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EXAMING POOR DRAINAGE IN BWAISE II PARISH, KAWEMPE DIVISION, KAMPALA

The streams in Bwaise II Parish are no longer in their natural state. They flow in straight courses and carry polluted water. This is because of the various forms of the both direct and indirect human interferences. Changes on the land surface consequent to urbanization constitute an indirect interference.

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BY

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SEPTEMBER 2011

DECLARATION

I, MUBIRU KATYA PAUL, hereby declare that this dissertation is my original work and has never been published or submitted to any university or institution of higher learning for the award of a Post graduate Degree.

SIGNED……..

DATE……

APPROVAL

This dissertation has been produced under my supervision and has been submitted with my approval as the university supervisor for examination and award of Masters of Science degree in Natural Resources Management.

Professor Eric Edroma	**…….**	**.....**
SUPERVISOR	**Signed**	**Date**

DEDICATION

This dissertation is dedicated to:

I. The people who will find my research data useful in helping to implement and cover the gaps of Environmental law,

II. The members of my family who have supported me emotionally and financially throughout my academic career,

III. My mother and father Mr and Mrs Katya II Difasi (Senior of Nawansenga Iganga District) and my Aunt Hanifa Nadongo Walangira (Bulebi- Bugiri) who sacrificed a lot for my education, and

IV. My wife Mrs Sarah Mubiru (Director of Katya Group of companies).

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List of Abbreviations

AEE	:	African Evangelical Enterprise
AMREF	:	African Medical and Research Foundation
CBO	:	Community Based Organisations
KCCA	:	Kampala City Council Authority
LC	:	Local Councilor
LGDP	:	Local Government Development Program
NGO	:	Non Government Organization
SUDS	:	Sustainable Urban Drainage Systems
V.I.P	:	Ventilated Improved Pit Latrines

ABSTRACT

The streams in Bwaise II Parish are no longer in their natural state. They flow in straight courses and carry polluted water. This is because of the various forms of the both direct and indirect human interferences. Changes on the land surface consequent to urbanization constitute an indirect interference. On the other hand modification of the channels through the connection of the storm drains, households and industrial outlets onto the streams, various forms of channelization, culvert and bridge installation across streams, and the use of sand bags, all constitute direct stream interferences.

The objective of the study was to examine the drainage system of Bwaise II Parish specifically factors responsible for poor drainage, the consequences and finding the measures so far taken to reduce flooding.

Some of the objectives were to analyse what kind of drainage system exists in Bwaise II Parish, the causes of poor drainage and effects on the community as well as implementing strategies to reduce flooding and water logging. However the research was mainly restricted to Bwaise II Parish area where drainage is a major problem.

Data was collected using different methods like research design, sample selection, oral interviews, administered questionnaire, group discussions, secondary data and data analysis. The findings show the extent at which the people of Bwaise are dealing with poor drainage issues like destroyed wetlands, increased presence of garbage in the drains, the topography of the area, construction of unplanned houses and increased population. However it should be noted that most of the factors responsible for poor drainage system in the Parish are man-made or caused by the activities of the people.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Surface water drainage has always been a very important aspect on the global scale and has presented a number of implications onto the inhabitants of urban areas. The rapid urbanization in developing countries and world over has led to the massive increase in human settlement which is growing faster than the rate at which the drainage network is being enhanced causing a mismatch between service and urbanization. This leads to health, social and economic problems which affect the urban settlers especially the poor. Because of these enormous mismatch related problems such as drainage, the World Bank (1996) has termed it the 'brown agenda'.

In many settlements of the developing countries of the world studies have indicated that drainage systems have been a big deterrent in the development of low cost settlements. It has led to serious and hazardous flooding and submergence of structures constructed on unsuitable land like low lying areas or reclaimed land for residential, industrial and, at times, commercial development. In Arusha, Hana Hasiff (a Non-Government Organization) developed a project in the area and worked on the drainage problems (Clifton, 2000). In Uganda Kalerwe Pilot Project was started with the assistance of UNDP (Komuhangi, 1993) to address the same issue.

Drainage can be considered at two levels: the neighbourhood level and the house-hold level. At the neighborhood level it includes: major drainage networks in cities, municipalities and townships. On the other hand at the household level it involves channeling away surface water or runoffs and waste water from individual households to the main drain which finally joins the main drainage channel.

The contents of drainage water also vary from storm water which is mainly a product of precipitation, waste water or sludge, and sewage or human wastes. In Uganda storm water, among others, ranks among the major problems when it comes to management and this is mainly due to inadequate facilitation and inefficient management, as features of poor or lack of training. Drainage and its attributes world over, and in developing countries in particular, have had implications on development of urban areas. Kampala City is surrounded by highly reclaimed

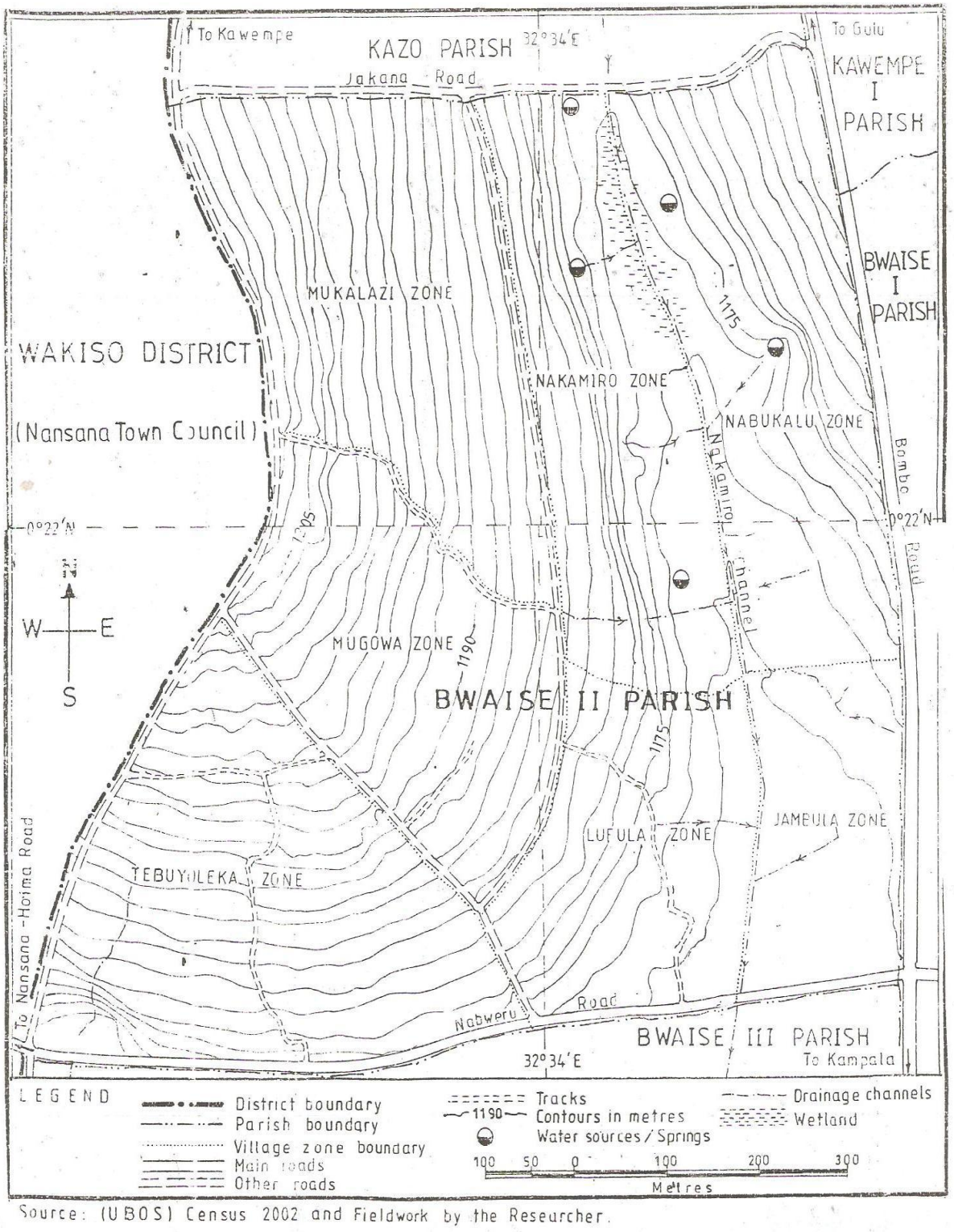
land and most parts of it were made up of swamps before 1986. Bwaise II Parish, which was formerly a swampy area of low lying area or flat land, is no exception.

1.2 Study Area

The research was conducted in Bwaise II Parish situated in Kawempe Division, Kampala district (Fig 2). The Parish (Fig.1) is bordered by five Administrative Parishes of Kampala City which are: Kawempe 1 Parish to the north, Kyebando Parish to the east, Mulago Parish to the southeast, Makerere III Parish to the south East and Kasubi Parish to the southwest. Kampala City is located on the Northern Shores of Lake Victoria formally known as Lake Nalubale and it covers approximately 1,935 sq Kilometers along latitude 0º 19 North and longitude 32º 33º east of the Greenwich 0º and 19 minutes north and about 45 kilometers north of the equator. Kawempe is located on latitude 0º23 North and longitude 32º 33º east. Kawempe though a swamp, is gazetted for industrialization. However other activities like settlement and trading (local trade) take place. These activities have contributed to massive degradation of the wetland, thus resulting in persistent poor drainage especially after heavy rains. Formally the wetland acted as a buffer zone that had controlled natural hazards like floods in the Kampala city.

The soils in Bwaise II Parish belong mainly to the Buganda soil 'catena'. Radwarisk (1960) divided the soils of the Buganda catena into two groups namely: the upland and the low lands soils.

a) The upland soils occur on the hill summits, slopes and pediment. The upland soils are free draining rocks ranging from 'basic Ph through acidic Ph' igneous formation to metamorphic sediments. The upland soils are sub-divided into two groups. The first category being the immature or skeletal soils with an imperfect structural horizon development. These mainly occur on the summits and steep upper slopes (Radwarisk, 1960). Their soil profiles are characterized by presence of fragments and boulders of the respective parent rocks, especially the relic laterite sheets which are undergoing disintegration. The second category of the upland soils is of deep soils occurring on relatively gentle slopes or middle slopes and pediments. The original parent rocks have been weathered beyond recognition and have some outstanding common characteristics regardless of the parent rock. The common characteristics include colour of the sub-soil which is usually red or brown; the presence of varying quantities of quartz gravel and



Source: (UBOS) Census 2002 and Fieldwork by the Researcher.

Figure 1: Bwaise II Parish.

Source: (UBOS) Census 2002 and field work.

