ALLUVIAL DEPOSITS AND THEIR EFFECTS ON THE PHYSICAL ENVIRONMENT AND SOCIO-ECONOMIC ACTIVITIES ON THE LOWER COURSE OF RIVER KUJA, NYATIKE DIVISION- NYATIKE DISTRICT, KENYA

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ABSTRACT

Alluvial deposits are features resulting from river deposition. They consist of gravel, sand and silt particles, formed on the lower course of a river. Deposition of sediments at the lower course of a river increases because of a decrease in the river flow and hence a reduction in the competence of the flow. This study focused on the lower course of River Kuja, approximately 5 km from the river mouth and 4 km away from the river channel on both sides of the floodplains. Continuous accumulation of sediments on the river channel makes the channel to become shallow in depth, thereby forcing water in the channel to go over the river bank, into the floodplains, carrying the river load into the farmlands and hence, an increase in soil fertility. Floods emerging from over bank flow can cause erosion of fertile soil along steep river banks, destroying crops, livestock and drowning homesteads of the inhabitants. The objectives of the study were to: identify types of alluvial deposits on lower course of River Kuja; determine the effects of alluvial deposits on the physical environment; find out the effects of alluvial deposits on socio-economic activities on lower course of River Kuja. A sample size of 384 households was obtained from a total of 20,000 households from the study area by the use of simple random sampling technique. Primary data was collected through Household Survey, Focused Group Discussions, Key Informant Interviews, Observation and Photography. Secondary data was collected by reviewing documented literature including reference books and from the internet. Quantitative data were analyzed by using descriptive statistics such as percentages. The study identified river channel deposits, the river bank and the floodplains deposits. Alluvial deposits can cause deep river channels to become shallow, cause over bank river flow into the floodplains, pools of stagnant water, soil erosion on steep river valley, drowning of homesteads and displacement of inhabitants from the floodplains. On socio-economic activities alluvial deposits affects crop farming, livestock keeping, fishing and trading activities. The results indicated that alluvial deposits are found on the channel, on the river bank and on the floodplains, where they affect the physical environment and socio-economic activities. Research study recommends that the roads leading to the river bank be improved, to enable trucks to reach the river bank and collect coarse sand from the river channel; deepen the channel and hence reduce over bank river flow that causes floods on the floodplains, encourage cultivation of farms along the contours, give early warning to the inhabitants to vacate areas prone to floods. This will reduce losses incurred when their properties are destroyed by the floods and finally encouraging the farmers, fishermen and traders to join co-operative societies to help them in identifying appropriate market for their produce even during flooding events. This will discourage the farmers from selling their produce to the middlemen who exploits them during flooding events when they are faced with limited market. Consequently, this will help in improving the livelihood of the inhabitants and hence, economic growth of Nyatike Division.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study.

Alluvial deposits are landforms that result from river deposition. They consist of gravel, sand and silt particles commonly found along river valley (Kibuuka and Karuggah, 2004). They are formed on the lower course of a river (Michael, 1995). Deposition of sediments occurs because of a decrease in ability of the river to transport its load along the channel and hence a fall in the competence of the flow (Arthur, 1998). A study on alluvial deposits was first advanced by Herodotus (484-425 BC), whose ideas have greatly contributed to what later became known as fluvial geomorphology. He observed that the fine deposits on the Nile valley were dropped by running water, which later developed into unique landforms (Campbell and Miller, 1969).

Michael (1995) analyzed alluvial deposits on the floodplains of River Donjek in Canada. According to Arthur (1998), some alluvial deposits have been formed on the floodplains of River Kosi in India, on River Mississippi in U.S.A, River Hwang Ho in China, and on the floodplains of River Rhine in Netherlands.

In Tanzania, river deposits are formed on River Kilombero, which are boarded by steep sided highlands of Uchungwe. At the foot of the valley, two or more deposits coalesce to form continuous landforms of river deposits (Kibuuka and Karuggah, 2004). In Kenya, alluvial deposits are formed at the confluence of River Ewaso Narok and Ewaso Nyiro near Barsalinga in Laikipia District. Deposits of river sediments are also formed on the floodplains of Rivers Nzoia, Yala, Nyando, and Tana.

Alluvial deposits on River Kuja consist of coarse sand, silt, and clay particles. They form on the river channel, river bank and on the flood plains. Deposition of the river sediment on the channel, lowers the river depth and hence, the river flow is directed onto the bank and finally into the floodplains, resulting into emergence floods on the floodplains of Nyatike Division between the months of March to May. This causes heavy loss to the inhabitants when their crops and animals are destroyed, homesteads drowned, trade partially stopped and the inhabitants displaced. Patches of stagnant water have become common phenomena onto the land on which mosquitoes causing malaria and snails carrying bilharzia breed (G.O.K, 2008). Therefore, the effects of alluvial deposits on the environment range from loss of life and fear of uncertainty, to direct effects on socio-economic activities (Jackson, 1989).

1.2 Statement of the problem.

Accumulation of channel deposits on River Kuja has made the channels to become shallow in depth. Such shallow river channels diverts the river flow, causing floods on the adjacent farmlands, forcing the inhabitants to migrate to the raised and drier areas of Nyatike Division especially during long rainy seasons (March to May) for safety. The diverted flow may reach the farmlands, destroying crops, animals, farmlands and homesteads. Lower Nyatike Division has become hazardous environment to human settlement, prone to floods, erosion and sedimentation. Therefore, the purpose of this study was to assess the effects of alluvial deposits on the physical environment and socio-economic activities of the inhabitants of Nyatike Division.

1.3 Objective of the study.

1.3.1 General objective

The general objective of this study was to determine the effects of alluvial deposits on the physical environment and socio- economic activities on the lower course of River Kuja, Nyatike Division.

1.3.2 Specific objectives

a) To identify types of alluvial deposits on the lower course of River Kuja.

b) To determine the effects of alluvial deposits on the physical environment of lower course of River Kuja.

c) To determine the effects of alluvial deposits on socio- economic activities of the inhabitants of Nyatike Division.

1.4 Research questions.

The study was guided by the following research questions:

a) What types of alluvial deposits are found on the lower course of River Kuja?

b) What are the effects of alluvial deposits on the physical environment on the lower course of River Kuja?

c) What are the effects of alluvial deposits on socio-economic activities of the inhabitants of Nyatike Division?

1.5 Justification of the study.

Gentle relief of the floodplains of Nyatike division has encouraged an increase in deposition of sediments on the river channel, river bank and on the floodplains (G.O.K, 2008). A study on the effects of alluvial deposits on the physical environment and socio-economic activities on lower course of River Kuja has not been conducted. Therefore, the findings of this study will assist the government and other stakeholders to take necessary measures of controlling negative effects of alluvial deposits on the physical environment and socio-economic activities and come up with ways that can help improve the livelihood of the inhabitants of Nyatike Division and in the neighbourhood.

1.6 Scope and limitations

The study was conducted in Nyatike Division in Nyatike District, at the lower course of River Kuja. Lower Nyatike was selected because it lies approximately 5 km from the river mouth and 4 km away from the river course, along the flood-plains where alluvial deposits are formed on the river channel, river bank and on the flood plains. The study focuses on alluvial deposits and their effect on the physical environment and socio-economic activities on lower course of river Kuja. Nevertheless, there were a number of limitations that were encountered during data collection. First, some areas of Kabuto village were not passable because the paths were flooded and slippery. Secondly, data collection also involved crossing one river bank to the other using a canoe. This slowed movement from one part of the floodplain to the other.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter gives a review on the studies that have been done on types of alluvial deposits; effects of alluvial deposits on the physical environment and socio-economic activities. In addition, the conceptual framework is presented.

2.2 Types of alluvial deposits.

Alluvial deposits can be identified by its area of location. Channel fans are specifically formed within the river channel. Michael (1995) noted that the river load may accumulate in the deepest part of the river channel, thereby making it shallow in depth. Eventually, over bank flows are developed at such shallow river channel. Channel- filled deposits are common in abandoned channel segment found at the meander cut-off. Rust (1990), explained that climate is an essential factor to the formation of alluvial deposits. High rate of coarse sediment supply are directly associated with storm events on the physical environment adjacent to the river course. This facilitates surface run off and transportation of sediment into the river channel.

Secondly, alluvial fans on the river bank forms river bank deposits. As the deposits continue to grow, deposited river load may be forced to emerge/coalesce to form an extensive feature called piedmont fan (Kibuuka and Karuggah, 2004). Over bank deposits are formed by river flood water outside or closest to the channel. The thickness of the deposits decreases from the edge of the channel into the floodplains. They are

characterized by a fairly regular structure, spreading out from the point at which channels fall into the valley. They form series of slopes of approximately uniform gradient bounded up and down by breaks of slope which are roughly pointing at the apex (Arthur, 1998).

Thirdly, some alluvial deposits are on the flood plains. Davis (1989) examined floodplain deposits that were massive, poorly sorted with gravel that are structureless in shape. Each thick bed is equivalent to individual flow, and material deposited traps and sieves fine sediment above it. Deep into the gentle river valley, they are recognized by their channelized base, internal bedding, often with better bed sorting. According to Payton and Christiansson (1992), several smaller fans were identified on wide strip of low-lying grounds where they are largely unvegetated while others have been cultivated. Floodplain deposits results when sediment transported by over bank flows reach the floodplains through the processes of suspension, saltation and traction. They are typically muddy fine deposits, occasionally being utilized for cultivation of crops and pasture land for livestock (Buckle, 1996).

