The community awareness and preparedness for floods along the lower Tana River, Tana River County.

By

Mulwa, Moses

C50/76620/2009

A Project Report Submitted in Partial fulfillment of the Requirements for the Degree of Master of Arts in Environmental Planning and Management

Department of Geography and Environmental Studies

University of Nairobi

August 2013

DECLARATION

This research report is my original work and has not been presented for a degree in any other University.

…… Date: ……

Mulwa, Moses

(Reg. No. C50/76620/2009)

This research report has been submitted for examination with our approval as the University Supervisors.

_____ Date: _____

Eng. Dr. Onyango Ogembo,

Department of Geography & Environmental Studies

University of Nairobi

_____ Date: _____

Dr. John Nyangaga

Department of Geography & Environmental Studies

University of Nairobi

DEDICATION

All the glory and honour to the Lord God Almighty. To my supportive parents.

ACKNOWLEDGEMENT

I take this chance to thank a number of people and institutions for support towards the completion of this study. Their contribution was positive not negative in any way and thus not responsible for any errors or omissions, whatsoever.

I take the earliest opportunity to sincerely acknowledge my able supervisors: Eng. Dr. Onyango Ogembo and Dr. John Nyanganga, for their guidance and intellectual critique during the study. They have instilled in me discipline and patience in approaching things. Under them, I have fined-tuned my approach to the study with an objective mindset. I will forever be indebted for their input. Over and above, I thank the input from other Departmental Staff at the Dept. of Geography and Environmental Studies starting with the Chairman: Dr. Samuel O. Owuor, Course Coordinator: Dr. J. K. Musingi as well as other Lecturers and Professionals.

I appreciate the National Council for Science and Technology for granting the research permit, the Education Officers at Tana River and Tana Delta for the facilitation and the cooperation by the household heads during the data collection.

Finally, I salute my immediate family members for financial and moral support, particularly during the frequent visits to Tana River. For those who contributed in whatever form and have not been mentioned, I appreciate too.

Table of Contents

List of Tables

List of Figures

List of Plates

List of Abbreviations

ASAL	Arid and Semi-Arid Lands
ASFM	Association for State Floodplain Managers
CRED	Center for Research & Epidemiology of Disasters
CRS	Community Rating System
DDEC	District Disaster Emergency Committee
DM	Disaster Management
EMCA	Environmental Management and Coordination Act
FAO	Food and Agriculture Organization
FEMA	Federal Emergency Management Agency
ENSO	El Nino-Southern Oscillation
EWS	Early Warning Systems
GHA	the Greater Horn of Africa
GoK	Government of Kenya
HFA	The Hyogo Framework for Action 2005-2015
IFRC	International Federation for Red Crescent
IPCC	Intergovernmental Panel on Climate Change
IRIN	Integrated Regional Information Networks
ITCZ	Inter-Tropical Convergence Zone
IUCN	International Union for Conservation of Nature
KNBS	Kenya National Bureau of Statistics
MAM	March-April- May

NADIMA	National Disaster Management Agency
NFIP	National Flood insurance Program
NGO	Non-Governmental Organization
OND	October-November-December
OCHA	Office for the Coordination of Humanitarian Affairs
RANET	Radio And Internet programme
SOI	Southern Oscillation Index
SRES	Special Report on Emissions Scenarios
TAR	Third Assessment Report
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
USD	US Dollars
WFP	World Food Programme
WHO	World Health Organization
WKCDD&FMP	Western Kenya Community Driven-Development And Flood Mitigation Project
WMO	World Meteorological Organization
WMS	Welfare Monitoring Survey
WRI	World Resources Institute

ABSTRACT

This study was undertaken in the Garsen and Wenje Divisions of the lower course of Tana River that is located in Tana River County. Over the time, lower Tana River has experienced flooding events of varying intensities and a delta has formed as it enters the Indian Ocean.

The aim of the study was to find out the community awareness and preparedness for floods along the lower reaches Tana River, where households reside along a flood plain, which is 4 kilometres wide from the river. Specific objectives of the study: analysis of community awareness of forms of conveying flood information and alerts, analyze preparedness to respond to flood events and find out available facilities to combat flood problems.

The main instrument for data collection was questionnaire administered on a sample size of 115 household heads drawn from sublocations selected from divisions, using a multistage sampling technique in a two stages. The selection of sublocations that border lower reaches of Tana River formed the first stage. A total of 7 sublocations were selected in two divisions. The second stage was to select respondents from the subgroup of household heads. The questionnaire format contained closed and open ended questions. In the analysis, data was subjected to frequency analysis as an exploratory technique and G-test applied for hypothesis testing.

It was revealed that the communities along the lower Tana River are exposed to flooding problems. The community members identified various sources of receiving flood information that is, traditional observation methods, civil society activities and media. There was lack of a common communication network for flood alert information. Households were not organized into community flood management groups to enhance their preparedness. In addition, availability of flood preparedness facilities was a problem.

The creation of awareness and developing of preparedness culture against flood disasters are imperative if the community is to reduce vulnerability to the problems of disasters within the society. Needless to say that the awareness and preparedness programmes require a bottom-up approach from grassroots community and top-down from the relevant authorities and stakeholders.

As recommendation, preparedness can be enhanced through developing a program on reducing flood risk that targets household heads in the flood prone areas.

CHAPTER ONE

1.0 Introduction

1.1 Study Background

Floods are the rise in the amount of discharge causing overflowing of a river or any other body of water onto areas not normally submerged (UNEP, 2012). One of the major causes of floods is heavy rainfall that leads to the level of the water in the river to rise above the banks and overflow. Other factors contributing to floods are melting of snow, overwhelmed dams as well as deforestation leading to exposure of soil to agents of erosion. Floods occur when widespread heavy rains last for a short period between hours and few days. Moreover, floods can occur as a multiple event and on seasonal bases. Heavy seasonal rainfall activity or high water levels in rivers and other large water masses cause the seasonal flood events. When rain falls within a short period onto dry, hard ground such that water fails to penetrate; this causes flash floods. Flooding ranges from small to pools of water over wide areas of land. Floods become disastrous when they cause widespread human, material, or environmental losses beyond the ability of the affected community to withstand using its own resources (WMO, 2006).

The level at which high water discharges are termed as floods is a matter of perspective. Based on a purely ecologic perspective, floods are overbank flows that come with moisture and nutrients to the floodplain. From a purely geomorphic perspective, high flows become floods when they provide large quantities of sediment or alter the morphology of the river channel and floodplain. From a human perspective, high flows become floods when they cause injury or death of people, or when they result damage on property, belongings or loss of sources of livelihood. Small floods result in relatively minor damage, but may have higher cumulative cost because they are frequent and occur in many locations. Larger floods are rarer and have the potential to cause heavy loss of life and economic damage (WMO, 2006).

According to World Meteorological Organization (WMO) weather patterns and climatic zones will change due to the warming of up to 5.0^{o}C leading to severe weather and flood events posing danger to human well-being. Indeed, most of the natural disasters are linked with climate and weather patterns. Other than climate and weather, there are human related activities such as degradation of the general environment, loss of forest cover and poor land use and management that exacerbate the events of floods. Some of these human causes trigger flooding within the river basins due to excess runoff even with normal rains.

In Kenya, heavy rainfall are the main natural causes of floods affecting people living in rural and urban settings. The floods affecting the rural and urban settings mostly occur as either flash or urban floods. The parts of the country where the people are mostly affected by floods are in the Western, Nyanza Provinces and Tana River District. In urban areas like in Nairobi, people dwelling within the informal settings are the most affected by the urban floods. In the Nyanza Province, rainy season causes the River Nyando to burst its banks. Areas affected by flooding in the Nyanza Province are Nyatike (Migori District), Kano Plains and Rachuonyo. The flooding in River Nzoia affects Budalangi in the Western province. The arid and semi-arid lands of the country as well as urban areas are affected by flash flooding (ICPAC, 2007; UN/OCHA, 2006). Tana River experiences seasonal river floods with the most affected areas being in the lower reaches.

The impacts of floods in Kenya take two forms; that is flood damages (physical destruction) and flood losses (intangible losses). The vulnerability to flood impacts have been characterised by dilapidated state of infrastructure, low education status and illiteracy levels, rising poverty rates and poor land use patterns such as settling and farming along the river banks and deforestation. In Kenya, the frequency rates of floods stands at 27% and accounts for 5% of the population affected by disasters. Deaths related to floods make up 60% of disaster victims in Kenya (UNEP, 2009).

1.2 The Problem Statement

Every year, floods cause a lot of destruction all over the world, resulting in direct economic losses, damage to historical and cultural values and ecosystems. Moreover, loss of lives and spread of diseases are also directly attributed to flood problems. The trail of destruction left behind after flood disasters can loosely be interpreted as originating outside the social system and as an 'acts of nature' disrupting the normal way of life. Nevertheless, flood events are aggravated by de-vegetation of the riparian sections for agricultural use, reduced capacity of soil to absorb water, settlement along the flood plains and harvesting of forest products within the flooding zones.

The Tana River basin experiences a bi-modal rainfall pattern with about 90 percent of rain falling during the wet seasons of March-May and October-December. There are years when the volume of rainfall within the catchment have been recorded as intensive with persistence of up to 4 to 5 days such as in 1961-62, 1997-98, 2006-07 and 2009-10. These heavy rainfall tend to have a return period and lead to increased flood problems. The Masinga Reservoir and

other hydroelectric stations were constructed to net headwaters from the main catchment areas of Tana River (that is, Mt. Kenya and Nyandarua Ranges) and curb flood problems in the lower reaches. Nevertheless, the Tana River continues to receive high discharges from some of its tributaries coming from Mt Kenya (Mutonga, Thuam Thura and Ena Rivers) and Nyambene Mountains (Rojewero, Bisanadi and Thangata Rivers) that by pass the reservoirs and are thought to be the main cause of reoccurrence of flooding in the lower parts. It has been found that seasonal river (lagas) feeding Tana River lead increased flood heights during high rainfall seasons. The floodwaters that affect the lower reaches mount up from the upper, then middle, and lower catchments. As part of flood mitigation, information generated from river water monitoring and rainfall gauging particularly on rising levels of water to alert levels play an important in the preparedness activities for communities found in the lower reaches of Tana River. The lower reaches of Tana River are dominated by a floodplain that starts after the Kora Rapids. The population along the lower Tana River becomes denser closer to the river. The reason is that the community actively engages in agriculture and relies on river water to sustain their activities. FAO (1968) identified the agricultural potential of the lower Tana River within the flood plain.

As part of climate change adaptation, Bangladesh implemented structural and non-structural measures of flood control. The lessons drawn from the measures were that early warning and preparedness planning reduced the severity of flood disaster impacts. In addition, the participation of community led to effective emergency flood fighting at the time of floods, evacuation and relief operation. However, there was also need to maintain properly the existing flood control dykes and floodwalls to eliminate effectively flood disaster in the prone areas. Enhancing community preparedness allows better understanding of the community ways of using flood management while integrating climate change adaptation into their coping strategies. Flood awareness enhances capacity to share information and actively engage community and other stakeholders.

This study therefore, seeks to establish the community awareness and preparedness for floods along the lower reaches of Tana River. The focus will be at the household level, who are exposed to floods.

1.3 Objectives and Research Questions of the Study

1.3.1 General objectives

To analyze community awareness and preparedness for floods along the lower reaches of Tana River.

1.3.2 Specific Objectives

1. To analyze community awareness of the sources of flood information and early warning for the lower reaches of Tana River.
2. To analyze community preparedness to respond to flood events within the lower reaches of Tana River
3. To find out the available facilities to cope with flood problems along the lower reaches of Tana River

1.3.3 Research Questions

1. Is the community exposed to floods?
2. What are the various forms of conveying flood information and early warning to the households?
3. What are the households awareness to respond to flood problems?
4. What facilities and skills are available to households for use during a flood event?

1.3.4 Research Hypothesis

H_0 The frequencies of the different sources of flood information are evenly distributed within the community

H_1 The frequencies of the different sources of flood information are not evenly distributed within the community

1.4 Justification of the study

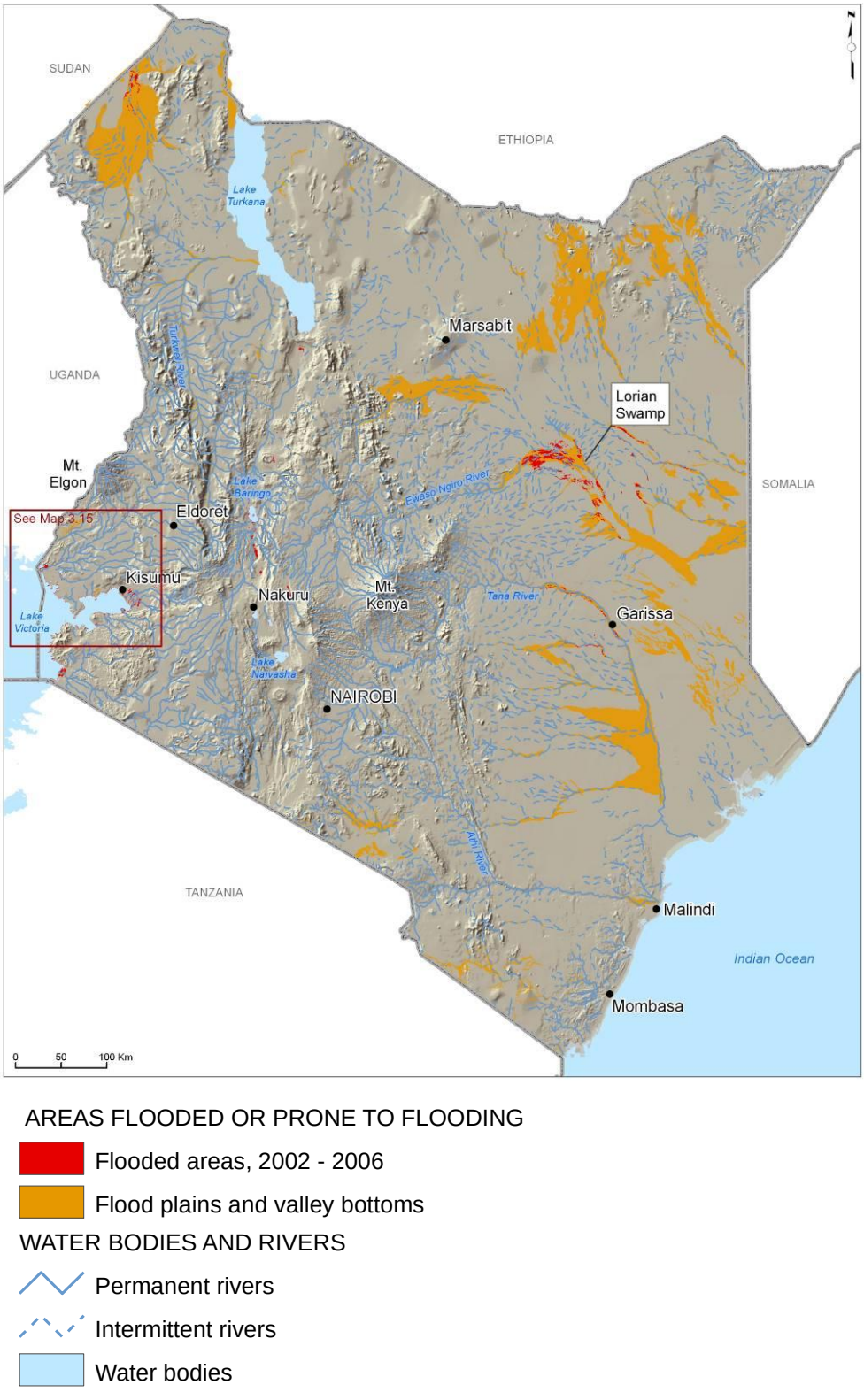
WMO alerted the world in 1976 that changes in global warmth had the potential to increase weather severity and floods leading to damages on food production and general environment. Poor countries in the developing world are more vulnerable to these climatic variability that lead to increased flood problems. The heavy rains of 1997/98, 2006 and 2009 brought with them such flood devastation, particularly in the south-eastern parts of the country like lower Tana River (World Bank, 2006). Other than the lower Tana River, the Western parts of the country experience perennial flood problems associated with low-lying regions. The lower reaches of Tana River lie in zone IV to VII of the agro ecological zones of Kenya, which range between semi humid (annual rainfall of 700-850mm) and very arid (annual rainfall of 200-300mm) making it unique from the western parts of Kenya that are found in the lake Victoria Basin that occur in zone I (Afro-alpine moorland and grassland or barren land above forest line) to III (Land of high agricultural value, low forest potential). See Figure 1.1 & 1.2, below for the flood prone areas in Kenya.

Communities in the flood prone areas have to be motivated to remain prepared for flood eventualities. In the absence of flood awareness, communities may be hindered from taking preparedness action by some psychological and social reasons that deter them such as past experiences of floods, the influence of uncertainty on decision making, lack of common way of learning and the credibility of individual connection to the sources of flood warnings. Moreover, it is likely that preparedness action becomes strengthened when it is a community affair (or founded on a formal and social network that has strong local links) than an individual undertaking. Community preparedness action against flood will rely on social networks to disseminate flood information ensuring community members are reached and heed to the warning of a flood event. Flood awareness enhances emotional bond between

individuals within the community and with the physical environment that facilitates them to act against floods as a block. A community approach leads to better preparedness through a common and prevailing belief held by each member about preparedness within the community. The role of awareness in enhancing prevailing belief is to promote attachment to the sources of flood information, the information itself and take responsibility of preparing and personal mitigation activities.

