

UNIVERSITY FOR DEVELOPMENT STUDIES

ASSESSING THE ACCEPTABILITY OF ECOLOGICAL SANITATION
LATRINE AMONG ADULTS IN THE TAMALE METROPOLIS

SAMUEL ATIBOLI

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2017

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LATRINE AMONG ADULTS IN THE TAMALE METROPOLIS

BY

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(UDS/CHD/OO24/11)

THESIS SUBMITTED TO THE DEPARTMENT OF COMMUNITY HEALTH,
SCHOOL OF ALLIED HEALTH SCIENCES, UNIVERSITY FOR
DEVELOPMENT STUDIES IN PARTIAL FULFILMENT OF THE
REQUIREMENT FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN
COMMUNITY HEALTH AND DEVELOPMENT.

APRIL, 2017



DECLARATION

I **Samuel Atiboli**, declare that this dissertation is the result of my own original work and that no part of it has never been presented for another degree in this University or elsewhere.

STUDENT: **SAMUEL ATIBOLI**

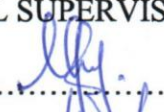
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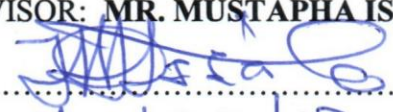
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ABSTRACT

There is a high global burden of diseases that are related to poor sanitation. Developing countries including Africa are more affected and Ghana is not left out. Ecological sanitation (EcoSan) is a strategic comprehensive sanitation approach which integrates all aspects of sanitation and links sanitation with agriculture and food production. Faeces and urine serve as vehicles for transmitting many communicable diseases to man. This study was therefore to assess the acceptability of Ecological sanitation latrine concept in the Tamale Metropolis. A cross-sectional survey of adults sampled from both rural and urban communities of the Metropolis was the study design. Data were collected using a semi-structured questionnaire and processed and analysed using the SPSS version 20. Descriptive data such as percentages, means or medians where appropriate were computed. The Chi-square test for associations was used to assess any associations between the primary outcome measure (acceptability of the EcoSan) and other respondents' variables. The level of significance was set at 5% and the Confidence Interval at 95%. The key findings were that, participants lack knowledge specifically with regards to EcoSan and religion was the only socio-demographic characteristics that showed significant influence on the acceptability and adoption of Ecosan ($p=0.007$). Misconceptions about the functioning of the EcoSan challenged its acceptability and defaecating in the field was still accepted by majority (83.8%). It is recommended that the Ministry of Local Government and Rural Development (MLG & RD) should intensify education on EcoSan to promote its adoption as an alternative form of sanitation in the study area. It is suggested that more studies should be carried out on the motivation for open defaecation.



DEDICATION

I dedicate this work to my dear wife for being my best companion.



ACKNOWLEDGEMENT

It is a fact that this work has drawn on the talent, advice and the encouragement of many people that I must acknowledge. I would therefore, like to recognize the contributions of many who have helped.

Before acknowledging the human contribution, I would first of all give credit to the Almighty God for his sustenance and guidance throughout the preparation of this work.

I sincerely acknowledged my dear supervisors, namely Dr. Baba Sulemana Mohammed and Mr. Mustapha Issahaku for their patience. Their contribution in guiding the preparation of the work was enormous and enlightening. They have really imbued in me the necessary skills for undertaking academic research. May the Almighty God richly bless them. I greatly appreciate the tutorials and the splendid support and encouragements from the Department of Community Health and Family Medicine of the University. I especially acknowledged Mr. Akwasi Boakyeyiadom, the course coordinator for his contributions.

My profound gratitude and appreciation goes to my wife, my spiritual and biological parents for the extremely financial and spiritual support offered me during the period of my study that culminated in this work.

The contributions of the study participants to the success of this study cannot be overemphasised. I therefore wish to express my sincere gratitude to them all for their patience and cooperation during the data collection of this study. Finally, I am grateful to those individuals, too numerous to mention by name, who have contributed to the success of this research in one way or the other.



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LIST OF ACRONYMS / ABBREVIATIONS

ECOSAN	Ecological Sanitation
TR	Technology readiness
TAM	Technology Acceptance Model
EOU	Ease of Use
NGO	Non- Governmental Organisation
IT	Information Technology
DTV	Digital Television



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CHAPTER ONE

INTRODUCTION

1. 0 Background of the Study

Faeces and urine serve as vehicles for transmitting many communicable diseases to man. (Stenström, 1996) The poor and unhygienic management practices regarding these human excreta, together with non- intensification of education on hygiene and sanitation to the public, constitute a major public health concern.

In the light of the above problem, there are at least 2.6 billion people in the world without improved sanitation. (Mülleger and Lechner, 2008). A similar view has been espoused by WHO and UNICEF (2010) that globally 2.6 billion people still do not have access to improved sanitation facilities as at 2009. Improved sanitation is defined by the World Health Organization as connection to a public sewer, connection to a septic system, a pour-flush latrine, a simple pit latrine or a ventilated improved pit latrine. But technically, even access to some “improved” sanitation does not solve the problem because conventional pit latrines are reported to usually fail to sanitize the environment and they contribute to groundwater pollution (Stenström, 2002). Also, septic systems and sewage treatment plants are often discharged into the environment with little or no sanitization or nutrient removal. Approximately 90% of the sewage in cities in developing countries is today discharged untreated, polluting rivers, lakes and coastal areas. Pit toilets also have limitations, especially in densely populated areas, with severe risks of contaminating groundwater (Esrey et al. 1998). Less than 5% of domestic wastewater is treated in urban areas of developing countries (World Resources Institute, 1996). In order to be sustainable, a sanitation system does not



only have to be economically viable, socially acceptable and technically and institutionally appropriate, but should also protect the environment and the natural resources (SuSan, 2008). In many parts of the world it is a tradition to keep urine and faeces apart, as occurred in the old Japanese practice of night soil recovery from urban areas where urine was separated from faeces, with the urine regarded as a valuable fertilizer (Matsui et al., 2001).

In the conventional systems of sanitation, urine and faeces are not separated and sanitized before use as fertilizer for crops. This poses a great risk of contamination to consumers as well as pollution of soil and water bodies. With the EcoSan however, urine and faeces are separated and sanitized before use. EcoSan also ensures the destruction of almost all disease-causing organisms in faeces before reused. Winblad and Hebert (2004) noted that although urine contains few pathogenic organisms, separating it from faeces which contain many pathogens and storing this undiluted urine for one month will render urine safe for use in agriculture. It is also known that undiluted urine provides harsher environmental conditions for micro-organisms, increasing the die-off rate of pathogens and preventing the breeding of mosquitoes (Winblad and Hebert, 2004). The level of awareness of this new system and factors that may influence its adoption in Ghana is however not known. It was for this reason that this current work was conducted within the Tamale metropolis with the goal of promoting its use in the country as a whole.

1.2 Problem Statement

In order to improve the lives of the people of the Tamale metropolis, there is the need for improved sanitation, which according to WHO (2000) means to be connected to a public sewer or septic tank system, a pour-flush latrine, a simple pit

latrine or ventilated improved pit latrine. This would reduce faecal-related diseases and those linked to poverty and unhealthy living conditions which represent a significant proportion of morbidities and mortalities. Poor management of excrement, unhygienic practices and lack of information on hygiene and sanitation by the populations are the main factors contributing to this situation.

In the Tamale metropolis, as in many parts of the world, water used in flushing toilets is of drinking quality. However, Tamale is one such area in Ghana where water is so scarce and only recently saw marginal improvement. Often, water used in flushing toilets is of drinking quality. It is therefore imperative to encourage the adoption and promotion of a dry sanitation facility like the EcoSan to curb the use of quality water on latrines.

The common types of latrine systems available in the city are the drop-and-store systems that combine urine and faeces and water in most cases and the drop-and-flush systems. These types of latrine systems attract high management cost in waste treatment plants and sometimes lead to ineffective and inefficient plants activity. These make the treatment of human excreta very difficult, thereby allowing it to pose a threat to the environment and human health.

In order to avoid contaminating drinking water, prevent the spread of disease, protect the environment, fertilize the soil and push towards sustainable solutions based on safe recycling of human excrement, there is the need to develop and encourage excreta disposal systems such as the EcoSan that do not present threat to drinking water sources and the environment as a whole.

Not only is the EcoSan system economical, simple and safe but it is also relevant for small scale agricultural development since the by-products are safe and useful for

soil fertilization and irrigation. The level of acceptability of this system within the Tamale Metropolitan Assembly is not known. It is in view of this that this study seeks to assess the acceptability and promotion of the EcoSan in the Tamale Metropolis. To facilitate the conduct of this study the following specific questions were asked.

1.3 Research Questions

1. What is the level of awareness on the EcoSan concept among inhabitants of the Tamale Metropolis?
2. Which socio-demographic characteristic of respondents affect the adoption of EcoSan within the Tamale Metropolis?
3. How do existing sanitation systems affect the adoption of EcoSan?
4. What attitudes and practices influence the acceptance and promotion of EcoSan systems

1.4 Objectives

In order to adequately answer the above questions, the following objectives were set:

1.4.1 General Objective: The general objective of this study was to assess the acceptability of Ecological sanitation latrine concept in the Tamale Metropolis.

1.4.2 Specific objectives

1. To establish the level of awareness among the people in the Tamale Metropolis regarding the EcoSan concept?
2. To determine the extent to which socio-demographic characteristics of respondents such as age, gender, religion and level of education affect the adoption of EcoSan within the Tamale Metropolis?



3. To determine challenges of existing sanitation systems to the acceptability of EcoSan
4. To establish the attitudes and practices that can promote the functioning of EcoSan systems

In order to adequately evaluate the acceptability of this new sanitation system, the various factors were modelled according to the framework as follows:

1.5 Conceptual Model

The study was conducted within a frame work that was built following an extensive review of literature on works that have been conducted on individuals, acceptability and adoption of new technologies, with particular attention on sanitation. The model is presented in Figure 1.

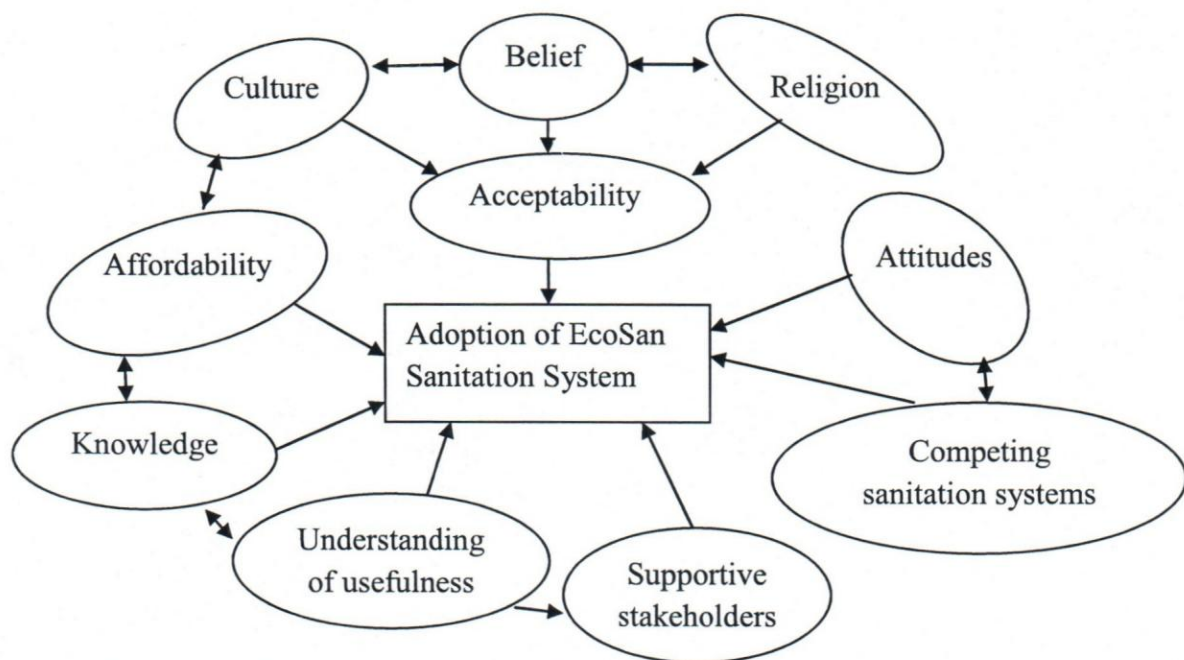


Figure 1.1: Conceptual framework

It can be seen in the above model that several factors may act independently and collectively to affect adoption. Religion can affect the adoption of EcoSan in the



sense that, where a particular religion demands the use of water when defaecating, the effective functioning of the system may be impeded. Culture might also be an important factor working for or against the adoption of the system. Where a culture supports open defaecation would make the adoption of EcoSan a problem.

The persons within the household who take the lead on each of these decisions will certainly vary across cultures and religions. In some religions, female heads of households have the final say in hygiene matters and male heads of households decide on major household expenditures. In other areas, decisions are shared and since the decision-making for a durable or good household improvement such as a latrine can be lengthy and have multiple steps. Household members other than the heads, such as children and in-laws, may also play an influential role. On the other hand, knowledge about any new technology enhances its acceptability and adoption whilst the opposite is true. As such the knowledge level of participants has been accessed in this study.

Competing sanitation systems that are promoted by some organizations could influence negatively the adoption of EcoSan. Also enabling environment such as availability of supportive stakeholders who will be prepared to support the promotion of the system could go a long way to enhance adoption.

Acceptability of the system is a factor that can influence its adoption but acceptability could be influenced by religion, culture and belief as indicated in the model. Understanding of the usefulness of the system for agricultural purposes in particular is another factor that could enhance its adoption. Such understanding could however be influenced by level of literacy among the communities concerned.



Affordability is influenced by many factors including household income, availability of cash, time of year, access to credit, and availability of affordable sanitation options in the area. Affordability is different from willingness to pay. A household may be able to afford to purchase a latrine, but if there is a history of subsidies in the region, they may not be willing to pay. In the model, the double arrow connecting the independent variables denotes a vice-versa influence on each other. In other words, it means a variable can affect the other variable and can in turn be affected by the other variable.

1.6 Relevance of the Study

The relevance of this study lies in the fact that, besides contributing to general knowledge in the field of study, the findings would provide baseline information regarding behaviour change on the adoption of EcoSan within the Tamale metropolis. The information obtained can be used to cause a change that could encourage the adoption of EcoSan. The adoption of the system would improve the socioeconomic status of people in the study area in particular and people elsewhere in general. This will be achieved through reduction in reliance on chemical fertilizers to enrich the agricultural land as well as reduction in water bills through lesser use of water, since the EcoSan systems would not require the use of water as is the case of some existing sanitation systems.

1.7 Scope of the Study

The study was limited geographically to the Tamale metropolis. In terms of content, it was limited to issues related to factors that may serve as barriers to the adoption of EcoSan in the Metropolis. The study further looked at how the nutrients in faeces and urine can be made available to crops to maintain the ecology.

1.8 Operational Definitions

ECOSAN - a sanitation system that renders faeces and urine harmless makes it possible for reusing of human excrement and conserving natural resources as implied by the term "ECOLOGICAL SANITATION"

ECOLOGY- This is the study of the relationship between living organisms including humans and their physical environment. It seeks to understand the vital connection between plants and animals and the world around them.

FAECOPHOBIA- a personal or cultural response to the fact that human faeces are malodorous and potentially dangerous.

FAECOPHILIA- having no problem of talking about human faeces, smelling it or handling it. Such a culture can be called 'faecophilic', thus represents one extreme point of a continuum where the other extreme is faecophobia

PERCEIVED USEFULNESS- refers to "the degree to which a person believes that using a particular system would enhance his or her job performance"

PERCEIVED EASE OF USE- refers to "the degree to which a person believes that using a particular system would be free of effort".

1.9 Profile of the Study Area

1.9.1 Study location

The study was conducted in the Tamale Metropolis. Tamale is the capital town of the Northern Region of Ghana, and the fastest growing city in West Africa (Tamale Metro records, 2013). Tamale is located 600 km north of Accra, with most residents being moderate followers of Islam, Due to its central location,

Apart from Metropolitan Tamale where there is ethnic diversity, almost all people in the surrounding villages are Dagombas. Even in the Metropolis, the Dagombas constitute about 80% of the total population (Tamale Metro records, 2013). Before the advent of both Western and Eastern Regions, the Dagombas were mostly African traditionalist.

1. 9.2. *Population size, distribution and growth rate*

With an urban population of 67.1%, the Metropolis is the only district in the Region which is predominantly urban. This implies that the Metropolis could be a growth pole for the three northern regions attracting both population and economic development in the area. The population density of 318.6 persons per square kilometers for the Metropolis is about 12 times higher than the Regional average density of 25.9 persons per square kilometers. With a population density of 318.6, there is a great potential for the housing industry and a good economic feature for high market and cheap labour (skilled, semi and unskilled) source for industry (Tamale Metro records, 2013).

1. 9.3 *Communities*

There are a total of 197 communities in the Metropolis of which 33 are urban communities. This implies that over hundred (100) communities in the Metropolis are either peri-urban or rural communities. Most of the rural communities are the areas where there is land for agricultural activities and serve as the food basket for the Metropolis. However, these communities still lack basic social and economic infrastructure such as good road network, schools, hospitals, market and recreational centres which hinder socio-economic development, poverty reduction and the general phenomena of rural urban migration of the area.