The literature review of Michael (1995), Rust (1990), Kibuuka and Karuggah (2004), Davis (1998 and Buckle (1996), basically describes the types of alluvial deposits on the floodplains along the river valley, yet there is need to research more on alluvial deposits formed on glaciated lowland areas where moraine/till deposits are formed by melting ice from the terminal moraine.

2.3 Effects of alluvial deposits on the physical environment

Alluvial deposits are composed of coarse sand and gravel while others comprise of mud.

Working on the flood plains of river Donjek in Canada, Michael (1995) reported that a channel bar deposit can block an active channel and diverts the flow into another channel to form braided channels. Such channels deteriorate down flow and sediments are formed largely through sedimentation on gentle slopes resulting into fine grained, flat-lying landforms of alluvial deposits. As the deposits expand at the valley floor, they may eventually be forced to emerge and coalesce to form extensive deposition landforms called a bajada. The perennial streams can drain the wet fan and occasional flood seems to be a dominant agent of transport of sediment on such fans (Kibuuka and Karuggah, 2004).

Erickson (1991) asserted that the development of alluvial deposits are characterized by gentle slopes, lateral erosion and large river load, which will be deposited on the channel. Conditions favouring fan development is a high rate of sediment supply from the mountain source area, decrease in stream competence, sparse vegetation cover and intense storm rainfall (Swanson, 1980). Arthur (1998) explained that the over-bank deposits are made by river flood waters outside the channel or closest to channel which form levees deposits. The thickness of the levees decreases from the channel banks towards the flood plain. Similarly, the grain size of the levees decreases from the channel into the flood plain. The channel-filled deposits are common in the abandoned channel segment found in the meanders neck-cut-offs. The abandoned channel segments that remain after a meander cut-off, usually contain stagnant water filled with muddy organic materials with plant vegetation cover. This vegetation cover on alluvial deposits may form a habitat to reptiles such as snakes, crocodiles and hippos (Faniran and Jeje,1983).

The alluvial deposits on river Kilombero in Tanzania are boarded by the steep sided highlands of Uchungwe (Kibuuka and Karuggah, 2004). Along both sides of the valley and at the foot of the valley, more fans have been formed giving rise to a bajada (Richard, 1992). Some deposits are also formed in areas that have been subjected to land uplift, followed by active vertical erosion. Such areas with land uplift can experience an antecedent drainage system, whereby the river is forced to maintain its direction of flow across the land which is undergoing uplift. Such vertical erosion yields a large river load at the foot of the mountain to form alluvial deposits. Alluvial deposits contribute to the landscape development in various ways.

Michael (1995) asserted that the fan deposits may accumulate in the deepest parts of the river channel, making the channel to become shallower hence increased floods in the adjacent lands. During the time of low flow, the braided bars emerge and the river is forced to go round the bars and commonly cutting into the edges of the bars. Materials carried by the river rolls and slides on the bar tops, reducing their surfaces making the bars to migrate down stream. Finally, fans are major sedimentary store, trapping especially the coarse fraction of the incoming sediments. Other factors, reported by Richard (1992) that governed alluvial deposits are essentially those controlling the hydrological and erosion rate within the river catchment. This includes topography, climate and vegetation cover. Topography influences the rate of sediment supply because erosion rates tend to be greater on steep slopes than on gentle slopes. Climatic factors are essential both directly and indirectly. Increased rates of course sediment supply are directly associated with magnitude storm events, which facilitate surface run-off and transportation of sediments. The climate also affects the extent of vegetation cover,

because sparse vegetation influences rapid generation of surface run-off and increased sediment supply in alluvial fan. Payton and Christiansson (1992) noted large accumulation of fans occur west and north of Lake Haubi in Tanzania. Several smaller fans were distinguished on the wide strip of low-lying ground, to the East of Lake Haubi. Some of these sand fans are active and remains largely unvegetated with stratification to the land surface, while others have been cultivated.

According to Adamson and Williams (1980), alluvial fan deposits results from sediment transport by fluvial flows and debris flows. Fluvial flows are those that carry sediment by suspension, saltation and traction within the flowing water, whether channeled or non-channelised. They have a relatively low viscosity, debris flows are sediment gravity flows which are typically muddy and its strength help to support clasts dispersed in it. They have relatively high viscosity. Factors that promote debris flows are intense rainfall over short period of time, steep slopes having insufficient vegetative cover to prevent rapid erosion and abundant source of sediments including clay and silt-sized particles. Deposits resulting from fluvial flow and debris flows can be differentiated by their sorting and texture. Fluvial flow deposits are characterized by relatively well-sorted, horizontally or cross- bedded deposits supported by gravels. Debris flow deposits are characterized by relatively poorly sorted materials. The slope of the river valley, high rate of sediment supply and increase in river discharge, can facilitate erosion and transportation and sedimentation of the river load in the channel. Such sediments can lead to the formation of flood plains, piedmont fan, braided channel, differed tributaries, delta and there by causing destructive floods (Arthur, 1998).

Stanley (1993) explained that the Stiff mud of the late Pleistocene edge, inter- bedded

with alluvial sands are buried beneath recent deposits of the Nile delta in Egypt. They accumulate in seasonally flooded inland channels which are covered with wind-blown sand. The Nile delta of Egypt is completely blanketed by Holocene sediments commonly termed as Nile silts, which range from about 5 to 50 metres. The underlying late quaternary deposits are only locally exposed in small topographic mounds and little is known about their distribution and origin (Hammad, 1980). Series of early studies, show that before the development of a river channel a section of Nile was flooded by distributaries flowing towards the Northwest delta this region, about 80km south of the modern Nile delta coast, which has mud-laden waters, breached banks and over topped natural levees that are approximately 1 to 3m higher than the adjacent fluvial plain. It has deposited mixtures of clay, silt and sand. During the past 7000 years, vegetation has increasingly covered much of these low-lying surfaces as man intensified irrigation. The Nile delta deposits are much harder than mud of equivalent age in the lower delta margin near the coast. A few sections reveal much cracks filled with sand, presumably of wind – blown origin. The sand-size fraction is dominated by light minerals, heavy minerals and plant debris. River Mississippi delta silt are more similar to those of Nile delta. They are formed of highly variable proportions of silt and clay. Sand is present in low proportions and the grains for the most part, are partially stained. Other types of alluvial deposits components include coarse debris, grains sized minerals and shells (Stanley, 1993).

Floods associated with alluvial deposits are major disaster affecting man and his environment. Its effect on human welfare ranges from direct impact such as loss of life to psychological cost associated with related fear and uncertainty, to less direct impact on socio-economic activities (Jackson, 1989). The last half of the twentieth has experienced

the severity of floods leading to loss of life and damage of property. In both South America and South Asia there is a wide spread acceptance that floods and mud floods have become more frequent and serious problems along the river channel. They have become the most frequent natural phenomena as well as leading cause of deaths from natural disasters in North America, with the mean annual loss of life from floods is estimated to be 146 deaths per year. A UNESCO study in 1973 estimated that each year in Asia alone, river floods damaged about 40,000 square kilometers of land and crops (David, 1984).

The China floods of 1332 are among the worst floods that have ever occurred. During those floods, 7 million people were drowned and over 10 million died from subsequent famine and diseases. In 1887, the Yellow River flooded causing deaths of between 900,000 and 2 million people by drowning and starvation (Clarke, 1991). In economic terms, floods results in damaging of property and agricultural lands. Direct damages on crops and properties were estimated to a total of 3,000 million Rands in South Africa. In analyzing the influence of flood events in Central Southern Somali, especially in Juba and Shebelle in 1981, a vast area of uncultivated land swamped the refugee camps, roads and more than 100 homesteads submerged (Buckle,1996). In large areas of Africa, roads are non-surfaced and each year they suffer heavy damage from torrential rains. Near the equator, many roads are closed during the wet months because alluvial silt deposits. In some years even major tract routes suffer occasional closure from floods or land slides. Heavy rains followed by flooding are the cause of washed out bridges. For example, the 1979 floods destroyed main road bridges at Makumi in Central Tanzania disrupting the traffic in Dar-es-salam from as far as west of Zambia (Buckle, 1996).

Ngaira (2004) asserted that floods occur when peak discharge exceeds normal channel or river bank capacity. Floods have negative effects such as drowning and displacement of people and animals. In the year 2002 alone, over 8 million square kilometers of land was affected by flooding, almost 3,000 people died due to drowning and property worth 30 million US Dollars was damaged. She noted that a natural hazard is an unexpected event which in extreme cases can lead to loss of human life and destruction of the environment and property. The impact on human environment is greater when it is not prepared for or when a human society cannot afford the protective measures necessary. Natural hazards related to the climate such as drought and floods are the most frequent occurring with the greatest impact in the developing countries such as Kenya.

Ojany and Ogendo (1973) observed that floods associated with alluvial fans are common features in Kenya especially on low-lying parts of Nyanza Gulf and lower Tana Basin. The exceptionally heavy and widespread rainfall experienced during October and November in 1961 resulted to severe siltation of sediments on Kano plains, Yala swamp, Budalangi.

The effects of alluvial deposits on the physical environment basically explains its impact on the land which is one of the aspects of physical environment and giving minimal attention to the atmosphere. There is need to asses the impact of alluvial fans to the atmosphere, basing on the fact that natural and planted vegetation cover along the river valley grows on alluvial deposits, which reduces the amount of carbon dioxide in the air hence purifying it.

