SANITATION, WATER AND HYGIENE IN ETHEKWINI MUNICIPALITY, DURBAN, SOUTH AFRICA: A BASELINE CROSS-SECTIONAL STUDY.

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ABSTRACT

Introduction: Inadequate water supply and sanitation adversely affects the health and socio-economic development of communities. Since 2003, more than 40 000 households in peri-urban and rural areas within eThekwini Municipality, South Africa, have been provided with urine diversion toilets, safe water and hygiene education. eThekwini Municipality have requested that these interventions be evaluated to monitor their effect on health outcomes.

Aim: The aim of the study is to describe the baseline situation in respect of sanitation, safe water and hygiene behaviour in Intervention Areas in eThekwini Municipality and compare these to Control Areas.

Methods: An observational analytic cross sectional study design was undertaken. A multi-stage sampling procedure was followed and six study areas were randomly selected. Three Intervention Areas (urine diversion toilets) were matched with three Control Areas (no urine diversion toilets). A total of 1337 households, comprising of 7219 individuals, were included in the study. A Household Questionnaire [a] and an Observational Protocol [b] was administered by fieldworkers. Data was entered onto a custom designed EpiData database, processed and analysed using SPSS version 13.

Results: The baseline characteristics revealed that Intervention and Control areas were very similar other than the provision of urine diversion toilets, safe water and hygiene education in the Intervention area. The Intervention area scored higher than the Control area (2.31 vs. 1.64) with regard to having a cleaner toilet, with no flies, no smells, having hand-washing facilities and soap provided close to the toilet. Some of the collected data from questionnaire responses were not consistent with the fieldworkers observations. It was reported that 642 households in the Control and 621 in the Intervention areas washed their hands with soap, whilst only 396 households in the Control and 309 in the Intervention areas were observed to have washed their hands with soap.

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[a] A Household Questionnaire representing 88 data fields, which includes demographics, socio-economic variables, types of sanitation facilities provided, source of water and hygiene behaviours.

[b] An Observational Protocol containing 30 items on a checklist relating to hand washing facilities, the use of soap, UD toilet or other observed sanitation facility, its appearance, cleanliness, usage, smell, the presence of flies and if other types of sanitation facilities were in use.

Conclusion: Households in the Control area are at a greater risk of developing diarrhoeal and other related diseases. The provision of safe water, urine diversion toilets and hygiene education in the Intervention area has proved to be successful.

Recommendations: eThekwini municipality must expand the package of services [c] to the Control areas. Sustainable hygiene education programmes must continue to be implemented and be evaluated over time.

Plate 1: Inside view of the UD Toilet

Plate 2: Ground tank providing 200 litres free water

Plate 3: Hygiene education material

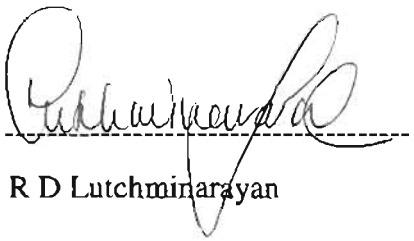
Plate 4: External rear view of the UD toilet

[c] Package of services to include safe water, appropriate sanitation technology and hygiene education.

DECLARATION

This Master of Public Health dissertation is my own work and all primary and secondary sources have been appropriately acknowledged. The dissertation has not been submitted to any other institution as part of an academic qualification.

This dissertation is prepared in partial fulfilment of the requirement of the Master of Public Health degree at the School of Family and Public Health Medicine, Nelson R Mandela School of Medicine, University of KwaZulu-Natal, Durban, South Africa.

Signature: 

R D Lutchminarayan

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PUBLICATIONS OR PRESENTATIONS

1. Presentation of Research Proposal to MPH Research Co-ordinator and selected Reference Group at the School of Family & Public Health Medicine, Nelson R Mandela School of Medicine. University of KwaZulu-Natal on 1 April 2005.
2. Presentation of Research Framework at the National Conference of the South African Institute of Environmental Health, International Convention Centre, Durban, South Africa on 7 February 2006.
3. Presentation of Preliminary Results to World Health Organisation and eThekwini Municipality at eThekwini Water and Sanitation Department, Durban, South Africa on 29 August 2006.
4. Poster Presentation at the AstraZeneca College of Health Sciences Research Symposium, College of Health Sciences, Nelson R Mandela School of Medicine, University of KwaZulu-Natal on 12 – 13 September 2006.
5. Preliminary results of the health outcomes of this study were included in a presentation during the Launch of the new WHO guidelines, for "The Safe Use of Greywater and Excreta in Agriculture", Beijing, International Water Association World Conference, September 2006.
6. Presentation of Research findings to the Health, Safety and Social Cluster Committee Meeting, Mandela Room, City Hall, Durban on 7 February 2007.
7. Invited to present an oral paper at the World Water Week in Stockholm, 20 to 24 August 2007, "Health Outcomes of Ecological Sanitation, Water Services and Hygiene Education in eThekwini Municipality, Durban, South Africa".
8. Invited to present an oral paper at the International Conference on Sustainable Sanitation, in China, 26 to 31 August 2007, "Health Outcomes of Ecological Sanitation, Water Services and Hygiene Education in eThekwini Municipality, Durban, South Africa".

ACRONYMS AND ABBREVIATIONS

C_1N	Control Area 1, Ogunjini, North Sub-District
C_2S	Control Area 2, Adams Mission, South Sub-District
C_3W	Control Area 3, Bux Farm, West Sub-District
DALY	Disability Adjusted Life Years
EcoSan	Ecological Sanitation
EWS	eThekwini Water and Sanitation Unit
GPS	Geographic Positioning System
I_1N	Intervention Area 1, Mzinyathi, North Sub-District
I_2S	Intervention Area 2, Sawpits, South Sub-District
I_3W	Intervention Area 3, Mtamuntengayo, West Sub-District
MDG	Millennium Development Goals
UD	Urine Diversion
UN	United Nations
UNICEF	United Nations Children's Fund
WHO	World Health Organisation

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1 CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

1.1.1 Water & Sanitation: The Global Context

In 2002, an estimated 2.6 billion people lacked access to improved sanitation, [d] representing 42% of the world's population. [1] A further 1.1 billion people lacked access to improved water sources, [e] representing 17% of the global population.[1] Diarrhoea causes 2 million deaths per year, affecting the most vulnerable members [f] of the world community. [2] Inadequate and unsafe water supplies and poor sanitation adversely affect the health and socio-economic development of communities. Unsafe water and inadequate sanitation are closely related to poor socio-economic development. [3] Water, sanitation, and hygiene interventions have been shown to improve health by reducing the burden of diarrhoeal and parasitic diseases, as well as hygiene related skin and eye infections. [1]

Improvement of health is the strongest and most frequent argument in support of interventions to improve both water supply and household sanitation. [4] The lack of sanitation facilities has negative consequences especially for women and children. Girls commonly avoid going to school when they do not have access to sanitation facilities. Women and girls wait until dark to defecate, exposing themselves to harassment and sexual assault.

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[d] Definition for improved sanitation is: connection to sewer or septic tank, pour flush, simple pit, ventilated pit- source: Joint Monitoring Programme for water supply & sanitation by WHO & UNICEF.

[e] Improved water source means household connection, public standpipe, borehole, protected spring or well, rainwater collection.

[f] Vulnerable member one without adequate protection –open to physical/emotional harm; extremely susceptible-easily persuaded/liable to give in to temptation; physically/ psychologically weak-unable to resist illness or debility.

Water related diseases and reproductive disorders accelerate when associated with the lack of water. [5] Sanitation, safe water and hygiene education are vital for the improvement of health, poverty alleviation and protection of the environment.

During the World Summit on Sustainable Development, held in Johannesburg in 2002, world leaders made a commitment to halve by 2015 the proportion of people without sustainable access to safe drinking water and sustainable sanitation. [6] In order to meet the sanitation Millennium Development Goals (MDGs), an additional 370 000 people per day up to 2015 need to gain access to improved sanitation and 260 000 people per day up to 2015 should gain access to improved water sources. [1] Between the period 2002 and 2015, the world's population is also expected to increase every year by 74, 8 million people. [1] This therefore poses additional challenges in trying to meet the MDGs.

To further emphasize the global importance surrounding the sanitation crises, 2008 has been declared the International Year of Sanitation (IYS). [7] The United Nations have also declared the period 2005 to 2015 as "Water for Life ", emphasizing the International Decade for Action and focusing the world agenda more directly on water related issues. [1]

1.1.2 The South African Perspective on the Water and Sanitation Crises

Access to safe water, provision of adequate sanitation and hygiene education are currently a high priority for the South African Government. The sanitation and water targets are set to clear the national sanitation backlog, provide adequate sanitation for all by 2010 and to provide safe water to every citizen by the year 2007.[8] Conventional approaches [g] have failed to reduce the sanitation backlog; consequently new approaches are needed to accelerate sanitation service delivery.

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[g] *Historically, provision of water supply & sanitation was driven by engineering solutions. This conventional approach often failed to address needs & priorities of users, leading to poorly designed or inadequately maintained systems.*

In South Africa, one fifth of the population do not have access to an adequate and clean supply of potable water and are unable to practice basic hygiene, such as washing their hands with soap and water; furthermore, half of the population lack basic sanitation, which causes individual suffering and a severe burden on the health system. [9] The elderly, the young and other individuals with underlying diseases such as HIV/AIDS or tuberculosis, are at a higher risk than the general population. It is estimated that there are 24 million incidences of diarrhoea per year in South Africa.[10] Well-planned water and sanitation interventions may be effective policies in reducing the burden of diarrhoea and other water-related diseases.

In keeping with National and International goals and targets, the South African Government together with their water and sanitation agencies are undertaking a vigorous campaign to provide water and sanitation for all. However, the actual outcomes on health have been poorly documented.

1.1.3 The Local Response to the Water and Sanitation Crises

The eThekwini Municipality, [h] situated in the province of KwaZulu Natal[i], South Africa, has implemented a Water and Sanitation programme[j] in its rural and peri-urban communities, in keeping with South Africa's National Water and Sanitation Policy. [11] This policy concentrates on the most pressing of issues, namely the safe disposal of human waste through the provision of adequate sanitation, safe water and the advocacy of appropriate health and hygiene practices. The major aim of the policy is to improve the health, and hence, the quality of life of the broader population of eThekwini Municipality.

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[h] A Metropolitan Municipality, situated on the eastern seaboard of South Africa in KwaZulu-Natal, is 2297 km^2 in size, with a population of 3 million which is 68% Black Africans, 20% Indian, 9% Whites and 3% "coloured", and comprises of urban, peri-urban and rural areas.

[i] KwaZulu-Natal lies on the north east coast of South Africa, with an area of 91 481km^2 having a population of 10.2 million people.

[j] The programme entails the provision of water & sanitation services under a single programme (200 litres free water supply to every household together with a sustainable, affordable sanitation option.

Sanitation systems should protect the environment and not harm it. Water is also a very scarce resource which should be protected and carefully used. Where there are poorly designed or no sanitation systems whatsoever, there are many threats of environmental pollution and serious health problems. Sanitation systems must be designed and constructed so as to minimise potential pollution throughout its life cycle.

In August 2001 a major cholera outbreak occurred in South Africa, with more than 260 deaths from the 100 000 cholera cases that were reported. KwaZulu-Natal was the province most affected. Durban had reported 2435 cases of cholera and 28 deaths, having a case fatality ratio of 1, 15. This cholera outbreak in Durban affected households in one of our study areas, namely Imzinyathi. Hence the roll out of the pilot project by EWS, which included the provision of safe water in ground tanks, a UD toilet and hygiene education programmes was implemented in Imzinyathi (an intervention area included in our study).[12] In 2003, there was another cholera outbreak affecting KwaZulu-Natal and the Eastern Cape, with 2362 cases of cholera being reported to the World Health Organisation (WHO). [13]

In responding to these above-mentioned outbreaks and in keeping with the national and international water and sanitation goals and target, the eThekwini Municipality realised the urgency of providing water and sanitation services to households in the rural/peri-urban areas not currently served by waterborne sewerage.

Based on research conducted globally, international and national experience, as well as a focus on success stories of dry sanitation technologies implemented locally, the eThekwini Municipality, through a consultative process, has decided to provide sanitation in the form of environmentally friendly, urine diversion (UD) [k] toilets, in some of the rural and peri-urban communities that are located outside the areas

[k] Urine diversion or "dry toilets" are an above ground structure with two components. Urine and faeces are separated at source with urine being diverted though a pipe to a urine soak-away pit built below the ground. The other component consists of an above ground faecal receptacle or vault where dry faeces dehydrate, desiccate and slowly decompose. A unique feature of the eThekwini model of UD toilet is that the faeces vault is divided into two so that once one is full the second can be used whilst the contents of the first vault is desiccating and decomposing for at least one year.

serviced by the waterborne sewerage reticulation system. These toilets are affordable as well as sustainable. The operation and maintenance of the UD toilet prevents smell and fly nuisances from arising. A free bulk supply of 200 litres of water per day has also been provided to each household within the municipality together with appropriate health and hygiene education programmes.

As of August 2007, eThekwini Municipality has provided 56 377 households with safe water in ground tanks, urine diversion toilets and hygiene education programmes and still had a backlog of 53 000 households. The first UD toilets were installed in eThekwini in 2003. The eThekwini Water and Sanitation Unit (EWS) plans to raise this figure to 47,500 by the end of 2007. EWS is currently installing approximately 1000 UD toilets per month.[l]

Ecological sanitation (EcoSan) is not well known in South Africa, although it might have been undertaken elsewhere without using this terminology. It is loosely defined by Morgan[m] as a system that makes use of human waste by turning it into something useful and valuable with minimum pollution of the environment. [14] eThekwini Municipality, in consultation with the respective role-players, has therefore selected ecological sanitation in the form of urine diversion (UD) toilets as the most appropriate sanitation system to be employed in rural/peri urban areas of the city where no access to water-borne sewerage systems exists. However, the wastes from these UD toilets within eThekwini are envisaged not be reused as fertilisers, as in other parts of the world.

1.1.4 Lack of Knowledge related to Sanitation & Health

The assumption is that this investment in water and sanitation will lead to improved health. The World Health Organisation has estimated that the improved public health

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[l] eThekwini Water and Sanitation Unit has spent R6000 per installation per household. Each installation involves the provision of a UD toilet, a ground water tank and health education at each household. 42 083 households throughout eThekwini Municipal Area have received this package of service. This translates into over R2, 5 million of costs incurred.

[m] Peter Morgan is a proponent of the VIP and arbaloo toilets. He has been working in the water and sanitation sector for 25 years, He is well known for his work in the field of ecological sanitation technlogies in Zimbabwe & other developing countries. He has been involved in the Blair Institute.

effect from such improved water and sanitation is more than six fold per unit spent. Source-separating sanitation is a recent health and management approach that requires documentation in relation to health gains. The eThekwini Municipality [n] has requested that the design, delivery and operation of the system be evaluated to monitor health outcomes. If the relevant outcomes are measured for this large intervention programme, the necessary operational procedures can be reassessed, justified and adjusted. This is in line with the White Paper on Basic Household Sanitation, September 2001.[15]

The Management approach taken by the Municipality involves the safe containment and storage of faecal material in a vault for a period of at least one year. It is completely separated from the urine, as the urine flows through a pipe into a soak-away pit. Both the technical system and the handling practices may be affected by both the socio-cultural habits and behaviours of individuals and the community. The impact of such factors is less well known and needs to be assessed and accounted for.

Additionally, if safely treated for an appropriate period, the desiccated faeces may be used as an excellent fertiliser for local farming or home gardens. One person's excreta for the year can fertilise the production of 100 to 200 kg of maize. However this practice requires stringent safety measures and is currently not advocated in eThekwini.

The aim of this baseline study is to describe and compare the different types of water and sanitation technologies used by households in the peri-urban or rural areas. Thereafter, the impact on health of this Ecological Sanitation Project implemented by the eThekwini Water and Sanitation Unit in eThekwini will be evaluated. The assessment may also serve as input for future management decisions on the safe reuse of excreta. The effect of this will be superimposed on the additional and parallel activities within the Water and Sanitation study, including health education activities and management strategies linked to environmental health improvements in the metropolitan area.

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[n] *The eThekwini Water and Sanitation Unit is the water and sanitation service provider who wanted a health study to be conducted to ascertain if their monetary investment in unrolling this package of services was resulting in health benefits to the community.*

1.1.5 What is the importance of this study?

This study describes and compares different types of sanitation, water and health hygiene interventions within the peri-urban areas of eThekwini Municipality. It also provides a baseline situational analysis suitable in the evaluation of a risk management approach based on the gathered information of the following factors: sanitation interventions, water availability, demographic and socio-economic indicators as well as behavioural factors and hygienic determinants. In addition it forms the basis for a prospective cohort study of the incidence of water and sanitation-related diseases. The study will serve as a practical management input in the local context and as a comparative example in the National and International context.

1.2 AIM OF THE RESEARCH

The aim of the study is to describe and compare the baseline situation within and between the Control and Intervention Areas, with regard to its socio-economic and demographic characteristics, the different types of sanitation provided, access to water sources, hygiene awareness and behaviour patterns of householders. This study will form the basis for a future prospective cohort study comparing the health outcomes of diseases in the Control and Intervention Areas of the EcoSan Health Study. It will further be used to inform decision making processes in relation to the choice of sanitation technologies to be made by the service providers within eThekwini Municipality.

1.3 SPECIFIC OBJECTIVES OF THE RESEARCH

1. To describe and compare demographic and socio-economic indicators; types of sanitation provided; availability of water and hygiene behaviour and other related determinants within each of the Intervention and Control Areas in the North, South and West Sub-Districts within eThekwini Municipality which will provide a baseline for future health impact studies.
2. To measure associations between different exposure variables such as education, socio-economic status and levels of sanitation and hygiene.

3. To correlate respondents reported level of sanitation, hygiene behaviour, and socio-economic determinants with structured observations by fieldworkers.

1.4 ASSUMPTIONS UNDERLYING THE STUDY

1. The Control Areas not exposed to urine diversion toilets had a variety of different types of sanitation interventions, unsafe water and levels of hygiene education awareness programmes implemented.
2. The Intervention Area will only have urine diversion toilets and no other type of toilet will be in use.
3. All households in the Intervention Area would have received hygiene education programmes.
4. The most senior female member of the household, over the age of eighteen years, will be the key respondent to answer the questionnaires administered.

1.5 OPERATIONAL DEFINITIONS USED

1. **Poverty Index**: Poverty estimates are calculated using a poverty line that varies according to household size. The poverty line used was based on the "Bureau of Market Research Minimum Living Level." The poverty index was determined by division of the total income of the household by the relevant family size of that household.
2. **Unemployment:** The potentially productive age group (15 to 65 years) from the sample size neither employed nor receiving any form of income was reported as being unemployed.
3. **Vulnerability Index:** The vulnerability index denotes the vulnerable part of the population (4 years and younger; 60 years and older) in comparison with the non-vulnerable part of the population (between 5 and 59 years).
4. **Age Dependency Ratio:** The age dependency ratio describes the relationship of the dependent part of the population (less than 15 years and over 65 years) to the potentially productive part of the population (between 15 and 65 years).
5. **Urine Diversion Toilet:** Urine Diversion or "dry toilets" are an above ground structure with two components. Urine and faeces are separated at source with urine being diverted though a pipe into a urine soak-away pit, constructed below

the ground. The other component consists of an above ground faecal receptacle or vault where dry faeces dehydrate, desiccate and slowly decompose. A unique feature of the eThekwini model of UD toilet is that the faeces vault is divided into two separate vaults. The toilet pedestal is placed over one vault. When the vault is full, the pedestal is placed over the second vault, whilst the faeces in the filled vault is left for approximately a year to desiccate and decompose. It usually takes at least one year for the vault to fill. When the second vault in use fills up, the desiccated matter from the first vault is removed manually by the householder and the toilet pedestal is replaced over the emptied vault yet again. This procedure is repeated either annually or each time the vault fills up.

1.6 SCOPE OF THE STUDY

1. The scope of this study was to assess the effectiveness of implementing an integrated package of services. This encompasses the following: the installation of a urine diversion toilet, 200 litres of safe water stored in ground tanks and a hygiene awareness programme at randomly selected households in peri-urban areas within the eThekwini Municipality in relation to outcomes of disease.
2. The scope of the study was to further describe and compare the types of sanitation, provision of safe water and the hygiene awareness status of households participating in the study, in the Intervention and Control Areas.
3. Finally, the scope of the study was to present the findings of what was reported on by the key respondent in each household in relation to what has been observed by the fieldworker.

1.7 ORGANISATION OF THE REPORT

Chapter one introduces the study and gives a brief background into the global, national and local scenarios relating to water and sanitation. This chapter further delineates the aims, objectives, assumptions and scope of the study.

Chapter two investigates and assesses relevant literature by further indicating the following: firstly water and sanitation targets, secondly the consequences of poor sanitation and thirdly the lack of safe water. Furthermore, it reviews the

implementation of sustainable sanitation technologies thereby aiming to reduce the burden of disease on the eThekwini Municipality.

Chapter three states the type of research undertaken, describes both the study design and the study population. This chapter clearly sets out the sampling framework and tools used to select the areas and the household members; it describes the measuring instruments employed, deals with the recruitment and training of fieldworkers, describes the data management procedures and finally covers the issues of ethical clearance and consent of participants.

Chapter four is a compilation of the results in terms of the objectives of this study.

Chapter five deals with discussion of results and looks at the results of various other studies conducted.

Chapter six contains the conclusions and recommendations of this study

References and appendices follow after Chapter six.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCING THE PROBLEM

Despite all the progress reported worldwide in recent decades, there are more than 2.4 billion people who still live without access to sanitation facilities and are consequently unable to practice such basic hygiene as washing their hands with soap and water.[2] There are an estimated 12 million people without access to an adequate water supply and about 21 million people without safe sanitation in South Africa.[16] Water and sanitation is one of the primary drivers of public health. Once access to clean water and adequate sanitation facilities for all people is secured, a huge battle against all kinds of diseases will be achieved.[1]

2.2 THE BURDEN OF DISEASE

Poor sanitation, inadequate personal and domestic hygiene and unsafe water supply account for 5.7% of the total disease burden or 84 million life years lost per year expressed as DALYs (Disability Adjusted Life Years). [17]

1.8 million people die every year from diarrhoeal diseases, of which 90% are children under 5 years of age.[1] An alarming 88% of these diarrhoeal diseases are attributed to unsafe water supply, inadequate sanitation and poor hygiene behaviour. An improved water supply has been found to reduce diarrhoea morbidity by 6% to 25%.[1] Furthermore, improved sanitation was found to reduce diarrhoea morbidity by 32% and hygiene interventions including hygiene education and promotion of hand washing have lead to a reduction of diarrhoeal cases by up to 45%.[1]

In developing countries, inadequate water supply and sanitation are largely responsible for the high levels of diarrhoeal diseases. An estimated 800 million cases of diarrhoea occur every year in developing countries, resulting in up to 4.5 million deaths.[18]

In South Africa the estimated incidence of diarrhoeal disease in under 5's in 2004, based on cases presenting to primary health facilities was 128.7 /1000, with wide

variations between provinces, from 8.1/1000 in Gauteng to 244.2/1000 in KwaZulu Natal.[19]

Unsafe water and lack of sanitation and hygiene is a key risk for diarrhoeal and other diseases. Worldwide unsafe water, lack of sanitation and hygiene has been estimated to account for 3.1% of all deaths and 3.7% of DALYs.[20]

The total burden of disease due to unsafe water, lack of sanitation and hygiene in 2000 was 418 790 DALYs, 92.2% of which was caused by diarrhoeal diseases, 5.3% and 2.5% by schistosomiasis and intestinal parasites respectively.[21]

Sanitation systems are one of the key defences in breaking the faecal-oral transmission route of many diseases. The capacity to ensure no human contact with faeces occurs or the reduction of pathogens to safe levels is an essential pre-requisite.[22] Infections due to transmission via the faecal-oral route are of significance in the context of water and sanitation due to the different routes of transmission for pathogens that are spread via the faecal-oral pathways. An example is enteric pathogens which may cause infection after ingestion because of excreta contaminated fingers, food and fluids.[23] To prevent pathogens from infecting new hosts and thus reducing the risk of new infections, excreta must be isolated and decomposed. Hence, improvements in sanitation to isolate and decompose excreta in exposed areas may lower the number of diarrhoeal diseases by at least 32%. [1]

Diarrhoeal diseases are amongst the top three killers in the world today. A systematic review relating hand-washing to the risk of diarrhoeal infections, conducted by Curtis and Cairncross gave the average estimate of 1.07 million lives that could be saved through the universal adoption of hand-washing with soap. The study showed the risk estimate of not washing hands with soap was 1.74 (95% CI 1.39 to 2.18), giving an equivalent reduction in risk of 43% if hands were washed with soap after defaecation.[24]

According to Pegram, Rollins and Espey, who have conducted a review of the cost of diarrhoea in Kwa-Zulu Natal and South Africa: [25]

- It is estimated that there are approximately 24 million incidences of diarrhoea per year in South Africa.
- 2.8 million patients require treatment at health care facilities; on average, one in every 14 South Africans requires formal treatment for diarrhoea every year.
- A substantial number of South Africans, about 43 000, die every year from diarrhoeal disease.
- The annual public and private direct health care costs incurred due to diarrhoea are at least R3.0 billion.
- The total social cost of diarrhoeal disease is at least 1% of the Gross Domestic Product in South Africa (R3.4 billion).

These alarming numbers have profound consequences for individuals, families and South African society, in terms of social disruption, lost economic opportunities and health costs. The most defenceless and economically marginalised segments of society are usually the most susceptible and therefore suffer the greatest.

2.3 SUSTAINABLE SANITATION SOLUTIONS

Conventional forms of centralized and individual sanitation systems have proved not to offer sustainable solutions in confronting the massive sanitation problems in the country. Despite the intensive efforts and timeframes set by Government to provide water and sanitation services, many areas still do not have an adequate supply of water and sanitation services. Costs are extremely high for service providers in the provision, operation and maintenance of such services and for users who must pay for receiving these essential services.

Since a majority of people living in very isolated rural areas are not connected to a centralized wastewater treatment plant or the waterborne sewerage system, alternative sustainable sanitation approaches need to be implemented.

Sustainable Development as defined in the Report of the World Commission on Environment and Development (WCED) is 'development that meets the needs of the present generation without compromising the ability of future generations to meet

their own needs'.[26] From both a sustainability and public health perspective, increasing access to adequate sanitation, safe water and promoting the adoption by individuals and communities of key hygienic behaviours and practices, are first priorities.

Sanitation for the household means much more than the building of toilets. The most important requirement for safe sanitation is hygienic disposal of human excreta. Also crucial are the mental and behavioural outlook of the hygiene and other health practices of individuals and communities.

Sanitation improvement is a bigger process aimed at the individual, the home and the community, which must include health and hygiene education, as well as sustainable improved toilet facilities, safe water supply and methods in the removal of dirty water and household refuse. [12]

Water supply and sanitation are unavoidably linked to the broader development process. The effects of the sanitation problem are threefold, impacting on health, the economy and the environment.

The impact of inadequate sanitation on the health of the poor is significant in terms of their quality of life, education and development potential. Poor health keeps families in a cycle of poverty and loss of income and hence has an economic impact. The environmental effects caused by inadequate sanitation lead to pollution of water sources, an increase in the cost of downstream water treatment and a further risk to communities who use untreated water, from contracting of diseases. [11]

Choosing the most suitable and sustainable sanitation system is not a simple decision to be made. Many different types of sanitation systems exist, which include the following: [27]

- **Traditional unimproved pits:** These pits do not provide a barrier against flies and odours and usually the quality of construction is poor. This type of toilet facility often results in environmental pollution and poor health outcomes.

- **The bucket toilet system:** This is not regarded as an adequate sanitation system and is generally regarded as socially and environmentally unacceptable. The collection, transportation and disposal of excreta by this method are usually uncontrolled and unhygienic, posing health risks to the collector and the community.
- **The portable chemical toilet:** This is not encouraged except in emergencies for short periods due to its high running costs.
- **Ventilated improved pit toilets:** These need both proper design and construction to function effectively. When the pit fills up it will require periodic desludging. Vehicular access for desludging is often hindered by poor accessibility to the area. Environmental pollution is often the result of seepage. The relocation of toilets is often problematic due to restricted space.
- **Septic tank:** Efficiency of this method depends on proper design and construction. Problems can occur with the environmental pollution of water sources when the tank is full and overflows. Groundwater pollution is often the result of poorly designed septic tanks. There are costs relating to periodic desludging.
- **Full water-borne sewerage system:** This system needs both a reticulation system and a treatment works. Its operation requires high water consumption and is expensive to maintain. Blockages may occur which may result in environmental pollution. High capital, operation and maintenance costs are associated with this system.
- **Urine Diversion toilets:** If used correctly, these are environmentally friendly. Such technology involves a dry toilet system that does not require water to function. Urine and faeces is separated at source. Odours and flies are controlled. It is an example of an affordable and sustainable sanitation technology. This option is available for the safe reuse of dehydrated/desiccated wastes as fertilizer. The health education in ensuring the correct use of this type of technology is essential.

