces the problem of flies which are also transmitters of diseases

The proposal of providing hand-washing facilities outside the EcoSan facilities if adopted would address route marked X. Hand-washing is one of the cheapest and simplest yet most effective way of preventing the migration/transmission of germs to the host. However, provision of the hand-washing facilities in itself is no guarantee that the facilities will be correctly used. Awareness campaigns on importance of hand-washing would have to be carried out to initiate behavioural change among the resident to achieve positive results.

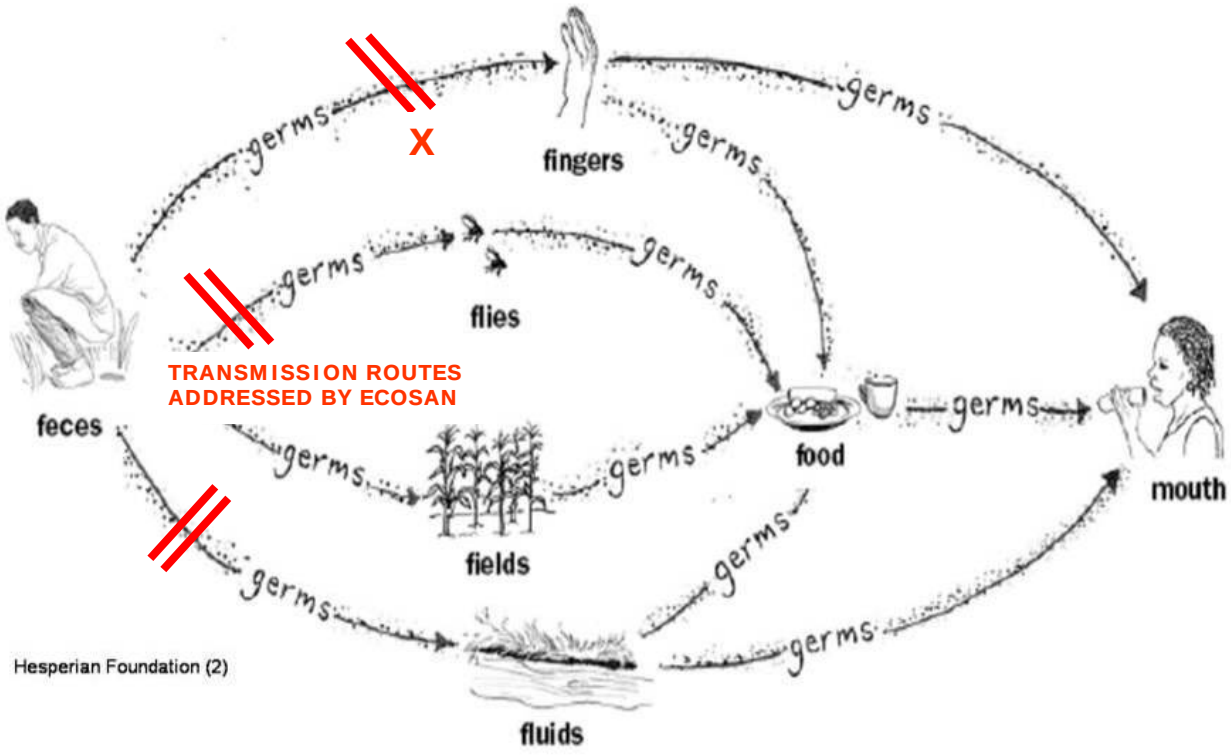

Figure 7.2: How EcoSan can help address some of the disease transmission routes

For these transmission barriers to be effective throughout the cycle of the facilities, there would be need to carefully control the disposal aspect. Currently, disposal is done manually with no specialised tools let alone protective attire. There is therefore a real danger of exposure of the workers to the hazard during the period of desludging which may lead to infections. This is worse in the case of Sundomes which are desludged before all the contents have been preliminary treated (i.e. at least dried/dehydrated for a period of six months.)

ii) Challenges

The EcoSan facilities in Chaisa Compound do not only have a success side to them but they also have a number of challenges as highlighted below.

a) Design

The design of EcoSan facilities is standardized. For example, in the sizing of vaults, design parameters considered are the possible number of users from which the optimum size of the vault is calculated. The vault size would then determine the time that would be required before the vault is desludged which should be adequate to give the excreta the required preliminary treatment of at least six months before the facility is emptied. In most designs, the waiting period would not be less than six months for a design population of about 6 inhabitants. However, in Chaisa Compound, about 55% of households interviewed had more than 10 inhabitants (Figure 7.3). Some households had well over 30 inhabitants. This is in a situation where a house has a number of rooms with each room accommodating a family. As a result, the vaults appeared to be too small requiring frequent desludging than expected. The situation was further worsened by the fact that where there were a lot of people at one house, usage of the facility was normally improper with water and urine being admitted to the vault.

To address the problem of not attaining the six month period required for preliminary treatment before desludging, it is necessary to have custom designed vaults to suit the situation for the place where the facility is being implemented than to have standard designs for all households.

b) Orientation on usage to new users

The system was also reported to pose a challenge where a new user (visitor) is to be oriented on how the facility is supposed to be operated. This stems from the fact that in the Zambian traditional, issues of defecation are treated as sacred. One of the biggest challenges identified in this respect was on how one would educate the in-laws on proper usage of the facility.

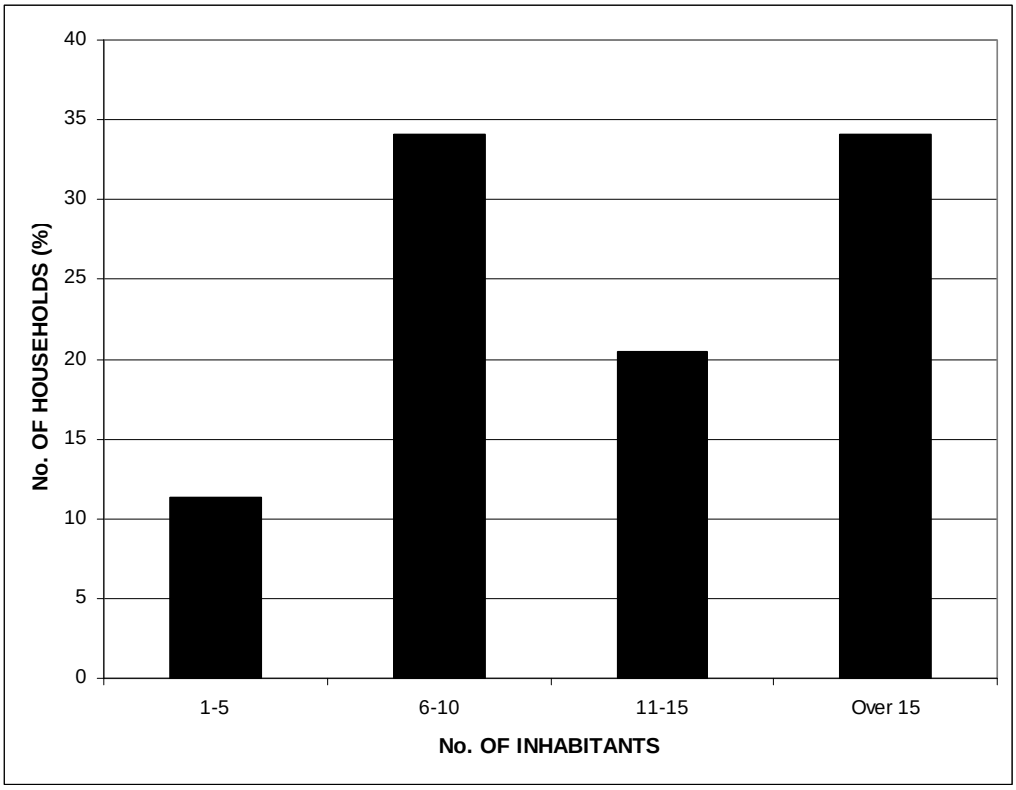

Figure 7.3: Number of inhabitants per household (In studied area 6-10 and over 15 had the highest frequency)

c) Design of the user interface

Sentiments were also echoed on the design, specifically those employing “squatting slabs” which were not able to accommodate the disabled and the pregnant women. The pedestal type was more preferable and more accommodating. However, in both the squat slabs and the pedestals, respondents indicated that the opening for the faecal matter was too big and fear was expressed that a child could easily fall in. Future designs should therefore take this aspect into consideration.

d) Desludging

Harvesting of the excreta was found to be the biggest challenge. To start with, people did not know how to harvest, who was to harvest and where the harvest was to be taken. Apparently, it seemed there was still a gap on this aspect. Infact, most respondents indicated preference to hire a vacuum tank to empty the toilet as opposed to them doing it and utilising the harvest. The community indicated that there was a general lack of appropriate tools required to off-load the dried faecal matter after maturation. The use of the faecal material as a fertilizer was also still a challenge. This was partly because most of the plots in Chaisa Compound are too small to have gardens where the faecal matter could be used as manure. Secondly, over 77% of the people were opposed to the idea of utilising faecal matter as a fertiliser.

The Sundome presented a special challenge because proper operation demands that once full, adequate time should be allowed for the material to dry before desludging. However, in all cases encountered, it was the only facility available, and as such, waiting for the faecal matter to dry up before desludging was not practical. In all cases where the Sundomes had to be desludged, the waiting period was less than one day. The custom was when the pit got full; a pit was dug nearby. Around 04 hours in the morning, the faecal matter was transferred from the vault into the pit which was then buried. This means the desludging was done when part of the faecal matter was still fresh.

e) Blockages of the urinal drain pipes

On most of the installed systems, frequent blockages of the urinal drain pipes was reported to be a problem. Though most respondents really did not have a clear answer as to what the cause of the problem really was, the most probable reason was formation of precipitates. When urine is allowed to stand for some time, reactions will start to take place which will result in formation of a precipitate. The design of the urinal drain pipe should therefore be revisited to make sure it does not promote stagnation of the urine. This can reduce on the rate of formation of the precipitate which has become a problem in the operation of some of the systems.

f) Routine repairs

It was reported that the systems required qualified plumbers were they needed to be repaired. This was a big challenge to the residents as resources were not readily available to engage plumbers were such type of repairs/maintenance requirements arose.

7.2.2 Additional Proposed Design Options and Products for the existing EcoSan facilities

The current systems have been identified as not adequately meeting the requirements for the disabled, children, the sick and the elderly. Where providing for all would be the ultimate desire, the cost implications associated with such modifications should also be looked at closely otherwise the facilities might become too expensive and hence difficult to implement in peri-urban areas. To this effect, proposals discussed here are those with manageable cost implications.

i) Modifications to meet requirements of the physically challenged

The study revealed that the pedestal type of user interface was more preferred than the squatting slab in addressing challenges of the physically challenged, pregnant women and children. This arises from the posture required to be adopted when using the facilities. More challenges are encountered with squatting slabs as opposed to pedestal.

Secondly, most facilities are designed with steps. This would be a challenge to someone on a wheel chair to access the facilities. This would require that the steps are replaced by rumps.

ii) Improving on safety

As already pointed out, the facilities were thought not to be too safe for children. This is because of the opening for faecal matter which is too big. In this respect, it is proposed that the opening be reduced. The size to be adopted should be such that the smallest child expected to use the toilet can not go through.

iii) Enhancing usability

Provision of Urinals in all available EcoSan toilets should be made compulsory. This is to cater for men who traditionally are used to standing when urinating. It therefore becomes difficult for them to squat in toilets without urinals. Absence of urinals can lead to misuse of the facilities as the men would direct the urine in the hole for faecal matter.

Another possibility, which would required more resources, is to modify the pedestal to have a mechanism of some valve which only opens the hole for faecal matter when one sits on it while the urine diverting system remains open.

iv) Design of the Vaults

As already pointed out in Section 7.2.1, adopting a standard size of vault size leads to a number of problems. For peri-urban areas of Zambia, the facilities would work better if they are custom designed. For easier implementation, a design table giving population and standard vault size can be developed. An illustration is given in Table 7.1.

