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STORM WATER MANAGEMENT IN THE LEAST DEVELOPED COUNTRIES

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DECLARATION

This Master Thesis is the product of the research work carried out by Salau Nurudeen Adeyinka of the Environmental Management and Sustainability Science Programme, Aalborg University, Denmark, in partial fulfillment for the award of a Masters degree in Environment studies under the supervision of Associate Professor Ole Busck and PhD Assistant Jie Zhang.

DEDICATION

This project is dedicated to Almighty God and my wonderful parents

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Many individuals and groups contributed to the successful completion of this master's thesis work and may not all be properly recognized here. I am grateful to all the members of the academic and non-academic staff of the Department of Development and Planning, Aalborg University for providing me with the relevant knowledge and skills required to carry out this Thesis research throughout the course of my studies at Aalborg University.

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ABSTRACT

Storm water management has become a continuous problem in the cities of the least developed countries, posing serious risks on human health and the environment. The common practice involving the construction of storm water drainage and storm sewers to allow this storm water get away from an area as quickly as possible has not shown any effective result in most of the least developed nations. For this reason, it is crucial to raise awareness of the problems in other to search for viable solutions for the least developed countries. The focus of this research was to investigate and produce knowledge about the problems that are associated with the present handling of storm water in the least developed countries and also to examine why the large donor –financed investment in urban drainage systems in Zanzibar is not sustainable. The wide-ranging definition of sustainable development set forth in the 1987 Brundtland Commission report to the World Commission on Environment and Development (WCED) was used as a reference ***"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".***

A qualitative research design is considered to be the best approach for answering the research questions, and Zanzibar being known for several years with frequent flood disaster and high level of runoff was selected as a case study, under certain condition, this case can lead to generalization in most part of the least developed countries having similar problems. Field notes, interviews, and photographs form a series of representation that helps in addressing the problem in focus. Local landscape and views were recorded during the field trip and Afterwards semi structured interviews was conducted with professionals working in the area and some of the citizens.

From the analysis, the existing storm water management system has failed to sustain the economy, protect the environment, and alleviate poverty and human suffering. The main challenges to these problems have to do with stakeholder involvement failure and lack of societal participation in decision making for the implementation of the urban drainage project; as well as the inability of government and authorities charged with storm water management

responsibilities to plan and implement urban drainage covering urban flood protection, pollution control and management catering for improved quality of life.

The most notable factors that make it difficult for the existing storm water management systems (***urban drainage***) to work efficiently like in countries that are more developed include: (1) unplanned settlement and continuous building of structures without legal permission, thereby limiting the space that urban drainage requires to reduce floods and at the same time increasing the flow of runoff. (2) No specific laid local policies to abide with by-laws at the ward Shehias levels. (3) no reliable cleaning routine of the existing drainage systems and close supervisions from the authorities charged with the responsibilities of managing storm water in the area, thus leading to the contamination of storm runoff by sewage, sediment and garbage ; (4) climatic and socio-economic factors favors the big layer of plastic garbage that covered most of the land area around all the illegal dumping sites and has reduced the level at which storm water penetrate and infiltrate into the ground; (5) lack of a technological basis for adequate drainage management, extension and rehabilitation of exiting drainage; (6) lack of Participatory approach that gave an opportunity for different stakeholders to exchange information and knowledge, and express their points of views and concern regarding viable alternative solutions to the existing urban drainage. Lastly, there is social disintegration i.e. adequate social status, strength and cultural diversity that are necessary to sustain and improve the efficiency of the existing urban drainage as well as obtaining viable alternative solutions to storm water management problems.

Based on these notable problems, it is concluded that there is need for a profound rethinking in storm water management in the least developed countries and this implies paying attention to particular situations in the local area. Learning about natural and manmade processes that affect the runoff quality and quantity is of prime importance. There is obviously a need for a basic sanitation and waste collection system as well as storm water management concept that considered storm water to be a precious resource which can be retained near the source to be reused and recharged to the underground for aquifer replenishment .

I.1. CHAPTER ONE: INTRODUCTION

Storm water is rainfall and snowmelt that penetrates into the ground or runs off the land into storm drains, gutters, streams and sea (Environment Canada, 2003). Storm water runoff holds up pollutants that have accumulated on the land surface and washes them into receiving waters. The contaminants can include eroded soil, bacteria, nutrients and toxic organic Chemicals (such as fertilizers, soaps**,** pesticides, oil, grease, gas); toxic inorganic chemicals (such as lead, zinc, copper and cadmium); salts; acidic and alkaline chemicals (such as bleach and battery acids) etc (Totten Sims et al, 2001). These pollutants runs directly into surface waters, including lakes and stream causing harmful effects on drinking water sources and food chain, it also destroy aquatic habitat, and can essentially destroy a lake and stream (Totten Sims et al, 2001).

Evidence from research on Storm water management in the least developed countries has shown that its management is primarily concerned with the reduction in the quantity of storm water runoff in urban areas as well as the downstream flooding potentials, most often the solution adopted is the construction of storm water drainage and storm sewers to allow this storm water get away from an area as quickly as possible (Silveira et al., 2001). However, in the least developed countries, climate change, rapid urbanization and socio economic conditions bring difficulties to the above mentioned system that is implemented in practice (Silveira et al., 2001). In many instances increased flooding, erosion and water quality problems has continuously remained. Problems such as unavailability of larger capacity pipe to control runoff, greater erosive capacity, uncontrolled and unplanned infrastructures and services, uncontrolled urban expansion, improper maintenance and precarious inspection services, besides technically obsolete and ill-planned storm drainage systems has made it worse, and thus not feasible to use (Silveira et al., 2001).

While the developed countries are concerned with advance problems on water management such as diffused pollution on the pluvial waters and quality of storm water runoff, the least developed countries still worried with the high quantity of storm water runoff, low coverage of good drinking water quality, sewage networks, and unsustainable urban drainage infrastructures (Joel

.A. et al, 2007). The potential problems of increased quantity and bad quality urban storm water runoff as well as flood peaks in urban areas in most part of the least developed countries have resulted from the urban drainage systems, since the usual practice to control runoff is the transportation of excess storm water to the sea without treatment done by open drainage and buried conduits, which are usually mixed with the sewage. Sediments and solid waste makes the situation to be more complex, adding to the spread of diseases to the populations (cited by Joel .A. et al, 2007).

Furthermore, rapid urbanization has increased urban development activities in the least developed countries nations. Development in urban areas increase the volume of land covered by hard and paved surfaces, it changes land drainage patterns, remove vegetation, or pave previously porous areas and consequently allow contaminants to enter local streams and seas. Urban development might be a symbol of improvement, but it also encourages unnecessary storm water runoff that adds pollution to our environment (Totten Sims et al, 2001). Urban development causes increase in storm water temperature as storm water drains over areas like pavements and roads that get heated up during hot climate. When storm water runs over pavements and roads, it turns out to be a form of non-point source pollution with the possibility to devastate local water quality and threaten aquatic life in streams that runs through urban areas (Totten Sims et al, 2001).

Based on this premises, storm water management practice in the least developed countries involving the construction of storm water drainage and storm sewers to discharge storm water runoff as quickly as possible can be described as blemish particularly in terms of cost, havoc and flooding it cause to some areas (Parkinson and Mark 2005). Besides that, accepting the thoughtful truth that storm water management project is fundamentally a collective public service and there is virtually no hope of obtaining any significant level of investment from either the individual household or the private sector without the government intervention, it is assumed that storm water management in the least developed countries with the simple function of collecting storm water and conveying and discharging same to the nearest point of disposal such as sea, drainage basin, etc as soon as possible without treatment has not giving a deep thought to the complex dynamics which interlink storm water management project i.e. social, ecological

and economic systems. So therefore in the face of the socio economic development and in an effort to ensure that storm water management projects contributes also to the livelihood of the people, it is important to investigate how a better management of storm water can be attained in the investigated area as well as in other areas and other least developed countries with similar problems. However, the use of other viable alternatives is requisite to reduce the incessant growing demand for fresh water from inadequate water aquifers and to lessen the adverse health impact of urban runoff on people and limited fresh water resources (Parkinson and Mark 2005). Therefore, Cutting down the runoff from frequent storm events decreases sediment runoff and sewage overflows. It also works against remobilization of pollutants that have been confined in the management of storm water measures.

1.2 URBAN DEVELOPMENT AND HYDROLOGIC CYCLE:

The concept of Hydrologic cycle can be used as a basis for understanding the negative impacts of urban development and human activities in our environment. The hydrologic cycle gives a picture of the continuous circulation of water between the oceans, atmosphere and land. Water is transformed from its liquid form to its vapor form and thus transferred from land and water masses to the atmosphere and transpiration by plants; it comes back again to the land when a portion of the atmosphere becomes saturated with water vapor and the water condenses. Within the land phase of the hydrologic cycle, water is stored by vegetation, snow packs, land surfaces, water bodies and subsurface soils. It is then transported between these storage spaces via overland runoff, stream flow, infiltration, groundwater recharge, groundwater flow and groundwater discharge (Environment Canada, 2003). See figure 1 below for Hydrologic cycle;

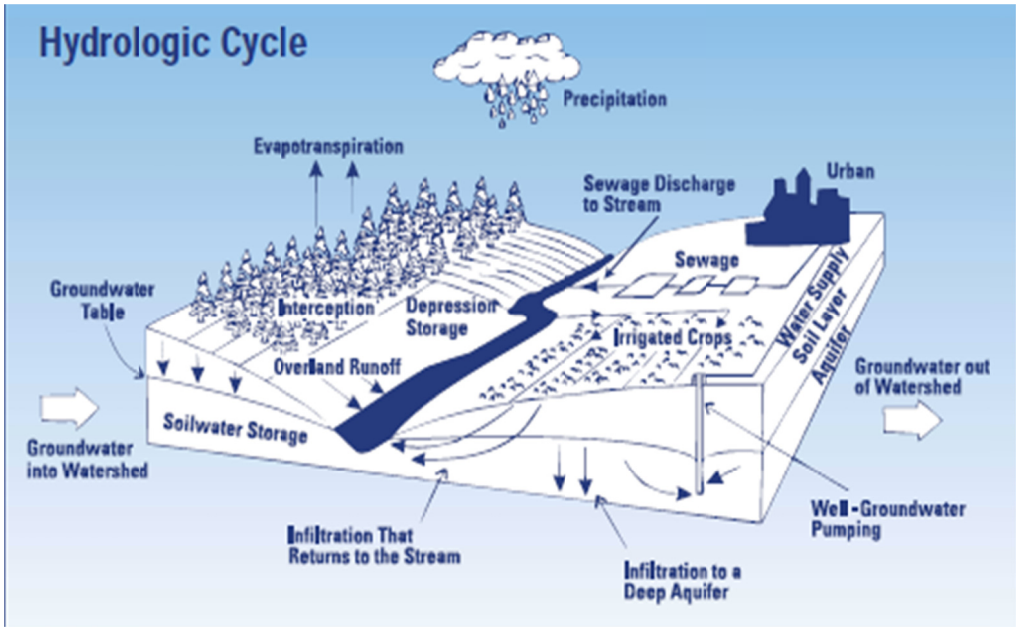

Figure 1.1: The Hydrologic cycle (Source: After, M. L. Davis, and Cornwell, D.A. Introduction to Environmental Engineering, 1991)

By reason of urban development, the hydrologic cycle changes from its natural form due to the transfer of water between storage compartments. The increase in impervious area (roads, driveways and buildings) that goes together with urban development serves as the major contributor to the lesser penetration of precipitation and storm water and this has produce as a consequence an increased amount of runoffs, floods and deteriorated houses (environment Canada 2003). The impacts of human activities with the resulting input of pollutants result in deterioration of water quality and ecosystem conditions. Human activities such as the extraction of water for agricultural, domestic and industrial uses degrade water quality when they are returned as wastewater (environment Canada 2003). The infrastructure costs, water quality and environmental concerns associated with continuing with this current paradigm are rising to unsustainable levels. See Figure 2 below for hydrologic cycle before and after development