Plate 5: Urine diverting toilet

Plate 6: Unimproved pit latrine

Plate 7: Water borne flush toilet

Plate 8: Pour flush toilet to septic tank

For normal functioning, a human body requires about 3 to 10 litres of water a day, depending on the climate and the workload. For flushing about 0.5 kg of faeces, one needs 9 to 20 litres of water per flush depending on the type of toilet. This means a very small fraction of faeces contaminates a huge amount of water, which will further require treatment again at the wastewater treatment works. This price is costly and calls for a change in thinking concerning excreta disposal options. [28]

The current way of thinking is to regard excreta as a resource rather than a waste and hence, the concept of ecological sanitation (EcoSan) has been introduced. Many governments and agencies in Africa are exploring the role of ecological sanitation within their environmental sanitation and hygiene improvement programmes. EcoSan represents a shift in thinking about, and acting upon human excreta. In its broadest sense, EcoSan ranges from simply planting a tree on a disused toilet pit, through to composting human excreta and re-using the products in agriculture. It is a closed loop approach, preventing pollution by recycling nutrients and organic matter, and is applicable in the North and South, in rural and urban areas, for both rich and poor alike.[29]

The technology of ecological sanitation or dry box toilet has been used for decades in developing countries inter alia Vietnam, China, Mexico, El Salvador, Guatemala, Ethiopia and Zimbabwe as well as highly developed countries like Sweden and Germany.[30]

The most important characteristic of the urine diversion type of sanitation technology is the low moisture content in the faeces receptacle. The urine is diverted at source by a specially designed pedestal and is not mixed with faeces. Ash, dry soil or sawdust is sprinkled over the faeces after defecation. This serves both to control the moisture as well as odours and flies. The dry conditions in the faeces receptacle facilitate the desiccation of its contents, which then become safe for handling. Faecal pathogens are vastly reduced or destroyed through the combined effects of lack of moisture, solar heat and time.

WHO Guidelines for the "Safe Use of Wastewater, Excreta and Greywater" describes the present state of knowledge regarding the impact of excreta and greywater use in agriculture, on the health of product consumers, workers and local communities. The guidelines maximises public health protection and the beneficial use of important resources.[31]

If eco-sanitation is more widely used, the need to build and operate expensive sewage treatment plants would diminish and the quality of waters in rivers would improve.

2.4 THE MILLENNIUM DEVELOPMENT GOALS

The United Nations General Assembly adopted the Millennium Development Goals (MDGs) on 8 September 2000.[32] These MDGs aim to achieve poverty eradication and sustainable development by rapidly increasing access to basic requirements such as clean water, energy, health care, food security and the protection of bio-diversity.[33] The United Nations Summit on Sustainable Development, held in South Africa in 2002, returned to the targets set by the MDGs with regard to water supply, and extended it to also include the provision of sanitation.[34] By including water supply, sanitation and hygiene in the MDGs, the world's communities have acknowledged the importance of their promotion as development strategies as per the set series of goals and targets.

Sub-Saharan Africa remains the area of greatest concern, where over the period 1990 to 2004, the number of people without access to safe drinking water increased by 23%, and the percentage of people without sanitation increased by 30%. [35]

The MDGs have set humankind on a common course to push back poverty, inequity, hunger and illness. The call is for all countries to set realistic goals, develop achievable plans, allocate financial and human resources needed to bring safe drinking water and basic sanitation to their populations, in a sustainable manner, while protecting the basic needs of the poor and vulnerable people.

The table below summarises the contributions that Environmental Health inputs can make in realising the MDGs.

Table 1: Contributions of Environmental Health to the UN MDGs

UN MDGs Goals and Targets	Environmental Health Inputs
Goal 1 Eradicate extreme poverty and hunger	A healthy environment means healthy people, able to secure improved livelihoods and break the cycle of poverty and ill-health
Goal 2 Achieve universal primary education	Freedom from diarrhoeal disease and other environmental health hazards will result in increased attendance and participation in school. School sanitation is an important determinant of girls' attendance.
Goal 3 Promote gender equality and empower women.	As the burden of environmental health risks falls disproportionately on women, effective interventions help to improve women's lives and empower them through increased participation.
Goal 4 Reduce child mortality	Appropriate environmental health interventions can significantly reduce the number of children under 5 who die because of unsafe water, inadequate sanitation and poor hygiene.
Goal 6 Combat HIV/AIDS, malaria and other diseases	Preventive environmental health measures are as important and at times more cost-effective than health treatments
Goal 7 Ensure environmental sustainability. Halve by 2015 the proportion of people without sustainable access to safe drinking water and sustainable sanitation. By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.	These goals are expressed in terms of environmental health improvements; environmental health measures such as provision of safe water and sanitation contributes to the MDGs.

2.5 THE LEGISLATIVE FRAMEWORK

South Africa's post apartheid Legislative Framework and Policy Directives aims at ensuring that the most basic human right of access to water and sanitation is provided to all.

South Africa's supreme law, the Constitution of the Republic of South Africa, Act 108 of 1996, recognises the injustices of the past and establishes a society based on values, social justice and fundamental human rights. Enshrined in Section 24 of the Bill of Rights, is everyone's right to an environment that is not harmful to health. Inadequate sanitation and access to unsafe water constitutes an environment that is harmful to health.

Section 3 of Chapter 1, in the National Health Act, No 61 of 2003, relates to the responsibility to ensure that the health of the population is protected, promoted, improved and maintained. Access to safe water, adequate sanitation and health and hygiene promotion is central to achieving the aims of the National Health Act.

The principles contained in the National Environmental Management Act, No 107 of 1998, addresses the issue of respecting, protecting and promoting the social, health and economic rights of people. It also requires that negative impacts on peoples' environmental and health rights be anticipated and prevented. As part of a sound integrated management plan, impacts of risks relating to the lack of safe water and adequate sanitation must be identified, predicted and evaluated, with the aim of making such basic amenities accessible to all people living within Southern Africa.

The National Water Act, No 36 of 1998, regulates the manner in which persons obtain the right to use water and provides for the just and equitable utilisation of water resources.

Sanitation, water and hygiene awareness policies must be enforced to ensure long term sustainable solutions are derived as quickly as possible.

The National Sanitation Policy for the Republic of South Africa, 2006, is aimed at improving the quality of life of the people of this country. This policy document concentrates on the most pressing of issues, namely, the safe disposal of human and

domestic wastes, provision of safe water and appropriate health and hygiene practices. Sanitation for households means more than just building toilets. It is a more widely embracing process aimed at the individual, the home and the community. It must include health and hygiene education, as well as improved toilet facilities that are sustainable and the provision of safe water.

South Africa, as a signatory to global policies and protocols, must also ensure that it meets the demands relating to the provision of sanitation and safe water. Policies such as the Millennium Development Goals, Agenda 21 and UN and UNICEF's targets are some of the protocols and policies that South Africa is signatory to.

2.6 WATER AND SANITATION PROGRAMME IMPLEMENTED BY ETHEKWINI MUNICIPALITY

The eThekwini Municipality has introduced a Water and Sanitation Programme that will deliver basic services to all households. In keeping with National Water and Sanitation Policies, the aim of this programme is to provide a socially acceptable basic level of water and an appropriate and sustainable sanitation service to disadvantaged communities living in the rural/peri-urban areas within the eThekwini Municipality. These areas do not have access to waterborne reticulated sewerage systems.

eThekwini is the first Local Government to provide a free bulk supply of 200 litres of water per day to each household. These rural and peri-urban communities lie far beyond the "water-borne sewerage line." They are provided with sanitation in the form of environmentally friendly, urine diversion toilets. These toilets are both affordable and sustainable.

A well-engineered toilet, correctly used and well maintained,[o] is an asset in the struggle to break the cycle of disease transmission and environmental degradation caused by inadequate sanitation facilities.

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[o] A well maintained UD toilet is to ensure the UD toilet is kept in good repair at all times.

A huge challenge is confronting barriers to change, which exist in all countries, societies, communities and organisations. These relate to religious taboos and the cultural foundation. Sanitation, according to Schuringa, is largely a social phenomenon rather than a technical one.[36]

The urine diversion toilet is engineered and built to handle urine and faeces separately. To handle faeces and urine separately is not a great problem, as each human produces only about 500 litres of urine and 50 kg of faeces per year. This should not constitute an insurmountable challenge. The problem arises when these two are mixed together and flushed into a pipe with water to form sewage. This means that instead of treating only 50 litres of problem material, it now becomes necessary to deal with 550 litres of polluted, dangerous and unpleasant sewage.[37]

The desiccated faecal matter makes a good soil conditioner, while the urine when diluted with water is an excellent fertiliser.[38] However, in the eThekwini District, the urine is piped into a soak away pit and the faeces is emptied and buried or bagged and disposed of. The implications of this UD system are less environmental pollution, reduced water consumption, no need for sewers or sewer treatment plants and the production of a valuable product.

The first units in eThekwini District were installed in 2003. The programme places the responsibility of monitoring the sanitation facility on householders and empowers them to manage their own systems.

Health and hygiene education is fundamental to the success of the programme and is designed to increase knowledge and improve the current and long-term health of communities. One of the main objectives of sanitation interventions is to protect and promote human health and to safeguard the environment against any possible detrimental effect.

The eThekwini Municipality have requested that the design, delivery and operation of the system be evaluated to monitor the impact of health effects, so that the design basis and operational procedures can be reassessed and adjusted. The Municipality is responsible for ensuring an environmentally safe approach to sanitation as well as for

monitoring the impact of the sanitation processes on the health of such communities[15]. This is in line with the White Paper on Basic Household Sanitation, September 2001.

The prime object of sanitation is to protect and promote human health. The entire sanitary system should be hygienically safe, posing as small a risk as possible of infection.[39]

Sanitary systems have, in addition, been developed in such a way as to protect the environment against possible detrimental effects. [40] There is a need to consider emissions from sanitary fittings to different recipients such as water, soil and air.

The prime objective of sanitation systems is to protect human health and the environment. However, sustainability in sanitation cannot be based only on these objectives, but needs to include social criteria as well, as these constitute the most crucial element regarding the sustainability and usage of services provided by the system. [11]

3 CHAPTER THREE: METHODS

3.1 INTRODUCTION

The aim of the study is to describe the type of sanitation, water supply, health and hygiene behaviour of householders in Intervention and Control Areas of the EcoSan Study in the eThekwini Municipality. The results of this baseline study will be used to evaluate health outcomes [p] of UD sanitation, water supply and sanitation health and hygiene interventions supplied by the eThekwini Water and Sanitation Unit in a prospective cohort study. The study commenced on 27 March 2006 and was concluded on 15 July 2006.

The Principal Investigator engaged the services of various role-players during the conduction of this study, to ensure that it would be well co-ordinated and effectively managed.

A Project Administrator (PA) was recruited to oversee the effective management of fieldworkers. 12 fieldworkers were split into three teams, comprising one team-leader and three fieldworkers, who were allocated to the North, South and the West Sub-Districts respectively. Each team was allocated a vehicle and all the essential equipment and tools to conduct the survey. The PA under the supervision of the Principal Investigator, dealt with all logistical arrangements and the administrative matters pertaining to vehicles, attendance registers, workload distribution, collection of completed questionnaires, fieldworker training and re-training, fieldworker supervision and team-leader meetings.

The Principal Investigator also engaged the services of a Financial Administrator to ensure that strict fiscal management of funds was adhered to in terms of all expenses incurred during the study period, and to enable salaries and sundry expenses to be paid out timeously. The services of data capturers, data base design consultants and data cleaning consultants were engaged to ensure that collected data was efficiently captured and data quality was assured.

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[p] Health outcomes to be measured include diarrhoea, vomiting, skin sores and worms.

This study is part of a larger cohort study which has been completed. The result of this baseline study, which is presented in this report, includes only data collected at the first visit. Data on the health outcomes was collected on all individuals in the 1337 households visited every two weeks, for six subsequent visits, and these results will be reported on under a separate submission.

3.2 TYPE OF RESEARCH

This is community-based epidemiological research.

3.3 STUDY DESIGN

An observational analytic cross sectional study design was used.
1337 Households comprising of 7219 individuals were included in the study.

3.4 STUDY POPULATION

The study population is all households and the people living in eThekwini Municipality who are outside of the area supplied by the water-borne sewerage system and supplied by the basic free-water supply of the eThekwini Water and Sanitation Unit.

3.5 SAMPLE

3.5.1 Determining the sample size

GIS Map Grids that were used to identify households included in the study. In order to show a significant reduction in episodes of diarrhoea from an estimated 150 per 1000 person years in control areas to 50 per 1000 person years in intervention areas at 80% power and with 95% confidence limits, 1352 households (with 676 households per group per exposure level) needed to be sampled. This figure incorporates a design effect of 3.4 (0.6 ICC), factoring in a 20% loss-to-follow-up.

3.5.1.1 Assumptions used to calculate the Sample Size

No data was used to calculate the required sample size; instead the research team used a computer programme using spreadsheets to calculate the sample size based on the following assumptions:

1. Disease frequency and reduction in episodes of diarrhoea was estimated at 150 per 1000 person years in the Control area;
2. Disease frequency and reduction in episodes of diarrhoea was estimated at 50 per 1000 person years in the Intervention area;
3. A design effect of 3.4 was selected, (corresponds with the intra cluster correlation coefficient of 0.6) which required a total of 1081.2 households to be included in the study. After we factored a 20% loss to follow up, we needed 1351 households to participate in the household. We actually had 1337 households that participated in the entire study, which was still slightly more than what we needed.

The study is definitely sufficiently powered to detect the difference that we had assumed in the sample size calculations.

3.5.2 Sampling method

A multi-stage sampling procedure was followed to select the areas and homes in the Intervention and Control Areas included in this study.

3.5.2.1 Selection of areas

A map (Appendix 01), detailing the completed project areas and future project areas in the North, South and West Sub-Districts was obtained from the eThekwini Water and Sanitation Department's Rural Water and Sanitation Projects division. A completed project area (Intervention Area) was matched with a future project area (Control Area). These were randomly selected [9] from this map in the North, South and West respectively.

An Intervention Area was defined as an area where each household received the package of services of a urine diversion (UD) toilet, provision of appropriate water

[9] All the intervention areas and control areas that met the inclusion criteria where listed in a spreadsheet. The Biostatistician then through a computer generated programme randomly selected the 6 study areas. Every area had an equal chance to have been selected to be included in the study.

supply, health and hygiene education. A Control Area was defined as an area where no UD toilets were provided, and varying levels of sanitation and water services may exist but where no formal sanitation, health and hygiene education programme had been implemented.

Mzinyathi (North - I_1N), Mtamuntengayo (West- I_2W) and Sawpitts (South- I_3S) were the three Intervention Areas randomly selected in each of the Sub-Districts and Ogunjini (North- C_1N), Bux Farm (West- C_2W) and Adams Mission (South- C_3S) were the three Control Areas selected.

3.5.2.2 Selection of households in areas

Once the six study areas were selected, a sampling frame of all households within the areas selected was obtained using the eThekwini Water and Sanitation Units Geographic Information System (GIS). A total of 1352 households were randomly selected from the six areas with a probability proportional to size (PPS) of the respective populations. A cluster of five households was randomly selected from the GIS map grids (Appendix 02). The focal household [r] was identified with its allocated metro household number being randomly selected, and the four closest households surrounding this focal household were then chosen. Between forty to forty six clusters were randomly selected in each of the six areas. This gave a sample of 200 to 230 households which were selected to participate in the study in each of the six study areas.

[r] The selection of the focal household was done through the spacial layout of households and the Geograghic Information System. A framework of all households and their metro numbers were put onto a spreadsheet and the focal household was randomly selected through a computer generated programme. The research team then verified using the GIS that every focal household selected had at least 5 households within a close proximity from it. If it did not then we excluded that household from the spreadsheet and randomly re-selected a focal household.

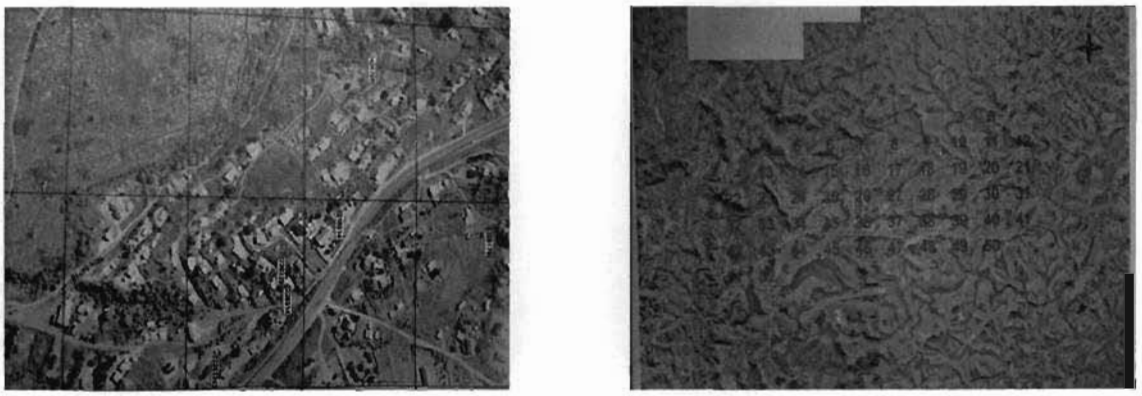

Plate 9: GIS grid maps were developed and used to identify households in the EcoSan study

3.6 MEASURING INSTRUMENTS

3.6.1 Household Questionnaire

A Household Questionnaire (Appendix 03A, B) was developed [5] to collect information about each household. Data fields included:

1. Demographics: This covered household composition, education levels, and income levels.
2. Socio-economic indicators: These included type of housing, type of fuel used for cooking, whether the household had a radio, television, telephone, cell phone, and a refrigerator and whether the household had books or its members ever read a newspaper.
3. Types of sanitation used: This included questions on whether the household had a UD toilet; whether the UD toilet was used as taught; children's usage of the UD toilet and several questions relating to the hygiene status of the UD toilet. If the

[5] The questionnaire was specifically developed for this study. It was initially tested amongst staff in the Health dept for accuracy. It was then revised. We proceeded to translate it into isiZulu. It was then translated back into English to verify its accuracy & to ensure interpretations were not altered. It was then re-tested in the health dept in both languages. We then engaged the expert assistance of Andrew Dellis who formatted and helped to code the questions so as to ensure forms are filled correctly and date capture was simplified. The questionnaire was then piloted. The questionnaires seemed to have worked well. It is very comprehensive and compares well with national and international data collection tools.

household did not possess a UD toilet, respondents were asked to specify what household sanitation system they used and what sanitation facilities children made use of.

4. Water: Sources of water available for household use, the distance travelled to collect the water, whether water containers were covered, how water was dispensed and if drinking water was not from a piped source, how it was treated.
5. Health and hygiene education: Information was collected relating to the household's knowledge and behaviour patterns in relation to hygiene and disease, washing of hands, soap usage and disposal of nappies.

In total, eighty-eight data fields were recorded for each baseline household visit.

3.6.2 Observational Protocol

An Observational Protocol, consisting of a checklist of 30 items, was developed and used by a trained fieldworker to record observations at the end of the home visit. The observations related to hand washing facilities and the use of soap, UD toilet or other observed sanitation facility and its appearance, cleanliness, usage, smell and the presence of flies. If other types of sanitation facilities were in use (or used at the same time as the UD toilet) this was also observed and recorded. The functioning of outdoor water tanks was observed as well as water storage. The presence of grey water, domestic water, animal or human faeces in the yards was reported.

3.6.3 Questionnaire Development

The Baseline Questionnaire and the Observational Protocol was developed in English, and was then translated into isiZulu. It was then retranslated into English to ensure consistency, correctness, clarity, validity and accuracy of the questions.

3.6.4 Piloting the Questionnaire

Before the actual study commenced the questionnaire was piloted by a trained fieldworker to test the accuracy of the questions asked and to assess the time taken to complete the questionnaire. Ten households were visited in Sawpits. This resulted in further refinement of the questionnaire. The questionnaire was then piloted again to

ensure clarity and understanding of questions. This data was not included in the results.

3.7 RECRUITMENT AND TRAINING OF FIELDWORKERS

Nine fieldworkers, who had prior experience of water and sanitation surveys, were recruited from the community, creating an employment opportunity for community members. Three team leaders from a professional research agency were recruited to supervise the three field-worker teams for each of the North, South and West Sub-Districts. All fieldworkers were fluent in the isiZulu language. The fieldworkers and team leaders were extensively trained (Appendix 04). During the training, the nature of the research, reason for undertaking the research and the objectives of the research study were carefully explained. Interview skills and use of data-collection tools were clearly explained and demonstrated. The fieldworkers were well supervised and adequately remunerated. A Project Administrator was employed to manage the fieldwork. [1]

[1] Rules, conditions of employment and specific instructions were explicitly discussed. Temporary employment contracts were signed. Clear lines of accountability and nature of supervision was explained. Team leaders were introduced. Field workers were organised into three teams each consisting of three fieldworkers and one team leader. Each team was allocated an Intervention and Control Area. A clear plan relating to data collection, administrative procedures, vehicle logistics, targets and other related fieldwork matters were clarified.

Plate 10: Extensive Training of all fieldworkers undertaken in the Boardroom at eThekwini Municipality.

3.8 IMPROVING RELIABILITY AND VALIDITY

Validity was improved by standardising interview and observation techniques and completion of the questionnaires and the checklist. Inter-observer bias was further reduced by:

- Intensive practical training.
- Close supervision and periodic checks on work undertaken.
- Fieldworkers and team leaders possessed similar education levels and experience in conducting surveys in water and sanitation research projects.
- The clarity and repeatability of the questionnaire as well as the proper recording of all data was ensured.

3.9 LOGISTICAL ARRANGEMENTS

3.9.1 Transport

A vehicle was allocated to each team leader working in the North, South and West Sub-Districts respectively.

3.9.2 Geographic Positioning System (GPS)

Each team had a Geographic Positioning System (GPS) to help locate the household cluster and to facilitate the same household for future identification. Geo-referenced grid map books were printed for each of the six areas to ensure sampled households were correctly identified.

Plate 11: Training of team leaders by S. Pietersen (EWS) on the use of the GPS and the map books

3.9.3 Team Leader Information Sheet

An information sheet summarising all the important rules of sub-dividing the workload clusters, pre-interview reminders, post-interview reminders, end of workday reminders and general rules were handed to all three team leaders.

3.10 DATA MANAGEMENT

3.10.1 Data Quality Assurance

The team leader, project administrator, data capturer and principal investigator checked all completed questionnaires for completeness, legibility and consistency.

3.10.2 Data Entry

A consultant was recruited to construct the EpiData Database, into which the data was entered by experienced data capturers specifically recruited and trained for this task.

3.10.3 Data Cleaning

The Principal Investigator, together with other experts, was engaged in ensuring that data was accurately captured. All outliers and inconsistent data entries were identified, verified and corrected.

3.10.4 Data Processing and Analysis

Data was transferred from the EpiData database and converted into the SPSS database. Using the SPSS output files, the descriptive data was summarised and

further processed using an EXCEL spreadsheet. It was then analysed using SPSS version 13. Pearson Chi-Square test was used, using 2 x 2 sided tables, if assumptions were not violated. If more than 20% of cells had expected counts of less than five, Fisher's Exact Test was used. If the dependent variable was quantitative with a skewed distribution, two independent group comparisons Mann Whitney Test were conducted.

Continuous data was tested for normality using the skewness statistic in SPSS. If the skewness statistic was more than twice the standard error of the skewness statistic then the variable was significantly skewed, if not then it was assumed to be approximately normally distributed and treated parametrically.

Plate 12: Training of data capturers

Plate 13: Development of the EcoSan database

3.11 ETHICAL REQUIREMENTS

3.11.1 Institutional ethical review

Ethical approval for the study was obtained from the Biomedical Research Ethics Committee of the Nelson R Mandela School of Medicine, University of KwaZulu-Natal - Ref: H095/05 (Appendix 07).

The Postgraduate Education Committee of the Nelson R Mandela School of Medicine, University of KwaZulu-Natal registered the research project for higher degree purposes (Appendix 08).

Permission to undertake the study was obtained from eThekwini Municipality, Health Department Research Committee (Appendix 09).

3.11.2 Informed consent

Written Informed Consent was obtained from the main respondent of each household (Appendices 06: A and 06: B). An information sheet was given to each household, detailing the aims, objectives and methods of the EcoSan research project.

3.11.3 Permission and community involvement

Permission was sought from councillors and community structures in each of the six areas before the study was undertaken. Several meetings were held with these key stakeholders to explain the purpose of the study (Appendices 05: A and 05: B).

4 CHAPTER FOUR: RESULTS

4.1 INTRODUCTION

The results describe and compare the demographic, socio-economic indicators, types of sanitation, availability of safe water as well as the hygiene behaviour and determinants within and between each of the Intervention and Control Areas in the North, South and West Sub-districts of eThekwini Municipality. The results from the Observational Protocol validate reported behaviour and actions of household members as compared with that observed by the fieldworkers. From the sampling frame of 1352 households, results will be presented for 1337 households only. Data on the 15 households could not be presented for the following reasons:
4 questionnaires were spoilt, 6 households had moved during the study period and could not be followed up, 2 households were demolished, 1 household dropped out of the study and refused to be followed up, and questionnaires for 2 households were missing.

4.2 DESCRIPTION OF SAMPLE

In total, 1337 households (N) were included in the study. There were 659 (49%) households from Intervention Areas and 678 (51%) from Control Areas. The proportion of homesteads from each type of area was similar (Table 2).

The 1337 households had 7219 household members with a mean occupancy of 5.4 people per household at the baseline visit. Bux Farm had a lower density per household (3.5) than the mean for the study area as a whole, and a lower density than its matched Intervention Area (Mtamuntengayo), which had 6.4 people per household (Table 2).

Table 2: Number (percentage) of Households, Household Members & Density in Intervention and Control Areas in EcoSan Study, eThekwini, 2006.

Respondent Area	Type of Area	Households No. (%)		Household Members No. (%)		Average Persons/ Household	Range of Household Size
Mzinyathi (I_1N)	UD	228	17.1	1221	16.9	5.4	1 – 14
Mtam'ngayo (I_2W)	Intervention	201	15.0	1286	17.8	6.4	1 – 14
Sawpits (I_3S)	Area	230	17.2	1446	20.0	6.3	1 – 16
Intervention Area		**659**	**49.3**	**3953**	**54.7**	**6.0**	
Ogunjini (C_1N)	Control	221	16.5	1255	17.3	5.7	1 – 14
Bux Farm (C_2W)	Area	229	17.1	807	11.3	3.5	1 – 12
Adams Mis'n(C_3S)		228	17.1	1204	16.6	5.3	1 - 16
Control Area		**678**	**50.7**	**3266**	**45.2**	**4.8**	
Total		1337	100.0	7219	100.0	5.4	1 - 16

4.3 DEMOGRAPHIC DETERMINANTS

4.3.1 Sex Ratio of Household Respondent[u] and Household Members

In the North and South Sub-districts, about two-thirds of the household respondents in the Intervention and Control Areas were female. In the West Sub-district, there were significantly more females (83%) in the Intervention Area, compared with 73% in the Control Area ($p = 0.012$).

The sex ratio [v] of the key respondents [w] that participated in the study was 0.36 in the Intervention Area and 0.40 in the Control Area, whilst the sex ratio of the household

[u] The key respondent present at the household at the time of the interview and who answered the questions.

[v] The sex ratio refers to the proportion of males to females.

[w] Gender data missing from 224 household members

members in the total study population was 0.89 in the Intervention Area and 0.80 in the Control Area (Table 3).

Table 3: Sex Ratio of Household Respondents and members in each Study Area in the EcoSan Study, eThewini, 2006.

Respondents Area	Key Respondents Male No.	Female No.	Sex Ratio	p value	Household Members Male No.	Female No.	Sex Ratio	p value
Mzinyathi I_1N	77	151	0.51	0.433	597	608	0.98	0.148
Ogunjini C_1N	67	154	0.43		580	664	0.87	
Mtamuntengayo I_2W	34	166	0.20	0.012	570	666	0.85	0.022
Bux Farm C_2W	62	166	0.37		318	459	0.69	
Sawpits I_3S	64	166	0.38	0.871	641	744	0.86	0.286
Adams Mission C_3S	65	163	0.40		507	641	0.79	
Intervention	**175**	**483**	**0.36**	**0.400**	**1808**	**2018**	**0.89**	**0.015**
Control	**194**	**483**	**0.40**		**1405**	**1764**	**0.80**	
Total	369	966	0.38		3213	3782	0.85	

4.3.2 Age Profile

4.3.2.1 Age of Household Members

The age data analysis in completed years was based on 7042[x] valid responses. This indicated a median age of 21 years (Inter Quartile Range 11 to 36 years), and a range of 0[y] to 96 years (Table 4). Control and Intervention Areas were very similar in age.