2.4 Effects of alluvial deposits on socio-economic activities

Sand harvesting on river Nzoia is advantageous to the inhabitants living on the lower parts of river Nzoia. Sand is scooped from the river bed using simple home made shovels. Stones are also crushed and sold with sand to the neighbouring towns of Ugunja, Sega and sometimes as far as Kisumu, where a tonne of scooped sand can fetch the inhabitants 350 shillings. These materials are used in constructing modern houses at reduced costs (Sunday standard Dec 14th 2008). Bluck (1982) noted that clay silts of alluvial fans are dominantly used as raw materials for making bricks. Dense vegetation can thrive on the alluvial soils to form a micro-climate and act as a habitat of wild animal species which can attract tourist hence a source of currency to the government. Alluvial deposits are also landforms potential for large scale and small scale agriculture and suitable for settlement. They form the finest-grain of all over-bank deposits and can be utilized as fertile soils however, they are hazardous environment for settlement subject to temporally and predictable flash floods, erosion and sedimentation.

During the rainy seasons, existing alluvial deposits form platforms over which more deposition takes place there by blocking roads and footpaths along the floodplains of river Nzoia and Yala (Karuggah and Kibuuka, 2004). Mburu (2005) asserted that there is a consistent low productivity of crop farming in Budalangi District because the crops are affected by floods before they are harvested leading to food shortages and starvation. In flood prone areas, floods do strike before harvest forcing the farmers to rely on relief food from the government. He analyzed that the presence of stagnant water on the gentle slopes of Budalangi have greatly hampered the development of dairy cattle in the division, because flooding events can create a conducive environment for the breeding of

tsetse flies causing nagana to the livestock.

Approximately 1,380 hectares of the total land area fall under agricultural land on the floodplains of river Nyando. The inhabitants receive abundant yields from the flood plain alluvial deposits, on which crops such as Katumani sorghum, beans, green grams, cowpeas, maize, millet and rice are grown. Livestock rearing is also practiced at the river valley bottoms where alluvial deposits favour the growth of green pasture for the livestock kept (Mathu and Davis, 1996). On the flood plains of river Yala, the farmers are forced to till small plots of land, less than half an acre because about eighty percent of the remaining patches of land are frequently drowned especially on the lowlands and even after the floods recede they opt to till small plots just to keep themselves busy. Sometimes they are not even sure of harvesting the few crops planted (Kabuuka and Karuggah, 2004).

According to Mathu and Davis (1996), the number of cotton farmers have declined drastically on the floodplains of river Nyando, due to extensive floods from the river bank into the river valley and the near collapse of cooperative societies that used to assist the farmers in marketing their produce during flood events there by avoiding middlemen. Crop farmers on the low lying flood plains have been demoralized in the recent past that even some do not bother tilling their lands because they are not even sure of any harvest after the floods

The greatest constrain in livestock keeping during floods is limited pasture for grazing the animals. The grazing land is completely submerged forcing the flood victims to look for pasture on raised grounds, exposing large number of livestock to be grazed together

making the animals to get little grass and hence, rendering them vulnerable to diseases. As the animals are moved to raised grounds away from flooded regions they carry ticks with them hence spreading tick borne diseases where they are grazed. (G.O.K, 2008).

Fishing is done on small scale using canoes and gill nets on the lower course of river Yala. Fishermen spend the night on shallow shores and remove their nets very early in the morning and sell their catch to the buyers who transport fish on bicycles to the local market. Maximum catch is often realized during the start of long rainy season (between March and May), when fish migrate towards the incoming water with fish food is washed from cultivated lands upstream and from other wastes introduced into the river by inflow (Kibuuka and Karuggah, 2004).

Buckle (1996) asserted that along the tropical regions of Africa, roads are partially closed during the wet months through flooding while some major truck routes suffer occasionally closure. The buyers have little access to the fishermen, forcing the fishermen to relocate fish-weighing stalls from the landing sites to about a kilometer away from the landing sites. Sand harvesting is equally affected on River Kuja during flood events. Inaccessible paths hinder trucks from reaching the river bank where they can access sand and gravel. The inhabitants are forced to bear the situation till the end of flood events (G.O.K, 2008).

Alluvial deposits can improve the socio-economic status of mankind but if proper utilization is not monitored properly on the river banks, then cultivation of alluvial soils along the steep river banks can eventually influence extensive soil erosion and degradation of the beauty of the environment

2.5 Conceptual framework

Alluvial deposits are fluvial landforms associated with the lower course of a river. Some alluvial deposits are formed on the river channel, river banks and on flood plains. The presence of channel deposits has led to formation of and shallow channels. Increased deposition on the channels makes the channels to become shallow, causing over bank flows which end up flooding the floodplains. This adds alluvial deposits on the farmlands. Pools of stagnant water are formed, homes are drowned and hence causing displacement of the inhabitants to raised grounds for safety.

Consequently, alluvial deposits on the environment affect social-economic activities of mankind. Deposits of alluvial on farmlands improves soil fertility for crop farming giving rise to green pasture land for the livestock, fishing, brick making. Alluvial deposits are thus significant landforms to the physical environment and socio-economic activities.

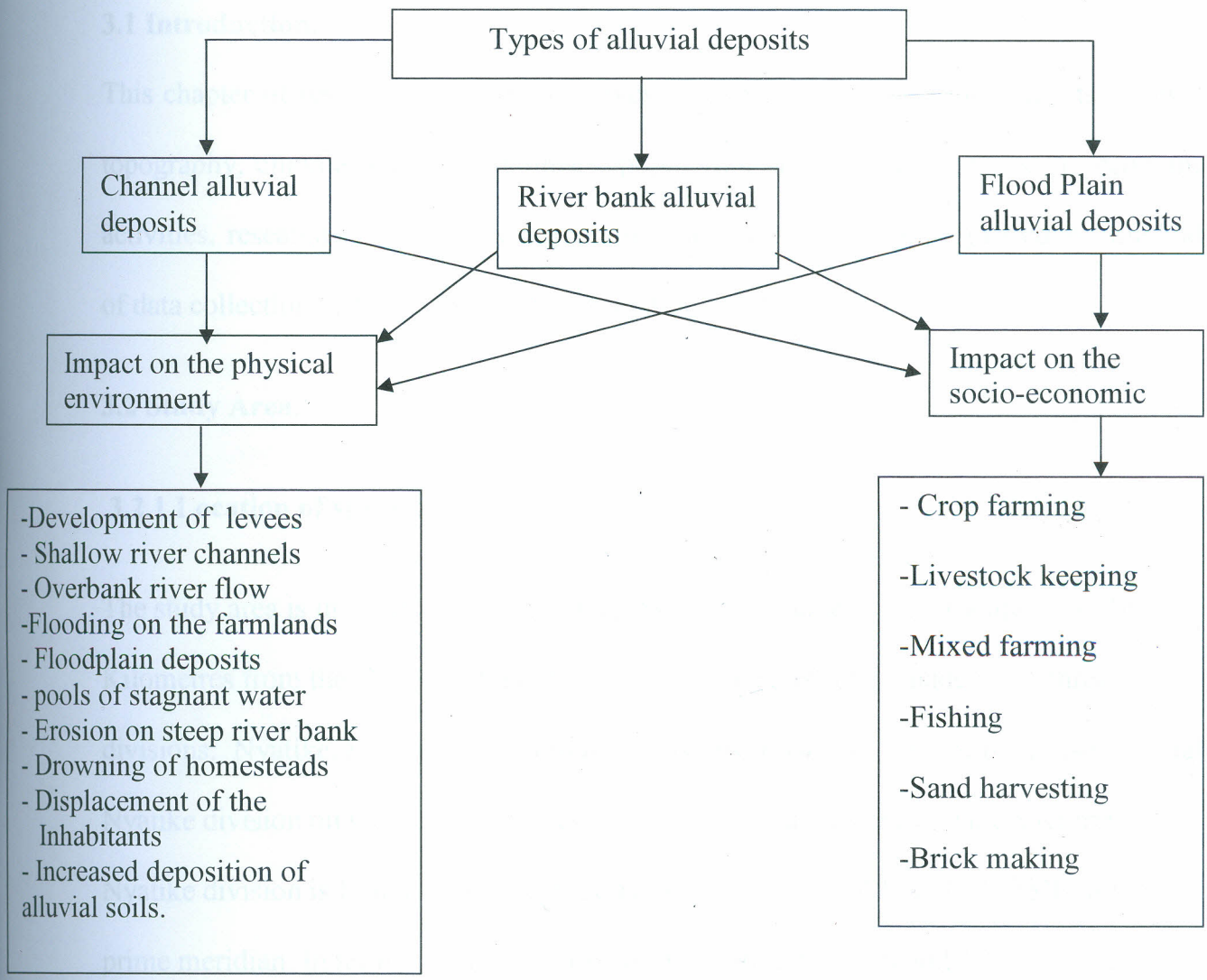

Figure 2.1: Conceptual Framework

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction.

This chapter of research methodology gives an over view of the following; its location, topography, climate, soils and drainage, population and settlement, the socio-economic activities, research design, study population, sample size, sampling procedure, methods of data collection, data analysis and presentation.

3.2 Study Area.

3.2.1 Location of study area.

The study area is in Nyatike District, along the lower course of River Kuja about five Kilometres from the shores of Lake Victoria. Nyatike District is made up of three divisions: Nyatike, Karungu and Muhuru Divisions. Basically, River kuja passes through Nyatike division on the floodplains before discharging its water into lake Victoria. Nyatike division is found within longitudinal extent of 34^0 16' E and 34^0 23'E of the prime meridian. In terms of latitudes it is located within 0^0 46' S and 1^0 11' S of the equator (Fig.3.1).