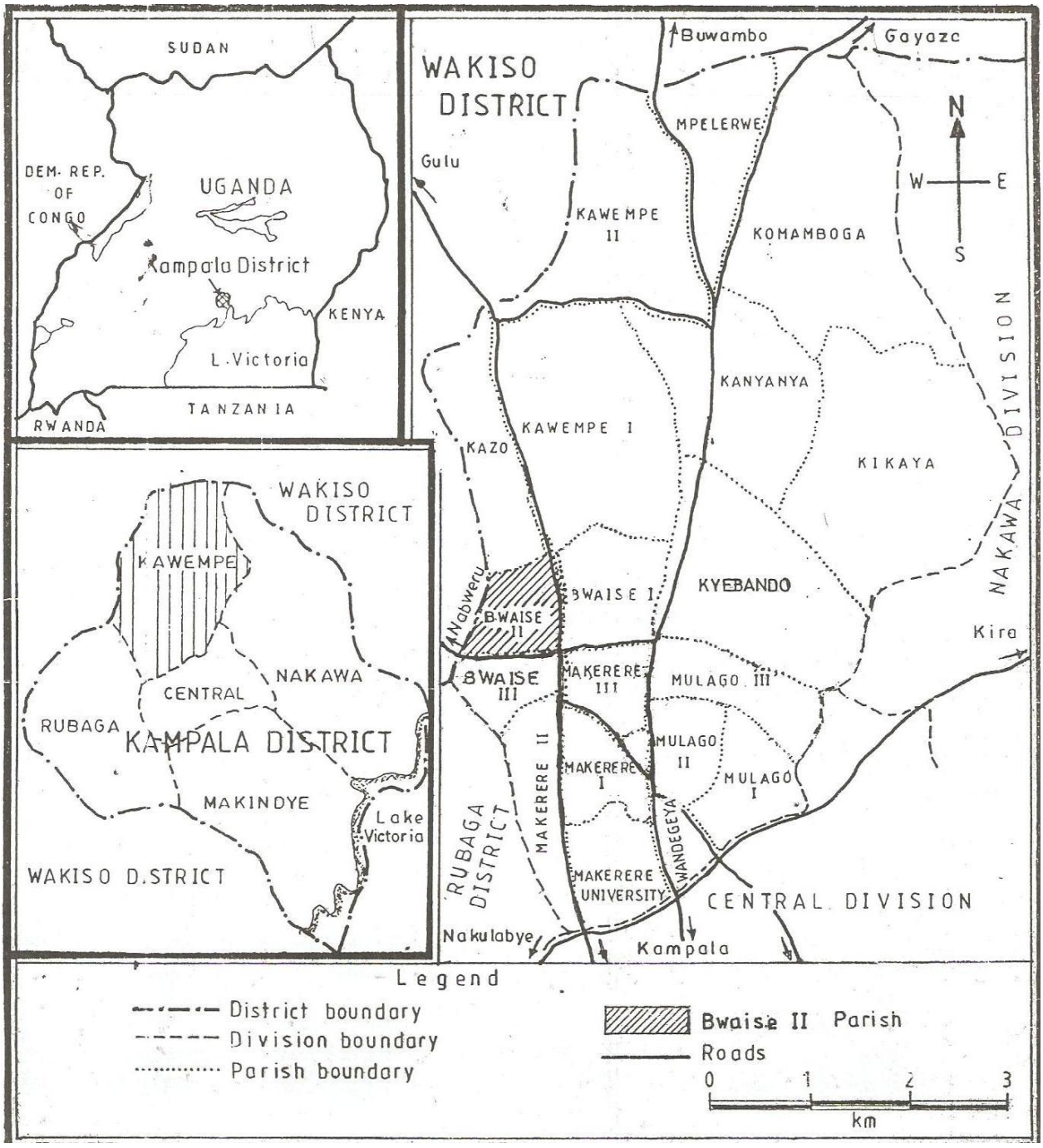


Figure 2: Location of Bwaise II Parish in Kawempe Division, Kampala District

Source: Population and Housing Census Uganda 2002 (UBOS)

Stones either scattered throughout the profile or forming distinct stone layer (stone lines) and the presence of iron stone concretions commonly known as murram (Radwarisk, 1960). Their texture varies from clay loam sands and surface topsoil contain mottled and slightly indurated lateritic horizons at depth. These originate as a result of precipitation of iron oxides from solution in the lower parts of the sub-soil usually at the junction between the weathered bed rock and the overlying parent material. The lateritic horizons may be exposed to the surface by severe sheet erosion particularly in the lower sections of the pediments. Once exposed they harden into massive benches of ironstone or disintegrate into soft earth mixed with iron concentrations (Radwarisk, 1960).

b) The lowland soils are found in alluvial or river valleys. These soils are developed from transported materials, varying in texture from heavy clay to coarse quartzite sand. They are usually yellow-grey to grey and occasionally black in colour. They have a seasonally fluctuating water table which causes impeded drainage conditions (Radwarisk, 1960). According to Waugh (1995), soil types are important in controlling the rate of infiltration, the amount of water storage in the soil and the rate of water flow. The sandy soils with large pore spaces allow rapid infiltration, and do not encourage flooding. While the clay soils have much smaller pore spaces which reduce infiltration and percolation but encourage surface runoff and increase the risk of flooding. 'Infiltration' is the process which allows water to move directly through the pores in the soil. According to Waugh (1995), the infiltration capacity of the soil depends on the amount of water already existing in the soil, the porosity structure of the soil, the nature of the soil surface, and the changes in the vegetation cover. When the water reaches the underlying rock layers or it fills the pore spaces creating a zone of saturation the upper boundary of which is called a 'water table'. If the water table reaches then the surface excess water forms a marsh where the land is flat (Waugh ,1995), a situation typical of the broad valleys separating the flat topped hills in the area of study.

The population of Bwaise II Parish based on the population and housing census of 2002 provisional estimates was 16,829 in total (Table 1). Bwaise II Parish covers 99.2 square kilometers, and it has 4,387 households of 7,787 men and 9,042 women. The growth of Kampala's population, standing at 1,289,100 people by 2001 from 774,241 people in 1991

(UBOS, 2006), mirrors ever- increasing land surface transformation into a variety of urban land uses, mainly constituting built up Environments, accompanied by generation of income. It has also escalated land competition, driving settlers to relatively cheap, but flood prone areas, a situation that calls for a number of interventions mainly channelization against flooding.

Table 1: The 2002 Population and household census statistics of Bwaise II parish

Characteristic	Male	Female	Total
Total population	7,787	9,042	16,829
Households	-	-	4,387

Source: The 2002 Population and Housing Census for Bwaise II Parish- Uganda.

Physiologically Kawempe rises from lowlands of 3,830 feet (1,167meters) to hilly surroundings of 4,100 feet (1,249 meters) above sea level. Apart from Jinja Kaloli, the rest of the hills like Makerere Hill, Mulago Hill and Kazo Hill are capped with lateric lithosols because they are constructed in areas. Valley sediments eroded from higher grounds form part of Kawempe Division. The Valley level where Bwaise II Parish is found is represented by Arena floor at 3800 feet. Being a valley, it influences poor drainage because whenever it rains water from all those hills collects in this area causing blockage due to siltation of the drainage systems and carrying dirty water with all its disease carrying vectors.

Bwaise II Parish experiences an equatorial climate with a double maxima type of rainfall pattern. Rainfall peaks are between March to May and September to December. Bwaise II Parish is prone to poor drainage that severely affects the people living there.

The geology of the area is comprised of Precambrian rock, one of the oldest rock systems. The geological formation of this region is mainly given by gneissose complex system (Nzabona 1996) comprising of swamp alluvium and lacastine deposits (Kampala District Environment Report 1996). Kampala is said to be associated with the upper and lower duricrust, in many places with very deep weathering. Latinate carapace is widespread on the hill and even below the summit level where it forms protective pavements to many hill slopes of Kampala. The latinate

have been weathered to give rise to different soils (Kampala District State of Environment Report, 1997). The geology of Bwaise also influences the water table, which is near to the surface that when it rains, it results into floods because the infiltration capacity of the soil is low. Kawempe Division is poorly drained as much of it is located in low lying areas. It has the slow winding channel of Nsooba, which is fed by Nakamiiro. The drainage system is of low capacity compared to the increased runoff caused by the constant new developments upstream. Heavy silting is a common occurrence whenever it rains and this affects the whole system causing serious flooding in the low plains. Bwaise and Nalukolongo channels also drain to the upper tributaries of River Mayanja and finally into Lake Victoria in the south and Lake Kyoga in the North (Nzabona, 1996).

Kawempe Division was originally covered with forests and swampy vegetation in the valleys where Bwaise II Parish is found. This has been degraded in the rapid urbanization and hence replaced by the residential, commercial and industrial infrastructure. Currently the natural vegetation is limited to a few patches of papyrus and hippo grass(vossia cuspidate). During the political instability of 1981-1986 many people who were displaced from 'Luwero Triangle 'settled mostly in Kwempe and after the war they did not permanently leave the division. Over the years the division has experienced a high population growth rate that has led to settlement on low lying swampy areas. The local authorities had not expected settlement in these areas hence no service had been planned there (Population and Household Census of 2002). Kawempe now serves as market link for farmers from Luweero, for their agricultural produce, to the city centre hence making Kawempe more endowed with agro-business and live stock trade with mainly the former Luwero Triangle.

The study population comprised of various categories of people who included the environmental officers of Kawempe Division, Kawempe Division Planners, the Local Council Chairmen, Councilors and the heads of households in Bwaise II Parish. Most drainage channels in Kampala have been naturally shaped but some channels have been constructed to cope with the large volumes of storm water in the area. Bwaise catchment with its tropical climate and heavy rains is strongly affected by storm-water runoff and its impacts on the community are regrettable. Kampala in which Bwaise II Parish falls, receives rainfall throughout the year although with

variations these days due to the over whelming climate change influences. Kampala receives two noticeable rainfall peaks between the months of March and May, and between October and December. The average rainfall depth of Kampala over the last 30 years as given by the Uganda meteorological stations is 1,162 mm/year (UBOS, 2006). Storm water drainage in Kampala City is a responsibility of Kampala City Council popularly known as KCC.

The road drainage structures fall directly under the city Engineers Department while permanently open channels are the responsibility of the Public Health Department. Bwaise drainage system has 3 types open drainage, lined and unlined drainage systems. Open and unlined drains which serve most of the Parish are heavily eroded and have, of recent, been greatly silted thereby reducing their overall capacities. This, together with the poor maintenance mechanisms of storm drains in the Parish, led to very serious flooding problems which have ranged from deterioration of hygienic conditions thereby putting public health at risk and closing businesses on the flooded streets. In general flooding levels in Bwaise have not been intolerable to the community but have proved a threat to the lives of people. This study is set out towards finding long lasting solutions to the Bwaise II Parish flooding problem.

1.3 Statement of the problem

Over the years the Bwaise II Parish has experienced severe flooding with an unacceptable high frequency. Despite numerous complaints from the communities and corresponding interventions from the authorities, repairs on the existing drainage structures through the Northern By-pass Project and AMREF project (African Medical and Research Foundation), the problem has only been reduced mildly without producing a comprehensive lasting solution to the flooding problem.

Environmental degradation of Bwaise II Parish is due to poor drainage system whenever there is a heavy rain. There is improper flow of storm water on the roads and it becomes normally flooded by water due to improper channeling of the drainage systems. This always resulted in flooding the whole area hence causing destruction of properties worth millions of shillings of assets. The magnitude of the crisis stated was for instance reported by the New Vision on 13th October 1999.

Much of Bwaise area is built up; this increases the catchments of storm water during rainy seasons because of the iron sheets on the buildings, and flood water generated in the area as a result of the household and commercial activities, without adequate provision for drainage systems /channels. The surface runoff and waste water therefore often result into stagnant water and flooding. This has prompted the residents to create small trenches and use of sand bags to control the flood water and runoff from reaching people's homes / houses as a temporary solution. This study was therefore geared towards investigating flooding problems and thereafter designing a technical system or solution to solve it in an economically acceptable way.

1.4 Objectives of the study

The main objective of the study was to examine the drainage system in Bwaise II Parish.

The specific objectives of the study were to find out:-

i) The factors responsible for poor drainage in Bwaise II Parish

ii) The consequences of the poor drainage in Bwaise II Parish.

iii) Measures taken so far to reduce flooding and water logging in Bwaise II Parish.

1.5 Research questions

i) What kind of drainage systems exist in Bwaise II Parish?

ii) What is causing the poor drainage systems in the Parish?

iii) What are the effects of poor drainage systems on the community of Bwaise II Parish?

i) What strategies exist to reduce the flooding and water logging in Bwaise II Parish?

1.6 Hypothesis

Flooding in Bwaise II Parish is a result of drainage systems.

1.7 Justification

Despite the numerous Engineering works on various streams traversing the heavily settled areas, drainage related problems have persisted in Bwaise II Parish. An ever growing population of the district has further complicated the problem. The aforementioned problems, coupled with lack of a comprehensive study which has been done by other scientists like Kulabako and Plan

International analyzing the effects of poor drainage systems in Bwaise II Parish have compelled this investigation, aimed at addressing the effects of poor drainage in Bwaise II Parish which is an urban setting so as to establish the status of the problem upon which sound water catchments and drainage system management strategies could be identified.