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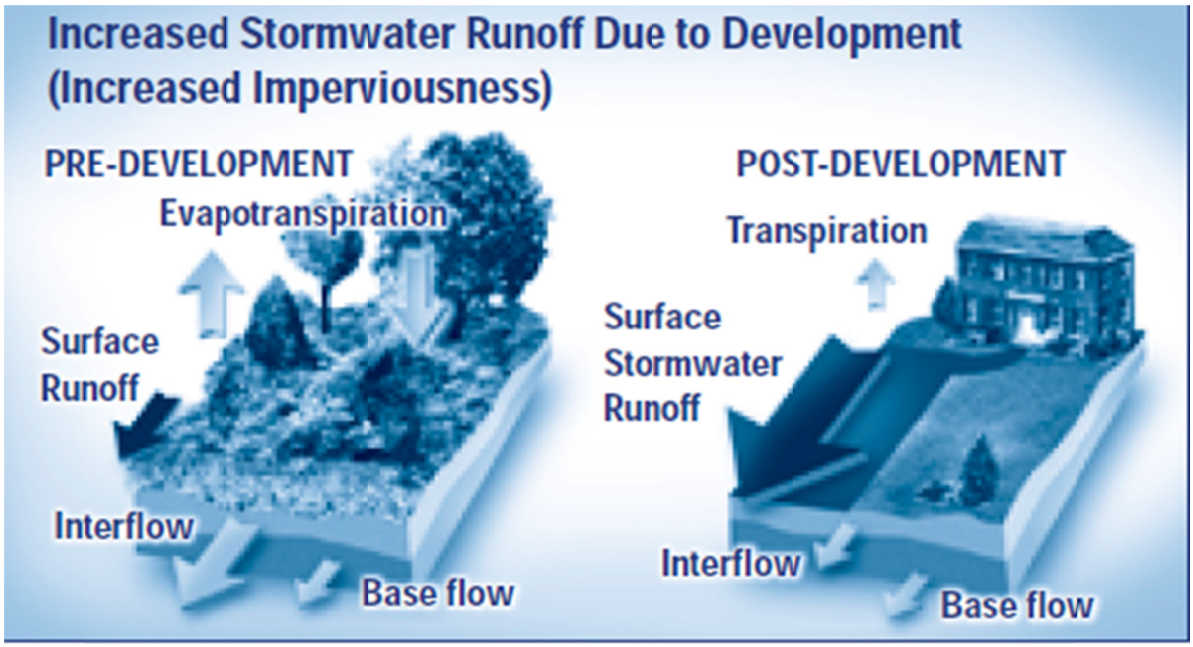


Figure1.*2: Hydrologic Cycle before and after development (CWP 1999*)

1.3 Problem Formulation

The uneven distribution of rainfall in terms of time and space is one of the most fundamental and critical issue connected with storm water runoff and its associated flooding in the least developed countries and climate change is expected to continue altering this distribution in the future. Storm water management has become a continuous problem in the cities of the least developed countries, posing serious risks on human health and the environment. The increasing Urbanization and developments makes the situations worse, and the municipalities lacking financial and technical resources, are unable to deal with the increased flooding, erosion and water quality problems that occur from this ineffective management. The construction of storm water drainage and storm sewers to allow this storm water get away from an area as quickly as possible has not shown any effective result in most of the least developed nations (Silveira et al., 2001). Solutions in the form of using the existing infrastructure and expand the traditional urban drainage system involving the use of more and bigger capacity pipes and drainage to discharge

storm water runoff as quickly and possible has however resulted in costly solutions and adverse environmental impacts. However, awareness of these problems is fundamental to the search for viable solutions appropriate for the least developed countries.

1.4 Research Questions

- What are the problems associated with the present handling of storm water in the least developed countries?
- Why is it that a large donor- financed investment in urban drainage systems in Zanzibar is not sustainable?

1.5 OBJECTIVES

1. To produce knowledge about storm water management problems in the least developed countries

2. To analyze the impacts of the identified problems in the existing urban drainage systems in Zanzibar

In other to answer the research question, the study starts by producing knowledge about the problems associated with the present handling of storm water in the least developed countries. The study focuses on the interaction between the economy, society and environment specifically identifying that a balance of this three systems must be maintained in a healthy relationship. The study explores some specific tools that are needed to design for sustainability and subsequently explaining why transformation structures and processes in laws, policies, institutions and culture is inevitable to improve the management of storm water in the least developed countries.

1.6 STRUCTURE OF THE THESIS:

The introduction chapter starts with the general description of storm water management problems in the least developed countries. The Problem formulation, the research questions, the aim and objectives of the project are also presented in this chapter.

The second chapter dwells on the methodological approach that was adopted in addressing the Research problem in focus. A Qualitative research design is considered as the best approach in addressing the problem in focus. Zanzibar being known for several years with frequent flood disaster and high level of runoff was selected as a case study, field notes, interviews and photographs are used to analyze the problems in focus. Local landscape and views was recorded during the field trip and Afterwards semi structured interviews was conducted with professionals working in the area and some of the citizens

Zanzibar is presented in the third chapter as a case study. The Zanzibar urban service project report (ZUSP) on the strategies for growth and reduction of poverty was reviewed and information on the socio economic conditions, geography and population of the area is presented after the review of the (ZUSP) report. This was followed with the description of the existing and proposed drainage system in Zanzibar as well as the local landscape and views that was recorded. The information provided in this chapter gives a hand in investigating and analyzing the impacts of the identified problems.

Chapter four is the theoretical frame-work that presents appropriate technology theory and sustainable livelihood analysis as theories that can assist in investigating the phenomenon. The appropriate technology theory clarifies that technological development in the least developed countries should aim at the eradication of poverty and the provision of a better living standards for the masses while the sustainable livelihood approach is another framework for development equally aimed at poverty eradication, by virtue of its context, objectives and main concerns. It clarifies that poor people have different kinds of capital (Human, social, natural, physical and financial) which should all be respected and protected. But if one capital is destroyed, there is always the possibility to base oneself on some of the other capitals. Besides, the approach also clarified that transformation of structures and processes is inevitable in the least developed nations to ensure that all of these other capitals are sustained and reached as at when needed.

The result of the interviews and analysis of the existing storm water management system in Zanzibar is presented in chapter five. The result of the interviews and information on the socio-economic condition of the project beneficiaries that was mainly extracted from the community baseline survey and the (ZUSP) Report was used in the analysis.

The last chapter dwells on the conclusion and the proposed perspectives specifically the idea of source control measures such as capturing of storm water and rain water before causing flooding and havoc to cities in the least developed countries.

CHAPTER 2: METHODOLOGICAL APPROACHES

2.1 CONCEPTUAL FRAMEWORK:

The concept of sustainable development serves as a guiding principle throughout the study. Sustainable development offers an alternative to conventional development by focusing on: social inclusion and participation, the natural resources base and the global commons long-term versus short-term time horizons, economic equity as well as growth, differences in perception, and the complex dynamics which interlink the project's social, ecological and economic systems. For the sake of this study, the wide-ranging definition set forth in the 1987 Brundtland Commission report to the World Commission on Environment and Development (WCED) was used as a reference.

„Sustainable development 0r equivalent term „sustainability by Design"

Definition of sustainable development:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

[World Commission on Environment and Development, 1987;
Our Common Future (Brundtland Report)]

2.2 QUALITATIVE RESEARCH DESIGN

A qualitative research design is considered to be the best approach for answering the research question. Qualitative research is defined by Denzin and Lincoln (2005, 3) as

'A situated activity that locates the observer in the world, it consists of a set of interpretive, material practices that makes the world visible. These practices transform the world. They turn the world into a series of representations including field notes, interviews, conversations, photographs, recordings, and memos of the self' qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, and phenomena in terms of the meaning people bring to them.

The significant element of the above definition is in connection with the way the world is represented by the researcher while being on the field. It stresses the significance of observing at variables in the natural setting in which they are found (J.P. Key 1997). A connection between variables is key. Comprehensive data is collected through open ended questions that provide direct quotations. The interviewer is an essential part of the phenomena been studied (cited by J.P. Key 1997). This is different from quantitative research which endeavors to collect data by objective methods to provide information about relations, comparisons, and predictions and attempts to remove the agent (cause) from the investigation (cited by J.P. Key 1997).

The interpretation of the world phenomena is also of significance when approaching a qualitative research. The wealth of the qualitative approach lies in its ability to come to the field with adaptable instrument that can be adjusted and not with encoded and prearranged categories. Quantitative approaches which generally count on statistics is able to take decision over an issue by collecting data from an extended number of cases. By difference, the qualitative approach, because of its distinctive features, has to rely on few cases, from which genuine information and clarifications are obtained. Most importantly a good reason why a case study is chosen for this research is because a full understanding of a problem is really only possible if you study the problem in its concreteness and in its context.

2.3 METHODS:

This section describes the means of collecting data for this research and how the research activity was carried out. The study address possible problems regarding storm water management and the reason why the large donor investment in urban drainage in Zanzibar are not sustainable. This work is done by several procedures explained in the following section.

Data collected for this study comes from a combination of books, articles, consultant documents and studies; field observation and interviews. Relevant research papers and articles were reviewed to describe storm water management problems in developing countries. The Author of this research is specifically doing a case study in one of the least developed countries that is experiencing storm water management problems as a consequence of rapid urbanization and climate change, under certain conditions; this case may lead to generalization in most of the poor developing countries that are facing similar problems of extreme rainfalls and largely unplanned in terms of housing, infrastructures and services. The visit to Zanzibar allowed a comprehensive collection of data that support in assessing and predicting the impact of the identified problem and besides, it was easier to understand the weaknesses and flaws with the existing storm water management practice and the vulnerability that makes such project difficult to be functional in the face of socioeconomic and environmental change.

Two different consultant baseline survey documents were critically reviewed to describe the socio economic conditions of Zanzibar. At the physical level (primary data) the author of this report travelled to Zanzibar and met with various stakeholders that were expected to be involved in the management of storm water. Semi-structured interviews were conducted in Zanzibar. Eight people were interviewed, notable among them the Head of the Department of Science of the Zanzibar State University; a lecturer in Marine Environmental Chemistry at the Institute of Marine Management, Zanzibar; a Director in the Zanzibar Municipal Council charged with Storm Water Management; the Zanzibar Director of Sewerage and Solid Waste; and representatives of a Zanzibar-based Non-Governmental Organization called CODECOZ. These interviewees were selected based on the extent to which they are familiar with the problems associated with flooding, runoff and environmental management in the area. I assumed that

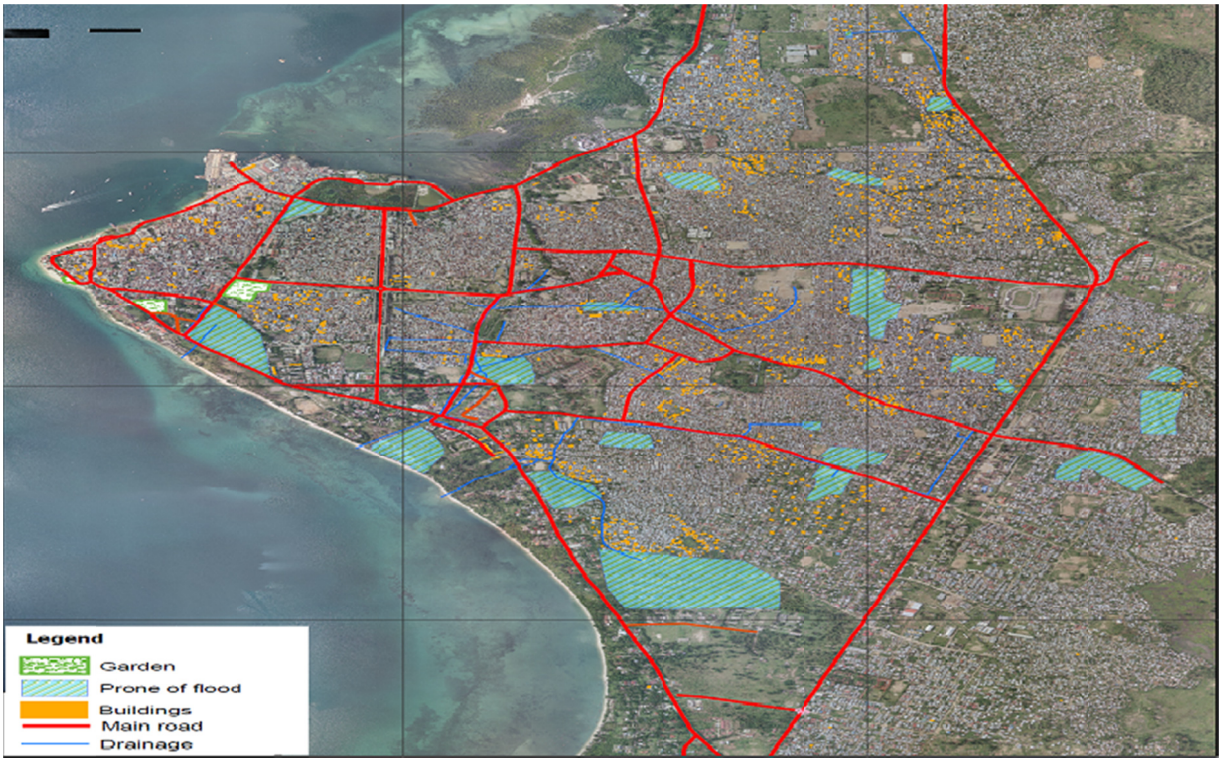
given their requisite experience and exposure, they would be able to provide useful information on the research area. This assumption turned out to be correct, as evident in my findings below. This kind of interview has its strength in allowing interviewees to respond with open-ended answers and besides it has the purpose for respondents to provide with their viewpoint of reality without being predisposing for answers (as in survey questionnaires). In general, the value of interviews of this kind is to be able to gather respondents "in vivo" quoting, their emotions, the way they see the world (Patton 2002, 21). A tape recorder was used to get the interviewees in vivo quoting. In addition, a field trip was performed in a number of days at around Zanzibar central Municipality to observe and identify with the several physical problems associated with storm water management in Zanzibar. With this method the researcher was able to capture information on available social services, main economic activities as well as destruction done by storm water drainage and waste management to health and property. This method enables the researcher to gather additional information from what is been reviewed from the consultancy report on the socio economic conditions of the study area. The field observations also provide an opportunity to observe the situation and the infrastructures in the project beneficiaries' area. Specific events and facilities were observed, focusing on type and quality of social services, notably health, education and Quality of living houses. This method was also used to assess the type and quality of livelihood assets, land use patterns, and life trends. Pictures were taken and notes were written.