The Division covers a total area of 502 km ^{2}, while Karungu and Muhuru covers 136 km^2 and 47 km ^{2} respectively (G.O.K, 2008). Among the three divisions, the study area is basically located in Nyatike Division (Fig. 3.1).

Figure 3.1 Administrative Boundaries of Nyatike District
Source: Migori District Development Plan (2008)

3.2.2 Topography

The altitude ranges from 1,135 metres above the sea level at the shores of Lake Victoria in Muhuru, Nyatike and Karungu Divisions to 1,700 metres above the sea level with several andulating hills, such as Nyakune (4,625 metres), God Kwach (`3,290 metres), God Kwer (1,420 metres) and Nyabisawa (1,489 metres). Nyatike Division lies in the low-lying tract of land that is prone to flooding which is caused by the increase in water volume in the river channel at its lower course(G.O.K, 2008).

3.2.3 Climate

Rainfall pattern in the district ranges from 700 - 1,800 mm annually, with the short rains occurring between March and May, while the long rains occur during October and December. The temperature ranges between 17 degrees centigrade and 30 degrees centigrade. The climate is modified by relief, altitude and proximity to the lake. It favors cultivation of crops such as maize, millet, cassava, pumpkins, beans, groundnuts, and vegetables like kales, cabbages, onions and tomatoes on the floodplains. The lake shores do experience unreliable and poorly distributed rainfall (G.O.K, 2008).

3.2.4 Soils and Drainage

The soils are fertile and well drained on the floodplains due to increase in alluvial deposits. Clay deposits are found on the river valley. They act as heavy deposits which are difficult to cultivate when both dry and wet. Alluvial soils encourage extensive cultivation of maize, beans, sorghum, cassava and vegetables. Along the shores of Lake Victoria the soils are poorly drained, causing heavy flooding at the lower course of River Kuja. The main tributaries of river Kuja are Migori, Gucha, Osani, Sare, Ndhiwa and Augo. River Kuja forms dendritic drainage pattern with its tributaries (Fig. 3.2).

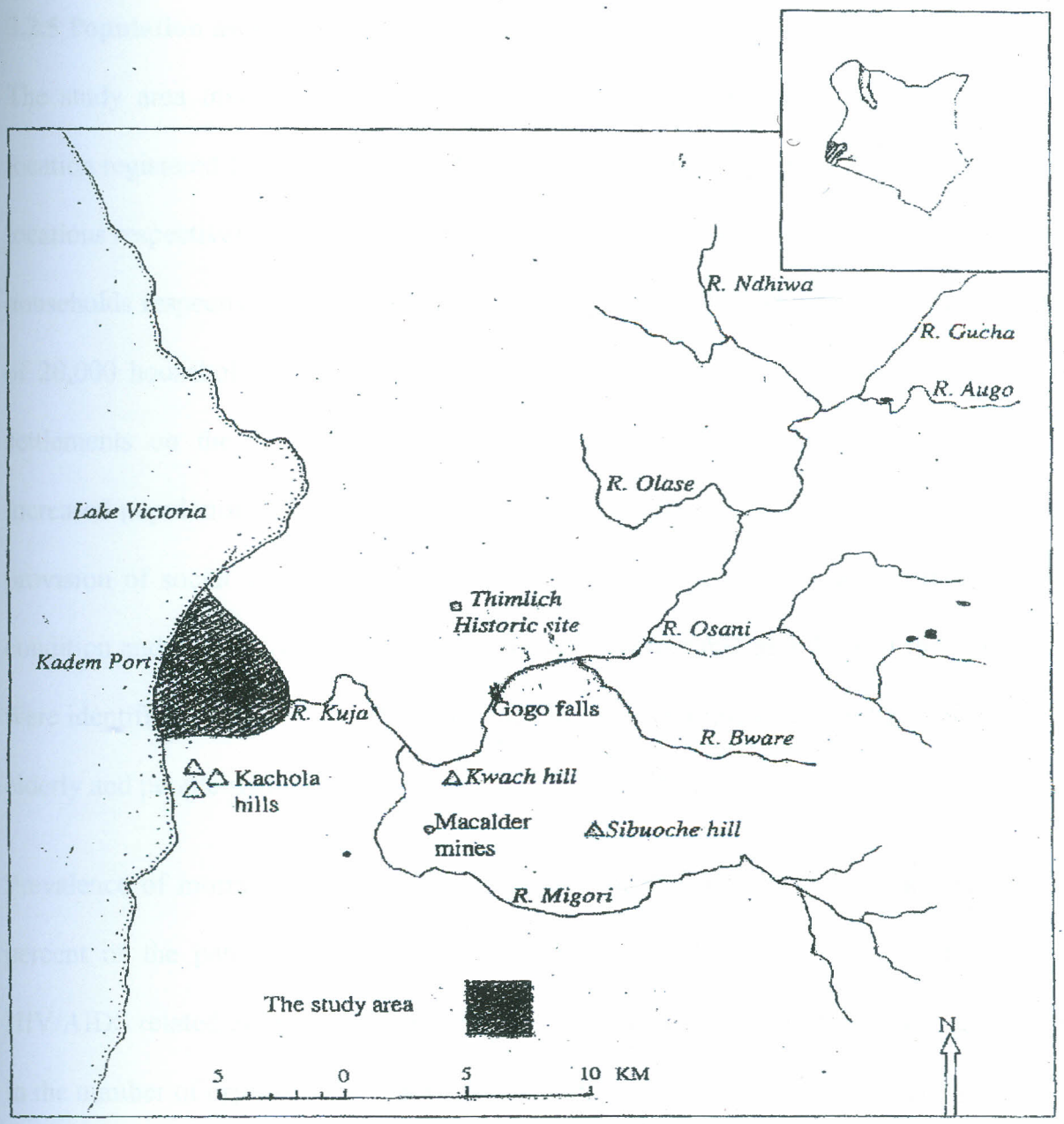

Figure 3.2: Drainage basin of River Kuja.

Source: Drawn from topographic Map of Migori District, scale of 1:50,000

3.2.5 Population and settlement

The study area involved Central, South and North Kadem locations. Central Kadem location registered 171 households with 143 and 28 households from Kakelo Kakoth sub-locations respectively. South and North Kadem locations were able to register 178 and 33 households respectively. This gave a total sample of 382 households out of a population of 20,000 households (Table 4.1). The population is evenly distributed with nucleated settlements on the floodplains of alluvial deposits. The major cause of poverty is increased population growth, a situation that is likely to put a lot of pressure on land and provision of social services, socio- cultural practices such as polygamy, harsh climate condition and the HIV/AIDS pandemic. The most vulnerable members of the community were identified as small- scale farmers, the fishing community, the orphans, widows, the elderly and people with physical disabilities (G.O.K, 2008).

Prevalence of mortality rates due to HIV/AIDS in the district is alarming. About sixty percent of the patients admitted in medical wards at the district are suffering from HIV/AIDS related ailment. One of the worst consequences of AIDS has been an increase in the number of orphans and widows in the district. Orphans whose parents died because of HIV/AIDS pandemic end up losing education opportunities, health care and family property. The increase in the number of Aids widows has led to more and more female-headed households (G.O.K, 2008).

3.2.6 Socio-economic activities.

The main economic activities of the inhabitants of Nyatike division include crop farming, livestock keeping, fishing and trade. Farmers practice small-scale crop farming and

livestock keeping. The main crops grown are beans, maize, millet, cassava, and sorghum. There are some onions, tomatoes and sukuma wiki grown within the floodplains. Livestock kept includes sheep, cows, donkeys and goats. Fishing is another economic activity carried out on the lower course of the River. Some of the fish species includes the Nile perch, Tilapia and Dagaa, which accounts for the largest proportion of the total catch every year. Sand harvesting and brick making are also carried out (G.O.K, 2008).

3.3 Research design

The research study employed a descriptive cross-sectional research design. This design facilitates collection of information from a sample of a population in order to describe their views in relation to the problem on the ground (Fraenkel and Wallen, 2000).

3.4 Study population and sampling procedure.

3.4.1 Study population and sample size.

A sample size of 384 households was obtained from the population of 20,000 households whose socio-economic activities are affected by alluvial deposits on lower course of river Kuja. The sample size was calculated according to Fisher *et al* (1983). Thus when the targeted population is greater than 10,000, then the following formulae is used.

$$n = \frac{Z^2pq}{d^2}$$

Where:

n= Desired Sample Size (if the target population is greater than 10,000)

z = Standard normal deviation at the 95% confidence level.

P = Proportion in the target population estimated to have characteristics being measured (5%)

q = 1-p

d = Level of Statistical Significance level (0.05)

$$n = \frac{(1.96)^2 (0.50)(0.50)}{(0.50)^2}$$

$$= 384$$

3.4.2 Sampling procedure

A sample size of 384 respondents was obtained from 20,000 households on the study area, by use of simple random sampling technique. Each household was assigned a number from which the 384 households were selected randomly. Central Kadem location was able to register 171 households, with Kabuto and Kakelo Kakoth sub-locations of Central Kadem location having 143 and 33 households respectively. South and North Kadem locations registered 178 and 33 households respectively. Each household was represented by one respondent and hence, a total of 384 households were obtained. This technique gives equal chance to each household to participate in the sampling procedure and also tends to minimize sampling error.

3.5 Data collection methods.

3.5.1 Primary data collection.

Various techniques were used to collect primary data. These includes: Household survey, Key Informant Interviews and Focused Group Discussions, observation and photographs

were also used. The household questionnaires were issued to 384 household heads. Where the household head was away, an adult member of the household was issued with a questionnaire. Once they had been filled, the questionnaires were collected for analysis.