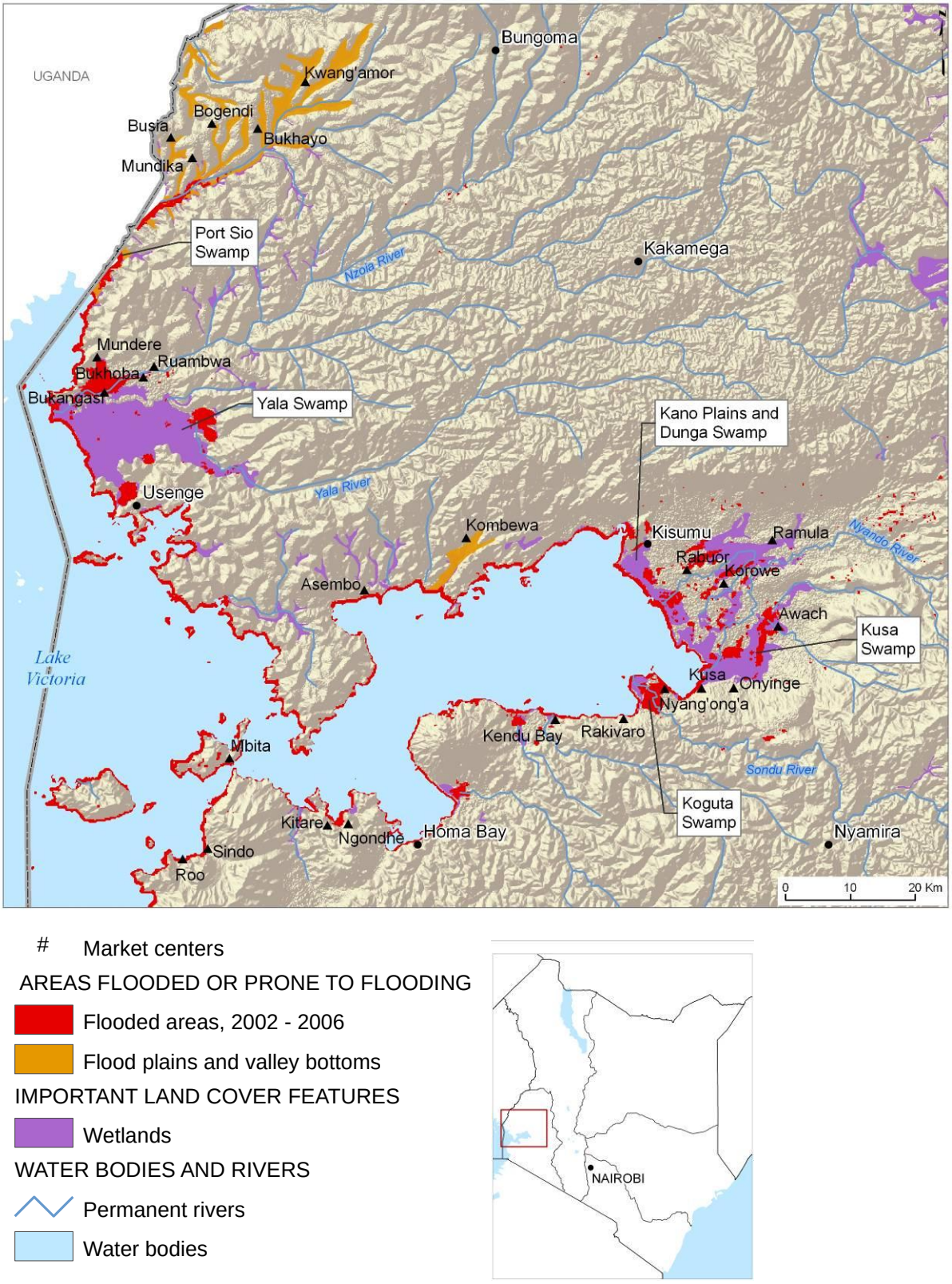
Community participation was prioritized as an indicator among the three strategic goals of 10-year disaster risk reduction (DRR) strategy of the Hyogo Framework for Action. In Kenya, efforts towards flood preparedness for community residing in the flood prone areas have been boosted by the initiation of the Kenya Community Driven Development and Flood Mitigation Project (WKCDD/FMP) by the Ministry of State for Special Programmes in 2007. This makes it important to enhance the capacity to share information and engage the community from the onset of flood preparedness activities. Flood awareness assists in raising levels of preparedness, aid in response and recovery activities.

Figure 1.1: Map of Kenya Showing Flood Prone Areas



Source: World Resources Institute (2007)

Figure 1.2: Flood Prone Areas in Western Kenya



Source: World Resources Institute (2007)

1.5 Scope of the study

This study focused on analyzing community awareness and preparedness for flood events by focusing on three aspects, namely, the forms of conveying flood information and early warning to household level; the awareness to respond to floods and available facilities and techniques that enhance preparedness against flood problems.

The study limited itself to households that reside along the lower reaches of Tana River, Tana River County (in both, Tana River and Tana Delta Districts) that are prone to flooding; thus, ought to be constantly prepared for future recurrences.

Besides floods, there are other disasters (such as insecurity, resource conflicts and drought) that face the lower reaches of Tana River. The physical aspects of floodplain topography and flooding patterns were not part of the study objectives. This study focused on flood awareness and preparedness because the river flows on a flood plain that experience high frequency of flooding and has attracted local agricultural community; thus prompting the urgency to protect them from floods.

Limitations due to insecurity problem

- Challenges during field visits:

i. Data collection involved frequent visits to the study area.
ii. The researcher had to aid respondents who were willing to participate but had difficulties in figuring out answers to questions. However, this was carefully done to avoid biasness. This intended to reduce the number of unanswered questions for instance challenges in fielding the Likert Scale questions. Many were reluctant to respond hence responses captured relied on willingness.

- Challenges During Data Analysis:

i. Some questions were merged and field notes used to reduce effect of unanswered questions to make reliable data analysis.

1.6 Operational Terms Used

A Disaster: A disaster is a serious disruption of the functioning of a community or society with extensive human, resources, economic or environmental damage or loses which exceed the ability of the affected community/society to cope using their own resources.

Disaster Preparedness: These are pre-disaster activities designed to increase the level of readiness or improve operational capabilities for responding to an emergency.

Disaster Response: These are interventions provided immediately after or during disaster. These interventions are intended to rescue and save lives and livelihoods as regards those damages resulting from the disaster.

Disaster Risk: This is the potential of harmful consequences or loss resulting from the interaction between natural hazards and vulnerable conditions of property and people.

Disaster Risk Management: These are short-term and long-term actions, programmes or policies implemented in advance of a natural hazard or in its early stages, to reduce the degree of risk to the people, property and productivity capacity.

Disaster Risk Reduction: This is the concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events**.**

Early Warning Systems: the provision of information on an emerging dangerous circumstance where that information can enable action in advance to reduce the risks involved.

Floods: Floods are usually high rates of discharge and/or water levels, often leading to inundation of land adjacent to rivers and streams.

Flood Awareness: An appreciation of possible flooding hazards and outcomes and an understanding of flood warning and evacuation procedures. Communities with a culture of flood awareness are quick and efficient in response to flood warnings, thus ameliorate likely damage consequences and life losses. Contrary, those below the thresholds of flood awareness hardly appreciate the imperative role of flood warnings and preparedness and are prone in the events of flooding.

Hazard: This is a potentially destructive physical event, human activity or phenomenon with potential to cause loss of life or injury, property damage, social and economic disruption of life, and environmental degradation among other effects.

Impact: These are the specific effects of hazards or disasters also referred to as consequences or outcomes.

Teleconnection: This is a spatial pattern and a timeseries describing variations in its magnitude and phase. Spatial patterns may be defined over a grid or by indices based on station observations. For example, the Southern Oscillation Index (SOI) is based solely on differences in mean sea-level pressure anomalies between Tahiti (eastern Pacific) and Darwin (western Pacific), yet it captures much of the variability of large-scale atmospheric circulation throughout the tropical Pacific.

Vulnerability: This is a set of conditions resulting from physical, social, economic and environmental factors, which increase the susceptibility of a community to the impact of disasters. Vulnerability may also imply characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard.

1.7 The Study Area

1.7.1 Introduction

The Tana River stretches to about 1,000km and has a drainage area of approximately 126,000km^2. It is estimated that Tana River supports more than four million in terms of livelihood. It is estimated that in excess of 400 000 people depend on the Tana's flooding for their livelihoods (IUCN, 2003).

The Upper reaches of the Tana Basin cover 7950km^2 with a relative altitude of 4143m. The upper catchment flows southwards and in parallel pattern coalescing into larger streams such as Thika, Chania, Maragua, Saba Saba, Thiba and Sagana (FAO, 1968). The consequent streams display part of the radial drainage pattern of Mt. Kenya. At the upper section of the River, the Masinga Dam serves as water reservoir, while the other seven folks dams are hydro-electric stations (UNEP, 2012).

There are tributaries at the midway section of the river (that is between Meru National Park and the Garissa Town) that include the Tula Laga and Thua Laga, which make their discharges during the wet season.

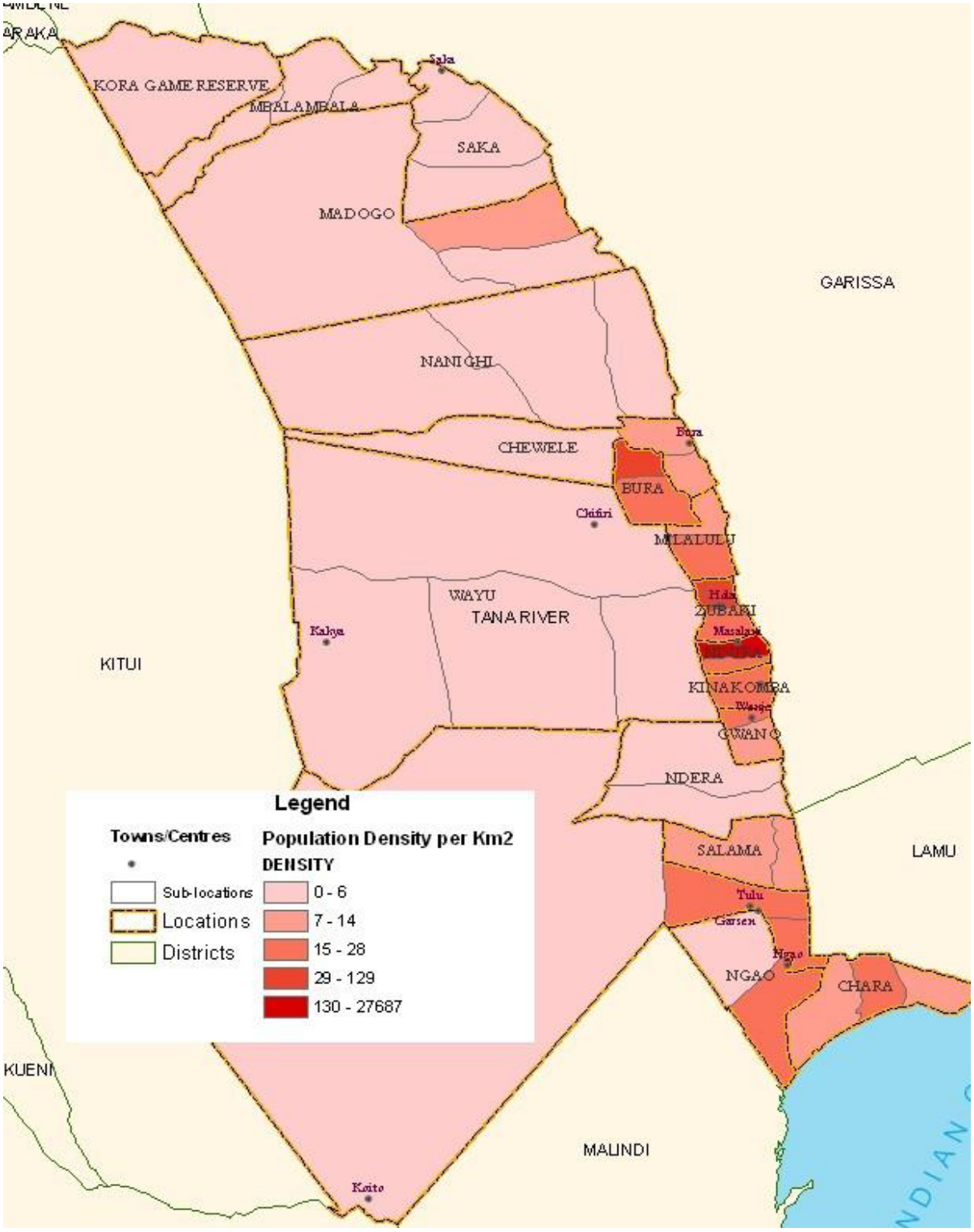
At the lower reaches (that is, past Garissa Town up to the delta), there are seasonal rivers joining the main river such as the Kolkani Laga, Hirimani Laga, Galole Laga (FAO, 1968). The seasonal rivers (at the mid and lower course) traverse through areas that receive meagre rainfall, hence, the river hardly gets any additional waters.

In this study, the study area is located on the Garsen and Wenje Divisions along the Tana River.

1.7.2 Location

The Tana River County borders Kitui to the west, Mwingi to the northwest, Garissa to the northeast, Ijara to the east, Meru North and Isiolo to the north, Lamu to the southeast, and Malindi to the southwest (see Figure 1.3, below). The County borders the Indian Ocean with a coastal strip of 35km. The County has 8 administrative divisions (Kipini; Tarasaa; Garsen; Wenje; Galole; Bura; Madogo; Bangale), 43 locations and sub-locations. The County covers an area of 38,694km^2.

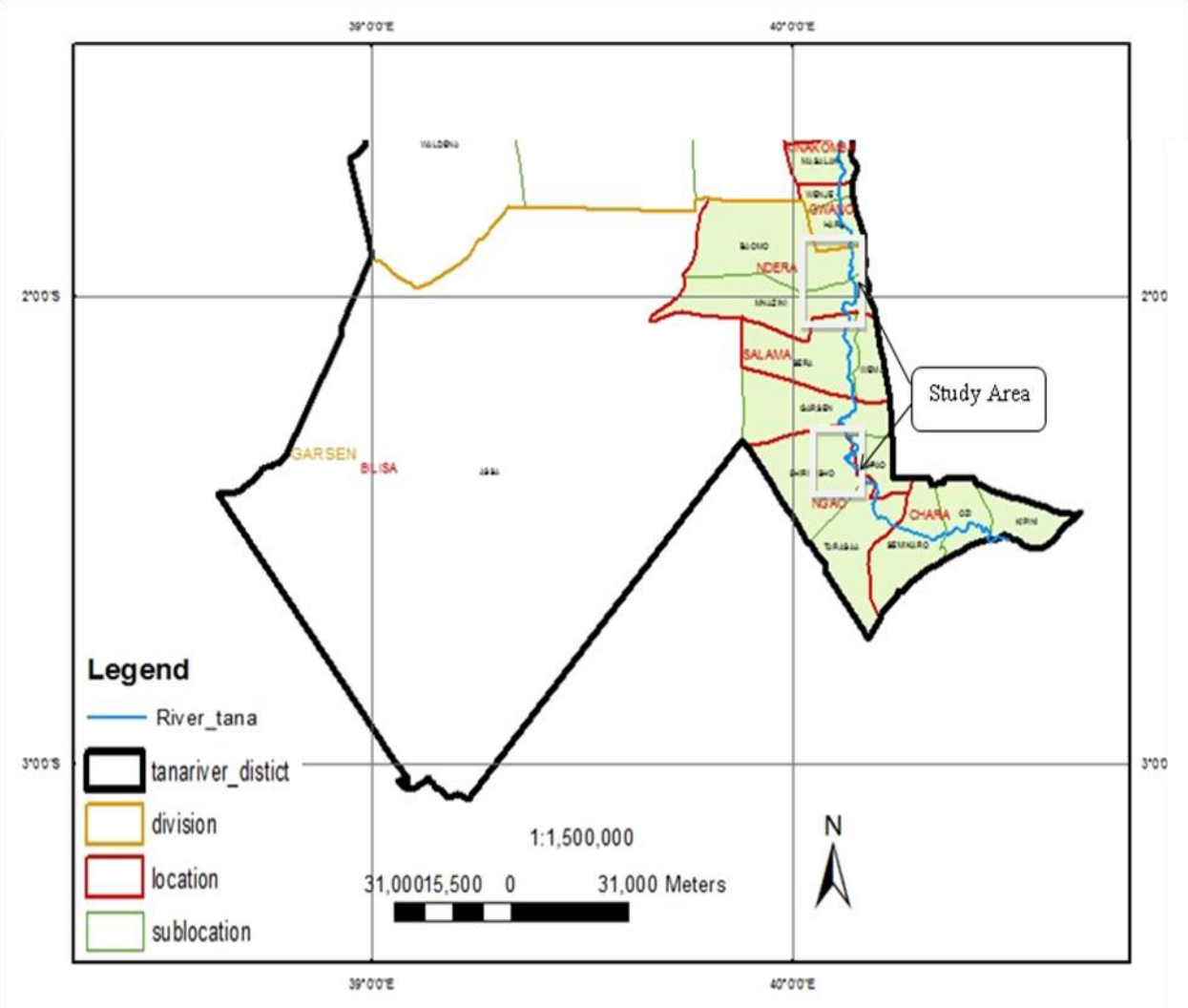
Figure 1.3: Administrative Areas and Population Density Pattern of Tana River County



Source: GoK, 2005

The County lies between latitudes 0^0 and 3^0 south and longitudes 38^030' east and 40^015'east. It has a geographical formation of an undulating plain that slopes southeast with an altitude ranging between sea level to about 200m above the sea level. The predominant feature is the Tana River (see Figure 1.4, below). The delta has seasonal streams, which provide wet-season grazing areas and serve as sources of inlets for earth pans.

Figure 1.4: Map Showing the Lower Part of the Tana River County and the Flow of the Lower Reaches of Tana River (including the Study Area)



Source: Researcher (2012)

1.7.3 Topography

Tana River forms the major physical feature within the Tana River County as it undulates across the plain that is interrupted a few low lying hills. The hills include those in Minjila, Bilbil and Madogo.

Tana River has an average width of 39.3 m, mean depth of 2.5m and an average flow rate of 41.98 m3/sec. From the source to the mouth of the river, the straight distance is 480km, but following the major directional curves is 1012km (FAO, 1968). The lower portion of Tana River covers approximately 625 km in length and the delta alone covers an area of about 3000 km^2.

The river enters the Indian Ocean at Kipini area with the freshwater flow branching off into a complex network of tidal creeks, savannah-like flood plains, coastal lakes and mangrove swamps which cover an area approximately 1,300km^2. This fun shaped fresh water flow is known as the Tana Delta (FAO, 1968).