1.9.4 Climate

The metropolis experiences one rainy season from April to September or October with a peak in July and August. The mean annual rainfall is 1100 mm within 95 days of rainfall in the form of tropical showers, under dry season from November to early April. The mean day temperatures range from 28 to 43 degrees Celsius while mean night temperatures range from 18 to 25 degrees Celsius. The mean annual day sunshine is approximately 7.5 hours (Tamale Metro records, 2013).

1. 9.5 Drainage

The Metropolis is poorly endowed with water bodies, which is attributed to the low underground water table. The only natural water systems are a few seasonal streams which have water during the rainy season and dry up during the dry season. Notable among these streams are the Pasam, Dirm-Nyogni and Kwaha. Aside these, some artificial dams and dug-outs have been constructed either by individual community members or by Non-Governmental Organisations in the Metropolis. Two of such dams are the Builpela and Lamashegu dams. These dug-outs serve as water sources for animals as well as for domestic purposes.

1. 9.6 Soil and Vegetation

The main soil types in the Metropolis are sandstone, gravel, mudstone and shale that have weathered into different soil grades (Tamale Metro records, 2013). Due to seasonal erosion, soil types emanating from this phenomenon are sand, clay and laterite ochrosols. The availability of these soil types have contributed to rapid real estate development in the area where estate developers have resorted to the use of local building materials such as river sand, gravel and clay.



Table 1.1: Disease situation

2012	NO. OF CASES	2013	NO. OF CASES	2014	NO. OF CASES	2015	NO. OF CASES
MALARIA	3769	MALARIA	4923	MALARIA	2151	MALARIA	1951
OTHER ORAL COND.	2116	OTHER ORAL COND.	2656	DIARRHOEA DISEASES	737	DIARRHOEAL DSE	774
R.T.A	1438	HYPERTENSION	1262	OTHER ORAL COND.	676	URTI	750
GYNAE. COND.	736	A.R.I	1060	HYPERTENSION	573	RHEUM.& JOINT PAINS	693
DIARRHOEAL DSE.	713	DIARRHOEAL DSE	960	RHEUM. & JOINT PAINS	551	ULCERS	650
SKIN DSE& ULCERS	686	VAGINAL DISCHARGE	903	VAGINAL DISCHARGES	375	HYPERTENSION	508
VAGINAL DISCHARGE	632	RHEUM. & JOINT PAINS	872	URTI	357	OTHER DSE, FEM.REP. SYSTEM	390
A.R.I	612	PNEUMONIA	387	UTI	334	ACUTE U.T.I	365
HOME ACC. & INJURIES	574	R.T.A	382	ULCERS	322	VAGINAL DISCHARGES	364
RHEUM. & JOINT PAINS	539	TYPHOID FEVER	363	DENTAL CARIES	313	DIABETES MELLITUS	215
OTHERS	7088	OTHERS	2290	OTHERS		OTHERS	4192

Top Ten (10) OPD diseases in the Metropolis from 2012 to 2015

Source: MHSD 2012

From the Table, it could be seen that sanitation related diseases (malaria, diarrhoeal diseases, and other faeco-oral diseases) are among the top 5 among the top 10 in the Metropolis. Malaria particularly topped the list from 2012 to 2015 while other faeco-oral diseases and diarrhoeal diseases occupied the second positions in the 2012/2013 and 2014/2015 records respectively. In 2012 and 2013, diarrhoeal diseases occupied the fifth positions in the list. This trend is a compelling reason for steps to be taken to correct the situation, including the need to adopt dry sanitation to reduce the breeding of mosquitoes, among others.



1. 9.6 Health facilities

The metropolis has thirty three (33) health facilities excluding the Teaching Hospital. The breakdown is as follows:

The government facilities are 20 (hospitals are 2, health centres or clinics 9, rehabilitated centres 3, community health planning service compounds 6). In addition to the above, there is one (1) community-initiated clinic, 10 private hospitals/clinics and 2 quasi-government hospitals/clinics/health centres.

1. 9.7 Educational facilities

The metropolis has 247 KGs, 275 Primary schools, 108 Junior High Secondary Schools (JHSS), 10 Senior High Secondary Schools (SHSS), two Technical/Vocational institutes and one Polytechnic. In addition to the above the metropolis has one public University, (University For Development Studies), one private University (TUCI), three health training institutions (Nurses and Midwifery Training College, Community Health Nurses Training School and School of Hygiene) and two Teacher training institutions (Tamale College of Education and Bagabaga College of Education) (Metropolitan Education Directorate of GES, 2012)

1. 9.8 Environmental sanitation

As one of the fastest growing cities in the country, Tamale is faced with daunting challenges in the management of both solid and liquid waste. According to UN-HABITAT (2009), the management of solid and liquid waste is the single greatest environmental problem facing the Metropolis. One hundred and fifty (150) tonnes of solid waste are generated daily but the Assembly is only able to clear 7.5 tonnes a day. About 80% of the population depends on public toilets or other illegal modes of defecating. The metropolis has an engineered landfill site and liquid waste



treatment plant but there are no vehicles to transport the waste to the disposal points (Tamale Metro. Records, 2013).

1.11 Organization of the Thesis

The thesis has been arranged in six chapters, with Chapter one presenting the background to the study. It also presents the problem statement and the research questions from which the objectives were set. The chapter also described the framework within which the research was conducted. Also covered in this chapter is an overview of the methodology used together with the profile of the study area. Chapter two provides a review of the literature relevant to the problem being researched. Both theoretical and empirical literature concerning sanitation and the EcoSan concept, and its place in the midst of other exiting sanitation systems were reviewed. In Chapter three, the various methods and techniques employed in the study from design, population sampling to data collection and analysis have been described. Chapter four analyses and presents the data collected as summaries in the form of tables and figures, whilst Chapter five discusses the findings in context of earlier published work. Chapter six presents the conclusions drawn from the key findings and provides recommendations aimed at providing strategies to ensure the successful promotion and adoption of EcoSan as a sanitation system.



CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents a review of the literature with regards to evidence on issues of acceptance and adoption of sanitation concepts, which informed the framework within which the research was conducted. The review was conducted under themes such as sanitation and health, sanitation systems, socio-cultural factors and adoption of sanitation concepts, and also knowledge, acceptance and adaption of EcoSan among others. The review covered all relevant information related to the study.

2.1 Sanitation and health

The towns, cities and rural areas where many people live nowadays in the world and go about their normal lives with their families are noted to be highly polluted places and although some of the developed countries are characterized by such pollution, developing countries are among the worst polluted and disease ridden habitats of the world (Esrey et al., 1998)

Müllegger and Lechner, (2008) stated that much of this pollution leads to high rates of disease, malnutrition and deaths. The foregoing submission seeks to underscore the overall importance of sanitation to human health. Progress in the provision of sanitation services is struggling to keep up with population growth, and Africa is lagging behind the most (Lane, 2008).

Within 20 years, it is expected that an additional 2 billion will live in towns and cities demanding good sanitation. The challenge is obvious, already today as



sanitation-related diseases and poor hygienic conditions cause 2.2 million deaths annually (mostly children under the age of 5) (SuSan, 2008).

It has been reported that approximately, 6000 children die every day from diarrheal diseases related to inadequate sanitation and hygiene (WEHAB Working Group, 2002). About 1 billion people worldwide, mostly children, are infested with intestinal worms and as a result suffer nutritional deficiencies and poor growth (WHO, 2003). Both of these groups of diseases are transmitted through human faeces in the environment.

Sewage discharges from centralized, water-borne collection systems are a major component of water pollution all over the world. Only about 300 million people in the world today have end-of-pipe treatment of sewage to a secondary level before the sewage is discharged into open bodies of water (Matsui et al 2001). Pollutants also leak into groundwater from sewers, septic tanks, pit toilets and cesspools (Barret, 2001). Nutrients and pathogens seeping from pour-flush latrines and septic tanks have been documented as the cause of contamination to ground water and nearby surface waters throughout the world (Briscoe and Steer, 1993). The pollution of water systems undoubtedly poses a serious public health concern for populations, especially in developing countries.

It was noted that the major pathogens found in urine which cause typhoid, paratyphoid and bilharzia and urine is a major source for the spread of bilharzia. Faeces on the other hand is the major source of pathogens for typhoid and paratyphoid. Pathogens and parasites found in human excreta can result in a wide variety of illnesses, including diarrhoea and malnutrition (Beneson, 1995). Poor growth, iron deficiency, vitamin A deficiency and other micronutrients deficiencies

also occur, with the effects sometimes lasting a lifetime. Not all pathogens and parasites result in death but the continual debilitation of disease and malnutrition predisposes people to continual disease or ill-health and death from other causes (Höglund, 1998; Esrey et al., 1998). In addition, surface water sources may be heavily impacted (Schönning and Stenström, 2004).

Esrey et al., (1998) stated that a combination of safe storage and fast destruction of the pathogens in excreta are needed in order to prevent contamination of the environment. They further elaborated two major ways needed to sanitize faeces as: dehydration and decomposition. Dehydration, or drying, of faeces is easier if they are not mixed with urine and water. When faeces decompose, the different living things in them die and are broken down into smaller parts. Thus with either method germs, eggs and other potentially unsafe, living things are made harmless. It is only then that faeces can be safely recovered and recycled.

It was also made known that lack of sufficient or adequate sanitation services which put man's life at a risk is as a result of many factors, including: bad attitudes always exhibited by people in most of their activities, misplaced priorities, and refusal to change in behaviour, inadequate financial resources, insufficient water, and lack of space, difficult soil conditions and limited institutional capabilities (UNDP, 1996).

2.2 Current sanitation systems

According to the (UNDP, 2010), the two acceptable broad types of latrine systems that are encouraged mostly and seriously promoted fall into one of the following: flush-and-discharge or drop-and-store groups. Esrey et al., (1998) have also repeated that the two most commonly used sanitation technologies today are the pit and flush toilets. They went further to say that the conventional waterborne sewage systems



have proven to be inappropriate to solve sanitation needs in developing countries. According to them the systems are too costly to be provided to all, and only wealthier upper and middle class areas are normally provided with those services. They concluded on these points that even approximately 90% of the sewage in cities in developing countries is today discharged untreated, polluting rivers, lakes and coastal areas and pit toilets also have limitations, especially in densely populated areas, with severe risks of contaminating groundwater.

Sayre, (1998) also stated that the resources found in the faeces and urine are either flushed away or stored without making use of them as being the case with the current sanitation system. He went further to declare that sanitation could be solved in a more sustainable and efficient manner if the resources contained in excreta and wastewater are recovered and used rather than discharged into water bodies and the environment. Faeces and urine are stored in EcoSan toilets and the resulting organic matter is used to fertilize plants such as vegetables which are very much needed in all places if promoted well. EcoSan is a system of closing the loop between agricultural production and health and sanitation and is a shift from the traditional end-of-pipe system (Werner et al, 2004).

Using faeces and urine as a resource also prevents them from contaminating the environment and prevent communicable diseases from spreading (Olsson, 1995): Ecological sanitation follows a principle which states that current policies in waste management are abusive to human well-being, economically unaffordable and environmentally unsustainable. It further states that human dignity, improved quality of life and environmental security should be at the centre of the new approach” and that “waste should be considered a resource (Olsson, 1995).

UNDP (2010) noted that what has been identified, recommended and chosen as the ideal technology, particularly for urban areas over the past years has been the 'flush-and-discharge' systems and has been used in many districts and municipalities in developing countries and the second option which is the drop-and-store systems, in which human excreta is stored indefinitely is often regarded as an inferior, temporary solution compared with flush-and-discharge systems.

So many premiums is placed on the flush-and-discharge systems such that most cities in the Third World cannot afford the necessary resources, in terms of water, money and institutional capacity, to provide the systems being promoted. Esrey et al., (1998) mentioned that about 80 countries with 40% of the world's population are already in a situation where they suffer from water shortages at some time during the year and the demand for freshwater has tripled in the past 50 years, with estimates being put that by 2030 more than half the world's population will face a shortage of water.. This lack of water would discourage the patronage of the drop and flush system of latrine. (United Nations, 2002)

According to the report of Barret, (2001) chronic fresh water shortages are expected by the end of the decade in much of Africa, the Middle East, and northern China, parts of India and Mexico, the western United States, north-eastern Brazil and in the former Soviet Central Asian republics. China alone has 300 cities facing serious water shortages. This precarious situation of water in the global community makes it imperative for the use of sanitation systems that require limited use of water, in which case EcoSan system comes handy.

Esrey et al., (1998) also reported that within 20 years from 1998, it is expected that an additional two billion people will live in towns and cities, mainly in developing

countries, demanding safe sanitation. Furthermore, many of the rapidly expanding towns and cities are located in arid and semiarid areas where water scarcity is severely reducing the volume of water available.

Additionally, the health implications of improper sewage discharge may significantly determine the type of latrine to use. Both the drop and flush and the drop and store systems have a high tendency of transferring infectious organisms to humans resulting in a variety of illnesses including diarrhoea and eventual malnutrition (UNDP, 2010).

Flush-and-discharge approaches can work well and achieve an acceptable level of pathogen destruction (UNDP, 2010). It has been observed that sewage is nearly always discharged into the environment without treatment and sewage discharges from centralized, water-borne collection systems are noted to be the actual sources of water pollution, contributing to the nutrient overload of water bodies (Drangert, 2004).

In the light of all the above exposition, it is inferable that, just as it is important to scale up the ownership and utilisation of household latrines, it is equally important to move to the adoption of more effective and environmentally friendly alternative latrines such as the EcoSan.

2.3 Alternative sanitation

Winblad and Simpson-Hebert (2004) have noted that since human society cannot do away with growth and development, towns, cities and rural areas will continue to expand as migration and population increase makes situation grow worse and therefore, safe, sustainable and affordable sanitation systems is required to commensurate this expansion. It is in this light that the concept of Ecological

sanitation (EcoSan) finds a place in the effort to reduce the adverse impact of sanitation on the wider population.

The principles underlying EcoSan are not novel, in the sense that in different cultures sanitation systems based on ecological principles have been used for hundreds of years. EcoSan systems are still widely used in parts of East and South-East Asia. In Western countries this option was largely abandoned as flush-and-discharge became the norm, but with a growing realization that conventional sewerage is unsustainable there is now a revival of interest in ecological approaches to sanitation (Esrey et al, 1998). It is worthy to note that, with the EcoSan system, disadvantages associated with the drop-and-store technologies do not exist. This is because with EcoSan, there is no need to dig the ground and so ground water pollution and destabilization of foundation of nearby houses cannot be a problem.

An important attribute of EcoSan is that it effectively separates urine from faeces and allows the two to undergo a level of treatment, all at no cost, resulting in a useful product that requires no disposal challenges. (Briscoe and Steer, 1993).

Esrey et al. (1998) estimated that over a year for each person, about 400-500 litres of urine and 50 litres of faeces are flushed away with 15,000 litres of pure water through a pipe system; the bath, kitchen and laundry water, often called grey water from the household are also added, culminating in between 15,000 and 30,000 litres for each person every year. The dangerous component, the 50 litres of faeces, is allowed to contaminate not only the relatively harmless urine but also the huge amount of pure water used for flushing and an equal or even larger amount of grey water. Although towards the end of the system there is supposed to be a treatment plant, in most cases there is none: over 90% of all sewage in Third World countries



is discharged completely untreated. If treatment is carried out it only separates the water from what has been added (Briscoe and Steer, 1993).

EcoSan has been viewed as a four-step process of dealing with human excreta: source-separation, containment, sanitization and recycling (Morgan, 2004). The objective of this concept is to protect and prolong human health as well as the environment while reducing the use of water in sanitation systems and recycling nutrients to help reduce the need for artificial fertilizers in agriculture. EcoSan represents a conceptual shift in the relationship between people and the environment; it is built on the necessary link between people and soil (Esrey et al, 1998).

Another important feature of EcoSan is that it is able to replenish soils with depleted nutrients thus reducing the reliance on artificial fertilizers. It has been noted that this new approach enables environment-friendly recovery of nutrients and water unlike what is obtained in water-borne sewer systems that blend water-mixed human excreta with grey water, storm water and industrial effluents into a hazardous mix, including human pathogens and toxic compounds (Mehl et al., 2011). By comparison, the EcoSan household or community source separates human excreta into urine, faeces, household organics and grey water. Each fraction is contained and handled separately.

Human urine contains about 75% of the nutrients leaving the body and represents about 80% of the total excreta volume (Shaw, 2010). The nutrient content of urine is comparable to commercial fertilizers. Sanitized faecal matter, composted with household organics, is therefore an excellent soil conditioner.



Human faeces contain bacteria, viruses and parasites, which, if not properly treated, can result in the spread of diseases (WHO, 2006). It is clear that without containment and sanitization, a vicious circle develops where the pathogens in excreta are released back into the environment, re-infect people through consumption of contaminated water or food, and are then excreted again, only to begin the cycle again.

Ecological sanitation systems are designed around true containment and provide two ways to render human excreta innocuous: dehydration and decomposition (Morgan, 2004). In this process drying materials, like wood ash, lime and soil, are added to cover the fresh excreta. Because ash and lime increase pH which acts as an additional toxic factor to pathogens if the pH can be raised to over 9.5 the better.

The dry Eco toilet meets all necessary health and environmental protection criteria and goes well beyond what conventional system can offer (Stenström, 2002; Schönning and Stenström, 2004). The authors noted that it saves water, prevents water pollution, produces no smell, does not attract flies and is noted to be sustainable, reliable, an affordable solution inside and outside of dwellings throughout the world.