1.8 Significance of the study

There is a general public demand (Komuhangi, 1993) for drainage provision in the entire Bwaise II Parish and many other urban settlements of the developing world. The availability of an efficient and effective drainage network is a major pre-requisite for achieving a clean and healthy environment. It's therefore imperative to ensure that in any human settlement, drainage systems must be given the priority it deserves in a given setting. Through these findings an impact will be made on the policy formulation and evaluation whenever it comes to drainage or road network project implementation, which has similar circumstances relatively known to urban settings.

Furthermore the strategies identified or pointed out in these research findings for solving the problem in Bwaise II Parish could be applied by civic leaders or decision makers like government, local councils and non-governmental organizations in other parts or areas of their jurisdiction, which are facing similar drainage problems. Lastly it is important to note that research has opened more doors for other contemporary researchers to venture in areas mentioned in this dissertation but not yet exhaustively analyzed, thus rendering this research study necessary.

1.9 Scope of the study

The study was carried out in Bwaise II Parish examining the effects of poor drainage systems as a Case Study of Kawempe Division, Kampala. Bwaise II Parish is made up of 8 zones namely Katale, Jambula, Mukalazi, Nakamiiro, Tebuyoleka, Lufula, Nabukalu, and Mugowa. The Parish covers a total area of 99.2 hectares.

The study covered all the 8 zones of the Parish focusing on the factors leading to poor drainage systems in the area and its impacts on the natural environment, social environment and economic impacts like hygiene, health, housing, accessibility, water quality, among others. This Parish is an ideal representative to critically expose the impacts of poor drainage and development in

Kampala and to yield sufficient evidence for formulating practical recommendations for alleviating the poor drainage system.

1.10 Conceptual Framework

The changes accompanying urban population growth range within land shortages; this triggers competition which leads to encroachment on the riparian areas of streams. These areas have a fluctuating water table, a phemonon which keeps the area slightly dry during dry seasons and constantly wet during rainy seasons. There is a need for flood control in the area for instance through channelization, stream diversion and use of sand bags to keep the water in controlled drainage pathways. The expansion of built up surface is a result of urbanization, which influences surface runoff and increases in the risk of flooding since the fully built up area has little or no 'infiltration' which is the process that allows water to move through the pores into the soil.

It is assumed that the growing abstraction of water from springs which serve streams partly accounts for the characteristic shallow depths of some streams during dry seasons, resulting into reduced stream discharge. This reduces the capacity of streams to transfer waste/ slowed rate of solid waste transfer hence contributing to waste accumulation on channel beds, which during the rainy season will contribute to flooding by blocking channels hence leading to impeded flows which result into poor drainage and it's related complications. High rate of solid waste deposition in streams brings about clogging of drainage channels making them too shallow for greater volumes of water in the rainy season leading to flooding of the surrounding areas and causing associated diseases (Fig 3).

A rise in stream discharge increases the flow velocity bringing about stream erosion. This results into a high rate of silt loading leaving parts of the channel permanently blocked. Impeded stream flow results into overflows at the banks and the surrounding areas affecting transport and health of the people. Increased flow velocity reduces time stage for the water to go through the drains and increases peak discharge since it flows in at once and flows out at a very high speed leading to drainage related problems of flooding and associated health hazards. The rise in stream discharge leads to drainage related problems because the drains are too small to accommodate

such large amounts of water hence leading to flooding and exposing people to associated water related diseases.

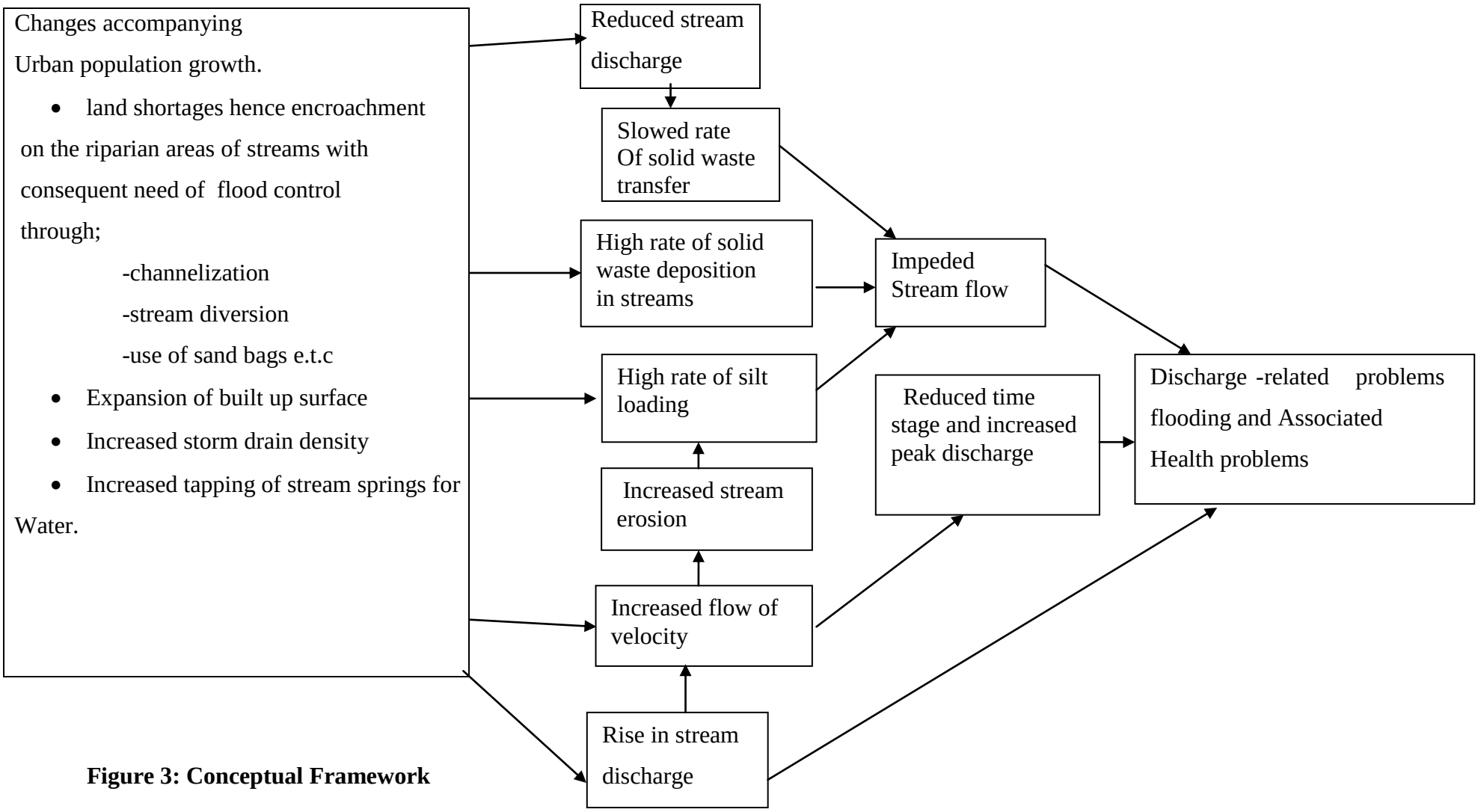


Figure 3: Conceptual Framework

CHAPTER TWO: LITERATURE REVIEW

2.1 Definition of drainage:

Linsley and Franzini (1972) referred to drainage as a system applied to dealing with excess water additionally, and he states that drainage deals with water before it has reached a major channel. However this is not concise because in general, the major channel carrying water is part of drainage. Drainage is an accomplishment of causing subterranean water to flow by gravity into swamps at the level which is usually pumped out (Abwot, 1999).

There are three types of drainage Abwot (1999) namely: urban storm water drainage, land drainage and high way drainage systems. For Ndiwalana (2002) urban storm water is a system both above and underground for carrying away storm water or waste water. Land drainage is the process of releasing running water through supply ditches allowing it to flow over land through supply ditches to furrows between blocks of land. On the other hand, highway drainage refers to the collection or transportation and disposal of surface water system originating on or near the highway.

The drainage system of Bwaise II Parish has all the three types of drains. These all have common burdens of water collection, transportation and disposal. The open water drains are used for carrying less foul water from kitchen, bathrooms, washing places and rain water from water closets. The open drains carry away sullage and rain water up to natural water courses or discharge it in public sewers. Open drains are mostly laid along boundary walls of buildings.

The two primary methods of surface drainage are land grading and field ditches. Dedericksen (1978) asserts that field ditches include bedding, furrows, field ditches and parallel open ditches. Furthermore the natural or artificial or constructed channel removes excessive surface water. The natural drains should not be ignored because they allow water to infiltrate or percolate into the ground and any excessive water either evaporates or transpires into the atmosphere.

2.2 Causes of Poor Drainage

Raj (1991) identified water logging as one of the causes of poor drainage. The causes of water logging are both natural and artificial. The natural causes include poor drainage of the sub-soil under favourable geological existence of hard pan below the surface, sub-mergence of land under floods and deep percolation from rainfall well as the artificial causes are excessive seepage from unlined ditches and distributaries, hydraulic pressure from upper saturated areas located at higher elevations, and poor maintenance of natural drainage or blocking of natural drainage by roads and railways. He further stated it that land drainage problems occur in flat areas of even land surface with depressions or ridges preventing natural runoff and in areas without any provision of outlet. According to Cara (1997) developing Africa faces problems due to rapid urbanization and its accompanying overcrowding and congestion of urban areas. Development on land surfaces reduces permeability by replacing vegetated ground with roofs, roads and paved areas. Furthermore Cara notes that there is an overall lack of physical structures like drainage systems, sanitation systems to support increasing urban population and insufficient funds to provide good environmental living condition to all. Informal and unplanned settlements like Bwaise II Parish with inadequate drainage systems have developed to accommodate most of the people. This situation has resulted into environmental problems of poor management of both the human generated wastes such as sewage, waste water and runoff.

The critical development issues in Colombo include drainage and flood control; many parts of the city are subjected to frequent flooding due to insufficient drainage Habitat (997). Residential encroachment along canal banks and improper solid waste disposal, filling of marshy land has reduced the natural water retention system. Furthermore many parts of the city are characterized by inadequate or no waste collection while the only disposable site causes environmental degradation. Smission (1980) states that the increasing population concentrations associated with the urbanization process also resulted in increases in waste generation. Household wastewater was connected (disposed off in the nearest open channel) and in turn created problems of smell. As a result, the open channels constructed to alleviate flooding were covered creating combined sewer systems.

According to Hollis (1988), the most obvious change that urbanization brings to a drainage basin is that it replaces vegetated landscapes with less permeable surfaces like tarmac roads and buildings. There is less surface storage and less water enters the soil and groundwater stores. The reduced water storage and vegetation cover mean lower evapotranspiration outputs. Consequently, the percentage of rain water that runs off increases. Ajayi (1993) stated that in most developing countries, solid waste disposal is closely linked with urban wastewater drainage in that open sewers and drainage channels often end up also being receptacles for solid wastes generated in the community. This leads to blockages, reductions in capacity and an exacerbation of flooding problems. In such situations, Ajayi suggested that the Institutional arrangements be along the lines of an "Integrated Environmental Service" provider (incorporating water supply, wastewater and solid waste functions) and a corresponding "Integrated Environmental Control Agency" Ajayi is of the view that the proposed Institutional arrangements will provide an appropriate framework for the equitable allocation of resources to the various environmental service needs and should result in a climate conducive to the implementation of the alternative approach being advocated.