Table 4: Median Age of Household Members in the EcoSan Study

Respondent's Area	N	Median	Inter-quartile range
Mzinyathi (I_1N)	1186	22	11 - 38
Mtamuntengayo (I_2W)	1224	20	11 – 34
Sawpits (I_3S)	1428	21	12 – 35
Ogunjini (C_1N)	1217	22	12 – 38
Bux Farm (C_2W)	789	22	10 – 34
Adams Mission (C_3S)	1198	23	12 - 37
Intervention	**3838**	**21**	**11 - 36**
Control	**3204**	**22**	**11 - 37**
Total	7042	21	11 - 36

4.3.2.2 Population Pyramid

1. The age and sex distribution of the household members at baseline for the whole study sample is represented by the population pyramid (Figure 1).
2. The shape of the population pyramid in the Intervention Area shows that there were a higher proportion of males in the 15 to 45 age group than in the Control Area (Figure 2). There were also a higher proportion of females in the 15 to 35 age group in the Intervention Area than in the Control Area. There was a significant difference ($p < 0.001$) noted between the proportion of male and female in each age group between the Intervention and Control Areas.

[x] 177 household members age data was missing.

[y] Under-1 year old children were recorded as age 0, as age was recorded as the number of completed years.

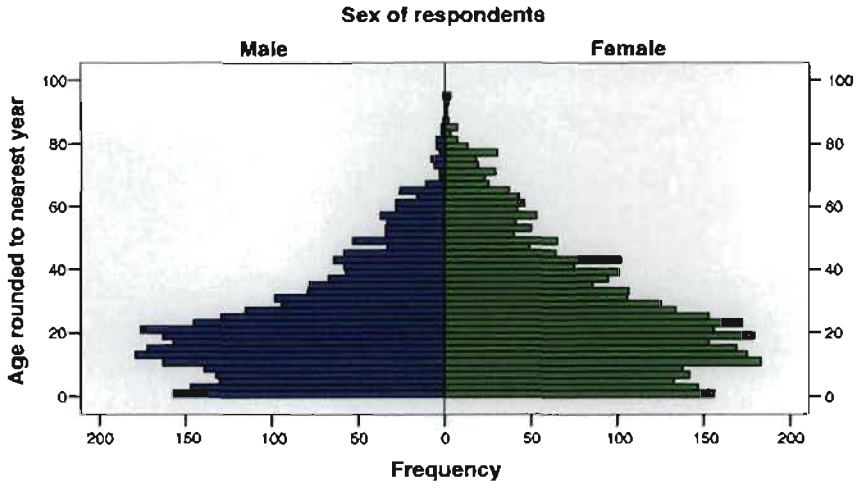

Figure 1: Population Pyramid depicting Age & Sex of Study Population in the EcoSan Study, eThekwini, 2006.

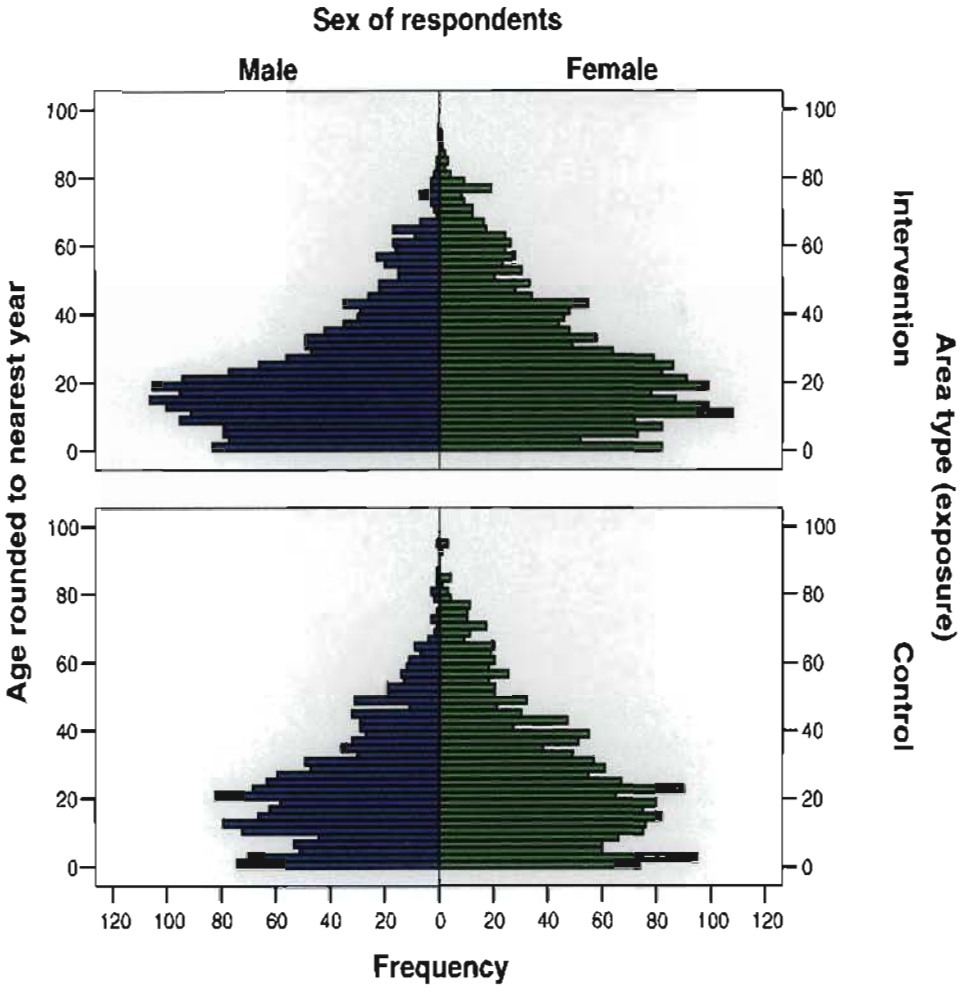

Figure 2: Population Pyramid depicting Age and Sex in the Intervention Area and Control Area in the EcoSan study population, eThekwini, 2006

4.3.2.3 Age Dependency Ratio [z]

The Age Dependency Ratio is slightly higher in Mtamuntengayo (0.67) as compared to the rest of the study areas (Table 5). The Control Area has a slightly lower age dependency ratio than the Intervention Area. Over half of the study population is dependent on the potentially productive part of the population.

Table 5: Age Dependency Ratio of Study Population, EcoSan Study, eThekwini, 2006.

Age Group	Mzin-yathi	Mtamun-tengayo	Sawpits	Ogun-jini	Bux-Farm	Adams-Mission	Inter-vention	Control	Total
< 15 or > 65	435	490	503	431	287	418	**1428**	**1136**	2564
15 - 65	751	734	925	786	502	780	**2410**	**2068**	4478
Total	1186	1224	1428	1217	789	1198	**3838**	**3204**	7042
Age Dependency Ratio	0.58	0.67	0.54	0.55	0.57	0.54	**0.59**	**0.55**	0.57

[z] The age dependency ratio describes the relationship of the dependant part of the population (less than 15 years and over 65 years) to the potentially productive part of the population (between 15 and 65 years).

4.3.2.4 Vulnerability Index

Bux Farm has the highest proportion of its population vulnerable. [aa]The Control Area has a slightly higher Vulnerability Index (0.21) compared with the Intervention Area (0.19).

Table 6: Vulnerability Index of the EcoSan Study Population in the Intervention and Control Areas, eThekwini, 2006.

Vulnerability Index (years)	Mzinyathi	Mtamun-tengayo	Sawpits	Ogunjini	Bux Farm	Adams Mission	Inter-vention	Control	Total
≤ 4 and ≥ 60	203	192	222	203	152	211	**617**	**566**	1183
5 - 59	983	1032	1206	1014	637	987	**3221**	**2638**	5859
Total	1186	1224	1428	1217	789	1198	**3838**	**3204**	7042
Vulnerability Index	0.21	0.19	0.18	0.20	0.24	0.21	**0.19**	**0.21**	0.20

4.4 EDUCATION LEVELS

The education levels [bb] have been calculated for household members who are 18 years or older.

4.4.1 Education Level Completed by Household Members

4222 individuals in the study population were 18 years of age or older. Of the 3710 individuals who answered the question about their highest education level attained, almost half (50%) had completed Secondary School. Only 1% of the individuals had completed tertiary education.

[aa] The vulnerability index describes the vulnerable part of the population (4 years and younger; 60 years and older) to the non-vulnerable part of the population (between 5 and 59 years).

[bb] Completed Primary School is defined as completed Grade 3 to Grade 6.

Completed Secondary School is having completed Grade 7 – Grade 11.

Completed High School is having completed Grade 12 to 2nd Year Tertiary Education.

Completed Tertiary is having completed 3rd and 4th Year at Tertiary Education, and,

None is defined as those having Grade 0 – Grade 2 Education.

4.4.2 Education Levels Completed per Study Area

Ogunjini in the North had the highest percentage (29%) of household members with no education. Between 15% and 18% of the household members in all six study areas had completed a primary level of education. Sawpits and Adams Mission in the South had the highest percentage of household members who had completed both a secondary and tertiary level of education. Completed primary, secondary and high school education levels were slightly higher in the Intervention Areas than in the Control Areas. Completed tertiary education was much higher in the Control Area (60%) than in the Intervention Area (40%). Over half of the households in the Intervention Area (53%) had no education compared with 47% of households in the Control Area (Table 7).

Table 7: Education Level Completed for Household Members in all areas in EcoSan Study, eThekwini, 2006.

Education Level	Mzin-yathi	Mtamun tengayo	Saw-pits	Ogun-jini	Bux Farm	Adams Mission	Inter-vention	Control	Total
None	48	50	37	73	32	13	**135**	**118**	253
	(19.0%)	(19.8%)	(14.6%)	(28.8%)	(12.6%)	(5.1%)	**(53.4%)**	**(46.6%)**	
Completed	84	77	89	74	83	74	**250**	**231**	481
Primary	(17.5%)	(16.0%)	(18.5%)	(15.4%)	(17.3%)	(15.4%)	**(52.0%)**	**(48.0%)**	
Completed	311	270	376	288	219	387	**957**	**894**	1851
Secondary	(16.8%)	(14.6%)	(20.3%)	(15.6%)	(11.8%)	(20.9%)	**(51.7%)**	**(48.3%)**	
Completed	227	107	259	229	47	193	**593**	**469**	1062
High	(21.4%)	(10.1%)	(24.4%)	(21.6%)	(4.4%)	(18.2%)	**(55.8%)**	**(44.2%)**	
Completed	4	2	21	21	1	18	**27**	**40**	67
Tertiary	(6.0%)	(3.0%)	(31.3%)	(31.3%)	(1.5%)	(26.9%)	**(40.3%)**	**(59.7%)**	

4.5 EMPLOYMENT STATUS

The age group 15 to 65 was categorised as constituting the economically active age group. There were 4478 household members in this category. Nearly two thirds (62%) of the household members were unemployed, with 66% reflecting this status in the Intervention Area and 58% in the Control Area. Only 16% were in full time employment, 3% in part time employment for 3 days a week, 10% were employed on a temporary basis and 8% received grants.

Table 8: Employment Status of Economically Active Age-Group (15-65 years) in the EcoSan Study, eThekwini, 2006

Employment Status	Mzin-yathi	Mtamun-tengayo	Saw-pitts	Ogun-jini	Bux-Farm	Adams-Mission	Inter-vention	Control	Total
Permanent	123	78	130	152	123	128	**331**	**403**	734
5 days/week	(16.4%)	(10.7%)	(14.1%)	(19.3%)	(24.5%)	(16.4%)	**(13.8%)**	**(19.5%)**	(16.4%)
Part time	29	15	24	28	4	22	**68**	**54**	122
3 days/week	(3.9%)	(2.0%)	(2.6%)	(3.6%)	(0.8%)	(2.8%)	**(2.8%)**	**(2.6%)**	(2.7%)
Temporary	60	69	84	75	95	74	**213**	**244**	457
	(8.0%)	(9.5%)	(9.1%)	(9.5%)	(18.9%)	(9.5%)	**(8.9%)**	**(11.8%)**	(10.2%)
Unemployed	493	495	599	454	254	496	**1587**	**1204**	2791
	(65.6%)	(67.9%)	(64.8%)	(57.8%)	(50.6%)	(63.6%)	**(66.0%)**	**(58.2%)**	(62.4%)
Grant	46	72	87	77	26	60	**205**	**163**	368
	(6.1%)	(9.9%)	(9.4%)	(9.8%)	(5.2%)	(7.7%)	**(8.5%)**	**(7.9%)**	(8.2%)
Total	751	729[cc]	924[dd]	786	502	780	**2404**	**2068**	4472
	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	**(100%)**	**(100%)**	(100%)

[cc] Information missing from 5(0.7%) household members

[dd] Information missing from 1(0.1%) household member

4.6 INCOME STATUS

4.6.1 Income Contributor

Combined Total Household Income

One third (33%) of households reported having a combined household income between R801 to R1600 per month, whilst 7% of households reported having no household income (Table 9).

Table 9: Monthly Household Income of all Households in the EcoSan Study, eThekwini, 2006.

Combined Income	Mzin-yathi	Mtamu tengayo	Saw-pitts	Ogun-jini	Bux-Farm	Adams mission	Inter-vention	Control	Total
None	15 (7.3%)	12 (6.3%)	8 (3.6%)	6 (2.9%)	23 (11.0%)	28 (12.8%)	**35 (5.7%)**	**57 (8.9%)**	92 (7.3%)
Less 400	24 (11.7%)	23 (12.2%)	17 (7.6%)	31 (14.8%)	24 (11.5%)	15 (6.8%)	**64 (10.4%)**	**70 (11.0%)**	134 (10.7%)
400 - 800	56 (27.2%)	47 (24.9)	31 (14.0%)	75 (35.9%)	51 (24.4%)	23 (10.5%)	**134 (21.7%)**	**149 (23.4%)**	283 (22.6%)
801- 1600	79 (38.3%)	51 (27.0%)	75 (33.8%)	74 (35.4%)	67 (32.0%)	72 (32.9%)	**205 (33.2%)**	**213 (33.4%)**	418 (33.3%)
1601 - 3200	32 (15.5%)	42 (22.2%)	51 (23.0%)	21 (10.0%)	28 (13.4%)	47 (21.5%)	**125 (20.2%)**	**96 (15.1%)**	221 (17.6%)
3201 - 6400	0	13 (6.9%)	30 (13.5%)	2 (1.0%)	14 (6.7%)	27 (12.3%)	**43 (7.0%)**	**43 (6.8%)**	86 (6.9%)
6400 +	0	1 (0.5%)	10 (4.5%)	0	2 (1.0%)	7 (3.2%)	**11 (1.8%)**	**9 (1.4%)**	20 (1.6%)
Total	206 (100%)	189 (100%)	222 (100%)	209 (100%)	209 (100%)	219 (100%)	**617 (100%)**	**637 (100%)**	1254 (100%)

4.6.2 Poverty Index

The poverty index is dependent on household sizes. The more members in a household, the larger is the income required to keep its household members out of poverty. Poverty estimates are calculated using a poverty line that varies according to household size. The poverty lines used was based on the Bureau of Market Research Minimum Living Level.[ee]

[ee] http://www.sarpn.org.za/documents/d0000990/index.php

Fact Sheet: Poverty in South Africa

4.6.2.1 Poverty Index of Households in each of the Study Areas

The poverty income data table (2001), using the income by household per family size provided the means whereby the poverty index of 1253 households in the EcoSan Study was determined. About half (51%) of households in the study area were below the poverty line. There was no significant difference ($p = 0.186$) in the proportion of households below the poverty index between the Control Areas and the Intervention Areas.

The South Sub-district (Sawpits and Adams Mission) had the highest proportion of households living above the poverty line. There was a significant difference ($P < 0.001$) in the poverty index amongst the different study areas (Table 10).

Table 10: Poverty Index of Households in each of the Study Areas in the EcoSan Study, eThekwini, 2006.

Area	Below Poverty Line No. (%)	Around Poverty Line No. (%)	Above Poverty Line No. (%)	Total No. (%)
Mzinyathi I_1N	122 (59.5%)	66 (32.2%)	17 (8.3%)	205 (100%)
Mtamuntengayo I_2W	104 (55.0%)	54 (28.6%)	31 (16.4%)	189 (100%)
Sawpits I_3S	94 (42.3%)	59 (26.6%)	69 (31.1%)	222 (100%)
Ogunjini C_1N	142 (67.9%)	53 (25.4%)	14 (6.7%)	209 (100%)
Bux Farm C_2W	90 (44.1%)	60 (29.4%)	54 (26.5%)	204 (100%)
Adams Mission C_3S	86 (39.3%)	59 (26.9%)	74 (33.8%)	219 (100%)
Intervention	**320 (52.0%)**	**179 (29.0%)**	**117 (19.0%)**	**616 (100%)**
Control	**318 (50.3%)**	**172 (27.2%)**	**142 (22.5%)**	**632 (100%)**
Total	638 (50.9%)	351 (28.0%)	259 (21.1%)	1248 (100%)

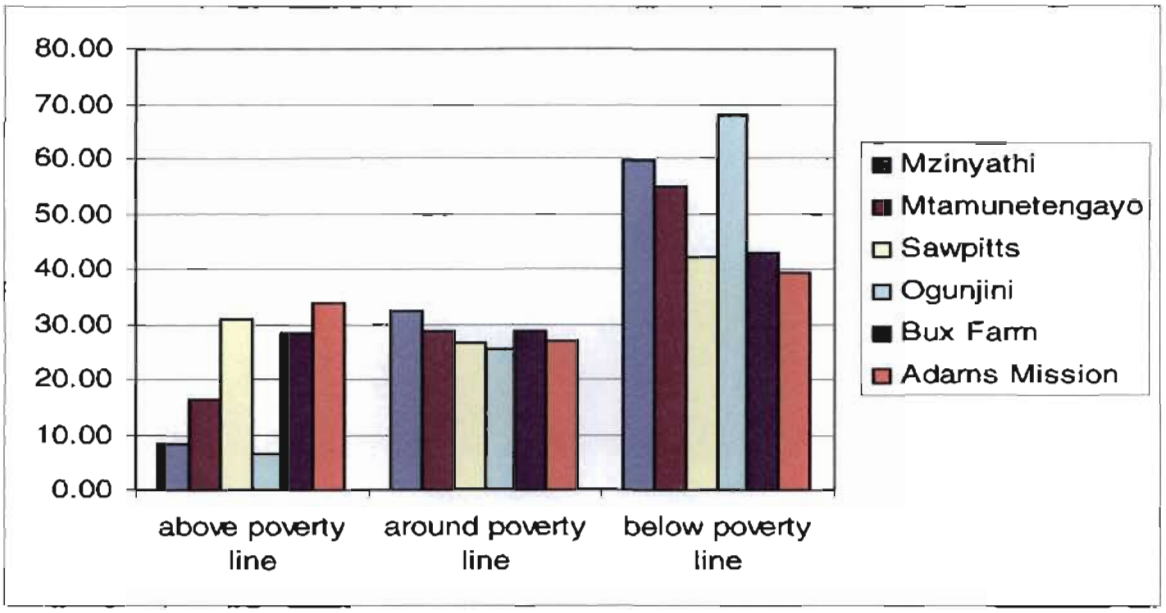

Figure 3: Graphical Presentation of the Poverty Index of Households in each of the Study Areas in the EcoSan Study, eThekwini, 2006.

4.7 SOCIO-ECONOMIC INDICATORS

4.7.1 Type of Housing

In the West Sub-district, 92% of households in Mtamuntengayo and 75% of households in Bux Farm consisted mainly of traditional type housing structures. In the North Sub-district, 66% of Mzinyathi and 64% of Ogunjini comprised of brick/concrete dwellings and the South Sub-district had an almost equal proportion of traditional and brick/concrete housing structures. Overall, there was little difference between the type of housing reflected in the Control and Intervention Areas.

Table 11: Type of Housing observed by field workers in Control and Intervention Areas in the EcoSan Study, eThekwini, 2006.

Respondents Area	Brick/Concrete		Informal Shack		Traditional	
	No.	%	No.	%	No.	%
Mzinyathi - I_1 N	151	66.2%	7	3.1%	70	30.7%
Ogunjini – C_1 N	141	63.8%	5	2.3%	75	33.9%
Mtamuntengayo - I_2 W	13	6.5%	2	1.0%	186	92.5%
Bux Farm - C_2 W	52	22.9%	4	1.8%	171	75.3%
Sawpits - I_3 S	119	51.7%	3	1.3%	108	47.0%
Adams Mission - C_3 S	101	44.7%	9	4.0%	116	51.3%
Intervention	**283**	**42.9%**	**12**	**1.8%**	**364**	**55.2%**
Control	**294**	**43.6%**	**18**	**2.7%**	**362**	**52.7%**
Total	577	43.3%	30	2.2%	726	54.5%

4.7.2 Type of Fuel Used for Cooking

Most households in the West Sub-district used an open flame (paraffin, coal & wood) for cooking purposes, whilst over 50% of households in the South used electricity. In the North, an equal proportion of households used electricity and an open flame to cook.

Table 12: Type of Fuel used for Cooking amongst Households in the EcoSan Study, eThekwini, 2006.

Respondents Area	Electricity No (%)		Open Flame No (%)	
	Yes	No	Yes	No
Mzinyathi - I_1 N	117(51.3%)	111(48.7%)	109(47.8%)	119(52.2%)
Ogunjini - C_1 N	94(42.5%)	127(57.5%)	127(57.5%)	94(42.5%)
Mtamuntengayo - I_2 W	18(9.0%)	183(91.0%)	182(90.5%)	19(9.5%)
Bux Farm - C_2 W	54(23.6%)	175(76.4%)	173(75.5%)	56(24.5%)
Sawpits - I_3 S	128(55.7%)	102(44.3%)	99(43.0%)	131(57.0%)
Adams Mission - C_3 S	139(61.0%)	89(39.0%)	87(38.2%)	141(61.8%)
Intervention	**263(47.8%)**	**396(50.3%)**	**390(50.2%)**	**269(48.0%)**
Control	**287(52.2%)**	**391(49.7%)**	**387(49.8%)**	**291(52.0%)**
Total and Average	550(41.1%)	787(58.9)	777(58.1%)	560(41.9%)

4.7.3 Access to Radio, Television, Telephone, Cellular Phone and Fridge

4.7.3.1 Radio and TV

Whether a household had a radio or TV was used to assess the influence of external media on knowledge about sanitation and hygiene. Most homes had access to a radio or TV (77% & 56% respectively), with the majority having a radio (Figure 4). At least 518 (78.6%) households had access to radios and 405 (61.5%) possessed TVs in the Intervention Area, whilst 509 (75.1%) owned radios and 340 (50.1%) households had televisions in the Control Area.

4.7.3.2 Refrigerator

The safe storage of perishable foods would prevent the possibility of food contamination and may be linked to a household owning a refrigerator. The frequency of this varied widely in the three Sub-Districts (Figure 4). The more traditional area in the West had a lower proportion of homes with a fridge (Intervention 26% and Control 24%). The proportion having a refrigerator in the Intervention and Control Areas were 388 (58.9%) and 366 (54.0%) respectively.

4.7.3.3 Telephones and Cellular phones

A small percentage (7%) of the households possessed landline telephones whilst a large percentage (72%) of households had access to cellular phones as a means of communication. Households with a cell-phone ranged from 59% in Bux Farm to 82% in Mzinyathi. The proportion owning a cell-phone in the Intervention and Control Areas was 512 (77.7%) and 452 (66.7%) respectively.

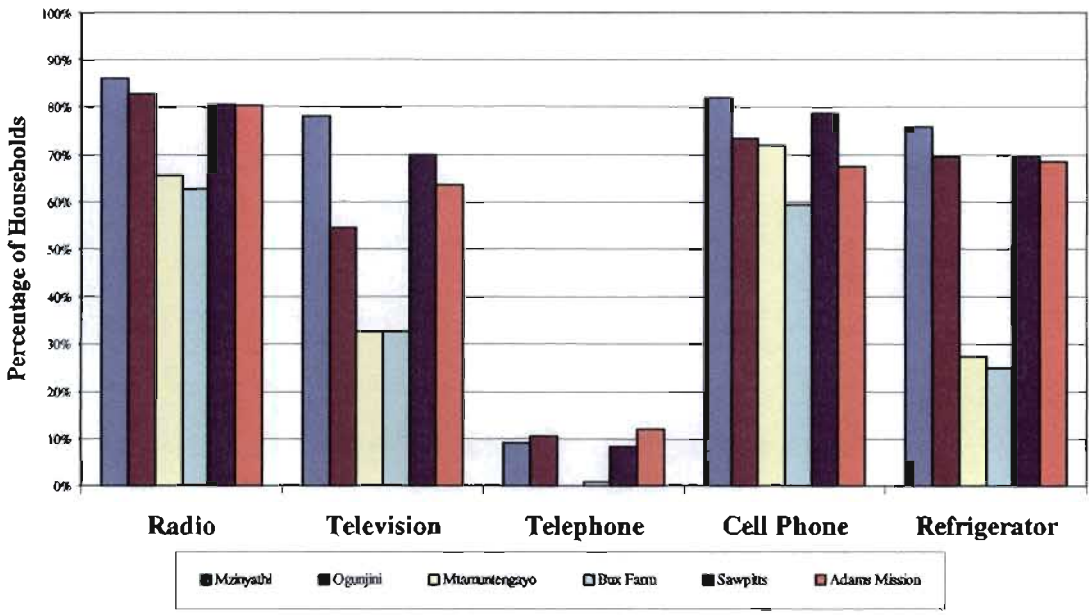

Figure 3: Households with Access to Radio, TV, Phones and Refrigerators in the EcoSan Study, eThekwini, 2006.

4.7.4 Books and Magazines

Assessing the number of books and magazines per household was indicative of their interest in reading and its possible influence on their knowledge about sanitation, hygiene & disease outcomes. The average household in the North & West Sub-

districts had no books, as the median was zero, whilst in the South Sub-district; Sawpits had a median of 4 whilst Adams Mission's median number of books was 2. The proportion of households owning books in the Intervention and Control Areas were 292 (44.3%) and 263 (38.9%) respectively.

4.7.5 Reading Newspaper

About two thirds (62%) of households reported that they read a newspaper. There was a significant difference (P = 0.017) between the Intervention and Control Areas in the South Sub-district with respect to the reading of such material. However, there was no significant difference (P= 0.360) noted between all the Intervention and Control Areas with regard to reading a newspaper. Overall, there was no difference between Intervention and Control Areas in reading the paper

Table 13: Percentage of Households that Read the Newspaper in EcoSan Study, eThekwini, 2006.

Respondents Area	Ever			Never	
	No.	%	p-value	No.	%
Mzinyathi - I_1 N	170	74.9	0.868	57	25.1
Ogunjini - C_1 N	167	75.6		54	24.4
Mtamuntengayo - I_2 W	117	58.2	0.481	84	41.8
Bux Farm - C_2 W	120	54.8		99	45.2
Sawpits - I_3 S	142	62.6	0.017	85	37.4
Adams Mission - C_3 S	163	73.1		60	26.9
Intervention	**429**	**65.5**	**0.360**	**226**	**34.5**
Control	**450**	**67.9**		**213**	**32.1**
Total (average)	879	61.8		439	38.2

4.8 SANITATION

4.8.1 Type of Sanitation in Sample Area

In the Intervention Area 581(88%) households had UD toilets, 66 (10%) households had pit or VIP toilets and 13(2%) households reported having no sanitation facility and were reliant on the bush to fulfil such natural functions.

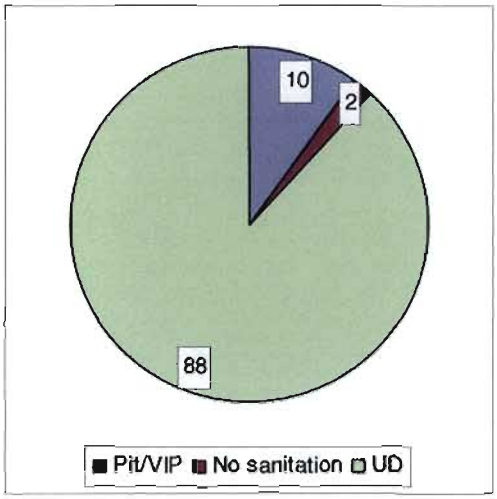

Figure 4: Type (percentage) of Sanitation in Intervention Area (N = 660)

In the Control Area, 534 (80%) had pit/ VIP toilets, 88 (13%) households had flush toilets and 46 (7%) of households had no sanitation and used the bush.