2.4 Culture and attitude towards faecal matter.

Socio-cultural factors are historically shaped traditions and beliefs and these include the level of trust in different institutions such as large corporations, local business or local government (Brohmann et al, 2007). Often, it is thought that technology changes culture.

It is noted that, while cultures are very robust and change slowly, it is typical for a new technology to be adopted within a culture and used to support existing patterns

of behaviour. For example, Genevieve Bell mobile phone manufacturers have developed popular phones for Muslim users that support their religious practices by (1) reminding them when it is time to pray, (2) orienting them towards Mecca. This certainly enjoys easy adoption of the new product among Muslims.

The fear of faeces (faecophobia) is a reality in both traditional villages and major cities in Africa, where many farmers have until recently been practicing shifting agriculture. (Herbert, 2004). Here there was no need for them to recycle human excreta and as shifting agriculture often meant a semi-nomadic life there was no tradition of building permanent wells and toilets. Faeces were dropped on the ground and the smell of other people's faeces was perceived as a warning signal.

In contrast, on the densely settled flood plains of China, farmers have for a few thousand years had to fertilize their fields, in some cases with human excreta. (Winblad and Kilama, 1985)

Traditionally in China all human excreta was returned to the soil, fresh or composted. In China human excreta was therefore considered a valuable product. Corroborating, the above, The authors noted that even today the rural Chinese have no problems talking about it, smelling it or handling it. Such a culture can be called 'Faecophilia'. Faecophilia thus represents one extreme point of a continuum where the other extreme is faecophobia. This model can be used to describe and understand a complex and changing reality. Indeed, most cultures – or sub-cultures – are somewhere between the extremes. This knowledge could be of benefit to this study since one since the people of the study area are known to defaecate around their dwellings and also use faeces to fertilize their crops and can therefore be considered

as faecophilic. This therefore can be exploited to the benefit of promoting EcoSan since it is a system that can render faeces more harmless and useful for use.

2. 5. The Phosphorus Crisis

Robinson (2005) reported that the main limiting nutrient elements for the growth of plants are nitrogen, phosphorus, and potassium. The plant nutrients that humans consume in the form of food are excreted in urine and faeces. In an adult, nearly 100 percent of the consumed plant nutrients are excreted because there is no longer net accumulation of nitrogen, phosphorus, or potassium in the body (Jönsson et. al. 2004). Therefore, the foods that one eats should be directly related to the amount of plant nutrients that one excretes.

Esrey et al., (1998) stated categorically that in a situation of food insecurity, decreasing soil fertility and escalating prices for fertilizers in world markets, there is a need to utilise the nutrients, especially in human urine, rich in nitrogen and phosphates, for agricultural purposes, thereby increasing productivity and reducing the needs for artificial fertilisers. It is obvious that this enormous challenge leads to a need to rethink, a need to raise the status of sanitation and a need for new approaches, techniques and methods.

Nutrient discharges (phosphorus and nitrogen) to surface waters are expected to increase substantially by 2050 from the combined impact of increasing population, urbanization and provision of sewers. This increase is especially great in southern Asia where phosphorus discharges are expected to increase by a factor of 4–5 (Van Drecht et al., 2009).

The above makes it such that there is reliance on Phosphorus as an artificial fertilizer which exerts a huge burden on the mining industry that has to keep up with the



agricultural sector (Gumbo et al., 2002). Although it is the eleventh most abundant element on earth, phosphorus never occurs in its pure form and is always bonded with other elements forming other compounds, such as phosphate rock. Data from a Chinese diet reported urine contained approximately 70% of the excreted nitrogen and 25–60% of the excreted phosphorus (Gao et al., 2002). More importantly, much of the phosphorus in soil is not available to plants, thus requiring nutrient additions to produce crops. In all, chemical fertilizers account for 80% of phosphates used globally, with the other 20% divided between detergents, animal feed and special applications (Gao et al, 2002).

Most of the plant nutrients in human excreta are found in the urine. An adult may produce about 400 litres of urine a year containing 4.0 kg of nitrogen, 0.4kg of phosphorus and 0.9 kg of potassium¹⁵ (Jönsson and Vinnerås, 2004).

Interestingly, these nutrients are in ideal forms for uptake by plants: nitrogen in the form of urea, phosphorus as superphosphate and potassium as an ion. The total quantities of nutrients in urine are more appropriate when compared with the quantities of nutrients in the chemical fertilizers used in agriculture (Esrey et al., 1998; WHO, 1997).

Estimates on the remaining amount of phosphorus vary, as do projections about how long it will take to deplete the irreplaceable resource entirely. Figures range from 60-130 years (Steen, 1998) and 60-90 years (Tiessen, 1995), at current market prices with diverse assumptions about the rate of production and demand, but all sources agree that continued phosphorus production will decline in quality and increase in cost. The relatively inexpensive phosphorus we use today will likely cease to exist within 50 years.

It is imperative that we begin to recycle phosphorus and return it to the soil to decrease the need for mined phosphorus as artificial fertilizer. Within a half century, the severity of this crisis will result in increasing food prices, food shortages and geopolitical rifts (Gumbo et al., 2002).

Most of the phosphorus consumed by animals and humans is excreted, and by safely recovering the nutrients found in human excreta through ecological sanitation, it is possible to reduce the depletion of phosphorus reserves. As recycling of phosphorus from sewage sludge is a very costly venture, alternative systems in the kinds of EcoSan, would be well positioned to present a solution to the looming phosphorous crisis. EcoSan offers a holistic system whereby human excreta is made hygienic and creates a valuable and effective organic fertilizer that recycles nitrogen, phosphorus, potassium and other nutrients contained in urine and faeces back into the environment, instead of groundwater and waterways.

Of the main sources of available phosphorus (phosphate rock, animal manure, human excreta), human excreta makes up the smallest mass (Cordell et al., 2009). However phosphorus material flows from human excreta should increase in the future as population and affluence (as measured by individual protein consumption) both increase, while greater demand for total food calories and protein will also increase the need for phosphorus fertilizer. Urine diversion and recycling would provide immediate advantages because most of the nutrients excreted are in this fraction.

If urine is recovered at source, the nutrient load to sewage treatment plants will be significantly reduced, possibly even eliminating the need for tertiary treatment.(Jönsson and Vinnerås, 2004) This recycling organic material from

households to farm soil, would further alleviate the need for additional nutrients. Closing the nutrient loop related to sanitation is now especially important because of the critical need to address the looming phosphorus crisis (Vaccari, 2009) and other articles in this special issue.. Also, a new paradigm emerging in water and wastewater management is to emphasize the resources (water, energy, and nutrients) that can be recovered from wastewater in addition to the constituents that must be removed (Guest et al., 2009).

2. 6 Acceptability of New Sanitation Concepts

According to Hall and Khan (2002) the contribution of new technology to economic growth can only be realized when and if the new technology is widely diffused and used, in effect accepted. These authors asserted further that diffusion itself results from a series of individual decisions that have been made for one to begin using the new technology. And these decisions are often the result of a comparison of the uncertain cost of the new invention with the uncertain benefits of adopting it. In this sense, for EcoSan to be accepted and adopted, there is the need for a rigorous awareness creation about its cost and benefits as against existing sanitation systems already in use in the study area.

On their part, Müllegger and Lechner (2008) asserted that even when municipal authorities place emphasis on sanitation improvement, the level of demand among the population may be much lower, because sanitation is not always prioritised. Therefore, creating demand for sanitation services becomes of paramount importance for a successful and sustainable implementation of any new sanitation technology. To support awareness raising activities, social marketing has proven to be a successful tool—because marketing is about creating and satisfying people's

needs and wants. The heart of the marketing task is to determine what consumers want and offer it to them in an attractive and accessible way (Outlaw et al, 2007). Social marketing uses marketing techniques such as advertising through mass media, demonstrations, special offers, word of mouth etc. to serve social objectives. WSP (2004) also emphasised the importance of social marketing in sanitation. The report therefore concluded that marketing can ensure that supply is adapted to people's preferences and their willingness to pay and good marketing can enhance long term financial sustainability while successful marketing at large scale can be cost effective in the long run as demand and investments increase. What is required in the promotion of EcoSan therefore is that, the technology has to be well packaged, presented in demonstrable forms close to the people and their awareness created regarding the cost and benefits of it as against existing sanitation system. This should be done in a manner as to whip up the desire of the people to want to adopt the technology.

Ridell and Song (2012) cited Welch, (1970); Wozniak, 1984, (1987); Krueger, (1993); Lleras-Muney and Lichtenberg, (2002) as having reported that, a large body of prior research has shown that highly educated workers tend to adopt new technologies faster than those with less education. Ridell and Song (2012) are therefore of the view that, generally, a new technology is associated with uncertain returns and up-front costs of adoption. The authors asserted further that, how quickly producers and employees can adapt to a changing set of production possibilities partly depends on their human capital and their knowledge of the new technology.

Ridell and Song (2012) again cited Wozniak (1987) to have concluded that, education and information reduce adoption costs and uncertainty, and thereby raise

the probability of early adoption. Ridell and Song (2012) further cited Krueger (1993) as having found that more highly educated workers were more likely to use computers on the job in the 1980s, a period of rapid growth in the adoption of computers in the workplace. It could be concluded from the above that, the level of education of users of new technologies constitutes an important determining factor in the acceptance of the technology.

A common strategy recommendation for organizations is to identify and consider the interests and concerns of their key stakeholders (Larson & Brown, 2013). Larson & Brown, (2013) further explained that, stakeholders can be groups or individuals who can affect or are affected by the achievement of an organization's objectives (e.g., owners, customers, employees, and suppliers). Wheeler and Sillanpaa (1998, p. 201) concluded: *"All the available evidence suggests that companies which are run with a view to the long term interests of their key stakeholders are more likely to prosper than those which take a short term, 'shareholder first' approach."* It is also on record that, integration of stakeholder concerns can, at least indirectly, create a competitive advantage for organizations (Driessen and Hillebrand, 2012). Mitchell, Agle, and Wood (1997) argued that stakeholders have different relationship attributes (e.g., power, legitimacy, and urgency) that influence their importance to the organization. These attributes, according to the authors, can create a stakeholder typology. The authors are therefore of the view that, mapping these perceived attributes may help organizations identify their definitive or core stakeholders (i.e., those who possess all the attributes).

A problem can emerge if managers assume some stakeholders do not have legitimate concerns and do not try to integrate them into the decision process

(Larson & Brown, 2013). According to Larson & Brown (2013), an illustration comes from Monsanto's development of genetically modified crops and the difficulties the firm faced as they tried to gain societal acceptance of the new technology. The firm focused on those perceived to be their core stakeholders: investors, scientists (both at the firm and in academia), farmer customers, and government regulators. According to Larson & Brown (2013), Hall and Martin (2005) believe Monsanto did not appreciate that economic, technical and regulatory pressures are not the only constraints that can hinder the development of a new technology or innovation.

On their part, Weisenfeld & Hunck-Meiswinkel (n,d) explained that technology development and implementation include social processes where various stakeholders voice their interests and concerns: stakeholders influence the process of technological advance in a variety of ways. These interests and concerns, in turn, are shaped by the stakeholders' institutional context. The authors asserted that, organisations involved in technological development have to acknowledge and integrate key stakeholders in order to promote the process in a successful way.

According to Weisenfeld & Hunck-Meiswinkel (n,d), important elements of such an engagement are:

- Identifying key stakeholders: the authors cited Mitchel, Agle and Wood (1997) as having propose 'power', 'legitimacy' and 'urgency of claims' as factors to rank stakeholders according to their importance for the organisation.
- Assessing the key stakeholders' perceptions: new technologies are associated with uncertainty. The organisation and its key stakeholders will differ with regard to knowledge about a technology. Perceptions, however, are based on knowledge and

one's frame of reference. Thus, differences in perceptions partly might derive from asymmetry of information. In that case, providing information could lead to an approximation of views.

· Assessing the key stakeholders' interests: the development and implementation of technologies are associated with a variety of interests. Usually, not all interests are complementary or neutral to each other. Depending on the nature of interests, different patterns of interaction between the organisation and its stakeholders may occur. Conflicting interests require the negotiation of the features and paths of technologies' development and may involve compromising. Thus, differences in perceptions require the willingness to learn from each other and differences in interests require the willingness to compromise—two objectives which could be quite difficult to achieve.

If the parties involved have a different cultural, economic and social background it may be even more difficult to achieve an agreement on how the technological development and implementation should proceed.

Weisenfeld & Hunck-Meiswinkel (n,d) cited an example named the 'Golden Rice' to illustrate this problem. 'Golden Rice' is an on-going project with technological and market uncertainties, coupled with technology transfer problems. It serves as an outstanding example for the importance of integrating key stakeholders into technological progress. Though the 'Golden Rice' example has not been fully narrated here, the authors use it to demonstrate the nature and impact of stakeholders' involvement in technological development and the transfer of a technology.



It could be inferred from the foregoing that, the extent to which stakeholders of a programme or by extension users of a technology are involved in the programme or technology design and implementation constitutes a determining factor in the success of the programme or adoption of the technology.

2. 7 Possible influence of Cost and Benefit on Acceptance of EcoSan

In every investment adventure, the initial cost is an important factor that can drive the investment or stifle it. In the same vein, the benefits to be derived from an investment are key in determining whether or not one undertakes the investment venture.

Lau (2010) observed that, the costs, especially those of the non-pecuniary “learning” type, are typically incurred at the time of adoption and cannot be recovered. Based on this observation, the author stated that, it is a great challenge to most African governments because cost is not recovered easily. One must further understand that in a bid to introduce a new technology, it is clear that there may be some cost implications (www.whatisseries.co.uk). Although the usage of an existing technology may involve a maintenance fee, typically it is much less than the full initial cost and a potential adopter weighs the fixed costs of adoption against the benefits he expects and when the benefits to be derived from the use of the new technology overweighs the cost, the tendency for adoption is high. This argument in turn implies two stylized facts about the adoption of new technologies: first, adoption is usually an absorbing state, in the sense that we rarely observe a new technology being abandoned in favour of an old one. This is because the decision to adopt faces a large benefit minus cost hurdle; and second, once this hurdle is passed, the costs are sunk and the decision, to abandon requires giving up the benefit



without regaining the cost. Second, when there is uncertainty about the benefits of the new technology, societies and individuals have a valuable option to wait before sinking the costs of adaption, which may tend to delay adaption (Lau, 2010).

The effect of cost on adoption has further been studied by Zheng et al (2012) reported that, as in the case of the investment decision, the adoption of new technology is characterized by; 1) uncertainty over future profit streams, 2) irreversibility that creates at least some sunk costs, and 3) the opportunity to delay. According to these authors, the advantage of the real options modelling approach is that it can explicitly incorporate these features into the adopter's decision-making. The primary implication of this way of looking at the problem is that there is "option value" to waiting: that is, adoption should not take place the instant that benefits equal costs, but should be delayed until benefits are somewhat above costs (that is, one invests when the option is "deep in the money"), thus providing yet another reason for which diffusion may be rather slow.

It was further reported that adoption and diffusion of innovation focuses on factors driving the adoption of new technologies at the level of the profit-seeking. (Stoneman, 1983). Studies also suggest that decision is affected by a key factor which is the assessments of expected profitability of the new technology, the expected benefits, for example, savings, new revenues, economies of scale, flexibility, and the estimated costs, e.g., price, manpower training, human resources, adaptation or substitution costs (Davies, 1969; Antonelli 1989; Katz and Shapiro 1994; Arvantis and Hollenstein 2001).

The implication of these theoretical underpinnings of the role of cost and benefits is that, in the case of promoting the adoption of EcoSan, recourse must be taken to

factor in the theoretical concerns in the design of strategies aimed at ensuring acceptance and adoption of the technology.

2.8 Effect of Perceived Usefulness of New Technologies

According to the technology acceptance model (TAM), perceived usefulness by consumers decides their attitude toward using and also influences how they accept commodity or service (Davis, 1989). They explained that the central determinants in TAM- *Perceived usefulness*, refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" and *perceived ease of use*, refers to "the degree to which a person believes that using a particular system would be free of effort". Perceived usefulness was also found to positively influence the adoption of a new technology such as IT. The authors emphasised categorically that behavioural intentions to use an IT were determined by an individual's attitude toward using the IT, as well as beliefs the user holds about its perceived usefulness. In predicting the adoption and usage of personal workstations, Moore and Benbasat (1996) identified perception of usefulness as being significantly related to usage.

2.9 Effect of Ease of Use on Acceptability

Ease of use (EOU), together with perceived use, have been found to be significantly correlated with intentions to initially adopt and also continue to use new technologies. (Davies, 1979). EOU of new technologies has also been explained by Rogers (1985), who, based on studies of multiple innovations in various domains, proposed that adoption behaviour is influenced by beliefs related to complexity. EOU suggests that a low cognitive effort would be preferred for using an innovation, whereas complexity connotes the opposite. Moore and Benbasat (1996) have also

identified ease of use as being significantly related to usage in their work on personal work stations.

2. 10. The Influence of Alternative Systems on the Acceptance of new System

The adoption of any new technology is known to be in no doubt influenced by already existing ones and this influence could be negative especially when there are no clear advantages to be derived from the new one (Godoy et al., 2009). Identification of antecedent technologies and their usage are therefore of major importance in the endeavour of technology adoption. For EcoSan, the existing competing systems are drop- and- store and drop and flush.