A World Bank report (1996) indicated that poor drainage conditions in developing countries are a result of weak institutional capacity, inadequate regulatory policies, inadequate governance, and generally lack of public Education / awareness /participation. The resolution of problems associated with infrastructural provision in most developing countries currently follows along the traditions of the developed countries. Often, this is not appropriate for the locality. A review of urban drainage practice shows that, in the past, the philosophy has been based on conveying peak flows of municipal waste water and storm runoff away from the urban areas as quickly as possible. This has resulted in downstream flooding and heavy pollution of receiving waters (Sonuga, 1993**)**. But it should not be forgotten that in some developing countries especially where the above mentioned qualities exist, still drainage problems especially those related to weather conditions do still occur. World Health Organisation report (1992) considered poor operation and maintenance as the major cause of poor drainage conditions. In Ugandan situation it would appear that poor drainage is a causation of blockage of the main channels and the drainage by directly dumping wastes of different kinds into these drains (Kampala Structural Plan, (1994).

Carcros (1990) observed that the increasing surface area coverage with roofs and roads in urban areas are the major causes of flooding since they leave volumes of water to be carried away by the drainage. This is so because there is no longer percolation action in the built up environment. In many cases even the surfaces or open yards are also concreted, leaving almost no room for percolation, let alone the tarmac roads and streets. Plan International (1997) reported the research done in Bwaise II parish is characterized by flooding, mainly due to poor drainage caused by siltation and open dumping of solid wastes in the main Nsooba drain which chokes the channel resulting into water overflows. Observations made reveal that these floods are caused by more than just siltation and dumping of wastes in the drains which this research intends to find out and even go further to look at the impacts of such occurrences to the areas of development.

Storm water drainage in Uganda is still a serious problem, which is due to the inadequacies of the drainage network. Ndiwalana further states that, the rapid commercial, residential, and urbanization developments in Uganda are responsible for increasing the risk of floods resulting from inadequate drainage. The rapid development leaves no space for provision of drainage systems. This is evident in most of the urban centres or areas that are undergoing haphazard and disorganized development and growth (Ndiwalana, 2000). For example Nakivubo Channel is 78 years old (New Vision, 2003) , but it is deeply silted and polluted, although it's purpose was to guide drainage water from Kampala and runoff into Lake Victoria it can no longer perform to it's full potential.

Magazine Proof (1999) reports that 59.1% of the homeless people have become homeless due to poor drainage which causes flooding in some areas. These affected homeless people are illiterate and do not therefore know anything about areas that are poorly drained and many of the people trained to educate these people speak English and use terms that can't be understood or interpreted clearly by the illiterate masses. The magazine goes on to report that some of the people are displaced from some places so that they can be face lifted. It also reports that such are compensated so that they can build in other areas and they make the area slum free. The example given is that of Namuwongo people(Kampala Uganda), who were compensated and they shifted to Bwaise and put structures in Kimombasa which is now a slum and it is part of Bwaise II

Parish. It's interesting to note that since these people are used to staying in such areas they can go ahead and build in other flood prone areas. They build poor residential structures that can't sustain flood water. The magazine goes on to report that these people don't even dig drainage channels to channel the water making them easy target for flooding.

2.3 Problems related to poor drainage

Clarence (1984) profounded that in many African countries sewage systems and disposal habits especially in urban areas rely upon storm water drainage and this is the major cause of health problems. Gordon (1971) indicated that waste water works remove about 70% of the water supplied together with sock ground water and surface runoff. This may enter or be admitted to the collecting system like Street gutters, open channels and covered structures for the removal of runoff accumulating from rain storms and melting snow since these are among the earliest public works of urban communities. They kept the low lying and often highly developed positions of the community from being flooded by converting and increasing over land flows.

New Vision (1999) reported a story 'several houses were lost in a heavy down pour and subsequent floods which hit Kampala and its suburbs. The worst hit areas were Kalerwe and Bwaise, where homes became inaccessible and five people were rescued from drowning. The floods up to window level submerged roads and entered people's houses, leaving household properties wet and damaged. Offices, machines and commercial property worth millions of shillings were lost in the floods. The World Health Organisation (1999) stated that 90% of the diseases in many countries are as a result of poor drainage. In the case of Uganda, it reported that due to El Niño which dominated the country from 1998 to the late 1999, there were heavy rains which affected many poorly drained areas in and around Kampala. The examples cited are Bwaise, Katanga, Kisenyi, Makerere and Kivulu. Due to those floods there was an epidemic of cholera in Kampala that made everyone scared of greeting freely with hand shake nick-named bonga ko. The New Vision (2003) reported an indication that the slime (fecal matter) comes from septic tanks that are intentionally emptied into the drainage system during rainy seasons. This is what most landlords resort to because payment for sewerage empting is expensive and sometimes they do not have the money to pay; also access to the area by cesspool emptier is difficult. Bernstein (1995) notes that 3.2 million children under the age of 5 years die each year

from diarrhoearal diseases largely as a result of poor sanitation, contaminated drinking water and associated problems from poor drainage and hygiene. Inadequate drainage posses additional health risks and may cause property damage, road congestion and disruption of other public services as well as water pollution. In many cities unsafe water and sanitation are the most important causes of mortality and morbidity among urban residents. Clarence (1984) notes that industries, communities and individual households discharge an infinite variety of unwanted waste products. In addition Agricultural drainage, urban storm drainage and natural wash carry large quantities of wastes to streams. He further points out that with the increasing variety and quantities of waste products and their interlinkages among solid, gaseous and liquid state cause a hazard of stream pollution. Raven (1993) points out that storm runoff quality is often worse off than that of sewerage. Storm runoff carries salts, oils, untreated garbage, construction sediments and traffic emissions through rain which washes pollutants out of the air. This normally contains asbestos, chloride, lead, organic wastes, sulphuric acid and zinc. Municipal waste water pollution is also a great problem in developing countries many of which lack water treatment facilities as compared to the developed countries.

The Uganda National Environment Management Authority (1997) points out those urban areas of Kampala those are prone to environmental health. This was evident from the many incidences of malaria, dysentery, typhoid, cholera and intestinal worms which are a result of poor solid and waste water management. Furthermore the Kampala City Council environmental profile in line with NEMA emphasizes that most areas of Kampala are prone to environmental health. National Report on Environment and Development (1991) points out that because of poor drainage and sewerage systems, open spaces, roads and slums in low lying areas are often flooded and water logged. It further states that better sewerage facilities are often available only in the medium and high income areas. In areas like Bwaise, Kawempe and Ndeeba it floods so much that whenever it rains, people have to wade or be carried across huge expanses of flood waters, vehicles get stuck, traders and families loose merchandise and household properties (New Vision, 2003).

2.4 Measures to reduce flooding

The United Nations Environment Programme (1994) recommended that land use plans should reserve low lying land close to receiving water, so as to alleviate drainage problem related to flooding and over-flows, while Sandy (1996) observed that a great discipline over building is necessary to ensure that plot boundaries are observed to prevent houses from obstructing the existing drainage path as well as from occupying land needed for future drainage work. He further states that planning should ensure setting out regular plots before construction starts. This will leave space for well aligned roads with adequate road width and road reserves that make construction of drains easier whenever needed.

Kemigisha (1990) perceives drainage as a major problem of the city and indicates that 'drainage can only be improved if the people in the city affected take part in the efforts to solve the problem. She goes on to indicate that the major reason why this problem has persisted is because most of the affected people think it is Kampala City Council and other government bodies concerned with the city's welfare to help, yet this should not be the case. Furthermore that when there is a problem results are best achieved in solving it. Since those affected know the problem extent best, they will give the correct advice on the policies that can work best in order to alleviate the problem. However people should bare in mind that such a proposal isn't practical in areas like Uganda because of the land tenure system and further more the tenure system is so complex for one to follow such procedures, leave alone the absence of such institutions to enforce it. In analysis of the layout of the drainage system conditions of the Kampala Structural Plan (1994) it was indicated that in high and low density housing areas where economy is a pre-requisite to design, open systems are invariably employed. Drainage from paved areas normally crossed open grassed areas and verges before reaching the drains. In practice this has the effect of delaying the runoff and also has a percolation effect there by reducing peak flows. From the drainage point of view, this system is highly efficient provided from play grounds and gardens to the drainage channel. In Kampala Urban Study (1993) it was observed that the major objective taken to control flow of surface water by collecting and transporting it through suitably designed conduits away from developed areas where it could otherwise cause flooding, there by impeding the safety, health and wellbeing of the public and disrupting essential public commercial services.

The Wadley Road storm Sewer system serves a steeply sloping catchment area of approximately 20 ha. overflows from storm water sewers had inundated Wadley Road in London. Every year for as long as residents can remember the Wadley storm sewer system created flooding up to about 1 meter deep (Andoh, 1994). The only solution which seemed possible (adopting the traditional approach) was the construction of a bypass sewer system at an estimated cost of $90,000 to $ 100,000. Though this solution would cure the flooding problems at Wadley Road, it runs the risk of flooding another street further downstream. A review of the problem showed that a viable and by far more cost effective alternative, solution would be to use Hydro-Brake TM flow controls to slow down flows and mobilize available system storage throughout the catchment area upstream. Nine Hydro-Brake TM flow controls of various suitable sizes were installed at a cost of $24,000 resulting in a reliable economical solution well below the cost of an unsatisfactory traditional alternative. Cooke and Doornkamp (1990) request for geomorphological assistance in environment management usually arise from a need to appraise the nature and especially the distribution and changes overtime of hazards and resources. The most common requirement is to map a landscape or selected attributes of it and or to monitor the nature and causes of change. It is valuable to emphasize some of the analytical approaches the geomorphologist brings these critical tasks of mapping and monitoring because they arise directly from geomorphological training.

Strahler (1964) defined the drainage basin as the basic geomorphological unit on the grounds that it provides firstly ‘a limited, convenient and usually clearly defined and unambiguous topographic unit, amenable to study at a variety of scales, and secondly a physical process-response system, receiving inputs as thermal energy from the sun, Kinetic and potential energy from tectonic activity, and chemical energy as a result of weathering process’. However this is very little human activity, as expressed through planning policies, engineering projects and land-use management, which does not have an impact upon drainage basin. Perhaps what is most often missing is an adequate level of awareness amongst environmental managers of how human activity affects the hydrology and water quality aspects of a basin. Certainly drainage basin management is often inadequate or badly supported by legislation, except most notably in the United States.

The alternative drainage concept being advocated utilizes the single pipe system philosophy. This approach differs from the conventional combined drainage concept in that no overflows are permitted from the single pipe system. A single sewer network system conveys the highly polluting urban wastewater sources to a treatment facility prior to its discharge as treated wastewater into a receiving water course. Flows in excess of downstream sewer capacities during rainfall are retained adjacent to the intakes to the sewer system, in local transient storage (Smission, 1980). Smission further notes that Wastewater that enters the sewer system is prevented from overflowing or flooding a downstream location because the rate of release of water from upstream parts of the catchment is limited, by the use of flow control devices, to the capacity of the downstream sewer.

The single pipe system design philosophy recommends the use of minor and major drainage systems. The minor system consists of a piped drainage network constructed to serve the area with sufficient capacity to convey base flows and the "more frequent" storm runoff from roads, highways and other paved areas likely to be sources of relatively polluted runoff. The major system consists of the natural drainage routes and patterns evolved by nature prior to mankind's interference through development. This is defined by the topography and geomorphology of the area. Overland flow routes for the major system may incorporate roadways, existing streams and their flood plains and suitably graded lawns, park lands and green belts. Overland routes can be engineered such that large parks and gardens, etc; are utilized as flow attenuation or retention/detection basins which encourage evapo-transpiration and percolation.