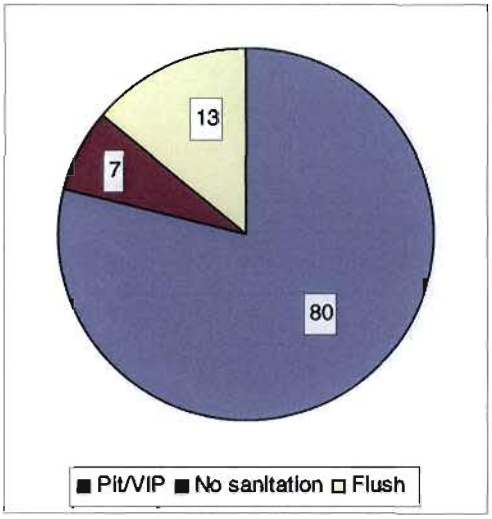

Figure 5: Type (percentage) of Sanitation in Control Area (N = 668)

4.8.2 Assessment of Households with UD Toilets

4.8.2.1 UD Toilet Usage

Despite 581 households having UD toilets in the Intervention Areas, 16% of the respondents indicated that their households never use these; On the other hand, 5% use the UD toilet some of the time and 79% always make use of the UD toilet (Table 14).

4.8.2.2 UD Toilet used as Taught

Out of the 487 households using the UD toilet always or some of the time, only 446 (92%) households reported that they use their UD toilet as they were taught (Table 14).

4.8.2.3 Hygiene Status of UD Toilets

A large proportion of households using UD toilets indicated that they always (86%) use covering material after defecating. There was a significant difference ($p < 0.001$), amongst the proportion of households in the Intervention Areas that never used covering material after defecating, with 27% of these households being in Sawpits (Table 14). A large proportion (77%) of households stated that their UD toilet did not smell, 82% of households reported that they do not have flies and 79% of households reported that their toilet pedestals were always clean (Table 15).

Table 14: Type of Sanitation and Hygiene Status of UD Toilets in the EcoSan Study

VARIABLES	North Area				West Area				South Area				Total		P- value
	Mzinyathi		Ogunjini		Mtamun-tengayo		Bux Farm		Sawpits		Adams Mission				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
Number of Houses	228	17.1%	221	16.5%	201	15.0%	229	17.1%	230	17.2%	228	17.1%	1337	100%	
Houses with UD	191	83.8%	0	0	190	94.5%	0	0	200	87.0%	0	0	581	43.5%	< 0.001
Houses with no UD (I)	37	16.2%	-	-	11	5.5%	-	-	30	13.0%	-	-	78	5.8%	
Houses with no UD (C)	-	-	221	100%	-	-	229	100%	-	-	228	100%	678	50.7%	
UD is used:															
Always / most times	154	80.6%	0	0	170	89.5%	0	0	135	67.5%	0	0	459	79.0%	< 0.001
Some of the time	7	3.7%	0	0	8	4.2%	0	0	13	6.5%		0	28	4.8%	
Never	30	15.7%	0	0	12	6.3%	0	0	52	26.0%	0	0	94	16.2%	< 0.001
Sub-total	191	100.0%			190	100.0%			200	100.0%			581	100.0%	
Is UD used as taught?	152	98.7%	0	0	165	97.1%	0	0	129	95.6%	0	0	446	97.2%	<0.001
Covering material used:															
Always / some times	144	89.4%	0	0	171	96.1%	0	0	133	72.7%	0	0	448	86.0%	< 0.001
Never	17	10.6%	0	0	7	3.9%	0	0	50	27.3%	0	0	74	14.0%	< 0.001
Sub-total	161	100.0%			178	100.0%			183	100.0%			522	100.0%	

Table 15: Type of Sanitation and Hygiene Status of UD Toilets in the EcoSan Study, eThekwini, 2006.

VARIABLES	North Area				West Area				South Area				Total		P-value
	Mzinyathi		Ogunjini		Mtamun-tengayo		Bux Farm		Sawpits		Adams Mission				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
Pit smells:															
Always / most times	38	23.6%	0	0	41	23.0%	0	0	40	22.1%	0	0	119	22.9%	0.574
Never / Some of the time	123	76.4%	0	0	137	77.0%	0	0	141	77.9%	0	0	401	77.1%	0.070
Sub-total	161	100.0%			178	100.0%			181	100.0%			520	100.0%	
Flies are present:															
Always / most times	32	19.9%	0	0	35	19.6%	0	0	30	16.4%	0	0	97	18.5%	
Never / Some of the time	129	80.1%	0	0	144	80.4%	0	0	153	83.6%	0	0	426	81.5%	0.001
Sub-total	161	100.0%			179	100.0%			183	100.0%			523	100.0%	
UD pedestal is clean:															
Always / most times	133	82.6%	0	0	133	74.7%	0	0	144	79.1%	0	0	410	78.7%	0.245
Never / Some of the time	28	17.4%	0	0	45	25.3%	0	0	38	20.9%	0	0	111	21.3%	0.852
Sub-total	161	100.0%			178	100.0%			182	100.0%			521	100.0%	

Table 16: Type of Toilet (UD and Non-UD) used by children < 12 Years in the EcoSan Study, eThekwini, 2006.

Where do children go to the toilet (UD and non UD)	Mzinyathi No. (%)	Mtamun-tengayo No. (%)	Sawpits No. (%)	Ogunjini No. (%)	Bux Farm No. (%)	Adams Mission No. (%)	Inter-vention No. (%)	Control No. (%)	Total No. (%)
UD	100 (64.5%)	68 (48.9%)	95 (52.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**263 (55.5%)**	**0 (0.0%)**	263 (29.5%)
Flush/sewerage	1 (0.6%)	0 (0.0%)	2 (1.1%)	4 (2.2%)	0 (0.0%)	0 (0.0%)	**3 0.6%)**	**4 (0.9%)**	7 (0.8%)
Flush/septic	4 (2.6%)	0 (0.0%)	3 (1.7%)	45 (25.3%)	1 (1.2%)	18 (11.5%)	**7 (1.5%)**	**64 (15.3%)**	71 (8.0%)
Pit VIP	6 (3.9%)	1 (0.7%)	16 (8.9%)	0 (0.0%)	7 (8.4%)	0 (0.0%)	**23 (4.9%)**	**7 (1.7%)**	30 (3.4%)
Pit	39 (25.2%)	13 (9.4%)	46 (25.6%)	90 (50.6%)	38 (45.8%)	103 (65.6%)	**98 (20.7%)**	**231 (55.3%)**	329 (36.9%)
Bucket	0 (0.0%)	0 (0.0%)	2 (1.1%)	2 (1.1%)	0 (0.0%)	10 (6.4%)	**2 (0.4%)**	**12 (2.9%)**	14 (1.6%)
Bush	5 (3.2%)	57 (41.0%)	16 (8.9%)	37 (20.0)	37 (44.6%)	26 (16.6%)	**78 (16.4%)**	**100 (23.9%)**	178 (20.0%)
Total	155 (100%)	139 (100%)	180 (100%)	178 (100%)	83 (100%)	157 (100%)	**474 (100%)**	**418 (100%)**	892 (100%)

4.8.3 Toilets used by Children under 12 years

The Intervention Area had 474 households with children under the age of 12 years of which, 55% of the households with children used UD toilets, 2% used water-flush toilets draining either to a septic tank or reticulated sewer system, 25% used a pit toilet and 17% used the bush as a toilet. Mtamuntengayo had the highest percentage (41%) of households with children resorting to the bush as a toilet (Table 16).

The Control Area had 418 households with children less than 12 years, of which 16% of these used a flush septic/sewerage toilet; 57% used a pit toilet; 3% used a bucket toilet and 24% used the bush as a toilet. Bux Farm had 45% of households with children who used the bush as a toilet (Table 16).

4.8.4 Type of Housing Structure and UD toilet usage

The type of housing structure and its influence on the household patterns of using the UD toilet was assessed. In 283 households constructed with brick/concrete, over half (59%) used their UD toilets. Of 363 traditionally built households, 77% of households used their UD toilets. There was a significant difference ($p < 0.001$) between the type of housing structure and the households' usage of urine diversion toilets (Table 17).

Table 17: Type of Housing Structure and UD toilet usage in EcoSan Study, eThekwini, 2006.

		UD toilet use		Total
		No	Yes	
Type of Housing Structure	Brick/Concrete	115 (40.6%)	168 (59.4%)	283(100%)
	Traditional Structure	84 (23.1%)	279 (76.9%)	363(100%)
	Informal Shack	6 (50.0%)	6 (50.0%)	12(100%)
	Total	**205 (31.2%)**	**453(68.8%)**	**658 (100%)**

4.8.5 UD toilet usage and having a cell phone/telephone

Having a telephone or cell phone does not predict UD toilet usage.

Table 18: UD toilet usage and having a cell phone/telephone in EcoSan Study, eThekwini, 2006.

		UD toilet use		Total
		Yes	No	
Having a cell phone or telephone	Yes	350 (80.6 %)	84 (19.4%)	434 100%)
	No	102 (86.4%)	16 (13.6%)	118 (100%)
	Total	**452 (81.9%)**	**100 (18.1%)**	**552 100%)**

4.8.6 Frequency of reading the newspaper and UD toilet usage

Two thirds of households (65%) reported reading the newspaper. There was no statistically significant difference (p = 0.833) between households that read or didn't read the newspaper and their use of UD toilets (Table 19).

Table 19: Frequency of reading the newspaper influencing the use of UD toilet in EcoSan Study, eThekwini, 2006.

		UD toilet use		Total
		Yes	No	
Reads Newspaper	Ever	292 (81.6 %)	66 (18.4%)	358 (100%)
	Never	158 (82.3%)	34 (17.7%)	192 (100%)
	Total	**450 (81.8%)**	**100 (18.2%)**	**550 (100%)**

4.9 WATER

There was a close correlation between the responses received relating to sources of water used for purposes of drinking, washing hands, bathing, washing clothes and preparing food. The data was therefore combined and dealt with as the same source of water being used for all purposes.

4.9.1 Protected Water Sources

A protected water source was defined as piped water, ground tanks, community stand-pipes, community tanks and boreholes; an unprotected water source was defined as water from dams, rivers, streams and unprotected springs.

Protected water sources were reported to be available at 648 households (98%) in the Intervention Areas and at 608 households (90%) in the Control Areas.

There was a significant difference ($p < 0.001$) between the West, North and South Sub-districts using unprotected drinking water. In the West Sub-district 13% of households reported using unprotected drinking water (Table 20).

Table 20: Snapshot of Water Sources per Sub-District in the EcoSan Study, eThekwini, 2006.

Sub-District	Protected Source	Unprotected Source	Total	P-value
	No. (%)	No. (%)	No. (%)	
North	424 (94.4%)	25 (5.6%)	449 (100%)	< 0.001
West	376 (87.4%)	54 (12.6%)	430 (100%)	< 0.001
South	456 (99.6%)	2 (0.4%)	458 (100%)	< 0.001
Intervention	**648 (98.3%)**	**11 (1.7%)**	**659 (100%)**	**< 0.001**
Control	**608 (89.7%)**	**70 (10.3%)**	**678 (100%)**	**< 0.001**
Total	1256 (93.9%)	81 (6.1%)	1337 100%)	

4.9.2 Water Source used in each Study Area

There was a significant difference ($p < 0.001$) between the use of protected and unprotected water sources in each of the six study areas. The Intervention Areas used a lower percentage (2%) of unprotected water sources as compared to the Control Areas (10%). Ogunjini, the Control Area in the North and Bux Farm, the Control Area in the West, showed the highest percentage of unprotected water usage (11% and 20% respectively).

Table 21: Percentage of Protected/Unprotected Water Sources used in the Intervention and Control Areas of the EcoSan Study, eThekwini, 2006.

Respondents Area	Protected Water sources No. (%)	Unprotected Water Sources No. (%)	Total No. (%)	P-value
Mzinyathi I_1N	228 (100%)	0 (0%)	228 (100%)	< 0.001
Mtamuntengayo I_2W	192 (95.5%)	9 (4.5%)	201 (100%)	< 0.001
Sawpits I_3S	228 (99.1%)	2 (0.9%)	230 (100%)	< 0.001
Ogunjini C_1N	196 (88.7%)	25 (11.3%)	221 (100%)	< 0.001
Bux Farm C_2W	184 (80.3%)	45 (19.7%)	229 (100%)	< 0.001
Adams Mission C_3S	228 (100%)	0 (0%)	228 (100%)	< 0.001
Intervention	**648 (98.3%)**	**11 (1.7%)**	**659 (100%)**	**< 0.001**
Control	**608 (89.7%)**	**70 (10.3%)**	**678 (100%)**	**< 0.001**
Total	1256 (93.9%)	81 (6.1%)	1337 (100%)	

4.9.3 Distance Travelled to Collect Water

Of those households reliant on collecting water from outside of their yard area, 68% travelled less than 200m. The West Sub-District had the highest percentage (74%) of households that collected water from outside their yards.

Table 22: Distance Households Travel to collect Water in EcoSan Study, eThekwini, 2006.

Respondents Area	Less than 200m	More than 200m	Total
	No. (%)	No. (%)	No. (%)
Mzinyathi I_1N	20 (95.2%)	1 (4.8%)	21 (100%)
Mtamuntengayo I_2W	135 (71.8%)	53 (28.2%)	188 (100%)
Sawpits I_3S	16 (84.2%)	3 (15.8%)	19 (100%)
Ogunjini C_1N	47 (61.8%)	29 (38.2%)	76 (100%)
Bux Farm C_2W	134 (60.4%)	88 (39.6%)	222 (100%)
Adams Mission C_3S	25 (86.2%)	4 (13.8%)	29 (100%)
Intervention	**171 (75.0%)**	**57 (25.0%)**	**228 (100%)**
Control	**206 (63.0%)**	**121 (37.0%)**	**327 (100%)**
Total	377 (67.9%)	178 (32.1%)	555 (100%)

4.9.4 Distance Travelled related to use of unprotected Water

Of 555 households that collected water from outside their yard area, 10 % travelled more than 200m to fetch water from an unprotected water source, compared with 4% travelling less than 200m to collect water from an unprotected water source. The households were more likely to use unprotected water when greater distances were travelled to collect water. There was a significant difference between the distance travelled to collect the water and the type of water source used ($p < 0.001$).

Table 23: Distance travelled influences type of Water Source used in EcoSan Study, eThekwini, 2006.

Distance Travelled	Protected Water Source	Unprotected Water Source	Total
Less than 200m	353 (63.6%)	24(4.3%)	377 (67.9%)
More than 200m	123 (22.2%)	55 (9.9%)	178 (32.1%)

4.9.5 Type of Container used

The type of a container used by households for collecting drinking water included buckets, drums and bottles. At least 61% of households used buckets to collect water and 80% of unprotected water was collected in buckets.

4.9.6 Was the container covered?

Almost 82% of households that collected water from outside the yard area covered the container. In Mtamuntengayo, 33% of drinking water receptacles were uncovered. This percentage differed significantly ($p < 0.001$) from the other study areas.

4.9.7 Is the container used for other purposes?

Almost one third of the households (34%) in Bux Farm, 10% in Sawpits and 8% of households in Ogunjini use the container they collect water in for other purposes. Households in Mzinyathi and Adams Mission do not use the container for any other purpose.

4.9.8 Storage and Dispensing of Water

Over 50% of households store drinking water in the home. At least 86% of households dispense the drinking water by scooping it, whilst 14% of households pour

the water. Most of those who scoop the water (92%) use the scoop specifically for this purpose only. Plastic jugs were the most common utensil used in this process.

4.9.9 Piped Water Source

At least one third of the households reported that they do not have a piped water source. In the West Sub-District 87% of the households in the Intervention Area and 97% from the Control Area reported that they did not have piped water (Table 24).

Table 24: Percentage of Households with Piped Water in EcoSan Study, eThekwini, 2006.

Respondents Area	Piped Water Source		Total
	Yes	No	
Mzinyathi I_1N	227 (99.6%)	1 (0.4%)	228 (100%)
Mtamuntengayo I_2W	25 (12.8%)	170 (87.2%)	195 (100%)
Sawpits I_3S	222 (96.9%)	7 (3.1%)	229 (100%)
Ogunjini C_1N	193 (88.1%)	26 (11.9%)	219 (100%)
Bux Farm C_2W	7 (3.2%)	214 (96.8%)	221 (100%)
Adams Mission C_3S	215 (95.1%)	11 (4.9%)	226 (100%)
Intervention	**474 (72.7%)**	**178 (27.3%)**	**652 (100%)**
Control	**415 (62.3%)**	**251 (37.7%)**	**666 (100%)**
Total	889 (67.5%)	429 (32.5%)	1318 (100%)

4.9.10 Treatment of un-piped Water

Of the 33% (429) households that do not have piped water, 88% of the households do not treat this before drinking. The West Sub-District has the highest percentage (94%) of households with untreated water (Table 25).

Table 25: Percentage of Households that Treat Un-piped drinking water in EcoSan Study, eThekwini, 2006.

Area	Do not treat	Add bleach	Boil	Other	Total
Mzinyathi I_1N	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)
Mtamuntengayo I_2W	157 (92.9%)	10 (5.9%)	2 (1.2%)	0 (0%)	169 (100%)
Sawpits I_3S	5 (71.4%)	2 (28.6%)	0 (0%)	0 (0%)	7 (100%)
Ogunjini C_1N	4 (14.8%)	22 (81.5%)	0 (0%)	1 (3.7%)	27 (100%)
Bux Farm C_2W	199 (93.9%)	12 (5.7%)	1 (0.3%)	0 (0%)	212 (100%)
Adams Mission C_3S	11 (91.7%)	1 (8.3%)	0 (0%)	0 (0%)	12 (100%)
Intervention	**163 (92.1%)**	**12 (6.8%)**	**2 (1.1%)**	**0 (0.0%)**	**177 (100%)**
Control	**214 (85.3%)**	**35 (13.9%)**	**1 (0.4%)**	**1 (0.4%)**	**251 (100%)**
Total	377 (88.1%)	47 (11.0%)	3 0.7%)	1 0.2%)	428 100%)

4.10 HYGIENE

4.10.1 Participated in Hygiene Awareness Programmes

Out of 1337 households, only 5% of households in the Intervention and Control Areas reported that they had participated in hygiene awareness programmes. The respondents from households in the West Sub-District revealed the highest percentage of participating in hygiene awareness programmes.

Table 26: Participation in Hygiene Awareness Programmes in EcoSan Study, eThekwini, 2006.

Area	Yes	No	Total
Mzinyathi I_1N	7 (3.1%)	220 (96.9%)	227 (100%)
Mtamuntengayo I_2W	14 (7.0%)	185 (93.0%)	199(100%)
Sawpits I_3S	9 (3.9%)	221 (96.1%)	230(100%)
Ogunjini C_1N	7 (3.2%)	214 (96.8%)	221 (100%)
Bux Farm C_2W	23 (10.1%)	204 (89.9%)	227 (100%)
Adams Mission C_3S	5 (2.2%)	222 (97.8%)	227 (100%)
Intervention	**30 (4.6%)**	**626 (95.4%)**	**656 (100%)**
Control	**35 (5.2%)**	**640 (94.8%)**	**675 (100%)**
Total	65 (4.9%)	1266 (95.1%)	1331 (100%)

4.10.2 Interest to learn more about Hygiene Practices and Disease

A high percentage of households (87%) were interested to learn more about the relationship between hygiene practices and diseases. Households in Sawpits and Adams Mission in the South Sub-District reflected only slightly lower percentages of interest to learn more.

Table 27: Household in Intervention and Control Areas that Want to Learn More about Hygiene Practices and Diseases in EcoSan Study, eThekwini, 2006.

Area	Yes	No	Total
Mzinyathi I_1N	217 (95.2%)	11 (4.8%)	228 (100%)
Mtamuntengayo I_2W	186 (92.5%)	15 (7.5%)	201 (100%)
Sawpits I_3S	166 (72.2%)	64 (27.8%)	230 (100%)
Ogunjini C_1N	199 (90.0%)	22 (10.0%)	221 (100%)
Bux Farm C_2W	215 (94.3%)	13 (5.7%)	228 (100%)
Adams Mission C_3S	173 (76.9%)	52 (23.1%)	225 (100%)
Intervention	**569 (86.3%)**	**90 (13.7%)**	**659 (100%)**
Control	**587 (87.1%)**	**87 (12.9%)**	**674 (100%)**
Total	1156 (86.7%)	177 (13.3%)	1333 (100%)

4.10.3 Understanding of Hygiene Practices and Diseases

The households understanding of hygiene practices and disease outcomes was assessed per Intervention and Control Area and dichotomised by education status, being split at grade 7 (Table 28). There was no significant difference ($p = 0.262$) between the education status and understanding of hygiene practices and diseases in the Intervention Area, but in the Control Area there was a significant difference ($p = 0.019$) between the 2 levels of education and their understanding the relationship between hygiene practices and diseases outcome. Almost 37% of households in both the Intervention and Control Areas do not understand the relationship between hygiene practices and disease outcomes.

Table 28: Understanding of Hygiene Practices and Disease per Intervention and Control Area as Dichotomised by Education Status in the EcoSan Study, eThekwini, 2006.

Area Type	Education	Understanding of Hygiene and Disease							
		Do not understand		Basic understanding		Fairly good understanding		Total	
		No.	%	No.	%	No.	%	No.	%
Inter-	< Grade 7	78	39.4	100	50.5	20	10.1	198	100%
vention	Grade 8 +	109	34.7	159	50.6	46	14.6	314	100%
Total		**187**	**36.5**	**259**	**50.6**	**66**	**12.9**	**512**	**100%**
Control	< Grade 7	92	43.0	107	50.0	15	7.0	214	100%
	Grade 8 +	133	36.1	182	49.5	53	14.4	368	100%
Total		**225**	**36.7**	**289**	**49.7**	**68**	**11.7**	**582**	**100%**

4.10.4 Knowledge of respondents in each household relating to washing of hands

The key respondents from each household reported on the household's knowledge of whether not washing hands after certain types of activities could make you sick. This included questions on whether the washing of hands after using the toilet, before cooking, handling food, eating and feeding a baby can make one sick. There was a good correlation with regard to the responses received for each of these activities. These responses were therefore combined (Table 29). Over 99% of households reported that not washing one's hands before or after certain activities could indeed make one sick.

Table 29: Knowledge of Respondents relating to not washing Hands in EcoSan Study, eThekwini, 2006.

Area	Yes Can make you sick	No Can't make you sick	Total
Mzinyathi I_1N	227 (99.6%)	1 (0.4%)	228 (100%)
Mtamuntengayo I_2W	199 (99.0%)	2 (1.0%)	201 (100%)
Sawpits I_3S	230 (100%)	0 (0.0%)	230 (100%)
Ogunjini C_1N	221 (100%)	0 (0.0%)	221 (100%)
Bux Farm C_2W	229 (100%)	0 (0.0%)	229 (100%)
Adams Mission C_3S	227 (99.6%)	1 (0.4%)	228 (100%)
Intervention	**656 (99.5%)**	**3 (0.5%)**	**659 (100%)**
Control	**677 (99.9%)**	**1 (0.1%)**	**678 100%)**
Total	1333 (99.7%)	4 (0.3%)	1337 (100%)

4.10.5 Knowledge of soap usage when washing hands

Respondents from each household were asked whether household members should use soap when washing hands. More than half (51%) of these reported that they should always use soap. Only 2% of households reported that they should never use soap. There was a significant difference ($p < 0.001$) between the Intervention and Control Areas with respect to households reporting on the frequency of whether soap should be used when washing hands for different purposes. A larger proportion of

respondents in the Intervention area had reported that soap should be used when washing hands compared to the Control area.

4.10.6 Responses to actions of washing hands [ff] after using the toilet and before eating

The hygiene behaviour and actions of household members were assessed, where the key respondents were asked to describe the normal actions of the household members with respect to the washing of hands after using the toilet and before eating. It was reported that 60% of households wash their hands after using the toilet and less than 1% indicated that they never wash their hands after using the toilet, whilst 58% of households reported that they always wash their hands before eating, compared to 2% who indicated that they did not wash their hands before eating (Table 30).

[ff] A grading scale was used to assess whether all, most or some wash hands. This is very subjective. Ther may have been information bias from a social desirability perspective. However, the observational checklist will be used to validate this response.

Table 30: Reported Actions of Hand washing Behaviour of Households in the EcoSan Study eThekwini, 2006.

Actions of washing hands	Respondent's Area					
	Mzinyathi I_1N	Mtamun-tengayo I_2W	Sawpits I_3S	Ogunjini C_1N	Bux Farm C_2W	Adams Mission C_3S
No one washes hands						
After Toilet	1 (0.4%)	1 (0.5%)	0 (0.0%)	2 (0.9%)	5 (2.2%)	0 (0.0%)
Before Eating	3 (1.3%)	4 (2.0%)	8 (3.5%)	3 (1.4%)	3 (1.3%)	1 (0.4%)
Some wash hands						
After Toilet	25 (11.0%)	37 (18.4%)	42 (18.3%)	37 (16.8%)	47 (20.5%)	26 (11.5%)
Before Eating	26 (11.4%)	39 (19.4%)	42 (18.3%)	42 (19.1%)	54 (23.6%)	26 (11.4%)
Most wash hands						
After Toilet	69 (30.3%)	34 (16.9%)	74 (32.2%)	69 (31.4%)	11 (4.8%)	49 (21.6%)
Before Eating	70 (30.7%)	32 (15.9%)	71 (30.9%)	73 (33.2%)	10 (4.4%)	52 (22.8%)
All wash hands						
After Toilet	133 (58.3%)	129 (64.2%)	114 (49.6%)	112 (50.9%)	166 (72.5%)	152 (67.0%)
Before Eating	129 (56.6%)	126 (62.7%)	109 (47.4%)	102 (46.4%)	162 (70.7%)	149 (65.4%)
Total						
After Toilet	**228 (100%)**	**201 (100%)**	**230 (100%)**	**220 (100%)**	**229 (100%)**	**227 (100%)**
Before Eating	**228 (100%)**	**201 (100%)**	**230 (100%)**	**220 (100%)**	**229 (100%)**	**228 (100%)**

4.10.7 Households that use soap after using the toilet and before eating

The responses received by the key respondents from each household correlated well with regard to whether household members used soap to wash their hands after using the toilet and before eating. Hence the 2 responses were combined and reported in Table 31. At least one third of the households always used soap to wash their hands, whilst 5% never used soap. The West Sub-District had the highest percentage of households that always used soap when washing hands.

Table 31: Reported usage of soap after using the toilet and before eating by Household Members in each Area in EcoSan Study, eThekwini, 2006.

Area	Always	Most of the time	Some of the time	Never	Total
Mzinyathi I_1N	58 (25.4%)	118 (51.8%)	47 (20.6%)	5 (2.2%)	228 (100%)
Mtamuntengayo I_2W	85 (42.5%)	27 (13.5%)	70 (35.0%)	18 (9.0%)	200 (100%)
Sawpits I_3S	57 (24.8%)	51 (22.3%)	108 (47.2%)	13 (5.7%)	229 (100%)
Ogunjini C_1N	38 (17.2%)	104 (47.1%)	75 (33.9%)	4 (1.8%)	221 (100%)
Bux Farm C_2W	148 (64.6%)	36 (15.7%)	31 (13.5%)	14 (6.1%)	229 (100%)
Adams Mission C_3S	56 (24.6%)	56 (24.6%)	98 (43.0%)	18 (7.9%)	228 (100%)
Intervention	**200 (30.4%)**	**196 (29.8%)**	**225 (34.2%)**	**36 (5.5%)**	**657 (100%)**
Control	**242 (35.7%)**	**196 (28.9%)**	**204 (30.1%)**	**36 (5.3%)**	**678 (100%)**
Total	442 (33.1%)	392 (29.4%)	429 (32.1%)	72 (5.4%)	1335 (100%)

4.10.8 Households that have babies using nappies

There was no significant difference in the number of babies using nappies in each household ($p = 0.316$) between the Intervention Areas and Control Areas. In the Intervention Area 27% of households had babies that used nappies whilst the Control Area had 29%.

Table 32: Number (Percentage) of Households where babies use nappies in EcoSan Study, eThekwini, 2006.

Area	Babies with nappies	No babies with nappies	Total
Mzinyathi I_1N	57 (25.0%)	171 (75.0%)	228 (100%)
Mtamuntengayo I_2W	67 (33.3%)	134 (66.7%)	201 (100%)
Sawpits I_3S	56 (24.5%)	173 (75.5%)	229 (100%)
Intervention	**180 (27.4%)**	**478 (72.6%)**	**658 (100%)**
Ogunjini C_1N	61 (27.9%)	158 (72.1%)	219 (100%)
Bux Farm C_2W	65 (28.9%)	160 (71.1%)	225 (100%)
Adams Mission C_3S	69 (30.3%)	159 (69.7%)	228 (100%)
Control	**195 (29.0%)**	**477 (71.0%)**	**672 (100%)**
Total	375 (28.2%)	955 (71.8%)	1330 (100%)

4.10.9 Disposal of Faecal matter from the nappies

Disposing faecal matter in the bush, the yard or the stream was defined an unsafe practice, whilst disposal in a pit or hole, toilet, in a bin or burning the faecal matter from nappies was defined as a safe practice. Of the 375 households with babies using nappies 27% engaged in unsafe practices with respect to the disposal of faecal matter from nappies.