When a new innovation is a close substitute for an existing technology, then the innovation itself may induce providers of the old technology to make improvements or engage in other types of competitive behaviour in an effort to retain their market position. This in turn will slow the diffusion of the new technology (Khan, 2004). The author further asserted that competitors, challenged by new rivals or new forms of competition, may turn to regulators for help. Competitors may ask governmental agencies under the guise of consumer protection to prohibit or restrict certain pro-competitive activity, such as discounts to their clients. They may enlist the government to increase trade barriers or for other protectionist measures. Such 'rent-seeking' behaviour benefits lobbyists and lawyers, but can substantially waste scarce resources.

2.11. The Influence of Beliefs and readiness on Acceptance of New Technologies

According to Parasuraman (2000) technology readiness (TR) refers to people's propensity or personality dimensions to embrace and use new technologies to accomplish goals in home life and at work. Parasuraman (2000) further stated that



“technology readiness” is a combination of positive and negative technology-related beliefs. These beliefs are assumed to vary among individuals. Collectively, these coexisting beliefs determine a person's predisposition to interact with new technology (Colby 2001). These beliefs, according to Parasuraman (2000), can be categorized into four dimensions viz: optimism, innovativeness, discomfort, and insecurity.

Optimism refers to a positive view of technology and a belief that technology offers people increased control, flexibility, and efficiency in their lives (Parasuraman & Colby, 2001). They further said optimism generally captures positive feelings about technology and function as mental enablers.

Innovativeness on the other hand is said to be a measure as to what degree individuals perceive themselves as being at the forefront of technology adoption (Tsikriktsis, 2004).

Discomfort is explained to mean a perceived lack of control over technology and a feeling of being overwhelmed by technology (Parasuraman & Colby 2001). Discomfort generally measures the fear and concerns people experience when confronted with technology.

The term insecurity means a distrust of technology and scepticism about its ability to work properly (Parasuraman & Colby, 2001). It focuses on concerns people may have in face of technology-based transactions.

Optimism and innovativeness are drivers of technology readiness. A high score on these dimensions will increase overall technology readiness. Discomfort and insecurity, on the other hand, are inhibitors of technology readiness. Thus, a high

score on these dimensions will reduce overall technology readiness (Parasuraman, 2000). It has been said that the four dimensions are fairly independent, each of them making a unique contribution to an individual's technology readiness (Parasuraman & Colby, 2001). According to the author, people who are optimistic and innovative with reference to technology in general are thought to hold positive attitudes toward new technology and technology use.

2.12 Supportive Stakeholders

Supportive Stakeholders can influence the societal acceptance of new energy technology projects in many ways (Brohmann, et al 2007; Tsoutsos, 2002, Khan, 2004). The authors summarized societal acceptance of technology in terms of three central challenges that project managers encounter when attempting to introduce new technologies as:

- ✓ Identification of critical issues and stakeholders,
- ✓ Introducing appropriate projects in appropriate contexts, and
- ✓ Interacting with the 'right people' in the 'right way' and 'at the right time'.

2.12.1 Identification of Critical Issues and Stakeholders.

In this regard, Brohmann, et al (2007) stated that project managers need to understand how the technology interacts with its context, and also how the specific design of the project influences its relation with stakeholders. Issues requiring consideration pertain to four broad categories, such as: issues pertaining to broader policy debates; principle and overall public perception; requirements for user involvement and the need for user adaptation; requirements of the project in terms of economic, social and technical integration; and finally, sitting issues and impact on the local economy, social structure and health, safety and the environment.





With regards to the first category, one should be asking about how the project fits into national and local broad policies as pertaining to the particular issue. Failure to make such considerations can spell doom to the success of the project since the needed support is not likely to come from national and local political stakeholders. Principles and overall public perception here refers to the broader workings mechanisms of the project and how the public perceive this to be in consonance with their desires and expectations. It is also necessary to find space for the user involvement as this is a step that permits users to make the adaptations to the project execution in order to meet their needs. Economic and societal considerations of the beneficial user group is needed also to be integrated to the technical design options of the project to ensure sustainability and long term maintenance by the users themselves. The last category of issues call for consideration of the potential effect of the project sitting on people's livelihood as it may negatively affect their daily earnings or dislocated existing social structures in terms of local governance and decision making authority as well as how the location of the project may impact on the health of the people or the sanctity of the environment.

In promoting EcoSan as a new technology therefore, the above issues need to be considered where necessary and factored in accordingly to ensure acceptability and adoption.

2.12.2 Introducing appropriate projects in appropriate contexts

There is evidence that for successful adaptation of a new technology, project managers need to consider the political will, policy guidelines, socio-economic, cultural and geographic conditions existing in different locations, as well as the timing of projects vis-à-vis changing framework conditions of the particular

technology (Tsoutsos, 2002.) Such contextual factors provide different conditions for project design and implementation, such as opportunities to integrate with the local economy, appropriate institutions to partner with, or appropriate procedures to involve various stakeholders.

It is therefore incumbent that to succeed in promoting the adoption of EcoSan in the study area sight should not be lost in the above considerations.

2.12.3 Interacting with the 'right people' in the 'right way' and 'at the right time'

In this context, 'right people' refers to partners that bring resources and support the project and also enable the project to interact with its external environment, and to the stakeholders who are influenced by the project or can be influenced by it.

It has been noted that, the 'right way' of interacting ensues from the kinds of concerns, issues and people involved (Khan, 2004). Examples of better and worse practices in the cases that have been reported indicate some generic issues, such as starting early and continuously, the importance of articulating concerns, mutual learning, and the need to ensure clarity of purpose and division of power and responsibilities. Formal administrative structures usually facilitate the process and make it more transparent, empowering and credible, but should be complemented with face-to-face interaction between the right people and 'keeping in touch' with each stakeholder.

However, Brohmann, et al (2007), also identified more generic factors pertaining to the kinds of social networks that build up around new projects and the negotiation and alignment of expectations. These networks were shown to be naturally different for different projects, and could involve experts from different technology providers and other social groupings Stakeholders' expectations that required negotiation



pertained to a range of factors. Some of them can be termed “genuine differences of interest”, such as the distribution of costs and benefits (Khan, 2004.)

‘Negotiating expectation’ refers to all kinds of moves, counter-moves and adaptations to the technology project before and during the course of the project. Some may be present already at the design stage, for instance in how the project was planned to integrate as wide range of expectations as possible.

It has been demonstrated that involving stakeholders at an early stage in a project allows these stakeholders to influence project design, gain sufficient information on the project to alleviate their concerns and to allow project managers to understand the local context that would enhance project integration (Szarka, 2006). Some management principles and procedures appear to be widely applicable to many kinds of energy projects. The author noted also that managers, whose projects were successful, recognized the dependence of the project on the co-operation of stakeholders. These managers were able to promote societal acceptance by having or developing a constructive relationship with the local community as well as viewing the project from a broader perspective and understanding local processes and contexts.

It was also demonstrated that establishing continuity and reserving sufficient time and patience to align different interests also promotes societal acceptance. Szarka (2006) also reported that using contextually appropriate procedures and, coordinating among many different factors and stakeholders contributes to the promotion of societal acceptance of a new technology.

The regulatory environment and governmental institutions more generally can have a powerful effect on technology adoption, often via the ability of a government to



“sponsor” a technology with network effects. Economic regulation has effects similar to the market size effects in that the effect of regulation is often to foreclose entry and grant fairly large market shares to incumbents, reducing incentives for cost-reducing innovation but also in many cases increasing the benefits from innovation due to the small number of firms in the market. The exact effects observed will depend partly on the particular price-setting mechanisms chosen by the regulator (Brohmann, et al., 2007)

Several empirical studies in the healthcare sector have highlighted the role of regulation in that sector on diffusion. Baker (2001) studied the effects of the provision of health insurance on the adoption of new medical procedures. He argues that by providing reimbursement for the use of advanced and costly procedures, a generous insurance system often fosters adoption of new techniques and methods of treatment.

Adoption of new technology is impacted not only by regulations about market structure or the insurance environment, but also by other types of regulations, such as environmental regulation. Environmental regulations directly affect adoption because in many industries regulations will either prohibit or require the use of certain technology or production methods. Baker (2001) used this regulatory shift to estimate the effect of regulation on investment strategies of firms in the paper industry, where environmental regulations could have encouraged adoption of new production technology if they required replacement of older, more pollution-creating machines or methods. However, they might also have reduced overall investment and therefore the diffusion of new innovations if it was costly for firms to purchase pollution abatement technologies or remodel older plants.

According to Brohmann, et al., (2007) adopting a new technology in a local context can lead to the development and diffusion of supportive institutions. Creating acceptance for supportive institutions is also an important part of creating acceptance for sustainable technologies. The authors thus stressed that local experiments are indeed extremely important for the further development of emerging alternative technologies

Gil, et al (2008) submitted that innovation potential of mega projects is thus subjected to a fundamental, unifying tension: on the one hand. They offer a one-off opportunity to invest in cutting-edge technologies and innovate socio-technical systems; on the other hand, project stakeholders they said have limited time to develop capacity to absorb novel technologies and negotiate differences on assessments of profitability and risk. They further stated that Stakeholders may therefore be compelled to agree to adopt proven technologies upfront to reduce uncertainty and mitigate risks, thus limiting the innovation potential of new infrastructure development.



2.13. The EcoSan System

In the transmission of diseases the causative organisms are transferred from faeces to fingers and fluids and from faeces to flies, fields to food before getting to the host (Figure 2.1).

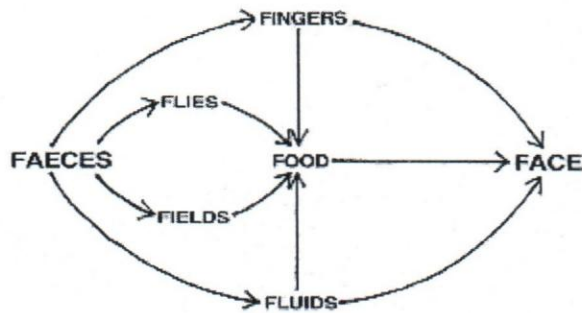
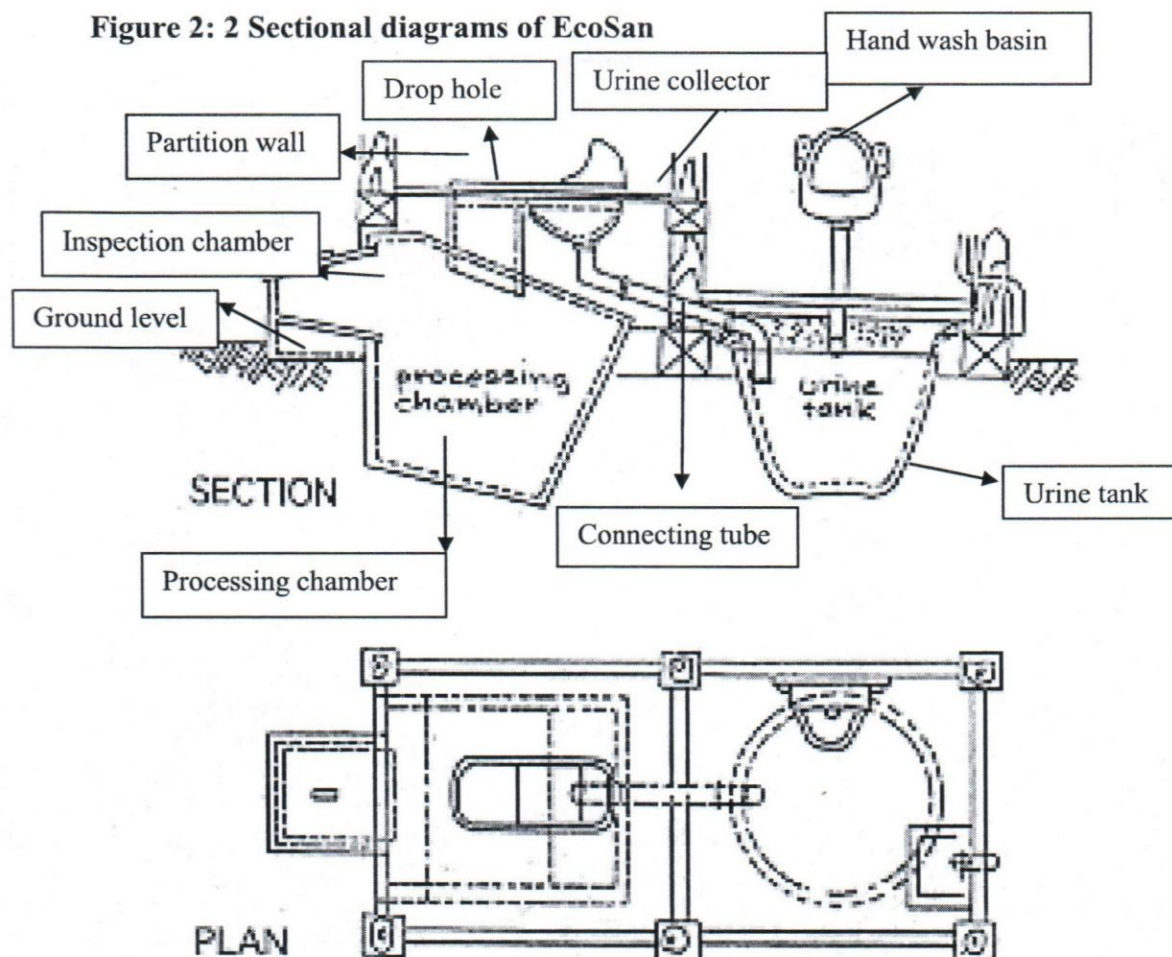


Figure 2.1: Pathogens in faeces transmission pathway

Source: Wimblad and Hebert, 2004

The major aim of EcoSan system is to make sure that a suitable barrier is created among faeces and flies, fields to food. Also another link is from fingers and fluids to food to the susceptible host. This link can be broken by separating urine from faeces first before allowing the faeces alone into a containment chamber which is a shallow pit where the disease causing organisms are reduced to an acceptable level before re-use. The content may be removed for further secondary treatment to make it even more safer. A sectional diagram of the EcoSan is shown in Figure 2.2

Figure 2: 2 Sectional diagrams of EcoSan



Source : Winblad and Simpson-Hébert (2004)

The end product of both the faeces and urine are used as manure in the farm instead of over reliance on artificial fertilizer.

2.13. Knowledge, acceptance and adoption of EcoSan

Esrey et al., (1998) made it clear that principles underlying EcoSan are not novel. They went further by saying that in different cultures sanitation systems based on ecological principles have been used for hundreds of years and this EcoSan systems are still widely used in parts of East and South-East Asia. They continued their submissions by saying that in Western countries this option was largely abandoned

as flush-and-discharge became the norm but in recent years there has been a revival of interest in ecological sanitation.

In addition to awareness of the existence of a technology, actual knowledge about its capabilities, and which requirements are necessary for its use must also be made available for the users (Rogers, 2003).

Promotion of EcoSan at the urban level usually begins with educating the populace on the benefits and costs of this new approach to urban sanitation. This may require visits to urban or rural communities that have adopted EcoSan so that the people can see EcoSan in operation for themselves. Once they are convinced that EcoSan would be good for their town or city then they are ready to adopt it (Winblad and Simpson-Hébert, 2004).

Hygiene education and behaviour change has also been highlighted by Martinez and Simpson-Hébert in a WHO (1997) report, for the successful promotion and adoption of EcoSan. The authors indicated in their submission that, every sanitation programme has a hygiene education and behaviour change component. This, according to them, is because during the planning phase, users will learn a great deal about disease transmission and how to block transmission. Eco-toilets often also require new behaviours that people need to adopt. In urine-diverting toilets for example, people are instructed to use these new toilets so that no urine enters the pit.

Households will need to know how their new system works, how to use the EcoSan devices properly and how much they need to pay (Lau, 2010). Drangert (2004) on his part, made the assertion that knowledge development and acceptability of EcoSan can seriously be enhanced through capacity building vis-à-vis, the



development of regional nodes so that regional-based training, policy development and implementation can be carried out.

The source further stated that the above could be achieved primarily through pilot projects in order to learn how these systems function, how households and users adapt to them, how authorities adapt to them and how the systems can be further improved.

Schönning and Stenström (2004) are of the conviction that proper planning for sanitation systems is crucial for the acceptance of a particular system. They went further to state that the basic strategy is to involve the users of the system and to propose several sanitation alternatives that comply to a Terms of Requirements taking into account both primary functions (hygiene/environment) as well as practical functions (costs/ user friendliness etc.) for them to choose from.

By this, the knowledge level of the households would be increased to inform a better judgement regarding the choices they make.

In conclusion, ecological sanitation (EcoSan) therefore represents an approach to sanitation where human excreta is contained, sanitized and put to a good use. Only a small part of the world actually is served with water-based flush systems (about 1.1 billion people, many of which are not provided with health and environmental safety through secondary level or better treatment). The rest (some 5.3 billion) either have no sanitation (about 2.6 billion) or pit latrines. The advantages in upgrading these systems to EcoSan would be cost-effective in terms of improving health, environmental quality and recycling of nutrients. These advantages of EcoSan can however be realised if the above theoretical and empirical expositions are considered in any strategies toward promoting the technology.