Flood hazard has inherent threats to sustainability of social and economic systems as well as national security. Sustainability is described by, Mannion (1992), as the ability of the present generations to ensure that the next generations shall have access to at least the same resources base as the previous generations. Thus striking a balance between development aspirations and the appropriate levels of resource use. For Mannion (1992), it is important for local urban planners to incorporate new developments while simultaneously protecting environmental quality especially that of the residential areas. With most people living in towns and cities situated near rivers, management of flood plains and therefore flood prone areas need to be managed in such ways as to keep the flood loss to minimum (Knapp, 1986). Generally Douglas (1993) points out that people respond to environmental hazards in different ways. The adoption

of a specific response being determined by assessment of risk (Middleton, 1995). Risk assessment may be done scientifically by calculating the probability of a particular hazard causing a disaster based on information of past events, frequency and areas of impact plus the current vulnerability of people and property. Although, many people have a fantastic approach believing that such 'acts of God' cannot happen to them to suffer the loss (Douglas, 1993), there are three approaches that can be adopted in way of flood hazard mitigation measures namely: the 'do nothing' approach, the build flood control structures and the manage the use of flood plains (non-structural). Douglas (1983) explains that the 'do nothing' approach relies on market forces to effect on equilibrium between benefits of flood plain occupancy and flood plain losses that are experienced. Generally, structure modification to stream channels has long been accepted as standard methods of coping with flood hazard in cities (Barrow, 1995 and Digby, 1995). These being due to seeming safety such structures bring to those concerned (Digby, 1995). The non structural approach promotes land use and construction practices which result into an occupancy pattern minimizing vulnerable settlements if planners can predict and develop mitigation strategies (Barrow, 1995). Waugh (1995) also suggests that people have six options to flood control. For example, they may try to prevent the event; modify the hazard; lessen the possible amount of damage by spending the losses caused by the event; claim for losses; do nothing pray that the event will occur again at least not in their lifetime. As a result the flood prone area dwellers and planners will invest in structural protection measures through engineering solutions and river basin management; modification of the burden of loss and bearing the loss caused by flooding (Digby,1995).

However, Digby argues that the strategy of river basin management should be based on flood plain zoning, whereby developments of flood prone areas is greatly controlled. For example the area can be sub-divided into three zones, namely:

- Zone I, the Prohibition Zone (this includes the land nearest to the river whereby no development should be allowed to take place, except for facilities;
- Zone II, the Restrictive Zone, whereby only essential developments and recreational facilities are permitted. All buildings in this zone should be flood proofed;
- Zone III, this should be the Warning Zone (this being the area furthest from the river) whereby the inhabitants receive warnings of impending flood, and reminded regularly of

the flood hazard (Digby,1995). So to Digby, river basin management means reducing the harmful effects of a flood, while accepting that a flood may happen. Other suggested methods by Digby (1995) of flood control in river basins management include;

- Flood abatement through afforestation of river basins, afforestation being able to delay the passage of water into a river channel through increased interception,
- Channel improvement through reduction of channel roughness by clearing the vegetation and other obstacles or taming the channel with smooth surface such as use of concrete,
- Construction of relief channels either by straightening a meandering channel so that the loops are by-passed or by deepening the main channel so that flood water is easily discharged,
- Building storage facilities which are specifically designed to store excess water, before it is gradually released, and
- Use of flood interception schemes like re-routing the river to by-pass settlements under threat; use of new channels to store water or by building embankments which help to contain water well from the places under threat.

However Douglas (1993) noted that structural control responses are characteristic of developed countries which have sufficient economic resources, infrastructure and trained personnel to organize and carry out such actions. Douglas also points out that an event which affects a certain number of people and causes a certain amount of damage will have a greater overall impact in a poorer country than a richer one. Pickering (1994) considered flood hazard monitoring to be widely used in most developing countries. This is whereby the heights in rivers is monitored using stream gauges, if the water level rises to a critical height then flooding is imminent and flood warnings are issued. In some cases monitoring is done using a rain gauge to monitor the progress of rainstorm, from experience and study of a particular river; warnings may be issued if floods are likely It is also possible for hydrologists advising engineers and planners in designing of structures and buildings to provide information on the size of a possible flood that may be expected to occur with recurrence interval of 10,20,25,50 or 100 years. The flood control strategies in flood prone areas should be worked alongside education to encourage flood-proofing. This being the process of designing new buildings or altering existing ones to reduce damage that could be caused by

flooding. Digby (1993) points out that where buildings are constructed in flood prone areas they should be built in such a way that they can withstand the stress put on them by the flood hazard. That is, the building structures should be able to resist to transmit all load induced by the flood waters. The structure should be able to adjust to all variations such as welling, expansion of settlement and contractions that may result from flooding. Cavities which may retain mud and water borne contamination should be reduced to allow for rapid and thorough drying after inundation (Douglas, 1993). Douglas also explains that extra-safety normally means extra cost, and so both private and public organizations have to make decisions about the level of environment hazard protection they can afford given the other commitments. Thus flood control is the responsibility of the individual, the community and the national governments concerned. As a result, several strategies adopted in different parts of the world, include formulation of policy and regulations, taking economic measures, promoting dissemination of information and international co-operation among those affected (HRAC, 1997). According to Platt (1997), the United States of America has spear-headed the world in passing regulations against flood plain control and management. Active legislation against occupation of flood prone areas is based on three basic ideas namely; to protect the unwary from investing in or occupying flood prone property; other riparian land owners (upstream, downstream or cross-stream) from higher flood levels due to ill-consideration encroachment on flood plains and their neighbours; and the community from cost rescue and disaster assistance.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Research Design

The study was both quantitative and qualitative because, among other things, it involved the observation of the nature of the drainage as well as the collection of the views from the community, especially those aimed at establishing whether there was any notable human interference with streams causing any observable drainage related problem like flooding. In this design a number of variables were investigated, that included prevalence of diseases, causes of present floods, and measures so far taken to reduce poor drainage systems in Bwaise II Parish. Analytical level of data collection was used for some variables depending on the facts to arrive at the conclusion. The variables that were not analyzed were described by emphasizing their awareness as far as wetland validity on minimizing of environmental degradation was concerned. The survey design was made in sketched samples of the findings, thus from carefully selected samples more information was gathered.

3.2 Sample selection

A representative number of 50 respondents were selected to avoid bias (Table 2), were from every third home, the parish head office, the local officials found at the division offices, two clinical administrators from Kampala City Council (KCC) Clinic in Kawempe division, and CBO's/NGO's field officials.

Table 2: The type of people selected to represent the population

Respondents	**Number represented**
Residents	40
Local officials	04
Clinic administrators	02
CBO and NGO field Officials	04
Total	**50**

3.3 Instruments in data collection

A number of instruments were used for data collection including:

3.3.1. Oral interview

An in-depth interview was conducted in the field on open-ended questions. NGO and CBO field staff, KCC staff, community health workers and community leaders of Kawempe Division were interviewed. Oral questions were administered in different zones like Nakamiiro and Katale zone to yield the information required on poor drainage, effects and the proposed solutions to the problem.

3.3.2 Administered questionnaires

Questionnaires (samples) were formulated and administered to target groups. Administered questionnaires were dropped to the busy offices of those people, and were picked up later with information about health diseases, their effects on social/economic/political aspects, and the measures taken to control poor drainage systems.

3.3.3 Direct observations and interviews

The data collection techniques stated above were supplemented with observation, to enable the identification of any form of human interference with streams other than channelization. The interview method was used to gather data from KCC Engineers and the LC1 officials within the study area. Different interview schedules were used to get information from these two categories of respondents. Appointments were first sought from these respondents and time to be spent while interviewing considered in order not to inconvenience and fatigue respondents.

3.3.4. Group discussions

Group discussions were carried out with the NGOs, CBOs, and KCC Officials about the area of study and the discussions mainly centered on the research questions in order to collect enough data.

3.3.5. Secondary data

Secondary sources which include the Main Library and Geography Department Library of Faculty of Arts of Makerere University, National Environment Management Authority library

including its yearly reports, World Bank reports and publications, journals, newsletters, and newspapers among other sources were used so as to gather literature review on the status of environmental education and environmental awareness.

3.4 Data analysis

Data analysis began with editing data collected from the field, which data was tabulated and presented in chapter four. Data was analysed on the information about the respondents, existing drainage system in Bwaise II Parish, factors responsible for poor drainage and the effects of poor drainage in the parish. This is important, for it guaranteed accuracy and consistence which was vital for reasonable analysis. The numerical data generated was systematically assembled in tables because they offer orderly placement of data and subsequent computations.

3.5 Limitations / Challenges

Most people gave false/incomplete information concerning the existing problems of poor drainage in the area while others were either unwilling to give the information or were not even aware of the existing drainage problems in Bwaise II Parish. Time was one of the biggest challenges because the local officials and the KCC officers didn't have a lot of time to answer all the question so I kept on getting more appointments to be able to cover the research questions.

Another problem encountered was language barrier since most are illiterate and speak different local languages therefore I needed to get an interpretor which made the research very costly. The roads were muddy and flooded hinded my accessibility to some zones like Nakamiiro and katale zone. The walk to work strike also led to some delays in acquiring information since the police was patrolling the area to the extent where I was tear gassed which caused me some health problems ledding to the delay of delivery of the research data. Delays in upgrading the KCC website hindered my acquiring current information about drainage in Bwaise II Parish and it took the KCC officials two weeks to give me the current information.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Information on respondents

On interviewing the representative number of residents was 40, (25 were female and 15 were male). Among the 25 females 10 reached senior four while the 5 reached primary seven and the remaining 10 didn't go beyond primary 5. The 15 male respondents all reached senior four. Of all the 40 residents only 20 were working, 10 were business owners, 5 worked as waitresses in the local restaurants and the 5 worked as casual labourers, therefore had no clear job description.

Bwaise II Parish has 8 zones but only 4 local officials were willing to give information on the drainage problem. The 4 local officials were all male, the two reached senior 4 while the other two did not disclose their education level but they spoke fluent English and gave accurate information on the drainage problems since they also face them first hand being the local officials of these zones. The local officials all represent the local people in division council as local leaders therefore that are their job description.

Only two Clinic Administrators were interviewed, one was male and the other a woman. The two were trained in the field of medicine and health science. The man was a doctor while the woman was a nurse. The CBO's and NGO's field officials were very co-operative, the three were women and one was a man. They were all qualified personnel's. The two women were Environmental Officers, the other woman was a health inspector and the man was a social worker. The two worked with a CBO called plan international and the other two worked with African medical and research foundation.

4.2 The existing drainage system of Bwaise II Parish

The existing drainage system in Bwaise II Parish is mainly secondary drains and primary channels. The Nakamiiro main channel is a tertiary drain which drains Bwaise II Parish. This drain is joined up by the many streams which emanate from different directions giving a dendritic pattern. These streams bring a lot of water from the densely populated Bwaise II Parish zones and other areas. These join the Nsooba tertiary channel, which ends up in river Lubigi.

4.3 Factors that contribute to poor drainage in Bwaise II Parish

There are very many factors that have contributed to poor drainage in Bwaise II Parish to a large extent that is the five major factors discussed below have greatly led to poor drainage in the parish like destroyed wetland, increased presence of garbage and polyethene bags, the topography of the area, construction of unplanned and sub-standard houses, and lastly increased population.

a) Destroyed wetland

Up to the 1980s, Bwaise was a wetland, but was cleared especially from 1986 during the NRM bush war which had very many people homeless and as a consequence population increased in Kampala. The cities population increases at 39% per year (UBOS, 2006). The increased housing population is responsible for surface coverage of roads which automatically increases the catchment area for surface runoff. On the other hand the vegetation cover has been cleared due to demand for land for building houses, commercial buildings, roads and small scale industries. This gives a golden opportunity to the surface runoff to erode as much soils as possible because the area has no vegetation to cause the silt to end up in the rivers. It's this silt that is responsible for reducing the carriage way for the drains such that when it rains it can't carry the volumes of water at its disposal, an aspect that results into flooding.

Increased surface runoff emanates from the physiology of Bwaise II Parish in Kawempe division which rises from low lands of 3,830 feet (1,167 metres). However Williams (1996) also contends that drainage problems and their causes widely differ depending on the nature of the physical landscape and the hydrological conditions.

Regarding the state of drainage in Bwaise II Parish, majority of the respondents (62%) revealed that the state of drainage was poor and only 16% said that the state of drainage was good and 2% of the respondents were not sure about the idea (Table 3). This is in line with Ajayi (1993) who stated that in most developing countries, solid waste disposal is closely linked with urban wastewater drainage where open sewers and drainage channels often end up being receptacles for solid wastes generated in the community.