Table 7.1: Example of a design table to be adopted

FAMILY SIZE	VAULT SIZE (m^3)
1 – 6	X
7 – 12	Y
13 – 18	Z

v) Products

The design of the current system employed in Chaisa Compound only allow for the harvesting of faecal matter. The urine is diverted into the ground and where it is 'wasted' into the ground. In EcoSan facilities, both the urine and faecal matter are resources that can be harvested (Figure 7.4). They both have fertilizing effects as explained under Section 6.2.7. This means future designs should aim at also harvesting the urine. Mention should be made here that this can only be possible when there is enabling environment both in terms of policy/legislature and appreciation of the value of the products especially by the farming fraternity.

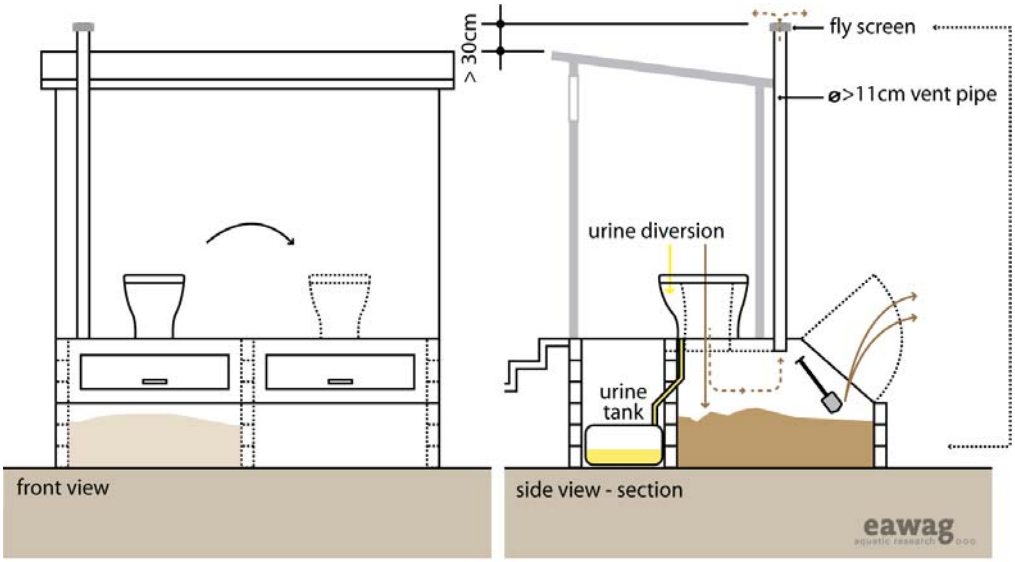

Figure 7.4: A Double Vault with a urine collection chamber (Source: www.akvo.org)

In a system like the one above, the only waste from a Double Vault would just be the grey water.

7.3 Stakeholder Involvement and Community Participation

The understanding of stakeholder involvement and community participation was cardinal for the review process. Importance was on understanding levels of involvement for all stakeholders in facilitating the implementation of EcoSan facilities and its use in Chaisa Compound.

7.3.1 Necessary Local Institutional arrangements for effective EcoSan implementation

Different local institutional arrangements exist for the management of developmental programmes in many given situations. In Chaisa Compound, the effective implementation of EcoSan facilities was made a success by the availability of local leadership such as the Ward Development Committee and the Water Trust including others such as Mandevu Health Centre and Community Committee vested with preliminary knowledge of the facilities and took on roles as representatives of the implementation agency. The local leadership also carried with them the mandate to campaign and make known of the EcoSan facilities to the target beneficiaries and on its effective use. Additionally, the effective collaboration with local leaderships and the implementing agency fueled the success of the implementation of the EcoSan facilities in Chaisa Compound. The existence of committees also created new decision making bodies which directly or indirectly decided on who gained access to the funded toilet infrastructure.

The effective implementation of EcoSan facilities in Chaisa Compound was also based on landlord/tenant relationships at play. In principle the house owners (landlords) are a key authority in deciding on the type of facility to be put on their property and are responsible for the maintenance of the facility. Their roles also include soliciting for the facilities and make it obligatory for tenants and other users to adhere to stipulated rules on operation and maintenance of the toilet facilities. However, such rules and projects may not easily be adhered to by tenants because of lack of knowledge on the use and maintenance of the EcoSan toilets. In essence, much sensitization is required to ensure continuity and sustainability of the EcoSan facilities for future generations.

7.3.2 Stakeholder involvement

On a wider perspective, on-site sanitation management in Zambia and Chaisa Compound in particular, follows localized arrangements with much emphasis of management placed on the users. The utility companies are responsible for provision of sanitation services working hand in hand with regulatory agencies. These institutional arrangements guiding sanitation management in Zambia are however much more pronounced for offsite sanitation in practice while the management of onsite sanitation is much more dependant on local individual arrangements of the users. In practice therefore, this means that the majority of individual peri-urban users in the country – including Chaisa Compound - are subject to individual initiatives to access toilet facilities which in most cases are in form of ordinary pit latrines and VIPs to a lesser extent.

During the implementation of EcoSan facilities in Chaisa Compound however, a number of stakeholders were involved as cooperating partners, regulating agencies and service providers,

among others. Notably, the implementation of the facilities drew cooperation from the ECZ, NWASCO and the DTF, LWSC and LCC.

7.4 Utilization of Facilities and User Satisfaction

Utilization of facilities and user satisfaction required knowledge on how acceptable the facilities were to the users and the viability in the context of Zambian peri-urban areas. The findings on these aspects are discussed in the subsequent sections.

7.4.1 Acceptability of Facilities by Users

While being a well accepted and applied concept in other countries world wide and Asia in particular, the ecological sanitation concept is a new concept in many African countries with its practical application seen only in a few areas and involving few people for instance in the Zambian context. The review carried out in Chaisa Compound revealed general acceptance of the EcoSan facilities by the users. Basically, acceptance is attached to the notion that the introduction of the toilets was attached to free access to the facilities as all the necessary materials were provided for and there is general hope among neighbouring households of the possibility to acquire such kinds of facilities for themselves without much financial input on their part. As much as there is insufficient knowledge on the use and maintenance of the toilet facilities, especially among people without the EcoSan facilities, prospectors hope for permanent better constructed less odour toilets with lockable doors and good roofing will not materialised.

Acceptance of the EcoSan toilets also follows unfavorable hardships people faced in accessing toilets for use in their area. Historically, initiatives of flying toilets and seeking access from neighbours and drinking places have caused a number of people to have high acceptance of the facilities because they are seen as a solution to their suffering in the past. Others see EcoSan toilets as a solution to eradicate unmaintained and dilapidated toilet infrastructures commonly found in Chaisa Compound.

It is however important to state that, high acceptance of such kinds of toilets is on the Double Vaults than on the Sundome types. Double Vaults have gained much preference because the receptor containers take a much longer time to fill up as they have two compartments. This means that as one compartment is being used as a toilet, the other serves as a bathroom and would only take its role as a toilet when the other one gets full. This gives people time to plan on how to dispose of the excreta while still having access to a toilet. The Sundome toilet however limits the ability to plan for desludging and leaves no option for users to continue having access to a toilet when the receptor containers get filled up. The Sundome toilet type is also known to collapse

during heavy rains further reducing its popularity among users. The collapse is usually associated with the receptor moving out of the position although the superstructure still remains in place. (Figure 7.5).

Figure 7.5: Sundome out of position due to collapsed receptor

On the other hand, acceptance of the EcoSan toilets does not include the part on disposal for many. There is lack of understanding on how disposal of the waste is supposed to be done especially among tenants. Many do not attach the aspect of agricultural uses to the desludging of the excreta. The majority would have no use for the waste material and can not apply it in fields as fertilizers as they do not own any fields in the first place. There is a strong belief that the use of excreta for crop production would jeopardize their sells of vegetables if people knew they used human waste to grow them. While this has nothing to do with norms or beliefs, the notion has everything to do with personal upbringing and societal consciousness of what others may think of them. The other problem lies on satisfying users that the faecal matter is safe for use as manure. People are normally convinced that faecal matter is not safe for crop production because it has

always been known to be associated with the outbreaks of enteric diseases. Insufficient land for cultivation is another demeaning factor for the use of the excreta for crop production. These among other reasons erode the purpose of the EcoSan toilets in closing the loop between sanitation and agriculture.

7.4.2 Viability in the context of Zambian Peri-urban areas

Viability of the EcoSan facilities in the context of Zambian Peri-urban areas can be viewed from two perspectives; Technical and Financial. These two aspects are discussed below.

i) Technical perspective

Ecological sanitation is a cycle, or closed-loop system, which treats human excreta as a resource. In this system, excreta are processed on-site until they are free of pathogenic (disease-causing) organisms. Normally, the treatment is through storage. Preliminary treatment takes place in the vault where the excreta is retained undisturbed for about six months before desludging. Thereafter, the sludge is taken for further treatment which can be by further dehydration or composting. Thereafter, the sanitized excreta are recycled by using them for agricultural purposes. This means the systems' viability should be assessed based on key features of the system namely prevention of pollution and disease caused by human excreta; treatment of human excreta as a resource rather than as a waste product; and recovery and recycling of the nutrients that are contained in the excreta.

There is general acceptance of EcoSan facilities especially the Double Vault system in Chaisa Compound as already pointed out. However, the acceptance is based more on the fact that the provision of these facilities in the compound is giving the community their only option of excreta disposal.

Zambian peri-urban areas, especially those in Lusaka, are characterised by high density of housing units with very limited space around. This fact makes it impossible to have a closed-loop system (cycle) with systems in peri-urban areas as residents do not have space where the manure can be used. The systems are used just as pit latrines and from the residents' perspective, EcoSan facilities are better than pit latrines mostly because of their comparative superior construction and not because of the principle of recycling upon which the system is based. Figure 7.6 summarizing responses on how the residents intend to use the manure from the latrines.

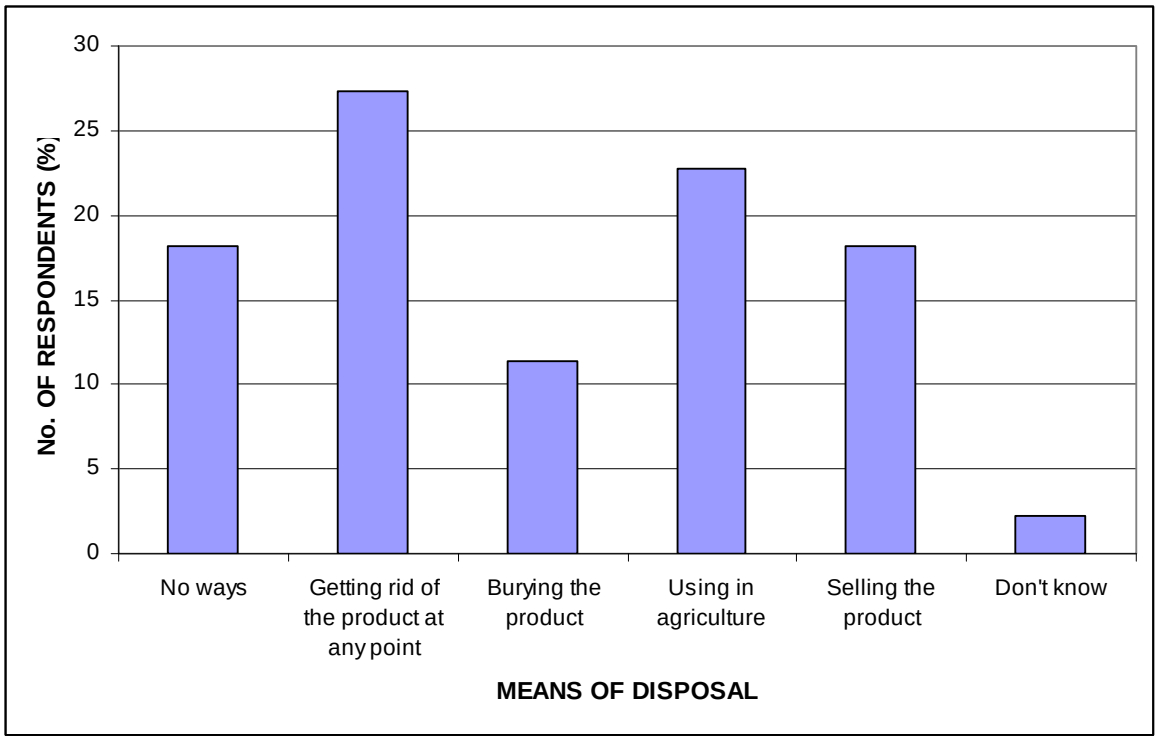

Figure 7.6: Responses on how respondent would use the harvest. (Getting rid of the product scored the highest signifying general lack of concept appreciation).