CHAPTER THREE

METHODOLOGY

3.0 Overview of the Methodology

The study was a cross-sectional survey of adults, proportionately sampled to give a fair representation of both the rural and urban inhabitants of the Tamale Metropolis. Data was collected using a semi structured questionnaire in a face-to-face interview of respondents. Both close and open-ended questions were used to gather information on the background characteristics, knowledge level, and existing sanitation systems, factors that may challenge the adoption of EcoSan and attitudes and practices that can promote the functioning of EcoSan.

Data was processed and analysed using SPSS version 20 (IBM, Illinois, USA) and the results presented as summaries of overall data collected. Descriptive data were presented as percentages, means or medians where appropriate. The Chi-square test for associations was used to assess any associations between the primary outcome measure (acceptability of the EcoSan) and other respondents' variables. The level of significance was set at 5% and the Confidence Interval at 95%.

3.1 Study Design

The design adopted for the study was the descriptive cross sectional type. Using a semi-structured questionnaire, data was collected from a cross section of individuals from the study population between September and December 2013.



3.2 Study Area

The study was carried out in the Tamale Metropolis.

3.3 Population

There were two sets of study populations. One set was the residents of the urban centre of the city of Tamale who have existing latrine systems as well as residents without any form of latrine in their premises. The second set was residents of rural Tamale who are currently not using any household latrine system, for the purposes of assessing their desire to accept and adopt the EcoSan system by presenting its prospects as against the known latrine systems. The inclusion criteria for the study were that, all participants were adults, whether literates or illiterates, male or female.

3.4 Definition and Measurement of Study Variables

The primary outcome of the study was to measure the level of acceptability of the Ecosan technology. This was defined by the variable acceptability and was measured by a Yes or No answer to the question whether or not participants were prepared to use a toilet facility in which urine and faecal matter were not allowed to mix. This was considered the dependent variable while all other variables like socio-demographic characteristic, cultural belief and attitudes were treated as the independent variables. Socio-demographic characteristics considered in the study included educational background, gender, religion and geographical location.

3.5 Sample Size Determination

The sample for the study was calculated from the formula:

$n = z(pq)/d$, where $z = 1.96$, p = proportion of population with characteristic of interest (0.5), $q = 1 - p$ and d = desired precision (i.e. 0.001) at 95% Confidence Level

$$\text{Therefore } n = 1.96 \times \frac{(0.5 \times 0.5)}{0.001} = 490$$

This gave a calculated sample size of 490.

From the formula, p is supposed to be gotten from an existing study statistics such as means or proportions. In the absence of any such study from which the statistics could be gotten, it is permitted to use 0.5 as the proportion assumed to have had the characteristic of interest. It was on the basis of this that the value of p to be 0.5 was arrived at.

According to the 2010 Population and Housing Census report, the urban population of Tamale was 274,022(74%) whilst that for rural was 97,329(26%) therefore assuming a proportionate sampling, the urban sample was obtained as 76% of 490=363 and the rural was obtained as 26% of 490=127.

3.6 Sampling Procedure

The techniques used to sample participants were the quota, purposive and the convenience sampling techniques. The quota technique was used to ensure proportionate distribution of the participants across the Metropolis. The purposive technique was to ensure that only residents with some specific characteristics were deliberately targeted for sampling while the convenience technique was adopted in view of the difficulties arising out of the lack of a sampling frame which is necessary for the employment of any probability sampling technique. The study area was divided in four areas namely north-east, north-west, south-west and south-east. Quotas were then assigned to each area, (one urban and one rural community) in a proportion as outlined in 3.5 above. Then the purposive technique was used to target latrine owners on one hand and those who did not have latrines in their premises on



the other hand. The convenience technique was then used to sample individual participants for the study. For this, residents in all the four areas (i.e. 8 communities) who met the inclusion criteria were contacted and their willingness sought for participation in the study. Where prospective participants were willing, they were administered the questionnaire.

The non-probability sampling techniques (i.e. quota, purposive and convenience) were used for a number of reasons. First among these reasons is that, most parts of the settlements lack proper house numbering system which made it impossible for the use of a systematic sampling technique. Another reason is that a sampling frame (i.e. list of all members of the population in an ordered manner) which is a basic requirement for the application of probability sampling (simple random, systematic, stratified and cluster sampling) was lacking and would be difficult in terms of cost and time to construct. Under the circumstance, the only alternative was to rely on the non -probability sampling techniques.

3.7 Data Collection Tool

The tool employed in data collection was a questionnaire, self-constructed and validated through an initial piloting. (Appendix A). The questionnaire was used as an interview guide strictly for those who could neither read nor write. The question items were read and explained to the participant and the responses recorded. The questionnaire had two major parts namely the introductory and the second part made of specific question items aimed at addressing the study objectives. Information gathered included socio-demographic characteristics of the respondents, questions on awareness of EcoSan, acceptance level regarding EcoSan, challenges to the



adoption of EcoSan, and on their attitudes and practices towards the new sanitation technology.

3. 8 Pretesting the Instrument

The instrument prior to its administration was pretested on individuals with similar characteristics with the study participants. This enabled the researcher to identify ambiguous as well as inappropriate questions and revised them which enhanced the validity of the study. The pretest was carried out on 10 participants; one half urban and the other rural.

3. 9 Administration of the Instrument

The instrument was administered by four trained research assistants and the researcher himself after a period of orientation for the research assistants. The research assistants were involved in the pre-testing as part of the orientation process, but prior to that they were taken through the purpose of the study and explanations of the individual question items to clear any ambiguity and misinterpretations. A period of three months was used to administer the instrument. This was broken down to two months for urban set of populations and one month for the rural. For consistency, the research assistants collected the data together in each of the communities at the same time before moving on to the next. The researcher carried out supervision by visiting the research assistants during the period and assisted in the process where necessary.

On entering each selected house, research assistants established the necessary rapport by greeting and explaining the purpose of the visit to the responsible individuals in the house and also sought permission to administer the questionnaire. Individuals who were not willing to participate in the study were not forced. Prior to



the collection of data, the opinion leaders in the community: chiefs and assemblyman were informed and necessary permission obtained from them.

Those who could read and write answered the questionnaire on their own after thorough explanation. The questionnaire were delivered by the researcher for these participants to complete at their convenience and agreed upon time which was within the collection period. They were collected by the researcher on the appointed agreed periods of time but responses were recorded immediately on copies of the questionnaire in the case of participants who were illiterates.

Each participant was involved in the research for 20 minutes, mainly in answering the questionnaire

3. 10 Data Analyses

Raw data was collated, coded and analysed using the SPSS version 20 software (IBM, Illinois, USA). Data was presented in tables and where appropriate in charts and graphs. Statistics computed were mainly descriptive such as frequencies and percentages. The Chi-square test for associations was used to assess any associations between the primary outcome measure (acceptability of the EcoSan) and other respondent variables. The level of significance was set at 5% and the Confidence Interval at 95%.

Interpretation of data also took into consideration information in the relevant literature. Conclusions were based mainly on the findings as related to the research questions and objectives.



3.11 Ethical consideration

The Metropolitan Chief Executive and Regional Environmental Health Officer were informed of the study and their consent sought. During the study period, informed consent was sought from all eligible participants before the questionnaire were administered.



CHAPTER FOUR

RESULTS AND DATA PRESENTATION

4.0 Introduction

The current chapter presents the results of analysis of the data collected from the study participants. The chapter is organised into two (2) major parts namely: socio-demographic data of participants and specific questions geared towards addressing the study objectives.

4.1 Socio demographic characteristics of participants

From Table 1, the majority of participants 317 (64.7%) were males. In terms of age, the majority of participants (97.8%) were within the active age category (18-59 years). The median age was 31 years with the minimum age being 18 and the maximum age 83 years. With regards to religion, most of the participants (74.9%) (367) indicated they profess the Islamic faith. Christians constituted 22.9% (112). Participants who said they were traditionalists constituted only 2.2% (11). In respect of educational attainment, participants who indicated they had no formal education constituted 30.4% (149) while those with only basic level education constituted 18.2% (89). Participants with secondary level education constituted 26.7% (131) while those with tertiary level educations constitute 24.7% (121). From the above, a total of 238 (48.6%) participants either lack any formal education 30.4% (149) or had only basic education 18.2% (89) which is not enough to appreciate literary issues. Concerning categorization of participants in terms of locality of residence, the majority of them (74.1%) were located in urban areas whereas those who resided in rural areas were 25.9% (127).



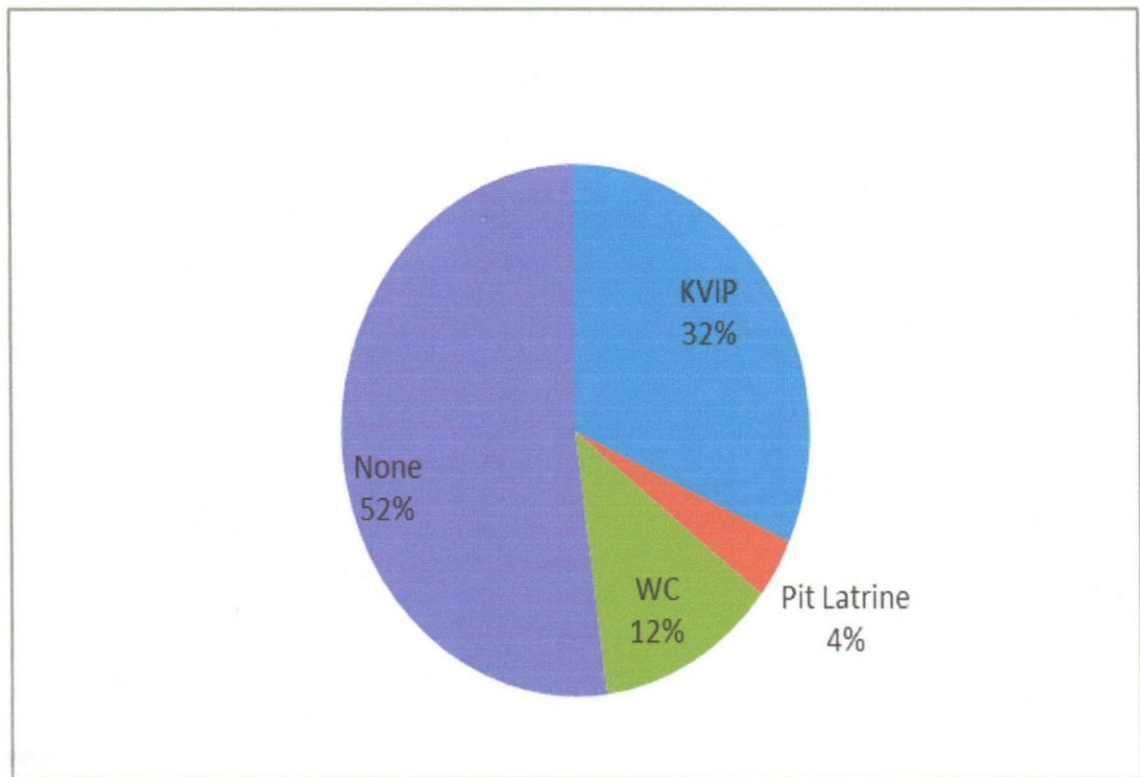
Table4. 1: Socio-demographic data of participants (N=490)

Variable	Category	Frequency	Percentage
Gender	Male	317	64.7
	Female	173	35.3
Age	18-59	479	97.8
	60+	11	2.2
	Median Age	30.5	-
	Minimum age	18	-
	Maximum	83	-
Religion	Christianity	112	22.9
	Islam	367	74.9
	Traditional	11	2.2
Educational Level	Basic	89	18.2
	Secondary	13	26.7
	Tertiary	121	24.7
	None	149	30.4
Locality	Urban	363	74.1
	Rural	127	25.9

Source: Field work, 2013



The chart below presents the type of toilets in participants' home.



Source: Field work, 2013

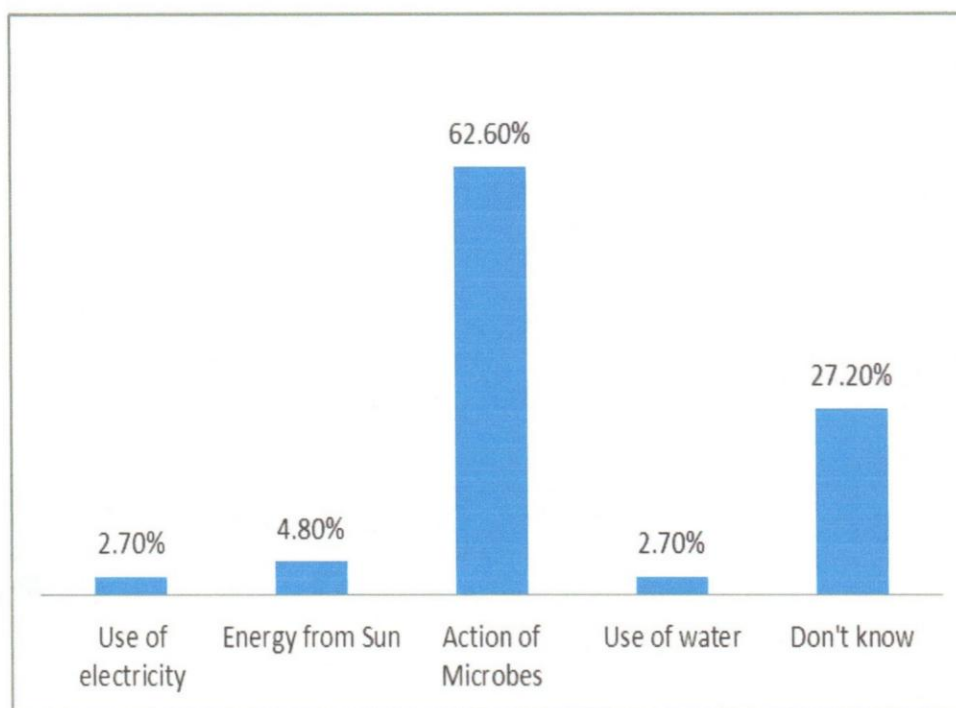
Figure 4.1: Type of toilet in participant's home.

With regards to the type of toilet in participant's home, 490 houses sampled revealed that 31.8% has KVIP, 3.7% Pit latrine, 12.4% Water closets and 52.0% has none.



4.2 Knowledge and Awareness about EcoSan

The chart below shows participants' opinion regarding the mechanisms by which a toilet considered harmless functions.



Source: Field work, 2013

Figure 4.2: Opinion on how harmless toilet functions.

Regarding opinion of participants as to how a toilet considered harmless functions, 62.6% (92) forming majority indicated by action of microorganisms, 2.7% (4) indicated by use of electricity. Participants, 4.8% (7) said by way of energy from the sun whereas 2.7% (4) said by use of water and 27.2% (40) said they did not know.



Table 4.2: Knowledge and awareness about Ecosan

Variable	Yes	%
Toilet that renders human excreta harmless	115	23.5
Defecation in the open is wrong	409	83.5
Knowledge of Ecosan in community	108	22
<u>Name given to toilet rendering faeces harmless</u>	Frequency	%
Do not know	18	17.0
Traditional Pit Latrine	11	11.3
KVIP	60	56.6
Water closet	17	15.1

Source: Field work, 2013

Regarding whether or not participants know of any toilet that renders human excreta harmless, 23.5 %(115) responded yes whereas 76.5% (375) forming the majority indicated no.

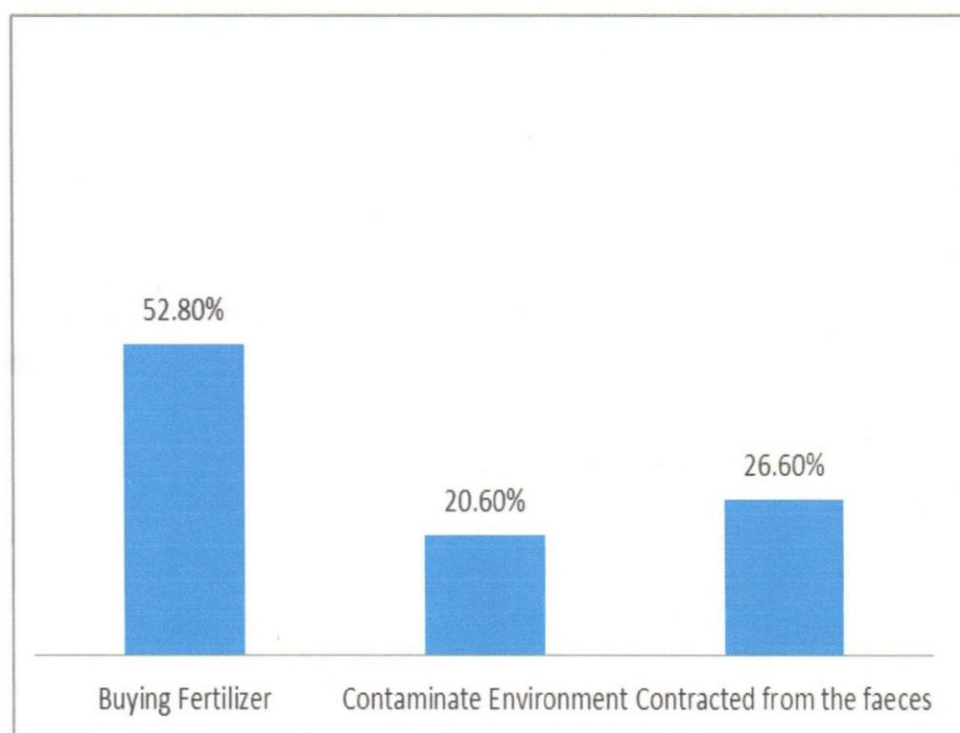
From the above, 83.5 % (409) of the respondents forming the majority said that it is wrong defaecating at a free range whereas 16. 5 %(81) said they have not seen anything wrong with it.