4.10.10 Nappy Disposal Practices amongst Households with a Radio

There was no significant difference ($p = 0.301$) between those households possessing a radio and those that did not with regard to safe and unsafe practices in disposing of faecal matter from babies' nappies. Therefore this material factor could not be used to predict nappy disposal practises.

Table 33: Nappies Disposal Practices amongst Households with Radios in EcoSan Study, eThekwini, 2006.

		Nappies Disposal Practices		Total
		Unsafe	Safe	
Radio	Yes	73 (25.4%)	214 (74.6%)	287 (100%)
	No	27 (31.0%)	60 (69.0%)	87 (100%)
	Total	**100 (26.7%)**	**274 (73.3%)**	**374 (100%)**

4.10.11 Households reading the Newspaper and Nappy Disposal Practices

The reading of a newspaper was used to determine whether households were influenced in disposing of faecal matter from nappies in a safe or unsafe manner. There was a significant difference ($p = 0.040$) between households that read the newspaper and those that did not with respect to whether the household disposes the faecal matter from nappies safely or not. Over three quarter of households (76%) reading the newspaper, disposed of faecal matter from nappies safely, whilst 32% of households who did not, resorted to unsafe practices.

Table 34: Nappies Disposal Practices amongst Households that read the Newspaper in EcoSan Study, eThekwini, 2006.

		Nappies Disposal Practices		Total
		Unsafe	Safe	
Reads Newspaper	**Yes**	62 (24.5%)	191 (75.5%)	253 (100%)
	No	38 (31.9%)	81 (68.1%)	119 (100%)
	Total	**100 (26.7%)**	**274 (73.3%)**	**372 (100%)**

4.10.12 Washing hands after changing babies nappies

The 375 households having babies with nappies were asked if family members from their households washed their hands after changing the babies' nappies. Sawpits and Adams Mission in the South Sub-District reported the lowest percentage (54% and 51% respectively). The total percentage of households that always washed their hands was 72% and only 1% of households indicated that they never wash their hands after changing babies' nappies. At least 75% of households in the Intervention Area always washed their hands after changing the babies' nappy, compared with 69% in the Control Area (Table 35).

Table 35: Number (Percentage) of Households that wash hands after changing babies nappies in EcoSan Study, eThekwini, 2006.

Area	Always	Most of the time	Some of the time	Never	Total
Mzinyathi I_1N	47 (82.5%)	8 (14.0%)	2 (3.5%)	0 (0.0%)	57 (100%)
Mtamuntengayo I_2W	57 (85.1%)	7 (10.4%)	3 (4.5%)	0 (0.0%)	67 (100%)
Sawpits I_3S	30 (53.6%)	22 (39.3%)	4 (7.1%)	0 (0.0%)	56 (100%)
Intervention	**134 (74.4%)**	**37 (20.6%)**	**9 (5.0%)**	**0 (0.0%)**	**180 (100%)**
Ogunjini C_1N	42 (68.9%)	16 (26.2%)	3 (4.9%)	0 (0.0%)	61 (100%)
Bux Farm C_2W	59 (88.1%)	5 (7.5%)	1 (1.5%)	2 (3.0%)	67 (100%)
Adams Mission C_3S	34 (50.7%)	28 (41.8%)	4 (6.0%)	1 (1.5%)	67 (100%)
Control	**135 (69.2%)**	**49 (25.1%)**	**8 (4.1%)**	**3 (1.6%)**	**195 (100%)**
Total	269 (71.7%)	86 (22.9%)	17 (4.5%)	3 (0.8%)	375 (100%)

4.10.13 Households that use soap to wash hands after nappy changes

A total percentage of 59 % of households always wash their hands with soap after changing the babies' nappies. At least 6% from the Control Area compared with 2% in the Intervention Area never use soap to wash their hands.

Table 36: Households that reported soap is used to wash hands after nappy changes in EcoSan Study, eThekwini, 2006.

Area	Always	Most of the time	Some of the time	Never	Total
Mzinyathi I_1N	42 (73.7%)	10 (17.5%)	4 (7.0%)	1 (1.8%)	57 (100%)
MtamuntengayoI_2W	45 (67.2%)	9 (13.4%)	10 (14.9%)	3 (4.5%)	67 (100%)
Sawpits I_3S	22 (39.3%)	17 (30.4%)	17 (30.4%)	0 (0.0%)	56 (100%)
Intervention	**109(60.6%)**	**36 (20.0%)**	**31 (17.2%)**	**4 (2.2%)**	**180 (100%)**
Ogunjini C_1N	37 (60.7%)	13 (21.3%)	10 (16.4%)	1 (1.6%)	61 (100%)
Bux Farm C_2W	53 (79.1%)	6 (9.0%)	2 (3.0%)	6 (9.0%)	67 (100%)
Adams Mission C_3S	21 (31.3%)	13 (19.4%)	29 (43.3%)	4 (6.0%)	67 (100%)
Control	**111(56.9%)**	**32 (16.4%)**	**41 (21.0%)**	**11 (5.7%)**	**195 (100%)**
Total	220(58.7%)	68 (18.1%)	72 (19.2%)	15 (4.0%)	375 (100%)

4.11 OBSERVATIONAL PROTOCOL

4.11.1 Introduction

The field-workers objectively observed the presence of hand washing facilities, soap, appearance and cleanliness of the toilets being used, condition of outdoor water-tanks, indoor water storage containers and the environmental condition of yard areas with respect to grey water, the handling of domestic solid waste and the disposal of human or animal faeces. The observation checklist was employed in the verification of the findings reported by the respondents during the interview. In addition to presenting the reported findings and comparing them with what fieldworkers observed, a scorecard was developed in relation to the observed state of cleanliness in the Intervention and Control Areas. These findings will be linked to the disease outcome variables as part of the larger analytic epidemiological study.

4.11.2 Hand washing facility inside the house

The fieldworkers observed that nearly two-thirds (60%) of households had a hand washing facility inside the house. Mtamuntengayo and Bux Farm in the West Sub-District had the highest percentage (85% and 92% respectively) of hand washing facilities inside the household, whilst Sawpits and Adams Mission in the South Sub-District had the lowest percentage (25% and 33% respectively). The Control Area was observed to have more hand washing facilities inside the household (53%) compared with 47% in the Intervention Area. The percentage of households with hand washing facilities differed significantly ($p < 0.001$) in each of the study areas.

Table 37: Observed Households with hand washing facilities inside the house in EcoSan Study, eThekwini, 2006.

Area	Number	%	Total
Mzinyathi I_1N	146	64.0	228
Mtamuntengayo I_2W	166	85.1	195
Sawpits I_3S	58	25.2	230
Intervention	**370**	**46.7**	**653**
Ogunjini C_1N	143	67.1	213
Bux Farm C_2W	206	91.6	225
Adams Mission C_3S	74	32.5	228
Control	**423**	**53.3**	**666**
Total	793	60.1	1319

4.11.3 Use of Soap

Soap was observed as being available in only 54% of households, while at the interview 95% of the key respondents from each household reported that they use soap for washing hands, either always (33%), most of the time (29%) or some of the time (32%).

Table 38: Reported and Observed frequency of soap usage in ECOSAN Study, eThekwini, 2006.

Area	Observed Number (%)	Reported Number (%)
Mzinyathi I_1N	147 (20.9%)	223 (17.7%)
Mtamuntengayo I_2W	119 (16.9%)	182 (14.4%)
Sawpits I_3S	43 (6.1%)	216 (17.1%)
Intervention	**309 (43.9%)**	**621 (49.2%)**
Ogunjini C_1N	147 (20.8%)	217 (17.2%)
Bux Farm C_2W	199 (28.2%)	215 (17.0%)
Adams Mission C_3S	50 (7.1%)	210 (16.6%)
Control	**396 (56.1%)**	**642 (50.8%)**
Total	705 (100%)	1263 (100%)

4.11.4 Use of UD toilet

There is good correlation between what has been reported by the respondents and what was observed by the field worker in relation to usage of UD toilets.

Table 39: Use of UD Toilets as observed by the Interviewer and reported by the Respondent in EcoSan Study, eThekwini, 2006.

Area	Observed Number (%)	Reported Number (%)
Mzinyathi I_1N	148 (32.7%)	116 (33.0%)
Mtamuntengayo I_2W	171 (37.7%)	178 (36.5%)
Sawpits I_3S	134 (29.6%)	149 (30.5%)
Total	**453 (100%)**	**488 (100%)**

4.11.5 Storage of Drinking Water

Households in the Control Area under-reported the storage of drinking water in the house, whilst the Intervention Area was slightly over-reported. This under-reporting was particularly evident in Bux Farm (Table 40).

Table 40: Reported and Observed frequencies on storage of drinking water in households in EcoSan Study, eThekwini, 2006.

Area	Observed Number (%)	Reported Number (%)
Mzinyathi I_1N	150 (14.7%)	133 (17.6%)
Mtamuntengayo I_2W	141 (13.8%)	113 (14.9%)
Sawpits I_3S	222 (21.8%)	164 (21.7%)
Intervention	**513 (50.3%)**	**410 (54.2%)**
Ogunjini C_1N	136 (13.4.%)	128 (16.9%)
Bux Farm C_2W	173 (17.0%)	49 (6.5%)
Adams Mission C_3S	197 (19.3%)	170 (22.4%)
Control	506 (49.7%)	**347 (45.8%)**
Total	1019 (100%)	757 (100%)

4.11.6 State of cleanliness of toilets and facilities provided at the toilet

Observations with regard to the cleanliness of toilets, the presence of unpleasant smells, flies, the existence of hand washing facilities and provision of soap nearby, were made. The toilets in the Intervention Areas were observed to be more hygienic than those in the Control Areas.

Table 41: Hygiene Status of toilets and facilities provided at the toilet in EcoSan Study, eThekwini, 2006.

Characteristic	Observed Number (%) Intervention Area	Observed Number (%) Control Area
Appears clean	442 (80.1%)	296 (49.7%)
Does not smell	366 (66.8%)	238 (39.9%)
Does not have flies	413 (74.7%)	304 (50.8%)
Has hand wash facility near toilet	80 (14.6%)	73 (12.2%)
Has soap provided near toilet	115 (21.2%)	64 (10.7%)

4.11.7 Toilet Checklist Scorecard[gg]

Based on the outcome of the observational protocol with regard to the five common characteristics described above (Table 41), a scorecard was developed to assign a score to each household, ranking it in terms of the state of cleanliness of toilets and the availability of facilities such as the provision of soap and hand-washing facilities. The higher the ranking the higher the scoring. The Intervention Area scored higher than the Control Area thereby indicating better hygiene standards of toilets and hygiene practices are more consistently maintained in this area than in the latter (2.31 vs. 1.64).

Table 42: Toilet Checklist Scorecard in Intervention Area and Control Area in EcoSan Study, eThekwini, 2006.

Respondents Area	*Mean Score*	*N*	*Std Deviation*
Mzinyathi	2.64	224	1.273
Mtamuntengayo	2.13	187	1.239
Sawpits	2.12	223	1.627
Intervention	**2.31**	**634**	**1.418**
Ogunjini	2.26	191	1.286
Bux Farm	0.96	197	1.243
Adams Mission	1.71	204	1.382
Control	**1.64**	**592**	**1.406**

[gg] The toilet checklist scorecard : 5 questions that were asked to households in the Intervention and Control areas relating to cleanliness of toilet, smells, flies, having a hand-washing facility and having soap near toilet. Each question was weighted equally where a score of 1 was allocated to a good/positve answer and a score of 0 to a poor/negative answer. We summed up the ones and zeros for each of the 5 questions for each household. A household could score a maximum of 5 or up to a minimum of 0. The higher the score the better the outcome.

4.12 SUMMARY OF RESULTS

Table 43: Summary of Results, EcoSan Baseline Study, eThekwini, 2006

	Intervention Area	Control Area	p-value
No. of Households	659 (49%)	678 (51%)	-
Household members	3953 (55%)	3226 (45%)	-
1. Average persons/household(mean, SD)	6.0	4.8	< 0.001
Sex ratio of members	0.89	0.80	0.015
Age (median, IQR)	21(11-36)	22(11-37)	0.307
2. Age dependency	0.59	0.55	0.128
3. Vulnerability index	0.21	0.19	0.076
> 18 year olds	1962 (56%)	1752 (58%)	0.034
4. > 18 with no education	135 (6.9%)	118 (6.7%)	0.325
> 18 Completed primary	250 (12.7%)	231 (13.2%)	0.128
> 18 Completed secondary	957 (48.8%)	894 (51.0%)	
> 18 Completed high	593 (30.2%)	469 (26.8%)	
> 18 Completed tertiary	27 (1.4%)	40 (2.3%)	
Productive age (15 - 65 yrs)	2404	2068	
Permanent employment (5 days/week)	331 (14%)	403 (19%)	0.498
5. Unemployed	1587 (66%)	1204 (58%)	
6. Households below poverty line	320 (52%)	318 (50%)	
7. Type of Housing			
Brick/concrete	283(43%)	294 (44%)	0.536
Informal Shack	12 (2%)	18 (3%)	
Traditional	364 (55%)	362 (53%)	
Type of Fuel used			
Electricity	263 (48%)	287 (52%)	0.407
Open flame	390 (50%)	387 (50%)	

Table 44 (cont.): Summary of Results, EcoSan Baseline Study, eThekwini, 2006

	Intervention Area	Control Area	p-value
Households with Access to:-			
8. Radio	518 (79%)	509 (75%)	0.252
9. Television	405 (61%)	340 (50%)	< 0.001
10. Refrigerator	388 (59%)	366 (54%)	0.076
11. Cell phone	512 (78%)	452 (67%)	< 0.001
12. Books in Household	292 (44%)	263 (39%)	0.010
13. Households Read Newspaper	429 (65%)	450 (68%)	0.016
14. Sanitation Type			
UD	581 (88%)	0	< 0.001
Pit/VIP	66 (10%)	534 (80%)	< 0.001
Flush	0	88 (13%)	
Bush	13 (2%)	46 (7%)	
Toilet used by children <12			
UD	263 (55%)	0	< 0.001
Pit/VIP	121 (26%)	238 (57%)	< 0.001
Flush	10 (2%)	68 (16%)	
Bush	78 (17%)	100 (24%)	
Bucket	2 (0%)	12 (3%)	
Water Sources			
Protected	648 (98%)	608 (90%)	< 0.001
15. Distance Travelled to collect water			
< 200m	171 (75%)	206 (63%)	0.003
16. Households with piped water	474 (73%)	415 (62%)	< 0.001
17. Treat un-piped water	14 (8%)	36 (14%)	0.075
18. Participated in Hygiene Programmes	30 (5%)	35 (5%)	0.604
Interest to learn about Hygiene	569 (86%)	587 (87%)	0.687

Table 45 (cont.): Summary of Results, EcoSan Baseline Study, eThekwini, 2006

	Intervention Area	Control Area	p-value
Not washing hands can make you sick	656 (99%)	677(100%)	0.619
19. All/Most wash hands after toilet/before eating	1090 (83%)	1107 (82%)	0.663
20. Soap usage after using toilet and before eating			
Always/most times	396 (60%)	438 (65%)	0.196
21. Households with babies in nappies	180 (27%)	195 (29%)	0.501
Households that wash hands after changing babies nappies			
22. Always/Most times	171 (95%)	184 (94%)	0.246
23. Safe Nappies Disposal Practices	115 (65%)	160 (81%)	< 0.001
24. Observed hand-wash facility inside house	370 (47%)	423 (53%)	0.011
25. Observed soap usage	309 (44%)	396 (56%)	< 0.001
Reported soap usage	621 (49%)	642 (51%)	0.196
26. Observed store of drinking water	513 (50%)	506 (50%)	0.496
Reported store of drinking water	410 (54%)	347 (46%)	< 0.001
27. Hygiene Status of Toilets			
Appears clean	442 (80%)	296 (50%)	
Do not smell	366 (67%)	238 (40%)	
Do not have flies	413 (75%)	304 (51%)	
Has hand wash facility near toilet	80 (15%)	73 (12%)	
Has soap provided near toilet	115 (21%)	64 (11%)	
Toilet Checklist Mean Score	2.31	1.64	< 0.001

Over 50 different variables were measured to assess whether the Intervention Areas were different to the Control Areas. The two areas were generally very similar with regard to demographics and socio economic indicators. The differences amongst the two groups are due to the provision of safe water, sanitation and hygiene programmes implemented in the Intervention area.

The Intervention area shows a slightly higher density of household members than the Control area. Higher density areas would usually be associated with poorer health outcomes. Both the Intervention and Control areas have over 50% of the study

population that is dependant, and a vulnerable index of 0.21 and 0.19 respectively. At least 50% of households in both the areas fall below the poverty line. Some parts of the study areas are still quite rural with over 53% of households being traditionally built and about 43% is built from either brick or concrete. Access to television and cell phone is higher in the Intervention area as compared to the Control area, whilst over 70% of households in both areas have access to radios. Literacy levels in both areas are fairly similar with regard to books in the household and reading the newspaper.

The Intervention area showed that 10% of households are still using the pit toilet, 2% are using the bush and the remaining 88% are using the UD toilet, whereas in the Control area 80% are using the pit toilet, 13% are using flush toilets and 7% are using the bush. When stratified by age group of less than 12 years, 17% of children are using the bush in the Intervention area compared to 24% in the Control area and 3% still use the bucket system in the Control area.

At least 73% of households in the Intervention area have access to piped water compared to 62% in the Control area.

There is a keen interest to learn more about hygiene and disease with both areas showing over 85% interest.

The study showed that over 94% of households say they wash their hands after changing babies nappy and over 83% say they washed their hands after using the toilet or before eating. However the field worker observation shows that only 47% of households in the intervention area have a handwashing facility in the house compared to 53% in the Control area. The importance of the observational protocol validating respondents responses to questions is crucial, especially when it comes to behavioural responses that would want to prompt positive responses from respondents.

Only 63% of households in the Intervention area dispose faecal material from nappies safely compared to 81% in the Control area.

The hygiene status of toilets is much higher in the Intervention area than the Control area. This may be as a result of the better facilities provided in the Intervention areas as well as the impact the hygiene education programme would have had in this area. This indicates the great success and impact the delivery of water, sanitation and hygiene services have made in the Intervention area.

Twenty seven of these variables were considered to be factors which could influence the incidence of faecal-oral infections in this community.

Of these 16 (59%) were not significantly different, 11 (41%) were assessed to be statistically significantly different. Of those that were different only 3 (11%) of the variables -having a television, having a cell phone and having books in the household would bias the results in favour of the Intervention Area. However, these variables will not have a major influence and alter the findings of the study. The other 5 (19%) variables, density of household, safe nappy disposal, observed handwashing facilities, observed soap usage and reported storage of drinking water, would bias any association against the intervention. The remaining differences are related to water, sanitation and hygiene status which are expected to be different in the intervention and Control area.

5 CHAPTER FIVE: DISCUSSION

5.1 INTRODUCTION

The results of this study describe the demographic details, socio-economic conditions, water, sanitation and hygiene awareness of the population included in the baseline EcoSan study which, will form the baseline of a larger analytic study to determine the health outcomes of these communities.

5.2 FINDINGS

The key findings of this study shows that a great impact has been made by the municipality in having provided safe water, sanitation, in the form of the urine diversion toilets and hygiene education programmes in the intervention area. There is a clear demonstrable outcome in terms of usage of the toilets, cleanliness of toilets, hygienic appearance of toilets, no smells, no flies, having wash hand facilities and soap provided close to the toilets in the Intervention area.

This study was also able to validate the reported responses of collected data from the questionnaire by comparing it to what was observed by the fieldworker as per the observational protocol. Households in the Control Area under-reported the storage of drinking water in the house, whilst the Intervention Area was slightly over-reported. Soap was observed as being available in only 54% of households, while at the interview 95% indicated that they used soap. There is good correlation between what has been reported by the respondents and what was observed by the field workers in relation to usage of UD toilets.

5.2.1 Demographics

Household Density: The proportion of households that participated in this study was very similar in the Intervention (49%) and Control Areas (51%) respectively, the household density in the Control Areas (4.8 vs. 6.0) was significantly less than the Intervention Area. This was mainly due to the low density in the Bux Farm area. Increased household density would be a risk factor for faecal-oral infections. Any selection bias would be in the direction of a reduced association between Intervention

and Control areas. As there is a higher density in the Intervention area, one would expect higher outcomes of diseases like diarrhoea, as compared to the control area.

Gender: There were a greater proportion of female respondents, 73% and 71%, who answered the questions in both the Intervention and Control Areas respectively, which was expected, as the senior male family members were out working. However, the gender distribution of the males and females in terms of the total household members in both the Intervention (56% and 53%) and Control Areas (44% and 47%) were equally distributed.

Age: This study showed that just over 50% of the population fell within the age category of being less than 15 years or being over 65 years, thereby depicting a very dependant population on the potentially productive part of the population. Further, the vulnerability index in the Intervention Area was 0.19 compared to the Control Area which was 0.21. This study did not take into consideration the vulnerable population in relation to disability, HIV/AIDS and other debilitating diseases. The provision of safe water, adequate sanitation and hygiene awareness programmes becomes even more critical in populations that have a high vulnerability index.

Education: The education levels of the participants who were 18 years and older, was similar in the Intervention and Control Areas. Only 7% of this age group had no education, 13% had completed a primary level of education, 50% a secondary level of education, 28% that completed at least 2 years of tertiary education and 2% have completed up to a fourth year tertiary education level.

Employment: This study showed that 62% of 4472 individuals who were in the economically active age group (15 to 65 years), indicated that they were unemployed, 30% were either in full time, part time or in temporary employment and at least 8% of the individuals received a grant.

Income: The total combined household income revealed that 6% and 9% of households in the Intervention Area and Control Area respectively received no income; around 11% received an income of below R400; 22% of households received between R400 and R800; whilst one third of the households' income was between

R801 and R1600 and 8% received a total combined household income of over R3201. There was no significant difference between the combined household income in the Intervention and Control Areas.

Poverty Index: Poverty estimates were calculated using a poverty line that varies according to household size, where a household with 4 persons has a poverty income of R1290 per month[hh]. This study showed that 51% of the households were living below the poverty line, compared to 28% around the poverty line and 21% of households were above the poverty line. There was no difference between the Intervention and Control Areas.

The Human Sciences Research Council (HSRC) in collaboration with Andrew Whitefield, a South African economist, has generated new estimates of poverty, which show that the proportion of people living in poverty in South Africa has not changed significantly between 1996 and 2001.[40] These estimates reveal that 57% of individuals in South Africa are living below the poverty income line. This percentage concurs with the results of shown in this study. The HSRC have further estimated poverty rates for each Municipality, with Durban having a poverty rate of 44%. They have also used a measure called the poverty gap that measures the required annual income transfer to all poor households to bring them out of poverty. Their study has shown the poverty gap for the Province of KwaZulu-Natal, with its large and poor population, to have the biggest poverty gap in South Africa of R18 billion, with Durban having the largest poverty gap amongst Municipalities in South Africa.

5.2.2 Socio-economic Indicators

The type of housing as observed by the fieldworkers in this study revealed that the North Sub-district mainly comprised of brick/concrete housing structures, where most of the households used electricity as a source of fuel for cooking purposes, and that this Sub-district showed the highest proportion of households with access to radios, televisions, telephones, cellular phones and refrigerators. The study also showed that

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[hh] Poverty Income: household size - R per month

1-R587; 2- R773; 3- R1028; 4- R1290; 5- R1541; 6- R1806; 7- R2054; 8+ - R2503.

the highest proportions of households that ever read the newspaper were from the North Sub-district.

In the West Sub-district, the fieldworkers observed that almost 90% of the housing structure was of a traditional type and in keeping with this traditional nature, most of the households used an open flame type of fuel (wood, coal and paraffin) for purposes of cooking. This Sub-district had the lowest proportion of households with access to radios, televisions, cellular phones and refrigerators, and the lowest proportion of households that ever read the newspaper, compared to the North and South Sub-districts.

On the other hand, the study shows that the South Sub-district has an almost equal proportion of traditionally built houses and houses built with brick/concrete, and, that about 58% of the households use electricity for cooking purposes. The proportion of households with access to radios, televisions, cellular phones and refrigerators as well as the proportion of households that ever read the newspaper is second highest when compared to households in the North Sub-district. The South Sub-district however indicated having the most number of magazines and books in the household. This is understandable; as the study has highlighted that the South Sub-district has the highest levels of tertiary education completed.

5.2.3 Sanitation

This study showed that only 1% of households in the Intervention Area and 7% of households in the Control Area had no sanitation and the members in these households used the bush as a toilet.

In the Intervention Area, 88% of households had a UD toilet whilst 6% of households in this area did not have UD toilets. Of the proportion of households that have the UD toilets, 84% use the UD toilet, whilst 16% do not use it. About 14% of those that use the UD indicated that they do not use covering material after defecating. An alarming 23% of households stated that their pit smells, whilst 19% of households stated that flies are always present and 21% indicated that the UD toilet pedestal is never clean.

Ookhin Nwe *et al.*[41] and Esrey,[42] in their enteric bacterial pathogens studies, have shown flies to carry pathogens on their feet, in their faeces and in their digestive juices which they regurgitate onto foods. Use of covering material after defecation in UD toilets, safe stool disposal in latrines, sewers or burying it thus has two benefits. It reduces the opportunities for flies to breed and it removes the source of fly transported pathogens.

A fly control study conducted in Gambia showed a mean reduction in the prevalence of diarrhoeal infections by 24%. This study investigated the efficacy of a hygiene education programme after a few months of its implementation, as an intervention to reduce diarrhoea amongst children.[43]

A key sanitation element is the safe disposal and treatment of human excrement. Ketil Haarstad *et al.* in their study stated that faeces are the principal carrier of pathogens and contain few nutrients (Nitrogen, phosphorous, potassium), whilst urine is relatively free of pathogens in healthy people and contains most of the excremental nutrients. This study investigates ecological sanitation as a solution by systematically presenting technical, economical and sociocultural issues in order to evaluate by screening. Some of the important excreted pathogens from faeces are viruses, bacteria, protozoa, helminths, and their associated diseases. Health risks are generally reduced when wastes are kept separated in smaller volumes. Based on the characteristics of ecological sanitation defined in this study, it was concluded that composting toilets and dehydration toilets meet the criteria for ecological sanitation.[44]

A cross sectional study on risk factors for infection with Giardia in pre-school children, in Salvador, Brazil, by Prado *et al.* was carried out as part of a longitudinal study of diarrhoea in order to identify risk factors for infection with *Giardia duodenalis*. After multivariate analysis, four significant risk factors were found: the Odds Ratio (95% CI), for visible sewerage material found near the household to be 1.85 (1.16 to 2.96); solid waste not collected had an Odds Ratio of 1.97 (1.22 to 3.16); the number of children in a family less than 5 years of age had an Odds Ratio of 2.08 (1.32 to 3.27) and the absence of a toilet had an Odds Ratio of 2.51 (1.33 to 4.71). [45]

In this study, it was noted that a larger proportion of households that used the UD toilets had the type of households constructed with traditional material, and a much smaller proportion of households that used the UD toilets were constructed of brick/concrete. There was insufficient information from other studies to determine if the type of housing structure was a good predictor for UD toilet usage.

5.2.4 Water

This study found that the West Sub-district had the highest proportion of households that used unprotected water sources, compared to the North and the South Sub-districts. It was also highlighted in this study that the Control Areas used a higher proportion of unprotected drinking water compared to the Intervention Area.

The WHO Report 2001, states that the assessment and management of the health risks associated with exposure to microbiological hazards through water present special challenges.[46]

Thomas Clasen *et al.* in a Randomised Controlled Trial in Colombia found that household water treatment was recognised as an effective means of reducing the burden of diarrhoeal disease among low-income populations without access to safe water. [47]

This EcoSan study did not include any questions relating to the links between HIV/AIDS, water and sanitation. Kamminga E and Schuringa MW reported the linkages between HIV/AIDS and water, sanitation and hygiene.[48]
Water is needed for bathing patients, for washing soiled clothing and linen. Safe drinking water is necessary for taking medication. Sanitation facilities close to the household is necessary for the weak patients. Their report states that water and sanitation is needed to reduce the risk of opportunistic infections, increases the sense of dignity for both the patient and the care giver, helps the HIV/AIDS patient to remain healthy for a longer period of time and reduces the chances of them getting diarrhoea and skin diseases.

This study showed that almost one third of the households had to travel more than 200m to collect drinking water. The study also found that the further the household member travelled to collect the water, the higher was the percentage for them to collect drinking water from an unprotected water source.

The most common type of container used by the households to collect drinking water was a bucket, and it was found that just over 80% of all the unprotected water was collected in buckets. The study also reported that just over 80% of the households cover the container used to transport the water.

Almost one third of the households in Bux Farm, 11% in Sawpits and 8% in Ogunjini stated that the container they collect water in is used for other purposes. This then poses a further risk of cross contamination.

The method used by households in this study, for dispensing stored water was either by scooping the water using a plastic jug or by pouring the water out. The hygienic condition of the scooping utensil is important if one considers the possibility of cross contamination.