As illustrated in Figure 7.6, less than 23% of the respondents say they can use it in agriculture. This defeats the purpose of providing EcoSan toilets. Although awareness creation was carried out, it apparently appears much was not said or appreciated on the aspect of re-use. For most residents with facilities that had not filled up yet, they did not even know what to do with the 'harvest'. Others indicated that there were pronouncements during the inception period that the manure would be bought and taken by a certain organisation. Therefore, currently, the manure is just being buried with no likely intention of ever re-using it.

Viability of the system is also hampered by lack of a clear cut policy/legislature on EcoSan in the Zambian institutional and regulatory framework. Legislature on sanitation advocates for safe collection, transportation, treatment and disposal. It does not support the re-use aspect which is a very pertinent aspect to EcoSan. It is concluded that unless the aspect of re-use is seriously addressed, the viability of ecological sanitation in Zambia will continue to exist but only in limbo.

ii) Financial Perspective

Whereas most traditional pit latrines cost less than K1,000,000.00 and in some cases costs completely nothing in terms of materials, an EcoSan facility costs about K4,500,000. This amount is

not compatible with the socio-economic status of most peri-urban areas of Zambia. Figure 7.7 summarises the responses on affordability by households owning the facilities.

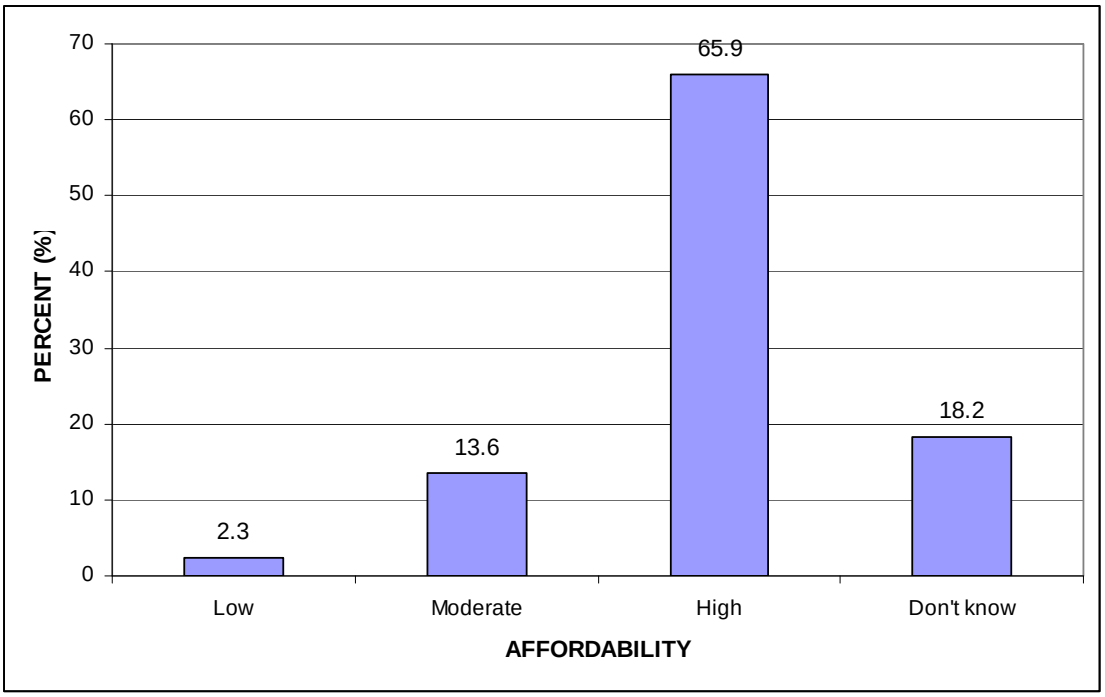

Figure 7.7: Responses on affordability of EcoSan Facilities by beneficiary individuals. About 66% indicated they were very expenses with only 2.3% indicating that they are affordable

From the Institutional perspective, the implementation of the system was also high. Cost analysis example of Chaisa Compound which has 5,916 households according to the EU Water Facility (Appendix A), and adopting the implementation cost of K4,500,000 per facility per household, the total amount required would be about 27 billion Kwacha. The costs for a few peri-urban areas CARE is mostly involved in including Chaisa Compound are presented in Table 7.2

Table 7.2 Estimated costs of implementing EcoSan facilities in a few selected Compounds in Lusaka

COMPOUND	No. OF HOUSEHOLDS	COST OF IMPLIMENTATION (ZMK)	COST OF IMPLIMENTATION (US$)
Chiboya	5,250	23,625,000,000	5,135,870
Chaisa	5,916	26,622,000,000	5,787,391
Chipata	14,161	63,724,500,000	13,853,152
Kanyama	33,109	148,990,500,000	32,389,239
TOTAL	58,436	262,962,000,000	57,165,652

Exchange rate used was 1US$ to ZMK 4600

This compared to the Water and Sanitation budget is over 50% of the allocated resources to water supply and sanitation sector for the year 2010. The total amount allocated to the sector is ZMK433.7 billion to cover the whole country. 100% of implementation of the EcoSan facilities in only five peri-urban areas above is translating to more than 50% of this amount. However, much as it looks expensive, the project is still feasible as implementation can be phased out. If other benefits associated with the improved sanitation are also taken into consideration, the seemingly high cost of implementation would easily be offset.

7.5 Training on Operation and Maintenance and Health Information

Operation and maintenance of EcoSan facilities is different from the operation and maintenance of the conventional systems. From the Zambian perspective, this concept is new. As such, wherever it is being implemented, there is need for training. In the Chaisa Compound pilot project, training was carried out and the sections below highlight the findings of the study on this aspect. Sections 7.5.2 and 7.5.3 highlight on up-scalability and promotion of the entrepreneurship and marketing in EcoSan systems respectively.

7.5.1 Achievements of Training Activities

Successful introduction of new sanitation options different from traditional systems in a community call for awareness campaigns in order for the facilities or the systems to be accepted. Introduction of ecological sanitation systems in Chaisa Compound was without doubt one such activity which required a lot of sensitization. Usually, ecological sanitation comes with a lot of negative social issues mainly to do with handling of the faecal matter. This in most cases is a problem where a

viable option is available. In Chaisa Compound, the idea of ecological sanitation was well received. This could be because of the hardships people were facing with respect to excreta disposal facilities rather than people accepting the facility because of the main principles of the system.

Training on the operation and maintenance of the facilities was carried out prior to and during the implementation of the project. From observations and interviews carried out it was observed that awareness was high among people who were there the time the facilities were being implemented compared to those who where not around at the inception period (Table 7.3). Apparently, the awareness campaigns were focused on the beneficiaries.

Table 7.3: Levels of awareness on facility utilisation versus exposure to awareness training

		Do you have adequate information needed to effectively operate the toilet?		**Total**
		No	**Yes**	
When you became a tenant, did you find the EcoSan toilet already operational at this house?	No	2	37	39
	Yes	3	2	5
Total		**5**	**39**	**44**

In Table 7.3, only two of the five people (40%) who did not directly receive the training knew how the system work as compared to 37 out of 39 people (about 95%) among those who received the training.

Chaisa Compound, like any other peri-urban area, has a high rate of tenant turnover. This could not be captured in this study because the sample was biased towards households with EcoSan facilities. One requirement that was proposed for anyone to benefit was that he or she should have proof of tenure and as such most of the respondents in this case were house owners.

Testing the effectiveness of training on the thinking of people on the safety and hence the willingness to handle dried feacal matter produced results presented in Figure 7.8. There were more people who were aware that dried faecal matter was safe to handle among people who received the training as compared to those who did not. Infact even among those that did not have the facility and did not receive the training, those who said they could handle the faecal matter had information from elsewhere. Slightly over 70% as compared to about 53% were willing to handle dried faecal matter respectively amongst the people with and without the facilities respectively.

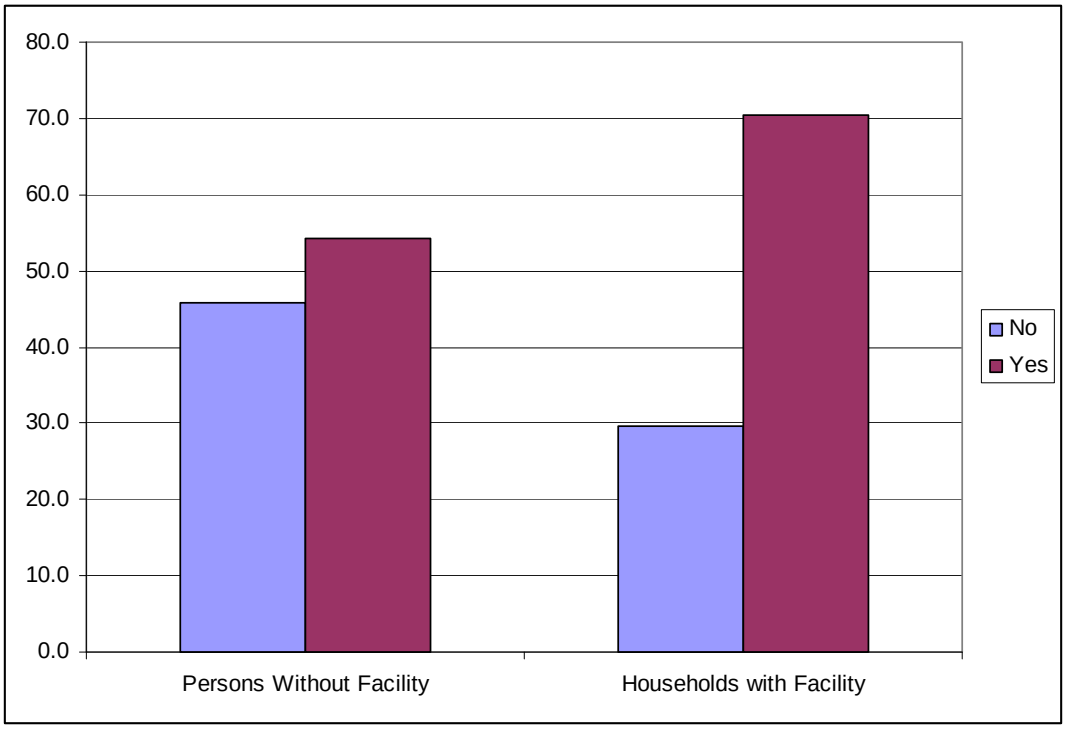

Figure 7.8: Comparison on willingness to handle dried faecal matter between people with EcoSan facilities and those without

From Figure 7.8, it is therefore concluded that the training achieved its intended purpose.

7.5.2 Promoting Ecological Sanitation at a Large-Scale

The financial implications of up-scaling the ecological sanitation concept is discussed in detail in Section 7.4.2 (b). This section looks at other factors relevant to the promotion of the concept at a large-scale.

The up-scaling of EcoSan toilets received much favour among current users because of the recognition of insufficient numbers of toilets in many peri-urban areas. 88% of the respondents said it was a good idea to up-scale EcoSan facilities to other peri-urban areas (Figure 7.9). However, a lot of prudent factors should be looked into when trying to promote the EcoSan concept on a larger scale and in many peri-urban areas.