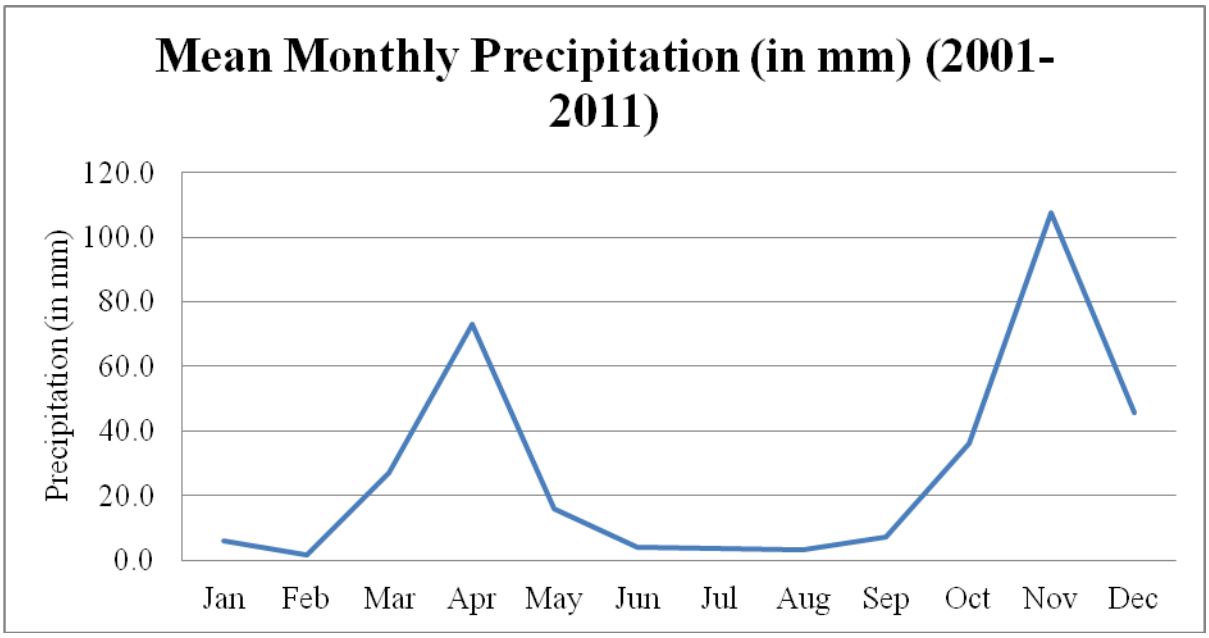
Kenya Soil Survey (1998) subdivided the Tana River floodplain into three physical components: First, levees (long wide ridges along the river channel) composed of stratified, non-calcerous fine sands to loams. Second, crevasse splays that are tongue-shaped masses composed of stratified sediments at in Garsen. Third, further away from the levee are the low lying lands referred to as the back-swamps.

1.7.4 Climate

There are two rainy seasons that occur with long rains between March and May, and short rains between October and December (Tamooh et al. 2012). Figure 1.5, below shows the mean monthly rainfall distribution and Figures 1.6 on annual distribution of rainfall for the lower Tana River. Figure 1.5 shows the bi-modal rainfall pattern experienced at the Lower Tana River.

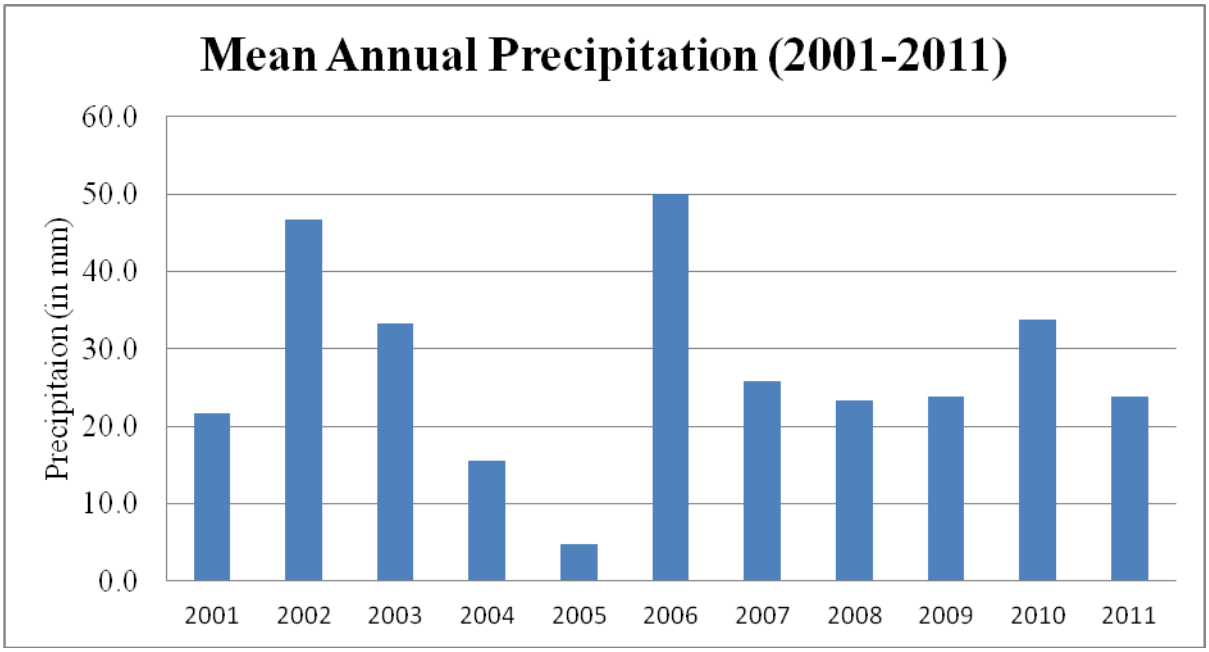
Lower Tana River is characterized by hot and dry weather. Much of the agriculture along the basin is dependent on water from the river. Temperature range is slight throughout the year between 26^oC in July-August and 29^oC in February –March.

Figure 1.5: Mean Monthly Precipitation Pattern for the Lower Tana River (2001-2011)



Data from Garissa Meteorological Station (courtesy of Kenya Met Dept., 2012)

Figure 1.6: Annual Rainfall Pattern for the Lower Tana River (2001-2011)



Data from Garissa Meteorological Station (courtesy of Kenya Met Dept., 2012)

1.7.5 Summary on Hydrology, Flood Probability and Flood Frequency and Inundation extents

Flood preparedness has a vital component that involves planning that concerns the river channel and valley floors in question, such as extrapolation from hydrological discharge and flood frequency records for the probability of floods. Thus, climate records on rainfall intensity play a vital role on calculation of flood hazard during flood preparedness planning. Insights from flood probability based on hydrological and flood frequency (for the river in question) provides information for river engineering designs, planning flood-insurance frameworks as well as land-use zoning based on flood proneness.

Data for the period between 1934 to 1970, from Garissa gauging station for the lower reaches of Tana River was used to produce flood frequency curves. The flood frequency curves had significant difference in gradients that indicated the influence of natural climatic variation on the flood frequency. However, http://www.uri.edu/.../Calculation_of_Flood_Hazard_p305_313.pdf warns that significant interpretations of these plots needs additional information regarding regional hydrology, historical records as well as other resources.

1.7.6 Geology

According to the Kenya Soil Survey (1988), the middle and the lower Tana-valley (that is, the lower reaches of Tana River) runs through the Plio-Pleistocene sediments of the Lamu embayment. The area where the Precambrian metamorphic area gives in to the sedimentary area, the channel pattern begins to meander resulting to the formation of a wide alluvial valley. Increase in erosion rates has led to widespread splay of deposits. Soil and irrigation feasibility studies within this stage of the river have revealed presence of multiple terraces. A low and middle terrace land occurs about 5metres above streambed (flood level) of the river and is characterized by a hardpan about 80cm thick. At the Delta area of the River, a different Lower terrace and an Upper terrace occur above the flood level at 2 to 3 and 5m , respectively. The coastal area comprises of beach ridges and coral rocks.

1.7.7 Soils

Soils within the flood plain are heavy black clays that swell up rendering them impervious to water during the wet seasons. In the impervious state, the soils become poorly drained and waterlogged; however, in the dry spell the soils develop deep cracks. The black clay soils are

alkaline with a pH ranging about 8. The soils indicate presence of salt accumulation that are high in sodium concentrations.

1.7.8 Agro-ecological Zones

The vegetation at the lower Tana River comprises of plain woodlands, wooded grasslands and arid thorn bush lands, pockets of indigenous riverine forests, and wetlands or swamps. At the floodplain, grass cover is predominant with patches of forest and woodland that depend on the flooding of the river. Natural forest covers include the Tana River Primate National Reserve and North Coast Mangrove Forests that are home to two endemic sub-species of primates: the Tana River Red Colobus (*Colobus badius rufornitratus*) and the Tana River Mangabey (*Cercocebus galeritus galeritus*) (UNEP, 2008).

1.7.9 Population Distribution

See Tables 1.1 to 1.6 on the demographics, schooling, literacy, education, and exposure to mass media statistics for Tana River County. See Figure 1.3, on the population distribution pattern across the Tana River County.

Table 1.1: Population Distribution by Sex, Number of Households, Area, Density & District, 2010

Background Characteristics	Male	Female	Total	Households	Area in Sq. Km	Density
Tana River	71,153	72,258	143,411	28,624	22,822.9	6
Tana Delta	48,700	47,964	96,664	18790	15,614.0	6

Source: KNBS & ICRF Macro, 2010

Table 1.2: Formal Education Attendance, 2008

Background Characteristics	Poor		Non-Poor	
	Attended	Never Attended	Attended	Never Attended
Tana River Administrative Region	45.8	54.2	68.1	31.9

Source: KNBS, 2008

Table 1.3: School Attendance, 2010

Background Characteristics	Male	Female	Total	Gender Parity Index
Primary School				
Coast	69.4	73.1	71.4	1.05
Secondary School				
Coast	22.1	14.6	18.5	0.66

Source: KNBS & ICRF Macro, 2010

Primary school is the percentage of the primary-school age (6-13 years) population that is attending primary school

Secondary school is the percentage of the secondary school age (14-17 years) population that is attending secondary school

Table 1.4: Educational Attainment, 2010

Background Characteristics	No Education	Some Primary	Completed Primary	Some Secondary	More than Secondary	Completed Secondary
Women						
Coast	24.3	25.6	21.6	9.3	4.9	14.2
Men						
Coast	3.1	20.5	27.0	14.3	9.4	25.6

Source: KNBS & ICRF Macro, 2010

Percentage distribution by both genders aged 15-49 years by highest level of schooling attended or completed

Table 1.5: Literacy, 2010

Background Characteristics	Secondary School or Higher	Can Read a Whole Sentence	Can Read Part of a Sentence	Cannot Read at All	Blind/ Visually Impaired	% Literacy
Women						
Coast	28.4	38.7	5.2	27.4	0.2	72.4
Men						
Coast	49.4	42.7	4.9	2.8	0.0	97.0

Source: KNBS & ICRF Macro, 2010

This refers to members of genders who have attended secondary school or higher & can read a whole sentence or part

Table 1.6: Exposure to Mass Media at Least a Week, 2010

Background Characteristics	Reads a Newspaper	Watches Television	Listen to the Radio	All Three Media	No Media
Women					
Coast	25.7	34.6	65.2	16.7	28.3
Men					
Coast	40.1	41.2	87.9	23	9.5

Source: KNBS & ICRF Macro, 2010

1.7.10 Socio-economic Characteristics

The main economic activities at the lower reaches of Tana River are crop farming, herding and livestock multiplication, fisheries and forestry and are tied much to the rhythm of the river discharge levels across seasons. Interestingly, livelihoods in this area act as the for local identity such the Pokomo are associated with the rain fed crop cultivation of maize, recession and tidal rice farming, mango and banana, fishing as well as tending of few livestock; while, Cushitic sub tribe practice pastoral herding. Charcoal burning has significantly increased in the area. See Table 1.7, below on the livelihoods zones in the Tana River County. Plate 1.1 & 1.2, below show loss of vegetation cover caused by human activities.

Table 1.7: Characteristics of Different Livelihoods Zones of the Lower Tana River

Characteristics	Agro Pastoralists	Dry Riverine Zone	Pastoralists	Tana Delta Zone
Cash Income Sources	Livestock Prod: 40% Food Crop Prod: 10% (Maize: 30%) Poultry Prod: 10%	Livestock Prod: 22% Firewood Collection: 12% Food Crop Prod: 10% (Maize: 30%) Hunting and Gathering: 10%	Livestock Prod: 68% Remittance and Gifts: 10% Firewood collection: 5%	Food Crop Prod: 40% (Mangoes: 37%) Formal Wage Labor: 15% Livestock Prod:10%
Expenditure of Households in Low Bracket	Maize: 50% Rice:10% Milk:10%	Maize: 50% Rice:10% Milk:10%	Milk Prod:40% Meat: 20%	Maize:47% Pulse:10% Vegetables:10%
Food Consumption	Maize: 40%	Maize: 50%	N/A	Maize: 41%
Maize sources for consumption	Own farm:40% Market purchase: 40% Gifts and Food aid: 20%	Own farm: 30% Market purchase: 10% Gifts and Food aid: 60%	Market purchase: 60% Gifts and food aid: 40%	Own Farm: 60% Market purchase: 20% Gifts and food aid: 20%
Livestock ownership	Poor Middle	Poor Middle	Poor Middle	
Cattle	20-50 70-100	0-2 2-5	5-20 30-50	2
Shoats	25-40 75-125	5-10 10-20	15-60 70-120	5

Source: World Bank (2006)

Plate 1.1: Bush-clearing along the river

Source: Researcher, 2012

Plate 1.2: Washed-away plant remains in Garsen area

Source: Researcher, 2012

CHAPTER TWO

2.0 Literature Review

Disasters disturb the functioning of community causing environmental, economic, human, and material losses and this has significantly occurred in countries in the developing world (See Table 2.1, below).

Table 2.1: Natural Disasters Figures, Victims and Economic Losses Distribution across Continents (for the year 2010 and yearly average for 2000/2009 decade)

Natural Disaster	Year	Natural Disaster Figures					
		Africa	Americas	Asia	Europe	Oceania	Global
Hydrological (flood-related)	2010	57	40	81	32	6	216
	Average 2000/2009	43	39	80	25	5	192
Meteorological (storm-related)	2010	5	35	27	14	7	88
	Average 2000/2009	9	33	42	14	6	105
Climatological	2010	6	16	6	22	0	50
	Average 2000/2009	9	13	13	18	1	54
Geophysical	2010	1	6	20	2	2	31
	Average 2000/2009	3	7	21	3	2	31
Total	2010	69	97	134	70	15	385
	Average 2000/2009	64	92	156	59	15	387
		Victims (in millions)					
Hydrological	2010	4.23	4.18	180.1	0.28	0.23	189.03
	Average 2000/2009	2.34	2.90	89.42	0.34	0.02	95.01
Meteorological	2010	0.20	1.11	6.88	0.50	0.05	8.73
	Average 2000/2009	0.45	2.62	36.31	0.32	0.04	39.74
Climatological	2010	5.44	0.18	6.52	0.06	0.00	12.21
	Average 2000/2009	12.21	1.21	70.57	0.26	0.00	84.25
Geophysical	2010	0.00	6.62	0.38	0.03	0.03	7.33
	Average 2000/2009	0.08	0.37	7.98	0.01	0.01	8.45
Total	2010	9.87	12.10	193.89	0.87	0.57	217.30
	Average 2000/2009	15.07	7.09	204.29	0.94	0.06	227.46
		Economic Cost					
Hydrological	2010	0.06	2.49	32.08	7.02	5.24	46.89
	Average 2000/2009	0.35	2.89	8.86	6.53	0.50	19.13
Meteorological	2010	0.00	16.22	0.90	6.95	2.77	26.84
	Average 2000/2009	0.08	37.82	10.21	3.44	0.29	51.83
Climatological	2010	0.00	0.11	0.27	3.60	0.00	3.98
	Average 2000/2009	0.04	2.29	3.56	2.90	0.47	9.26
Geophysical	2010	0.00	38.01	1.51	0.13	6.50	46.15
	Average 2000/2009	0.67	0.69	16.73	0.54	0.02	18.65
Total	2010	0.06	56.84	34.76	17.70	14.51	12386
	Average 2000/2009	1.15	43.69	39.36	13.41	1.27	98.87

Source: CRED (2011)

Climate change has been identified as a driving force for the frequency and intensity weather related disasters. Towards the end of the 1970s decade, the WMO informed the world of the

potential effects climate and global warming on the natural environment with flooding problems being one of them. The 2001 Third Assessment Report by the Intergovernmental Panel on Climate Change made a conclusion that there was stronger evidence on human influence on the global climate and that there was warming in the climate conditions (WMO, 2010). The decade ending in 2006 was found to have the warmest years within the records of worldwide surface temperature since 1850. Moreover, over the last half century weather events have changed in frequency and intensity with the recurrence of heavy precipitation in most areas being experienced (IPCC, 2007).

According to WMO, the challenges of shifting seasonal rainfall, rise in climate variability and changes in water resources availability are manifesting parallel to the impacts of climate change with likely indicators being rise in sea level and increase in extremes of flood events and drought. As from 1975, the global occurrence of disaster rose from about 75 to over 400 a year. For instance, the number of hydro-meteorological (weather-related events) disasters went up by more than 100 percent in 2004 to range between 200 in 2006 (UN/ISDR, 2008). The World Meteorological Organization informed that since 2002 floods in more than 80 countries had resulted to a global hardship for more than 17 million people. Almost 3,000 people have lost their lives while property damage amounted to over thirty billion US dollars (UNESCO, 2010). The rise of the disaster occurrence was attributed to increase in the number of weather relate disasters. In the period between 2000 and 2007, every year people affected by disasters were more than 230 million. The factors that led to increase in disaster losses were increased weather events due to climate change, population growth and environmental degradation (UN-World Food Programme, 2008).