Focused group discussions were six (6), and were made up of between 6-12 persons. Two of the focused groups were from Kabuto and Kanyarwanda Sub-locations respectively, because they are the largest of all the five sub-locations. The remaining two groups, each were selected from Kakelo, Kakoth and Kanyuor South Sub-locations. Three of the focused groups were made up of males while the remaining three groups consisted of females. This was meant to ensure effective participation because a freer atmosphere was provided by having gender based groups. Each group was guided by a facilitator, who led the discussions. A moderator, who could verify ambiguous questions and answers, and a recorder, who noted down points discussed in the groups, areas that need clarifications and areas that needs further research.

Various Key Informant Interviews were carried out. This involved face to face encounters with Key Informants such as Agricultural Extension Officer, Mr William Achar, Fisheries Extension Officer, Mr James Ogallo and Mr. Ogonji from the ministry of Water, Hydrology Section of the Division. This enabled the researcher to get their views on the effects of alluvial deposits on the Physical environment and socio-economic activities in Nyatike Division. Interviews enabled the researcher to elaborate on the purpose of the research and to convince the respondents about the importance of the research study.

Direct observations were made from the field with the use of photographs. This enabled

the researcher to obtain primary information direct from the area of study on the types and effects of alluvial deposits on the physical environment and socio-economic activities on the lower course of River Kuja.

3.5.2 Secondary data collection.

This involves reviewing relevant literature from internet services, references from Encyclopedia, Journals, Newspapers and books from professionals. Data was obtained from local government offices such as, Ministry of Agriculture and Livestock Development and fisheries department. Migori District Development Plan also provided background information on the study area.

3.6 Data analysis and presentation

3.6.1 Quantitative data analysis.

Data obtained from household questionnaires, focused group discussions and key informants were analyzed by use of descriptive statistical methods such as, mean, percentages, graphs and tables where inferences were made.

3.6.2 Qualitative data analysis.

The qualitative data was analyzed by coding and organizing the data into themes and sub-themes in note form, photographs and evaluating the usefulness of the information obtained in answering research questions in the questionnaires.

3.6.3 Data presentation.

The data obtained was, presented in form of discussions, tables, and maps. Photographs

were also displayed showing types and effects of alluvial deposits on the physical environment and socio-economic activities on the lower course of River Kuja.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter describes an overview of socio-economic characteristics of the respondents, various types of alluvial deposits, and the effects of alluvial deposits on the physical environment and socio-economic activities of the lower course of River Kuja.

4.2 Socio-economic characteristics of the respondents.

The study area is basically made up of three locations; Central, North and South Kadem locations. From the total number of 382 respondents interviewed, 46.9 % (N-179) of the respondents were from Central Kadem Location, 15.7 % (N-60) from North Kadem and 37.4 % (N-143) from South Kadem Location. The study noted that the highest percentages of respondents were obtained from Central Kadem location while the lowest percentage of the respondents were from North Kadem location. This is because Central Kadem is entirely located on the floodplains of River Kuja, which has attracted settlement and farming activities

The study sub- locations were Kabuto, Kakelo Kakoth, Kanyarwanda and Kanyuor north sub-locations. Kanyarwanda sub-location had the highest number of respondents which was 46.6% (N-178) of the total respondents, where as Kakelo Kakoth registered the lowest percentage of 7.3% out of the total households interviewed. The findings showed that most of the respondents were from Kabuto and Kanyarwanda sub-locations, which cover larger areas of the floodplains of River Kuja (Table 4.1).

Table 4.1: The sub-locations of the study area

Locations	Sub- locations	Number of respondents	Percentage
Central	Kabuto	143	37.4
	Kakelo kakoth	28	7.3
South	Kanyarwanda	178	46.6
North	Kanyuor North	33	8.6
	Total	382	100.0

From the 382 respondents interviewed, the findings showed, 83% were females, while only 17% were male. Therefore, there was significant variation in gender representation among the respondents at 95 % confidence level (Female = 78.8 % - 86.6 %; Male 13.5 % - 21.2 %) as indicated in the table 4.2 below.

Table 4.2: Distribution of respondents by gender in Nyatike Division

Sex of the respondents	Number of respondents	Percentage	Cumulative Frequency
Male	65	17.0	13.5 - 21
Female	317	83.0	78.8 – 86.6
Total	382	100.0	

Basically, majority of the respondents according to the distribution of age-group was ranging between 40-49 years. This accounted for 38.5% of the respondents. However,

3.9% of between the age-group of 19-29 of the respondents registered the lowest percentage (Table 4.3).

Table 4.3: Distribution of respondents by age group in Nyatike Division

Age group	Number of the respondents	Percentage
19 - 29	15	3.9
30 - 39	140	36.6
40 - 49	147	38.5
50 - 59	57	14.9
60 and above	23	6.0
Total	382	100.0

The findings showed that most of the inhabitants of Nyatike Division were basically agro pastoralists, keeping livestock and practicing crop farming. Basically the respondents that practiced crop farming and livestock keeping alone were 12% and 0.5% respectively. The study findings showed that most of the inhabitants depend on mixed farming because of climate variation, especially when floods affect the crops they can still depend on the livestock for their livelihood (Table 4.4).

Table 4.4: Main sources of livelihood

Source of livelihood	Number of the respondents	Percentage
Livestock keeping	2	0.5
Crop farming	44	11.5
Mixed farming	324	84.8
Fishing	28	7.3
Sand harvesting	225	96.6

4.3 Types of alluvial deposits.

Three types of alluvial deposits were identified on the lower course of River Kuja. These included channel alluvial deposits which are found deposited on the river channel, river bank alluvial deposits which are basically dropped by the river bank, and floodplains alluvial deposits which are distributed on the floodplains.

4.3.1 Channel alluvial deposits

Alluvial deposits on the channel of River Kuja consist of sand and gravel particles. The river channel is situated on the gentle relief of Nyatike Division, on which river Kuja has developed winding channel from one bank to the other bank (Plate 1).

Plate 1: Cross-section of the winding channel of River Kuja on its floodplain.

(Notice shallow river bank at the centre but to the right side of the photograph where overbank river flow can begin, with an increase in river discharge.)

The study noted that a reduction in the competence of the river flow, leads to an increase in deposition of the load within the channel where they form channel deposits. Continuous deposition of the river load on the channel can make the channel to become shallow in depth there by influencing over bank flow (Plate2).

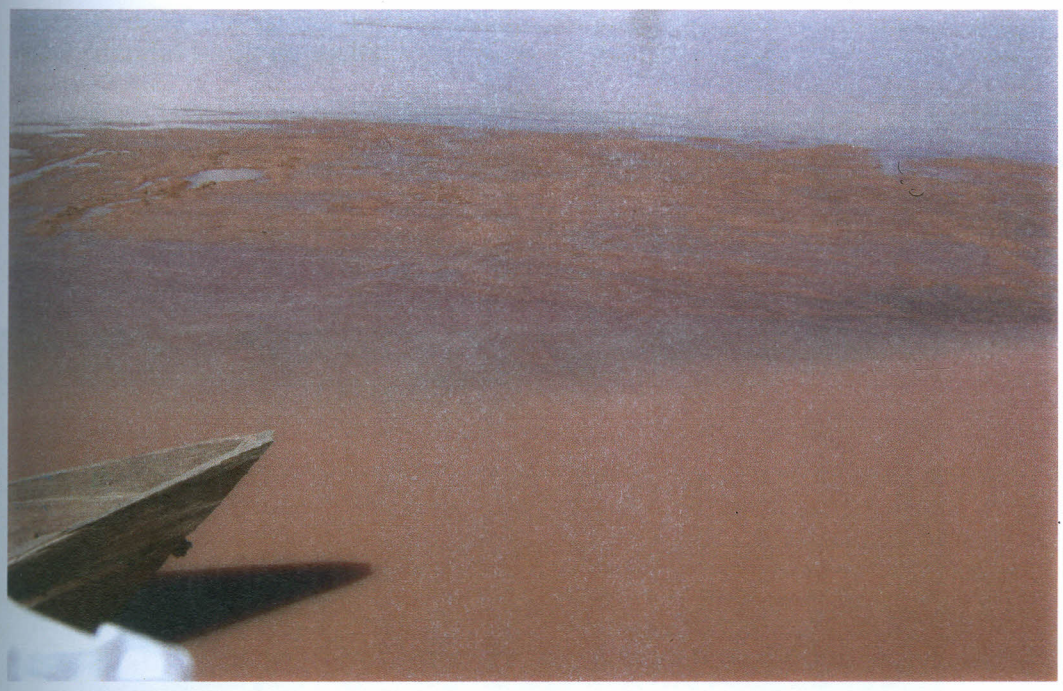

Plate 2: A section of channel deposits on River Kuja.

(Notice the channel deposits that has made the channel to become shallow on the middle ground of the photograph.)

Michael (1995) asserted that accumulation of silt, gravel, sand and mud particles in the deepest parts of the channels of river Donjek in Canada, has made the channel to become shallower and hence, causing over bank river flows into the adjacent flood plains. Kibuuka and Karuggah (2004) explained that channel- filled deposits are common features in the abandoned river channels and on meander cut-offs. Channel deposits can act as sedimentary stores trapping incoming sediments transported by the river water.

The findings concur with the views of Michael (1995), that channel deposits can lower river depth thereby causing river water to flow over the banks, into the floodplains there by causing flooding.

4.3.2 Alluvial bank deposits.

Over bank river flow from the channel into the floodplains facilitate deposition of sediments closest to the river bank on which vegetation grows (Plate 3).