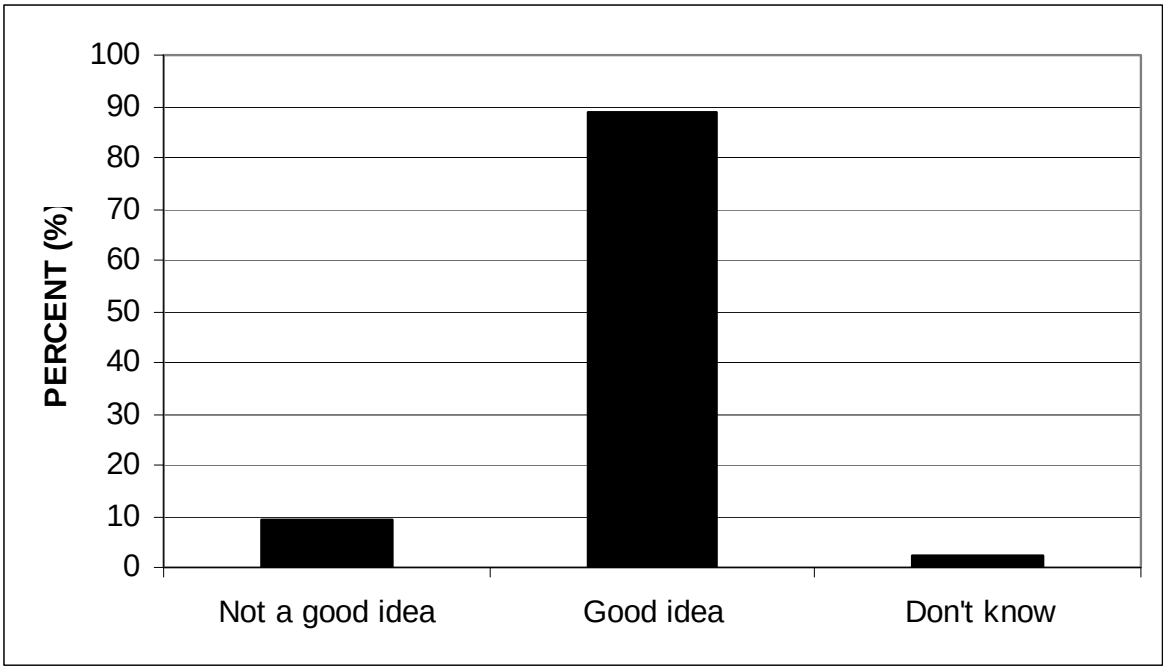

Figure 7.9: Preference by respondents to the idea of up-scaling. Close to 90% were for the idea.

To begin with, there is need for massive sensitization on the actual motive behind the concept of the EcoSan toilets because knowledge gaps exist on its operation and continuity even for people who are currently using the facility. There is little if no adherence to proper disposal of excreta, which in most cases is done when faecal matter is still fresh. Excreta is desludged from its containers and buried in the ground whilst fresh, causing a problem of groundwater contamination which in the initial sense was the reason for the introduction of EcoSan toilets which are a solution for environmental protection from waste contamination. Justification for this action is based on the unavailability of other toilet options for use when the EcoSan toilet fills up and people need to continue using the toilet facility, for instance in the case of Sundome.

Hydrogeological factors should also be taken into consideration when promoting EcoSan toilets on a larger scale. It was observed that the EcoSan concept would not apply easily in areas prone to flooding especially for the Sundome types. This is because where the soil was weak, the receptor tanks tended to sink hence opening up (Figure 7.5 above). Where this happened, the system started to admit water into the tank which then filled up quickly and started to stink. Double Vaults were less susceptible to this condition and hence are a better alternative in this respect. However, caution should be taken when building on flat ground even for the Double Vaults because during the rainy season, runoff water finds its way into the excreta tanks. Therefore, the success of EcoSan toilets should take into consideration all the hydrogeological conditions of the area.

In many peri urban areas surrounding Chaisa, opportunities for promoting EcoSan toilets are there because people have embraced the concept with admiration of what they have observed in Chaisa Compound. This is evident from a number of individuals who have come to borrow the initiative for implementation elsewhere. A total of 15 individuals from other compounds have, using there own resources, implemented EcoSan facilities at their properties. This is indicative of the people's willingness to move up the sanitation ladder.

However, the concept of agriculture still remains incognito because people only find the construction and outlook of the toilets satisfying, while little or no knowledge on its operation is available to increase on its acceptance for promotion to other peri-urban areas in Zambia. This is supported by the responses from people without the facility but living in the vicinity of EcoSan facilities. Out of the 24 households that were interviewed, 20 indicated they preferred the EcoSan toilet because it looked better than the ordinary pit latrine. On whether they knew how the facilities operated, about 55% of the respondents without the EcoSan facilities said they had no idea on how the facilities operated (Figure 7.10).

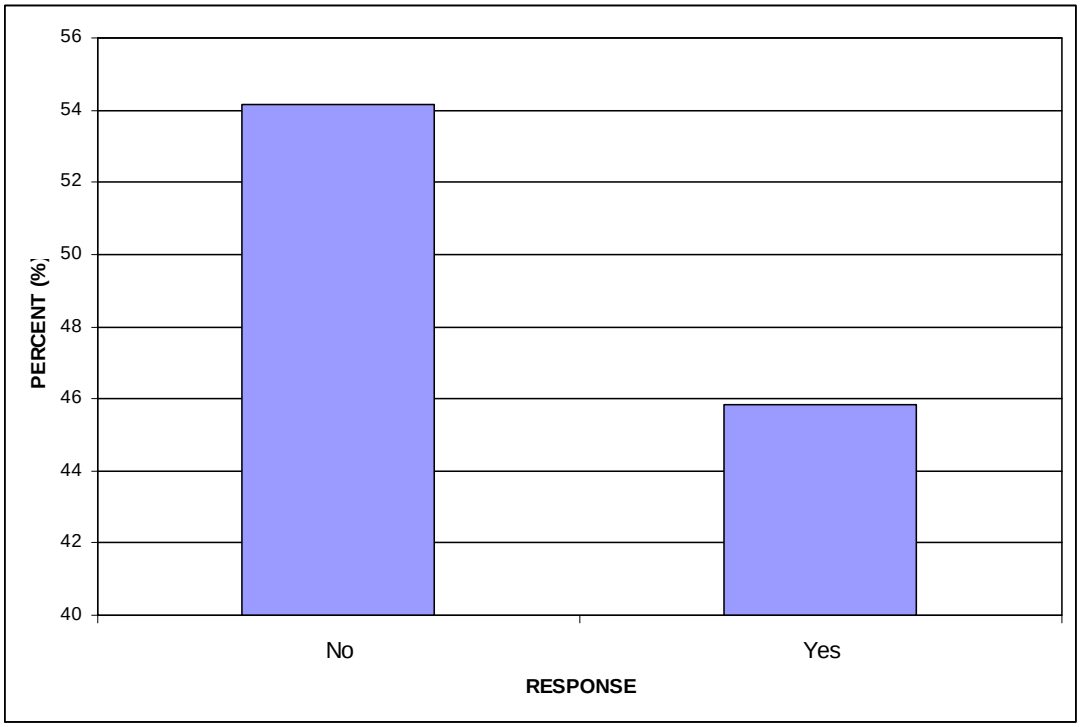

Figure 7.10: Knowledge on how the facility operates by respondents without EcoSan facilities

It is also important to mention that there is a misconception on ecological sanitation. The thinking is that EcoSan is only for peri-urban areas and rural areas. This is one of the reasons why it is not

prominent on the government's sanitation agenda. If there is a realisation of the true benefits that accrue from the utilization of EcoSan especially on the part of policy makers, then most of the challenges of up-scaling can be overcome. EcoSan, if adopted on a larger scale has the potential to:-

i. Protect groundwater and surface water resources as this system has literally no discharge;
ii. Lessen water consumption as there would be no need of water for flushing of toilets. This would lessen the burden on water resources and in terms of water supply by the water utilities, the coverage would increase; and
iii. Increase food productivity as would require less commercial fertilisers, much of which is washed out of the soil into water bodies, thereby contributing to environmental degradation.

7.5.3 Promoting the Concept of Business Entrepreneurship and Marketing in EcoSan Facilities

With respect to ecological sanitation, any business entrepreneurship and marketing would require an enabling environment and awareness creation. The starting point would be the incorporation of Ecological Sanitation in the national policy and to promote legislature which would promote its adoption. This means there is need for lobbying government so that there is recognition of ecological sanitation as an economically and ecologically sound sanitation system. Once the system is appreciated by the policy makers, then we would be one step towards achieving business entrepreneurship and marketing in EcoSan facilities.

Awareness creation would also be needed to clear the misconceptions surrounding ecological sanitation. From the results of the study, it is concluded that in Zambia, EcoSan can be a sanitation option for the peri-urban areas. The aspects of nutrient recovering do not seem to come out so prominently and it is upon this single aspect that the whole system becomes economically viable.

If the above is to be achieved, there should be widespread awareness creation covering residents of the peri-urban areas and farming communities. Issues on value associated with excreta and how to conserve the value (i.e. following guidelines as not to reduce the value of the manure through "contamination" like addition of non biodegradable constituents) would be one aspect of concern. This information would be targeted at the users. On the part of the farming communities, effectiveness of excreta as a fertilizer and how it is supposed to be applied would be the biggest aspect of concern. Here, farming communities have been brought in because in peri-urban areas where this system is being implemented, there is no space where one would do some gardening which can require the manure from the EcoSan toilets. Therefore, most of the manure that would be harvested would have to be exported and used in farms elsewhere.

A business opportunity exists for people emptying the pits. Many people (57%) would rather have their facilities emptied by hired labour (Figure 7.11). Currently, where hired labour is used, it is by individuals and the charge is only between K50,000 to K100,000. Unfortunately, disposal is by burying in pits which compromises the environment. Where there is formalization of the systems, private investors would easily take up the aspect of emptying and transporting.

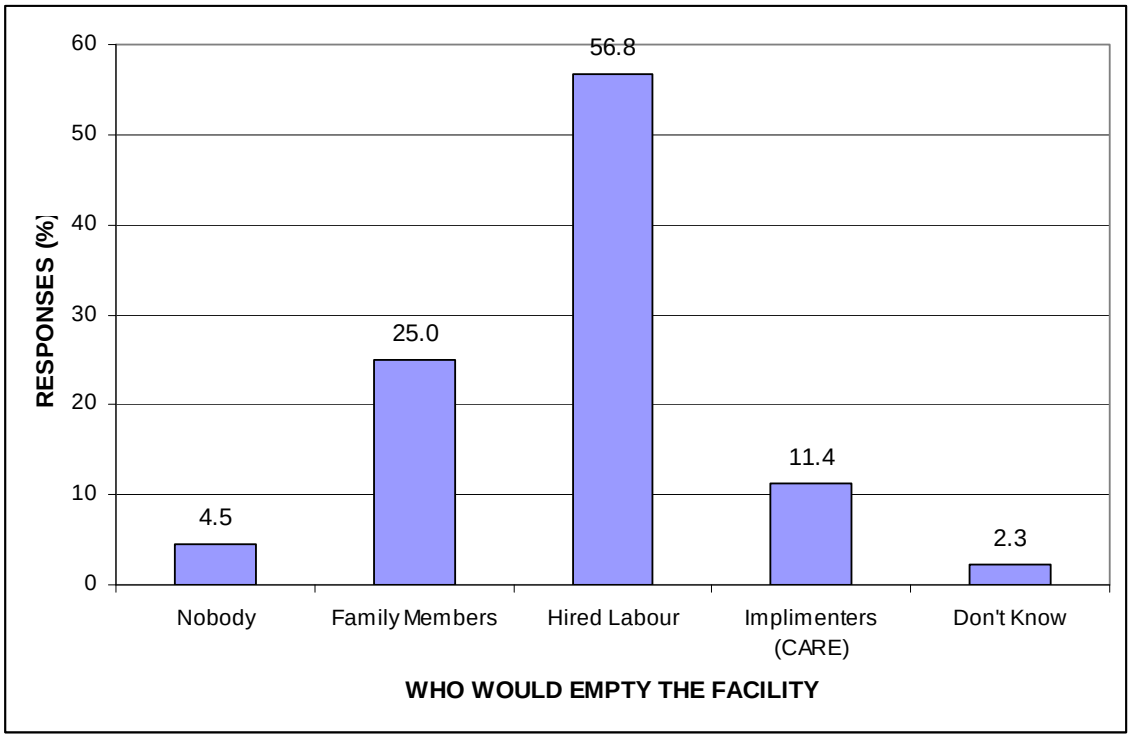

Figure 7.11: Responses on who would empty the facility when it fills up. (Over 55% indicated they would use hired labour)

Demand for manure is high. For manure from the conventional wastewater treatment plant (e.g. from Manchinchi Wastewater Treatment Plant) demand always outstrips supply showing the potential for the EcoSan Product. The financial returns cannot however be guaranteed. Government would need to somehow come in to provide adequate incentives for the system to succeed. Governments motivation should be from the fact that with the promotion of EcoSan facilities, the incidence of enteric diseases would go down which would be a benefit as there are indirect colossal expense on the part of the Government associated with its citizens being sick.