With respect to whether or not anybody in the community uses any toilet that renders faces harmless which can be used as manure, majority forming 78.0% (382) said no whereas 22.0% (108) said yes.



With respect to the name of the toilet that renders faeces harmless for use as manure, majority of the respondents 56.6 % (60) indicated KVIP, 15.1% (17) said water closet, and 11.3% (11) indicated traditional pit latrine and 17% (18) said they do not know the name.

The bar chart below shows the reasons for which participants would prefer a toilet that renders faeces harmless



Source: Field work, 2013

Figure 4.3: Reasons for participants preference for toilet that render faeces harmless

Concerning the reason for which participants would prefer or not prefer a toilet that renders faeces harmless 52.8%(203), indicated spending less on fertilizer, 20.6% (79) said reduction in environmental contamination and 26.6% (102) indicated diseases contraction be reduced.



Table 4.3: Attitude towards sanitation

The table below assesses participants' preferences, likes and dislike of practices as a way of making inference to their attitude regarding EcoSan.

Responses	Frequency	%
<u>Type of latrine preference</u>		
The current toilet known to me	290	59.2
The one that converts faeces to something that can be disposed	200	40.8
<u>Why not build a toilet that renders faeces harmless</u>		
I have no use for harmless faeces for Agric. purposes since I am not a farmer	72	67.9
It may cost more than the one I am used to	22	20.8
Human faeces is harmful	12	11.3
<u>To share a toilet with neighbour, yes or no</u>		
Sharing toilet with neighbour	363	74.1
<u>Having a toilet in or outside one's house</u>		
In the house	365	74.5
<u>Reasons of defaecating in the field</u>		
a. To fertilize the land	385	78.6
b. To prevent the place from being bushy	7	1.4
c. For maggots to grow for fowls	1	0.2
d. For pigs to feed on	4	0.8
e. Do not know	35	7.1
f. Because they do not have latrine	58	11.8
<u>Choice to use either artificial or faeces manure</u>		
a. Artificial fertilizer	247	50.4
b. Manure from human faeces	243	49.6
Encouraging people to defecate on the field	221	45.1
<u>Defaecation on their field or depositing it in a toilet and later be taken to the field.</u>		
a. I see it as good	181	83.8
b. I don't see any difference	32	14.8
c. I don't see it good	3	1.4

Source: Field work, 2013



Concerning the type of toilet preferred by participants, 59.2% said they preferred the current toilet known to them whereas 40.8% said they preferred the harmless one. This indicates that, the majority has positive attitude toward existing toilet facilities than the new technology.

About 106 participants did not prefer a toilet that renders faeces harmless. Of this 67.9% (72) forming the majority indicated that since they are not farmers they may not have the use for harmless toilet. The majority therefore has negative attitude toward the new technology for the purposes of agriculture. On the other hand, 20.8% (22) said a toilet that renders faeces harmless may cost more than the one I am used to whereas 11.3% (12) said human faeces is harmful. Opinion was sought from participants if they would be prepared to share a toilet with a neighbour in order to produce harmless faeces, majority (74.1%) (363) said yes whereas 25.9% (127) said no.

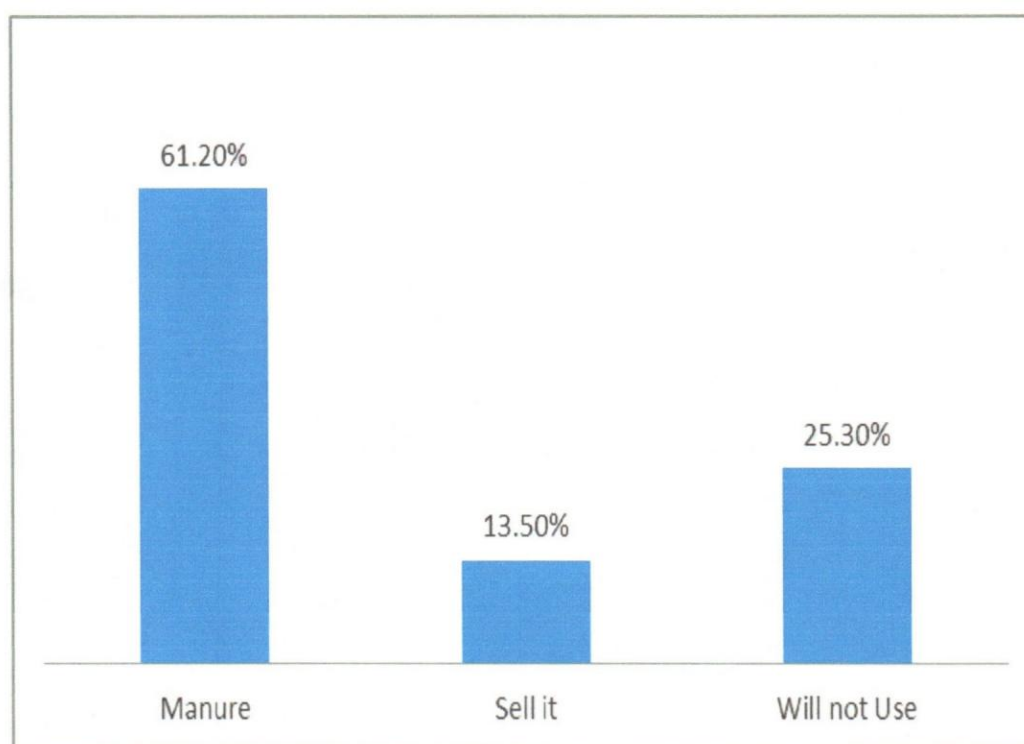
Concerning having a toilet in or outside one's house, majority 74.5% (365) indicated yes whereas 25.5 % (125) indicated no.

Regarding the reason why some residents defaecate in their field, majority 78.6% (385) indicated land fertilization, 1.4% (7) indicated bushy field prevention. Other participants 0.2% (1) indicated maggots for fowls, 0.8% (4) said Hog. feeding, and 7.1% (35) said no knowledge whereas 11.8% (58) indicated lack of latrine.

Regarding the choice to use artificial fertilizer or manure from human faeces, 50.4 % (247) indicated artificial fertilizer while 49.6% (243) indicated human faeces manure. Regarding whether or not participants would encourage people to defaecate on their field as a way of fertilizing it, majority, 54.9 % (269) indicated no while 45.1% (221) indicated yes.

With regards to the opinion of participants who would encourage defecation on their field to fertilize it would rather allow the faeces to be deposited in a toilet and later be taken to the field, majority 83.8% (181) indicated seeing it good, 14.8 (32) % indicated no difference, 1.4%(3) indicated not seen it good.

The manner in which participants intend to use faeces rendered harmless by toilet systems such as EcoSan is presented in the figure below. This was to assess possible intended uses of harmless faeces if participants were to adopt EcoSan.



Source: Field work, 2013

Figure 4.4: How participants intend to use faeces rendered harmless as manure.

The Figure above shows that majority of participants 61.2% (300) said they would use faeces rendered harmless to manure their land while 13.5% (66) indicated they will sell it. The remaining 25.3% (124) said they will not use it at all.



Table 4.4: Practices regarding sanitation

From the Table below, participants intended practices regarding specific sanitation activities have been presented in order to make inference regarding whether or not they will conform to the demands for the proper function of EcoSan.

Variable	Frequency (Yes)	%
Preference to build a toilet	379	77.3
Preparedness to use and wash outside a toilet	349	71.2
<u>Reasons not to wash outside the toilet</u>		
Waste of time	50	41.0
Because of contamination	28	23.0
Because in Islam you have to clean your anus before going out	44	36.0
<u>Where people without toilet defaecate</u>		
Bushes around	209	42.7
Dig and burry	23	4.7
Uncompleted buildings	7	1.4
Public toilets	240	49.0
Into drains	11	2.2
<u>Fertilize crops with harmless faeces</u>		
It is wrong eating food grown on land fertilized by human faeces	166	33.9
Readiness to use faeces to fertilize land	273	84.3

Source: Field work, 2013



Seeking the opinion of respondents whether they would prefer to build a toilet that makes faces harmless, 77.3% (379) said yes forming the majority. In contrast, only 22.7% (111) said no.

Regarding opinion of participants on whether or not they would be prepared to use a toilet and wash outside the toilet rather than in the toilet, a majority of 71.2% (349) indicated yes while 28.8% (141) indicated no.

Regarding reasons why some participants would not be prepared to wash outside the toilet, 41.0% (50) indicated lack of time, 36.1% (44) indicated in the Islamic religion washing outside is not allowed, 23% (28) indicated this would lead to contamination.

Seeking where people without toilets in their houses defaecate, 42.7% (209) indicated that the people do defaecate in the bush around, 49.0% (240) indicated the public toilet and 4.7% (23) indicated dig and burry, 1.4% (7) said in uncompleted building and 2.2% (11) indicated drains deposition

Concerning whether or not there is anything wrong with eating crops grown on a piece of land fertilized by human faeces, majority 66.1% (324) indicated no while 33.9% (166) indicated yes.

Seeking opinion of whether or not participants who see nothing wrong with eating crops grown on land fertilized with faeces are prepared to use faeces to fertilize their land, majority 84.3% (273) indicated that they are prepared to use faeces to fertilize land after seeing nothing wrong with eating crops grown on land fertilize with faces whereas 15.7% (51) said that they are not prepared to fertilize land with faeces.

Table 4.5: Cultural beliefs regarding sanitation

Responses in the Table below make inferences to participants' beliefs and culture that could either promote or discourage the adoption of EcoSan.

Variables/Responses	Frequency	%
Whether human faeces can be used to fertilize land	456 (yes)	93.1
Disposal of human faeces at a fixed location	93(yes)	19.0
Men and women faeces should not be mixed	87(yes)	17.8
<u>Reasons why Men and women faeces should not be mixed</u>		
Because of transmission of disease women faeces should not be mixed with men's faeces	36	41.4
For privacy reasons	51	58.6
<u>Why it is wrong to eat crops grown on land fertilized with human faeces</u>		
Eating such crops is indirectly eating the faeces	76	45.2
It is not safe since some crops are not cooked before eating	92	54.8
<u>Disadvantages of open defecation</u>		
Source of disease transmission	212	52.2
It pollutes environment	30	7.4
Breeding of flies, transmitters of diseases	44	10.8
It gives bad odour	120	29.6

Source: Field work, 2013



Regarding the opinion from participants if they believe whether human faces can be used to fertilize land, majority (93.1%) indicated yes while 6.9% no.

Concerning whether or not participants have any culture that is against the disposal of human faeces at a fixed location, majority 81.0% (397) of participants indicated no whereas 19.0% (93) said yes.

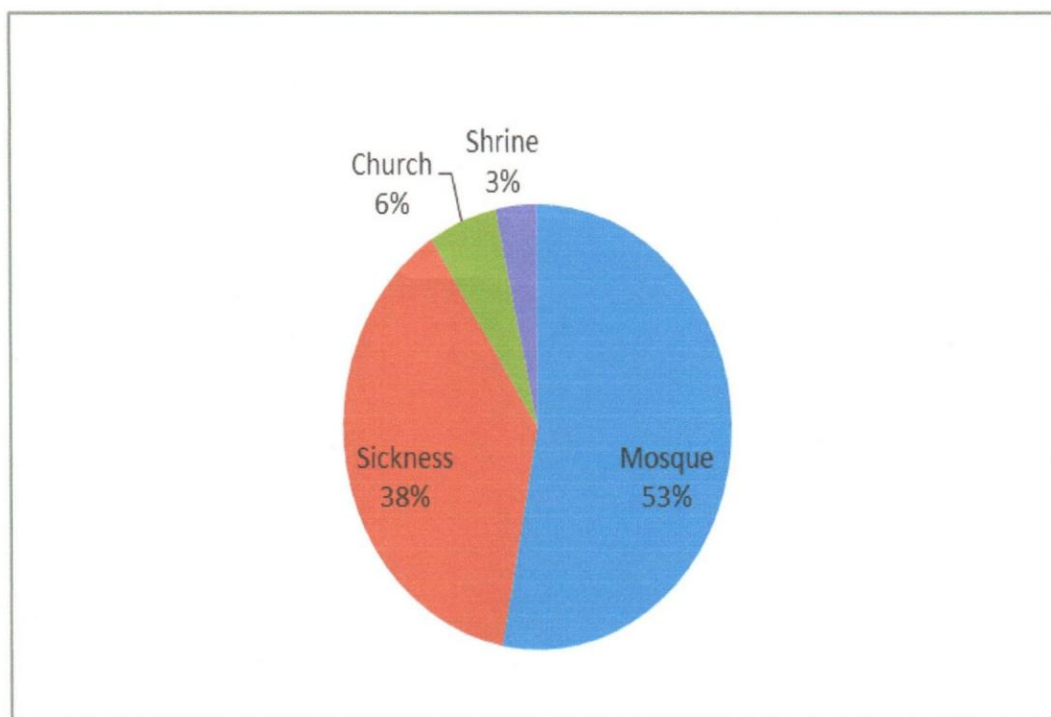
With regards to existence of any belief whether, men and women faeces should not be mixed, majority 82.2 % (403) of the participants indicated yes, 17.8 % (87) indicated no.

Regarding the reasons why Men and women's faeces should not be mixed, 41.4% indicated transmission of diseases while majority 58.6% said for privacy reasons.

Regarding participants concern why it is wrong to eat crops grown on land fertilized with human faeces, 45.2% indicated eating faeces indirectly while 54.8% said not safe.

With regards to the advantages of open defaecation, 52.2% (212) of participants indicated it a source of disease transmission, 29.6 % (120) indicated a bad odour emanation. Other participants 10.8% (44) indicated breeding of flies, transmitters of diseases, whereas 7.4% (30) indicated environment pollution.





Source: Field work, 2013

Figure 4.5 Culture regarding sanitation

Of those who thought culture was a factor, majority 52.9% (46) indicated because faeces is not supposed to be disposed near the mosque, 37.9% (33) indicated transferring of diseases, 5.7% (5) indicated the church location disposal, 3.4% (3) indicated disposal near the shrine. **(Figure 4.5)**



Table 4.6: Acceptability of Sanitation

Responses in the Table below make inferences to participants' preparedness to use toilet where water and urine are not allowed into the same pit which will enhance acceptability of EcoSan.

Variable	Frequency	%
Preparedness to use toilet where water and urine are not allowed into the same pit	303	61.8
<u>Reasons why participants are not prepared to use toilet where water and urine are not allowed in</u>		
It is difficult to practice	19	15.0
It affects the action of the microbes	28	22.0
Cannot be possible because I must urinate when I defecate	80	63.0

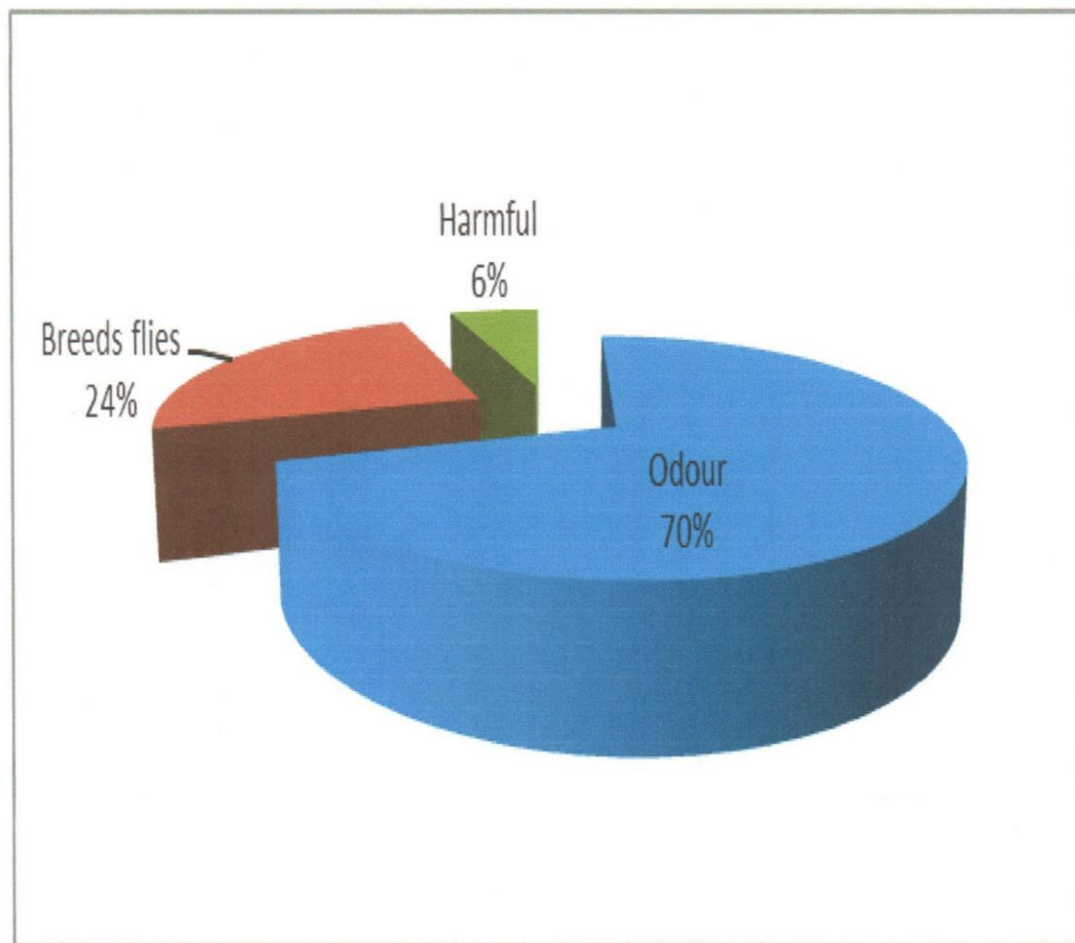
Source: Filed work 2013

As to whether or not participants would be prepared to use a toilet where water and urine are not allowed into the toilet, majority, and 61.8% indicated yes while 38.2% indicated no.