Curtis *et al.* reported that diarrhoeal pathogens use water as a route to reach new hosts.[49] Their study further states that water can become contaminated by storing water in unclean containers, by not covering the stored water, using an unclean vessel to scoop the water out. Water that is free of pathogenic agents at the source may become contaminated in the private domain as it is transported to the household, stored or used.

Yeager, in a study in Lima, Peru, found that diarrhoea incidence was lower in households where water was stored in a container with a tap. This type of container will reduce unnecessary handling of the stored water and prevent cross contamination if using unclean scooping utensils.

This study showed that just over 35% of households in the Control Area and 25% in the Intervention Area do not have access to piped water. It further indicates that a high proportion of households in the Mtamuntengayo do not treat the unpiped water they

receive. Although Mtamuntengayo is in the Intervention area, at the time of the study, the ground tanks were not yet installed by the service provider.

5.2.5 Hygiene

Improving domestic hygiene practices is potentially one of the most effective means of reducing the global burden of preventable water-borne and excreta related diseases, especially with regard to children and other vulnerable groups. Hygiene practices that are a major source of risk must therefore be identified and targeted if hygiene education is to be successful.

Out of 1337 households that participated in this study, only 5% indicated that they have participated in a hygiene awareness programme. The expectation was that all households in the Intervention Area should have indicated that they had gone through a health and hygiene education programme at the time EWS installed the UD toilets. This therefore raises questions on the effectiveness of the hygiene education programmes run by the consultants and community facilitators that EWS had engaged, and highlights the importance of ensuring that such programmes are sustainable.

Almost 87% of households in both the Intervention and Control Areas indicated that they would like to learn more about hygiene and its relationship to the outcomes of disease. This high percentage is indicative of the communities thirst for knowledge and information, which if structured well, could help to encourage behaviour change, which is often very complex, and may result in decreased outcomes of preventable diseases.

This study looked at two levels of education, none to grade 7 and grade 8 to tertiary level, and compared responses relating to their understanding of hygiene practices and disease outcomes based on three categories of do not understand, basic understanding and good understanding. There was no significant difference amongst the individuals in the two levels of education and each category of understanding in the Intervention Area, whilst the Control Area showed a significantly higher proportion of individuals with higher levels of education having a good understanding of hygiene and disease outcome, and a significantly lower proportion of individuals with higher levels of

education that do not understand the relationship between hygiene practices and disease outcomes (Table 28).
In trying to understand what knowledge individuals in households had in relation to hygiene practises, questions were asked at a household level, on whether not washing of hands before and after certain activities could make them sick, and how frequently they should use soap when washing their hands. Respondents generally replied in the affirmative.

The study then looked at asking respondents at each household to report on the actual hand washing behaviour of its members, and found that about 62% of households in the Control Area reported that they washed their hands after using the toilet and before eating respectively, compared to a surprisingly lower percentage of between 56% of households in the Intervention Area. The study also revealed that a slightly higher percentage of households in the Control Area reported to use soap always (36%) when washing their hands, compared to 30% in the Intervention Area.

A systematic review relating hand-washing to the risk of diarrhoeal infections, conducted by Curtis and Cairncross gave the average estimate of 1.07 million lives that could be saved through the universal adoption of hand-washing with soap.[50]

A research team in Guatemala asked mothers to wash hands after using the toilet, after changing a nappy, before preparing food, before eating, before feeding baby, before touching drinking water and before going to bed. They found that this required mothers to wash their hands on average 32 times, which needed an additional 20 litres of water and an additional hour per day.[51]

Wilson *et al.* reported an 89% reduction in diarrhoea in an Indonesian Village through the promotion of hand-washing.[52]

Han and Hlaing claimed a 30% reduction in diarrhoea morbidity in Burma through regular hand washing with soap.[53]

Hoque *et al.* also reported reductions in diarrhoeal prevalence, six years after an intervention to improve water, sanitation and hygiene in Bangladesh.[54]

Water availability is likely to have an impact on the frequency of hand-washing. When water is freely available at a close range, hand washing becomes more frequent.[55]

The consumption of food contaminated with pathogens is potentially important in disease transmission. To break this link in the chain of transmission in diarrhoeal pathogens from faeces to a new host, hand-washing before food preparation and handling, safe food storage, hand-washing after use of toilet, after changing babies nappies, before eating and feeding children is necessary.

Esrey and Faechem reviewed 70 studies relating to the impact of food hygiene on diarrhoea morbidity and mortality, found evidence for the contamination of food with *E. coli,* Klebsiella and Salmonella and reported the presence of faecal indicator bacteria in food. These findings indicated that it was highly plausible from a biological point of view, that food contamination was linked to diarrhoeal incidence.

A systematic review on the effect of washing hands with soap on diarrhoea risk in the community was undertaken by Curtis and Cairncross found that interventions to promote washing hands with soap were associated with a decrease in risk of diarrhoeal diseases by 47% (95% CI: 24 to 63%).[56]

In a domestic hygiene and diarrhoea review, undertaken by Curtis *et al.* the epidemiological evidence for the effect of safe stool disposal was found to be a primary barrier to diarrhoeal transmission and maybe more important than hand-washing before eating, which constituted a second barrier.[49] This review supports the conclusion that hygiene promotion programmes should give priority to the safe disposal of faecal matter and adequate washing of hands after contact with adult and child stools.

The unsafe disposal of faecal matter is further supported by Stanton and Clemens in a randomised trial to assess the impact of educational intervention on hygienic behaviours and rates of diarrhoea. During the six months after the intervention the rate of diarrhoea (per 100 person weeks) in children under six years of age was 4.3 and 5.8

in the control community. This study showed that educational interventions for water and sanitation practices can have beneficial effects on children.[57]

In another study conducted by Han and Moe it was found that defecating indiscriminately near the home or in the surrounds of the living areas was found to be associated with an increased incidence of diarrhoea.[58]

A case control study of risk factors for diarrhoea in children under 3 years in Burkina Faso reported that unsafe disposal of children's stools were associated with 50% increase in the risk of hospitalization with diarrhoea, by comparison with disposal in a latrine (95% Confidence Interval 1.09 – 2.06). [59]

A summary of the key findings as reported in the General Household Survey, conducted annually by Statistics South Africa, provides a snapshot of the overall result.[60]
The following table compares the National percentage of various variables for the last three years, to the results of this EcoSan study.

Table 46: Results of National GHS 2005 compared to EcoSan Study 2006

Variable	National %			EcoSan Study
	2003	2004	2005	2006
% with no formal income	11.4	11.0	10.2	7.3
% with matric	21.6	22.7	21.9	30.4
Employed persons	22.0	22.4	21.3	29.4
Housing type - % informal	12.5	11.3	11.7	2.2
Sanitation – Bucket/none	11.8	10.8	10.2	4.4
Electricity supply	77.6	80.4	80.2	41.1
Energy source – cooking paraffin/wood	36.8	35.0	33.5	58.1
Piped water in dwelling-on site	67.3	67.8	68.5	67.5
Has Radio	80.6	80.8	78.9	77.0
Has Television	57.9	59.2	60.0	56.0
Has cell phone	40.2	49.6	59.7	72.0

The EcoSan study was confined to the eThekwini Municipal area only, whilst the GHS relates to National percentages. The percentage that completed matric in the EcoSan study included only those who were over 18 years of age, and was much higher than the National percentages. The electricity supply percentage and the percentage of informal housing in the EcoSan study was much lower as the study areas were peri-urban areas only. The percentages relating to employed persons, access to piped water, radio and TV were similar.

5.2.6 Observational Protocol

Survey questionnaires have been the most commonly used instruments to measure hygiene behaviours related to water and sanitation. In addition to a survey questionnaire, this study had also used a structured observational protocol to study practices and to verify what was reported by the key respondent of households and what was observed by the trained fieldworkers.

Oral reports given by the key respondent and members of the family often poorly reflect reality. Respondents would want to respond in the affirmative to prevent feeling embarrassed and may over-report desirable behaviours. At the same time, open questions might have lead to under-reporting of certain behaviours or facilities.

A major problem when attempting to measure hygiene behaviours and the state of cleanliness, is that no gold standards exists. Therefore, the use of a questionnaire and direct observation to measure hygiene and the state cleanliness, together with the development of a scorecard allowed us to make comparisons and conclusions regarding the outcomes of this study.

In the questionnaire survey of this study, key respondents reported on hand-washing practices and whether they use soap after using the toilet, before preparing food and after changing babies nappies, whether they stored drinking water in the house and specific questions were reported on relating to the hygiene status of the toilets used. The observational protocol required the fieldworkers to observe if hand-washing facilities and soap were provided in the household, near the toilet and at the ground tank, if UD toilets were used and on the state of cleanliness of toilets used.

In this study, it was observed by the trained fieldworkers, that 47% of households in the Intervention Area and 53% in the Control Area had provided hand-washing facilities inside the house. There was poor agreement on what was reported by respondents compared to what was observed with respect to usage of soap inside the house (54% observed vs. 95% reported).

It was further evident that the UD toilet usage was also over-reported as compared to what was observed (78% observed vs. 84% of reported). Respondents in this study slightly over-reported storage of drinking water in the Intervention area (50% observed vs. 54% reported); whilst this was under-reported this in the Control Area (50% observed vs. 45% reported).

This study compared five common characteristics observed, relating to the hygiene status of the toilets and hygiene practices of households in the Intervention Area and Control Area, and developed a toilet checklist score. The five characteristics included the following: State of cleanliness of the toilets, toilet does not smell, toilet does not have flies and hand-washing facilities and soap are provided near the toilet. In the Intervention Areas, the hygiene practices were ranked higher and the toilets were observed to be in a more hygienic condition than those in the Control Areas. The Intervention Area obtained a higher score of 2.31 whilst the Control Area scored 1.64.

Supporting this study, Stanton *et al.* found poor agreement between the questionnaire data and those obtained by direct observation of selected hygiene practices in Bangladesh, with desirable practices apparently being over-reported by respondents.[61]

Manun'Ebo *et al.* conducted a trial in Bandundu, Zaire, where both instruments were used to measure the disposal of child faeces and various hand-washing practices, which at the individual level, showed that agreement between the observed and reported behaviour was a little better than what might be expected by chance.[62] There was over-reporting of hand-washing before food preparation (44% vs. 33%; $p = 0.03$), hand-washing before eating (76% vs. 60%; $p < 0.001$), and disposal of children's faeces in a latrine (75% vs. 40%; $p < 0.001$).

The cost of soap also limits hand-washing activities by the family, although most households do have soap, which they use for washing clothes or bathing. Han *et al.* showed that hands readily become contaminated after defecation.[63] In Peru, only 11% of people were observed to wash their hands after defecation and the use of soap was even rarer.[64]

Curtis and Cairncross in a systematic review retrieved 38 papers to determine the impact of washing hands with soap on the risk of diarrhoeal diseases, of which 10 studies were observational. The pooled relative risk of diarrhoeal disease associated with not washing hands from the intervention trials was 1.88 (95% CI 1.31 – 2.68).[24]

Valid information from research studies are essential to develop, implement and evaluate interventions to enhance the quality of life of people and improve public health. One therefore needs to question the accuracy of this information and try to understand if information on hygiene behaviours obtained from structured observations is more valid than those obtained from an interview.

The argument of respondents over-reporting good behaviours or under-reporting others, does not constitute strong evidence that observations provide an accurate measure of behaviour. Just as respondents may tailor their responses to a question to conform to what they perceive to be the interviewer's expectations, so too can they alter their behaviour in the presence of an observer, to present what they perceive to be a desirable image. One way to overcome such bias is to perform repeated observations with the expectation that the respondent will become accustomed to the observer and revert to the usual practice. As this study is part of a larger analytic epidemiological study, six repeated observational visits were conducted and the replicability of the data will be reported on at a later stage.

5.2.7 Limitations of the study

1. The EWS unit advised the Research team that the Control Areas had no water and sanitation services. These areas were identified as future project areas where the package of services of installing a UD toilet, providing a ground tank with free 200 litres of safe water and undertaking hygiene education was to be unrolled.

When these control areas were visited it was found that water and sanitation was provided but in varying levels. None of the households in the control areas had UD toilets, so the inclusion criteria were still satisfied; hence they were included as part of the study.

2. Over 25 clusters of households (125 households) that were randomly selected in the Intervention Area of Mzinyathi could not be accessed. These households were part of a gated religious organisation called the Nazareth Church community. These households were occupied only when the Nazareth community held religious events. This caused a delay as new household numbers had to be randomly selected and new map grids had to be developed.

3. Access into the study areas after heavy rainfall was very difficult, as the roads were slippery and vehicular access was difficult. Due to the cost factor, the vehicles hired for use in this study were not 4x4 vehicles. Fortunately we did not conduct this study during the rainy season, so the delays based on poor weather conditions were factored into the study period, and were minimal.

4. Whilst the Intervention Area was supposed to have only UD toilets in use, this study found that many households still had their pit toilets in use as well. This information was collected, and in the analysis phase of the study this was accounted for, so as to ensure that correct conclusions were made.

5. It was later realised that the baseline questionnaire should have included a question relating to the date on which the UD toilet was built and handed over to the household for use in the Intervention Area.

5.2.7.1 Bias in the Study

Bias can enter the research process at any stage, and special attention has been outlined on how bias will be avoided or controlled for at the various stages.

5.2.7.2 Selection Bias

Sampling bias was controlled for in the study design by ensuring the sampling frames of households in the study areas were completed, and by randomly selecting study areas and households to be included in the study. These representative samples were drawn from the population in order to make the findings of the study applicable to the population. A procedure was further put into place to ensure if homes were locked, then that home was replaced by the next closest home.

5.2.7.3 Information Bias

In order to control for information bias; systematic inaccuracies, data capture and recording errors in the analysis of data, it was ensured that any form of misclassification be identified and controlled for or be completely avoided. Control with regard to social desirability was built into the Questionnaire. Respondents will be reluctant to divulge information about themselves or their families which portrays them in bad light. This tendency is likely to be more pronounced with behaviour patterns such as washing hands with soap. Hence this study included an observational protocol which the fieldworkers completed. The respondents reported actions could then be compared to the fieldworkers observed actions.

5.2.8 Directions for Future Work

At the time of conducting this research study, an initial visit was conducted at 1337 households to collect baseline data and an observational checklist was completed by the fieldworker at the end of every household visit, as presented in this dissertation.

A further prospective cohort study comprising of 5 more follow up visits has already been conducted at each of these household every two weeks, during which time data was collected from 7219 individuals on diarrhoea episodes, vomiting episodes, skin sores and worms. An observational checklist was completed by the fieldworker after every visit. The study represents close to 111 000 person days of follow up. This part

of the research findings was too big to be presented in partial fulfilment of the Master in Public Health, and the work will be reported on as part of a PhD study a little later.

The purpose of these studies were to assess if the roll out of the UD toilets together with the provision of 200 litres of free water in ground tanks and the implementation of the hygiene education programmes, translated into improved health status.

Within the frame of the established co-operation between UKZN, eThekwini Municipality, Swedish Institute for Infectious Diseases, World Health Organisation-Geneva and the Stockholm Environment Institute, a further intervention study is in the process of being planned in the control areas of the study.

It is also recommended that a number of qualitative studies can be done arising out of the outcomes of this baseline study. Some of them can include looking at why 16% of households are not using the UD toilets that have been provided, or why the 8% of households do not use the UD toilet as they were taught, or why did only 5% report to have received hygiene education in the Intervention area?

Due to the large database been created by my study (over 1,2 million variables), other researchers/students are carrying out further studies in the same area and adding great value to the area of research and development.

A follow up study performed by a Master student from the Royal Institute of Technology in Sweden, was undertaken to assess the prevalence of protozoan infections, with a focus on Giardia and Cryptosporidium. The study was conducted in the Intervention areas of my study, using a sub-sample of the same study population, where faecal material from UD vaults was analysed. The initial screening with Immunomagnetic Separation (IMS) and immunofluorescence antibodies showed an occurrence of Giardia cysts in 55% of the household samples and of Cryptosporidium oocysts in 21%. In 15% of the investigated toilets both Giardia and Cryptosporidium were detected. Concentrations above approximately 40,000 cysts/g did occur in 54% of all samples positive for Giardia and in 31% of samples containing Cryptosporidium.
Within this group, a parallel testing was also done for helminth ova.

A greywater study and a water quality study have also been conducted by other Master students from Pollution Research Group at UKZN, also using a sub-sample from my study population.

It has been estimated (Pegram, Rollins and Espey, 1998), that approx 24 million incidences of diarrhoea occur per year in South Africa with 2.8 million patients requiring treatment at health care facilities, with a substantial number of yearly deaths in diarrhoeal disease (about 43 000). The annual public and private direct health care costs incurred due to diarrhoea are at least R3.0 billion and the total social cost of diarrhoeal disease is at least 1% of the Gross Domestic Product in South Africa (R3.4 billion). It is thus essential to prove that the investments done actually are leading to a substantial improvement in health outcome. The most defenceless and economically marginalized segments of society are usually the most susceptible. Within the investigation areas a high unemployment rate occurs, and a large part of the population is living below the poverty line. HIV/AIDS is prevalent and underlying diseases are potentially high.

The use of wastewater, excreta and greywater in agriculture is partly a key determinant in the sanitation debate. It may provide poor household with an essential fertiliser thus enhancing small-scale business, but if not managed properly may enhance the likelihood of secondary transmission and potentially affecting vulnerable portions of the population, with underlying disease. Poor households spend a larger percentage (50–80%) of their income on food and water than do households that are better off (Lipton, 1983; World Food Programme, 1995). Based on household surveys in India it was found that per capita expenditure on food averaged 30%, 44% and 66% in urban, peri-urban and rural areas, respectively.

Without access to fertilisers many poor families would not be able to meet their nutritional needs, or may spend more money on food and less on other health-promoting activities, such as primary health care or education. Hence further research needs to be undertaken to explore the practise of safe reuse of excreta and grey water for agricultural purposes.

6 CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSION

Access to safe water and sanitation is a basic human right. This accompanied with appropriate hygiene education programmes can result in tangible benefits to public health. Therefore every effort has to be made to provide safe water, adequate sanitation and hygiene education programmes to communities in the control area of the study.

The study shows the positive impact the provision of these services have had in the Intervention area with regard to toilet usage, cleaner toilets, no smells, no flies, provision of hand washing facilities and soap.

Health and hygiene education has been singled out as the most effective mechanism in preventing water related diseases. The health and hygiene education programmes aimed at changing health and hygiene habits and behaviours will serve as a barrier to water related diseases.

The study shows that only 5% of households in the Intervention and Control Areas reported that they had participated in hygiene awareness programme, and 87% of all households were interested to learn more about the relationship between hygiene practices and diseases.

This study enabled us to measure associations between different exposure variables such as type of housing structure and its influence on the household patterns of using the UD toilet was assessed. Out of 283 households constructed with brick/concrete, over half (59%) used their UD toilets. Of 363 traditionally built households, 77% of households used their UD toilets. There was a significant difference ($p < 0.001$) between the type of housing structure and the households' usage of urine diversion toilets. On the other hand having a telephone or cell phone or reading the newspaper does not predict UD toilet usage.

The households understanding of hygiene practices and disease outcomes was assessed per Intervention and Control Area and dichotomised by education status, which showed 37% of households in both the Intervention and Control Areas do not understand the relationship between hygiene practices and disease outcomes, 50% have a basic understanding and only 12 % has a good understanding. This is indicative of where our focus needs to go.

The impact of provision of safe water was also very evident in the Intervention area with 2% of households using unprotected water sources compared to the Control area where 10% use unprotected water. Further the study shows that households are more likely to use unprotected water when they have to travel greater distances to collect water

This study allowed us to correlate respondents reported levels of sanitation use, safe storage of water and hygiene behaviour knowledge and practices, with that of the structured observations made by the trained fieldworkers. This information will be of great benefit in the prospective cohort study, which assesses health outcomes in the Intervention and Control Areas.

This study has provided a baseline for the prospective cohort study, which has assessed the health outcomes of water, sanitation and health and hygiene interventions with eThekwini.

This study has produced a demographic site which can be utilised by national and international researchers for future work. Several further studies have already commenced.

6.2 RECOMMENDATIONS

1. Social acceptability and political will both constitute very important factors for the success in implementation of sanitation interventions. Service providers must ensure that adequate advocacy is given to leaders. Advocating and supporting of areas and leaders who are engaged in overcoming ignorance, disease and poverty in a sustainable manner must be encouraged. Strong public accountability, more effective monitoring of water and sanitation services is needed to improve governance and service delivery to the poor.

2. Women are important change agents in promoting ecological sanitation approaches and women and children are the prime handlers (keepers) of the EcoSan toilets. The future of EcoSan is in the hands of the user. If users apply the required principles adequately, fewer problems would exist. If users employ it incorrectly, there will develop a reluctance to use the UD toilet and its good purpose and advantages will be nullified. The sanitation system must therefore be acceptable to the user. User education must be an integral part of sanitation projects. Special needs of children, disabled persons and the elderly must be considered in the design of the sanitation facility.

3. Although health gains may be the major benefit derived from water and sanitation improvements, it is often not regarded as the main contributor towards health in the perspective of the consumer. The links between safe water and adequate sanitation and improvements in health need to be continuously reinforced in the community.

4. There has to be a realisation that sanitation is more about behaviour change. The challenge is linking poor sanitation practises to prevalence of excreta related diseases and trying to break the faecal oral route of disease transmission by promoting total sanitation. Interventions to encourage the safe disposal of faecal matter and adequate hand washing after contact with faeces should pay greater dividends. Hand washing has been recognised as a key infection control practice whilst the importance of hand- washing in the home receives little attention.

Hand-washing facilities need to be promoted and included in conjunction with the toilet structure.

5. The WASH campaign promotes a partnership between both public and private sectors to provide more equitable and affordable services. It also raises the commitment of the political and social leaders to achieve the goals of reducing the burden of poverty and sickness and to impact on necessary behaviour changes.

6. Increased efforts to use traditional and mass media, street plays and drama and the erection of strategically placed billboards focussing on hygiene promotion at schools and within the communities are an essential part of water and sanitation improvements.

7. Training and building local capacity for communications and improving networking and research capabilities in the water and sanitation fields in a sustainable manner must be encouraged.

8. Hygiene promotion programmes are to be clearly formulated and demonstrably effective.

9. Such programmes must focus their efforts on a small number of messages of proven public health importance in order to avoid the wasting of the resources of programmes and communities which they target.

10. As part of the Sanitation Improvement programme, it is recommended that purpose made laundry facilities close to water supply points should be encouraged. Almost all the households lacked suitable areas to wash their laundry. This has lead to unsatisfactory conditions around water sources and improper disposal of waste water.

11. Improving and increasing efforts to highlight health promotion and sanitation within the eThekwini Municipality's poverty reduction strategies needs to be emphasized.

12. A poverty alleviation framework needs to ensure that the socio economic and equity aspects that play a role in water, sanitation and HIV/AIDS are addressed.

13. Safe water and sanitation constitute a basic need as well as a human right and this applies even more to people affected by HIV/AIDS as it will assist their long-term sustainability health-wise. It will also facilitate the care of ill patients and will enhance their dignity. There will also be a need to integrate hygiene education in the training given to home care volunteers in order to ensure safe water handling practices. Accessible and plentiful supplies of water facilitate and encourage better hygiene and more frequent hand-washing.

14. Sanitation improvements act as a catalyst for a wide range of human development benefits. It serves as a protection against illnesses; it lifts people out of poverty, raises production, boosts economic growth and creates employment.

15. The findings in this study may help to refine the approach to future water, sanitation and hygiene interventions in eThekwini. The integrated approach taken by the eThekwini Municipality incorporating engineering solutions with appropriate education to maximise facility usage and improve hygiene practices, is a useful example of how the desired health benefits can be obtained from projects of this type.

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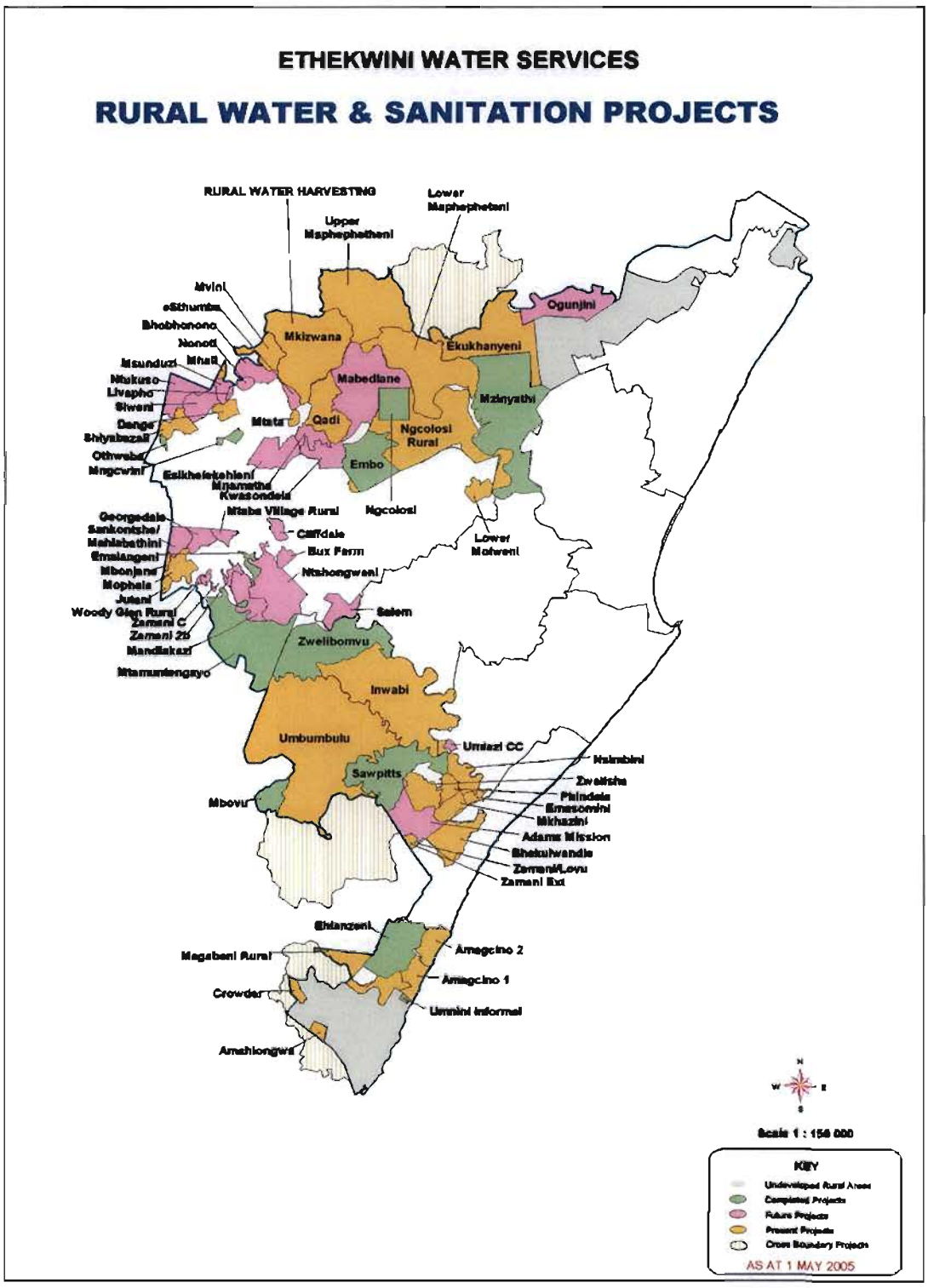
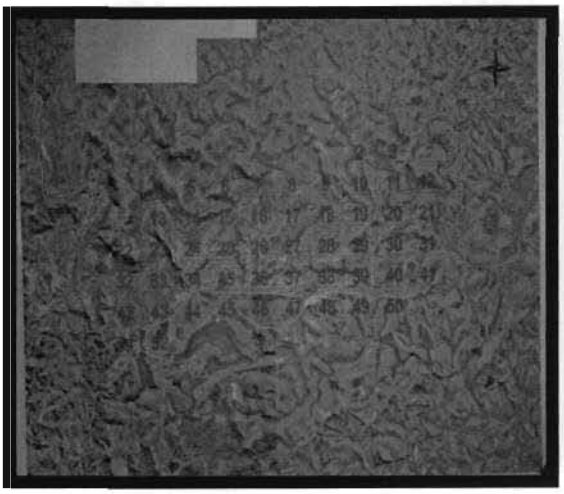
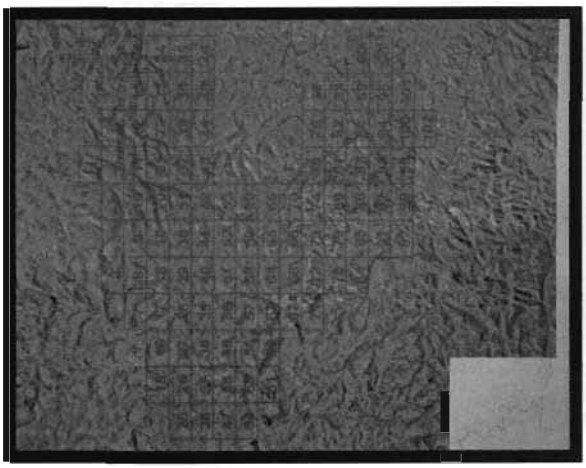
8 APPENDICES

Appendix 01: Rural Water and Sanitation Projects Map



Appendix 02: GIS Map Grids





Appendix 03 A: Household Questionnaire and Observational Protocol – English

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ECOSAN HOUSEHOLD QUESTIONNAIRE

D (1-3) Demographics

[D1 Respondent Details]

D1.1. Respondent's name: Last: _____ First: _____

D1.2. Respondent's sex: [1] [2]

Male Female

D1.3. Municipality Number: _____

D1.4. Respondent's Area: [1] [2] [3] [4] [5] [6]

Mzinyathi Mtamunetengayo Sawpitts Ogunjini Bux Farm Adams Mission

D1.5. Respondent's Address: _____

D1.6. Date: ____/____/____

D1.7. Interviewer: [ ]

[D2 Household Composition, Education & Income]

D2.1.1 – 2.1.xx (Coder to see code sheet).