Over 75 percent of people in the developing countries reside in the rural areas, which are highly dependent on agriculture for their food and livelihoods. This people are more vulnerable to disasters, which lead to perpetual poverty caused by the devastation. In Bangladesh, the district of Homna is home to more than 400,000 people who are farmers. Heavy monsoon (seasons in South-East Asia) rainfall results in excessive discharges in the river hence floods occur nearly every year. These floods cause damages on houses, agricultural crops, and the infrastructure in the area. In Homna, much of the rain season leaves two-thirds of the area under six feet water. Among the direct effects of this flooding are the dramatic loss of employment opportunities. The loss of employment opportunities due

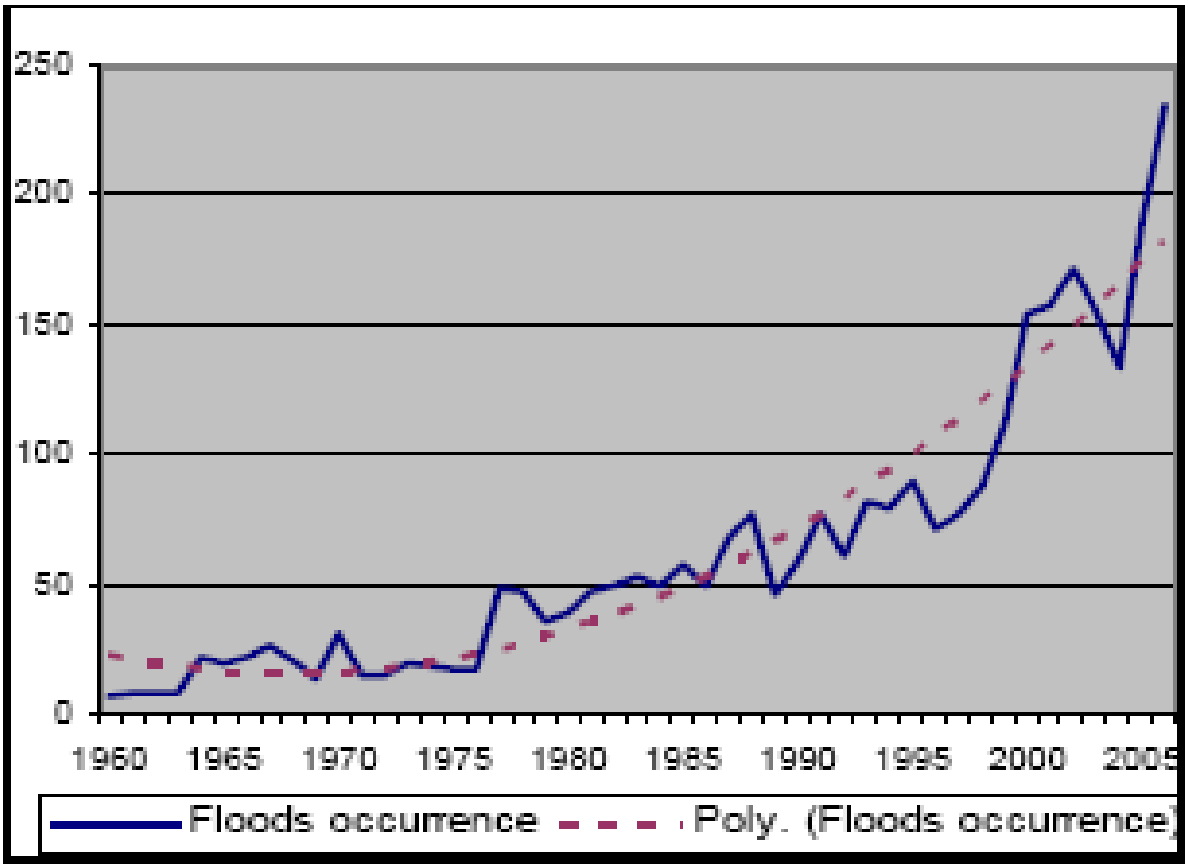
to flood problems rises up to 80 percent in the Homna area during the Monsoon period (Brouw er et al. 2007).

It is expected every year that natural disasters claim about 100,000 lives and that 97 percent of these deaths occur in developing countries. The accompanying economic losses of these disasters are ten times higher and disproportionately affect developing countries. For instance, in some developing countries, rural communities have been forced to migrate to the towns and cities due to flood devastation. Industrialized countries incur the highest property losses; however, when economic losses are a percentage of the GDP the resultant is higher in developing countries. The severity on the development growth by similar natural disasters has led to 20 times worse situation on developing countries than in industrialised countries. In 2000, the floods in Mozambique contributed to a fall in the GDP growth from 10 to 2, left about 700 people dead, close to 150 000 homes were washed away and numerous livelihoods affected (DFID, 2004).

WMO cites that major flood disasters that have been listed since Biblical times to be 118 and that between 1947 and 1991, a list of 87 floods have caused devastation to 50 000 people rendering them homeless. In terms of devastation, the flood on Yellow River in China in 1887 was the worst, caused at least 1.5 million deaths, and rendered close to ten million homeless. In the recent past, floods occurring between 1982 and 1991 have caused annual death to about 21 000 and affected million persons. Crops lost due to flooding every year have been estimated to be on the order of 10 million acres in Asia alone (WMO, 2006).

It has been found that heavy rains that lead to floods cause more devastation and kill more people worldwide compared to other natural disasters and in every decade that passes there is a rise in the number of flood disasters and the number of people affected (World Meteorological Organization, 2007). See the figure 2.1, below. The rise in flood damages has been attributed to more occupation within the floodplains and larger floods due to environmental degradation such deforestation which reduce the capacity of the land to absorb rainfall. Heavy rains saturate the upstream of river basins leading to large volumes of water to flow downstream hence occupying the low-lying regions which are floodplains with settlements and livelihood activities.

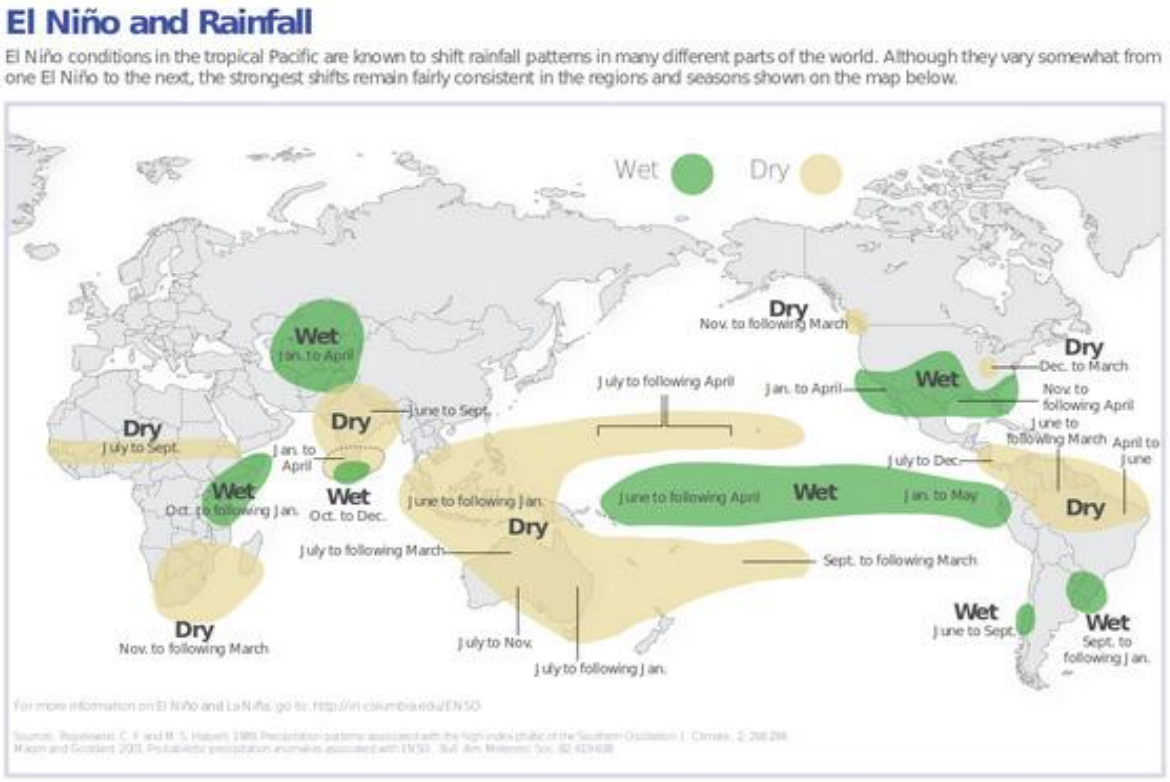
Figure 2.1: Trend of Internationally Reported Flood Events Showing Steadily Increasing Frequency between 1950 and 2005



Source: OCHA Natural Disaster Bulletin, 2007

Extreme flooding events and temperatures have also been linked with El Nino in countries surrounding the Pacific and in other parts of the world through distant connections. The El Nino has been associated with climate variability in many countries in Asian, African, and North and South American continents. In these countries, precipitation patterns and surface temperatures have had changes. Flooding disasters are becoming more frequent during the El Nino; however, there is no overwhelming evidence to associate El Niño with the number of flood disasters. Nonetheless, El Niño increases the likelihood of extreme events occurring making the probability of floods disasters happening during heavy precipitation (World Meteorological Organization, 2011). In the events of the El Nino 1997/98, Kenya experienced extreme flooding events, and rainfall between October, 1997 and February, 1998. Other parts of the world that were hit by heavy rainfall were along the coastal regions of Ecuador and Northern Peru (WMO, 1998). See figure 2.2, below.

Figure 2.2: Global Influence of El Nino on Heavy Precipitation



Source: IRI-IFRC, 2012

In 2011, Italy was among the European countries that experienced a localized storm that resulted in flash floods in late October and November. The extreme events took place in Liguria in northwestern Italy. On 25 October, Borghetto DI Vara received 472 mm for as long as 6 hours and Vicomorasso near Genoa, received 400 mm in 12 hours on 4 November. The flash floods in these two events led to 19 deaths in Italy (WMO, 2011).

In the Balkan Peninsula, heavy rain caused rivers to overflow and flood areas of Albania affecting the north-west. While, 1,010 families were evacuated, the count of houses that were submerged under flood waters were 2,205. With the flooding events, a total of 10,270 ha of farmland and 9,830 livestock were lost, serious damages were caused on the water supply system and transportation system making areas around the Shkodra reachable by small boats (OCHA, 2010).

In 2011, Pakistan experienced monsoon season rainfall that was the fifth-highest on record (248 per cent above average). It was revealed through the National and Provincial Disaster Management Authorities after assessment of the devastation that the floods had directly affected more than 15.4 million people. The numbers of people injured were 2024 and those

dead were more than 1,500. In Sindh and Balochistan Provinces, floods caused damage or destroyed more than Over 893,000 houses and 5,457 schools. Some of the schools were converted as temporary shelter camps for the IDPs. It was estimated that over 200,000 livestock were lost and with millions of small and large animals directly affected (OCHA, 2011).

The Philippines experienced a devastating storm that overflowed Mandulog and Agus river systems and flooded the cities with muddy water. Residents in the flooded areas were drowned while at sleep, and the numbers of people dead were 508 and an additional of 408 reported missing. Flooding caused damage and destruction to about 10 000 houses and community connection to power, water and communication remained partially cut off. Rice and corn fields that were the agricultural mainstay of the populace were extensively damaged during the floods (OCHA, 2011).

In 2011, heavy rains caused persistent flooding in Colombia, which was described as the most severe natural disaster in the country's history, with over 500 fatalities and affecting more than four million people as well as damage to agriculture, buildings, and infrastructure. The rains began in mid 2010 and persisted throughout to the mid of 2011. The flood devastation caused economic losses amounting to over US$5 billion in a country whose Human Development Index rank at 87 and GDP total/per person rank at 28/77. Among the flood victims, 4 out of 10 were sheltered in the IDP camps (OCHA, 2011).

In Brazil, an estimated 300mm of rain fell over a 24-hour period beginning on 12 January 2011. The heavy rains caused numerous rivers in the state of Rio de Janeiro to overflow. The flooding events led to more than 850 deaths and affected almost 1.2 million people. The heavy rains accumulated and fell within the short period of time that exceeded the limit of the soil absorption capacity. Floods in the affected areas caused disruption of local services of electricity, water and telecommunications. Communities within the flooded areas lost agricultural fields and houses the alongside of rivers (IFRC, 2011).

In Australia, heavy rainfall events in 2010/2011 caused flash floods in over one million square kilometres of Queensland and New South Wales. This was the second-wettest year on record that was 52 per cent above the average for the period between 1961 and 1990. Part of the wide range impacts of the floods were inundation of some 2,000 homes and evacuation of 70 towns. Economic losses and damages associated with the floods amounted to excess of US$15 billion. The flood caused disruption in the power supply to approximately 480,000

homes and businesses. Other investments and holdings that were affected by floods included 54 coal mines, 11 ports, 139 national parks and 411 schools (World Bank, 2011).

Torrential rainfall in 2010, in the West Africa led to the worst flooding in Benin over the last 50 years. The floods affected a total of 55 communities out of 77. The floods affected more than half million people and left close to 50 dead and over 1,000 injured. The floods left at least 150,000 people without homes and destroyed about 55,000 houses and 133,047 hectares of crops; 12,000 tons of stored food were left under water and 81,000 heads of livestock lost; and about 500 schools and 90 health centres destroyed (CERF, 2011).

Extreme rainfall events that began in mid-July 2010 left over half a million people affected by floods in the Tillaberi, Tahoua, Maradi, Agadez and Zinder regions in Niger. The flood devastation exceeded the capacity of the national response by the government hence made a call for international support. The floods affected 30 villages, decimation of 63,485 livestock; damage to housing structures and death of at least 68 people. In addition, 553 hectares of cropland were lost during the floods (IFRC, 2010).

Floods as a natural disaster have led to devastating results in the U.S. and have accounted for three-quarters of all presidential disaster declarations. The U.S. as a whole is considered to be prone to flood disaster, though in varying degrees. Floodplains cover 7 percent (94 million acres) of the U.S. and 15 percent of all urban areas. More than 10 million residential and commercial buildings and 80 percent of the nation's wetlands are located in floodplains. The encroachment of urbanization into the floodplains has greatly exacerbated problems associates with flooding. On average, over 300,000 people in the U.S. are rendered homeless due to flood events, 200 flood-related fatalities occur, and US$4 billion in total flood damages are managed on yearly bases. Floods are one of the leading causes of death from natural disasters in the U.S. The most common causes of floods are excessive rainfall, snow-melt and hurricane storm surges (FEMA, 2011).

In emergency management terms, a community is viewed as a group of people residing within the same area or near the same risk. However, other factors related to wealth, social status or labour activity among the people may lead to further differentiation and segmentation of the same community. Thus, communities may be dynamic as a matter of location, occupation, economic status, gender, religion or recreational interests, yet sharing the same risk. Since community cannot exist in isolation, its resilience capacity is influenced by outside capacities, more so with regard to emergency management services (DFID, 2007).

The Hyogo Framework for Action identifies community participation as part of priority areas in reducing vulnerability to disasters. HFA emphasizes that the initial point towards disaster risk reduction is to have the knowledge of the hazards and the physical, social, economic and environmental vulnerabilities facing the local community. In addition, community further requires knowledge that facilitates their participation in taking action against disasters. HFA identifies ways of promoting community participation to include building networks, management of volunteer resources and providing resources.

The HFA views that early warning should focus on the target people by timely conveying the information and in a way the receiver understands. This takes into account population distribution, livelihood, culture and gender characteristics. The disaster reduction should take into account the sustainable use and management of ecosystems by having proper developmental activities that reduce vulnerability of the community.

In the case of the US, a national flood management program, set up in 1968 as a federal program targeting property owners for communities to participate for protection against flood losses in return for State and community floodplain management regulations that reduce future flood damages (Murase *et al.*, 2009). Communities can take various forms like villages, towns, city, state, or district. The program seeks to encourage States and local governments to realize and mitigate flood hazards in land use and development decisions. In some communities, this is achieved by guiding development to areas with lower risk. The national flood management program requires communities to maintain a minimum level of floodplain management for its residence to be eligible to acquire flood protection through minimized exposure to floods and related damage. Once in the program a Community Rating System (CRS) is set up to motivate communities to exceed the minimum requirements. Nonetheless, any community may exceed the minimum program requirements by adopting regulations that are more restrictive. Communities often do this when they have access to information or knowledge of the conditions required, particularly for human safety, higher standards than the minimum program requirements. Therefore, any floodplain management regulations that are more restrictive than the program requirements should take precedence.

The long-term objective of the national floodplain management program on reducing flood damage and losses is achieved by encouraging communities to guide development to lower risk areas, and by requiring the elevation of new construction and existing buildings that have been substantially improved or substantially damaged. The participation in this program is

voluntary, and only 20-30 percent of those eligible participate in the programme. Nevertheless, economic incentives to improve motivation could be worth to factor in. Activities for communities participating in a Community Rating System (CRS) are organized into four categories: public information (such as giving reading materials on flood protection at the public library); mapping and regulations; reducing damage due to floods (such as obtaining, raising, and/or moving away from flood-prone buildings so that they are out of the floodplain) and Flood preparedness (such as providing early flood warnings to the vulnerable).

Other agencies involved in flood preparedness in the United States are the National Oceanic and Atmospheric Administration (NOAA) and National Weather Service (NWS). With regard to floods, the NWS provides enhanced river and flood forecasting and water information. NWS maintains stations that monitor height of water in rivers and streams across the country and generates data on the present river condition, which is the initial bases for river forecasting. In addition, the NWS has partnered with volunteers in the community to increase the network of river monitoring activities for predicting and detecting floods known as the local flood warning systems. Information on current stream heights and flood stages generated by the NWS is provided either on an online map or through radio services. The data from the gauging stations forms the basis for initiating the early warning signals for the radio broadcast. NOAA and National Weather Service collaborate through a network of radio stations that continuously provides weather information directly from a nearby National Weather Service office whether it is a warning, watch, forecast or other hazard information in 24 hours a day.

In terms of flood awareness, there is a World Wide Web searchable library maintained by the Federal Emergency Management Agency (FEMA) with information on floods that is publicly accessible. The online resource maintains readable materials that are convertible into hard copies. The reading material provided are in simplified language and stored in diverse forms of CDs, DVDs, publications, brochures, guidance and policy papers, program regulations and guidelines, forms, disability resources, audio and video files, posters and slide presentations. Other than the online sources, reading materials are also provided through distribution centres that are within local reach. Catalogue lists provide menu of reading resources that are available and are subject to continuous revision such as the flood hazard maps of the prone areas.