Table 3: Rating the state of drainage in Bwaise II Parish

Response	Frequency	Percentage
Very good	-	-
Good	8	16
Poor	31	62
Very poor	10	20
Not sure	1	2
Total	**50**	**100**

One of the factors that cause poor drainage in Bwaise II Parish is swamp degradation. This was pointed out by 20% of the respondents (Table 4). There is wide clearing of the swamp in Bwaise II Parish and the high rate of swamp degradation is due to the need of creating space to set up housing quarters in the Parish. Yet these houses are unplanned hence increasing surface runoff from rooftops of the mushrooming structures in the Parish.

Up to 16% of the respondents pointed out that excessive heavy rains are experienced in the area causing flooding in Bwaise II Parish. This is mainly because the area is over built and there is limited land left for percolation to take place. With this natural factor they have nothing much to do but only to take the necessary precautions to control it by piling sacks full of sand on their verandahs and pathways to create easy movement. This in a way increases silts in the drainage passage from the sacks of sand which are used as an aid in transport and protection of their property.

Table 4: Factors that cause poor drainage in Bwaise II Parish

Factors.	**No. of respondents.**	**Percentage**
Swamp degradation	10	20
Heavy rains	8	16
Small drains	7	14
Increase in urban population	6	12
Unplanned developments	5	10
Siltation	5	10
Poor waste disposal	4	8
Lack of frequent cleaning of The drainage systems	3	6
Human activities	2	4
TOTAL	**50**	**100**

b) Increased presence of Garbage and polythene bags

There is a lack of responsibility of the communities in Bwaise II Parish toward waste management, due to their poor attitude towards waste disposal and management. Traditional cultures and norms allow people to litter and practice open dumping in the guise of what 'their grandparents told them that the rubbish will rot, be burnt and washed away by rain to a safe place; not knowing that, such a practice will choke the drainage system and make it unable to perform.

The community is unwilling to pay for garbage collection since some people regard it as the responsibility of KCC to use the money collected from taxes, for garbage collection in the Division Lubigi swamp. There is lack of cooperation between KCC and Wakiso District to de-silt the drainage channels the two districts share which is Lubigi swamp. This creates a back–flow and flooding during rainy seasons and sometimes it floods up to 4 days after the rains.

Through direct observations and interviewing the respondents, blocking channels is found to be one of the causes of poor drainage in Bwaise. This is absurd considering that Kawempe Division spends about 848,000,000 million shillings each year (23% of the LGDP fund) in construction of drainage channels (Kampala City Council accountant Kawempe Division). The drainage channels are blocked by solid waste and soil erosion, which is transported by the runoff from surrounding hills. These wastes join the drainage channels and block normal flow of water hence causing floods. The residents said that clay or sand from uphill causes siltation that results in the moving water to meander. However, brokers are employed regularly to remove it. This is a serious problem because it also blocks the small drainage channels, which are constructed to join the big channels.

Bwaise II Parish is settled mainly by low income earners who do not have money to pay land planners resulting in Buildings constructed in circular form or too close to one another. Due to poor structural planning, Bwaise II Parish therefore faces a problem of poor waste disposal and drainage management, and failure of the waste trucks to maneuver through the residential homes to collect the wastes and to desilt the blocked drains.

Table 5: Methods of waste disposal

Site for dumping Solid wastes	**Frequency**	**Percentage**
Wetlands(swamps)	3 4	68
Open space	11	22
Pits	05	10
Total	50	100

Further information was sought about the way local people dispose off their wastes so as to make a relationship with the causes of poor drainage. It was found out that 68% of the people dispose their waste into the drainage channels (Table 5) because they lack space for dumping. But this

was just an excuse because the local people build illegal blocking structures which make it hard for the collection trucks to reach such areas.

The other method of disposal was open space, which also allows the wastes to end up in the swamps because they are carried away by storm water and wind since all the drainage channels in Bwaise II Parish are open drains. Some of the wastes block the channels in the process causing water logging, stagnation and flooding of the area during rainy seasons. Generally this means that 100% of the total waste generated end up in the drains and their chances of blocking the major and minor drains are therefore high.

c) Topography

The geology of Bwaise II Parish also plays a significant in influencing floods. The topography is composed of different soils like clay soil and fluvisols. The clay soils are heavy soils with poor aeration and low infiltration capacity. They are a result of the runoff staying for longtime since clay has fine texture. Topography is also influenced by Bwaise II Parish's water table, which is, too near to the surface. Whenever it rains, the water does not therefore infiltrate easily but instead remains on the surface causing floods. Another factor accelerating poor drainage is inadequate funding by Kampala City Council. Although 80% of the KCC budget (650 million shillings) is spent on waste management, it cannot fully cater for all the services. Bwaise II Parish covers a small area of 99.2 km^2; this makes it susceptible to poor drainage since Kawempe Division is a very big division to be drained by a small place like Bwaise II Parish. This is a major problem facing Bwaise II Parish as it lies in a valley.

d) Construction of unplanned houses

The construction of buildings on very small plots one after another has led to high housing density within Bwaise II Parish. Table 6 shows poor housing conditions in the Parish. For example only (16%) of the respondents are housed in permanent buildings, while the majority (40%) of the respondents live in semi-permanent houses, and the remaining (20%) are housed in temporary buildings. Temporary houses in most cases are made out of mud walls and corrugated iron sheet roofing, whereby they are small in size often occupied by the lowest income groups who cannot afford to pay for better housing. It was also noted that the construction materials like

bricks and mud are affordable while the corrugated iron sheets and bricks are acquired on the commercial market.

Therefore only 10% of the household respondents have houses with mud walls, while 12% had houses with brick walls and 10% had houses with block walls. However, all respondents had corrugated iron sheets for their roofing materials. The study also noted that the buildings in the residential areas were not planned. In conclusion the unsystematic layout of the buildings in Bwaise II Parish tends to affect the layout of drainage channels making them follow plot boundaries rather than ideal courses.

Table 6: Housing types found in Bwaise II Parish.

House type	**Number of respondents**	**Percentage**
Permanent brick house	08	16
Semi-permanent brick house	20	40
Temporary mud-house	10	20
Others	12	24
TOTAL	**50**	**100**

e) Increased population

The population and housing census of 2002 indicated a total of 4,387 houses found on a square mile of 99.2 km of Bwaise II Parish which has a total of 16,829 people both male and female (Table 1). This clearly shows that there are more people than houses available in Bwaise II Parish. These findings confirm what Ndiwalana (2000) stated that storm water drainage in Uganda is still a serious problem, which is due to the inadequacies of the drainage network. He further states that, the rapid commercial, residential, and urbanization developments in Uganda are responsible for increasing the risk of floods resulting from inadequate drainage. The rapid development leaves no space for provision of drainage systems. This is evident in Bwaise II Parish which is undergoing haphazard and disorganized development and population growth.

The local community uses the wastes generated and dumps them in the wetlands supposedly to fill them up for settlement. Consequently people have almost built the entire swamp area which used to act as sponge to absorb the excess water which Nakamiiro Channel could not carry immediately. In the process they also covered the already existing narrow drains; and when it rains flooding is inevitable. It was discovered that the blocking of the drains with solid wastes dumped directly in the swamp is the major factor causing flooding and water logging in the areas (Plate 1).

Plate 1: Blockage by silt, garbage and sediments in the Nakamiiro Channel in Bwaise II Parish.

Taken by the researcher in the field

Information was sought to find out whether the local people were aware of their contribution to the problem of poor drainage beforehand. However 88% of the respondents stated that they lacked awareness of their contribution to poor drainage in Bwaise II Parish (Table 7). This clearly shows that lack of awareness is making the people to dump wastes in the drains and building in drainage passages without knowing that their activities were causing serious drainage problems.

Table 7: People's awareness on the consequences of their behaviour

Do you have any problem with staying in such a place	Frequency	Percentage
Yes	9	12
No	41	88
Total	**50**	**100**

Local authorities in charge of controlling development and the other human activities in the area are to blame for the poor sensitization of the people on drainage. Kampala City Council has not played its part in trying to avert the situation. There are a number of factors related to this failure to perform on the local authorities and this ranges from the political and corruption tendencies which negate the improvement of the situation. Politically the local authorities encourage these people to settle in such areas expecting compensation from these people in form of voting them in offices. Sometimes the local leaders prevent the technical staff from executing their duties because they want to support the local peoples' agenda so that they retain their office in the coming elections.

4.4. Effects of poor drainage in Bwaise II Parish

A number of effects of poor drainage were reported by the 50 respondents including flooding which destroys their property, and affects the quality of housing because the houses are submerged in water every time it rains. The quality of water is also reported to have been reduced because the runoff ends up in springs and wells whenever it floods, putting sanitation and health of the people at risk.

a) Nature of Bwaise Informal Settlement

The unplanned nature of Bwaise II Parish settlement has led to poor management of garbage collection. Garbage collecting trucks cannot penetrate through to reach the collecting sites in Bwaise 11 Parish. Out of the 8 zones only 4 are served with kits for garbage collection. The

remaining zones find their means to dispose off their garbage. This leaves Bwaise residents more susceptible to communicable diseases than people elsewhere.

Many diseases in Bwaise showed a seasonal pattern suggesting sensitivity to the seasonal flooding in this area. Floods are associated with risk of diarrhearal and other hygiene-related diseases because of the runoff flood wash that contaminates the water supply as stated by Nakazibwe Josephine a clinical attendant in KCC Health Centre. The major causes of diarrhea are linked to contaminated water supplies with other diseases like cholera, cryptosomatism, and typhoid as reported by Doctor Bulwadda Daniel of KCC, Health Centre Kawempe. It was reported that the quality of life is generally affected through the bad odour which becomes a public nuisance to the people in the surrounding areas because the drainage system runs through the residential areas.

b) Environmental health and sanitation in Bwaise

In investigating whether or not the people in Bwaise II Parish are seriously exposed to unhealthy environmental conditions, many factors were identified including security on the land tenure, social-economic, and educational. Table 8 reveals that 92.3% of the people catch diseases due to poor drainage system while 7.7% do not catch any diseases due to poor drainage. With the total of 50 respondents 46 of them attributed catching of diseases to poor drainage which only leaves a small number of healthy people in the parish.

Table 8: Occurrence of diseases

Diseases due to poor drainage systems	**Frequency**	**Percentage**
Yes	46	92.3
No	04	7.7
Total	50	100

Bernstein (1995) reported on the same finding in his book that 3.2 million children under the age of 5 years die each year from diarrhoral diseases largely as a result of poor sanitation, contaminated drinking water and associated problems from poor drainage and hygiene. Inadequate drainage posses additional health risks and may cause property damage, road

congestion and disruption of other public services as well as water pollution. In many other countries unsafe water and sanitation are the most important causes of mortality and morbidity among urban residents. The people live in single roomed houses with no access to good toilet facilities, and they fetch water from contaminated water sources in swampy areas served with poor drainage system.

Table 9: Types of Diseases

If yes what kind of disease	**Frequency**	**Percentage**
Malaria	33	65.7
Cholera	15	30.0
Diarrhoea	02	04.3
Total	**50**	**100**

It has been stated that 65.7% of the respondents (Table 9) said that people were affected by malaria due to poor drainage which acts as a harbouring place for vermins, while 30.0% are infected with cholera due to flood water contamination of underground water, springs and wells where the people of Bwaise II Parish collect water for home use. Only 2 respondents (04.3%) suffer from diarrhea which is also a water borne disease.