Relationship to respondent (e.g. Mother)	**Age (Years)**	**Highest Education Level Achieved* (Years)**	**Employment****	**Income Contributor*****
Respondent				

Note: * **98** = None, **0** = Pre-primary, **1** = Grade 1, **2** = Grade 2) (**13**, **14**, **15**... = Number of years past Grade 12) (**0** = Abet 1, **3** = Abet 2, **6** = Abet 3, **9** = Abet 4).

** **1** = Permanent Employee Full Time (5 days), **2** = Permanent Employee Part time (3 days or less), **3** = Temporary Employment, **4** = Unemployed, **5** = Grant

*** Does this person contribute income to the household? **1** = Yes, **2** = No

D2.2.What is the combined **total** income of your household?

1	2	3	4	5	6	7	99
None	Less 400	401-800	801-1600	1601-3200	3201-6400	6401+	Refuse/Not sure

[D3 Socioeconomic Indicators]

D3.1. What type of housing unit/s does this household occupy?

[allow multiple response]

1	2	3
Brick or concrete	Informal Shack	Traditional Structure

D3.2 How many rooms are used for sleeping in the house?

No:

D3.3. What type of fuel do you use for the following activities?

D3.3.1. Cooking?

Codes
1 = Electricity, **2** = Gas, **3** = Paraffin,
4 = Wood, **5** = Coal, **6** = Candles
7 = Animal Dung, **8** = Other (specify in box)

Code:	Code:
Mainly	Sometimes

D3.3.2. Heating?

Code:	Code:
Mainly	Sometimes

D3.3.3. Lighting?

Code:	Code:
Mainly	Sometimes

D3.4. Do you have any of the following in **working** condition?

D3.4.1. Radio	1 Yes	2 No
D3.4.2. Television	1 Yes	2 No
D3.4.3. Computer	1 Yes	2 No
D3.4.4. Telephone	1 Yes	2 No
D3.4.5. Cell Phone	1 Yes	2 No
D3.4.6. Refrigerator	1 Yes	2 No

D3.5. How many of the following items are in your household?

D3.5.1. Children's Books	No:
D3.5.2. Books	No:
D3.5.3. Magazines	No:

3.6. If someone in the family reads a newspaper, would you say of the one who reads it the most that they read it [always/ most of the time/ some of the time/ do not read it]?

1	2	3	4
Always	Most of the time	Some of the time	do not read it

S (1) Sanitation

[S1 Toilet Facilities & Use]

S1.1. Does this household have a Urine Diversion Toilet?

1 Yes

2 No [Coder code **9** if not applicable]

S.1.1.1.Whilst at home, where do people in the household **mainl** go to the toilet?

1	2	3	4	5	6	7
Flush (sewerage)	Flush (septic)	Chemical	Pit VIP	Pit	Bucket	Bush

S.1.1.2. Whilst at home, do members of the household go to the toilet anywhere else and if so where?

8	1	2	3	4	5	6	7
No	Flush (sew.)	Flush (sep)	Chemical	Pit VIP	Pit	Bucket	Bush

[Coder Code **9** if not applicable]

S.1.1.3. Whilst at home, is the UD toilet used [always/ most of the time/some of the time/or never] by members of the household?

1	2	3	4
Always	Most of the time	Some of the time	Never

S.1.1.4. Whilst at home, do members of the household go to the toilet anywhere else and if so where?

8	1	2	3	4	5	6	7
No	Flush (sew.)	Flush (sep)	Chemical	Pit VIP	Pit	Bucket	Bush

[Has UD Toilet] [Coder code **9** if not applicable] **[No UD toilet]**

S1.2. Does everyone in the family use the UD toilet?

1 Yes

2 No → [Coder code **9** if not applicable]

If No,

S1.2.1. Who does not use it?

_____

S1.2.2. Why do they not use it?

_____

S1.2.3. Where do they go to the toilet?

1 Flush (sew.) 2 Flush (sep) 3 Chemical 4 Pit VIP 5 Pit 6 Bucket 7 Bush

S1.3.Does everyone in the family use the UD toilet as they have been taught to use it?

1 Yes

2 No → [Coder code **9** if not applicable]

If No:

S1.3.1. Who does not use it properly?

_____

S1.3.2. What is it that they do wrong?

_____

S1.4. Do the children in your family (under 12) use the UD toilet **most** of the time?

1 Yes

2 No → [Coder code **9** if not applicable]

9 No children in household

If No:

S1.4.1. Why do they not use the UD toilet most of the time? _____

S1.4.2. Whilst at home, where do they go to the toilet most of the time?

1 2 3 4 5 6 7

[Has UD Toilet]

[No UD toilet]

S1.5. Where do children (under 12) **mainly** go to the toilet?

[Coder code **9** if not applicable]

1	2	3	4	5	6	7
Flush (sew.)	Flush (sep)	Chemical	Pit VIP	Pit	Bucket	Bush

[No UD toilet]

S1.6. Is urine diverted in the toilet [always/most of the time/some of the time/never]?
[Coder code **9** if not applicable]

1	2	3	4
Always	Most of the time	Some of the time	Never

S1.7. Does water get in to the faeces chamber [always/most of the time/some of the time/never]? [Coder code **9** if not applicable]

1	2	3	4
Always	Most of the time	Some of the time	Never

S.1.8. Is a covering material (e.g. sand/ash) used after defecating in the toilet [always/most of the time/some of the time/never]?
[Coder code **9** if not applicable]

1	2	3	4
Always	Most of the time	Some of the time	Never

S1.9. Does the pit smell [always/most of the time/some of the time/never]?
[Coder code **9** if not applicable]

1	2	3	4
Always	Most of the time	Some of the time	Never

S1.10. Are there flies around the toilet [always/most of the time/some of the time/ never]?
[Coder code **9** if not applicable]

1	2	3	4
Always	Most of the time	Some of the time	Never

S1.11. Is the toilet pedestal kept clean [always/most of the time/some of the time/never]?
[Coder code **9** if not applicable]

1	2	3	4
Always	Most of the time	Some of the time	Never

[Has UD Toilet]

W (1-4) Water

[W1 Water Sources]

W.1.1. What water facilities/sources are used by the household?

[Interviewer allow multiple response]

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	other

[W2 Water Uses]

W2.1. Where do you mainly get water for the following uses?

W2.1.1. Drinking

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

W2.1.2.Washing hands

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

W2.1.3. Bathing

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

W2.1.4. Washing clothes

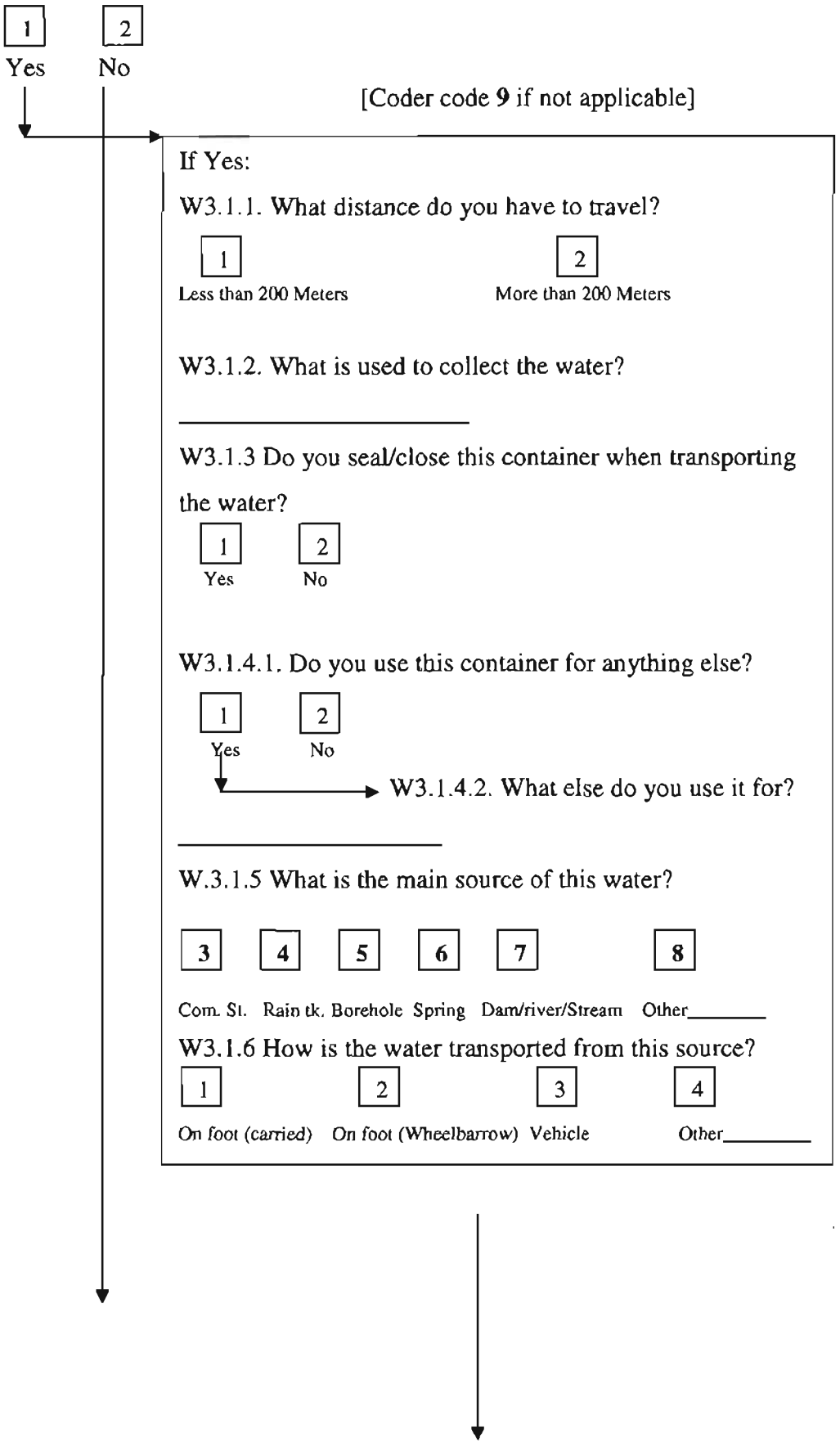
1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

W2.1.5. Preparing Food

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

[W3 Water Collection]

W3.1. Is drinking water collected from outside the household and garden area?



[W4 Water Storage]

W4.1. At home, do you keep a **store** of drinking water in a container separate from the water source (e.g., from the tank, from a tap, from the river)?

[Coder code **9** if not applicable]

1 Yes

2 No

If Yes:

W4.1.1. What kind of a container do you use for this purpose?

_____

W4.1.2. Do you cover/seal this container?

1 Yes 2 No

W4.1.3.1 How do you dispense the water from this container?

1 Pour it out 2 Scoop it out

W4.1.3.2 What do you use to scoop the water out? _____

W4.1.2.3. Is this object used only for this purpose?

1 Yes 2 No

W 4.1.2.4. What else do you use this object for?

_____

W4.1. Is your drinking water from a piped source?

1 Yes 2 No

[Coder code **9** if not applicable]

If No:

W5.1.1. How do you treat your water?

1 Do not treat 2 Add Jik/bleach 3 Boil ☐ Other_____

H (1-2) Health & Hygiene

[H1 Health Information]

H1.1. Do you know about the **Water and Sanitation Hygiene** (WASH) program?

1	2
Yes	No

H1.2. Have you ever participated in a hygiene awareness program?

1	2
Yes	No

H1.3. Would you like to learn more about the relationship between hygiene practices and disease?

1	2
Yes	No

H1.4. Which of the following statements best describes your understanding of the relationship between hygiene practices and disease?

I already have a **fairly good** understanding of the relationship between hygiene practices and disease 3

I have a **basic** understanding of the relationship between hygiene practices and disease 2

I **do not yet understand** the relationship between hygiene practices and disease 1

H1.5. Can you tell me about **poor hygiene** practices?

H1.6. Before and after which activities do you think good hygiene practices are important?

H1.7. Do you think that **not washing hands** after going to the **toilet** can cause sickness?

1	2
Yes this can make you sick	No this cannot make you sick

H1.8. Do you think that **not washing** hands **before cooking or handling food** can cause sickness?

1	2
Yes this can make you sick	No this cannot make you sick

H1.9. Do you think that **not washing** hands before **eating** can cause sickness?

1	2
Yes this can make you sick	No this cannot make you sick

H1.10. Do you think that **not washing** hands before **feeding a baby** can cause sickness?

1	2
Yes this can make you sick	No this cannot make you sick

H1.11 Would you say that **you should** use **soap** [always/ most of the time/some of the time/or never] when washing your hands?

1	2	3	4
Always	Most of the time	Some of the time	Never

H1.12. You may have heard that **poor hygiene** practices can cause a number of diseases. Can you tell us which diseases you think can be caused by poor hygiene? [Do not read out boxes]. [Allow multiple responses].

9	1	2	3	4	5	6
Don't know	Diarrhoea	Vomiting	Worms	Skin sores	Scabies	Other -

[H2 Hygiene Behaviour]

H2.1 Which statement best describes the normal actions of your family?

All the members of my family wash their hands after using the toilet.	4
Most members of my family wash their hands after using the toilet.	3
Some members of my family wash their hands after using the toilet.	2
No-one in my family washes their hands after using the toilet.	1

H2.2. When members of your family wash their hands after going to the toilet, would you say they use soap [always/ most of the time/some of the time/or never]. [Code coder 9 if not applicable].

1	2	3	4
Always	Most of the time	Some of the time	Never

H2.3 Which statement best describes the normal actions of your family?

All the members of my family wash their hands before eating.	4
Most members of my family wash their hands before eating.	3
Some members of my family wash their hands before eating.	2
No-one in my family washes their hands before eating.	1

H2.4. When members of your family wash their hands before eating, would you say they use soap [always/ most of the time/some of the time/or never]. [Code coder 9 if not applicable].

1	2	3	4
Always	Most of the time	Some of the time	Never

H2.5. Are there any babies in this household using nappies

1	2
Yes	No

[Coder code 9 is not applicable]

If Yes,

H2.5.1. Where is the faeces from the nappies thrown away?

H2.5.2. After the person has changed the babies nappies would you say they wash their hands [always/ most of the time/some of the time/or never].

1	2	3	4
Always	Most of the time	Some of the time	Never

H2.5.3. When the person washes their hands after changing the babies nappies would you say they use soap [always/ most of the time/some of the time/or never].

1	2	3	4
Always	Most of the time	Some of the time	Never

Thank you very much for your time. I would like now to take a quick look around your home and garden area.

Household ID number: _____

OBSERVATIONAL CHECKLIST

Observation	Yes	No	N/A	Comments
Inside Hand washing Facilities				
HW1) There is hand washing facilities inside the house	1	0		
HW2) There is soap provided inside the house for hand washing	1	0		
Household has a UD Toilet: Ask 1 – 14	**1**	**2**		
UD1) The toilet appears to be used by the family	1	0		
UD2) Other outside toilets appear to be in use	0	1		
UD3) The toilet door is broken or missing	0	1		
UD4) The toilet door is closed	1	0		
UD5) The toilet walls are clean	1	0		
UD6) The toilet floor is clean	1	0		
UD7) The toilet seat is clean	1	0		
UD8) Sand/ash is available in the toilet ready for use	1	0		
UD9) The toilet smells badly	0	1		
UD10) There appears to be moisture/wetness in the faeces chamber	0	1		
UD11) There are flies around the toilet	0	1		
UD12) The ground around the toilet is muddy	0	1		
UD13) There are hand washing facilities near the toilet	1	0		
UD14) There is soap provided for hand washing after toilet use	1	0		
Household has other (non-UD) outside toilet(s): Ask 1-5	**1**	**2**		
OT1) The toilet smells badly	0	1		
OT2) There are flies around the toilet	0	1		
OT3) The toilet area appears clean	1	0		
OT4) There are hand washing facilities near the toilet	1	0		
OT5) There is soap provided for hand washing after toilet use	1	0		
Household has outdoor ground Water Tank: Ask 1-4	**1**	**2**		
GT1) The ground around the	0	1		

outdoor ground tank is muddy				
GT2) The ground tank is damaged/defective /missing	0	1		
GT3) The outdoor ground tank tap is leaking/or missing	0	1		
GT4) There is soap near the outdoor tank	1	0		
Household has no indoor piped water: Ask 1 – 2	**1**	**2**		
IP1) There is a store of drinking water (not including the ground tank).	1	0		
IP2) The store of water is covered	1	0		
Yard Area				
YA1) There is grey/stagnant water in the yard	0	1		
YA2) There is domestic waste and litter in the yard	0	1		
YA3) There is animal/human faeces in the yard	0	1		

Appendix 03 B: Household Questionnaire and Observational Protocol – IsiZulu

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ECOSAN HOUSEHOLD QUESTIONNAIRE

D (1-3) Demographics

[D1 Respondent's Details]

D1.1. Respondent's name: Last: _____ First: _____

D1.2. Respondent's sex: ☐ 1 Male ☐ 2 Female

D1.3. Municipality Number: _____

D1.4. Respondent's Area: ☐ 1 Mzinyathi ☐ 2 Mtamunetengayo ☐ 3 Sawpitts ☐ 4 Ogunjini ☐ 5 Bux Farm ☐ 6 Adams Mission

D1.5. Respondent's Address: _____

D1.6. Date: ____/____/____

D1.7. Interviewer: ☐

[D2 Household Composition, Education & Income]

D2.1.1 – 2.1.xx (Coder to see code sheet).

Uhlobene kanjani nalowo oxoxa naye (e.g. Umama)	**Iminyaka yobudala**	**Ibanga agcine eliphasile* (Years)**	**Uyasebenza****	**Ikhona imali ayingenisayo*****
Lowo oxoxa naye				

Note: * **98** = None, **0** = Pre-primary, **1** = Grade 1, **2** = Grade 2) (**13**, **14**, **15**... = Number of years successfully completed past Grade 12) (**0** = Abet 1, **3** = Abet 2, **6** = Abet 3, **9** = Abet 4).
** **1** = Permanent Employee Full Time (5 days), **2** = Permanent Employee Part time (3 days or less), **3** = Temporary Employment (i.e., fixed duration), **4** = Unemployed, **5** = Grant
*** Does this person contribute income to the household? **1** = Yes, **2** = No

D2.2. Uma ucabanga malini engenayo laphekhaya uma **isihlanganiswe yonke** ?

1	2	3	4	5	6	7	99
None	Less 400	401-800	801-1600	1601-3200	3201-6400	6401+	Refuse/Not sure

[D3 Socioeconomic Indictors]

D3.1. Zakhiwe ngani izindlu okuhlalwa kuzo laphekhaya?
[Allow multiple response]

1	2	3
Iyisitini noma iyisakhiwo esiqinile	Isakhiwo sesikhashana/umjondolo	Isakhiwo sesintu

D3.2 Mangaki amakamelo okulalwa kuwo kulendlu?

No:

D3.3. Nisebenzisani ekwenzeni lezizinto ezilandelayo?

D3.3.1. Ekuphekeni?

Codes
1 = Electricity, **2** = Gas, **3** = Paraffin,
4 = Wood, **5** = Coal, **6** = Candles
7 = Animal Dung. **8** = Other (specify in box)

Code:	Code:
Enijwayele	Enithukela nikusebenzisa

D3.3.2. Ukufudumeza indlu?

Code:	Code:
Enijwayele	Enithukela nikusebenzisa

D3.3.3. Ukukhanyisa?

Code:	Code:
Enijwayele	Enithukela nikusebenzisa

D3.4. Kukhona eninakho **okusebenzayo** kulokhu okulandelayo?

D3.4.1. Radio	1 Yes	2 No
D3.4.2. Television	1 Yes	2 No
D3.4.3. Computer	1 Yes	2 No
D3.4.4. Telephone	1 Yes	2 No
D3.4.5. Cell Phone	1 Yes	2 No
D3.4.6. Refrigerator	1 Yes	2 No

D3.5. Zingaki izinto eninazo kulezi ezilandelayo laphekhaya?

D3.5.1. Children's Books	No:
D3.5.2. Books	No:
D3.5.3. Magazines	No:

3.6. Ungathi emndenini wakho ofunda iphepha kunabobonke ulifunda {njalo/isikhathi esiningi/kuyethukela nje/ noma akekho olifundayo?

1	2	3	4
Njalo	Isikhathi esiningi	Kuyethukela nje	Akekho olifundayo

S (1) Sanitation

[S1 Toilet Facilities & Use]

S1.1. Ingabe laphekhaya ninalo ithoyilethi elehlukanisa indle nomchamo (ithoyilethi iUD)?

1 Yes

2 No

[Coder code **9** if not applicable]

S.1.1.1.Laphekhaya, **nivamise** ukuzikhululela kuphi?

1	2	3	4	5	6	7
Elishaywayo elixhunywe kumapayipi ahambayo	elishaywayo elixhunywe kumapayipi omgodi osekhaya	elifakwa imithi elingenawo umgodi	elomgodi elingangenis ukukhanya	elomgodi	elebhakede	ehlathi
Flush (sew.)	Flush (sep)	Chemical	Pit VIP	Pit	Bucket	Bush

S.1.1.2. Laphekhaya, ingabe amalungu omndeni kukhona lapho abuye ayozikhululela khon. uma kunjalo ayaye ayekuphi?

8	1	2	3	4	5	6	7
No	Flush (sew.)	Flush (sep)	Chemical	Pit VIP	Pit	Bucket	Bush

[Go to S1.5]

[Coder Code **9** if not applicable]

S.1.1.3. Laphekhaya kungabe ithoyilethi iUD lisetshenziswa amalungu alapha{njalo/isikhathi esiningi/kuthukela nje/noma akwenzeki}?

1	2	3	4
Njalo	Isikhathi esiningi	Kuthukela nje	Akwenzeki

S.1.1.4. Laphekhaya, ingabe amalungu omndeni kukhona lapho abuye ayozikhululela khona, uma kunjalo ayaye ayekuphi?

8	1	2	3	4	5	6	7
No	Flush (sew.)	Flush (sep)	Chemical	Pit VIP	Pit	Bucket	Bush

[Has UD Toilet] [Coder code **9** if not applicable] **[No UD toilet]**

S1.2. Kungabe onke amalungu omndeni wakho ayalisebenzisa ithoyolethi iUD?

1 Yes

2 No → [Coder code **9** if not applicable]

If No,

S1.2.1. Obani abangalisebenzisi?

_____

S1.2.2. Abalisebenzisi ngani?

_____

S1.2.3. Bazikhululela kuphi?

1 Flush (sew.) | 2 Flush (sep) | 3 Chemical | 4 Pit VIP | 5 Pit | 6 Bucket | 7 Bush

S1.3. Kungabe bonke abomndeni bayalisebenzisa ngendlela abafundiswa ngayo ithoyilethi iUD?

1 Yes

2 No → [Coder code **9** if not applicable]

If No:

S1.3.1. Obani abangalisebenzisi kahle?

_____

S1.3.2. Yikuphi abakwenza ngendlela engafanele?

_____

S1.4. Kungabe izingane zomndeni wakho (ezingaphansi kweminyaka engu - 12) Ziyalisebenzisa ithoyilethi iUD isikhathi **esiningi**?

1 Yes

2 No → [Coder code **9** if not applicable]

9 No children in household

If No:

S1.4.1. Kungani bengalisebenzisi ithoyilethi iUD isikhathi esiningi? _____

S1.4.2. Laphekhaya ziyaye ziyephi ukuyozikhulula isikhathi esiningi?

1 Flush (sew.) | 2 Flush (sep) | 3 Chemical | 4 Pit VIP | 5 Pit | 6 Bucket | 7 Bush

[Has UD Toilet] **[No UD toilet]**

S1.5 Izingane (ezingaphansi kweminyaka engu 12) **zijwayele** ukuzikhululela kuphi?

[Coder code **9** if not applicable]

1	2	3	4	5	6	7
Flush (sew.)	Flush (sep)	Chemical	Pit VIP	Pit	Bucket	Bush

[No UD toilet] [Go toW1.1]

[Coder code **9** if not applicable]

S1.6. Kungabe umchamo uke ungene ngaphakathi ethoyilethi [njalo/isikhathi esiningi/ kuyethukela nje/ noma akwenzeki}?

1	2	3	4
Njalo	Isikhathi esiningi	Kuthukela nje	Akwenzeki

S1.7. Kungabe amanzi ake angene emgodini wendle [njalo/isikhathi esiningi/kuyethukela nje/ noma akwenzeki]?

1	2	3	4
Njalo	Isikhathi esiningi	Kuthukela nje	Akwenzeki

S.1.8. Kungabe okokwemboza (e.g. sand/ash) kuyasetshenziswa emuva kokuzikhulula ethoyilethi[njalo/isikhathi esiningi/kuyethukela nje/ noma akwenzeki]?

1	2	3	4
Njalo	Isikhathi esiningi	Kuthukela nje	Akwenzeki

S1.9. Kungabe umgodi uyanuka [njalo/isikhathi esiningi/kuyethukela nje/ noma akwenzeki]?

1	2	3	4
Njalo	Isikhathi esiningi	Kuthukela nje	Akwenzeki

S1.10. Kungabe zikhona izimpukane ngasethoyilethi [njalo/isikhathi esiningi/kuyethukela nje/ noma akwenzeki]?

1	2	3	4
Njalo	Isikhathi esiningi	Kuthukela nje	Akwenzeki

S1.11. Kungabe isihlalo sethoyilethi sihlale sihlanzekile [njalo/isikhathi esiningi/kuyethukela nje/ noma akwenzeki]?

1	2	3	4
Njalo	Isikhathi esiningi	Kuthukela nje	Akwenzeki

[Has UD Toilet]

W (1-4) Water

[W1 Water Sources]

W.1.1. Niwatholaphi amanzi eniwasebenzisayo laphekhaya?

[Interviewer allow multiple response]

1	2	3	4	5	6	7	8	9
Ithangi leplastiki lamanzi epayipi	amanzi epayipi	Awepayipi	Ithangi lemvula	Ipitsi	Isiphethu	Idamu/umfula/ umfudlana	Ithangi lomphakathi lamanzi epayipi	Okunye
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

[W2 Water Uses]

W2.1. **Nijwayele** ukuwatholaphi amanzi alokhu okulandelayo?

W2.1.1. Awokuphuzwa

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

W2.1.2.Awokugezizandla

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

W2.1.3. Awokugeza umzimba

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Commu Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	CommTank	Other

W2.1.4. Awokuwasha izingubo

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

W2.1.5. Awokulungisa ukudla

1	2	3	4	5	6	7	8	9
Ground Tank	Piped water	Community Stand	Rainwater tank	Borehole	Spring	Dam/river/Stream	Community Tank	Other

[W3 Water Collection]

W3.1. Kungabe amanzi okuphuzwa niwakha ngaphandle kwasekhaya nangaphandle kwezingadi zasekhaya?

[1] Yes [2] No

[Coder code **9** if not applicable]

If Yes:

W3.1.1. Nihamba ibanga elingakanani?

[1] Less than 200 Meters [2] More than 200 Meters

W3.1.2. Nisebenzisani ukuyokha amanzi

_____

W3.1.3 Niyayivala/niyayimboza into yokukha amanzi ngenkathi niwathutha?

[1] Yes [2] No

W3.1.4.1. Kungabe lento enikha ngayo amanzi kukhona okunye eniyisebenzisela khona?

[1] [2]

W3.1.4.2. Kuyini okunye eniyisebenzisela khona?

_____

W.3.1.5 Kungabe nivamise ukuwakhaphi wona lamanzi?

[3] Com. St. [4] Rain tk. [5] Borehole [6] Spring [7] Dam/river/Stream [8] Other_____

W3.1.6 Niwathutha ngani lamanzi uma nisuka lapho?

[1] On foot (carried) [2] On foot (wheelbarrow) [3] Cattle [4] Other_____

[W4 Water Storage]

W4.1. Kungabe ekhaya **kukhona lapho enigcina khona** amanzi okuphuzwa entweni eyehlukile kuleyo enisuke niwakhe nawafaka kuyo (e.g., ukusuka ethangini, ukusuka empompini, ukusuka emfuleni)?