The resource library is accessible to different users (individuals, communities, States and federal agencies). It gives advice to people on matters concerning flood preparedness. The library provides flood awareness on the floodplain management requirements of the national flood management program in the form of a study guide and a reference material. According to FEMA, this is intended to enhance the knowledge and skills of locals for proper administering and enforcing of local floodplain management requirements. It also broadens the understanding of floodplain management strategies that are locally applicable. For the purposes of enforcement, only local officials are eligible since been subject to exam by the Association of State Floodplain Manager's (ASFPM) Certified Floodplain for designation as managers.

Other than information materials on the national flood management program, the resource library targets property owners by providing information on different techniques of making flood resistant through reducing property losses, guidance to help in decision making for readers with little or no knowledge about flood protection, reading materials on elevating buildings and safely locating fuel systems, electrical connections, waste disposal management and potable water systems.

Reading resources provide mitigation ideas against flood losses for property on measures to take, house placement options, special designs and construction techniques for manufactured homes. Homeowners with property in the high-risk areas have to follow acceptable procedures as per the hazard-resistant codes and standards before installing on the proposed site. During the construction process, there are mitigation techniques provided that further reduce hazard risks. The flood prone area is divided into a stream channel, floodway, and 100-year floodplain. Each section of the prone area has its own minimum regulations for safe property development.

There are resources specially designed to guide decision making for readers who have little or no knowledge about flood protection methods or building construction techniques. Some of the professionals targeted by these reading resources include engineers, architects, and construction contractors by suggesting general retrofitting methods and the binding regulations within the Community Rating System (CRS) and Flood Insurance Rate Maps (FIRM) across the Federal, State, and Local levels. In addition, the cost estimates for the different retrofitting methods for elevating, relocation, floodwalls, demolition, and wet and dry flood proofing.

The public is also provided with information on ways of protecting the essential household utilities from flood damage. There are special construction and fitting designs for either indoor or outdoor household equipments. These designs protect the utilities from inundation by floodwaters or silt sedimentation that result in corrosion damage, short-circuiting of electrical and heating appliances. It is suggested that fuel supplies are safe from floods by placing them on an elevated surface.

Beyond providing publicly accessible information, awareness action on floods and floodplain management is promoted through education and training. The Association of State Floodplain Managers (ASFPM) conducts training program and certification of floodplain managers through a continuing education policy. Floodplain managers enhance knowledge in flood mapping, building construction in flood hazard areas, administering floodplain management regulations, and related topics, after which the person undergoes a rigorous certification exam. Before the certification exam, candidates attend classes, workshops or home study courses that increase knowledge on the new approaches, standards and programs for their community floodplain management. The program contains fundamentals on flood mapping, managing floodplain development, national and state standards, and how to apply them to a local administered program. Study guides and desk references come with expected outcomes upon completion of learning which form the bases of personal evaluation of achievements during the study period. In readiness for the certification exam candidates may receive support from the state training program and the application for this exam has no fixed date but depends on whether the candidate in question has fully prepared across the courses being examined.

In order to increase credits (Continuous Education Credits, CECs) after certification, floodplain managers need to maintain a continuous education as part of policy recommendation by attending training, workshops/technical conferences or by completing graded home study courses. Gaining more credits implies that the floodplain manager continues to effectively serve the community. The certified floodplain managers are required to provide verification for successfully completed continuing education after every two year renewal period, thus demonstrating their continuing competency in handling their community's floodplain program. Proficient certified floodplain managers have enabled their communities to receive credits, while others have reported less trouble with the construction industry because the staff is able to clearly explain the process and requirements of the local

floodplain ordinance. When flood evacuation becomes necessary floodplain managers avail information to the community via varied information sources that are deemed reliable such as radio broadcasts, sirens or telephone calls. Families stay informed about daily flood forecasts by listening to National Oceanic and Atmospheric Administration (NOAA) Weather Radio All Hazards, commercial radio or television or go to internet for the latest flash flood and watches, warnings and weather advisories. Weather forecasts are in both short and long terms from minutes to months to inform for decision-making process at family, local state and federal levels. Other forecast products are on real time flood forecast maps that depict the actual extent of flooding.

FEMA and the American Red Cross Society emphasize that flood preparedness for families within the prone areas should have a preparedness plan that has emergency contact lists. Other supplies listed in the preparedness plan are fire extinguisher, alert systems/ alarms, collapsible ladders, first-aid kits, and utility shut-off points. The supplies kits items should be stored in a portable container(s) and placed near the exit door. Families are advised to review the contents of the kits at least once per year or as needs change. The American Red Cross Society provides templates, samples and relevant information for public access through its online website. For instance, the emergency contact lists are packaged into wallet cards with blank spaces for filling contact information that can fit in a wallet, purse, backpack, etc., for quick reference.

Flood producing rains in Kenya are often driven by complex climatic variability phenomenon such as the El Niño. Kenya was amongst the 16 worst affected during the 1997/98 El Niño (Otiende, 2009). The 1997-98 El Niño floods of the century as they have become to known resulted in severe floods after the major rivers in the country overflowed leading to widespread socioeconomic impacts.

River floods are among the most dominant floods in Kenya. River floods mostly occur along floodplains as a result of exceeded stream flow capacity leading to over spilling of the natural banks or artificial river bank protections. Major rivers in the country such as Nzoia, Nyando, Yala, Athi, Nairobi and Tana experience seasonal river floods originating from the country's highlands that receive high annual rainfall ranging from 1600-2000mm (Nyakundi, 2010).

The extend of the impact of floods in Kenya at the last quarter of 2008 affected more than 300,000 people and with over 50 fatalities according to the Reliefweb organization online database. The flood impacts were widespread across the country: the Coast, Central, Parts of

Eastern, Nairobi, Nyanza, Much of the Rift Valley and Western provinces (see Table 2.2, below).

Table 2.2: Profile of Recent Flood Events and Aftermath in Kenya

Date	Parts Affected	Inundation Levels	Damage Caused
2010	North and South Rift Valley, Western Nyanza, Kwale, Taita Taveta and Magharini	1,301.6 acres of farmland submerged in water	8,198 household displaced 27 people died, 297 cholera cases reported, 4,543goats, 196cattle, 62donkeys and 193camels died 2 schools and health facilities destroyed Kenyan-Sudan road cut off by flood waters Boreholes and latrines destroyed 1991hectares of farmland washed away
2009	East, Central and South Turkana and South Pokot Lower Tana, Kitale, Rift Valley-Sigor, Pokot, Siaya, Migori, Kitui and Mandera	Turkana Morulem Scheme 1,000 acres of it were flooded 1,800 acres and 1,500 hectares of farmland submerged in water	7,792 households were displaced 14 people drowned in the raging waters 5bridges and 20pit latrines collapsed 2schools and 2health facilities destroyed 6,734shelters destroyed 4,533goats, 196cattle, 60donkeys and 193camels died Kenya-Sudan road cut off 218,869people displaced, 5,000people marooned, 1 dead of cholera,350 treated of diarrhoea Karagoni bridge destroyed 1 vehicle swept away
2008	Taita		Over 2000 people were displaced Schools were closed and over 400pupils sent home Churches, cheifs camp and farmland submerged
2007	Lower Tana River; Western; Athi		In Tana River District more than 125,000people affected of which 81,095 were displaced 3people trapped in a roof of the house 1 trapped on top of a tree Transport along Nairobi-Namanga was paralysed
2006	Migori, Nyatike, Lower Tana River, Mwingi, Garissa, Moyale and Isiolo	Over 2.5km of lower R. Tana course submerged; 300 homesteads submerged	3,000people affected, 12,860families displaced, 38people rescued from floods and 7 people died, 1,742 people are marooned and 1person affected by diarrhoea Areas 20km radius from town center was cut off in Tana River 3 primary schools closed Destruction of water pumps at the irrigation schemes 5 people spent two nights on trees 50 camels, 50 goats, 14 cattle and 27 donkeys were washed away
2005	Taita		1 person drowned; Houses submerged; Plantation destroyed
2004	Nyando		50 people died, 7,886 people displaced 21 primary schools severely damaged Destroyed most crops including maize and millet
2001	Rachuonyo area		2000 people displaced; Property destroyed

Source: Compilation from Daily Nation Newspapers Reports, IFRC online reports as well as GoK and inter agencies reports (2011)

It is apparent that nearly on yearly bases flood disaster events occur in different parts of the country, resulting in flooding of rivers, urban settings and inundating of households and farmlands. The aftermath of these are fatalities, displacement of the affected, loss of livestock and destruction of property and crops. In some instances, the damage and loss to the people affected is irreparable and beyond quantifying, ranging from loss of societal values due to livelihood disturbance and loss of lives.

The heavy rains caused rivers to overflow their banks and inundate villages and farmland, resulted landslides, and increased the risk of vector borne and waterborne diseases that are contracted and spread when water and sanitation systems are contaminated by floods. With regard to the devastating floods that hit most parts of the country in the 1998, the cost of damage estimated at US $151.4 million only for the public property, while in total the damage was equivalent to US$ 1 billion (Otiende, 2009).

In order to institutionalize efforts addressing disasters in Kenya, the process of developing a draft National Policy on Disaster Management began in 2002. Though at the moment it is still a draft, the policy suggests preparedness on the part of the government, communities and other stakeholders in disaster risk reduction activities. The policy purposes the setting up of new disaster management structures, partnerships, networks and mainstreaming of disaster risk reduction in the development process in a bid to enhance the resilience of vulnerable groups to cope with potential disasters. It envisages the establishment of a National Disaster Management Agency (NADIMA) via an Act of Parliament. From a developmental perspective, the policy recognizes the significance of the concept of disaster risk reduction through integration into the country's development process through the medium-Term Expenditure Framework, Poverty Reduction Strategy Paper (PRSP), National Development Plan, National Poverty Eradication Plan, Economic Recovery Strategy for Wealth and Employment Creation (ERSWEC) and HIV/AIDS policies.

There have been efforts by the central government to bring about integrated development through watershed management. In 1967, the Government of Kenya initiated development of Tana River water resources for hydropower development, flood control and irrigation. To date, five major reservoirs have been built on the upper reaches of the Tana River: Kindaruma (1968); Kamburu (1975); Gitaru (1978); Masinga (1981) and Kiambere (1988). Dam construction has had a major influence on the river's downstream flow and physical characteristics, most notably through regulating water flow and decreasing the frequency and

magnitude of flooding. The Masinga Dam has the largest water holding capacity for hydropower generation, along with the river; thus plays an important role in controlling of river flooding downstream. When the dam spills, a huge amount of water is released. Dam spills and releases result in a rise in water levels.

Due to floods, the Kenya Red Cross Agency, initiated a two-year Flood Recovery project in the lower Tana River. The project components comprised of elementary community health and safety and oral rehydration and critical hygiene techniques training as well as latrine disinfecting. This project was decommissioned in 2009.

In reaction to the incidences of flood problems, some long term projects by the government have began, but in the western parts of Kenya. The Nzoia River basin has water radar sensors to warn downstream dwellers of possible floods.

The Radio and internet (RANET) programme is an initiative for disseminating flood forecasts to rural communities in the flood prone areas of Kenya. RANET is an initiative of the African Meteorological Applications for Development (ACMAD), National Hydrological and Meteorological Services (NHMS) in the different countries. The programme was introduced in Kenya by the Kenya Meteorological Department in 2001.

Kenya's meteorological institution keeps watch on river water levels, which generates important data and information that can warn the local community and other stakeholders on the risks of rising river waters. The conveying of the early warning systems (EWS) provides one of the means of utilizing this form of data and information. On this ground, if the early warning from the meteorological stations are properly and timely relayed to intended persons and acted upon, then the desired paradigm shift is promptly achieved as entrenched in the revised draft National Disaster Policy 2009 and in the Hyogo Framework of Action of 2005.

The Western Kenya Community Driven-Development And Flood Mitigation Project (WKCDD&FMP) under the Ministry of State Special Programmes implemented structural measures (in the form of dykes) in the Nzoia River Basin to control floods in the western parts of Kenya. WKCDD&FMP has resulted in using the structural and non-structural measures as renewed efforts to manage floods.

Flood awareness draws more community participation by facilitating dissemination of flood information and early warning among the members. Olowu (2010) concluded that African

countries had not fully implemented The Hyogo Framework for Action on disaster management and reduction.

Shauri (2007) takes a broad view of disasters in Kenya but less in-depth analysis into the flood disasters in particular; however, reviews preparedness as an element of disaster management in Kenya but not as applied in a local community set-up.

It is worth noting based on literature that more study effort on advancing flood disaster preparedness has inclined towards the western part of Kenya. Bakibinga-Ibembe1 *et al.* (2011) focuses on environmental legislation related to periodic flooding in the Lake Victoria Basin of East Africa. The study brings out the relevant policies and laws and their applicability. The study prioritizes on the management and utilization of resources but hardly on awareness and preparedness for flood disasters.

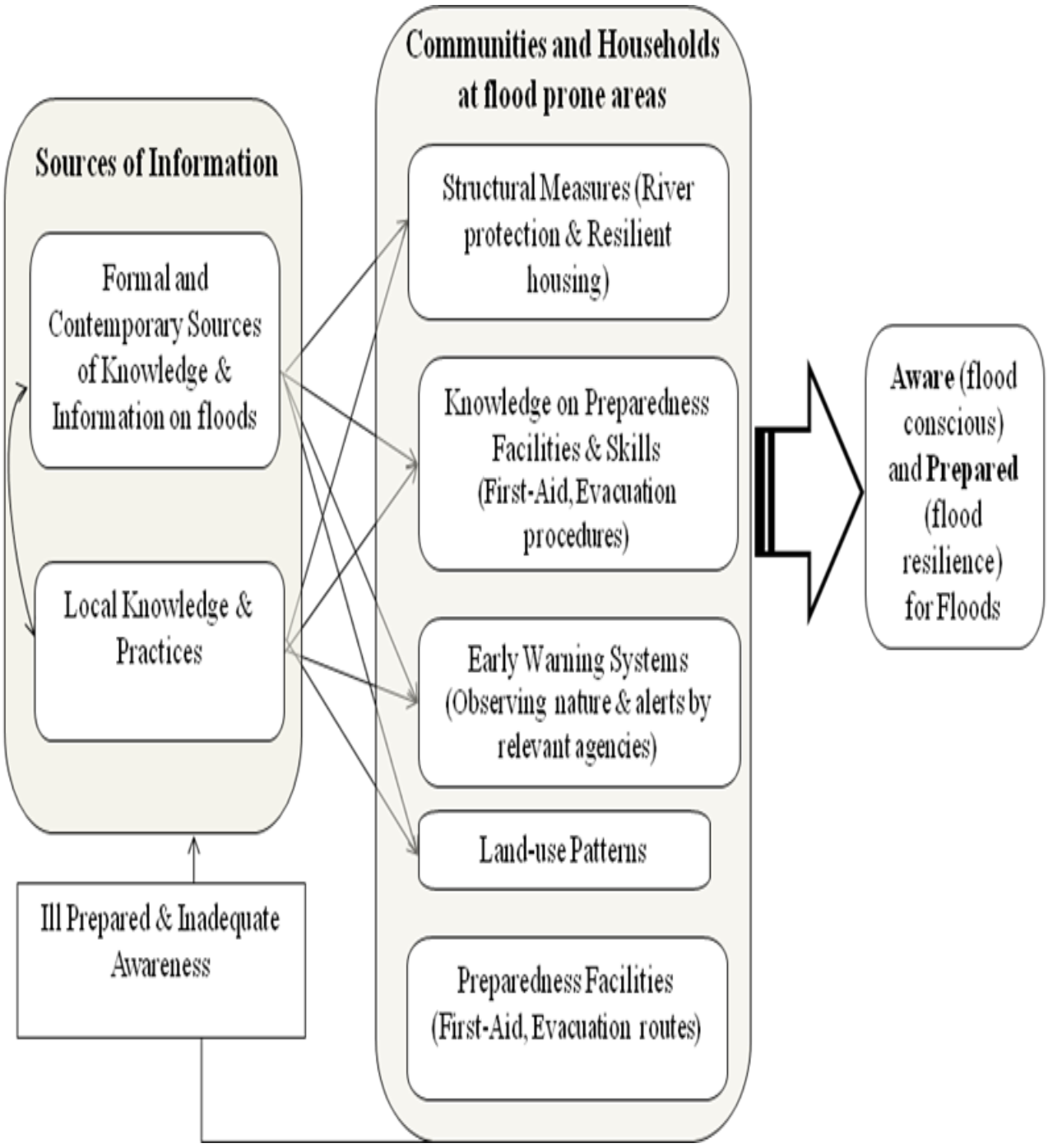
World Bank (2006) did a pilot study and developed hazard maps for early warning and preparedness for the middle and lower Tana River. Nonetheless, the study emphasizes that the lower reaches of Tana River are the most prone compared to the upper reaches of the entire basin. Assessment of the awareness for floods can be a value addition for effective structural and non-structural measures against flood damage and loss.

This study therefore sought to analyse the community awareness and preparedness for floods at the lower reaches of Tana River.

2.1 The Conceptual Framework

Over the time, flood events have proved to have a social, health, economic and environment impact. While, it may have positive impacts such as sediment deposition (leading to higher soil fertility), the negative consequences have outweighed markedly the positive impacts resulting to flooding events being branded as disaster occurrences that necessitates adequate awareness and proper preparedness (see the figure 2.3, below).

Figure 2.3: Conceptual Framework



Source: Researcher (2012)

Creating awareness and conveying of flood information enhances preparedness through appreciating the local knowledge and integrating contemporary sources of information and their means of conveying them. Local knowledge is based on traditional practices and ways of coping with flood problems. The knowledge is built on local interaction with the natural environment and has the potential of being passed across generations. Contemporary sources of information come-in to augment the local capacity through informing on alternative means of conveying early warning, sustainable land use, preparedness planning and community participation.

According to the Hyogo Framework for Action (HFA), climate change and variability play an important role in community vulnerability to disasters particularly with loss of lives and livelihoods and damages such as heavy rainfall events that continue to influence the flood extremes in the East Africa. Hence, the approach to flood awareness has a sustainable development element by allowing local participation in taking decisions on their livelihoods (in farming practices, settlement and health matters) and on managing of area natural resources through water conservation and river bank protection. Such knowledge on floods should build on structural and non-structural measures that develop local culture, knowledge, institutions, and leadership.

Elsewhere, Liao et al. (2010) applied a related model on situational awareness while studying trust in both formal and informal information Sources for personal hygiene practices.