The drainage projects that is been executed as a solution to the flooding, storm water runoff and water quality problems in the area was strictly studied and Observations was reported by visiting several flooded areas, legal and illegal dumping sites, sea outfalls, deteriorated houses in the flooding prone areas and the drainage pipes and gutters that was constructed to transport storm water to the sea.

CHAPTER 3: ZANZIBAR AS A CASE STUDY

Zanzibar is an island that lies in the tropical belt. The island experienced a very heavy rainfall in April 2005 which is thought to be the worst downpour in the past 40 years. This unusual rainfall, which lasted 36 hours and measured 149+ millimeters, took place between 15 and 17 April 2005 and 10,000 households lost their homes and lots of property was destroyed and many people died as a result of the subsequent flooding (International Federation of Red Cross 2005). The floods also caused a significant loss to the infrastructure, and as well badly damaging a bridge in the southern locations. The road system was also affected and some parts remained impassable until the flood water subsided (International Federation of Red Cross 2005). The water supply services were disrupted by the flooding and overhead pollution arising from heavily polluted water has brought about several disease outbreaks that have killed a large number of people on the island (International Federation of Red Cross 2005). Since the occurrence of this sad incidence quite a lot of efforts have been taken to combat these problems, yet the problems of floods and runoff is still a major concern on the island.

Until today, most part of the island is frequently flooded during raining season and Runoff in the area is very high. The island was chosen as a case with the purpose of investigating why the flooding and runoff problem still persist and to identify what could be done to improve the management of storm water in the targeted group of countries. The following map shows parcel of drainage system and areas that are frequently flooded.

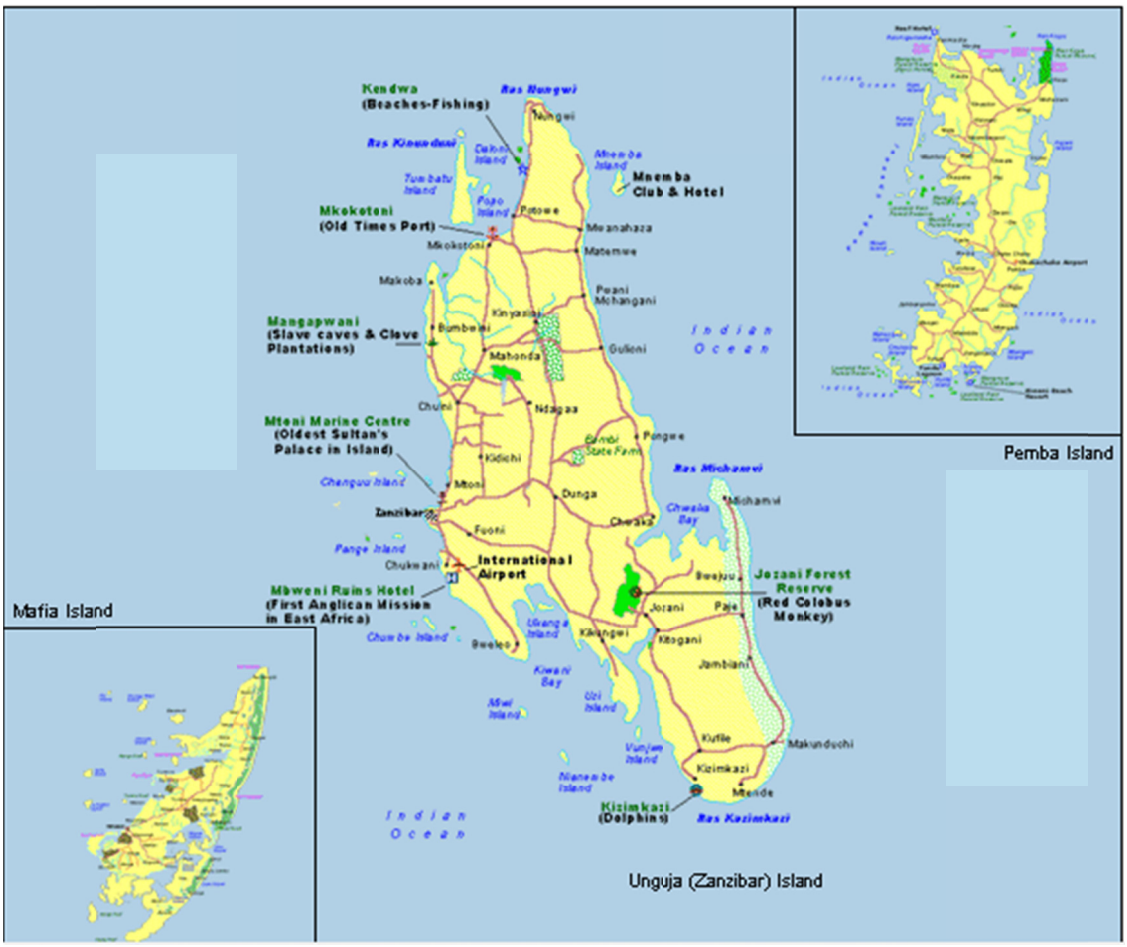


Map 3.1 : Map showing parcel of drainage systems and areas that are frequently flooded ((Source: ERC Baseline survey, 2011)

3.2 THE GEOGRAPHY OF ZANZIBAR

The archipelago of Zanzibar essentially comprises of two major islands, Unguja (area 1,666 square kilometers) and Pemba (the smaller island with area 988 square kilometers) and several surrounding islet. Zanzibar city is situated on the west coast of Unguja Island at the centre of the island and is the capital of Zanzibar. Stone Town, which was acknowledged a World Heritage Site in 2000, is the historical part of Zanzibar City with a distinctive nature representing the historical influence of different eras during which Zanzibar functioned primarily as a trading port (Golder Associates 2010). The municipality of Zanzibar is located on the west coast f Unguja Island. Apart from the historic old city known as stone town, the urban area extends to the east into the new town (Ng'anbo area) and further east to the more recently developed new planned areas. The area is relatively flat in the west and rises gently from the coast towards the east. The

mean coast elevation is 6.6 meters above sea level, whilst to the east the Masingini ridge climbs to the highest point of 105 meters in elevation. See the map of Zanzibar in the figure below:



Map 3.2: ***MAP OF ZANZIBAR ISLAND (UNGUJA)***

3.3 POPULATION OF ZANZIBAR

According to the 2002 census, the population of the two main islands of Zanzibar was 984,625 with Ugunja having a population of 622,459 persons and Pemba with a population of 362,166 persons. The 2002 census split Zanzibar- Unguja into three district regions namely Urban west, North Unguja and south Unguja. The municipality of Zanzibar lies in the urban western region. The Census also indicates the urban west region is having a land area of 230 square kilometers

and the municipality is estimated to occupy about 15 square kilometers. It is indicated in the 2002 census report that the urban west region has a population of 391,002 and a population density 1700 persons per square kilometers while the urban district has about 13000 persons per square kilometers. The census also indicates that there are 74,363 households within the urban west region and with an average household size of 5.4 persons per household. The urban district (Zanzibar municipality has 37, 404 households and an average household size of 5.6 persons per household. Annual average growth rate for Zanzibar and the Urban district (Zanzibar Municipality was reported as 4.5%.

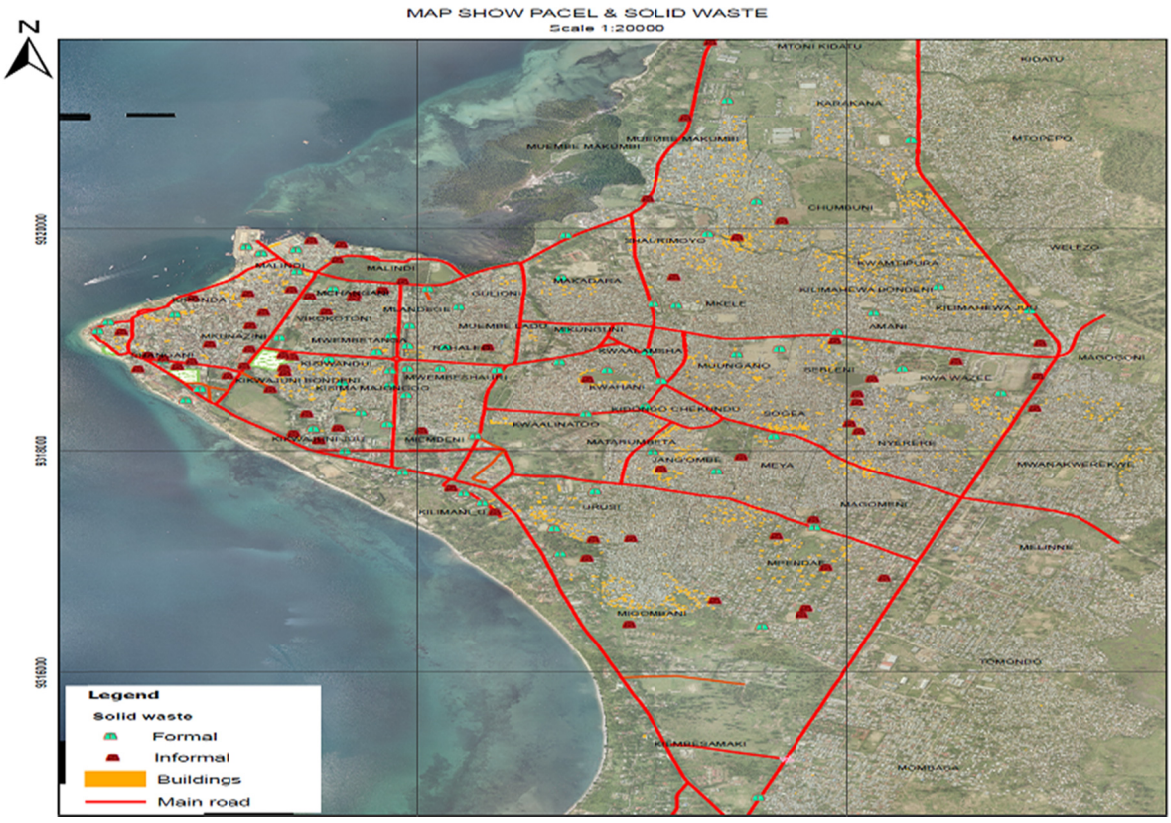
3.4 THE EXISTING AND PROPOSED PHASE (III) STORM WATER DRAINAGE PROJECT IN ZANZIBAR TANZANIA

The interim development plan, the Zanzibar strategy for growth and reduction of poverty (ZSGRP) of the revolutionary government of Zanzibar (RGZ) aims to improve the standard of life of the citizens and has several development initiatives. In this context, the united republic of Tanzania requested the World Bank to assist in funding the Zanzibar urban services project (ZUSP). The overall objective of the ZUSP includes the improvement of public health by enhancing sanitation, cleanliness as well as the improvement of the biophysical environment of Zanzibar in light of the preservation of Zanzibar as an ancient historic and tourist site.