The few toilets in this area have been constructed shallow within 10-15 feet deep. These pits cannot resist the acidity of the faeces and instead end up cracking down and letting all the waste to pour out. This has greatly destroyed the environmental health and sanitation of Bwaise II Parish. The New Vision (2003) notes that there are indications that the slime (fecal matter) comes from septic tanks that are intentionally emptied into the drainage system during rainy seasons. This is what most land lords resort to because payment for waste water emptier is expensive and sometimes they do not have the money to pay. Human waste (sludge) management is typically a big problem in the area. Therefore when it rains they let go of the sludge into the drains as a way of emptying their pit latrines. This has a big effect on sanitation and the contamination of the underground water which most of the people depend on in Bwaise II Parish from the Nabukalu well or fresh point water source.

Most of the waste water is openly released into the Nakamiiro main channel which means that all the detergents and other chemicals from motor garages end up in the swamps where people draw

water for use. It should be noted that pollution has no boundaries therefore the problem may not be restricted to the people of Bwaise II Parish only but to some parts of Kampala through use of polluted underground water.

Table 10: Methods of waste water disposal

How do you dispose sullage	**Frequency**	**Percentage**
Open spaces	14	28
Drain channels	34	68
Soak pit	02	04
Total	50	100

From the analysis, it's clear that 68% of the sullage (Table 10) ends up in the drainage channels a practice which is very dangerous to both humans and to the natural environment.

However, NGOs like Plan International, Save the Children (UK), and Concern Worldwide have run to the rescue of the residents through constructing VIP latrines in markets, public places and institutions like schools. The above situation has led to high infant morbidity, and the maternal mortality is also common. The diseases that are common include malaria, diarrhoea, measles and intestinal warms. In order to minimize such diseases, Kawempe Health Center is being used as a Primary Health Unit despite its experiences of shortages of drugs like cortem, rehydration solution, ciproflaxin and tetracycline for treating diseases like malaria, typhoid and cholera.

The quality of water is seriously affected by siltation and waste disposal, because most people in the area use protected springs (76%) and wells (20%) (Table 11). This puts the residents of Bwaise II Parish at risk because as shown in Table 5, 68% of the people dump wastes in the wetlands which act as water treatment plants for spring water which affects the pure water point sources. Clarence (1984) also notes on water quality that industries, communities and individual households discharge an infinite variety of unwanted waste products. In addition urban storm drainage and natural wash carry large quantities of wastes to streams. He further points out that with the increasing variety and quantities of waste products and their interlinkages among solid, gaseous and liquid state cause a hazard of stream pollution. These two sources of water are

susceptible to flooding and so, when it floods, all the dirty water mixes up with the clean water exposing the local people to water borne diseases like cholera.

Table 11: Types of water sources

Where do you get water for domestic use	**Frequency**	**Percentage**
Protected springs	38	76
Wells	10	20
Ponds	02	04
Piped water	-	-
Total	**50**	**100**

Raven (1993) points out that storm runoff quality is often worse off than that of sewerage. Storm runoff caries salts, oils, untreated garbage, construction sediments and traffic emissions through rain that washes pollutants out of the air. This normally contains asbestos, chloride, lead, organic wastes, sulphuric acid and zinc. Municipal waste water pollution is also a great problem in developing countries many of which lack water treatment facilities as compared to the developed countries.

Poor drainage in itself can bring about flooding which in most cases submerges the buildings, roads and makes it hard for people to move about. Usually those with no alternative means remove their shoes and cross while others pay someone to sail them aboard on a bicycle or on their backs (Plate 2)

Plate 2: Effects of poor drainage on transport in Bwaise II Parish whenever it floods. Taken from the monitor newspaper archives

National Report on Environment and Development (1991) points out on effects of poor drainage that, because of poor drainage and sewerage systems, open spaces, roads and slums in low lying areas, are often flooded and water logged. It further states that better sewerage facilities are often available only in the medium and high income areas. Whenever it rains in areas like Bwaise, Kawempe and Ndeeba, it floods and people have to wade or be carried across huge expanses of flood waters (New Vision, 2003).

One should however note that walking in such dirty water has a lot of risks because flood runoff moves at a high speed than what it seems like on top thus putting people's lives at risk of dying. It is also good to note that, flood water contains a lot of debris and harmful species like snakes which have been swept away from their sand habitats which are dirty and have a lot of hygienic consequences which people seem not to be aware of. Sometimes when the situation is worse school children do not go to school while others are forced to take long walks home (Table 13). Young children abandon the idea of going to school in fear for their lives, an aspect that affects a lot of their performance in school.

Table 12: Rating the state of flooding in Bwaise II Parish

Response	**Frequency**	**Percentage**
Very high	27	54
High	10	20
Low	3	6
Very low	10	20
Not sure	-	-
Total	**50**	**100**

Regarding the state of flooding in Bwaise II Parish, most respondents (74%) revealed that flooding was high whereas 26% noted that flooding was low(Table 12). It should however be noted that flooding was only noted to be very high in rainy seasons. The above findings support those by Carcros (1990) who had observed that flooding is common in rainy seasons in urban centres because of the increasing surface area coverage with roofs and roads in urban areas.

Table 13: Traveling whenever it floods

How do you travel or Move whenever it floods	Frequency	Percentage
Take longer routes	35	70.2
Don't travel at all	10	20.0
Hire bicycle men	05	09.8
Total	50	100

Whenever it floods in Bwaise II Parish 70.2% of the respondents reported that the people take longer routes to travel because the accessible routes get blocked off by the flood water which increases the amount of time spent to get to work (Table 13). While 20.0% don't travel at all thus denying them of work and income for livelihoods. The responses for the remaining 09.8% hire bicycle men to ferry them across at great risk of falling down who are at a risk of falling in the moving water sometimes with lethal results. Floods are also responsible for the loss of land through inundation. The original size of land one owned before flooding is seriously reduced (Plate(3).

Plate 3: Effects of flood water on houses in Bwaise II Parish after heavy rains. Taken by the researcher in the field

New Vision (1999) reported a story in line with (Plate 3) where 'several houses were lost in a heavy down pour and subsequent floods which hit Kampala and its suburbs on Wednesday October 13th 1999. The worst hit areas were Kalerwe and Bwaise, where homes became inaccessible and five people were rescued from drowning. The floods up to window level submerged roads and entered people's houses living household properties wet and damaged. Offices, machines and commercial property worth millions of shillings were also lost in those floods.

Flooding affects aesthetics of the whole place and it promotes stagnant water in the area. There is therefore s need for serious intervention before the situation goes out of hand (Plate 3).

Economically most people whose employment levels do not go beyond the jurisdicted flooded area are affected. Those engaged in business in the Katale zone, brick makers and many other activities have their work affected for months till the water sub-sides leaving their business capital destroyed. Raj (1991) identified water logging as one of the causes of poor drainage. The causes of water logging are both natural and artificial. The quality of housing is also affected by the floods. The submerged water soaks the walls resulting into cracking of the walls and

weakening the structure (Plate 4). This puts the house dwellers in an accidental situation for their lives.

Plate 4: Effects of poor drainage on the quality of living in Bwaise II Parish whenever it floods.

Taken by the researcher in the field.

In the final analysis it can be said say that the drainage system of Bwaise II Parish is seriously dangerous to the local inhabitants and the environment in general. Therefore there is urgent need for intervention in order to avert the situation.

Table 14: A correlation between flooding and state of drainage in Bwaise II Parish

		Rating the State of drainage In Bwaise II Parish	Rating the State of Flooding in Bwaise II Parish
Rating the state of Of drainage in Bwaise II Parish	Pearsons correlation	1	. 754**
	Sig. (2-tailed)	.	.000
	N	50	50
Rating the state Of flooding in Bwaise II Parish	Pearsons correlation	.754**	1
	Sig. (2-tailed)	.000	.
	N	50	50

The Pearson correlation in Table 14 shows that flooding was positively related with the drainage systems in Bwaise II Parish using data from (Table 3 and 12). This therefore implies that it was because of the poor drainage systems that there was continuous flooding within the Parish. The correlation value is 0.754** at significant level 0.000 which implies that the effect of poor drainage systems of flooding in Bwaise is very significant. Basing on the above analysis, it can be concluded that flooding in Bwaise II Parish is as a result of poor drainage system. Therefore, the hypothesis for the study is maintained which states that flooding in Bwaise II Parish is as a result of poor drainage system.

4.5 Measures to control the problem of poor drainage in Bwaise II Parish

On interviewing some of the KCC officials the following are some of the measures they suggested:

4.5.1 Upgrade and reconstruct Lubigi wetland

Upgrading and reconstruction of Lubigi wetland will soon be done under Kampala integrated Development project (KIDPU), reconstruction is done through replacing the already degraded vegetation with the same vegetation species through manual planting/man-made wetland to carryout the work of the previous wetland which had been destroyed. This project was approved in March 2011 by the Minister of State for Environment, National Water and Sewerage Corporation Managing Director William Muhairwe and the Minister of Water Miria Mutagamba but not yet put in place. The projects main aim is to prevent backflow whenever it rains since Lubigi has been constructed in it cannot handle a lot of runoff at once. Under the KIDPU project Nsooba channel will be widened in order to contain more water during rainy seasons to reduce the level at which it backflows to Nakamiiro main channel in Bwaise II Parish causing flooding in the area.

Through the upgrade of Lubigi, there will be increased drainage capacity of a sewage system which is the most typical solution in urban drainage for solving water quantity problems. By doing this the problem is transferred downstream. To avoid such problems the drainage systems therefore needs to be wide enough to retain the water for some hours, and then discharge the

water in a controlled manner through slowed rates of discharge by creating hedges in the existing drainage system.

More so, dual systems should be designed to transport sewage separately from rainfall run-off. It will integrate the drainage systems with the collection and treatment of industrial and domestic waste water, to minimize the contamination of the effluent towards the surface water. By flushing the surface water we prevent the development of diseases and blue-green algae.

4.5.2 Clean Up

Clean up should be done in all the channels in Bwaise II Parish to avoid sedimentation and siltation which are one of the main causes of poor drainage. If this is put in place it will mitigate the problem of stagnant water, flooding, open space dumping and dumping garbage directly in the drainage system by providing garbage containers and collecting of solid waste in Bwaise II Parish. Some development partners like AMREF and AEE water aid programme have come up to help. Although they have curbed some of these problems they still need to increase on their funding and also to sensitize the local people on their hindrances on the drainage systems.

4.5.3 Sustainable Urban Drainage Systems (SUDS)

Sustainable urban drainage systems (SUDS) have been developed to improve drainage and reduce the volume of surface runoff in urban areas. The use of green space in the design of SUDS allows water to be controlled using trees and vegetation, green roofs, ponds and wetlands. Green roofs can especially be implemented in order to increase interception, storm water storage and evaporation in highly urbanised areas where the space to introduce green infrastructure is restricted.

CHAPTER FIVE: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5. 1 Summary

Drainage is an accomplishment of causing subterranean water to flow by gravity into swamps at the level which is usually pumped out (Abwot, 1999). The study investigated the factors responsible for poor in Bwaise II Parish. The study questions were related to examining poor drainage in Bwaise II Parish. The background focused on defining and understanding why drainage is a general problem in Bwaise II Parish and a very important aspect of our urban environment. The research confirmed that poor drainage is as a result of rapid urbanization in Kampala city due to massive increase in human settlement compared to attempts to improve the drainage networks in the study area for example; Bwaise II Parish has 4,387 households compared to the 16,829 total population in the area. The drainage systems are therefore a big deterrent in the development of settlements even though low cost which has led to serious hazardous flooding and submergence of structures constructed on unsuitable low lying areas or reclaimed wetland. Environmental degradation in Bwaise II Parish caused by the poor drainage systems has health implications on the people leaving in the area.

Various methods such as posing research questions, administering questionnaires, maps and collecting relevant secondary data were applied during the research. Data were collected on features of the location of Bwaise II Parish. The Parish is in a valley and a wetland swamp. This put the Parish at a high risk of flooding from the high raised surroundings of Kazo hill, Mulago hill, Makerere hill and Kawempe Mbogo raised surface areas. The soils of Bwaise II Parish are alluvial or river valleys. These soils are mainly developed from rain transported materials varying in texture from heavy clay to coarse quartzite sand, and they have a seasonally fluctuating water table, which characteristically causes impeded drainage conditions (Radwarisk 1960). The vegetation of Bwaise II Parish is mainly swampy although it has been heavily reclaimed. The reclamation is one of the major causes of the poor drainage in Bwaise II Parish. The Parish has a total population of 16,829 people and it covers an area of 99.2 sq km with 4,387 households. The unplanned houses and their poor construction on drainage passages worsens the flooding. A large number of channels within the area of study were either blocked or very small as a result of constructing the buildings too close to the drainage system.