CHAPTER THREE

3.0 Research Methodology

3.1 Introduction

This study focused on community awareness and preparedness for floods along the lower reaches of Tana River, Tana River County through analysis of sources of early warning information, analysis of preparedness for floods and finding out the availability of facilities to use during flood problems. The sample consisted of household heads residing in sub-locations that border Tana River, an area which is dominated by a flood plain that is prone to flood events caused by river overflow. The household head was preferred because they have higher direct interaction with the river; thus, ought to be aware and prepared for floods, beforehand.

3.2 Research Design

This study used a survey research design to determine awareness and preparedness of the community in the event of floods in the area. This study adopted a descriptive survey research design. Questionnaires were administered to gather primary data that describes the awareness and preparedness levels through questioning respondents about their knowledge, perceptions, and behaviour in the event of floods. The researcher explored into existing and relevant literature as an early opportunity to gain bases on the awareness and preparedness to flood events aspects. This study preferred the survey research design because the primary data collected was quantitative. This design is considered appropriate as the study seeks to do an analysis of community awareness and preparedness along lower Tana River, Tana River County.

3.3 Target Population

The target population of the study was the communities living along the lower Tana River within the Tana River County and more specifically populations living in the two divisions sampled. This research targeted 115 respondents (as the upper limit) from local community household heads. KNBS (2010) averages the density of the County to be six persons per km^2.

There are two administrative districts, namely Tana River and Tana Delta in Tana River County. There are 8 divisions, 7 locations and 34 sublocations bordering Tana River within the County. For the purpose of this study two division were selected out of the eight.

At the household level, the data was collected from the family head, if not available any other mature and responsible person (from 18 years and above) was used. These household heads were area residents. The household is a basic unit of the community. The household was preferred based on the assumption that their lifestyles have a higher direct interaction with the river. Household head was the preferred respondent on the premises of their decision-making influence and longer understanding and experience of local flood awareness and preparedness practiced.

3.4 Sample Design

This study used a multistage sampling technique in order to determine community awareness and preparedness for floods. A two stage sampling design was applied where the first stage involved selecting the sub-locations that lie along the lower Tana River. A total of 7 sub-locations (out of the 2 divisions) were selected in the process. The second stage involved selection of key respondents from the different sub-groups in the community. The household head was chosen on the premises of their proximity and higher interaction with the river; are primary candidates of receiving flood information; are aware of existing flood preparedness and are provided with facilities, techniques and equipment in readiness of flood events. The multisampling technique ensures the apportioning of respondents is representative across the study area.

3.5 Data Collection Procedure and Instruments

This study sourced both, primary and secondary data to achieve its three specific objectives.

3.5.1 Primary Data

The primary data was obtained through the distribution of questionnaires to the key respondents. Household heads were served with one type of questionnaire throughout the study area. Moreover, opportunistic questions were asked at some instances were favorable. The questionnaire format contained, both close-ended and open-ended questions. Likert-type

scaling with a 5 matrix alternative was included to improve on the response alternatives for closed-ended questions to include less extreme and neutral response choices. Likert type scale has questions that seek participant's preferences or degree of agreement via a statement or set of statements. Likert scales are a non-comparative scaling technique and are uni-dimensional (only Measure a single trait) in nature. One type of questionnaire was applied since household heads are equally served with flood information disseminated locally, have knowledge of community flood preparedness measures, and are provided with facilities, equipments, and techniques.

3.5.2 Secondary Data

Secondary data was obtained from review of published books and documents sourced from the University libraries, online sources from government ministries and agencies such as Kenya Met. Dept.

3.5.3 Field Visits

Field visits were conducted after a thorough review and inclusion of information on the study. The purpose of this was to improve on secondary data gathered during the review of the documented literature by administering questionnaires to the respondents and later analyze the data obtained.

3.6 Data Processing and Analysis

3.6.1 Data Processing

The data collected from administering questionnaires was scrutinized (data cleaning) for completeness, coding, organization and scoring in readiness for analysis. Only those qualifying from the data cleaning criteria were subject to analysis. The screening process ensured consistency in the data while preparing for data entry and manipulation. In preparation for analysis, data was entered based on set variables into the MS Excel computer applications. MS Excel was applied for statistical testing because of its flexibility and ease when handling data that has both quantitative and qualitative aspects.

The G test is a non-parametric test applied to establish whether the frequencies of the different sources of flood information are distributed along a provided ratio (occur as expected proportions). The computed χ^2 for frequencies of the different sources of flood information was calculated as follows:

$$\text{Computed } \chi^2 = \Sigma f_t \ln [f_t \text{ ratio}]$$

This is a one tailed test tested at a level of significance, α, of 0.05.

3.6.2 Data Analysis

3.6.2.1 Determining Distribution Tendencies

Distribution tendencies were performed on the data as an exploratory technique for frequency analysis.

3.6.2.2 Analysis of Community Awareness Of Various Sources Of Flood Information And Forms Of Conveying Early Warning

3.6.2.2.1 Analysis of Exposure to Floods

To investigate on the exposure to floods, this study used frequency distribution tables and graphs. The areas explored into were livelihood sources of households; flood experiences; influence of floods on household stay as well as explanations for exposure to floods.

Moreover, the study also investigated household head's knowledge of floods.

3.6.2.2.1.1 Analysis of the Various Sources of Flood Information and Forms of Conveying Early Warning

This study used frequency distribution tables and chart to analyze various sources of flood information and the use of local knowledge on flood indicators.

3.6.2.2.1.2 Analysis of Community Awareness to Respond to Flood problems

This study used exploratory techniques to investigate knowledge of community preparedness to respond to flood events, which was presented in the form of frequency distribution tables. Aspects investigated were knowledge on what to do before, during and after flood events.

Frequency tables were applied on likert scale results for awareness on flood level and frequencies.

3.6.2.2.2 Analysis of Available Facilities and Techniques to manage flood problems

Radar chart was used to present Likert scale results for flood preparedness.

Frequency analysis explored on the available facilities and skills to manage flood problems by investigating existing skilled first-aid capacities in the community, evacuation procedures and capacity of raised structures.

3.6.2.2.3 Testing Hypothesis using the G-Test

H_O The frequencies of the different sources of flood information are evenly distributed within the community

H_1 The frequencies of the different sources of flood information are not evenly distributed within the community

CHAPTER FOUR

4.0 Results and Discussion

4.1 Introduction

As specified in the research methodology section, this current section will analyze and discuss findings. The overall scope will be to analyze local community awareness and preparedness to combat and respond to floods along the lower reaches of Tana River.

This chapter is mainly organized in three parts. The first part is on the community awareness of the sources of early warning and flood information. The second is on the community awareness to respond to flood problems, and the third section is on the available facilities and skills to cope with flood problems.

4.1.1 Response Rate

The study intended to gather primary data from 115 respondents on the analysis of community awareness and preparedness to combat and respond to floods along the lower reaches of Tana River. The study's primary data collection exercise realized 62 administered questionnaires, which is about 53.9 percent of the initially intended target (see Table 4.1, below). This response outcome is a significant achievement considering the field visit involved prior arrangement for frequent visits as well as informing the respondent on the importance to participate in the study during the filling-in of the questionnaires.

Table 4.1: Participation Rates

Respondent Category	Questionnaires Target	Analyzed questionnaires	Percent of the analyzed Questionnaires
Household Heads	115	62	53.9

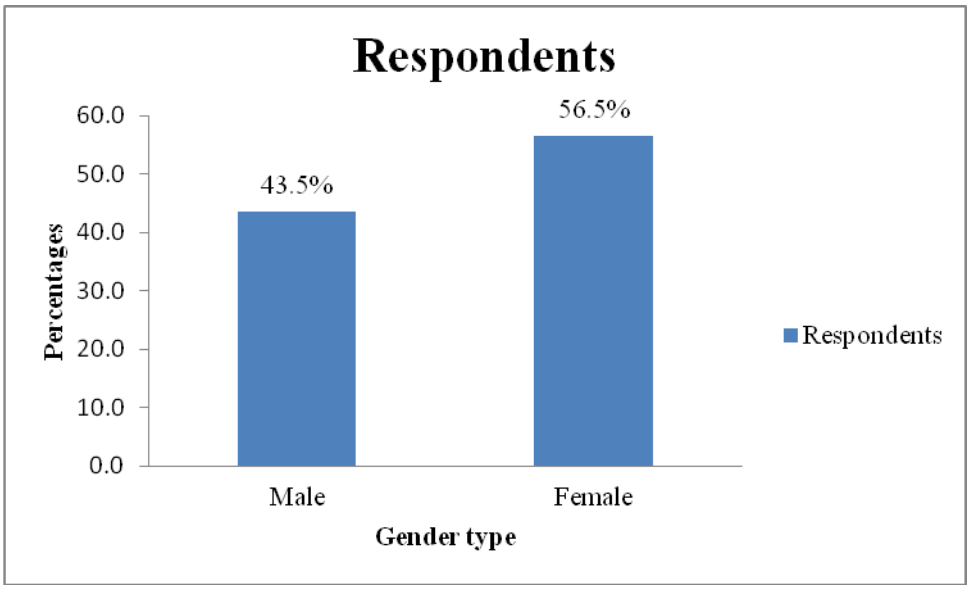
Source: researcher, 2012

Based on the study's participant response rates, there is a prevailing concern by the community residing along the lower Tana River to eliminate the suffering resulting from the flood events. The household heads' response showed concern on improving the safety levels for their lives, livelihoods and property against flooding events. Household heads were hardly aware of the relevant local institutions (disaster committees), though insisted on the need for action to be taken.

4.1.2 Respondents' Gender Composition

Regarding the gender composition of the respondents, the female respondents dominated at 56.5 percent (see Figure 4.1, below).

Figure 4.1: Gender Ratio in the Respondent Categories



Source: researcher, 2012

This shows that both genders from the community were part of the respondents.

4.2 Analysis of community awareness of the various sources of flood information and early warning

To address objective one, to analyze community awareness of the various sources of early warning information, aspects investigated include:

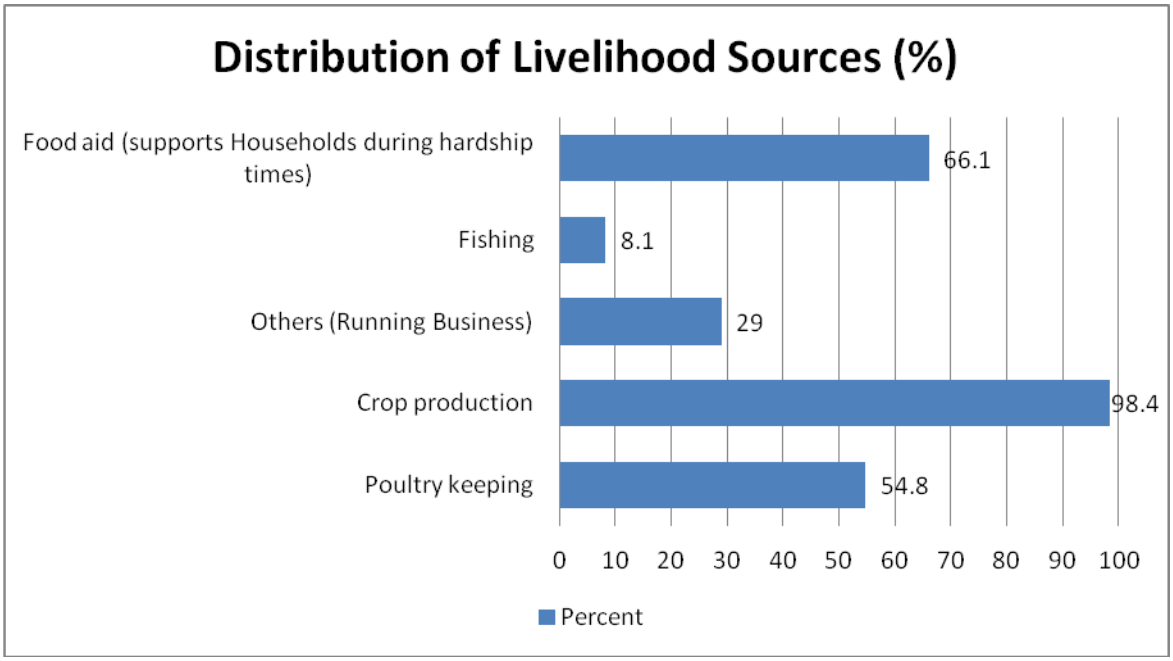
4.2.1 Livelihood Sources of households

This study investigated livelihood sources of households.

Based on the household heads who responded, 98.4 percent practiced crop production; 54.8 percent did poultry production; 8.1 percent involved in fishing and earned waged labour. About two-thirds (66.1 percent) had received food aid and donations from well-wishers. More than a quarter (29.0 percent) mentioned to involve in other livelihood activities such as small business and trading. See Figure 4.2, below on the distribution of livelihood sources.

Responses by household heads show that the populace along the river is agriculture-based. Farming dominantly consists of crop and poultry keeping.

Figure 4.2: Respondents Livelihood Sources



Source: Researcher, 2012

Livelihood categories of the respondents as represented show that households are vulnerable and likely to be affected more often when floods occur. This prioritizes them as potential victims who should be targeted during the dissemination of flood information and conveying of flood early warning. Flood waters that cover community land lowers its productivity and increases the chances losing harvest and property; ultimately household stand to loss their livelihood sources. This is further reinforced in that there are households that have received food aid and donations from well-wishers at one point. In the Tana River District, at times loss of crop produce due to floods lead to food shortages and sudden rise in commodity prices (World Bank, 2006). In Western Kenya, crop loss of up to 50 percent happens once in three years (Otiende, 2009).

4.2.2 Respondents' Knowledge of Floods

This investigated whether community has the knowledge of floods. All (100%) the respondents indicated to know about floods. There were no community groups dedicated towards management of flood problems.

This is an indication that flooding along the river is a problem to the community at the lower Tana River. Not only do the household heads agree to be affected by flood occurrence but also confirm that flooding usually covers wide area in the region away from the banks of the

River. In addition, this shows that community of the lower Tana River is not free of flooding and that the floods problem stands to disturb the normal way of life. Disasters still acquire multiple interpretations with the supernatural (religious expression) being dominant but the social meaning is fast getting recognition due to harm happening to people (Nyakundi et al. 2010).

4.2.3 Flood Experience

This investigated where the respondents had experienced floods. Majority (77.4 percent) of the household heads indicated that they had directly been affected by floods (see Table 4.2, below). A significant number (14) indicated that they had no significant flood experience and that level of water in the river went below its flooding heights soon after check dams were constructed upstream. Close to two-thirds (66.1 percent) of the respondents indicated that their flood loss experiences were within their homesteads and crop fields causing destruction of household structures, belongings, inundation of standing crops and outbreaks of water-borne diseases.

Table 4.2: Distribution of Flood Experiences

Item	Household Heads Sampled
Directly experienced floods	48 (77.4 %)
Not affected	14 (18.0 %)

Source: Researcher, 2012

This shows that the community of the lower Tana River has been directly affected by flood problems. Community members with flood experiences enhance awareness through sharing their life experiences as well as in assisting to identify flood hazard spots. Identification of hazards spots is a requisite to hazard mapping and strategic positioning of flood warning signs. Informative sharing of life experiences contributes to better visualize local flood problems.

4.2.4 Influence of Floods on Households Displacement

The study investigated the effects of floods on household stay. Most (58.1 percent; 36) of the household heads indicated that they had moved due to floods. Out of this, 47.2 percent of the households had to evacuate for weeks and the remaining 52.8 percent spent more than a month away (see Table 4.3, below).

Table 4.3: Household and Duration Spend While Displaced

	Weeks	Months
Respondents	47.2% (17)	52.8% (19)

Source: Researcher, 2012

This shows that households at the lower Tana River have to relocate due to floods. Nonetheless, the displacement causes disruption of the normal life, not only house routines but also livelihood activities. Livelihoods lost translate to a drawback into poverty or lost earnings/incomes or wasted efforts and resources. Community with relocation experiences helps to better visualize the magnitude of the local flood problem, which raises the interest to learn more about local flood risks and the consequent reduction measures.

4.2.5 Exposure to Floods

The household respondents were required to indicate whether they felt safe from floods. A majority (77.4 percent) of household heads indicated that they were not safe from floods.

This shows that within the community there is a risk of floods. Awareness can easily play role in providing knowledge to the community that minimize loss and damages caused by devastating flood events. This knowledge is based on the appreciation that floods occur and pre-disaster activities (that is, flood preparedness) are intended to equip the community on what to do before, during and after floods. Studies show that families that move back after floods subside remain a concern due to their exposure to future events of flooding in the same areas.

4.2.6 Explanation for Exposure to Floods

This intended to establish from the household respondents whether their compounds were unsafe in case of a flood. Most (27.9%) of the households linked their exposure to floods with farming and other closely related reasons (See Table 4.4, below).

Table 4.4: Flood Exposure

Explanation for Exposure	Frequency of Respondents
River level and flow	24.6% (15)
Housing structures	13.1% (8)
Farming and other closely related reasons	27.9% (17)
No Reason provided	34.4% (21)

Source: Researcher, 2012

This shows that there are priority areas the community need to reduce flood problems. Raising the capacity of communities to adapt to changes of river flow involves imparting knowledge on simple measures such as lining-up sandbags to protect household compounds against flood damage (ASFPM, 2003). In addition, adaptation strategies will require community awareness on resilient housing structures that withstand flood damage. Housing structures are made resilient by elevating them above flood levels (FEMA, 2005) and using strong building materials such as stone. Knowledge on sustainable land-use has the potential of providing skills on crop production and agro-forestry for improved food security during flood and soil loss protection.

Plate 4.1: A Household compound

Source; Researcher, 2012

This shows that the knowledge to impart during flood awareness will rely on preparedness measures to combat flood disasters for the community along the lower Tana River. Awareness action will alleviate fear from the flood risks, while preparedness measures will restore confidence for normal livelihood activities. World Bank (2006) notes that there is need to develop understanding of community flood experiences along the lower Tana River on the bases of "who is affected" and "where are they located" because some sectors of the population are more affected than others. This understanding becomes important during th planning of social aspects of flood emergency management.