This project has several key initiatives part of which is the storm water drainage system. The first phase of the drainage project was implemented between 1994 and 1998 and the second Phase in February 2003 and until today most part of the island are frequently flooded and runoff is a constant problem in the areas. The Urban West region in the wards of Mwanakelekwe, Jang'ombe, Sebuleni, Kwahani, Mombasa and Miembeni were regularly flooded all around the year. In contrast, the Ng'ambo area, on the other side of the old Darajani Creek which used to separate it from Stone Town, is the dormitory of Zanzibar City, densely populated and largely unplanned in terms of housing, infrastructure and services. Moreover, the area has numerous low lying areas (land depressions), natural streams and wetlands which have been largely overlooked by those residing in the area. The consequence is that houses are occasionally flooded during the

wet and rainy season and streets are regularly changed into spontaneous storm water canals. Stagnant water is a permanent feature in most part of the island which breeds mosquitoes and increases the variety of water-borne diseases such as diarrhea, cholera, typhoid and bilharzias.

The situation was made worse by the failure of the drainage system to accommodate the flood waters as often most of the drains were blocked by solid waste and the presence of buildings along the storm water channels. (International Federation of Red Cross, 2005). The map below shows parcel of legal and illegal solid waste disposal site, buildings and the surrounding main roads.



Map 3.3: Parcel and Solid Waste Disposal site (Source: ERC Baseline survey, 2011)

The Zanzibar urban services project (ZUSP) is currently estimated to receive around USD 32 million from the international Development association (IDA), and the project will be implemented over a period of five (5) years. The phase III of the storm water drainage project was designed by H.P. Gulf engineering company targeting affected populations in Zanzibar flooding prone areas and it is expected to drain some catchment areas and in addition it is anticipated also to control runoff from the roads and surroundings along the road. A baseline survey was conducted among the shehias group generally known as the project beneficiaries understanding fully well that the drainage systems is expected to pass through many shehias dwellings in Zanzibar municipal council areas. A total of 2054 households which is 10.8% of the 19294 total households (study population) in the zone were selected for the survey. The households were selected on the following criteria: houses must be close approximately 100-500 meters along the drainage systems on vertical and horizontal directions to capture the most affected beneficiaries in the project area. Parceling or building number for each house which is geo-referenced was available for the houses earmarked for interviews. The proposed phase III of the drainage systems are in seven areas generally expressed as drainage system C, D, E, F, G, H AND I. Several problems were identified in all of the proposed drainage systems catchment areas. Using the drainage system C, F and E as an example, the C drainage is expected to cover the Magogoni and chumbuni region of Zanzibar and part of this was initially constructed in the phase I which has considerably deteriorated reason been that the surrounding areas of this region have been developed without proper planning and infrastructure standards such as good solid waste management, effective land use planning and management. Several pipelines are expected to be constructed in this area to drain some portions of the flooding depressions. Consequently the pipes will be placed alongside the existing unpaved road to assist in collecting runoff from the road due to ineffective land use planning.

In addition, uncovered and covered drainage channel is expected to be built in phase III work as part of the drainage E systems. Part of the system E was designed in the phase II project and according to the phase III final design report the line from Migombani along botanical gardens and Jagombe was not physically implemented during the phase II work and as a result most part of the phase II project is still flooded and runoff still persist in the area until today. The covered drainage is estimated to be much more expensive than the uncovered drainage system. Besides, there is a crucial inundated wetland in the binti Armani area that has formed a big flooding

depression due to the storm water in the area and areas surrounding this depression are densely populated. The depression which collects storm water in this area makes this area to be filled with water and this therefore resulted in situation where the Binti Armani people use this source of water for washing, stock watering and fishing. The existing drainage system in the area currently discharges into the south of kilimani and the pipelines are currently in an unsatisfactory position thereby storm water and sewage are mixed during storms.

The Mnazi Mmoja playing grounds (System F) is an existing system that has been constructed in view of its value to the public as a venue for sports and recreation. This system has however deteriorated to a stage where it is now not functional. And lastly in the process of managing storm water, a transport system was adopted in the phase I AND II by laying HDPE pipes, DN400 to transport storm water to the sea outfalls. However due to the constantly shifting of sand by tidal waves, the existing pipelines gets blocked. In addition, the flexible HDPE pipes have undulated due to sand movements. On the other hand, in this selected prone areas it is anticipated that the phase III of the storm water drainage project will cost more than 10million dollars.

3.5 ETHNOGRAPHIC FIELD OBSERVATIONS

Picture 3.5.1: Mnazi Mmoja Playing Ground (Source: Field work (2011)

The Mnazi Mmoja playing grounds (Proposed in System F of the phase III work) is an existing system that has been constructed in view of its value to the public as a venue for sports and recreation. The playing ground is directly opposite the sea. A sluice valve was constructed around this playing ground in a view to allow storm water discharge to the sea during low tide and during high tide it is expected to be close to avoiding the back flow of sea water.

Picture 3.5.2: The sluice Valve (Source: Field Work 2011)

The sluice valve was damaged before its designed life span and this led to the replacement of a new valve by the Zanzibar municipal council. The size of the new valve was not fitting with the previous pipe. The end result of the poor installation of the new pipe is the back flow of sea water into the playing ground. The acknowledged problem is associated with poor infrastructure maintenance and incompetency on the part of the authority that is charged with the responsibility of managing storm water in the area. This system has however deteriorated to a stage where it is now not functional and for this reason it was proposed to be reconstructed in the phase III work.

Picture 3.5.3: Meya Proposed in System E (Source Field work 2011)

Meya is a low level area where all water from all the surrounding areas flows to, people residing in this environs use this opportunity to dispose their waste on the Meya ground. During heavy rain the areas are flooded and water and solid waste spreads to the surrounding residential areas.

Picture 3.5.4: Flooded houses around in the Meya communities (source: field work 2011)

Ignorance from the side of the communities is manifesting itself as they are not aware of the consequences of their decision. There is spread of diseases and damaged houses in the Meya communities, and as well air pollution and poisonous gases are found in the surrounding areas.

Picture3. 5.5: Damaged houses in the Meya communities (source: field work 2011)

Picture 3.5.6: Botanical Garden (source: field work 2011)

The botanical garden is an open dump site surrounded by beautiful trees. According to the final draft report for the proposed phase III work, uncovered and covered drainage is expected to be built in this area and part of this area has been constructed in the phase II work but due to the inefficiency of the existing drainage, the area is frequently flooded and runoff still persist in the area till today. In early 1980s the Botanic Garden was the most attractive area in Zanzibar and was characterized by large and tall exotic trees from several areas of the world. The landscape of the area was very attractive due to the natural sloping and stream flowing in the direction of storm water drainage. Wetness, heavy shed covered with long tree and beautiful lawn on the whole landscape made the Botanic garden cool and relaxed area during day time. Tourist and local visitors were attracted from Stone Town and other places for picnic and resting especially during the evening time. The houses within the Botanic Garden were not flooding prone area between 1960s and 1980s and solid waste collection services were adequate enough for the population in the area. Generation of solid waste was low and there was only an official collection site and in this manner solid waste is properly disposed in the area and in other areas of the town.

Picture 3.5.7: Scattered Garbage around the collection point at Botanic Garden (source: field work 2011)

Rapid urbanization alongside unplanned buildings, infrastructures and services led to the emergence of flooding and runoff in the area. The existing drainage has become inefficient due to the poor management of solid waste and besides the society is fond of using rainfall as an opportunity to dump their household waste in and around the existing drainage. There is also improper monitoring of the existing drainage and lack of community sensitization on good housekeeping in the side of the Zanzibar municipal council and this has increased and made worse the level of floods and runoffs in the area. Water levels get to approximately 130cm high from the ground in some houses in the area. The picture below is showing an example and the consequences of building houses in a low lying area.

Picture 3.5.8: A House built in a low lying area (source: field work 2011)

Picture 3.5.9: The HDPE Pipes DN 400 (proposed to be reconstructed in the phase III work) (source: field work 2011)

In the process of managing storm water, a transport system was adopted in the phase I and II work by laying HDPE pipes, DN400 to transport storm water to the sea outfalls, However due to the constantly shifting of sand by tidal waves and illegal dumping of solid waste, the existing pipelines gets blocked. In addition, the flexible HDPE pipes have undulated due to sand movements.

Picture 3.5.10: Undulated HDPE Pipes (source: field work 2011)

Picture 3.5.11: Sand movements by tidal waves (source:field work 2011)

Drainage Basin in a central area around Kilimanu: The height of roads in the area were raised to solve the problem of runoff and floods and despite the huge amount of money spent; the

problems still persist in the area. Afterwards, a Centralized Drainage Basin was also constructed in the area to capture storm water and thereby transport to the sea. The communities are not fully aware and involved in this process and most often they are found dumping solid waste in this basin consequently resulting in the blockage of the pipe that was constructed and storm water becomes stagnant water frequently found in the basin. It can be observed that lack of adequate knowledge is manifesting itself on all sides, Decision makers and governments not aware of the consequences of their decisions and the societies as well not aware of the consequence of their actions. See the Drainage basin in the figure below

Picture 3.5.12: Drainage Basin in a centralized area (source :field work 2011)

Picture 3.5.13: Bawani swamp (source: field work 2011)

The Bwawani club and hotel is a famous place in Zanzibar and it's close to the sea outfall, after the construction of this hotel, this swampy area was specifically kept for water sports, but the resulting problem of back flow of contaminated sea water and storm water has brought about eutrophication that has lead to the growth of vegetation on the area. This water sports area have totally deteriorated to a stage that it is also now not functional.

3.6 Description of the Socio-Economic conditions of households in Zanzibar

The information presented in this section was extracted from the baseline survey conducted by the Golder associates and Environmental Resource consultancy. According to the Golder associate social baseline survey, Zanzibar's major economic sectors include agriculture, trade and industries, and tourism. Agriculture constitutes the core of the economy and it is the foremost foreign currency earner for the islands of Zanzibar and Pemba. About 24% of the total population is engaged in farming or livestock keeping, with a further 4% in fishing. Though, these economic activities are largely concentrated in rural areas.

The main employment opportunities in the Urban District are in the government sector (13%), or self employment without employees (16%). The percentage of housewives without economic activity (20%) reveals the social value that is placed on women as homemakers and primary caregivers. The largest part of the secondary activity in the Urban District was farming or keeping livestock (14% of the population). The high concentration of people in the project area has produce as a consequence very little agricultural opportunities and only in the more spacious areas was there evidence of a tract of buildings and farmland cultivated for the purpose of agricultural productions.

The Urban District has the largest percentage of households whose main source of income is cash wages (43%) and 23% of households reported owning a business. Growth in family-owned businesses of 45% since 2001 and 93% of the businesses in the Urban district was reported in the 2004 Business Census with wholesale and retail trade sector having the largest portion. Substantial proof of small business trading was also reported in the urban district ranging from small supermarkets to specialized carpenter business, home-based tailors and street hawkers selling fruits, vegetables and other daily domestic consumables. The district also has the largest proportion of households (13%) participating in savings or current accounts in Zanzibar compared to the national average of 6%. The district also has the highest rate of formal bank loans, with 3% of households reporting taking out a loan in the 12 months preceding the Household Budget Survey compared to the average of about 2%.

Access to cash wages and exposure to small business management and the use of financial facilities point to financial literacy in the project area. Larger percentage of the buildings in The Urban District has been constructed with modern materials, with 93% of houses encompassing a modern roof and non-earth floor, and 74% on all sides of modern walls. Majority of the houses are owned by the urban households around 72% and 14% live without paying rent. Housing was built with durable walling and roofing materials generally indicating permanency.

Around 67% of households have electricity connections in the Urban District, the highest figure in Zanzibar and many rural areas have no electricity at all. The majority of households in the Urban District use a pit latrine (72%) as their main form of sanitation, followed by a flush toilet (25%). Only 1% of the population in the district has no toilet facilities; a much lower figure than

the average for Zanzibar (28%) and rural areas where more than 74% of households have no toilet facilities. Sanitation facilities are generally available in the urban district of Zanzibar.