Without a subsidy at the beginning, the whole venture would not be viable. This is in light of the cost of manure. Data obtained from LWSC puts a ton of treated sludge at K6,000. Manure from EcoSan facilities requires consideration of emptying and transportation of the product to a central place where potential buyers can pick it since implementation is in peri-urban areas. The total mass

of the vault contents would not go beyond 3 tons especially if well dehydrated. Table 7.4 summarises the likely income and expenses on ten tons of manure which would be from about three facilities.

The promotion of EcoSan facilities is a viable option for the creation of Public Private Partnership (PPP) entrepreneurships. The promotion of EcoSan facilities will create partnerships between the stakeholders in sanitation like LCC and LWSC private companies involved in the manufacturing of EcoSan Products. This symbiotic relationship between the service providers and the private entrepreneurs would culminate into adequate service provision to the communities.

If the option of coming up with a biogas plant that is being proposed by the Local Authorities succeeds, there would be opportunities for private enterprises to collect and sell the faecal matter to the Local Authorities. This would in turn even lessen the burden of desludging as market for the waste would be readily available.

Table 7.4 A summary of anticipated revenue and manure on ten tons of EcoSan products (manure)

ASPECT	COST (ZMK)	COMMENT
Emptying	(150,000)	Assuming three pits are emptied to obtain a ten ton truck load.
Transportation	(100,000)	Hiring of a ten ton Truck
Sale Price	60,000	Assuming ten tons were collected
Profit/Loss	(190,000)	A loss of 190,000 is incurred

Formalisation of the system may enable private investors or implementing institutions secure specialised equipment for desludging and transportation of the product which may increase the profit margin or lessen the losses on the direct financial benefits.

7.6 Services Complimenting Implementation of Sanitation Strategy by the Local Authority

The Local authority (LCC) is involved in a number of sanitation initiatives to promote health in the City of Lusaka. Sanitation, especially in the rain season, takes the centre stage on the activity agenda of the Local authority. This is especially so in peri-urban areas where the incidences of enteric diseases is serious during this season. Cholera is one of the main water borne diseases afflicting the peri-urban population in the city of Lusaka. Cholera in Lusaka is seasonal, triggered off

by the onset of the rain season. Every rain season, the water tables in most of these peri-urban areas rise. As these areas are mostly serviced by pit latrines and shallow wells, the rise in water tables leads to contamination of the shallow wells. Another contributing factor is the lack of proper disposal of solid waste. Waste is indiscriminately disposed off in most of these areas. And where means of disposal are provided like skip bins; waste is still improperly disposed off. This in itself is a hazard and contributes greatly to the cholera outbreaks as it facilitates breeding of a number of vectors.

Figure 7.12: Example of Improper disposal even where skip bins are provided

Most outbreaks are associated with the onset of rains. Infact, it has been observed that for years of draught, cholera outbreaks have been completely absent whereas when good rains are experienced, outbreaks are rampant. For example, in 2000 and 2002, there were draughts and there were no cholera outbreaks in Lusaka (Figure 7.13).

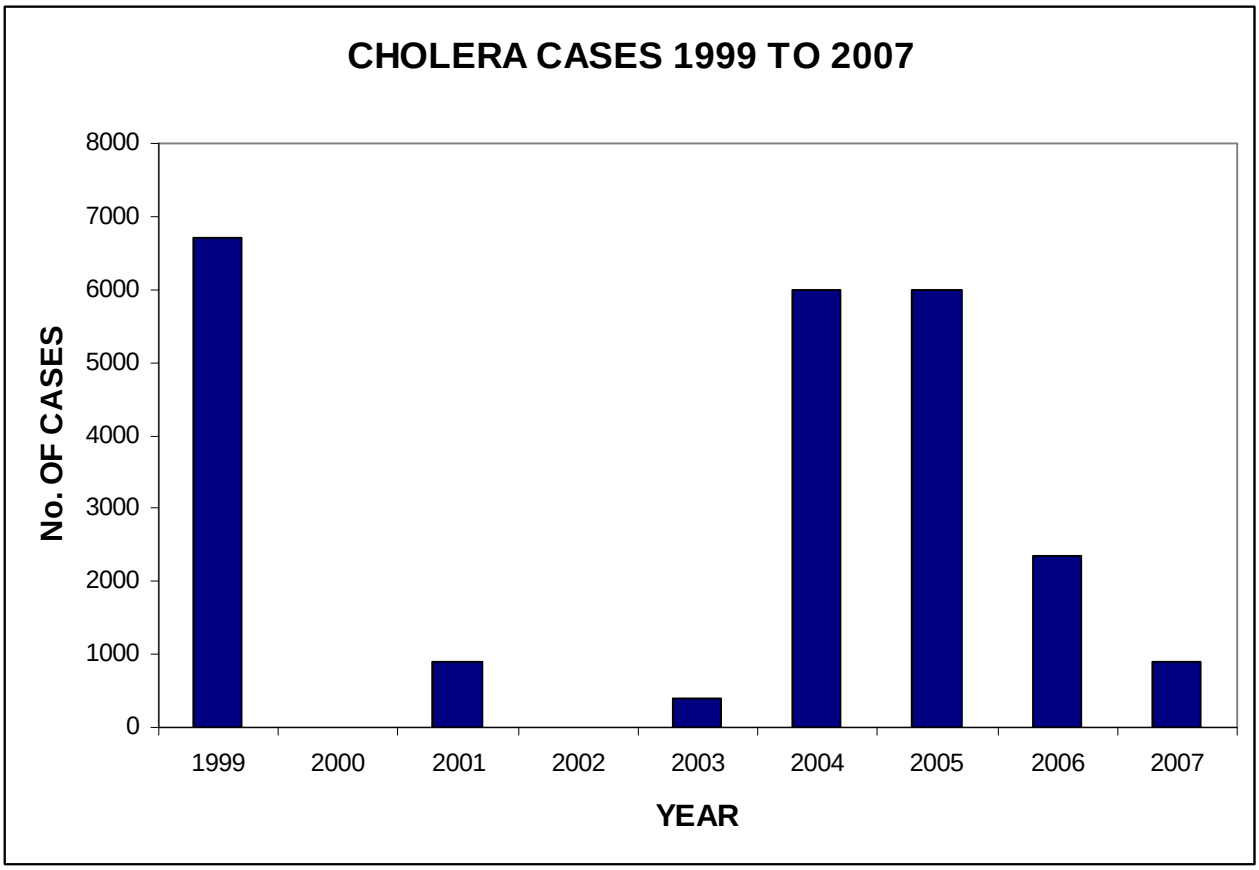

Figure 7.13: Cholera Cases for Lusaka for the Period 1999 and 2007 (Source LCC)

Other contributing factors to outbreaks of enteric diseases in Lusaka include the following:-

- Lack of or inadequate sanitary facilities in unplanned settlements;
- Poor water supply sources and distribution systems;
- Lack of food safety-street food vending;
- Lack of knowledge on transmission and the spread of the disease; and
- Poor personal and domestic hygiene.

Interventions by the Local Authority

In trying to address the issue of sanitation and hence public health for the city, the Local Authority has been undertaking a number of intervention measures. Some of the interventions on ad-hoc basis that are made or that have been made in the recent past include but not limited to:-

- **Liming pit latrines:** Until recently, the Local Authority with the help of donors had been liming pit latrines in the peri-urban areas. This was being done to enhance the inactivation of microorganisms in the pit latrines to reduce ground water contamination.

- **Garbage Collection:** Garbage is known to be associated with a number of diseases outbreaks. The local authority undertakes to collect and dispose of garbage generated in peri-urban areas. However, due to limited resources, there is still a problem in this area.

- **Construction of drainage systems:** Drainage is an important aspect of sanitation. Areas employing pit latrines (including VIPs and EcoSan facilities) do not operate well in areas that are prone to flooding. Flooding in most peri-urban areas of Lusaka results in the mixing of the faecal matter from the latrines with ground water. The resulting cocktail is a recipe for disease outbreaks. The LCC has been working on improving drainage in peri-urban areas of Lusaka. For Example, currently, drainage systems are being constructed in Kanyama Compound. If this activity is executed satisfactorily, the incidences of enteric diseases will definitely go down

- **Distribution of household Chlorine:** During the rain season, the Local Authority together with other stakeholders undertakes the distribution of household chlorine. This is done to enable the communities treat their water before consumption as the water in peri-urban areas is polluted especially that from the shallow wells.

- **Burying shallow wells:** The Local Authority has also been trying to educate the people on the dangers of utilising water from shallow wells and has been burying some of the shallow wells in the peri-urban areas.

- **Inspection of food and premises:** The Local Authority, through its Public Health Section makes inspections of the food and premises where food stuffs are produced/packaged. This is an important intervention as it helps break the transmission route for enteric diseases which are mostly associated with food and water.

- **Intensification of awareness campaigns and distribution of Information, Education and Communication (IEC) materials:** Behavioural change can contribute significantly to the reduction of diseases in a country. For example, it has been reported that proper hand-washing after using toilet facilities can reduces the incidence of enteric diseases by up to 70%. However, for one to embrace this, there is need for awareness which can eventually lead to behaviour change. Because of this, the Local Authority is involved with awareness campaigns and distribution of IEC materials on sanitation which in most cases is intensified during the rain season.

7.7 Other Facilities to be considered for enhanced provision of EcoSan Facilities

The fundamental reason for implementing ecological sanitation in the peri-urban areas of Lusaka is to promote health and hygiene and to some extent, to enhance utilization of the products (urine and faeces) in a way that is beneficial. As such, accessory facilities that can enhance health and hygiene should be made as integral parts when implementing EcoSan facilities. These are discussed below.

7.7.1 Facilities for Hand Washing

As already pointed out in Section 7.2.1, Hand-washing is one of the cheapest and simplest yet most effective ways of preventing transmission of pathogens from the hazard to the host. This therefore calls for provision of hand washing facilities as integral components of the EcoSan facilities. To avoid water mixing with the excreta, these facilities should be provided outside the facilities probably at the entrance. The facilities can simple as the one shown in Figure 7.14.

Figure 7.14: Example of a simple cheap hand washing device for outdoor use

7.7.2 Receptors for Anal Cleansing Materials

In ecological sanitation, the excreta is intended to be reused in agriculture as a fertiliser. As such, the value of the product would depend on how 'pure' it is. In most facilities, the anal cleansing materials, i.e. tissue, water, stones, etc, will be deposited in the same receptor as the faecal matter. In most cases, sanitary pads will also be part of the materials disposed into the receptor for faecal matter. In ecological sanitation, this would reduce the value of the manure. For this reason, in the

design of these facilities, receptors for anal cleansing materials together with sanitary pads should be made integral to the facility.

7.7.3 Facilities for Emptying and Transportation of the Sludge

The study brought out a number of challenges the Chaisa Compound community was facing in terms of tools and facilities to use in emptying and disposing of the waste matter. As already mentioned in previous sections, emptying is done using unhygienic means with disposal being in the ground. This puts both the people emptying the facilities and groundwater at risk. In this regard, a number of solutions are proposed here below.

i) Adopting vault types that are easy to empty

Figure 7.15 gives the design options of vaults that are easy to empty. Picture A and B presents the executive designs. Provided the receptor is big enough, this type of design would simplify the desludging aspect of the facilities. Having the system above the ground (Pictures C and D) also makes it easier to empty the toilet at harvesting time and is also a good idea in areas where the ground water table is high as is the case with Chaisa Compound.

With respect to tools required to empty the vaults, in the first case, it would only be gloves and possibly respirators although if the faecal matter has received adequate treatment (adequate retention time) in the vault, there would be no need for these. In the second design, if the system is operating as an EcoSan facility (providing adequate primary treatment to the sludge before emptying) only shovels and wheel burrows and/or buckets would be required.