Concerning why participants would not be prepared to use toilets where water and urine are not allowed into the toilet, majority 63% (80) indicated it cannot be possible, 22% (28) indicated it effects the action of microbes negatively 15% (19) indicated it is difficult to practice.



4.3 Attitude towards sanitation



Source: Field work, 2013

Figure 4.6: Why respondents prefer having toilet outside their house

Regarding participants opinion why they prefer having toilet outside their house, majority 70.5(86) indicated that toilet in the house emanates offensive odour, 23.8% (29) said fly breeding whereas 5.7% (7) indicated the harmfulness to health.



4.4 Factors affecting the acceptability of EcoSan

The main outcome measure of the research was the acceptability of the EcoSan, which was measured by assessing the preparedness of respondents to use the technology.

Where participants were prepared to use a toilet facility in which water and urine are not allowed to mix, it was assumed that they would accept the EcoSan. The effects of socio-demographic characteristics on the acceptability of EcoSan are presented in Table 4.6.

A total number of 349 respondents, representing 71.2% were ready to accept the EcoSan. Among these participants without any form of education were the least 65.1%, (97) represented among those who accepted the new sanitation technology whilst those with secondary education were the most 77%, (101) category that accepted it.

A chi-square computation however supported a lack of association between acceptability and educational background ($P=0.6$). From the basic level education up to none education the proportions were 66.3-66.5(%)

When gender was investigated for its effect on acceptability of EcoSan, it was revealed that of the 317 males in the sample, 234 (73.8%) were ready to accept the technology compared to the 114 (66.3%) of the 172 females in the sample who were ready to use the technology. Assessing the p value however did not show any association between gender and acceptability as p was 0.17.

Of the 112 Christians sampled, 83% (93) accepted the technology whilst of the 367 Muslims, 248 (67.6%) accepted it. Most traditionalists 72.7% (8/11) accepted the



new technology. The p value (0.007) of the chi-square test was statistically significant and therefore confirmed an association between acceptability and religious background. This results show that Christians were more likely, followed by traditionalist and then Muslims, to accept the new technology.

There were a total of 130 rural dwellers out of which 90 (69.2%) accepted EcoSan, compared with 258 (71.9%) of urban dwellers who accepted it. However, this difference in proportion was not statistically significant to support any association between locality and acceptability ($p=0.7$).



Table 4.7: The effects of education, gender, religion and user location on acceptability (N =490),

Variable	Category	n	Percentage	P
Educational Level	Basic	8	66.3	0.6
	Secondary	101	77.1	
	Tertiary	92	76.6	
	None	97	65.1	
Gender	Male	234	73.8	0.12
	Female	114	66.3	
Religion	Christianity	112	83.0	0.007*
	Islam	93	67.6	
	Traditional	248	72.7	
Locality	Urban	90	69.2	0.7
	Rural	258	71.9	

n = the total number of participants that indicate their willingness to accept EcoSan.

Source: Field work, 2013



Table 4.8: The association of cultural-belief and attitude on acceptability of EcoSan

Variable	N	%	P
<u>Cultural Belief</u>			
Yes	46	13.2	0.001
No	303	86.8	
<u>Willingness to build</u>			
Yes	75	78.8	0.23
No	74	21.2	
<u>Places of convenience for those without household latrine</u>			
Bush around	152	72.7	0.03
Uncompleted buildings	2	28.6	
Dig and bury	15	65.2	
Public toilet	175	72.9	
Into drains	5	45.5	
<u>Preference for artificial fertilizer to human faeces manure</u>			
Artificial fertilizer	181	51.9	0.3
Manure from human faeces	168	48.1	
<u>Eating crops from human faeces</u>			
Yes	121	72.9	0.6
No	228	70.4	

Source: Field work, 2013

With regards to the ecosan, the main cultural belief was with regards to the mixture of male and female faeces. Of the 349 participants who accepted the technology, 13.2% (46/349) did not believe that female and male faeces should be mixed, whilst 86.5% (303/349) believed that, male and female faeces could be mixed. The difference in these proportions was statistically significant ($p=0.001$), suggesting a

strong association between the belief around the mixing of male and female faeces. It shows that those who believed that male and female faeces could be mixed were more ready to accept the new technology than those who did not hold that belief.

When the willingness to build the new technology and acceptability were investigated for any association, 78.8% (275/349) who were willing to build accepted it compared to 73.8% (104/141) who were willing to build but did not accept the technology. There was no significant association between willingness to build and acceptability ($p=0.23$).

Of the 209 participants who defecated in the bush 72.7% (152/209) accepted the EcoSan, whilst of the 23 who dig and bury, 65.2 % (15/23) accepted it. Only 28.6% (2/ 7) of those who used uncompleted building accepted the technology, whereas 2.9% (175/240) of those who used public toilet accepted EcoSan, 45.5 % (5/11) of those who defaecated into drains accepted the technology. There was a statistically significant association between choice of place of convenient and acceptability of EcoSan ($p=0.03$). It shows that those who use public toilet are most likely to accept the new technology when the least to accept the technology are those who defaecate in uncompleted building.

There was a total of 247 of those who have preference for artificial fertilizer, out of which 51.9% (181/247) accepted EcoSan compared with 48.1% (168/243) of those who had preference for human faeces manure and accepting the new technology. Assessing the p value however revealed a value of 0.3 indicating that preference for fertilizer was not associated with acceptability of EcoSan.

Of the 166 who saw something wrong with eating crops grown on a piece of land fertilized by harmless human faeces, 72.9% (121/166) accepted EcoSan compared

with 70.4% (228/324) of those eating crops planted on harmless human faeces accepted it. There association between the mode of fertilizing land and acceptability was not statistically significant ($p=0.6$).



CHAPTER FIVE

DISCUSSION

5.0 Introduction

As has been stated in earlier chapters of this thesis, this work was conducted to assess the level to which individuals within the Tamale metropolis are ready to accept and adopt a new sanitation technology known as the Ecosan so as to enable its promotion. To achieve the above objective, a cross sectional study was conducted involving a total of 490 individuals, representative of the Tamale metropolis, between the period of September and December 2013. This chapter discusses the results of the study with respect to the objectives which were set out to answer the specific questions the research intended to answer.

5.1 Knowledge level of the people in Tamale Metropolis regarding EcoSan concept.

Regarding whether participants knew any toilet that renders human excreta harmless, only 23.5% indicated they knew but the majority (76.5%) said they did not know of any such toilet. Since EcoSan falls within the category of toilets that render excreta harmless the implication is that the majority of participants and by extension residents of Tamale Metropolis are likely not to know about EcoSan. This actually reflects Roger's submission that, prior to the formation of an opinion about the usefulness of an innovation, a process of uncertainty reduction has already occurred. In this process, the potential adopter becomes aware of the existence and possibilities of the innovation (Rogers, 2003).

On the contrary however, regarding opinion as to how a toilet considered harmless functions the majority of participants (70.1%) provided responses that indicate good



knowledge in that regard. For instance an appreciable number of respondents (62.6%) rightly cited the activity of microorganism (small creatures/living things in the soil) for making such toilets harmless and just a few cited the use of electricity, water, and energy from the sun as a mechanism for rendering faeces harmless. In addition to those who made such citations were some who indicated outright that they did not know the mechanism by which human excreta in toilets could be made harmless.

The proportion of participants who rightly cited the activity of microorganisms provided responses that are scientifically plausible in explaining how faecal matter is rendered harmless. In this regard it could be concluded that there has been an appreciable level of knowledge among participants regarding how toilets are rendered harmless. This demonstration of knowledge may encourage the adoption of the technology. This is supported by Winblad and Simpson-Hébert, (2004), who have shown that when households know how their new system works, they are more interested in the ownership and management as well as the proper use of the device.

In conformity with the fact that the majority (76.5%) of participants lacked knowledge about any toilet that could render faeces harmless, a high number (78.0%) of participants indicated they did not use any such toilet. The lack of knowledge was evidenced in the wrongful indication by a good number of participants that toilets such as the KIVIP (by 56%), WC (by 15.1%) and the Traditional Pit Latrine (by 13.3%) as types of toilets that rendered faeces harmless.

When the issue of rendering faeces harmless by any sanitation technology was asked, participants thought that the current toilet facilities they used were suitable for that purpose. However these facilities, unbeknown to the respondents have not been

designed to render faeces harmless, and the faecal matter discharged from these toilet facilities still contain pathogens. This is reported to be a source of many parasitic diseases. (Lucas and Gilles, 2003).

Over half of the respondents (59.2%) indicated that they preferred the toilets they used. This could be due to the fact that by participants wrongly thinking that it is safe to use the excreta from their existing toilet facilities as manure, there was no point changing to a new facility. Clearly users would readily accept a change when they are guaranteed of benefits to be derived. This is supported by reports in the literature that, "the adoption of any new technology will be in no doubt influenced by already existing ones, especially when there are no clear advantages to be derived from the new one" (Godoe et al., 2009).

It was found in this study that, although a majority (76.5%) of participants lack knowledge about the EcoSan (76.5%), they demonstrated an appreciable knowledge (70.1%) of the mechanisms by which this toilet operates. Additionally they were commendably knowledgeable on how other types of toilets worked, which could enhance their adoption of the EcoSan. Understanding the mechanism by which technologies operate has been shown to influence how a group of people will accept the technology. For instance, Wright (2014) reported that by encouraging formal learning in the communities regarding the technology to be adopted there is the need to be part of the learning environment that fosters the development of local learning in communities so that the potential people can obtain the face-to-face contact that is part of their rich-cultural heritage."



5.2 Socio-demographic characteristics and the adoption of EcoSan.

The gender representation in the study had males forming the majority of participants (64.7%). The high male participation was mainly due to the fact that they were the sex group that were available and willing to divulge information on behalf of the household. This has a far reaching implication on the decision that would eventually be made in the wider population, as it is well known that in Ghana and Tamale in particular males hold the authority on issues regarding families as well as in the larger society. This fact can be exploited by involving many males in any awareness creation endeavour towards the promotion of EcoSan while not excluding the significant proportion or number of females.

Of all the socio-demographic characteristics, it was religion that influenced the acceptability of the Ecosan. Majority of Christians (83.0%) were ready to accept the new technology compared to a smaller number of Moslem who did. This poor acceptance by Moslems may be explained to some extent by the continual use of water as a key component in keeping clean after every visit to the latrine. In particular, designs that do not so much require the separation of urine or water from the faeces should be considered for promotion since the majority who are Muslims will prefer toilet systems that will allow the use of water. This however appears to be a challenge to the successful adoption of EcoSan, even though it is a challenge that could be addressed with alterations of designs. Consequently a well thought out strategy needs to be adopted to ensure effective acceptance of this new technology. The effect of religion on attitudes such as acceptance and adoption of new facilities has previously been reported by Morris and Angela (2007). These authors reported that the differences in cultural and religious values can have a great impact on the process of innovation adoption. In this, they cited an example, on September 10,

2003; news reported that the government of Saudi Arabia had banned Barbie toys from Saudi Arabian markets citing religious reasons. The report stated that the religious police of Saudi Arabia declared Barbie dolls to be a threat to morality, complain that the revealing clothes of the "Jewish" toy--already banned in the kingdom--are offensive to Islam.

The other socio-demographic characteristic considered was educational level attained by participants. A total of 48.6% of participants either had no formal education or had only basic education and the remaining proportion of participants had levels of education ranging from secondary to tertiary (51.4%) The difficulty in making residents appreciate the value of EcoSan would therefore not arise in a majority of cases since the literacy level is slightly more than 50%. This is supported by an earlier work by Rahm and Huffman, (1984) with their submission that in agriculture, farmers with higher education have better access to information and knowledge that are beneficial to farming operations.

The farmers also tend to possess higher analytic capability of information and knowledge necessary to successfully implement new technology and realize expected results. Hence, higher education allows farmers to make efficient decisions regarding adoption of new technologies.

Mishra and Uematsu (2010) also supported the view by saying that education is positively correlated with technology adoption.

This however calls for a special effort in addressing the difficulties that will arise in trying to raise the level of appreciation of residents who are without any significant formal education in order to see EcoSan in the positive light. The special effort is required because lack of significant formal education is a potential threat to

accepting principles in sanitation for that matter prevention of diseases which was also expatiated by Lucas and Gilles (2003).

Since the rural dwellers have already started using a form of faecal matter in farming, although not sanitized, such usage could have enhanced their acceptance (69.2%). From the technology acceptance model (TAM), it is posited that, perceived usefulness by consumers decides their attitude toward using and also influences how they accept commodity or service (Davis et al., 1989). Cognizance of this, the bases for promoting EcoSan should be other than farming or agricultural purposes in the case of urban dwellers. On the other hand, promotion of EcoSan should be more targeted at rural residents considering the agricultural benefits of the technology as an attraction.

In conclusion based on the foregoing discussion, it is noted that some socio demographic characteristics of participants such as age and gender could be exploited for the successful promotion of EcoSan whereas those who are potential barriers such as religion, level of education and place of residence, could also be factored in the design, and implementation of promotional strategies of EcoSan.

5.3 Extent to which existing sanitation systems affect the adoption of EcoSan.

A little over half (52%) of the participants indicated there were no toilets of any kind in their homes, but the rest indicated they have KVIPs, pit latrines and WCs. The benefit of owning and using household toilets among the 48% of participants could be exploited in favour of the adoption of EcoSan. This category of participants already know the comfort of having a toilet at home and could be convinced of increasing the benefit beyond having a toilet at home to include benefit such as environmental safety and agricultural application of the by-products of EcoSan as



further attraction towards the adoption of EcoSan. This has been supported in a submission by Müllegger and Lechner, (2008) who mentioned some of the consequences of the massive pollution of water (rivers and lakes) and soil, which may lead to diseases and then the loss of innumerable school and working days, losses in tourism income as well as prevention of economic growth. Much of this pollution is noted to be caused by a lack of latrine accommodation and inadequate sanitation services. The foregoing submission seeks to underscore the overall importance of sanitation to human health. For the majority of participants without any toilet system in their home, EcoSan stands a better chance of being adopted if well promoted among them, spelling out the usefulness. The above view is in agreement with the thoughts of Davis et al., (1989), in accordance with the technology acceptance model (TAM). The acceptance of EcoSan could be achieved by spelling out the benefits associated with the technology and the dangers associated with open defecation coupled with the availability of social interventions towards supporting families or communities to own EcoSan technologies. The dangers associated with open defecation has been amply published, where it has been reported that approximately, 6000 children die every day from diarrheal diseases related to inadequate sanitation and hygiene (WEHAB Working Group, 2002). There are even later reports that 1 billion people worldwide, mostly children, are infested with intestinal worms and as a result suffer nutritional deficiencies and poor growth (WHO, 2003). Both the diarrheal diseases that are related to inadequate sanitation and intestinal worms are transmitted through human faeces disposed of indiscriminately in the environment.

The reasons cited by participants for which they will not prefer toilet technology that renders faeces harmless, could also be used in targeting households in the promotion

of ecosan. For instance participants who indicated they were not farmers (67.1%) for which reason they do not see the need to own a toilet that renders faeces harmless could be offered other compelling reasons such as conservation of water, non-pollution of water sources, non-breeding of flies for the adoption of the system other than the agricultural uses of the by-products of EcoSan. The above advantages of EcoSan were well spelt out by Matsui et al., (2001) that pollutants also leak into groundwater from sewers, septic tanks, pit toilets and cesspools whiles EcoSan does not allow the leakage of any pollutant whatsoever. In addition to the foregoing, Barret, (2001) further made a submission that nutrients and pathogens seeping from pour-flush latrines and septic tanks have been documented as the cause of contamination to ground water and nearby surface waters throughout the world. It was later agreed by Briscoe and Steer, (1993) that pollution of water systems undoubtedly poses a serious public health concern for populations, especially in developing countries.

An appreciable percentage of respondents cited cost as an obstacle in the adoption of the Ecosan. The belief was that Ecosan was going to be more costly than existing facilities such as KVIP, WC and the rest. This concern has been earlier identified by Zheng et al. (2012) who noted that cost was a factor likely to affect the adoption of EcoSan. This problem of cost could be addressed through conscientization on the need to adopt shared ownership of the technology to reduce cost as well as being made to appreciate the cost benefit analysis of owning EcoSan technology.

The conclusion that could be inferred from the foregoing is that, while the existing sanitation systems being used by participants could constitute fertile ground for the

adoption of EcoSan reasons offered for non-preference of the technology could be factored in the promotional strategies or messages for the adoption of the EcoSan.