Economic Activity	**Frequency**	**Percent**
Civil Servant	321	15.6
Private Employee	176	8.6
Self Employment	632	30.8
Farming/Fishing	166	8.1
Small Business	485	23.6
Livestock	9	0.4
Other	265	12.9
Total	**2,054**	**100.0**

Table 3.1: Economic Activities in Zanzibar (Source: ERC Baseline survey 2011)

According to the baseline survey, (30.8 per cent) of the total household are self employed, followed by (23.6 per cent) of the household members are in small businesses. The number of the household, which do livestock, is very few (0.4 per cent) as there is no space for urban farming and livestock keeping in Zanzibar town. Private sector contribute (8.6 per cent) to the households income while farming and fishing sector contribute (8.1 per cent) of the livelihood of the survey area.

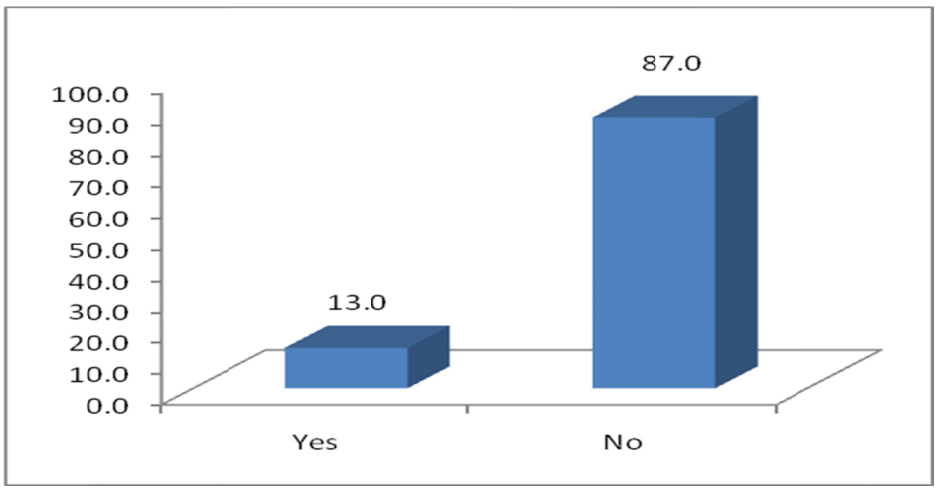


Figure 3.6.1: Possession of vegetable garden (Source: ERC Baseline survey 2011)

The other aspect of determining household wealth is the possession of assets and other investments. Closely related to household food security in this aspect is the possession of agricultural investments such as livestock, farm and others. This Figure shows the distribution of households by possession of vegetable garden. As it can be seen there that 87% of the households do not possess any vegetable garden while the remaining 13% of the households possess one. The reasons behind high proportion of households with no any vegetable garden is that almost all of these households are located in urban and especially town areas where it is difficult to have even a piece of land for growing such kind of garden apart from the land for house building.

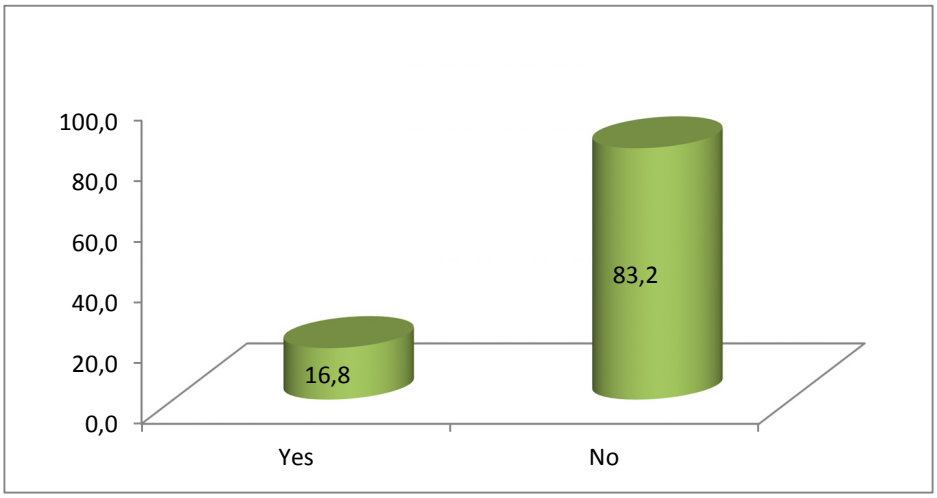


Figure 3.6.2 : Possession of livestock (Source: ERC Baseline survey 2011)

Figure3.6.2 display similar information to those shown in Figure 3.6.1 as with the case of vegetable garden, almost similar trend of observation is reported. It was observed that 83.2% of the households do not possess any livestock in their homes whereas the remaining 16.8% of the households do have some. The same reason given above for uneven distribution of possession of vegetable garden applies in this case too.

Chapter4: Theoretical Framework

4.1 Appropriate Technology Theory

In the modern society, especially in most part of the least developed countries, sustainable outcome from development projects are often unmet since the centralized approach to development is frequently adopted (J. Abraham 2010). Governments of these nations are often capitalizing on, and using to their own benefits, the current political, social, economic arrangements; and as well copying the developed countries development strategies. The consequence of this is seeing the poor and the underprivileged population of the world, especially the vast majority in the least developed countries to be left out of the benefits achieved from several developments efforts (J. Abraham 2010). The theory of appropriate technology clarifies that technological developments are appropriate only if it aims at the development of all human beings and their potentials. It stresses that the question of basic human needs occupies a predominant position in any technological development strategy that is well thought-out to be appropriate (J. Abraham 2010). The theory affirms that technology and development should aim at achieving the well being of the majority by the eighty five per cent of people living in villages. For this reason, there should be no doubt that the fundamental aim of any technological development is the eradication of poverty and the provision of better living standard for the masses.

From a sustainability perspective it is argued that '*New and efficient technologies will be essential to increase the capabilities (in particular of developing countries) to achieve sustainable development, sustain the world's economy, protect the environment, and alleviate poverty and human suffering. Inherent in these activities is the need to address the improvement of technology currently used and its replacement, when appropriate, with more accessible and more environmentally sound technology'* (UNEP- ESTs2003, Pg 2). Though, governments of these nations seem to be committed to developments with their policies and development strategies that are adopted through inspiring growth in certain sector of the economy, they however do not improve the living standard of poor people and indeed, create a large group of

development victims (J. Abraham 2010). Experience has shown that social, environmental, economic, cultural, and ethical aspects of any development project are often more important than the technical aspects. To cite an example, Okonko et al 2007, presented a case of the initial water treatment method by physical, chemical and thermal process, a system which is being planned centrally and directly copied from the developed countries. They clarify that though these systems are fast and controllable but they require high energy and are cost prohibitive. They also described that the way in which this method is being applied and implemented has made agencies responsible for the provision of portable water in Nigeria unable to cope with the present demand as often there are problems of water scarcity. This scarcity was ascribed to several reasons such as power failure in developing countries, lack of chemicals and breakdown in operational systems. These issues were not given a deep thought prior to making decisions on the use of such conventional treatment method and therefore, it is described as not being implemented in line with the principle of sustainable development. The social, economic, cultural and ethical analysis required before the implementation of such an extensive system is insufficient and some necessary criteria required for its effective implementation such as good water analysis that can connect researchers, different institutions, and the recipients together in order to work towards a common goal were not deeply considered.

The problem discussed above is also reflected in the management of Storm water since drainage requires a good solid waste and effective land use planning to work effectively. The management of storm water requires a number of professionals and a detailed financial, social and institutional analysis for its effective management (cited by Joel .A. et al, 2007). Experience has shown that several development projects that have been implemented without the aforementioned criteria have resulted in creating several future problems. Nevertheless, the key aim of removing this barrier of future problem in any development strategy is ensuring active man participation in decision making and as well as making certain that technology recipients, institutions, societies and users are able to make informed choices by being able to identify themselves and procure the most appropriate investment in environmental, economic and social terms technology for a given application in any society (UNEP 2003). This, in a nut shell shows that technology development should create a vast prospect for institutions and citizens representations.

It is pertinent to state that ignorance is a major drawback in the least developed countries that even the greatest organized social capital will not be able to resolve. Institutions fail to reach their objectives, which may result from the deficiencies of social capital. Examples of such failures include unsuitable government interventions and inefficient governments in general, as well as stakeholder involvement failures. Some of these failures could be avoided had the society been more involved in all of the processes that might affect it. However, social capital restructuring represents the best answer to the problem of ignorance. (Sendzimir foundation, 2010). The society should be informed, aware and well educated in an attempt to describe a development project as being designed for sustainability and in supporting sustainable development. *'Such a civic society can be shaped with the use of relevant policies (increasing society's share in decision making, stimulating civic activity, and facilitating communication) and education (increasing the citizens' awareness of opportunities and benefits of their involvement)'*. (Sendzimir foundation, 2010: p 16). Institutions can ensure adequate stakeholder involvement and as well enhance an improved social status to the in the least developed countries. Institutions can also resolve both the described ignorance and active man participation problems and thus increase society's share in decision making through cooperation and coordination. Institutions can shape and coordinate the desired results that are often unmet and as well as specifying an appropriate behavior and making sure that there are solutions to problems and the expected societal behaviors are observed (Stein, 1982).

An instance of an appropriate development strategy was cited by J Abraham 2010. He presented a case of Tanzania experience in the Arusha province under the leadership of Julius Nyerere, where he attempted the anti-capitalist and anti-urban road to development, an independent rural development strategies along populist-socialist lines.

The strategic approach to development as at that time laid emphasis on the development in the rural areas and abandoned the growth of cities and urban areas. The most imperative social and institutional settings through which this was carried out is the family hood village scheme also known as the Ujamma village. The scheme however promotes socio-economic development through encouraging rural communities to collectively share responsibility and authority to plan and produce the good and services they require. The villagers decided on their own free will

without been paid to independently live together and work together for the common good, the idea which is referred to as a radical attempt for the development of people. According to J Abraham, "Nyerere declared that the development of people, roads, buildings, the increase of crop output, and other things of this nature is seen only as tools of development and not development itself.

The scheme produced many thousands of rural settlements comprising at least two hundred and fifty households on average, each house having a small private plot of land while a communal farm area is established in a central clearing (J. Abraham 2010). By 1976 virtually all of the peasantry was resident in these villages. The Tanzanian experience was evaluated in the spirit of participatory and appropriate development strategy. The family hood village scheme was described by Diwan and Dennis (1979) as a people centered development strategy basically because the scheme contained all the elements of appropriate development strategy. The production and distribution are based on local resources and local initiatives. The process of decision-making is decentralized, participatory and well coordinated. 'Village' implies an emphasis on the rural and the needs of the poor.
In this way, Livelihood assets are assessed, used, controlled and decided upon by the rural people and a system approach to development where government gathered in a close system and making decision without the involvement of the societies and institutions is strictly discouraged. The notion of this participatory and appropriate technology development approach is recognized as promoting coordination and collaboration that any technological development in the least developed countries should address in other to improve the quality of life of the masses.