4.2.7 Sources of Information on Flood

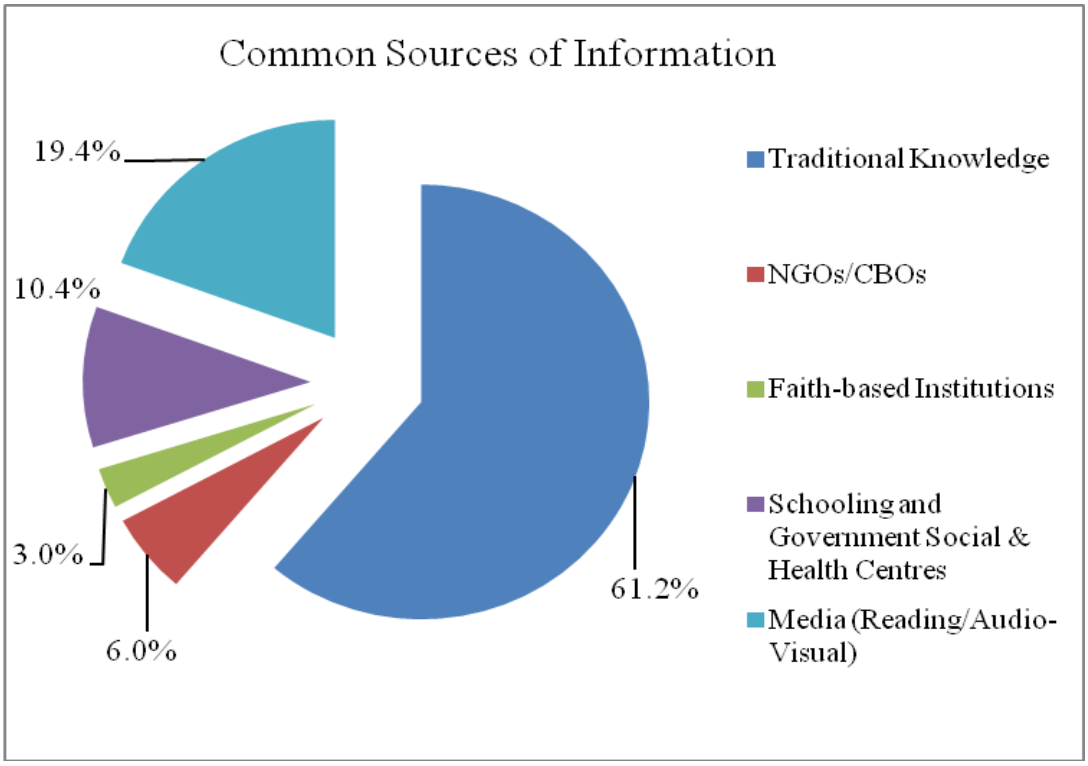
Sources of information on what to do before, during and after flood events were indicated by the respondents. The local knowledge was the most popular (61.2%) (see Table 4.5 and Figure 4.3, below).

Table 4.5: Sources of Information for Flood Event Preparedness

Sources of Information on Flood	**Percent**
Local Knowledge	61.2
NGOs/CBOs	6.0
Faith-based Institutions	3.0
Schooling and Government Social & Health Centres	10.4
Media (Reading/Audio-Visual)	19.4

Source: Researcher, 2012

Figure 4.3: Sources of Information for Flood Event Preparedness



Source: Researcher, 2012

This shows that the community has various sources of information on flood awareness with local knowledge being the most common of all. The different sources have diverse ways of conveying flood preparedness information to the community. Though different, the sources have the potential for integration for a common access within reach for every member of the community. According to ASFPM (2003), community education and outreach programs were intended to make people more aware of the flood hazards and protection alternatives; more-over, they are now going one step further to impart knowledge that will change attitudes and behaviour.

4.2.8 Local Knowledge on Flood Indicators

Respondents were required to indicate on a commonly known local flood indicators. Only 62.9% of the respondents specified the nature of local flood knowledge (see Table 4.6, below).

Table 4.6: Distribution of the local Knowledge of Flood Indicators

Local Flood Knowledge Indicators	Frequency	Percent
Knowledge of Flood Cycles	11	25.0
Knowledge of Weather Pattern	6	13.6
Behaviour of Humans, Animals and Plants	27	61.4

Source: Researcher, 2012

The existence and use of local knowledge for predicting floods in the lower Tana River shows the concern by the local community to participate actively in flood preparedness. This local knowledge is based on observing nature and monitoring natural environment such as observing intensity of dew forming, croaking of frogs, spotting of certain type of river snake, a flock of certain birds near the river or swarm of butterflies near crop fields. Old people know how the natural environment including weather has changed over the time. On these grounds, it is easily passed from one generation to another.

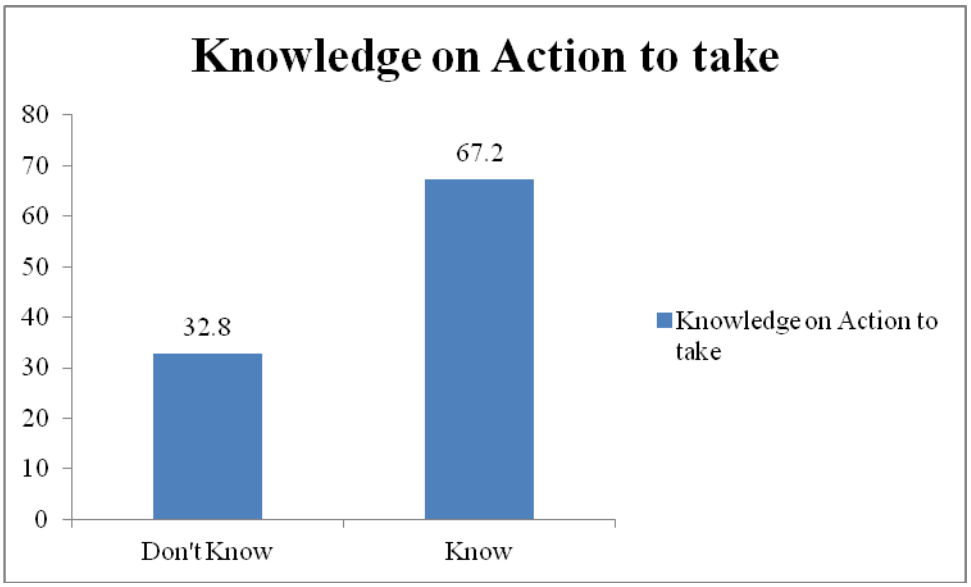
4.3 Community Awareness to Respond to Flood Problems

To address objective two, to analyze community preparedness to respond to flood events, the following aspects were looked at:

4.3.1 Knowledge on what to do before, during and after flood event

This investigated on the household head knowledge of what ought to be done before, during and after flood occurrence. Over two thirds (67.2%) of household respondents indicated that they knew what to do (See Figure 4.4, below).

Figure 4.4: Knowledge on Action to Take



Source: Researcher, 2012

Whether those household heads indicating to know about what to do before, during and after flood events is the most appropriate and effective and in line with agreed flood disaster preparedness and response strategy within the national draft policy on Disaster Management, was not immediately established during the study undertaking. Indigenous knowledge was a vital tool in reducing flood risks in ancient traditional communities as it provided warning signs for those settled on the flood prone areas. In the USA, a Certified Floodplain Manager is employed at County level to assist communities comply with activities that prepare them for floods and liaise the State Officials in planning and administering response and recovery activities (FEMA, 2005).

4.3.2 Awareness on Flood Levels and Frequencies

This investigated whether respondents were regularly aware on flood forecasts and frequencies. Majority (21.4 percent) of the household heads who responded were neutral on this (see Table 4.7, below).

Table 4.7: Flood forecast and Frequencies Awareness

Households Heads	Disagree	Neutral	Agree
Frequencies	1	3	1
Percentages	7.1	21.4	7.1

Source: Researcher, 2012

Unless the household are consistently informed of the water levels along Tana River; it is likely that they will become oblivious of the flood risks thus increasing their vulnerability. Established synergies between relevant government instruments (disaster committees) and the community members will raise the concern on the localized flood risks. Flood forecasts initialize forward thinking into pre-emptive and preventive measures for future events. In the USA, the National Weather Service (NWS) characterizes (into minor, moderate or major flooding) for effective communication of flood forecasts (NOAA, 2005). Minor flooding constitute minimal or no property damage but with possible public threat or inconvenience. Moderate flooding constitutes some inundation of structures and roads near streams. Some people may evacuate and move property to higher grounds. Major flooding is an extensive scale of the moderate stage. For every NWS river forecast location, flood stage associated with each of the NWS flood severity categories are established in cooperation with local public officials. Impacts vary from one river location to another because a certain river stage (height) above flood stage in one location may have an entirely different impact than the same level above flood stage at another location (NOAA, 2005).

4.4 Available Facilities To Cope With Flood Problems

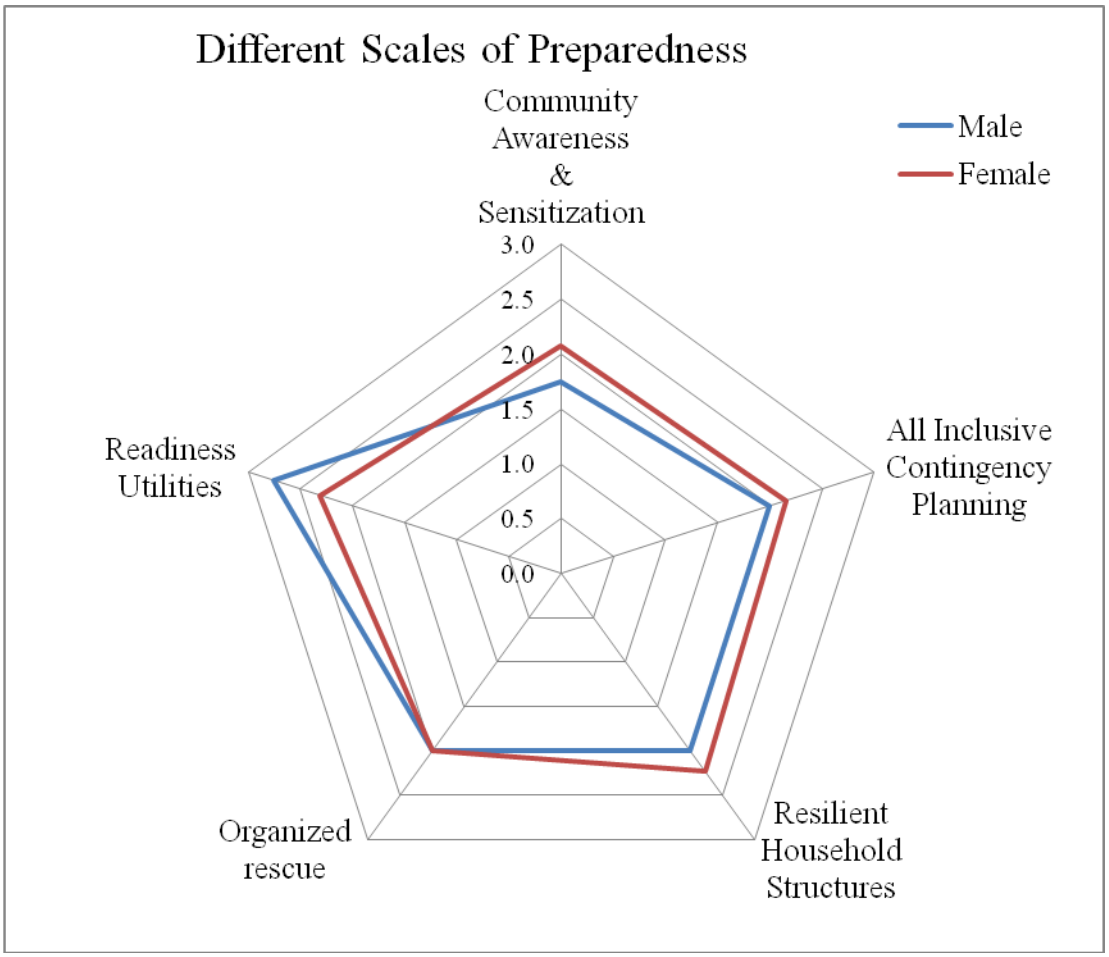
4.4.1 Household Scales of Preparedness

In order to address objective three, the study analyzed the household scales of preparedness based on the Likert where 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree; the means (α) of different aspects of flood disaster preparedness and response were applied (see Figure 4.5, below).

On whether there are sensitization activities to strengthen community disaster awareness, both males (α=1.8) strongly disagreed and females (α=2.1) respondents disagreed. Regarding whether everyone in the community participates during the events of flood, both males (α=2.0) and females (α=2.2) disagreed. On whether there are materials (clean water, blankets, tents, battery-powered radio) provided by agencies/organizations in-readiness for disasters, both females (α=2.3) and males (α=2.8) disagreed. Regarding whether structures within the household compound are built/erected to defend and protect against flood damage (in terms protecting livestock, belongings and lives), both males (α=2.0) and females (α=2.2) disagreed. On whether as a community member have an organized plan to guide rescue activity during disasters, both males (α=2.0) and females (α=2.0) disagreed. On whether

household keeps a contact list in-cases of flood emergencies, both males (α=2.0) and females (α=2.0) disagreed.

Figure 4.5: Household Preparedness Scales



Source: Researcher, 2012

The spread of mean values (α) shows that at household level, views along lower Tana River indicate low levels of flood awareness. Communities vulnerable to flood problem require knowledge on coping strategies such as building designs for flood prone areas, adoption of disaster management plans, conservation of riparian vegetation as a strategy to reduce risk, among others. Flood awareness should consider the new coping strategies as part of building capacity on to advance flood preparedness as part of climate change. Knowledge on these strategies are developed to assist the community as a whole to adapt to the problems associated with climate change. In the USA, the "No Adverse Impact" (NAI) principle is advanced by the ASFPM to guide community pre- and post- disaster planning of

development activities to avoid future damages by floods (ASFPM, 2003). For instance, communities that adopt NAI concept have pre-planned emergency operations.

4.4.2 Facilities to Manage Flood Problems

The study investigated on the facilities available to the community to cope with flood problems (See table 4.8, below).

Table 4.8: Available Facility

Available Facility and techniques		Yes	Percent (%)
First-Aid skills		3	4.8
Availability of Evacuation Routes		4	6.5
Capacity of raised structures	1 - 2	2	3.2
	3 - 4	4	6.5
	5 & more	3	4.8

Source: Researcher, 2012

There is need to equip households with essential life saving skills such as in administering rescue and resuscitation from drowning as well as injuries and wound dressing, among others. The flood hazards along the Tana River make the inhabiting households priority candidates for training and organizing as first aid brigade. Such primary health services will save lives. In addition, first aid training modules are packaged with hygiene and sanitation education that are valuable in preventing disease outbreaks in case of flood events.

Considering the flooding tendencies of the lower Tana River, it is imperative that evacuation routes at household level be in place as a preparedness measure against floods. Lack of evacuation routes for flood escape partly may lead to loss of lives through drowning, particularly during extreme flooding events.

Considering the landscape and density pattern of Tana River County, the current carrying capacity of raised structures is not safe since most of the existing can hold fewer at a go. On average household size within the Tana River Districts is six members.

4.5 Testing Hypothesis

H_o The frequencies of the different sources of flood information are evenly distributed within the community.

H_1 The frequencies of the different sources of flood information are not evenly distributed within the community

Table 4.9: Sources of Flood Information

Sources of Information on Flood	**Observed Freq (f_0)**	**Expected Ratios**	**Ratios**	**ln Ratio**
Knowledge of Flood Cycles	11	1	1.1	1.048
Knowledge of Weather Pattern	6	1	0.6	-3.065
knowledge on Behaviour of Humans, Animals and Plants	27	1	2.7	26.818
NGOs/CBOs	4	1	0.4	-3.665
Faith-based Institutions	2	1	0.2	-3.219
Schooling and Government Social & Health Centres	7	1	0.7	-2.497
Media (Reading/Audio-Visual)	13	1	1.3	3.411
Total	70			
Computed ln Ratio				37.662
Computed χ^2				1.31E-06

Source: Researcher, 2012

The computed ln Ratio (χ^2) value of 37.662 has a P-value of 0.00000131 (1.31E-06) and is in the rejection region at significant level of 0.05. The decision therefore is to reject the H_o. The difference between the observed and the expected frequencies is not due to chance. Rather the differences between the two are large enough to be considered significant. The chance of these differences being due to sampling is very small so we conclude that it is unlikely that the frequencies of the different sources of flood information are evenly distributed within the community.

The community members can benefit from a common access that facilitates learning of new methods of sourcing flood information. In addition, this will increase local involvement of each community member in reducing flood risk through diverse ways of conveying sources of flood information. In the USA, the Federal Emergency Management Agency (FEMA), the Corps of Engineers, National Oceanic and Atmospheric Administration and American Red Cross Society (ARCS) came together to set up the Association of State Floodplain Managers (ASFPM) to provide training and education to individuals on flood plain management. The program awards certification for successful completion and keeps skills up through continuing education as credits increase (ASFPM, 2003).

CHAPTER FIVE

5.0 Summary, Conclusions and Recommendations

Introduction

This chapter provides a summary of main findings, conclusions and recommendations drawn from the study.

5.1 Summary of Findings

This study reveals that members of the community along the lower reaches of Tana River are affected by floods. The livelihood sources practised (crop production) and safety concerns confirm that indeed flood is a disaster, through inundation and property damages. Household heads further revealed that they have had to relocate for safety because floods contribute to disturbed livelihoods.

In this study, the community members knew floods and there were various sources of conveying flood information. Local knowledge was applied side by side with the channels of conveying early warning on floods by the relevant authorities. The Ministry of State for Special Programmes releases the early warning alert information on floods for timely dissemination. Exposure to floods was mainly linked with level of water in the river, farming, and housing structures.

It came out in the study that respondent household heads were not organized and participating in any community flood management initiatives. Such organized grouping provide structural platform upon which preparedness practices are realized, through rolling-out local flood management initiatives beyond the confines of the household level. The community level of organization presents the next tier above household upon which to manage disaster preparedness and response activities. The community tier intervenes when the household is overwhelmed in the event of flood problems.

Lastly, the study found that community along the lower Tana River was ill equipped in preparation for flooding events. Majority of households had low understanding of evacuation measures. The carrying capacity of the raised structures was below the average number of household members. There were few community members skilled to administer life saving services in the event of disaster strikes.