[Coder code **9** if not applicable]

1 Yes

2 No

If Yes:

W4.1.1. Inhloboni into eniyisebenzisela lokhu?

_____

W4.1.2. Niyayimboza noma niyayivala leyonto?

1 Yes 2 No

W4.1.3.1 Niwakha kanjani amanzi kuleyonto ?

1 ...etha 2 ...akhelela

W4.1.3.2 Nisebenzisani ukuwakhelela/ukuwetha amanzi?

_____

W4.1.3.3. Kungabe leyonto isetshenziselwa kuphela ukukha lamanzi

1 Yes 2 No

W 4.1.2.4. Yini enye esetshenziselwa yona leyonto?

W4.1. Kungabe amanzi enu okuphuza ahamba ngepayipi?

1 Yes 2 No

[Coder code **9** if not applicable]

If No:

W5.1.1. Niwahlanza ngani amanzi enu?

1 Asiwahlanzi 2 Sifaka ujikhi/isisusa mabala 3 Siyawabilisa 4 Okunye_____

H (1-2) Health & Hygiene

[H1 Health Information]

H1.1. Uyalwazi uhlelo **lokuhlanzeka kwamanzi nokuthuthwa kwendle** olubizwa ngokuthi (iWASH)?

1	2
Yes	No

H1.2. Wake walibamba iqhaza ohlelweni lokuqwashisa ngenhlanzeko?

1	2
Yes	No

H1.3. Ungafisa ukufunda kabanzi mayelana nobudlelwane phakathi kwezenzo zenhlanzeko kanye nezifo?

1	2
Yes	No

H1.4. Imiphi kulemisho echaza kangcono ukwazi kwakho ubudlelwane phakathi kwezenzo zehlanzeko kanye nezifo?

Senginalo ulwazi **oluhle nje** ngobudlelwane phakathi kwezenzo zenhlanzeko kanye nezifo	3
Nginolwazi **oluncane** ngobudlelwane phakathi kwezenzo zenhlanzeko nezifo	2
Anginalo ulwazi ngobudlelwane obuphakathi kwezenzo zenhlanzeko kanye nezifo	1

H1.5. Ungangitshela **ngezenzo ezingezinhle zokungahlanzeki**?

H1.6. Kukuphi lapho ucabanga ukuthi izenzo zenhlanzeko ezinhle zisemqoka khona?

H1.7. Ucabanga ukuthi **ukungazigezi izandla** emva kokuya **ethoyilethi** kungabanga ukugula?

1	2
Yebo lokhu kungakugulisa	Cha lokhu kungeke kwakugulisa

H1.8. Ucabanga ukuthi **ukungazigezi** izandla **ngaphambi kokupheka noma ukuphatha ukudla** kungabanga izifo?

1	2
Yebo lokhu kungakugulisa	Cha lokhu kungeke kwakugulisa

H1.9. Ucabanga ukuthi **ukungagezi** izandla ngaphambi **kokudla** kungabanga ukugula?

1	2
Yebo lokhu kungakugulisa	Cha lokhu kungeke kwakugulisa

H1.10. Ucabanga ukuthi **ukungagezi** izandla ngaphambi **kokupha ingane ukudla** kungabanga ukugula?

1	2
Yebo lokhu kungakugulisa	Cha lokhu kungeke kwakugulisa

H1.11 Ubona ukuthi **kufanele nisebenzise insipho** [njalo/isikhathi esiningi/kuyethukela
nje/ noma akwenzeki] uma nigeza izandla zenu?

1	2	3	4
Njalo	Isikhathi esiningi	kuyethukela nje	Akwenzeki

H1.12. Kungenzeka ukuthi uke uzwe ukuthi **izenzo ezingenanhlanzeko** zingabanga izifo ezimbalwa? Wena ungasitshela ukuthi iziphi izifo ezingabangwa ukungahlanzeki kahle?**[Do not read out boxes]. [Allow multiple response]**.

9	1	2	3	4	5	6
Angazi	Uhudo	Ukubuyisa	Izikelemu	Izilonda esikhumbeni	Utwayi	Okunye

[H2 Hygiene Behaviour]

H2.1 Imuphi umusho ochaza kahle kakhulu okujwayelekile okwenziwa umndeni wakho?

Onke amalungu omndeni wami ayazigeza izandla emva kokuya ethoyilethi. 4

Imvamisa yamalungu omndeni wami ayazigeza izandla emva kokuya ethoyilethi 3

Amanye amalungu omndeni wami ayazigeza izandla emva kokuya ethoyilethi 2

Akekho emndenini wami ozigezayo izandla emva kokuya ethoyilethi. 1

H2.2. Uma amalungu omndeni wakho ezigeza izandla emva kokuya ethoyilethi, ungathi ayayisebenzisa insipho [njalo/isikhathi esiningi/kuyethukela
nje/ noma akwenzeki]. [Code coder 9 if not applicable].

1	2	3	4
Njalo	Isikhathi esiningi	kuyethukela nje	Akwenzeki

H2.3 Imuphi umusho ochaza kahle kakhulu okujwayelekile okwenziwa umndeni wakho?

Onke amalungu omndeni wami ayazigeza izandla zawo ngaphambi kokudla. [4]

Imvamisa yamalungu omndeni wami ayazigeza izandla ngaphambi kokudla [3]

Amanye amalungu omndeni wami ayazigeza izandla ngaphambi kokudla [2]

Akekho emndenini wami ozigezayo izandla ngaphambi kokudla [1]

H2.4. Uma amalungu omndeni wakho ezigeza izandla ngaphambi kokuyokudla, ungathi ayayisebenzisa insipho [njalo/isikhathi esiningi/kuyethukela nje/ noma akwenzeki]. [Code coder 9 if not applicable].

[1] [2] [3] [4]

Njalo Isikhathi esiningi kuyethukela nje Akwenzeki

H2.5. Bakhona abantwana laphekhaya abasebenzisa amanabukeni

[1] [2]

Yes No [Coder code 9 is not applicable]

If Yes,

H2.5.1. Indle esemanabukenini ilahlwaphi?

_____

H2.5.2. Uma ngabe umuntu eselishintshile inabukeni lomntwana ungathi uyazigeza izandla [njalo/isikhathi esiningi/kuyethukela nje/ noma akwenzeki].

[1] [2] [3] [4]

Njalo Isikhathi esiningi kuyethukela nje Akwenzeki

H2.5.3. Uma umuntu ewasha izandla zakhe emva kokushintsha inabukeni lomntwana, ungathi uyayisebenzisa insipho[njalo/ isikhathi esiningi/kuyethukela nje/akkwenzeki].

[1] [2] [3] [4]

Njalo Isikhathi esiningi kuyethukela nje Akwenzeki

Ngiyabonga kakhulu isikhathi sakho. Ngicela ukuba kengibone ikhaya lakho ngaphakathi nangaphandle.

Household ID number:_____

OBSERVATION CHECKLIST

Observation	Yes	No	N/A	Ukuphawula
Inside Hand washing Facilities				
HW1) Kunezinto zokugeza izandla ngaphakathi endlini	1	0		
HW2) Kukhona insipho ebekelwe ukugeza izandla ngaphakathi endlini	1	0		
Household has a UD Toilet: Ask 1 – 14	**1**	**2**		
UD1) Ithoyilethi libonakala sengathi liyasetshenziswa umndeni	1	0		
UD2) Amanye amathoyilethi angaphandle kwendlu abonakala sengathi ayasetshenziswa	0	1		
UD3) Isivalo sethoyilethi sephukile noma asikho	0	1		
UD4) Isivalo sethoyilethi sivaliwe	1	0		
UD5) Izindonga zethoyilethi zihlanzekile	1	0		
UD6) Phansi ethoyilethi kuhlanzekile	1	0		
UD7) Isihlalo sethoyilethi sihlanzekile	1	0		
UD8) Inhlabathi/umlotha ukhona ethoyilethi ulindele ukusetshenziswa	1	0		
UD9) Ithoyilethi linuka kabi	0	1		
UD10) Kubukeka kunokuswakama /ubumanzi kwindle esemgodini	0	1		
UD11) Kunezimpukane ezizungeze ithoyilethi	0	1		
UD12) Phansi endaweni ezungeze ithoyilethi kuwudaka	0	1		
UD13) Kunezinto zokugeza izandla eduzane nethoyilethi	1	0		
UD14) Kunensipho ebekelwe ukugeza izandla emva kokusebenzisa ithoyilethi	1	0		
Household has other (non-UD) outside toilet(s): Ask 1-5	**1**	**2**		
OT1) Ithoyilethi linuka kabi	0	1		
OT2) Kunezimpukane ezizungeze ithoyilethi	0	1		

OT3) Kubukeka kuhlanzekile ngasethoyilethi	1	0		
OT4) Kunezinto zokugeza izandla eduzane nethoyilethi	1	0		
OT5) Kunensipho ebekelwe ukugeza izandla emva kokusebenzisa ithoyilethi	1	0		
Household has outdoor ground Water Tank: Ask 1-4	**1**	**2**		
GT1) Phansi endaweni ezungeze ithangi lamazi leplastiki elinepayipi elingaphandle kuwudaka	0	1		
GT2) Ithangi lamanzi eliyiplastiki elinepayipi lilimele/linesici	0	1		
GT3) Umpompi wethangi lamazi leplastiki elinepayipi elingaphandle uyavuza noma awukho	0	1		
GT4) Kunensipho eduzane nehtangi elingaphandle	1	0		
Household has no indoor piped water: Ask 1 – 2	**1**	**2**		
IP1) Kunendawo lapho kufakwa khona amanzi okuphuza (asisho ithangi lamanzi eliyiplastiki elinepayipi)	1	0		
IP2) Kumboziwe lapho okufakwe khona amanzi	1	0		
Yard Area				
YA1) Kunamanzi angcolile enensipho/amanzi amile egcekeni	0	1		
YA2) Kunezibi kanye nodoti olahlwe egcekeni	0	1		
YA3) Kunendle yezilwane/neyabantu egcekeni	0	1		

Appendix 04: EcoSan Project Training Schedule

9.00 – Introductions & Teams

9.30 – Project Overview

- Background
- Aim of the Study
- Study Objectives/ Research Questions
- Nature of the water & sanitation intervention
- Sample & Measure points
- Your role as researchers in the study

10.30 – Interviewing & the Research Tools

- Consent Forms & Study Information
- The Household Questionnaire & Observational Checklist
- The Occurrence of illness Questionnaire

1.00 – 2.00 - Lunch

2.00 – The Logistics of the Data Collection

- The Areas & The Teams
- One week turnaround
- Household Clusters
- Locating the Households (Maps & GPS)
- Registers (Attendance / Data / Log Book)

3.30 – Administrative matters

- Addresses & Directions
- Contracts

4.00 – Team Leader Meeting

Appendix 05 A: Information Document-English

STUDY INFORMATION DOCUMENT

Study title: A Comparative Study Evaluating the Health Impacts of Ecological Sanitation Interventions, Water Services and Hygiene Education Programmes individually and in combinations, in eThekwini District, Durban, South Africa.

Introduction: Renuka Devi Lutchminarayan is doing research on evaluating the health impacts of Ecological Sanitation Interventions with Provision of Water and Hygiene Programmes individually and in combinations in the eThekwini District, Durban.

You are invited to participate in this health study, which assesses the provision of toilets, water & Health Education programmes, and its impact on the health status of members in your family. We will be visiting your household 6 times over the next 4 months. This is our first visit and we need you to assist us in completing this questionnaire. During our next 5 visits, we will need your assistance to complete a very short form about diarrhoea. We may also need to have a look around your household.

Interview: You will be interviewed in a warm and friendly manner using the preferred language of your choice (Zulu). Research is just the process to learn the answer to a question. In this study we want to assess the health impacts of using urine diversion toilets together with provision of water and hygiene programmes within certain communities in eThekwini and compare it to areas that do not have the same combination of interventions. We want to determine the incidence of diarrhoeal diseases in each of these areas; to highlight the impact of poor sanitation on health, living conditions and the environment and to reduce the burden of health expenditure on preventable water borne diseases, through the provision of adequate sanitation and water services as articulated by Government Policies on Sanitation

Participants: We are inviting you and members of your household to participate in this research study.

What is involved in the study: Three communities using the UD toilets and three communities not using the UD toilets have been selected. There will be 1352 households chosen altogether to participate in this study. Each of these households will be visited every two weeks for 3 months, to check if there is any incidence of diarrhoeal and other water-washed diseases.

The head of the household over 18 years of age, present on the day the household is visited by a trained fieldworker, will be asked to complete the questionnaire and occurrence of illness form. Other adult members of the family if present at the time of interview will also be asked a few questions about their health. Permission has been given by the Tribal Chief/Councillor of the area to conduct this study. The committees and community representatives in the area have also been consulted.

Risks: There are no risks to you of being involved in this study

Benefits of being in the study. You will be able to help us make informed decisions about the health impacts of water and sanitation interventions, which would translate into community health benefits and improvements in the quality of life of people living in these communities. You will be given pertinent information about the study while involved in the project and after the results are made available.

Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you otherwise would have been entitled. You may discontinue participation at any time without penalty or loss of benefits to which you would otherwise be entitled.

Reimbursements: Participating in this study will not cost you anything, other than the time for the field workers to visit you during the period of the study.

Confidentiality: Efforts will be made to keep personal information confidential. Households will be given Identification Numbers. First names of household members will be used only in the Occurrence of Illness Record Sheet. This is only for administrative purposes so that on subsequent visits we would use less of your time and it will enable the field-worker to record information correctly on each of the individual members of the household.

Contact details of the Researcher
Renuka Devi Lutchminarayan
Tel: 031 - 561 1101
Fax: 031- 561 1883
E-mail: renukal@iafrica.com
Please don't hesitate to contact Renuka for further information about the study.

Contact details of REC Administrator and Chair:
Medical Research Administration
Tel: 031 - 260 4495
Fax: 031 - 260 4410
E-mail: ethicsmed@ukzn.ac.za

Chair: Professor A. Dhai
Tel: (031) 260 4604
Fax: (031) 260 4410;
E-mail: dhaia1@ukzn.ac.za

Appendix 05 B : Information Document-isiZulu

Isihloko: Ucwaningo oluqhathanisayo oluhlaziya imithelela yezempilo ngokungcoliswa kokuthuthwa kokungcola nokulahlwa kwendle, ukunikezwa kwamanzi nezinhlelo zenhlanzeko lokhu kwenziwa ngakunye futhi kubuye kuhlanganiswe ezindaweni ezakhele iTheku eThekhwini, eningizimu Africa.

Isingeniso: U Renuka Devi Lutchminarayan wenza ucwaningo lokuhlaziya imithelela yezempilo ngokungcoliswa kokuthuthwa kokungcola nokulahlwa kwendle kanye nezinhlelo zokunikezwa kwamanzi nezenhlanzeko lezizinhlelo zizimele noma zihlanganisiwe ezindaweni ezakhele iTheku, nakhona eThekwini.

Niyacelwa ukuba nubambe iqhaza kulolucwaningo lwezempilo,oluhlola izinhlelo zokunikezwa kwamathoyilethi, amanzi kanye nezoqeqesho lwezempilo,futhi lubuye lucwaninge nemithelela yalokhu empilweni yamalungu emindeni yenu Sizovakashela amakhaya enu kasithupha ezinyangeni ezine ezizayo. Namhlanje kungokokuqala lokhu kuvakasha. Siyanicela ukuba nisisize ekugcwaliseni lemibuzo ehleliwe esephepheni. Ekuvakasheni kwethu okuhlanu okuzayo,siyobe sisanicela ukuba nisisize ekugcwaliseni imibuzo ephepheni elobe lilifushane

Ucwaningo luyindlela nje yokufunda impendulo yombuzo. Kulolu cwaningo sifuna ukubheka kabanzi imithelela yezempilo yokusebenzisa izindlu zangasese ezihlukanisa indle nomchamo kanye nezinhlelo zokunikeza amanzi kanye nenhlanzeko emiphakathini ethile yaseThekwini siyiqhathanisa nezinye izindawo ezingenazo lezinhlelo ezifana nalezi ezihlanganisiwe zokuvikela. Sifuna ukutholisisa ngezifo eziphathelene nohudo kulezizindawo ngayinye, sibhekisise umthelela empilweni owenziwa ukuthuthwa okungekuhle kwendle nokungcola, indlela okuphilwa ngayo kanye nobunjalo bendawo futhi nokwehlisa ukusinda kwezindleko zezempilo ezifweni ezinokuvimbeka ezitholakala emanzini. Lokhu kwenziwa ngokuba kutholakale izindlela ezifanele zokuthuthwa kwendle nokungcola kanye nokunikezwa kwamanzi afanele njengoba kuchazwa kumgomo kahulumeni mayelana nezokuthuthwa kwendle nokungcola.

Okuqukethwe yilolucwaningo: Umphakathi wezindawo ezintathu osebenzisa amathoyilethi ahlukanisa umchamo nendle kanye nomunye futhi umphakathi omuthathu ongasebenzisi lamathoyilethi ahlukanisa indle nomchamo usukhethiwe. Kuzokhethwa imuzi engu 1352 kuzozonke lezizindawo ezizozibandakanya kulolucwaningo. Lemizi ngamunye iyovakashelwa njalo emuva kwamasonto amabili ezinyangeni ezintathu ukuze kubhekwe kabanzi ubukhona besifo sohudo kanye nezinye izifo eziphathelene namanzi.

Umuntu wesifazane omdala kunabo bonke emndenini ongaphezulu kweminyaka engu 18, oyobe ekhona ekhaya ngalelo langa lokuvakashelwa ngumsebenzi oqeqeshiwe, uyocelwa ukuba agcwalise imibuzo ehleliwe kanye nefomu enemibuzo emayelana nezigulo ezenzekayo ekhaya. Amanye amalungu omndeni wakho asekhulile angahle abekhona ngosuku esobuya sizoxoxa nawe ngalo sowacela ukuba nawo aphendule imibuzo emibalwa ngempilo yawo.

Imvume seyacelwa ezinduneni zamakhosi endawo noma kumakhansela endawo yokuba kuqhutshwe lolucwaningo. Abanye abaceliwe baziswa ngalolucwaningo oluzokwenziwa ngamakomidi nalabo abamele umphakathi kulezizindawo ezikhethiwe.

Ubungozi: Abukho ubungozi kuwena ngokubamba iqhaza kulolu cwaningo.

Imivuzo ekubeni kulolucwaningo: Uyokwazi ukusisisiza ekwenzeni izinqumo ezinokubonisana mayelana nemithelela yezempilo eyenziwa ngamanzi kanye nokungenelela ekuthuthweni kwendle nokungcola, lokhu kungashintsha ekuzuzeni kwezempilo yomphakathi nokwenza ngcono isimo sempilo yabantu abahlala kulezizindawo. Uyonikezwa umbiko ofanele mayelana nalolucwaning ngesikhathi usazibandakanye kuloluhlelo nasemuva kokutholakala kwemiphumela.

Ukubamba iqhaza kungukuzinikela: Ukunqaba kwakho ukubamba iqhaza akuyukuba nanhlawulo noma ukulahlekelwa ukusizakala obungaba nelungelo lakho. Ungayeka ukubamba iqhaza noma inini ngale kokuhlawuliswa noma ukulahlekelwa usizo obungaba nelungelo lwalo.

Okutholakalayo: Ngokubamba iqhaza kulolucwaningo ngeke ulahlekelwe lutho ngale kwesikhathi sabaqheqheshelwe ukusebenza emphakathini abazokuvakashela ngaso.

Ubumfihlo: Imizamo iyokwenziwa ukugcina imininingwane yomuntu ibe imfihlo. Imizi iyonikwa izinombolo zokuyibalula. Amagama amalunga emindeni ayosethshenziswa kuphela lapho kugcwaliswa ikhasi elimayelana nezigulo (Occurrence of illness Record Sheet). Lokhu kwenzelwa kuphela imicikilisho yehhovisi ukuze kuthi uma sesiphinda sikuvakashela singachithi isikhathi sakho futhi kokwenza lowo okuvakashele abhale imininingwane eyiyo kulelonalelo lunga lomndeni. Okuxoxwe abayiqembu khona kobikwa kuphela. Siyabonga

Imininingwane ngomcwaningi
Renuka Devi Lutchminarayan
Tel: (Ucingo): 031 - 561 1101
Fax: (Isikhahlamezi): 031- 561 1883
E-mail: renukal@iafrica.com
Ungangabazi ukuthintana noRenuka ngolunye ulwazi ongaluthola mayelana nocwaningo.

Imininingwane yokuxhumana nomabhalane nosihlalo.
Medical Research Administration
Tel: (Ucingo): 031 - 260 4495
Fax: (Isikhahlamezi): 031 - 260 4410
E-mail: ethicsmed@ukzn.ac.za

Chair: Professor A. Dhai ; Usihlalo: Usolwazi [Professor] A. Dhai
Tel: (Ucingo): 031- 260 4604
Fax (Isikhahlamezi): 031- 260 4410
E-mail: dhaia1@ukzn.ac.za

Appendix 06 A: Consent Form-English
Consent to Participate in Research

You have been asked to participate in a research study

You have been informed about the study by the Tribal Chief/Councillor of Area, the Project Steering Committee and Facilitators.

You may contact Renuka Devi Lutchminarayan at eThekwini Health Department at 031- 561 1101 at any time if you have questions about the research

You may contact the Medical Research Office at the Nelson R Mandela School of Medicine at 031-260 4604 if you have questions about your rights as a research subject.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to stop.

If you agree to participate, you will be given a signed copy of this document and the participant information sheet, which is a written summary of the research.

The research study, including the above information, has been described to me orally. I understand what my involvement in the study means and I voluntarily agree to participate.

_____
Name of Participant

_____ _____
Signature of Participant Date

_____ _____
Signature of Witness Date
(Where applicable)

Appendix 06 B: Consent Form

IsiZulu **Isivumelwano sokubamba iqhaza ocwaningweni.**

Uceliwe ukuba ubambe iqhaza ocwaningweni.

Utsheliwe wachazelwa ngaloluhlelo kabanzi ngamakhosi asemakhaya ngamakhansela endawo amakomidi kanye nalabo abangabagqugquzeli.

Ungaxhumana noRenuka Devi Lutchminarayan osemnyangweni wezempilo eThekwini kule nombolo 031-5611101 noma yingaziphi izikhathi uma unemibuzo mayelana nocwaningo.

Ungaxhumana nehhovisi locwaningo iNelson Mandela School of Medicine kule nombolo: 031-2604604 uma unemibuzo mayelana namalungelo akho njengomuntu ozobe enza ucwaningo.

Ukubamba kwakho iqhaza kulolucwaningo kungukuzinikela ngeke ugxekwe noma walelwe uma sewufuna ukuyeka.

Uma uvuma ukubamba iqhaza ocwaningweni uyonikezwa amaphepha omqulu asayiniwe kanye nekhasi elobe liqukethe umbiko wakho njengoba uyobe ubambe iqhaza liyobe lingumbhalo ofingqiwe wocwaningo.

Ucwaningo kanye naloku okubhalwe ngenhla ngikuchazelwe ngomlomo. Ngiyaqonda ukuthi ukuzibandakanya kwami kulolucwaningo kusho ukuthini futhi ngiyavuma ngokwami ukuzibandakanya.

_____

Igama Lozibandakanyayo

_____ _____

Ukusayina Kozibandakanyayo usuku

_____ _____

Ukusayina kwalowo ohumushayo usuku

Appendix 07: Biomedical Research Ethics Committee Letter

UNIVERSITY OF
KWAZULU-NATAL

23 November 2005

Mrs R D Lutchminarayan
P O Box 1904
UMHLANGA ROCKS
4320

e-mail : renukal@iafrica.com
renuka@durban.gov.za

Dear Mrs Lutchminarayan

PROTOCOL : A comparative study, evaluating the health impacts of ecological sanitation interventions, water services and hygiene education programmes individually and in combinations, in eThekwini District, Durban, South Africa. R D Lutchminarayan, Community Health. Ref.: H095/05

The Biomedical Research Ethics Committee considered the abovementioned application and the protocol was approved at its meeting held on 3 May 2005 pending administrative and ethics issues being addressed appropriately and approval being granted by the Postgraduate Education Committee. These conditions have now been met, the study is given full ethics approval and may begin as at today's date : 23 November 2005.

This approval is valid for one year from 23 November 2005. To ensure continuous approval, an application for recertification should be submitted a couple of months before the expiry date. In addition, when consent is a requirement, the consent process will need to be repeated annually.

May I take this opportunity to wish you everything of the best with your study. Please send the Biomedical Research Ethics Committee a copy of your report once completed.

Yours sincerely

PROFESSOR A DHAI
Chair : Biomedical Research Ethics Committee

c.c. Dr S Knight, Community Health
Mr S Siboto, Postgraduate Education

Appendix 08: Postgraduate Education Committee Letter

UNIVERSITY OF
KWAZULU-NATAL

25 October 2005

Mrs R D Lutchminarayan
P O Box 19094
UMHLANGA ROCKS
4320

e-mail : renukal@iafrica.com
renuka@durban.gov.za

Dear Mrs Lutchminarayan

PROTOCOL : A comparative study, evaluating the health impacts of ecological sanitation interventions, water services and hygiene education programmes individually and in combinations, in eThekwini District, Durban, South Africa. R D Lutchminarayan, Community Health. Ref.: H095/05

The Postgraduate Education Committee considered the abovementioned application and the protocol is approved for your MPH degree

Please note that the study may not begin without ethics approval – a copy of which must be submitted to this Committee

May I take this opportunity to wish you every success with your study

Yours sincerely

PROFESSOR M ADHIKARI
Chair : Postgraduate Education Committee

c.c. Supervisor
Mr S Siboto, Postgraduate Education

Nelson R Mandela School of Medicine, Faculty of Health Sciences,
Medical Research Administration

Postal Address: Private Bag 7, Congella 4013, South Africa

Telephone: +27 (0)31 260 4495 **Facsimile:** +27 (0)31 260 4529 **Email:** borresen@ukzn.ac.za **Website:** www.ukzn.ac.z

Medical School Pietermaritzburg Westvill

Appendix 09: Approval to conduct study by ethekwini Municipality

Health, Safety and Social Services Cluster
Health Unit

P O Box 2443
Durban 4000

Tel: (031) 311 1111
Fax: (031) 311 3530
Website: http://www.durban.org.za

Our Ref:

Your Ref:

Dr R Gajee
Telephone : 300-3179

Enquiries:

2005-07-08

Renuka Lutchminarayan
Environmental health Department
Umhlanga Rocks

Dear Madam

RE: RESEARCH REQUEST : A COMPARATIVE STUDY, EVALUATING THE HEALTH IMPACTS OF ECOLOGICAL SANITATION INTERVENTIONS, WATER SERVICES AND HYGIENE EDUCATION PROGRAMMES INDIVIDUALLY AND IN COMBINATIONS IN ETHEKWINI DISTRICT

Approval is granted for the above study to be conducted.

Please ensure that you adhere to the attached list of requirements.

Yours faithfully

U. Sankar
HEAD : HEALTH
2005/07/08

ETHEKWINI MUNICIPALITY
Health, Safety and Social Services Cluster
Health Unit

9 Old Fort Place
Durban 4001

P O Box 2443
Durban 4000

Tel: (031) 300 3911
Fax: (031) 300 3030
Website: http://www.durban.org.za

Our Ref :

Your Ref :

Enquiries :

Dr R Gajee
Telephone: 300-3179

Dear Sir/Madam

RE : RESEARCH REQUEST

The following requirements need to be complied with before permission is granted for you to undertake research in this department.

1. A full written protocol, with written proof of approval by an accredited Ethics Committee (NB. This will also be required for changes to research methodology).
2. A briefing meeting with relevant staff, or community if indicated.
3. An assurance that our services will not be disrupted.
4. An understanding that participation in your study by members of the public is on a voluntary basis.
5. Compliance with Access to Information Act and other relevant legislation.
6. You will assume full responsibility for obtaining informed/ written consent from the public/ patients, and maintaining confidentially.
7. All drugs used in research trials/studies must be registered with the MCC
8. eThekwini Municipality - Health Department requires indemnity against any claim that may be brought about by researchers/ research workers in terms of the Compensation of Occupational Injuries and Diseases Act.
9. The eThekwini Municipality Health Department requires indemnity against any claims that may arise as a direct or indirect result of any acts or omissions by the research team.
10. Submission of progress reports/ meetings at appropriate intervals, or on request.
11. Obtain prior permission from this Department before press releases, and release of results to communities/ stakeholders.
12. Withdrawal of permission to conduct research will be left to discretion of the eThekwini Health Department.
13. This Department is to receive recognition for the assistance given, and a copy of the research results on conclusion of the study must be submitted before publication.

Having accepted and complied with the above terms, you will then be informed of the outcome of your request.

Yours faithfully

pp U. Sankar
HEAD : HEALTH