Plate 3: Section of vegetation growing on river bank deposits of River Kuja.

(Gentle slopes on the river bank has influenced deposition of river bank deposits.)

The study noted that the river bank deposits on River Kuja on the gentle relief of the floodplains are vegetated. River bank deposits are sediments from the river load and are deposited on the bank by over bank flow. According to Michael (1995), river bank deposits are characterized by a fairly regular structure, spreading out from the point at which the river valley falls from the channel into the flood plains. They form series of slopes of approximately uniform gradient bounded up and down by breaks of slopes. The thickness of river bank deposits decreases from the edge of the levees into the floodplains (Arthur 1998). The research finding concur with that of Arthur (1998) that bank deposits

do exist though the thickness of the deposits decreases from the edge of the levees towards the flood plains.

4.3.3 Flood plain alluvial deposits

Over bank river flows with greater competence can carry part of the river load from the river channel into the flood plains, where the sediments are finally deposited on the low lying gentle land of Nyatike Division, where they form floodplain deposits (Plate 4).

Plate 4: A section of floodplain deposits on the floodplains of River Kuja.

(Notice gentle relief of the floodplains with floodplain deposits on the foreground of the photograph.)

The research finding shows that floodplain deposits on the gentle slopes of Nyatike Division are vegetated while others are cultivated. They are cultivated as farmlands where crops such as maize, beans, millet and cassava are grown. The study findings showed that maize, millet and beans were mostly grown on the floodplains and the most preferred crop was maize that was grown by 95.8% of the households (Table 4.5)

Table 4.5: Main crops grown on the floodplain deposits of River Kuja

Main crops grown	Number of respondents	Percentage
Beans	309	80.9
Maize	366	95.8
Millet	314	82.2

Arthur (1998) noted that some floodplain deposits remain unvegetated while others are cultivated extensively. According to Payton and Christiansson (1992), floodplain deposits are massive, poorly sorted with gravel that are structure less in shape. Deep on the gentle river valleys, they are recognized by their channelized base and internal bedding, often with better bed sorting. These sediments are transported along the river valley into the floodplains through three main river transportation processes such as suspension, saltation and traction (Davis, 1989). The findings of the study concur with the views of Arthur (1998), that floodplain deposits are the type of river deposits on the floodplains that are vegetated with grass or cultivated as farmlands.

4.4 Effects of alluvial deposits on physical environment.

Large areas of the flood plains covered with alluvium form fertile farmlands on which variety of crops are cultivated. Shallow river channels create over bank river flows into the floodplains which causes erosion on steep river valleys.

4.4.1 Alluvial deposits and the floods.

Increased floods on the banks of River Kuja into the adjacent farm lands has forced more than 100,000 of the inhabitants to be displaced annually to raised areas for safety during the emergence of flooding events on the floodplains of lower Nyatike Division. The study noted an increase in flood magnitude in 2007, when more than 700,000 inhabitants were displaced. Floods in Nyatike Division, on the lower course of River Kuja have become an annual environmental disaster which has forced some families to put up with friends and relatives on raised grounds or be housed temporarily at the district headquarters for sometimes until the floods subside (Table 4.6).

Table 4.6: The relationship between flood magnitude and displaced inhabitants.

Years	Flood magnitude (Cubic metres)	Displaced inhabitants
2003	322.7	110,921
2004	401.0	121,690
2005	391.2	544,207
2006	296.7	235,215
2007	494.3	784,190
2008	335.7	550,402
2009	404.1	590, 321

Source: Ministry of Water, Hydrology Section, Nyatike Division

Continuous deposition of sediments on the river channel makes the channel to be shallow hence this develops into over bank river flow into the flood plains. The inhabitants living

adjacent of River Kuja, observed that over bank river flows can reach into the floodplains there by causing severe floods on lower Nyatike Division (Plate 5).

River floods reaching into the floodplain have caused insecurity to Nyatike inhabitants especially with the onset of the rainy seasons. Their farmlands are usually destroyed, crops and domestic animals drowned, raising the fear of a possible food shortage if the rains continue (GOK, 2008).

Plate 5: Part of flooded river bank on River Kuja.

(Increased river volume on the fore ground the photograph can influence the development of overbank river flow into the floodplains.)

Clarke (1991), observes that in 1887, River Yellow was flooded which caused death of between 900,000 and 2 million by drowning and starvation. Floods caused by over bank river flow is a major environmental disaster affecting mankind. It affects human welfare

ranging from direct impact such as loss of life to psychological cost associated with related fear and uncertainty to less direct impact on socio-economic activities (Jackson 1989). This finding agrees with that of Clarke (1991) in that river floods causing panic, insecurity and death when the area is drowned, and starvation when crops are destroyed on large scale.

4.4.2 Alluvial deposits and soil erosion.

Fast flowing over bank river flows creates soil erosion on the steep slopes located adjacent to the river valley there by exposing it to thin, rugged and infertile soils (Plate 6)

Plate 6: River valley exposed to over bank flow which has left part of the river bank not suitable for crop farming. ***(The picture was taken from the top of the levee towards the flood plain)***

The study noted that continuous over bank river flow can destroy the farmlands situated on steep river valley by carrying away the top unconsolidated surface materials.

Nevertheless, some of the respondents have been forced to till small sections of land because part of their farmlands situated adjacent to the river valley are frequently eroded by over bank river flows. According to Smith (1998), lateral erosion on the river bank can yield a large amount of river load at the foot of the mountain. Topography influences the rate of sediment supply in an area because the steep river valley is exposed to greater surface run off compared to gentle slopes (Buckle, 1996). The finding agrees with the research work of Buckle (1996), in that the slope of the land determines the rate of surface run off because the steeper the slope the faster the rate of surface run off. Therefore, farmlands located adjacent to the steep river valley are prone to surface runoff which leaves the soils infertile for crop farming.

4.4.3 Alluvial deposits and displacement of the inhabitants.

The river waters that finally settles in the flood plains influences the development of stagnant waters on the flat zones of the flood plains making the environment to become wet and hence, not conducive for human settlement. Increase in flood waters can cause extreme floods there by forcing the inhabitants to be moved to raised grounds for safety. Over bank river flow along the steep slopes into the floodplains creates poor drainage on the farmlands, forcing the inhabitants to move to raised areas because of fear of severe and unpredicted floods.

More than 100,000 families every year are rendered homeless after heavy rains have destroyed their houses, farms and livestock after River Kuja has burst its banks causing raging floods (Table 4.7). The affected families are forced to put up with their friends and relatives, but with increase in amount of rainfall even the relatives hosting them could

also be affected (Migori District Development Plan 2008). According to Ojany and Ogendo (1973), floods associated with alluvial fan deposits on the floodplains is a common phenomena on the low-lying parts of River Tana basin, Yala swamps and in Budalangi area. The findings of this study are consistent with that of Ojany and Ogendo (1973), that floods associated with alluvial deposits have become a serious environmental menace to the inhabitants staying on low land areas adjacent to the river bank because during the onset of flood events they are relocated to raised drier areas for safety.

4.4.4 Alluvial deposits and fertile soils

Topography of the land determines the rate of sediment supply in an area. The gentle relief may experience greater deposition of the sediments than on steep slopes, because on gentle slopes the ability of the river water to carry its load is reduced, facilitating mounds of alluvium on gentle farmlands, where they form fertile soils for crop farming (Plate 7).

Plate 7: A Section of crop farm grown on alluvial soils.

(Increase in deposits of alluvial soils on the farmlands has encouraged cultivation of crops on the floodplains of River Kuja.)

The findings revealed that gentle relief of lower Nyatike Division have greatly supported crop farming. Crops such as maize, beans, millet and cassava are some of the staple foods which are highly valued by all the inhabitants and are grown on large scale on alluvial deposits of the floodplains. Michael (1995) noted that fine fraction of alluvial deposits can be accumulated on the gentle relief where they form extensive fertile farmlands. Such accumulations of sediments are able to reduce surface runoff hence an increase in infiltration of water into the soil layers. Areas with thick alluvial deposits have a higher water holding capacity. These research findings concur with that of Michael (1995) that alluvium deposits on the flood plains are fertile farmlands suitable for crop farming.

4.4.5 Alluvial deposits and pools of stagnant water.

The presence of river deposits the river channel can make the channel to become shallow in depth. This will eventually result into over bank river flow into the flood plains thus creating pools of stagnant water on the land surface. Alternatively, such sediment may divert the flow into the farmlands resulting into stagnant water (Plate 8).

The study showed that on lower parts of Angugo village, Central Kadem in Nyatike District, the region remains with pools of stagnant water for along period of time after heavy down pour due to poor drainage. Such stagnant water forms conducive environment on which pests and disease vectors breed.

Plate 8: A pool of stagnant water on the floodplains of river Kuja on the middle ground of the photograph.

On analyzing the influence of flooding events in Central and Southern Somali especially in Juba and Shebelle, Buckle (1996) explained that a vast area of uncultivated land was characterized by swampy tracts of land with more than 100 homesteads submerged while others are abandoned. Kibuuka and Karuggah (2004) asserted that the abandoned channel segment after a meander cut-off usually contains stagnant water where mosquitoes breed. Wild animals such as snakes, hippos and crocodiles living in such waters are a threat to human settlement. They have become hazardous environment to human settlements, subject to temporary and unpredictable flash floods that results into stagnant water (Faniran and Jeje, 1983). The findings agree with the views of Kibuuka and Karuggah (2004), that most of the areas which are swampy with pools of stagnant water are sparsely populated because the inhabitants fear infection by water borne diseases or being attacked by wild animals.