5.4 Factors that may challenge the adoption of EcoSan within the Tamale Metropolis.

Regarding what use participants will put manure generated from toilet technologies such as EcoSan, 74.7 % indicated that they will use it to manure their land or sell it to other users. The above submission was a clear indication that they will put the manure to some kind of economic use. The use of manure from EcoSan will make it such that over reliance on Phosphorus as an artificial fertilizer will reduce because it exerts a huge burden on the mining industry that has to keep up with the agricultural sector (Gumbo et al., 2002). This was also supported by Esrey et al., (1998) by stating categorically that in a situation of food insecurity, decreasing soil fertility and escalating prices for fertilizers in world markets, there is a need to utilise the nutrients, especially in human urine, rich in nitrogen and phosphates, for agricultural purposes, thereby increasing productivity and reducing the need for artificial fertilisers. The remaining indicated they will not put the manure to any use. The challenge here is that since this proportion of participants does not appear to have any alternative use of the by-product, the incentive to adopt the technology is limited.

This challenge however could be countered by including in the promotional drive a market for manure produced from EcoSan that could attract residents who will not have any immediate use for it to adopt the technology. In this way they would be aware that apart from the comfort and privacy the new ecosan offers, they stand the chance of gaining financially therefore social marketing is strongly needed as was



stated in the submission of Outlaw et al., (2007) that to support awareness raising activities, social marketing has proven to be a successful tool –because marketing is about creating and satisfying people’s needs and wants. The heart of the marketing task is to determine what consumers want and offer it to them in an attractive and accessible way. Social marketing uses marketing techniques such as advertising through mass media, demonstrations, special offers, word of mouth etc. to serve social objectives. WSP (2004) also emphasised on the importance of social marketing in sanitation. They therefore concluded that marketing can ensure that supply is adapted to people’s preferences and their willingness to pay and good marketing can enhance long term financial sustainability while successful marketing at large scale can be cost effective in the long run as demand and investments increase.

With regards to reasons for which majority of participants prefer a toilet technology like EcoSan, a little over half of the respondents (52.8%) indicated the benefits they will derive such as spending less in buying fertilizer, reduction of environmental contamination and. reduction in disease contraction. The above assertion was supported by Lucas and Guiles (2003) in their submission which pointed to the fact if human faeces is not managed well; it becomes a potential source of both environmental pollution and spread of communicable diseases. . Among these participants, the fear of lack of knowledge on the benefits of the toilet technology like EcoSan did not arise and therefore does not constitute a challenge since all the reasons offered are scientifically founded.

A good proportion of the respondents (10.8%) provided a rather uncompromising stands by saying human faeces is harmful irrespective of any treatment. While the

concerns of those who cited lack of agricultural use and cost of the technology can easily be addressed, the notion of human faeces being harmful no matter what, would require quite an effort to deal with since this is a matter of attitude and belief system. This is an understandable and to some extent, a rational fear of human excrement, which we might refer to as 'faecophobia' (Winblad and Simpson-Hebert, 2004). Faecophobia according to the authors is a personal or cultural response to the fact that human faeces are malodorous and potentially dangerous. In some cultures, such as in Hinduism, this response has been codified into concepts of 'clean' and 'unclean'. They further asserted to the fact that a typical traditional upper caste Hindu would have nothing to do with human faeces, not even his own. This is not because they are malodorous but because they are perceived as unclean. Anyone touching them also becomes unclean. The only people who are supposed to handle human excreta and to clean toilets are the 'untouchables'.

In terms of readiness or preparedness to marshal resources with other neighbours to share a toilet with the new technology in view of the benefits to be derived, the majority of participants (74.1%) indicated their readiness, implying a chance for acceptability. Their readiness or preparedness was possible because cost was to be shared to lessen the burden on the prospective adopters. The above was backed by Lau, (2010) who reported that it is a great challenge to most African governments because cost is not recovered easily when new technologies are adopted. He went further to state that one must further understand that in a bid to introduce a new technology, it is clear that there may be some cost implications.

As to whether or not people's belief about the possibility of rendering faeces harmless could be a challenge to the adoption of EcoSan, a huge proportion (93.1%)

of participants indicated they believed that human faeces could be rendered harmless. In a like manner, the existence of any cultural belief against disposing human faeces at a fixed location did not constitute a challenge against the adoption of EcoSan. This is because over 80% of respondents indicated that there was no such culture. Furthermore, when the main cultural belief with regards to the mixture of male and female faeces and acceptability were investigated for any association, majority of the participants who did not see anything wrong with the mixing of male and female faeces readily accepted the Ecosan. The above implies that EcoSan, when promoted with good messages such as “optimism” will work on the belief of households which may enhance patronage by the people. The above agreed with what Parasuraman & Colby, (2001) said that *Optimism* is a positive view of technology and a belief that it (technology) offers people increased control, flexibility, and efficiency in their lives. This generally captures positive feelings about technology and function as mental enablers.

A possible challenge which was encountered was the issue of mixing water and urine in the same facility since in the case of EcoSan separation of water/urine from faeces is necessary for efficient functioning. In this regard, quite an appreciable number of participants (61.8%) indicated they were prepared to use toilets in which water and urine are not allowed into the toilet. but the remaining number indicated they were not prepared for a toilet facility like that. Although in the minority, this number that did not seem to be happy with the EcoSan, was expected since the majority of the residents of the metropolis are Muslims who invariably use water in cleaning themselves after defaecating. This may pose a challenge in the acceptability and adoption of ecosan, especially by the people of the Islamic faith. However the



challenge cannot be daunting since the design of the technology could be made to suit that religious demand, where water and faeces may not be mixed.

A follow up question which sought to ascertain reasons for which some participants are not prepared to use toilets that do not allow water and urine into the toilet, 63% indicated that it was impossible to achieve this. This observation was merely a case of poor knowledge of the technology as has been found (76.5%), which could affect its acceptability. Knowledge has been reported to affect how individuals will relate and accept new technologies (Rogers, 2003). This implies in the promotional effort for the adoption of the ecosan a lot more has to be done on the education on the working of this new system of sanitation.

A majority of participants indicated their willingness to use a toilet and wash outside the toilet rather than in the toilet. This allays the fear of non-acceptability in terms of religious grounds earlier anticipated

With respect to whether or not participants will prefer a toilet inside their houses, 74.5% indicated they would like to, whereas the remaining indicated they would rather prefer to have toilet outside their house. . In a follow up question to ascertain reasons for which some participants would prefer to have toilet outside the house, 70.5% indicated that toilets emanate odour whereas 23.8% cited fly nuisance. These notions could be exploited in favour of EcoSan since it is a technology that is neither associated with odour generation nor fly nuisance if utilized properly.

In conclusion therefore, the majority of households will not consider it difficult to use manure from EcoSan to fertilize their soils or sell it, and a good number (77.3%) are more likely to adopt EcoSan for agricultural purposes. It is also worthy to note that the challenge for non-preference could largely be addressed except for those

reasons that border on belief systems. Also refreshing is the finding that the majority of participants indicated preparedness to pool resources with other neighbours to own EcoSan. Religious dictates could however be a challenge to an extent, but can be addressed. Misconceptions about the functioning of the system without water and urine are held by some participants as barriers.

5.5 Attitudes and practices that can promote the functioning of the EcoSan systems

With regards to where residence without toilet in their houses defaecate, 42.7% indicated that such people defecate in the bushes around homes whereas 49% indicated that such people use the public toilet. Participants' attitude, as to place of convenience influenced the acceptability of the Ecosan ($p=0.03$). Those who used public toilet were most likely to accept the new technology whereas the least to accept the technology are those who defecated in uncompleted buildings. This seems to indicate that people who did not have their own facilities and were mindful of their privacy were more likely to embrace the new technology. This may be explained by the fact that individuals place a lot of premium on their privacy and therefore visiting the latrine invokes a high level of consciousness of the people around. This makes them do all that is possible, including finding an enclosed structure, to hide from the general public during defecation. The protection of the human dignity has been previously reported as an important determinant in the acceptance of new sanitation technologies (Schönning and Stenström, 2004).

Regarding opinion of participants as to whether or not there is any negative consequence of open defaecation, the majority indicated there was. This overwhelming recognition of the negative consequence of open defaecation can be



exploited to the promotion of EcoSan if accompanied by very convincing benefits in the promotional drive.

There has also been a good demonstration of knowledge among participants regarding why open defaecation has negative consequence. Little over half of the participants who saw open defaecation as negative consequence cited disease transmission as a consequence whilst the rest cited bad odour, fly breeding and environmental pollution. This is a very good foundation upon which promotional drives of EcoSan can be built. This finding supports upon as was supported by Drangert (2004), who said that a shift from conventional pit or flush toilets to EcoSan will be more easily accepted if there is little or no odour from the excreta which attracts flies. He further agreed that covering the faeces with ash or lime effectively and periodically reduces the smell, and zero smell can totally be achieved by ventilation. Transforming the faeces, paper and ash to a hygienic product which looks like soil or humus makes handling more acceptable.

The conclusion that could be drawn from the foregoing is that, there is a negative attitude toward using human faeces as a soil conditioner, particularly for the urban participants whereas the rural participants are likely to accept the use of faeces for that purpose. It is also inferable that strategies to be used to promote the adoption of EcoSan among participants should vary with agricultural benefits being the overriding message for rural participants and for the urban participants, benefits other than agricultural concerns should be emphasized.



CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

The chapter summarises the study by highlighting all the relevant sections covered. The chapter further drew conclusions regarding major findings as a way of addressing the study objectives. The chapter then closes with recommendations, whereby strategies have been outlined as to how the EcoSan system could be promoted among residents of the Tamale Metropolis..

6.1 Summary

Since human excreta serve as a potential source of spreading communicable diseases to man, poor and unhygienic management practices together with non-intensification of education on hygiene and sanitation, constitute a major public health concern. However, there has not been effective and reliable systems that are capable of making faeces harmless and acceptable to the people.

In the Tamale metropolis, as in many parts of the world, water used in flushing toilets is of drinking quality but Tamale is one of the areas in Ghana where water is scarce. The mixture of faeces, urine and water makes the treatment of human excreta very difficult. It is therefore imperative to encourage the adoption and promotion of a dry sanitation facility like the EcoSan to curb the use of quality water on latrines. The aim of this study was to assess the acceptability and promotion of Ecological sanitation concept in the Tamale Metropolis.



A cross-sectional survey of adults proportionately sampled was used in the study. Data were collected using a semi-structured questionnaire in a face-to-face interview of respondents. Data were processed and analysed using the SPSS version 20.

6.2 Key findings

The level of acceptability of ecosan was estimated at 71 %. However, the results indicate that, the majority of participants lack knowledge specifically with regards to EcoSan (76.5%).

The only socio-demographic characteristics that influenced the acceptability and adoption of EcoSan was religion, where Christianity positively influenced the acceptability of the new technology. Cultural beliefs, such as female and male faeces not to be mixed discouraged the acceptability of the new sanitation system, which like any toilet facility allows mixing of faecal matter from both gender. The anticipated high cost of EcoSan compared to existing facilities was identified as a challenge to the acceptability of the new technology.

Using public toilets and defaecating in the bush, as a mark of the absence of one's toilet facility strongly encouraged the acceptance and possible adoption of the Ecosan.

6.3 Conclusion

The following conclusions were drawn from the study:

There is a high level of acceptability of EcoSan (71.2%). Religion was the only socio-demographic characteristics that showed significant influence on the acceptability and adoption of Ecosan (chi-square results, $p= 0.007$). However, misconceptions about the functioning of the EcoSan challenged its acceptability. It

was also found that defaecating in the field was still accepted by majority of respondents (83.8%), a practice that would not promote the use of EcoSan.

6. 4 Recommendations

The following are recommended for adoption in order to promote EcoSan in the study area and elsewhere:

1. The Ministry of Local Government and Rural Development (MLG& RD) and other stakeholders such as NGO's who are interested in sanitation should intensify education on EcoSan.
2. Ministry of Local Government and Rural Development (MLG& RD) and other stakeholders such as NGO's in EcoSan promotional strategies should target those without any toilet facility in their residences.
3. Civil Society Organisations and NGO's into EcoSan promotional strategies should take into account and exploit religion, a socio demographic characteristic of the target population for it to be effective.
4. The dictates of the Islamic religion which could serve as challenge to adoption of EcoSan should be taken note of by organisations interested in the promotion and designs of EcoSan done to address those concerns.
5. The use of faeces from EcoSan for agricultural purposes should be emphasized by Ministry of Food and Agriculture as a benefit among rural agricultural residents and for the urban population benefit such as environmental cleanliness, limited use of water and other nuisance control should be highlighted.



6.5 Recommendation for further research

It was suggested that more studies should be carried out on the motivation for open defaecation



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APPENDIX

UNIVERSITY FOR DEVELOPMENT STUDIES

Graduate School

Department of Community Health and Family Medicine

QUESTIONNAIRE

TOPIC: Assessing the acceptability of a new sanitation concept among adults in the Tamale Metropolis.

Introduction: This exercise is seeking information in order to assess the acceptability of Ecological Sanitation (EcoSan) in the Tamale Metropolis.

It is purely academic exercise and not meant for any political reasons. You are assured of full confidentiality in whatever information you provide.

By: ATIBOLI SAMUEL

Date:

Part 1. Socio Demographic Information

1. Sex: Male ()

Female ()

2. Age.....

3. Religion:

a. Christianity

b. Islam

c. Tradition

4. Educational level:

Primary ()

JSS/JHS ()

SSS/SHS ()

Tertiary ()

Vocational ()

None ()

Other, specify



5. Locality (Urban/Rural)

6. What type of toilet do you have at home?

- a. KVIP
- B. Traditional pit latrine
- c. Water closet
- d. None
- e. Other specify

Part II. Awareness of EcoSan concept.

7. Do you know of any toilet facility that renders excreta harmless?

Yes ()

No ()

8. If yes to question (7) what makes the toilet function the way it functions.

- (a) By the use of electricity
- (b) By the way of energy from the sun
- (c) By action of micro-organism
- (d) Others Specify.....

9. Is there anything wrong with defaecating at a free range?

Yes ()

No ()

10. Is anybody in this community using any toilet that renders faeces harmless which can be used as manure?

Yes ()

No ()



11. If yes to question (10) what name is given to the toilet?

Specify.....

Part III. Acceptance level of the people regarding EcoSan concept

12. A toilet that converts faeces to something you can dispose around your house with any danger and the current type of toilet known to you, which of them do you prefer?

A. The current toilet known to me ()

B. The one that converts faeces to something that can be dispose around house ()

13. If a toilet renders faeces harmless and useful as manure how would you use the manure?

A. Manure my land

B. Sell it

C. Will not use it at all

14. If you have money to build a new latrine, would you be prepared to rather build a toilet that makes faeces harmless and useful for agric purposes?

Yes ()

No ()

15. If yes to question (14) why?

A. Because I would spend less buying fertilizer

B. Because the faeces would not be left to contaminate the environment

C. Because disease would no longer be contracted from the faeces

Other, specify



16. If no, to question (14) why?

- A. I have no use for harmless faeces for agric purpose since I am not a farmer
- B. It may cost more than the one I am used to
- C. Other,
Specify

17. Would you be prepared to share a toilet with your neighbour in order to produce harmless faeces?

Yes ()

No ()

Part 4. Possible challenges to the adoption of EcoSan concept

18. Do you believe human faeces can be used to fertilize land?

Yes ()

No ()

19. Do you have any culture that is against the disposal of human faeces at a fixed location?

Yes ()

No ()

20. If yes to question (19) explain.

21. Do you believe that men and women faeces should not be mixed?

Yes ()

No ()

22. If yes to question (21) above, why?



23. Would you be prepared to use a toilet where water and urine should not be allowed into the toilet?

Yes ()

No ()

24. If no why?.....

25. Would you be prepared to use a toilet and wash yourself outside the toilet rather than the toilet?

Yes ()

No ()

26. If no to question (25) why?.....

27. Would you prefer to have a toilet in your house?

In ()

Outside ()

28. If outside why?

Part 5. Attitudes and practices of communities within Tamale Metropolis that is conducive for the adaptation of ECOSAN?

29. Within this community where do people who do not have toilet in the house defecate?

- A. Bush around
- B. Dig and bury
- C. Uncompleted buildings
- D. Public toilets
- E. Into drains
- F. Other, specify

30. Why do some residents in this community defaecate in their fields?

- A. To fertilize the land
- B. To prevent the place from being bushy
- C. For maggots to grow for fowls
- D. For pigs to feed on
- E. Other, specify

31. Is there anything wrong with eating crops grown on a piece of land fertilized by human faeces?

Yes ()

No ()

32. If yes to question (31) above which of the following is your concern?

- A. Eating such crops is indirectly eating the faeces
- B. It is not safe since some crops are not cooked before eating
- C. Before, specify

33. If no to question (30) above, would you be prepared to use faeces to fertilize your land?

Yes ()

No ()

34. Given the choice to use artificial fertilize or manure from human faeces, which one would you choose?

- A. Artificial fertilizer
- B. Manure from humans faeces

35. Would you encourage people to defaecate on your field as a way of fertilizing it?

Yes ()

No ()



36. If yes to (34) above, how do you see depositing the faeces in a toilet which you can later remove to fertilize the land?

- A. I see it is good
- b. I don t see any difference
- c. I don t see it good
- d. Other, specify

37. Is there any negative consequence of open defaecation?

Yes ()

No ()

38. If yes to question 36 above give examples.

.....

Thank you for your co-operation.