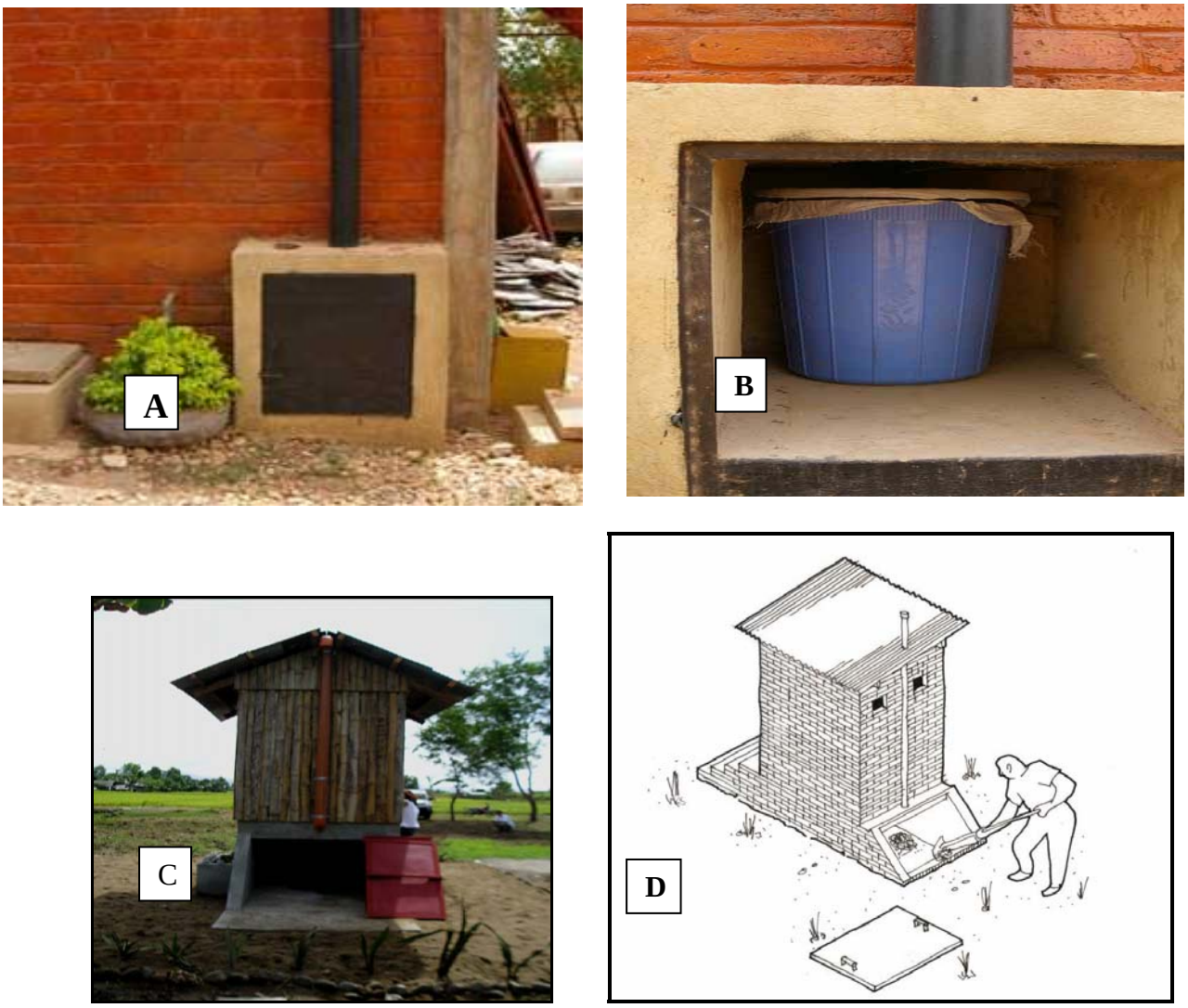

Figure 7.15: Designs that would make the emptying easier at small scale

Where the sludge is to be pumped in liquid form, hand-pump specially designed for sludge and also a portable, manually operated pump Auger type can be used. These tools can easily be sourced locally and for the hand pump these can be designed and made at the TDAU unit at the University of Zambia. Apart from gloves and respirators, workers would in this case also need some protective clothing such as Gum boots and gloves.

For transportation the using of a pushcart or tricycle to transport containers/drums containing urine and excreta would be more appropriate (Figure 7.16). This is because in peri-urban areas, access to some of the facilities by specialized trucks would be impossible. A Small tank can be mounted on

the pushcart with either flexible horses or steel pipes. These can easily access small streets in peri-urban areas.

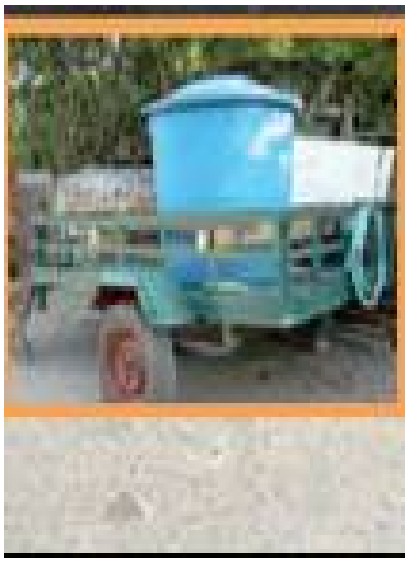

Figure 7.16: Example of Tricycle transporting containers/drums containing urine

8.0 LESSONS LEARNT

a. For peri-urban areas, the rate of turnover of house owners is high. In this study, it was found that about 10% of the interviewees were new tenants. This figure seems to be low but this is because in this pilot project, facilities were mostly provided to house owners. The picture could have been very different had the facilities just been randomly distributed. However, it was still clear that knowledge on the operations of the facilities was low among new occupiers who were not there when the awareness campaigns were being conducted. Only 40% of the new tenants had information on the operations and maintenance of the facilities as compared to about 95% for those that received the training. From these statistics, the conclusion is that awareness campaigns should be made an ongoing activity in these areas. Otherwise, with new tenants without adequate information moving in, there is a danger of abuse of the facilities if there is no continuous sensitization.

b. EcoSan facilities are designed based upon normal standard assumption on population for a household. It was observed that Chaisa Compound is not only overcrowded in terms of housing units but the households are also overpopulated. This is true for most peri-urban areas especially those in Lusaka. This led to the vaults filling up more quickly than anticipated. The quick filling up would not give the faecal matter adequate treatment in a situation where there is desire to utilize the manure for agricultural purposes. Six months is the minimum recommended period. It is therefore concluded that for Zambian peri-urban areas, custom designs should be considered for individual households to take into consideration the obtaining situation as opposed to provision of standard designs with fixed capacities.

c. From the interviews and observations, it was learnt that the market for human manure is still very low. This situation is exacerbated by a clear policy on EcoSan on the part of the government. The ACT on sanitation advocates for safe disposal of excreta related wastes as opposed to re-use. The main reason for this low appreciation of the re-use of the excreta in agriculture was found to be lack or inadequate knowledge on the subject matter by both institutions and individuals. It was observed that a lot of education was required in this area for the success of the system.

d. It was learnt that the Sundome toilet is an inferior system for implementation in the Zambian setup of peri-urban areas. This was/is because in an area with limited space like Chaisa Compound where people only have one toilet, the Sundome toilets are inappropriate in that if people are to follow the operation procedures, then they would have to go for six months

without toilet facilities. Sundome toilets therefore should not be considered for implementation in future projects.

e. There is appreciation and high demand for EcoSan facilities in Chaisa Compound because they were given almost free of charge. From this it was learnt that people will adopt and embrace the technology even when they do not fully understand it if it is given free of charge. For peri-urban areas, adoption of EcoSan systems would not be a problem as people in these areas lack basic sanitation services and facilities. However, a cycle in most cases will not be completed as the re-use part is not fully understood and is less appreciated.

f. Ecological sanitation in peri-urban areas of Zambia can only succeed if the communities are assisted in acquiring the facilities. Over 95% of the interviewed households indicated that they would not have managed to construct the EcoSan toilets as the whole undertaking is very expensive.

9.0 RECOMMENDATIONS

This section presents recommendations from the consultants and stakeholders.

9.1 Recommendations by the Consultants

From the analysis of all the data and other information gathered by the Consultancy Team the following are the recommendations:

s) As EcoSan facilities are not ordinary toilets, there is need to include instructions on use to minimize misuse of the facilities. It is recommended that instructions are put on the door before one enters and also on the walls the user faces when entering and during the utilization of the facility. This is to minimize risks of first time users misusing the facilities due to 'ignorance';

t) Hand-washing is one of the most effective barriers in the faecal oral route of disease transmission. Almost all the EcoSan facilities that were evaluated did not have any provision for hand-washing. All future EcoSan facility designs should incorporate hand-washing facilities with the wastewater draining into the soakaway provided for the grey water and urine;

u) Awareness campaigns on importance of hand-washing should be an ongoing activity to initiate and sustain behavioural change among the residents in peri-urban to achieve positive results.

v) Many facilities had blocked urinal drain pipes resulting from formation of precipitates in the piping. The design of the drain pipes should therefore be revisited to make sure they do not promote stagnation of the urine which enhances precipitation and hence blockages.

w) To enhance good usage of the facilities, especially by the men folk, there should be compulsory provision of urinals in all the facilities.

x) To improve on the safety of the EcoSan facilities, the opening for the faecal matter should be reduced to a size that does not pose a danger of falling in to children.

y) It is necessary to have custom designed vaults to suit the situation for places where the facilities are to be implemented than to have standard designs for all households. This would

enable all facilities attain the minimum desired retention time necessary for preliminary treatment before the vaults are emptied.

z) The EcoSan facility should be made user friendly to the disabled, pregnant women, elderly and men. This is in form of accessing the toilet and also the user interface. A person on a wheel chair can easily access a facility provided with an access ramp as opposed to stair cases. For all users, the pedestal type of interface is friendlier than the squat slab.

aa) EcoSan toilets should be taken on a large-scale to address the sanitation problems in peri-urban areas as it is effective and efficient in the provision of on-site sanitation i.e. it does not require water to operate, can be built inside the house, the waste can be used as manure thus alleviating poverty by enhancing food security, ash is available locally which can be used to sprinkle on the faecal waste to enhance the dehydration, decomposition and odour reduction.

bb) Political will should be mobilized to help in speeding up the acceptance of the technology and also help in amending the gaps in the legislature on sanitation by putting up a deliberate policy to encourage the implementation of on-site sanitation technology options like EcoSan.

cc) There is also need to share EcoSan experiences among stakeholders to enhance full scale implementation of EcoSan in the country. It should also be noted that unless the aspect of re-use is seriously addressed, the viability of ecological sanitation in Zambia will continue to exist but only in limbo.

dd) There is need to introduce EcoSan in school curricular and also in colleges and universities so as to build capacity at all stages.

ee) The media i.e. radio, television and the print media, needs to play a role in the sensitization of people about the EcoSan toilets and also the need to change the mindset and consider excreta management a topic of discussion like water.

ff) Private sector participation should be encouraged in order to complement government efforts in the area of sanitation; specifically ecological sanitation.

9.2 Recommendations by the Stakeholders

From their experience, stakeholders recommended the following:

a) Since the harvest from the facilities is expected to be in solid/dry form, there is need to design tools/equipment for removing the dry solid matter. To the inclusion of solid waste management, CBEs could be empowered to include in their responsibilities the aspect of sludge collection from the EcoSan facilities. Whereas the CBEs involved in the desludging would be paid per facility desludged, it was recommended that residents pay a monthly fee to the Water Trust who would then take up the financing of the desludging aspect when the facilities are due.

b) The CBEs should work with LWSC, LCC and ECZ on the aspect of collection and disposal. It was proposed that once collected, the sludge should be taken to the LWSC drying facilities without intermediate storage within the compounds. The sludge so disposed of at the LWSC drying facilities would then received the required tertiary treatment (further dehydration) before being sold to customers together with the sludge from the conventional treatment plants.

c) Personnel who had been actively involved in desludging feacal matter previously be identified and brought to a round table with all relevant stakeholders to discuss business opportunities for better desludging methods to be improved. Training activities were also seen as an option for building capacity on better methods to be employed in the desludging of feacal matter.

d) WDCs, LCC and ECZ to monitor the operations of the CBEs in the collection and disposal of the sludge

10.0 BIBLIOGRAPHY

1. ACP-EU Water Facility Actions in ACP Countries; Appendix A1 (2006)

2. Esrey SA, Feachem RG & Hughes, JM (1985). Intervention for the control of Diarrhoeal diseases among young children: Improving water supply and excreta disposal facilities. WHO Bulletin.

3. Esrey SA, Potash JB, Roberts L & Shiff, C (1991). Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and tracoma. WHO Bulletin.

4. Hutton G. Haller L. (2004). Evaluation of the Costs and Benefits of Water and Sanitation Improvement at Global Level. WHO Bulletin.