4.5 Effects of alluvial deposits on socio- economic activities.

The inhabitants of Nyatike Division, lower course of River Kuja are basically engaged in various economic activities like crop farming, livestock keeping, fishing and small scale trade.

4.5.1 Crop farming

Out of the 382 respondents interviewed, all were engaged in crop farming as the daily practice. The study revealed that 97.1 % (N- 365) of the crop farmers felt that alluvial deposits increases soil fertility, and hence an increase in crop yields while 2.9 % (N- 17) of the respondents argued that they did not know whether alluvial deposits affected their crop farming or not.

Alluvial deposits on the environment have both positive and negative effects on crop farming. Negative effects include increased erosion on steep river bank, water logging on the farmlands, drowning of crop farms and delay in weeding of the farms (Table 4.7). On the other hand, most of the respondents; that is 56.6 % argued that increase in alluvial deposits in the land add more soils on the farms thereby making the farmlands to have deep well drained soils suitable for crop farming . Alternatively, 11.4% of the respondents reasoned that continuous erosion on the river bank lowers crop yield because nutrients are swept away and the soils are left infertile (Table 4.7).

Table 4.7: Effects of alluvial deposits on crop farming

Effects of alluvial deposits	Number of respondents	Percentage
Accumulation of soils on the farm land	204	56.5
Soil erosion on steep river banks	41	11.4
Causes water logged farms	2	0.6
Drowning of farm land	13	3.6
Addition of silt deposits	101	28.0
Total	361	100.0

Crop farming in Nyatike Division involve small-scale farming where the inhabitants grow subsistence crops and excess yields are sold for money. The study showed that preparation of the land, weeding, harvesting have become a continuous practice all the year round in Nyatike Division. On the same plot of land, one section of the land clearing and ploughing takes place, to the next, there is planting of seeds, weeding on the next and

harvesting on the last piece of land. This has become the lifestyle of the small scale crop farmers in Nyatike Division. Abundant crop farming yield is being realized due to the fact that alluvial deposits form fertile soil. Tomatoes, kales, onions, cabbages and watermelon, though subsistence are also grown for commercial purposes. A total of 95.8% of the inhabitants attributed an increase in maize yield on the farmlands located on the floodplains of Nyatike Division.

Out of the 382 households, 95.8% (N=366) of the respondents were maize farmers. One maize farmer, from central Kadem location, Kakelo Kakoth Sub-location having lived in the area for 32 years with eight people in his household, explained that maize farming has greatly assisted him in educating his four children in high cost secondary schools. He grows maize in his five acres of land adjacent to River Kuja, where alluvial deposits have greatly improved soil fertility in his farmland such that every harvest time, he obtains twenty sacks of maize. He feels that alluvial deposits are fertile and he does not need to use fertilizer in his farmlands. From the yields he obtains he uses five bags of maize for domestic purposes and sells the remaining fifteen bags to get money to educate his children

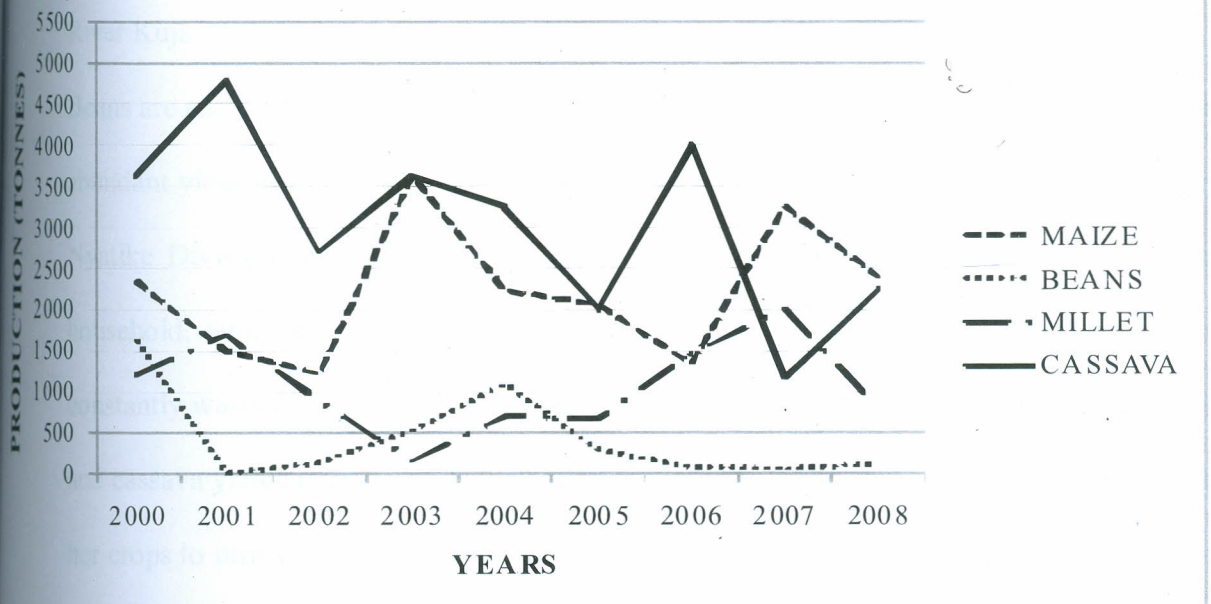

Figure: 4.2 Production of selected crops grown between (2000-2008)

Source: MoALD, Nyatike Division.

The study findings showed that 44% of the respondents interviewed felt that for them to get abundant harvest on the crop farms, they do cultivate their farmlands once a year to maintain soil fertility, while 24% of the respondents felt that they do not have particular seasons for their farming activities but have engaged their farmlands with crops annually (Table 4.8).

Table 4.8: Regularity in cultivation of crops

Crop cultivation	Frequency	Percentage
Twice a year	114	31.8
Once a year	158	44.1
Throughout the year	86	24.0
Total	358	100.0

The study noted that maize and beans are extensively cultivated on the floodplains of River Kuja. Once it is harvested, it is dried and mixed with millet or cassava to give flour. Beans are early maturing crops and when planted early enough, they mature first and give abundant yield from alluvial soils (Plate 9). However, one female farmer, having lived in Nyatike Division for 17 years, in Kanyuor South Sub-location with 11 people in her household, lamented that her two acre piece of land located adjacent to river Kuja is constantly washed away by over bank river flows. This has drastically reduced her maize and cassava yields every year. Her flooded farmlands are exposed to excess water making her crops to turn yellow with retarded growth. She is unable to weed her farm at the right time because she has to wait until the rains subside which often makes the weeds to destroy her crops thereby forcing her to get low farm yields.

Plate 9: A section of crop farm on the flood plains of River Kuja.

According to Buckle (1996), soils of alluvial deposits are characterized as agriculturally productive, consisting of a mixture of sand, silt and clay. They are finally deposited by flood plain waters where they are utilized for crop farming. Yanosky (1982), noted that alluvial deposits form potential areas for large and small scale agricultural land and suitable for settlement. They form the finest grain of over bank deposits that can be utilized as fertile soils. This research study agrees with the views of Yanosky (1982) in that alluvial deposits form fertile soils that are utilized for small scale crop farming especially when deposited on the flood plains.

4.5.2 Alluvial deposits and livestock keeping.

Livestock keeping is the second important economic activity among the inhabitants of Nyatike Division. The research findings noted that out of the 384 respondents interviewed, 97% (N =372) were keeping livestock in their farmland for their basic needs. Out of the 372 livestock farmers interviewed, 97.3% (N= 358) of them felt that alluvial deposits on the farmland affects pasture on which their livestock graze, while 2.7%, suggested that alluvial deposits does not have effect on pasture land. The findings showed that there is an increase of pasture growing on alluvial deposits, which supports livestock. On the other hand, wet farmland forces the animals to be relocated to drier raised grounds, where the animals suffer from outbreak of diseases at the various camp sites at Nyatike District headquarters. About 53% of the livestock farmers reasoned that pools of stagnant water enhances the emergence of breeding areas for pests and diseases that affects livestock kept (Table 4.9)

Table 4.9: Effects of alluvial deposits on livestock farming

Effects of alluvial deposits	Number of respondents	Percentage
Increased pasture land on alluvial deposit	18	5.2
Bury pasture land.	45	13.1
Displacement of livestock.	25	7.3
Enhanced breeding of pests and diseases	180	52.5
Erosion on the pasture land	3	0.9
Drowning of livestock	72	21.0
Total	343	100.0

Livestock keeping is an important economic activity in Nyatike Division. 21% of the respondents felt that alluvial deposits on the river channel create overbank flow that causes flooding and drowning of homesteads where livestock are kept. However 5.2% of the respondents observed that alluvial deposits are fertile soils on which pastures grow that support livestock kept. Domestic cattle are reared mainly for milk and meat production. Goats, sheep and donkeys are also reared for sale (GOK, 2008). The study showed that local breeds of livestock depend on grazing (Plate 10).

Plate10: A section of pasture land for the livestock on the background of the photograph.

(Notice pasture land buried with alluvial deposits on the foreground of the photograph.)

Over bank river floods can erode the fertile soils on the grazing lands leaving infertile soils which yields poor pasture for the livestock kept. Flooding events have forced the inhabitants to relocate to drier areas of Nyatike District Headquarters thereby interfering with the grazing patterns of the livestock kept. More over, unexpected over bank river floods cause damage to the livestock when they are drowned into flooded homesteads (G O K, 2008).