4.2 Sustainable livelihood Approach

Just as the appropriate technology theory aims at the eradication of poverty and the provision of better living standard through technological development, the sustainable livelihood approach is another framework for development equally aimed at poverty eradication, by virtue of its context, objectives and main concerns. The approach clarified that poor people have different kinds of capital (human, social, natural etc.) which all should be respected and protected. But if one capital base is destroyed, there is always the possibility to base oneself on some of the other capitals. Besides, the approach also clarified that transformation of structures and processes is

inevitable in the least developed nations to ensure that all of these other capitals are sustained and reached as at when needed. It focuses on one of the most essential facets of life: the ability of people to provide for themselves the basic amenities of life, both in the present and into the future (Peter Castro 2002). According to this framework, Transformation in laws, policies, culture in the least developed countries is requisite to reduce the poor and underprivileged people vulnerabilities to disasters as well as enabling them to have influence and access to all forms of capitals. It emphasize that development project must not exploit or bring injustice to the environment or other livelihoods, present or future and without a doubt it should advance the well-being of the majority and that of future generations (Chambers and Conway 1992). In this sense, it is crucial that technological development must be people-centered, reacting quickly and favorably to suggestions, participatory, building on people's strengths (human, financial, physical, social and natural capital) and addressing vulnerabilities in other to be describe as sustainable (DFID, 1999). The approach in particular emphasizes an all-inclusive and participatory system of development, by way of involving the local community in the formulation of laws, policies, cultural changes and the setting up of relevant institutions, thereby giving the beneficiaries a sense of belonging and the necessary knowledge that will ultimately lead to transformation within the system, and as a result, an improved social status within the populace. The analysis of sustainable livelihood suggests that involvement in a process eradicates ignorance and makes all parties involved a part of the system. The notion stresses that livelihood are affected by the diversity and number of assets and the balance between them. Additionally, it clarifies that people's ability to escape poverty depends on access to assets both material and social resources. People's livelihoods and the wider availability of assets are fundamentally affected by critical **trends** as well as by **shocks** and **seasonality** – over which they have limited or no control. Assets on all sides of human, social, physical, natural and financial capital must be able to cope with and recover from stresses and maintain the current standard of living without undermining the natural resources base (DFID, 1999). See figure below for sustainable livelihood framework;

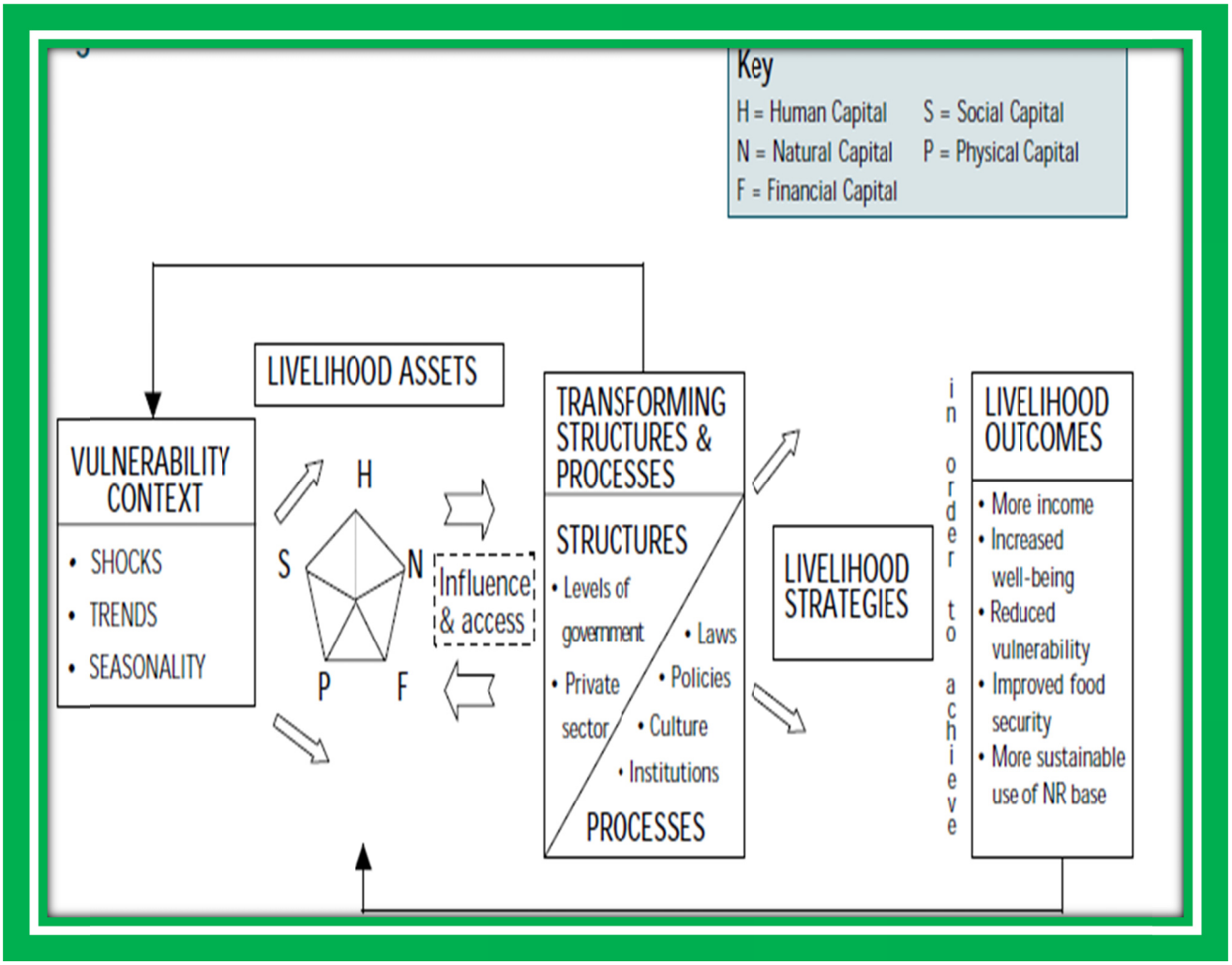


Figure 4.1: Sustainable Livelihood Frameworks (Source DFID 1999)

The factors that make up the Vulnerability Context are important because they have a direct impact upon people's asset status and the options that are open to them in pursuit of beneficial livelihood outcomes.

• Shocks can destroy assets directly (in the case of floods, storms, civil conflict, etc.). They can also force people to abandon their home areas and dispose of assets (such as land) prematurely as part of coping strategies. Recent events have highlighted the impact that international economic shocks, including rapid changes in exchange rates and terms of trade, can have on the very poor.

• Trends may (or may not) be more benign, though they are more predictable. They have a particularly important influence on rates of return (economic or otherwise) to chosen livelihood strategies.
• Seasonal shifts in prices, employment opportunities and food availability are one of the greatest and most enduring sources of hardship for poor people in developing countries (DFID 1999).

Nevertheless, the acceptance of decentralized planning as a way to facilitate socio economic development of poor people is indispensable in the provision and sustenance of the above mentioned assets. Decentralized planning includes the partial transfer of power, resources and functions, from central government to institutions at regional level or local level and also the promotion of local governments and rural communities' ability to integrally share responsibility and authority to plan, produce, and finance the goods and services they require. It is in this way that laws, policies, culture and institutional structures and processes can be transformed to influence livelihood assets that can reduce the stresses of vulnerability. By this approach, the appropriateness of Development investments, policies and processes is based on how it is often more people centered, implemented in partnership and building on the strength of the poor (DFID, 1999).

The intrinsic weakness of poor people's livelihoods makes them unable to cope with stresses, It also makes them less able to control or influence their environment to lessen those stresses; as a consequence they become ever more vulnerable and even when trends move in the right direction, the poorest are often unable to benefit because they lack assets and strong institutions working to their advantages. So therefore, Livelihood strategies that will provide sustainable livelihood outcomes and resilience capacities to vulnerabilities must promote the responsiveness, efficiency and effectiveness of local institutions and consequently providing the building blocks to good governance (DFID, 1999). By so doing local initiatives and ownership is seen as fundamental to societal empowerment.

Chapter 5: Analysis of Results

This chapter presents the results of the interviews and the analysis of the impacts of the identified problems

5.1 Results of the Interviews:

A common factor emphasized by all interviewees is the people's lack of awareness and low level of knowledge in the area of environmental management. This, according to my findings, is responsible for people building houses in low-lying areas and dumping of solid waste in the constructed drainages, which has consequently led to the blockage of such drainages. According to them, storm water management problems in the area started with people dumping solid waste in the constructed drainages and authorities charged with the management of storm water have failed to develop a mechanism for controlling the situation. The suggested solution to this is raising awareness amongst the people.

Another problem associated with the present storm water management system in Zanzibar is the mismanagement of the drainage facilities as occasioned by lack of follow-up and proper monitoring post-implementation. The various interviews revealed that due to lack of a follow-up mechanism, sewers get blocked after a short while. For instance, there is no reliable cleaning routine of the existing drainage system and no close supervision by the municipal council charged with the overall responsibility of managing the facility. To this problem is suggested that reconstruction of blocked sewers should be followed-up by proper monitoring and maintenance to ensure effectiveness.

Sewage disposal is another problem in the management of storm water in Zanzibar. This, according to findings, is really affecting coastal marine life and as well creating serious health impacts on humans since Water table in Zanzibar is very high, and the majorities of the people use septic latrines, soak pits, or pit latrines. These sewage systems have the potentials of mixing with storm water and discharging into the surface and the sea. I observed, and later confirmed via the interviews, that storm water drainage system is a transport process in Zanzibar, rather than a

management process. The present system only moves the storm water into the sea, thereby aiming at reducing only the quantity of storm water runoff in urban areas and not protecting the environment as a whole. What is done in effect is to move the storm water from areas of economic importance to other areas of less significance. However, my interviewees suggested that storm water management is supposed to reduce, neutralize or turn storm water into something different that can improve the quality of life of the people, the coastal resources, and the environment as a whole. A former written comment that specifically mentioned and clarified this unsafe circumstance was cited in the world water quality facts and statistics; thus, emphasizing that polluted water with human waste significantly compromises quality in nearby water bodies and posses extreme health risk. Going by these clarifications, infectious diseases from contaminated water with all forms of human waste are the number one killer of children under five years old; polluted water with human waste is also directly linked to unsafe sanitation and hygiene that causes approximately 3.1 percent of all deaths world, and 3.7 percent of DALYs (disability adjusted life years) worldwide (Cited by Pacific Institute, 2010).

Finally, the issue of societal participation was harped on by all interviewees. They all argued that involvement of major stakeholders in the planning and implementation of development projects is lacking in Zanzibar, and that it is only when this is addressed and put in place that the community will have a sense of 'ownership' and can then participate in the monitoring of the systems and ensure they function properly. Their individual submissions gave a general impression that relevant stakeholders are only consulted when government is having problems with the systems. For instance, the head of the department of science at the Zanzibar State University lamented that the institution was only contacted once when the municipal council was having problems of sludge with one of its sewers. He said the university was contacted to analyze the samples of the sludge after the garbage collectors and other related parties had complained of handling dangerous materials. In a similar vein, the representatives of the NGO CODECOZ specifically mentioned that communities and institutions are never consulted during planning and implementation of projects and therefore feel they are not part of the decision-making process and that it's only at the point where the government is having problems that their

opinions are sought. They however advised that participatory approach be embraced for the successful implementation of future projects.

The problems and characteristics of the existing storm water management system in Zanzibar can be summarized below based on the conducted interviews as well as observations; the ZUSPs report and the two consultancy documents I have had access to:

1. The municipality of Zanzibar is characterized with unplanned settlement and continuous building of structures without legal permission which drastically increases floods and at the same time reducing the flow of runoff and as a result increasing the number of dilapidated and flooded houses in and around Zanzibar. The drainage system is insufficient to solve the flooding and runoff problems in the area as there is no reliable cleaning routine of the existing drainage systems and close supervisions from the Zanzibar municipal council that is charged with the responsibilities of managing storm water in the area
2. There is Poor extension and rehabilitation of exiting drainage: I observed in the ZUSP report that the extended exiting drainage done in 1990s was aimed to remove storm water collected from various street points but unexpectedly found that the increased number of chambers was the result of bringing sea water from the sea . The situation was the reason of more play ground destruction as they allow sea water flowing up out of chambers.
3. I also concluded that storm water drainage system is a flawed practice in Zanzibar as Storm water; sewage and solid waste are mixed and often discharged to sea without treatment.
4. There is no officially constructed storm water drainage in some areas and has made some of the existing drainage to be inefficient.
5. There are no specific laid local policies to abide with by-laws at the ward Shehias levels in the interim development plan of the Zanzibar Municipalty, some residents have been taking loopholes of dumping solid waste at illegal areas during night time and heavy rain falls.

6. A big layer of plastic garbage has covered most of the land area around all the illegal dumping sites and has reduced the level at which storm water penetrate and infiltrate into the ground
7. Participatory approach that gave an opportunity for different stakeholders to exchange information and knowledge, and express their points of views and concern regarding a proposal before decisions are made is missing in the Zanzibar strategy for growth and reduction of poverty
8. Full study of significant issues related to the management of storm water before making decisions on a projects and suggestions of alternatives is missing in the management of storm water in Zanzibar
9. There is social disintegration i.e. the involvement of local people in decisions and responding to their concern as a strength and cultural diversity to reduce environmental problems and improve the functioning of the existing management is missing in the system

5.2 ANALYSIS OF IMPACTS OF STORM WATER MANAGEMENT SYSTEM IN ZANZIBAR

The analysis of the impacts of storm water management system in Zanzibar is presented below based on the three components of sustainability.