All in all the factors contributing to poor drainage in Bwaise II Parish are degraded wetlands, heavy rains, small drains, dumping garbage into the streams, increased urban population, unplanned developments, siltation, poor waste disposal practices, lack of frequent cleaning of the drainage systems, and poor waste management.

Channelisation by building stream walls and beds along Nsooba has been done with the support of the Parish Council and NGOs like CONCERN. The major Nsooba stream was channelized by KCC although floods are still common. Furthermore, because of the role played by silt in interference with the channel geometry, the LC1 officials encourage the communities to desilt and unblock the channels. This goes hand in hand with snagging and channel widening in many cases. They also advice them to line the channel banks with sand bags (levees), especially during rainy seasons.

Finally, because of the perceived importance of activities along the streams and the riparian areas, in as far as contributing to the drainage problems such as flooding, KCC is trying to enforce appropriate regulations for people to carry out activities according to rules and regulations laid down. Not withstanding some of the measures have been successful. Case in point, Jambula and Nabukalu zones used to flood and destroyed peoples' property and their drains had stagnant water as it is now in Nakamiiro and Katale zone but that is nolonger a problem. This is attributed largely to the upstream location of the villages, such that minor controls may be successful with significant impact. However, limited long term success has been achieved in the down stream villages, such that the remedies are only effective for a short-while but the problems resurrect after a while. This is possibly due to the upstream works like channelisatin, whose related rise in discharge destabilizes flow conditions and any efforts downstream.

KCC is only mandated to carryout and monitor such works on the major streams, while minor streams are left to the Parishes and Divisions. Kawempe division spends 848,000,000 per year on drainage through KCC but it doesn't give any amount to LC's to facilitate drainage in the parishes. This state of affairs is not helping, for without facilitation, LC1 officials are limited to

mobilizing local manpower to channelize streams. They admit that at times it has been predominantly a community initiative, and on a number of occasions facilitated by NGO's like CONCERN. They cite reluctance of KCC to provide the necessary facilitation so as to realize long lasting solutions, arguing that what is done is temporary, for it is only after a short while that the problem resurrects. This then implies that the strategies employed are either inefficient or inappropriate in the light of the current modified state of the streams and the entire sub-catchments. Hence, flooding has persisted and have perpetuated other drainage-related problems like ailments like, malaria, and in extreme circumstances, cholera. Even though these diseases naturally exist in the tropics, the high peaks associated with periods of floods and areas of persistent poor drainage, point to the linkage postulated.

5.2 Conclusions

It was found out that most of the factors responsible for poor drainage system in Bwaise II Parish were man-made or caused by the activities of the people. Due to the ever increasing population, wetlands have been degraded to provide land for houses. Unfortunately, the houses are unplanned buildings and not constructed to the level of architectural design of leaving space for a landfill, drainage systems and roads.

The existing drains in Bwaise II Parish are too small or heavily silted whenever it rains because of the topography of the Parish. Frequent cleaning of the small drainage channels due to limited funds given to the local government for the work.

A lot of the effects of poor drainage are as a result of the nature of the informal sector of Bwaise II Parish which doesn't allow for garbage trucks to penetrate through the zone to collect rubbish and cleaning up drainage channels. Since these settlements are unplanned it leaves the residents of the Parish susceptible to communicable diseases. Many prevalent diseases in the Parish show a seasonal pattern of outbreak. During rainy seasons the residents are affected with high levels of diarrhoea, cholera and typhoid while during dry seasons it is malaria, flu and cough because the open drain harbour places for mosquitoes and the one roomed houses with bad ventilation have no access to fresh air. Most of the waste water is openly released into the drainage channels since most of these houses have no toilet facilities.

This is a big problem when it floods the water ends up in the fresh water springs and wells where people draw water for domestic use. This has affected the quality of water seriously in some parts of Kampala. Poor drainage also affects transport when it submerges roads and houses making it impossible for the residents to leave home.

The measures so far taken are widening of drainage channels, desilting and putting traps in drainage systems to trap garbage from blocking the main drain of Nsooba channel.
Another measure to be taken is the upgrading of Lubigi wetland; this will help stop the frequent back-flows which cause flooding. The use of green space in the design of Sustainable Urban Drainage Systems allows water to be controlled using trees, vegetation, green roofs and wetlands.

5.3 Recommendations

5.3.1 The People

The people residing in Bwaise II Parish should be sensitized about the impacts of unplanned poor construction of houses on the environment. Environmental bodies like the National Environment Management Authority should get in partnership with Kampala City Council and formulate a wide campaign on public awareness and sensitization through seminars and workshops concerning environmental protection. This will enhance better solid waste disposal, waste water disposal and avoiding developments/activities that are not environmentally friendly. There is also a dire need for sensitization of the communities about the danger of settling within the riparian areas of the streams case in point; 88% of the residents of Bwaise II Parish were not aware of the problems related to settling in flood plains, this is because of the corrupt tendencies of the local officials who don't follow the KCC set urban plans. The conservationist should endeavor to encourage people to use the resources sustainably than to put a total ban to their use. The people should use them sparingly and consciously and have it in mind that the future generations need their use. Natural resources are there for people to enjoy but not to endanger them to extinction. The community affected by the flooding should be involved in solving the drainage problem since they know the extent of the problem. Regulations for punitive measures for culprits should be instituted

5.3.2 Local Councilors

The local councilors should exercise a great discipline over building to ensure that plot boundaries are observed to prevent houses from obstructing the existing drainage path as well as occupying land needed for future drainage work. Planning should ensure setting out regular plots before construction starts. This will help leave space for well aligned roads with adequate road width and road reserves, and it will make construction of drainage systems easier whenever needed. If the Local Councilors take this recommendation and enforce it the work of the Kampala City Council will be made much easier.

5.3.3 Kampala City Council Authority

It was established that the maintenance of minor streams is the burden of parishes and divisions within the northern parts of Kampala district. Because of the reported inadequate funds at their disposal, little can be achieved. It is therefore recommended that KCC prioritizes drainage for local government development programme funding so that flooding zones along streams are channelized or reconditioned to stimulate previous natural conditions. This will facilitate swift evacuation of stream water to the lower reaches which may be allowed to flood since the surrounding zones will have been fenced off and free from settlement, implying that no loss of whatever form will be expected. KCC should carefully consider the type of channelization and the materials to be used for the modification, such as those that counter the speed of flow to give chance for the down stream reaches of the streams to prepare for the incoming stream water.

Secondly, KCC should plan to restore the wetlands that are currently settled in, and are also the flood zones. This will involve relocation of the settlers with compensation as suggested by the KCC assistant engineer and fencing off the flood zones are appropriate. The boundaries of the zones to be fenced off should be hydrologically determined, such that only areas where rise in stream flow peak is likely to cause flooding are fenced off. This will require to first install gauges along specific sites of the streams so as to capture data concerning flow peaks, which if modeled with other basins and climatological parameters, will be used as a guide to demarcate the boundaries of zones susceptible to stream floods. Notice should be taken of the future impacts of the changing land uses within sub-catchments and of the appropriate land surface which can never be inundated even during high rainstorm events.

Thirdly, because of the contribution of the built up areas in raising the streams flow, it is recommended that appropriate means to reduce surface flow be devised. This can be done through mandatory installation of soak pit facilities for all establishments, and harvesting of rain water for domestic use. The essence of this approach is to reduce the amount of water contributed by the sub-catchments to the streams which would otherwise raise the streams flow peak to levels that are disastrous.

Fourthly, since the culverts across streams within the northern part of Kampala city have small cylindrical conduits which contribute to flooding during and after down pours by ponding stream water behind them, it is recommended that these are replaced with culverts that have large squarely or rectangular conduits of the same width as that of the channels at sections where they are installed so as to accommodate the natural peak flow. This will ensure that there is little or no change between the flow conditions before and after culverts during a storm.

Fifthly, land use planning which is an orderly process by which the use of land within a municipality, a county or some other jurisdiction is regulated, is highly recommended for Bwaise II Parish. To be effective, the land use planning should be based upon a comprehensive plan, emerging from long-term studies and considering broad social, economic, environmental, political issues.

The zoning ordinance is the mechanism by which new development is controlled as growth occurs. As such, zoning is a classification of land uses that limits what activities can or cannot take place on a parcel by establishing a range of development options. It is therefore recommended that the Government should improve the institutional frame work governing environmental management, and it should through Kampala City Council involve the police in zoning which is a form of Police power delegated by the State to local governments through enabling legislation to ensure the welfare of the community by regulating the most appropriate use of the land.

5.3.4 Government

The national Constitution of 1995 and the National Environment Act 2000 should have solved the problem of flooding once and for all. But they lack the enabling guidelines and schedules of duties to be followed when enforcing them. It is therefore recommended that the Government reviews the Law and comes out with a new and comprehensive sound and implementable legal framework to govern the environment as a whole. The local institutions should be strengthened and involved for the policy and Law on wetlands to succeed.

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APPENDIX 1

Examining poor drainage in Bwaise II Parish, Kawempe Division- Kampala

Questionnaire

This questionnaire is intended to collect data from the residents of Bwaise II Parish and the main aim of using the questionnaire is that I generate large amounts of data over a wide area since Bwaise II Parish is quite wide.

To achieve it will be wise to develop meaningful questions that will generate the desired information since the success of questionnaire survey is dependant upon the quality of information collected

Therefore the questions will be made short; clear and simple to minimize the possibility of misunderstanding them.

A total of about 20-25 questions will be conducted and the questionnaire will be divided into two (2) sections.

The questionnaire has two sections

BACKGROUND INFORMATION

SECTION A

A: basic information

1. Name .....
2. Marital status? ……
3. Number of children? ……..
4. Number of dependants? …….
5. Occupation? ……...
6. Education standard? ……..
7. Village of residence? …….
8. Tribe? ……
9. Responsibility in the village? ……
10. What do you understand by the term drainage?…

……..

11. What do you understand by drainage system?……

12. What do you understand by poor drainage systems…….

……

……

13. How well has drainage management been enforced……..……

……

……

14. Which organizations provides drainage maintance in Bwaise II Parish?

……

……

……

15. Which activities do local people engage in with the environment?

.....

.....

.....

SECTION B

16. What is the category of the dwelling units?

Permanent ☐

Semi permanent ☐

Temporary ☐

17. What do you think is the nature and pattern of settlement in Bwaise II Parish?

.....

.....

18. What are the materials used for wall building?

.....

.....

19. Do you experience floods during rainy season?

Yes ☐ No ☐

20. If yes why do you think floods occur in your area?

.....

.....

21. Do you experience any diseases after floods?

Yes ☐ No ☐

If yes which diseases?.

.....

.....

22. Which of the above disease is more acute after floods?

.....

.....

23. Where do you dispose off solid wastes and waste water?

.....

.....

24. Were the water drainage channels, constructed well to drain away waste water?

Yes ☐ No ☐

25. How often is solid waste collected in the area?

.....

.....

26.What is the biggest problem in the area?

.....

27. Do you think the above problem can be remedied

Yes ☐ No ☐

Explain……

……

27. Would you like to shift to another area?

Yes ☐ No ☐

If yes,

why?.....

.....

If no,

Why……

……

28. Do you think Bwaise II Parish is more susceptible to diseases than anyother places?

No ☐ Yes ☐

29. What assistance does the government give to people affected by

floods……

……

30. Is the assistance acceptable by the community if No/Yes give reasons why.

……

……

31. How do you think we can mitigate environmental problems which result from floods.

……

…….