5. Jönsson, H, Richert Stinzing, A., Vinneras, B., Salomon, E. (2004) Guidelines on the Use of Urine and Faeces in Crop Production, Stockholm Environment Institute (get from www.EcoSanres.org) *

6. Lopez A.D. & Murray C.J.C. (1996). The Global Burden of Disease. Global Health Statistics. Cambridge, MA, Harvard School of Public Health on behalf of the WHO/WB.

7. MOH/WHO (1997), Zambia CDD Health Facility Survey Lusaka: Central Statistical Office

8. Morgan, P. 2003. Experiments using urine and humus derived from ecological toilets as a source of nutrients for growing crops. Paper presented at 3rd World Water Forum 16-23 March 2003.

9. Ridderstolpe, P. (2004) Introduction to greywater management, Stockholm Environment Institute, Sweden (get from www.EcoSanres.org) *

10. Tchobanoglous, G., Burton, F.L., Stensel, H.D. (2003) Wastewater Engineering, Treatment and Reuse, Metcalf & Eddy, Inc., McGraw-Hill, 4th edition. Good book on conventional wastewater treatment

11. http://www.arkvo.org

APPENDICES

APPENDIX A: LIST OF INSTITUTIONS AND PERSONS CONSULTED

Mr. George Nyendwa	Councilor
Mr. Adrian Nsefu	Chairperson - Chaisa WDC
Mr. Avion Muntanga	Secretary – Chaisa WDC
Mrs. Charity Mawanga	Member - Chaisa WDC
Mr. Joseph Pupe	CARE
Mr. Samuel Gonga	Devolution Trust Fund
Mr. Curtis Muleya	National Water and Sanitation Council of Zambia
Mr. George Phiri	Africa Development Bank/Ministry of Agriculture and Cooperatives
Mr. Peter Lungu	Water and Sanitation Association of Zambia/Bremen Overseas Research Development Agency
Dr. Simone Klawitter	GTZ
Ms. Yvonne Siyeni	Lusaka Water and Sewerage Company Limited
Mr. Trophius Kufanga	Lusaka City Council
Ms. Chisha Chongo	National Industrial and Scientific Research
Mr. Isaac Mbewe	Water Trust – Chaisa
Mrs. Alice Mwanza	Chaisa Health Centre
Mrs Catherine Tembo	DANIDA
Mrs. Charity Mundia	Environmental Council of Zambia
Mr. Humble Sibooli	Water Aid

APPENDIX B: ATTENDANCE LIST FOR THE CHAISA COMMUNITY WORKSHOP HELD AT CHAISA COMMUNITY HALL ON 7TH DECEMBER 2009.

Mr. Mkandawire Reuben	Secretary – ZDC
Mr. Stephen Phiri	Member – ZDC
Mr. David Bwalya	Member – Zone 4
Mr. Andrew Mambo	Memmber – Zone 2
Mrs. Grace Phiri	LCC
Mr. Maureen Lukhelo	CBE
Mrs. Agnes Phiri	WDC
Ms. Charity Mawanga	WDC
Mr. Isaac Mbewe	Chaisa Water Trust
Mr. George Mbuwa	LCC
Ms. Bernadette Luo	Beneficiary
Ms. Christine Lubungu	Zone Leader
Ms. Rebecca Njovu	Zone Leader
Ms. Alice Mutanuka	Zone Leader
Ms. Ida Tembo	Zone Leader
Ms. Chaku Chiuta	Beneficiary
Mr. Azion Muntanga	WDC
Ms. Tiyaukenji Mbewe	Cooperative
Mr. George Nyendwa	Ward Councilor
Mr. Lameck Kalaswa	Zone Leader
Mr. Nebat Ngulube	Zone Leader
Mr. John Chonda	CBE
Mr. Langford Mwale	CARE
Mr. Chipunde Manfred	Plant Operator
Mr. Adrian Nsefu	WDC
Ms. Ireen Mulaisho	CARE
Mr. George Zulu	Zone 13
Ms. Mary Phiri	LCC
Mr. Burton Mukomba	CARE
Mr. Geoffrey Sungete	CARE
Ms. Carol Mweemba	Consultant
Mr. Joel Kabika	Consultant
Mr. James Tembo	Consultant
Prof. Imasiku Nyambe	Lead Consultant

APPENDIX C: ATTENDANCE LIST FOR THE DISSEMINATION WORKSHOP HELD AT CARE INTERNATIONAL OFFICES ON 22ND DECEMBER, 2009

Mr. Matongo Mundia	Water Aid
Mr. Burton Mukomba	CARE
Ms. Ireen Mulaisho	CARE
Prof. Imasiku Nyambe	Lead Consultant
Ms. Carol Mweemba	Consultant
Mr. Joel Kabika	Consultant
Mr. James Tembo	Consultant
Ms. Cathryn Mwanamwambwa	CARE
Mr. Joseph Pupe	CARE
Mr. Adrian Nsefu	Chaisa WDC
Mr. Henry Zimba	Chaisa Water Trust
Mr. Langford Mwale	CARE
Ms. Yvonne Siyeni	LWSC
Mr. Trophius Kufanga	LCC
Mr. Mulimba Yasini	LCC
Mr. Wilson Silomba	SNV
Mr. Victor Muyeba	NWASCO
Mr. Reuben Sipuma	WSUP

APPENDIX D INSTRUMENTS USED

APPENDIX D1: QUESTIONNAIRE FOR INSTITUTIONS

Institutional Questionnaire on the Evaluation of the EcoSan Facilities in Chaisa peri – urban area of Lusaka

SECTION I: QUESTIONNAIRE IDENTIFICATION				
Name of Institution:			Institution ID:	
SECTION II: EFFICIENCY AND EFFECTIVENESS OF ECOSAN FACILITIES				
1.1.1.	What component of sanitation are you involved in?	☐ 0. No involvement ☐ 1. Excreta management (urine and faeces) ☐ 2. Grey water management (e.g. water from sink, bath tab) ☐ 3. Solid waste management ☐ 4. Storm water management (rain water) ☐ 5. Combination, please specify …… ……....		
2	Were you involved in setting up the EcoSan toilets in Chaisa?	☐ 0. No ☐ 1. Yes		
3.	If yes, what was your involvement in setting up the facilities?	☐ 1. Contractor ☐ 2. Regulator ☐ 3. Service provider ☐ 4. Financing agency ☐ 5. Other, *please specify* ……		
4.	Is the programme achieving its intended objective of promoting suitable options for excreta disposal?	☐ 0. No, ☐ 1. Yes Explain your answer …….. …… …… ……		
5.	Is the programme increasing health and hygiene awareness?	☐ 0. No ☐ 1. Yes Explain your answer …….. …… …… …… ……..		
6.	Is the programme encouraging gender equity?	☐ 0. No ☐ 1. Yes Explain your answer …….. …… …… …… ……		
7.	What was (were) your contribution(s) to the programme?	☐ 0. Nothing ☐ 1. Financial ☐ 2. Technical ☐ 3. Advisory ☐ 4. Other, *please specify* ……		

8.	Could there have been other cheaper methods of doing the work to end up with the same outcome?	☐ 0. No ☐ 1. Yes ☐ Explain your answer ……... …… …… ……
9.	If yes, why did you not adopt the cheaper option?	☐ 0. No reason ☐ 1. Money was available ☐ 2. We looked at the qualitative aspect of the option ☐ 3. Project demanded implementation of the EcoSan toilet ☐ 4. Other, please specify ……..
10.	Based on the technical inputs, do you think the EcoSan toilet is a viable option?	☐ 0. No ☐ 1. Yes Explain your answer …….. …… …… ……
11.	Does the community for which it was intended utilize the toilet as was expected?	☐ 0. No ☐ 1. Yes Explain your answer …….. …… …… ……
12.	If no, what have you done to ensure that the purpose it was intended for was achieved?	☐ 0. Nothing ☐ 1. Carried out awareness campaigns ☐ 2. Other, please specify …… …… …… ……
SECTION III: MECHANISMS AND SUITABILITY OF OPERATION AND MAINTENANCE OF ECOSAN FACILITIES		
13.	How suitable is the facility to the male user in terms of usability?	☐ 0. Not suitable ☐ 1. Slightly suitable ☐ 2. Suitable ☐ 3. Very suitable ☐ 4. Other, please specify…….. Explain your answer……... …… …… …… ……
14.	How suitable is the facility to the female user in terms of usability?	☐ 0. Not suitable ☐ 1. Slightly suitable ☐ 2. Suitable ☐ 3. Very suitable ☐ 4. Other, please specify…….. Explain your answer ……... …… …… ……

15.	How suitable is the facility to the child user in terms of usability?	☐ 0. Not suitable ☐ 1. Slightly suitable ☐ 2. Suitable ☐ 3. Very suitable ☐ 4. Other, please specify…….. Explain your answer ……. ……. ……. …….
16.	How suitable is the facility to the aged user in terms of usability?	☐ 0. Not suitable ☐ 1. Slightly suitable ☐ 2. Suitable ☐ 3. Very suitable ☐ 4. Other, please specify…….. ☐ Explain your answer…… ……. ……. …….
17.	How suitable is the facility to the physically challenged user in terms of usability?	☐ 0. Not suitable ☐ 1. Slightly suitable ☐ 2. Suitable ☐ 3. Very suitable ☐ 4. Other, please specify…….. ☐ Explain your answer…… …… …… ……...
18.	Do you think users have adequate information needed to effectively operate the toilet?	☐ 0. No ☐ 1. Yes. Explain your answer ……... ……. ……. …….
19.	What challenges do you think users would face in operating the system, especially at the time of excreta disposal?	☐ 0. No problems ☐ 1. Technical problems ☐ 2. Social problems ☐ 3. Financial problems ☐ 4. Other, please specify …… ....
20.	How do you rate the attention given to sanitation in Zambia?	☐ 0. No rate ☐ 1. Poor ☐ 2. Fair ☐ 3. Good Give reasons for your answer ……. ……. …….
21.	Is there enough attention given to on-site sanitation by the legal framework	☐ 0. No ☐ 1. Yes

	on water supply and sanitation in Zambia?	Give reasons for your answer …… …… ……
22.	Are there adequate synergies and complementariness among the stakeholders in the sanitation sector in Zambia?	☐ 0. No ☐ 1. Yes Give reasons for your answer …… …… ……
23.	Are there any specific measures put in place to sustain the EcoSan toilet facilities in Chaisa?	☐ 0. No ☐ 1. Yes ☐ 2. Give reasons for your answer …… …… ……
24.	What challenges do you think the users face in trying to sustain such kinds of toilet facilities?	☐ 0. No challenges ☐ 1. Technical ☐ 2. Social ☐ 3. Financial ☐ 4. Other, please specify …… …… ……
25.	What is your opinion on adopting EcoSan as the sanitation option for peri – urban arrears in Lusaka?	Explain your answer …….. …… …… ……
SECTION IV: STAKEHOLDER INVOLVEMENT, COMMUNITY PARTICIPATION, UTILIZATION OF FACILITIES, USER SATISFACTION, TRAINING ON OPERATION AND MAINTENACE AND HEALTH INFORMATION		
26.	Have you ever done any sensitization campaign in relation to ecological sanitation?	☐ 0. no ☐ 1. yes Explain your answer…… …… …… …… ……
27.	*If yes,* state some of the difficulties you faced in your campaign if any?	☐ 1. Unwillingness to participate by community ☐ 2. Communication barriers ☐ 3. Mobility constraints ☐ 4. Other, *please specify* …… …… ……
28.	What kind of response did you get from users?	☐ 0. No responses ☐ 1. Positive ☐ 2. Negative ☐ 3. Other, please specify …… …… ……

29.	If response was positive, what do you attribute the response to?	☐ 1. Local participation ☐ 2. Sufficient knowledge of the facility ☐ 3. Need for the facility ☐ 4. Other, please specify …… …… ……
30.	What is your perception of user acceptability of the EcoSan toilet facility?	☐ 0. Not satisfied ☐ 1. Satisfied ☐ 2. Other, please specify …… …… ……
31.	If not satisfied, why do you think the facility is not satisfactory to the users?	☐ 1. Technical aspects of the facility ☐ 2. Social aspect of handling faecal matter ☐ 3. Gender aspect of usability ☐ 4. Other, please specify …… …… ……
32.	Are there enough incentives in the sanitation sector to promote implementation of EcoSan in Zambia?	☐ 0. No ☐ 1. Yes Support your answer …… …… ……
33.	Are there any cultural beliefs in Zambia that hinder the implementation of EcoSan in systems?	☐ 0. no ☐ 1. yes
34.	*If yes,* state some of these cultural beliefs?	Explain your answer …… …… ……
35.	How do you rate the affordability of an EcoSan toilet in relation to low income class of people?	☐ 1. Not affordable ☐ 2. Affordable ☐ 3. Very affordable ☐ 4. Other, *please specify* …… …… ……
36.	Do you have reason to believe that the future prospects for implementing EcoSan projects in Zambia are bright?	☐ 0. No ☐ 1. Yes Please specify your reasons …… …… ……
37.	Do you have any other general comments in relation to the EcoSan facility being implemented?	…… …… …… ……
END OF INTERVIEW		
Thank you for your time and for all the information you have given us!		