5.2.1 Economy:

According to the socio-economic conditions of Zanzibar presented in chapter 3, section 3.5, agriculture constitutes the core of the Zanzibar economy and is therefore considered as the foremost foreign currency earner for the island of Zanzibar and Pemba. However, the high concentration of people and the high percentage of clustered and unplanned buildings in the urban districts have produced, as a consequence, very little agricultural opportunities. It is only in the more spacious areas that there are evidence of a tract of buildings and farmland cultivated for the purpose of agricultural productions. As a result, agriculture-related economic activities, that should expectedly be the driver of the Zanzibar economy, have been relegated to the

background as an indirect result of unplanned infrastructures and services. The socio-economic conditions of the supposed beneficiaries of the existing storm water management project revealed an extremely low standard of living, low per capita income, meager wages, and little possession of agricultural investments such as livestock, farmland and others. The project has failed to address the full study of significant issues related to storm water management and suggestions of alternative ideas that would enhance and improve the management of storm water and at the same time the agricultural opportunities and investments that hitherto served as the major source of income for the community. The disbursement of huge amount of money for the construction of drainages has failed to achieve the desired improvement in the reduction of floods, runoff, standard of living of the people and as well as maintaining and enhancing capabilities and livelihood assets. In this sense, storm water drainage project in Zanzibar could be described as an inappropriate investment, going by the clarifications of the "appropriate technology theory" that the fundamental aim of any technological advancement and development is the eradication of poverty and the provision of better living standard for the masses. Development project and technology in the least developing countries should therefore aim at achieving the well-being of the majority by the eighty five per cent of people living in villages. It is also worthy of mention that the storm water drainage project has failed to cope with, and recover from, the stresses and shocks of storms in the area, since floods and runoffs still persist to a large extent, a menace which has forced people to abandon their home areas and dispose of tangible assets. For instance, the walls of some houses have cracked, and electric shocks are common due to run-off water flowing directly into and settling above electrical installation systems. Furthermore, muddy walls have collapsed while some houses are silted by sedimentation reaching one meter above ground level, which continues to force the owners to other safe places as a consequence of floods and poor management of the existing drainage system. The socio-economic conditions of Zanzibar also revealed that the majority of these houses are privately-owned by individuals and the cost associated with renovation of damaged buildings and lost household items is borne by the individuals.

Another notable economic activity in the area is fishing. According to the baseline survey, the degradation of the marine environment as a result of the direct discharge of storm water to the sea without treatment is expected to reduce the income and living standard of fishermen, since

the uncontrolled assault on the seafood and fishes, occasioned by this practice, will continue to reduce biodiversity. For this reason, the present storm water management project has failed to achieve the desired improvement in the well-being and economic prosperity of the host community. Rather, it has only succeeded in further impoverishing the residents and consequently, the local economy. The project has also failed to reduce vulnerability, neither has it been able to provide more income nor improve food security amongst its beneficiaries. It has also led to wasteful consumption of resources, since material resources are continually deployed in the renovation of dilapidated houses and in the procurement of new sets of household items. Above all, the project has not made the local economy more robust in any way, or boost productivity at the local and regional economic circuits. It has therefore failed to improve the financial situation of the common man, and is totally futile in increasing the economic benefits and social status of the average resident of Zanzibar.

5.2.2 Environment and Natural Resources

The interviews and the field observation revealed a number of environmental problems associated with the existing drainage systems. Storm water management system in the area is in form of transporting storm water through the constructed drainages and discharging same into the sea without treatment. Oceans and seas provide 99% of the available living space on the planet, covering 71% of the earth surface and containing 90% of the biosphere. Consequently, they contain more biological diversity than terrestrial and freshwater ecosystem. Nevertheless, Marine environment has deteriorated from this approach as a result of contamination by toxic products, euthrophication, over exploitation, the introduction of pathogenic agents into the sea. This has drastically reduced the possibilities of people and other forms of life to flourish forever. The direct discharge of storm water to the sea without treatment has failed to contribute to the benefits of natural areas in the vicinity to support environmentally friendly, biodiversity and quality of natural habitats. Furthermore, incompetency on the side of the authorities charged with the responsibility of storm water and sewage management in terms of poor extension and rehabilitation of existing drainage, and lack of proper monitoring have created several problems ranging from improper infiltration of storm water into the ground, sea water covering the original land, green house gases emission, amongst other issues. Factors such as poor drainage

performance, sluice valve failure and absence of sluice valve controller have been the cause of these problems and in this sense the project is futile in the reduction of environmental hazards and prevention of water, air and soil pollution in the area.

5.2.3 Society, Social Aspects and Culture

The analysis of sustainable livelihood stresses that livelihood are affected by the diversity and number of assets and the balance between them. It distinguished that the transformation of laws, policies, cultures, institutional structures and processes is indispensable in the least developing countries. For example; '*increasing society's share in decision making, stimulating civic activity, and facilitating communication) and education (increasing the citizens' awareness of opportunities and benefits of their involvement)'* (Sendzimir foundation 2010: p 16) can influence livelihood assets that can reduce the stresses of vulnerability and besides enhance people's ability to escape poverty in the least developing countries. Reflecting back to what characterizes the existing management system in Zanzibar, there is no facet of the above mentioned transformation in the system. On the contrary, centralized system of planning from above that has been in practice for so many years was discovered as what characterized the existing system. In this sense, social equity and equal opportunities for all members of the society has failed to flourish within the society. Participatory approach that gave an opportunity for different stakeholders to exchange information and knowledge, and express their points of views and concern regarding a proposal before decisions are made; and the involvement of local people in decisions and responding to their concerns as a strength and cultural diversity to reduce storm water problems in the area are missing. This however has confined the project to increase the social capital in the community which is as strong as mutual trust and relations within the society. The interviews conducted described that societal participation such as cooperation and alliance with local shehias in one way will improve the social status that is needed to improve the efficiency of the drainage system. The villagers tend to have a sense of ownership and in this way they can participate in the monitoring of the systems and ensure that the system is working properly.

Furthermore, the situation of more playing ground destruction, deterioration of buildings and loss of livelihood assets as a result of poor extension and rehabilitation of the existing drainage has created several syndrome of homelessness, inability of students to attend schools and feelings of restlessness among families – an indication of poor standard of living and poor access to community facilities and services. The urban drainage system have also failed to reduce risks for humans, leading to a spatial inducer of security, and it is as well futile in contributing to the prevention of crime and increased perception of safety for the population as often evacuated houses are turned into drug-abusers camps and dumping sites for solid wastes. Lack of an open space in the Botanical Garden has made the young generation to lose hope, consequently turning a large proportion of the youth into drug addicts who are big burdens and liabilities to their respective families in particular, and the country as a whole.

Chapter 6: Conclusion and perspectives

6.1: CONCLUSION

Going by the clarification of the (UNEP-WWF 1991), *'sustainable development is that which improves the quality of human life while living within the carrying capacity of supporting ecosystems'*. The human and organizational processes involved in the management of storm water in Zanzibar are far from satisfactory in the phase of sustainable development. The existing urban drainage system has being a function of collecting storm water and conveying and discharging same to the nearest point of disposal such as sea, drainage basin, etc as soon as possible without treatment. The drainage system has failed to sustain the economy, protect the environment, and alleviate poverty and human suffering. The main challenges to these problems have to do with stakeholder involvement failure and lack of societal participation in decision making for the implementation of the urban drainage project; as well as the inability of government and authorities charged with storm water management responsibilities to plan and implement urban drainage covering urban flood protection, pollution control and management catering for improved quality of life. The absence of collective and alternative solutions as well as considerable coordination and cooperation between the residents themselves is due to the aforementioned stakeholder involvement and active man participation problems and as a result, the large donor-financed investment in drainage systems quickly became recipients of waste of all kinds, including water, feaces , sewage and solid waste.

The most notable factors that make it difficult for the existing urban drainage systems to work efficiently like in countries that are more developed include: (1) unplanned settlement and continuous building of structures without legal permission, thereby limiting the space that urban drainage requires to reduce floods and at the same time increasing the flow of runoff. (2) No specific laid local policies to abide with by-laws at the ward Shehias levels. (3) no reliable cleaning routine of the existing drainage systems and close supervisions from the authorities charged with the responsibilities of managing storm water in the area, thus leading to the contamination of storm runoff by sewage, sediment and garbage ; (4) climatic and socio-

economic factors favors the big layer of plastic garbage that covered most of the land area around all the illegal dumping sites and has reduced the level at which storm water penetrate and infiltrate into the ground; (5) lack of a technological basis for adequate drainage management, extension and rehabilitation of exiting drainage; (6) lack of Participatory approach that gave an opportunity for different stakeholders to exchange information and knowledge, and express their points of views and concern regarding viable alternative solutions to the existing urban drainage. Lastly, there is social disintegration i.e. adequate social status, strength and cultural diversity that are necessary to sustain and improve the efficiency of the existing urban drainage as well as obtaining viable alternative solutions to storm water management problems. However, awareness of these difficulties is fundamental to the search for viable solutions appropriate for the least developed countries.

Based on these notable problems, it is concluded that the concept of sustainable development is provoking a profound rethinking in the approach to storm water management in the least developed countries. The concept calls for overall rethinking and this implies paying attention to particular situations in the local area. Learning about natural and manmade processes that affect the runoff quality and quantity is of prime importance. There is obviously a need for a basic sanitation and waste collection system as well as storm water management concept that considered storm water to be a precious resource which can be retained near the source to be reused and recharged to the underground for aquifer replenishment etc. In such sense, Flood control and other notable problems are dealt with, focusing on reducing vulnerability to flood disasters in urban areas in the least developed countries.

6.2: PERSPECTIVES

Where water acts as the primary conveyor of pollution, as is the case of storm water in Zanzibar, source control measures can be taken to reduce the impact of such pollution, by controlling the flow of water. The value of freshwater is constantly being depreciated in Zanzibar, and other least developed nations, as a result of contamination by groundwater, runoffs and soil erosion. If this continues, the provision of sustainable drinking water will be a daunting task, and the

government of these nations, being the primary provider of basic amenities, will be faced with ridiculously high cost of governance. In a bid to forestall this and provide sustainable water at affordable cost, environmentalists have come up with the idea of source control in water management (Peter Coombes and George Kuczera, 2005). Source control in water management could be achieved through harvesting of rainwater, detention of storm water, onsite treatment of laundry water, bathroom and kitchen), use of water-efficient appliances and practices, as well as onsite infiltration. In my opinion, of the various source control techniques, rainwater harvesting can be considered a viable alternative and can also be compared with other alternatives to sustain the existing urban drainage system of storm water management in Zanzibar and other least developed nations having similar problem.

Rainwater harvesting is a technology used for collecting and storing rainwater which falls on the roofs of buildings/houses. Water catchment from roofs of houses is of good quality and can be stored in tanks/sumps either for direct use or diversion to the existing borewell/open well for groundwater recharge (UN Habitat, 2005). Recent research in developing countries have also pointed out that rainwater is relatively free from impurities, apart from those picked up from the air and the environment (Adrian, 2005). Rainwater harvesting technology most often comprises of a roof catchment area, a storage tank and gutters to convey the water from the roof to the storage tank. The deployment of a suitable rainwater technology is essential to reduce the amount of runoff and flood, and also for the utilization of rainwater as a water resource. The system must, in particular, include the following components:

· **Roof catchment -** The roof of the house is used as the terrace for collecting the rainwater. Many rooftops in the urban districts of Zanzibar are made with corrugated iron sheet or tiles and thatched roofs are also used as roof tops in a nearby island.
· **Gutters** – are waterways connected to the edges of roof all around to collect and convey the rainwater from the roof to the storage tank. Gutters can be constructed in semi-circular and rectangular shapes and can be made from locally available materials, such as plain galvanized iron sheet, PVC pipes or bamboo.
· **Down pipe** – the down pipe transports the rainwater from the gutters to the storage tank. The down pipe is joined with the gutters at one end, and the other end is connected to the filter unit of the storage tank.

· **First-flush –** Generally the first 50 liters of rainwater per 1,000 square feet of roof surface that is diverted by a pipe due to potential for contamination. It removes debris, dirt and dust collected on the roofs during non-rainy periods. This first 50liters of rain water if washed into the storage tank can cause contamination of water collected in the storage tank, thereby rendering it unfit for drinking and other necessary purposes.

· **Filter unit** – is a chamber containing a filter material such as coarse sand, charcoal, coconut fiber, pebbles and gravel to get rid of the debris and dirt from the water that enters the tank. The chamber is made with a perforated bottom to allow the passage of water. The filter unit is usually placed over the storage tank.

· **Storage tank -** is used to store the harvested water. Storing considerable quantities of water that can reduce runoff and floods will require a larger tank with as much as necessary strength and durability. The storage tank is made with a cover on the top to avoid the contamination of water and in addition, pipe fixtures are fixed at appropriate places to draw the water, clean the tank and to dispose the unwanted water.

Collection pit – a small pit is dug in the ground, beneath the tap of the storage tank and constructed in brick masonry to make a chamber, so that a vessel could be conveniently placed beneath the tap for collecting water from the storage tank. A small hole is left at the bottom of the chamber, to allow the excess water to drain-out without stagnation.