One of the clan elders of Nyatike Division aged 75 years explained that cattle and sheep are mostly affected by floods. Emergence of pools of stagnant water where animals graze has forced the inhabitants to relocate their cattle to temporary homes to avoid the flooded grounds, there by destabilizing normal life pattern of the inhabitants staying adjacent to the river bank. He noted that floods have created the growth of papyrus vegetation and

reeds which are conducive environments for the breeding of tsetse flies thereby increasing the spreading of Nagana.

According to Mburu (2005), there has been consistency in the number of livestock kept in Budalangi Division. This is attributed to adequate water and pasture on the flood plains. Over bank flows on the lower course of river Nzoia carries with it fine alluvial silts and are deposited on gentle relief. Such deposits form fertile lands that favour the growth of green grass where the animals are grazed well and hence producing plenty of milk to the farmer. The findings of this study agree with the findings of Mburu (2005) in that deposited alluvial soils are fertile zones where green pasture grows. This forms grazing grounds on which the cattle are grazed there by giving plenty supply of milk to farmers and hence improving their livelihood.

4.5.3 Alluvial deposits and fishing.

Fishing is mainly carried out for subsistence and commercial purposes by use of canoe along the river bank. It is the third economic activity in Nyatike Division. The findings showed that 16.9% (N= 64) of the respondents interviewed were fishermen, while the remaining 83.1% (= 314) of the respondents suggested that they were not fishermen. (Table 4.10)

Table 4.10: Distribution of fishermen by locations of the study area

Location	Number of respondents	Percentage
Central Kadem	38	41
North Kadem	19	31
South Kadem	7	5

Central Kadem location had the greatest number of fishermen interviewed, which was 41% of the total number of fishermen interviewed, where as South Kadem registered the lowest percentage (Table 4.11).This was attributed to the presence of alluvial deposits on the river channel which bring with it fish food from the land. About 24% of the fishermen indicated that the presence of alluvial deposits bring with it fish food and hence making fish to move in the direction of incoming deposits where they are easily trapped by fishermen (Table 4.11) The shallow river channels with alluvial deposits usually exposes fish on the water surfaces hence they can be easily spotted and trapped. The study showed that over bank river flows carries fish into the floodplains hence they can be caught easily using lines, baskets and spears.

Deposits of the river load on the channel can burry the breeding grounds, especially for the dimersal fish species, which breed in deep waters therefore forcing them to move downstream in shoals where they are easily trapped. Land derived minerals that fish feed on are washed into the river, while mixed up with alluvial soils. About 52% of the fishermen suggested that the presence of alluvial deposits makes fish to swim upstream along the river channel where they are easily spotted and trapped by fishermen and hence alluvial deposits affects fishing positively and negatively (Table 4.11).

Table 4.11: Effects of alluvial deposits on fish distribution

Effects of alluvial deposits.	Number of respondents	Percentage
Alluvial deposits with fish food	12	24.0
Attract fish to swim upstream.	26	52.0
Exposes fish on water surface.	6	12.0
Emergence of stagnant water where fish breed	2	4.0
Washes away fish food	4	8.0
Total	50	100.0

One of the village elders from Kanyuor sub-location observed that the presence of alluvial deposits bring with it fish food that the fish depend on. As the alluvial deposits flow into the river channel, fish are attracted to flow towards the incoming alluvial deposits and hence, their movement can be controlled and trapped easily using gill nets. The study showed that about 37.5% of the fishermen get their maximum catch along a river without alluvial deposits, because dimersal fish breed well in cool deep waters in shoals, while 54.7% obtain maximum catch on river channel with alluvial deposits when the river channel becomes shallow in depth. This is because, the presence of alluvial deposits exposes the breeding areas where fish can hide thus they are easily trapped by fishermen.

Table 4.12: Seasonal variation on fishing activity on River Kuja.

Variation in fishing	Number of respondents	Percentage
River without alluvial deposits	24	37.5
River with alluvial deposits	35	54.7
Total	64	100.0

Fishing activity is mainly carried out by use of canoes on the banks of river Kuja (Plate 11). Main fish species include Tilapia, Nile Perch and Dagaa. The main fishing seasons begin during the rainy seasons (March-May) and from (September to December), although some fishing activities continue throughout the year. Fishermen spend the day casting out their nets in the water while others use hand lines, fishing baskets.

According to Kibuuka and Karuggah (2004), fishing has become one of the economic activities carried out on lower course of river Tana. Basically, it is carried out for subsistence purposes by men living adjacent to the river banks and along the shores of Lake Victoria. They use boats, nets and hand lines. The presence of alluvial deposits on the river course brings with it land derived minerals which attracts fish towards the river hence they are easily trapped in shoals.

Plate 11: A group of fishermen at the bank of River Kuja.

The findings agree with the views of Kibuuka and Karuggah (2004) that alluvial deposits bring with it fish food into the river channel. Such river sediment is basically a mixture of fish food that attract fish, and hence fishermen are able to realize heavy catch.

4.5.4 Alluvial deposits and sand harvesting.

The inhabitants of Nyatike Division are also engaged in sand harvesting as an economic activity. The study noted that 96.6% (N= 225) were involved in sand harvesting from alluvial deposits that consisted of sand from the river channel however, 3.4% (N= 9) noted that the deposits mined consist of gravel. This gave a total of 234 of the total respondents that were trading on sand and gravel. The findings noted that those involved in sand harvesting suggested that there is an increase in quantity of sand obtained on the river channel when alluvial deposits are formed. That there is an increase in sand harvesting with an increase in deposition of alluvial deposits, because river channel deposits consist of the coarse fraction of sand that is harvested from the river channel (Table 4.13).

Table 4.13: Seasonal variation on sand harvesting

Variation on sand harvesting	Number of respondents	Percentage
River without alluvial deposits	6	2.6
When alluvial deposits are formed	229	97.4
Total	235	100.0

4.5.5 Alluvial deposits and brick making

Brick making is another trading activity in Nyatike Division. The study noted that men were engaged in brick making which is basically done on the floodplains (Plate 12).

Plate12: Making of bricks from clay soils on the banks of River Kuja.

(Clay soils are part of alluvial deposits.)

They use fine clay from the floodplains which they burn by exposing alluvial clay to great heat, causing the soils to become hard and well compacted together. Once they have

been fully burnt they are sold to the local constructors. One of the elders of Kanyuor South Sub-location explained that he can obtain six thousand shillings when he prepares 2,000 bricks, which he uses to educate his son at Angugo Secondary School in Nyatike Division for four years. He therefore believes that alluvial deposits are useful to the physical environment. Bluck (1982) noted that alluvial deposits on the floodplains are dominantly used as raw materials for making bricks. Therefore the study concur with the views of Bluck (1982) that brick making is carried out on the floodplains on the lower course of a river.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter basically examine main conclusions and recommendations on the research study area of the lower course of River Kuja

5.2 Conclusion

The study determined that some of the alluvial deposits are deposited on the river channel, hence they form channel deposits, those deposited on the river banks form river bank deposits, while the deposits on the flood plains develop into flood plain deposits.

On the physical environment, increase in alluvial deposits has led to an increase in soil fertility on which crops are grown, deep river channels become shallower in depth thus causing over bank river flow during flooding events. An increase in over bank river flow creates stagnant water where pests and disease vectors breed and consequently, the displacement of the inhabitants to raised land for safety.

On the socio-economic activities, alluvial deposits on the farms has led to an increase in accumulation of fine deposits where crops are grown annually. Increased soil erosion on steep river banks thus lowering soil fertility, water logging on the farms, over bank river flow makes crops on the farms to be drowned. Alluvial deposits form fertile areas on which pasture grows for the livestock kept. Increase in river discharge can transport alluvial deposits onto the floodplains burying the pasture, results to displacement of livestock from the floodplains, breeding of pests and disease vectors that lower the quality of livestock kept and drowning of livestock. Mixed farming is practiced nearly by

all inhabitants so that incase of climatic variation, the inhabitants are able to depend on either crops or livestock for their livelihood. On fishing, alluvial deposits on the channel brings with it fish food which attract fish to swim towards inflowing water where the fish are easily trapped. Shallow river channel can expose fish on the water surface there by scattering fish food into the flood plains. Finally, fine fraction of alluvial deposit provide raw material for making bricks while the coarse fraction of the deposits is harvested and sold to construction industry in the neighbourhood.

5.3 Recommendations

1. Improving the rural access roads leading into the banks of River Kuja. This will enhance the removal of sand from the river channel using lorries and trucks, and eventually reduce accumulation of coarse fraction of the river load in the river channel and hence, an increase in the river depth. Deep channels will allow water flow within the channel thereby controlling over bank river flows into the flood plains and hence, reducing frequent floods in Nyatike District.
2. Cultivation along the contours. This will help in controlling surface runoff caused by over bank flow which destroys the farmlands annually during flooding events.
3. Early warning should be given to the inhabitants of lower Nyatike Division so that they vacate areas prone to floods early enough. This will ensure timely delivery of the people staying in flood prone areas, and hence reducing the losses they experience when their properties are destroyed.
4. The need of cooperative societies: Farmers, fishermen and other small scale traders should be encouraged to join cooperative societies, to assist them in identifying market for their produce especially during flood events. This will discourage farmers from

selling their produce to middlemen who exploits them during flooding events. Consequently this will assist in improving the livelihood of the inhabitants and hence economic growth of Nyatike Division.

AREAS FOR FURTHER RESEARCH

The research study recommends the following areas for further research.

1. Effects of alluvial deposits on the lower course of rivers that enter Lake Victoria.
2. Indirect effects of alluvial deposits on micro-climate on the lower course of River Kuja.

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