APPENDIX D2: QUESTIONNAIRE FOR HOUSEHOLDS WITH ECOSAN FACILITIES

Household Questionnaire on Evaluating the EcoSan Facilities in Chaisa peri – urban area of Lusaka

SECTION I: QUESTIONNAIRE IDENTIFICATION			
Name of community		Household ID	
SECTION II: HOUSEHOLD CHARACTERISTICS			
1.1.2.	Sex of respondent(s) *Don't ask, just note!*	☐ 1. male ☐ 2. female ☐ 3. couple – male and female	
1.1.3.	Are you the household head(s)?	☐ 0. no ☐ 1. yes	
3.	How many people are in your household?	☐ 1. 1 – 5 ☐ 2. 6 – 10 ☐ 3. 11 – 15 ☐ 4. Over 15	
4.	What is your status in terms of house ownership?	☐ 1. Owner ☐ 2. Tenant	
SECTION III: EFFICIENCY AND EFFECTIVENESS OF ECOSAN FACILITIES			
5.	Who financed the construction of your toilet?	☐ 1. Own resources ☐ 2. Project resources ☐ 3. Project and own resources Explain procedure…… …… ……..	
6.	Before you started using the EcoSan toilet, what kind of toilet where you using?	☐ 1. Flush toilet ☐ 2. Ordinary pit latrine ☐ 3. VIP ☐ 4. Other, *please specify* …….. .... ……	
7.	Of the two options, which system do you prefer?	☐ 1. Old toilet ☐ 2. EcoSan toilet ☐ 3. Don't know Justify your answer …….. …… ……	
8.	How long have you been using the EcoSan toilet?	☐ 1. Less than 1 year ☐ 2. 1 – 2 years ☐ 3. Over 2 years	
9.	Is the project achieving its intended objective of promoting suitable options	☐ 0. No, ☐ 1. Yes	

	for excreta disposal?	☐ 2. Don't know Explain your answer …… …… …… ……
10.	Is the project increasing health and hygiene awareness?	☐ 0. No ☐ 1. Yes ☐ 2. Don't know Explain your answer …… …… …… …… ……
11.	Is the project encouraging gender equity?	☐ 0. No ☐ 1. Yes ☐ 2. Don't know Explain your answer …… …… …… …… ……
SECTION IV: UTILIZATION, USER SATISFACTION, AND SUITABILITY OF OPERATION AND MAINTENANCE OF ECOSAN FACILITIES		
12.	How suitable is the facility to you in terms of usability?	☐ 0. Not suitable ☐ 1. Slightly suitable ☐ 2. Suitable ☐ 3. Very suitable ☐ 4. Other, please specify..... Explain your answer …… …… ……
13.	What improvements can you suggest to improve on the suitability?	Give us your views …… …… …… ☐ 99. N.A
14.	What are the general reactions of new users about the EcoSan toilet (for instance visitors)?	☐ 0. Don't like it ☐ 1. Like it ☐ 2. Other, please specify …… …… ……
15.	What challenges do you envisage to face in operating EcoSan toilet especially at the time of excreta disposal?	☐ 0. No problems ☐ 1. Technical problems ☐ 2. Social problems ☐ 3. Financial problems ☐ 4. Don't know ☐ 5. Other, please specify ……..

		…… …….. ……..
16.	What challenges are you facing as the tenant/owner of this house in terms of maintenance of facility?	☐ 0. No problems ☐ 1. Technical problems ☐ 2. Social problems ☐ 3. Financial problems ☐ 4. Don't know ☐ 5. Other, please specify …… …… …… ……
17.	What is your view on the idea of promoting EcoSan toilets to other peri urban areas?	☐ 0. Not a good idea ☐ 1. Good idea ☐ 2. Don't know Justify your answer …… …… …… ……
18.	What are the expected challenges to the applicability of the project in other peri – urban areas?	Explain your answer…….. …… …… ☐ 99. N.A
19.	Would you recommend to your friends to build an EcoSan toilet?	☐ 0. No ☐ 1. Yes Give reasons for your answer …… …… ……
SECTION IV: STAKEHOLDER INVOLVEMENT, COMMUNITY PARTICIPATION AND TRAINING ON OPERATION AND MAINTENACE OF ECOSAN FACILITIES		
20	Do you have adequate information needed to effectively operate the toilet?	☐ 0. No ☐ 1. Yes. Explain your answer …….. …… …… ……
21	If yes, how did you get to know of how to effectively use the toilet?	☐ 1. Training ☐ 2. knowledge from others ☐ 3. Other, please specify …….. …… …… …… ☐ 99. N.A
22.	Has you toilet ever had a technical problem?	☐ 0. No ☐ 1. Yes Give reasons for your answer ……..

		…… …… ……
23.	If yes, explain the problem?	Give reasons for your answer…… …… …… ☐ 99. N.A
24.	How did you solve the problem?	☐ 0. Did not do anything ☐ 1. worked on the facility by ourselves ☐ 2. Hired experts to work on facility ☐ 3. Project assisted us ☐ 99. N.A
25.	What would you say on the cost of an EcoSan toilet?	☐ 0. No comment ☐ 1. Low ☐ 2. Moderate ☐ 3. High ☐ 4. Don't know
26.	When you became a tenant, did you find the EcoSan toilet already operational at this house?	☐ 0. No ☐ 1. yes ☐ 99. N.A
27.	If yes, what was your perception of the facility?	☐ 0. No comment ☐ 1. Thought the facility was bad ☐ 2. Thought the facility was good ☐ 3. Other, please specify ……. ☐ 99. N.A
28.	Do you know how the EcoSan facility came in being in your community?	☐ 0. No ☐ 1. Yes
29.	If yes, how did you get to know about it?	☐ 1. Through awareness campaigns ☐ 2. Through community meetings ☐ 3. Friends and/or family ☐ 4. Other, *please specify* ……. ☐ 99. N.A
30.	If meeting(s) held, who was actively involved in the deliberations of the meeting(s)?	☐ 0. Did not participate in meeting ☐ 1. The whole community ☐ 2. The implementers ☐ 3. Community leaders ☐ 4. Implementers and community leaders ☐ 5. community and community leaders ☐ 6. Community and implementers ☐ 7. All (Community, implementers and community leaders) ☐ 8. Other, *please specify* ……..
31.	Did the meeting(s) give you chances to air your views on what you thought	☐ 0. No ☐ 1. Yes

	about the EcoSan toilet facility that was being proposed?	☐ 99. N.A
32.	What was first reaction at the idea?	☐ 1. Didn't like it ☐ 2. Mixed feelings ☐ 3. Liked it ☐ 4. Don't know Justify your answer ……
33.	What was your involvement in the setting up of the toilet	☐ 0. No involvement ☐ 1. Individual verbal (or other way) contribution of ideas ☐ 2. Collective verbal (or other way) contributions of ideas ☐ 3. Financial input to complete construction ☐ 4. Material input to complete construction ☐ 5. Financial and material inputs ☐ 6. other, *please specify* ……..
34.	Has the EcoSan facility delivered according to your initial expectations?	☐ 0. No ☐ 1. Yes ☐ 2. Other, *please specify.* ……..
35.	If no, what differences have you observed?	☐ 1. Did not think it would be hard to dispose of the waste ☐ 2. Have no use for waste so I prefer other type of toilet ☐ 3. Not easy to use ☐ 4. Other, please specify ……. ☐ 99. N.A
36.	How do you intend to dispose of the dry faecal matter?	☐ 0. No ways ☐ 1. Getting rid of the product ☐ 2. Burying the product ☐ 3. Re-using in agriculture ☐ 4. Selling the product ☐ 5. Other, specify ……. ☐ 99. N.A
37.	Who will empty the faecal matter once the EcoSan toilet is full?	☐ 0. No body ☐ 1. Everybody at home ☐ 2. Husband ☐ 3. Wife ☐ 4. Children ☐ 5. Hired labourer ☐ 6. Other, *please specify* …….
38.	Would you personally handle dry faecal matter from the EcoSan toilet?	☐ 0. No ☐ 1. Yes Justify your answer …….
39.	If your answer to question 38 is yes, what would you use the dry faecal matter for?	☐ 0. Nothing ☐ 1. Crops and vegetable gardens ☐ 2. Lawn ☐ 3. Flower beds ☐ 4. other, *please specify* _..... ☐ 99. N.A
40.	Do you have any beliefs or opinions concerning the handling of faecal	☐ 0. No ☐ 1. Yes

	matter?	☐ 2. If yes, *please specify your belief* ……
41.	Have you had any sanitation expert talk to you about EcoSan toilets?	☐ 0. No ☐ 1. Yes ☐ 2. If yes, *please specify* organisation ……
END OF INTERVIEW		
Thank you for your time and for all the information you have given us!		

APPENDIX D3: QUESTIONNAIRE FOR HOUSEHOLD WITHOUT THE ECOSAN FACILITIES

Household Questionnaire on Evaluating the EcoSan Facilities in Chaisa peri – urban area – Household without the EcoSan facility

SECTION I: QUESTIONNAIRE IDENTIFICATION			
Name of community		Household ID	

1.1.4.	Sex of respondent(s) *Don't ask, just note!*	☐ 1. male ☐ 2. female ☐ 3. couple – male and female
1.1.5.	Are you the household head(s)?	☐ 0. no ☐ 1. yes
3.	What type of toilet are you currently using	☐ 1. Flush toilet ☐ 2. Ordinary pit latrine ☐ 3. VIP ☐ 4. Other, *please specify*……
4.	Do you know what an EcoSan toilet is?	☐ 0. No ☐ 1 Yes
5.	If yes, how did you come to know about?	☐ 1. Through awareness campaigns ☐ 2. Through community meetings ☐ 3. Through friends and/or family ☐ 4. Other, *please specify* ……
6.	Between the system you are using and EcoSan, which one would you prefer?	☐ 1. Current ☐ 2. EcoSan Give reasons …….. …….. ……
7.	What is your view on the idea of promoting EcoSan toilets to other peri urban areas?	☐ 0. Not a good idea ☐ 1. Good idea ☐ 2. Don't know Justify your answer …….. …… …… ……
8.	What challenges do you think would arise if EcoSan facilities were provided to all peri-urban areas?	☐ 0. No problems ☐ 1. Technical problems ☐ 2. Social problems ☐ 3. Financial problems ☐ 4. Don't know ☐ 5. Explain your answer:…… …… …… ……
9	Do you know how to operate an EcoSan toilet?	☐ 0. No ☐ 1. Yes.

10	If yes, how did you get to know of how to effectively operate the toilet?	☐ 1. Training ☐ 2. knowledge from others ☐ 3. Other, please specify …….. …… …… …… 99. N.A
11.	Would you personally handle dry faecal matter from the EcoSan toilet?	☐ 0. No ☐ 1. Yes Justify your answer …….
12.	If your answer to question 38 is yes, what would you use the dry faecal matter for?	☐ 0. Nothing ☐ 1. Agriculture ☐ 2. Other, *please specify* _..... ☐ 99. N.A
13.	Do you have any beliefs or opinions concerning the handling of faecal matter?	☐ 0. No ☐ 1. Yes If yes, *please specify your belief* ……
14.	Has anyone ever talked to you about sanitation?	☐ 0. No ☐ 1. Yes If yes, *please specify* organisation …….
15.	The cost EcoSan toilet is about K4,000,000; can you afford	☐ 0. No ☐ 1. Yes
END OF INTERVIEW		
Thank you for your time and for all the information you have given us!		