During the interviews that were conducted in Zanzibar, the potentials of rain water harvesting were also investigated and all of the interviews agreed that it is necessary to encourage rain harvesting in Zanzibar. Obviously it is considered as an idea that will reduce storm water runoffs, floods and as well improve the quality of life of the people. The interviewee's consent that they will prefer rain harvesting after the first flush for drinking purposes, reason being that government and individual household well that serves as the major source of drinking water are open well and runoff water and soil erosion is often seeping into the well. Another important benefit that was raised is connected with the improvement of livelihood and the socio-economic conditions of the household. It was revealed that rain harvesting will improve the current agricultural practices that constitutes the core of the Zanzibar economy since water that is harvested can be used for irrigation and other useful purposes.

Based on my findings, collective approach of rain water harvesting can lead to a situation where the project is considered as a government project and governance system where all facilities are governed by the government has failed totally in the management system today. The decentralized (individual) system is suggested as the best alternative. Individual households tend to be committed, having a sense of belonging and feelings about it and if it is beneficial to them, they will continue to work on it and make it better. It was also revealed that land use planning is inevitable for the collective system and to supply it to respective users, conversely, there is no land to channel pipelines and this will eventually cost a lot more. Tax reduction and loans that can be repaid over a long period is raised as a thought that can aid the effectiveness of the individual rain harvesting system in a country like Zanzibar where the socio-economic conditions of the household revealed that majority of the people do have access to loans. There are lots of occurrences of development projects in the least developed countries where individual household paid some fewer percentages and Governments and/or private investors pays the rest to be repaid in a long period of time. My research revealed that majority of the houses in Zanzibar are individually owned houses and there is this conception that if you can afford a house, you should be able to afford rain harvesting. Setting up institutions for demonstrations, training, awareness and engaging the societies to have a sense of ownership is expected to motivate the people and in setting up a system that will allow the investment to be repaid and continue to function in years to come. The benefits of rain harvesting and reuse most notably includes the possibilities to have water for years, the inclination for decreased flooding, runoffs to seas and damaged houses and the mere fact that individuals stands reduction in the risk and functions that is foreseeable from the cost and maintenance of water services in the future.

Practical Advantage	Qualitatitive Advantage
1 Availability of water not subject to outside utility control 2 Availability not subject to pipelines failures 3 Quality is controlled by the consumer (An improved social status) 4 Available where electricity brings about water scarcity 5 Available even when storm and disaster strike 6 Reduces Run off and erosion 7 Reduces mosquitoes breeding ground 8 God for people with low sodium diets and weakened immune system 9 Available for emergency fire suppression	1 No dissolved minerals 2 useful where there is salt water intrusion to water aquifers 3 Aboundantly available in the least developing countries 4 free for individual households who harvest rain water 5 Environmentally, socially and Economically sustainable

Table 6.1: Practical and Qualitative advantage of rain water harvesting

Lesson learned from the Chumbe Island eco Bungalows

Chumbe Island Coral Park is a nature conservation project in Zanzibar Tanzania and the first privately managed Marine Park in east Africa. It is a financially sustained initiative which is run

by a non for Profit Company where income from visitors is re-invested into the conservation and environmental education operated within the park. The original investment was paid by a German woman called Sibylle Riedmiller, who negotiated with Zanzibar government about the protection of the island. The bungalow is built based on the art of eco-architecture and eco-technology and water is harvested from each of the bungalow during raining season captured from a specially designed roof as there is no any ground water source on the island.

Picture 6.1 and 6.2 : Chumbe Island eco Bungalow (source: Field trip 2011)

The harvested rain undergoes series of multifaceted sand filtration and it is stored in a spacious underground cistern. The water is then hand-pumped through a solar-powered heating system into hot & cold-water containers for the shower and hand basin in the bathroom and kitchen. The harvested water is used for several purposes other than drinking ranging from cooking, bathing, washing etc (Chumbe Island, 2009). Nevertheless, waste water from these specific purposes can increase the amount of Micro Algae in the coral reef if directly discharge to the coral without treatment, thereby reducing the amounts of oxygen as well as sunlight that reaches the coral. A well developed Initiative in the island today is a planted bed to remove phosphorus and nitrogen from waste water before discharging to the coral reefs. The used water from showers, kitchens, sinks and basins containing high amount of nutrients is filtered with sand ending in specially sealed plant beds to ensure that no polluted water enters the Reef Sanctuary (Chumbe Island, 2009). The planted beds are water and nutrients demanding, and therefore they ensure that

nitrates and phosphates are easily absorbed and thus, preventing the nutrients to be released to nature (Chumbe Island, 2009).

Another special feature of the eco-bungalow is the composting toilet that was initiated to deal with sewage. The eco-toilets prevent sewage seeping through the porous ground into the reef sanctuary. Human waste is quickly decomposed to natural fertilizers when mixed with compost in the presence of oxygen in the composting chamber. To ensure the experience is the same as with any regular toilet, specialized designs have been implemented with wind powered vent pipes and gradient storage so that it feels no different to using a regular toilet; except that composting toilets need no flush water at all, thus they also effectively reduce water consumption and lastly of all, lights are provided by photovoltaic panels constructed on the roof of the houses that make available ample environmentally friendly 12V energy for normal usage (Chumbe island, 2009). It is very crucial at this point to emphasize that this is only a kind of image of how an alternative system could function; however, it will take a lot of change in a huge set of parameters to introduce it at a general community level.

Certain activities that is been conducted by the company to promote environmental conservation and to contribute to the livelihood of the residents in Zanzibar was also observed. Chumbe island coral reef is creating awareness and supporting secondary schools in and around Zanzibar with training and skills to develop several small scale environmental projects. The program was implemented via training and encouraging students to design projects that would be beneficial to each and every one of them in their respective home and the best groups with the best design is given an opportunity to visit the Conserved Island free of charge. It will be beneficial if such an idea is introduced in the case of rain water harvesting and in other viable storm water management alternatives bringing together educational and local institutions, government agencies, corporate bodies and the societies in general to support in raising awareness as well as ensuring local initiatives and ownership by individual households in the least developed countries.

Based on this premises, the improvement of urban drainage system as well as the implementation of other viable alternatives in the least developed countries should be people centered,

implemented in partnership and built on the strength of the entire society. The adoption and its implementation will be more effective and sustainable through measures ranging from educational to institutional issues. The involvement of the local community in the process eradicates the ignorance in the existing urban drainage as well as in other viable alternatives and makes all parties involved a part of the system. In terms of awareness and knowledge, institutions are inevitable to provide useful information to decision makers and the entire society about storm water management problems as well as the existence of other viable alternatives, in particular the importance of rain water harvesting in the least developed countries.

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Appendix

Issues and questions that were specifically raised during the interviews are presented below:

- The problems that are associated with the present handling of storm water in the area
- The possibilities of rain harvesting in Zanzibar and whether it should be done collectively or by individual households
- The social, environmental and health impact that has taken place from the poor management of storm water in the area
- The level at which the informants and institutions in general are participating in the decision making and planning process of development projects
- Other questions like the system that is been adopted by the authorities charged with the responsibility of storm water management in the area is also raised
- And lastly, to what extent can the urban drainage system assist in addressing the floods and runoff problems in the area and how storm water drainage system can be more effective and efficient in the area.

Results of the interviews:

According to the head of department of science, Zanzibar state university, he gave emphasizes on the unplanned infrastructures and services that is common everywhere around Zanzibar. A situation he expressed has led to the blockage of most of the constructed drainages. He also mentioned that lack of awareness and inadequate knowledge in the society has made people to build houses in low lying areas. He also revealed Mismanagement of the present drainage facilities. Storm water management problems in the area started with people dumping solid waste in the constructed drainages and authorities charged with storm water management has failed to develop a mechanism of monitoring the situation. However he explained that some sort of cooperation and alliance with the local village leaders is indispensable. Through the local shehias leaders, there is tendency that the dumping of solid waste to drainages can be reduced. He also emphasized that the drainage project has failed to work for a longer period of time because there

was no follow up and proper monitoring after the implementation stage. Automatically sewers gets blocked again without proper monitoring and if that will be reconstructed, then those follow up and proper monitoring should go with it to ensure its effectiveness.

Nevertheless, when the question of societal and institutional participation in decision making and planning process was raised, he however revealed that neither himself nor any member of the university has been called to contribute or even to give ideas on what should be done to the floods and runoff problems in the area. He clarifies that this is one area that has been neglected in the planning and management process in Zanzibar. He revealed that if societal participation in development project is not ensured, then the community tend to lose a sense of ownership and only if this is been done that they can participate in the monitoring of the systems and ensure that the system is working properly. He clarifies that the involvement of Higher education and research institutions may also assist to give solutions to some of the problems. The university was cited as an example, the university started with the education department and government implementing such a big project can use the educationist to inform and train the societies on the importance of the project. They have also created a science department and environmental department and in this case if they are involved they can have a chance to give ideas on how and what should be done but however they are not consulted at all. He revealed that it happen only ones when the municipal council was having problems of sludge with one of their sewers; they were only contacted to analyze the samples of the sludge when some of the garbage collectors and other people complained that they were handling dangerous materials. He particularly emphasized that it was only when and after they have taken decision and having one problem or the other that they were contacted. The university has never been called to address issues relating to the decision making, planning and management of storm water project in the area.

Another interview was conducted at the institute of marine management in Zanzibar with Dr. AVITI J. MMOCHI who is a specialist in marine environmental chemistry. He revealed sewage as another problem that has contributed to the poor management of storm water in the area and that this has really affected coastal marine life. He emphasized that storm water drainage system is a transport process in Zanzibar and not a management process. Water table in Zanzibar is very high and majority of the people are using septic latrine, soak pit or pit latrine and there is

possibility that everything coming out. This is one major problem that he revealed as the reason why storm water drainage system has failed in the area. He emphasized that storm water management in Zanzibar only get the sewage and storm water into the sea, in this sense management will tend to mean not protecting the environment in general but the people, removing the storm water from areas of political economic interest to somewhere else. On the contrary, he explained that management is suppose to reduce, neutralize or turn storm water into something different that can improve the quality of life of people and the coastal resources as well as the environment in general. It was also brought to my notice that the member of the institutes are only contacted when the authorities charged with storm water management responsibilities are having big crisis but not when they are taking decision on a development project. You can only be consulted to do a small project as part of a decision and when the environment demands but neither himself nor any member of the institute are involved in the decision making and planning of how storm water is to be managed. Several problems mentioned with the present handling of storm water are similar to most of the problems that has been observed physically.

A reputable NGO working in the area called CODECOZ revealed that no NGOs in the area is working on storm water management and that no special curriculum on storm water management has been conducted by any NGOs in the area. The director of the Ngo Captain Hamza Omar revealed that he is not aware of the phase III work of the proposed drainage system and he also emphasize that many drainages has failed to work because of illegal dumping of solid waste in the area. Annual radio program on environmental education is done twice a year and this program has never address storm water management problems in the area. He specifically stated that communities and institutions are not part of the decision making and planning process of development projects.

Another interview was conducted with the Director in the municipal council that is charged with the responsibilities of storm water management and in particular he consent that there is storm water management problems in the area and the measures the authorities are taking as a solution is draining the storm water to the sea. Afterwards I raised the question and issues of lack of treatment of storm water before discharging to the sea. He clarifies that in his own opinion the

construction of a close drainage system will help to minimize the impact of sea water contamination and however it is very costly so therefore they cannot afford it now. On the other hand he emphasized that by improving the method of the solid waste collection system in the area and raising awareness will help to reduce the problem. He specifically made it clear to me that the idea of treating storm water before discharging to the sea is not in their management system at the moment.

I also inquire that to which extent the community and societies in general is been involved in the planning and decision making process and he affirm that it was only when the communities are having problems, they complain to their wards representatives in the council and during the council meeting internally they digest the problem and find solution to the problem. He however agrees with me that this is a gap and immense problem in their management system and that the involvement of the societies and participation in the planning and decision making process will be beneficial to the management of the storm water problems in the area. Another gap that he clarifies as not been a good practice in their management practices is that they are also fond with the attitude of not using Higher education and research institutions in the planning and decision making process, that most of the time they find their own solution to the problem during their council meetings. The interview conducted with the director of sewerage and solid waste indicated that the processes and tools that in a system and societal perspectives can be used to deal with the possibilities to ensure that human and other forms of life will flourish forever within Governance, policy making and planning is not deeply explored in the municipality of Zanzibar.