5.2 Conclusions

Based on the results of the study, the households residing along the lower Tana River stand vulnerable to flood events. The lower reaches of Tana River is characterised by a flood plain that has attracted the local agricultural communities. Floodwaters from the River find their way into households and farms. The floodwaters pose risk on households with low knowledge on floods and have houses constructed with material that are low resilient to floods as well as lack special arrangement on early warning in the event of floods.

At community level, households along lower Tana River have the potential but lack adequate information on importance of organizing themselves into flood disaster groupings that raise awareness on flood preparedness measures. The presence of community level preparedness enables households to pool resources, facilitate educational training (on managing flood problems at the household level) and volunteer programs (such as flood watch), mobilize supplies (blankets, torches, first-aid kit and tents) in the event of floods and erect flood warning posts to measure floodwater levels. At lower Tana River, the community level can be made aware of the importance of flood preparedness from a common access for early warning information and maintaining an emergency contact list. Without emergency contact lists how do households backchannel information in the event of flooding? Community level participation in preparedness is largely a bottom-up initiative for locals to help themselves from a disaster. Issues identified as overwhelming at community level are brought up to district level for prioritization during development planning and more expert input.

Along the lower Tana River, various sources of conveying flood information operate side by side with the local knowledge on floods being popular. In a disaster conscious society, the household are the first-line of preparedness to combat flood events, which is demonstrated by knowledge on proper skills and facilities.

Structured knowledge will promote harmony within the community awareness through integration of local knowledge and scientific information on early warning, affordable technology, uses of facilities and activities for flood preparedness and response.

5.3 Recommendation

In order to reduce the level of disaster occurrences, the household as the basic unit of the community ought to be adequately aware on measures of achieving management of disasters.

5.3.1 To Policy Makers

A program should be developed for awareness on reducing flood risk that involves relevant actors and specialists and targets household heads in flood prone areas. Dissemination should be packaged alongside preparedness equipments and facilities for implementation.

As part of addressing flood issues, community flood management groups and associations can bring together several households. Such groupings can easily form disaster management-demonstration centres that implement pre-disaster activities such as local emergency planning, river level monitoring, first-aid and rescue brigades and emergency contact lists as well as ground the need that every community member to equally participate in addressing disaster matters. These groupings become the liaison stakeholders for the upper echelons (line ministries and lead agencies) involved in disaster management.

Community demonstration centres should be set up to serve as local repositories for education materials and where communities are mobilized for learning and practising flood preparedness activities. Activities at the demonstration centres act as indicators of community participation, level of engagement and community resource capacities. Demonstration centres may facilitate the dissemination of early warning information to the community members once released by the relevant authorities.

Like in the USA, volunteers within the community should be trained and facilitated to administer flood management. While household heads provide leadership on flood management matters at household level, these volunteers provide leadership and assistance at community level. These volunteers should facilitate operations at their local community demonstration centres. In the USA, these volunteers are known as Certified Floodplain Managers, and are on continuous education program conducted by relevant authorities, and earn extra credits as they undergo more training and gain experience in the field.

5.3.2 To Future Researchers

Future researchers explore the use of motivational skills in flood management education. There is need to draw more attendance during awareness and sharing of flood information.

6.0 References

ASFPM, 2003. *NO ADVERSE IMPACT: A Toolkit For Common Sense Floodplain Management.* [Online] [Accessed 15 January 2013].

World Bank, 2006. Natural disaster hotspots case studies. Washington DC:The World Bank.

Bakibinga-Ibembe1, J.D., Said, V.A. and Mungai, N.W., 2011. Environmental laws and policies related to periodic flooding and sedimentation in the Lake Victoria Basin (LVB) of East Africa. *African Journal of Environmental Science and Technology,* 5(5), pp.367-380.

Bouillon, S., Abril, G., Borges, A.V., Dehairs, F., Govers, G., Hughes, H., Merckx, R., Meysman, F.J.R., Nyunja, J., Osburn, C., Middelburg, and J.J., 2009. Distribution, origin and cycling of carbon in the Tana River (Kenya): A dry season basin-scale survey from headwaters to the delta. *Journal Biogeosciences,* 6, pp.5959–6023.

Bouwer, L.M., Crompton, R.P., Faust, E., Höppe, P., Pielke Jr., R.A., 2007. Confronting Disaster Losses. *Science*, 318, p.753.

CRED, (2011). *Annual Disaster Statistical Review 2010: The numbers and trends*. [Online] Available at: <http://www.cred.be/sites/default/files/ADSR_2010.pdf> [Accessed 28 August 2011].

DFID, 2007. *Characteristics of a Disaster-resilient Community*. [Online] [Accessed 15 January 2013].

DFID, 2004. *Adaptation to climate change: Making development disaster-proof.* [Online] [Accessed 15 January 2013].

FAO (Food and Agriculture Organization), 1968. *Survey of the Irrigation Potential of the Lower Tana River Basin. Prepared by ACRES International Limited.* Canada: International Land Development Consultants N. V. and the Government of Kenya.

FEMA, 2011. *Floods/Farm Waste Spills.* [Online] Available at: <http://training.fema.gov/emiweb/downloads/is111_Unit%2011.pdf> [Accessed 28 August 2011].

FEMA, 2005. *Floodplain Management Requirements: A Study Guide and Desk Reference for LocaL Officials.* [Online] [Accessed 15 January 2013].

GoK, 2009. *Draft National Policy for Disaster Management in Kenya, 2009*. [Online] Available at: <http://www.kecosce.org/downloads/DRAFT_DISASTER_MANAGEMENT_POLICY.pdf> [Accessed 28 August 2011].

GoK, 2005. *Tana River District Strategic Plan 2005 – 2010: For Implementation of the National Population Policy for Sustainable Development.* [Online] [Accessed 15 January 2013].

ICPAC, 2007. *Climate Change and Human Development in Africa: Assessing the Risks and Vulnerability of climate Change in Kenya, Malawi and Ethiopia.* [Online] [Accessed 15 January 2013].

IFRC, 2011. *Brazil: Floods.* [Online] [Accessed 15 January 2013].

IFRC, 2010. *Niger: Floods.* [Online] [Accessed 15 January 2013].

IUCN, 2003. *Tana River, Kenya: Integrating Downstream Values into Hydropower Planning*. [Online] Available at <http://cmsdata.iucn.org/downloads/casestudy06tana.pdf> [Accessed 15 January 2013].

KNBS, 2008. *Well-being in Kenya: A Socio-Economic Profile.* Kenya:KNBS

Leauthaud, C., Duvail, S., Belaud, G., Moussa, R., Grunberger, O. and Albergel, J., 2012. Floods and wetlands: combining a water-balance model and remote-sensing techniques to characterize hydrological processes of ecological importance in the Tana River Delta (Kenya). *Hydrol. Earth Syst. Sci. Discuss.,* 9, pp.11267–11318.

Liao, Q., Cowling, B.J., Lam, W.W., Fielding, R., 2010. The Influence of Social-Cognitive Factors on Personal Hygiene Practices to Protect Against Influenzas: Using Modelling to Compare Avian A/H5N1 and 2009 Pandemic A/H1N1 Influenzas in Hong Kong. *International Journal of Behavioral Medicine,* 18, pp.93–104.

Ministry of Environment and Natural Resources, 1985. *Lower Tana River: District Environmental Assessment Report*. [Online] [Accessed 15 January 2013].

Murase, M., Tyagi, I., Saalmueller, J., and Nagata, T., 2009. *Organizing CommunityParticipation For Integrated Flood Management.* [Online] [Accessed 15 January 2013].

NOAA, 2005. *Floods: The Awesome Power*. [Online] [Accessed 15 January 2013].

Nyakundi, H., Mogere, S., Mwanzo, I., Yitambe, A., 2010. Community perceptions and response to flood risks. *Journal of Disaster Risk Studies*, 3(1), pp.346-366.

OCHA, 2011. *Philippines: Tropical Storm Washi*. [Online] [Accessed 15 January 2013].

Olowu, D., 2010. The Hyogo Framework for Action and its implications for disaster management and reduction in Africa. *Journal of Disaster Risk Studies,* 3(1), pp.303-320.

Onywere, S.M., Getenga, X.M., Mwakalila, S.S., Twesigye, C.K. and Nakiranda, J.K., 2011. Assessing the Challenge of Settlement in Budalangi and Yala Swamp Area in Western Kenya Using Landsat Satellite Imagery. *The Open Environmental Engineering Journal,* 44, pp.97-104.

Otiende, B., 2009. *The Economic Impacts of Climate Change in Kenya: Riparian Flood Impacts and Cost of Adaptation.* [Online] Available at: <http://kenya.cceconomics.org/kedo/kenya-riparian-floods-case-study.pdf> [Accessed 28 August 2011].

Perez, R.T., Espinueva, S.R. and Hernando, H., 2007. Community-Based Flood Early Warning Systems. *Journal of Environmental Science and Management,* 11(1), pp.55-63.

Shauri, H.S., 2007. *Social services in disaster situations in Kenya.* [Online] Available at: <http://www.ifra-nairobi.net/cahiers/Cahier_35.pdf> [Accessed 28 August 2011].

Shaw, R., 2006. Critical Issues of Community Based Flood Mitigation: Examples from Bangladesh and Vietnam. *Journal of Science & Culture,* 72 (1), pp.1-17.

Tamooh, F., Van den Meersche, K., Meysman, F. and Marwick, T.R., Borges, A.V., Merckx, R., Dehairs, F., Schmidt, S., Nyunja, J. and Bouillon, S., 2012. Distribution and origin of suspended sediments and organic carbon pools in the Tana River Basin, Kenya. *Journal Biogeosciences*, 9, pp.2523–2566.

UNEP, 2012. *Fresh Water for the future: A synopsis of UNEP activities in water*. [Online] Available at: <http://www.unep.org/pdf/Water_Report_2012> [Accessed 15 January 2013].

UNEP, 2008. *Africa: Atlas of Our Changing Environment.* [Online] [Accessed 15 January 2013].

UN-ISDR, 2008. *Gender Perspectives: Integrating Disaster Risk Reduction into Climate Change Adaptation Good Practices and Lessons Learned.* [Online] [Accessed 15 January 2013].

WFP, 2010. *Climate Change: A humanitarian challenge for the 21st century*. [Online] Available at: <http://documents.wfp.org/stellent/groups/public/documents/communications/wfp212397.pdf> [Accessed 28 August 2011].

World Bank, 2012. *The Role of Hydrometeorological Services in Disaster Risk Management.* [Online] [Accessed 15 January 2013].

World Bank, 2011. *Recovery and Reconstruction in the Aftermath of the 2010/2011 Flood Events and Cyclone Yasi.* The International Bank for Reconstruction and Development / The World Bank: Washington DC.

World Bank, 2006. *Natural Disaster Hotspots Case Studies*. The International Bank for Reconstruction and Development / The World Bank: Washington DC.

World Meteorological Organization, 2011. *WMO statement on the status of the global climate in 2010.* [Online] [Accessed 15 January 2013].

WMO, 2010. *Weather Extremes in a Changing Climate.* [Online] [Accessed 15 January 2013].

WMO, 1998. *EL Nino Update.* [Online] [Accessed 15 January 2013].

World Resources Institute, 2007. Nature's Benefits in Kenya: An Atlas of Ecosystems and Human Well-Being. [Online] [Accessed 15 January 2013].

Appendix

Appendix I Time Schedule

Item	Task	Start	End	Month:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Proposal Development	Jun '11	Jun '12													
2	Preparation for data collection	Jun '12	Jul' 12													
3	Data Collection	Aug '12	Dec '12													
4	Data Analysis and Interpretation	Nov '12	Dec '12													
5	Report Compilation	Dec '12	Apr '12													
6	Project Presentation and Defense	May '13														
7	Incorporation of Remarks	Jun-Jul '13														
8	Draft Final Report	July '13														

Appendix II PROJECT BUDGET

The cost estimates for the project

Item/Activity	Amount	Price per Item	Total
Preparation of Write-ups			
1. Drafting and Printing			10,000
2. Information Search			15,000
3. Communication			5,000
Administration of questionnaires			
1. Research Assistant	33 days	1200	39600
2. Transport			15,000
3. Communication			5,000
Sub-Total			**89,600**
Contingency (10% of Sub-Total)			**8,960**
Grand Total			**98,560**

Appendix III Questionnaires

The set of questionnaires to administer during the primary data collection are of one kinds, that is questionnaire for Household Heads

(a) Questionnaire for Household Heads

Please tick (√) in the box provided for the right response

Division Name: _____
Location Name:_____ Sub-location Name:_____
_____

What is your gender?
☐ Male ☐ Female

Which livelihood sources does the household fall-under?

Characteristic	Own Farm	Crop Prod.	Livestock Prod.	Poultry Prod.	Fishing	Waged Labor in paddies/Farms	Gifts and Food Aid	Others (name)
Tick (√)								

1. Do you know what flood is?
☐ Yes ☐ No
If yes, proceed to question 1(b), if no go to question 2,
(a) Have you ever experienced a flood event? ☐ Yes ☐ No
If yes, proceed to question 1(c) and (d),
(b) Where were you when you experienced the flood event?
_____
_____
2. Are you aware of what to do before, during and after flood event has occurred?
☐ Yes ☐ No
3. (a) Have you ever been evacuated from your residence due to floods?
☐ Yes ☐ No
If yes, proceed to 3(b), if No go to question 4.
For how long were you evacuated or displaced?_____
4. (a) Does anyone impart you on what to do before, during and after a food event?
☐ Yes ☐ No
If yes, proceed to question 4(b) and (c), if no go to question 5.
(b) Who has imparted on you?
☐ Intergenerational Knowledge ☐ Self-Help Group ☐ CBOs/NGOs ☐ Media
☐ School and Government Social and Health facilities ☐ Faith-Based Institutions ☐ Others

(c) Which awareness creation and sensitization platforms were used to impart?

☐ Open Discussion ☐ Workshop/Seminars ☐ Public Barazas

☐ Reading Materials Only ☐ Demonstrations

5. (a) Do you reckon there is a District Disaster Emergency Committee (DDEC) in this area? ☐ Yes ☐ No

(b) Is your community represented? ☐ Yes ☐ No

6. Do you know any Flood Management Groups (Community Disaster Management Initiatives)? ☐ Yes ☐ No

If yes, proceed to question 6(b), if no go to question 7.

(b) Do you have any in your local community? ☐ Yes ☐ No

7. (a) In case of a flood event in the household compound, do you have raised structures that secure property from being washed away or inundated?

☐ Yes ☐ No

If yes, proceed to part 7(b), if no go to question 8.

(b) What types of valuables are placed at the raised structures?_____

_____

8. In case of a flood event in the household compound, do you have an escape rote which to follow in order to evacuate? ☐ Yes ☐ No

9. (a) Is there a safe raised ground in the household compound tat water cannot reach where you can run for refuge, in case of flood event? Yes ☐ No ☐

If yes, proceed to part 9(b), if no go to question 10.

(b)How many people can be accommodated there at one time?_____

10. (a) Do you have at the household a fast-aid kit or improvised facility for the same?

☐ Yes ☐ No

If yes, proceed to part 10(b), if no go to question 11.

(b) Are you or any other household member trained in administering fast-aid?

Yes ☐ No ☐

11. (a) At household level, do you have an alerting system, in case of a flood event in the compound? Yes ☐ No ☐

If yes, proceed to part 11(b), if no go to question 12.

(b) Do you have an assembling point/place in case of an alert has been raised

Yes ☐ No ☐

12. (a) Which of the below local ways (Traditional Early Warning Flood Indicators) of knowing whether it would flood do you know?

This will apply when the researcher encounters an elder during data collection at household level

No.	Traditional Flood Knowledge Indicators	Tick (√) (where applicable)
	Behaviour of Humans, Animals and Plants	
1	Old people's bone aching	
2	Large numbers of cow egrets sited	
3	Loud persisted croaking of frogs	
4	Domestic animals making loud distraught noises	
5	Movement of ants to higher grounds	
	Knowledge of Weather Pattern	
6	Heavy rains in the area for long periods of time	
7	Heavy rains in the upper catchments areas	
8	Lightning and thunder on the river	
9	Temperatures higher than usual	
10	Strong winds blowing from river to the hills	
	Knowledge on Nature of River	
11	Rising of the river	
12	Debris in the river	
13	Noise level of the river increases	
14	River turns dirty brown	
	Knowledge of Flood Cycles	
15	Knowledge of seasons	
16	Knowledge of flood cycles	

Modified from Nyakundi *et al.,* 2010

(b) If there is any other traditional flood knowledge indicator, state below

No.	Traditional Flood Knowledge Indicators	Tick (√) (where applicable)
1		
2		
3		
4		
5		

Please tick (√) in the respective box for the right response, use the key provided;
1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree

No	Questions	1	2	3	4	5
13.	There are advocacy activities to strengthen community disasters awareness					
14.	Contingency plan is all inclusive (factors in farmers, fishermen, pastoralists, business operators, among others)					
15.	There are core competent experts involved in imparting and preparing households for a flood event (such as engineers, social and health workers, environmentalists, disaster specialists)					
16.	Structures within the household compound are build/erected to resist and protect against flood damage causes (in terms protecting livestock, belongings and lives)					
17.	At community level, there is an evacuation and rescue manpower in-line with area contingency plan					
18.	At the community level, there are supplies (clean water, blankets, tents, battery-powered radio) provided by agencies/organizations in-readiness for disasters					
19.	The riverbanks are strengthened enough (in terms of dyke and floodwall structures capacity) to prevent undesired flooding occurrence (flood defenses)					
20.	There are localized flood watch volunteers that inform households about the floodwater levels of the river					
21.	At community level there are installed "flood warning" posts with colored indicators to measure floodwater levels					
22.	Households maintain an emergency contact list in case of the flood event					
23.	Household heads do not participate during awareness to impart preparedness skills and drills					
24.	The household keeps a contact list of relevant authorities to report to in-cases of flood emergencies					
25.	Households are provided with a contingency plan to apply during a disaster					
26.	Contingency planning process is consensual					
27.	The household is always concerned about the flood forecasts (river water levels and frequencies of floods)					
28.	Area land-use plans factor in flood risk management regimes					
29.	The area development planning recognize contingency programmes such as flood recovery, disaster funding provisions, search and rescue missions					

30. (a) In a case a flood event, do you think your household compound is a safe place to be? ☐ Yes ☐ No

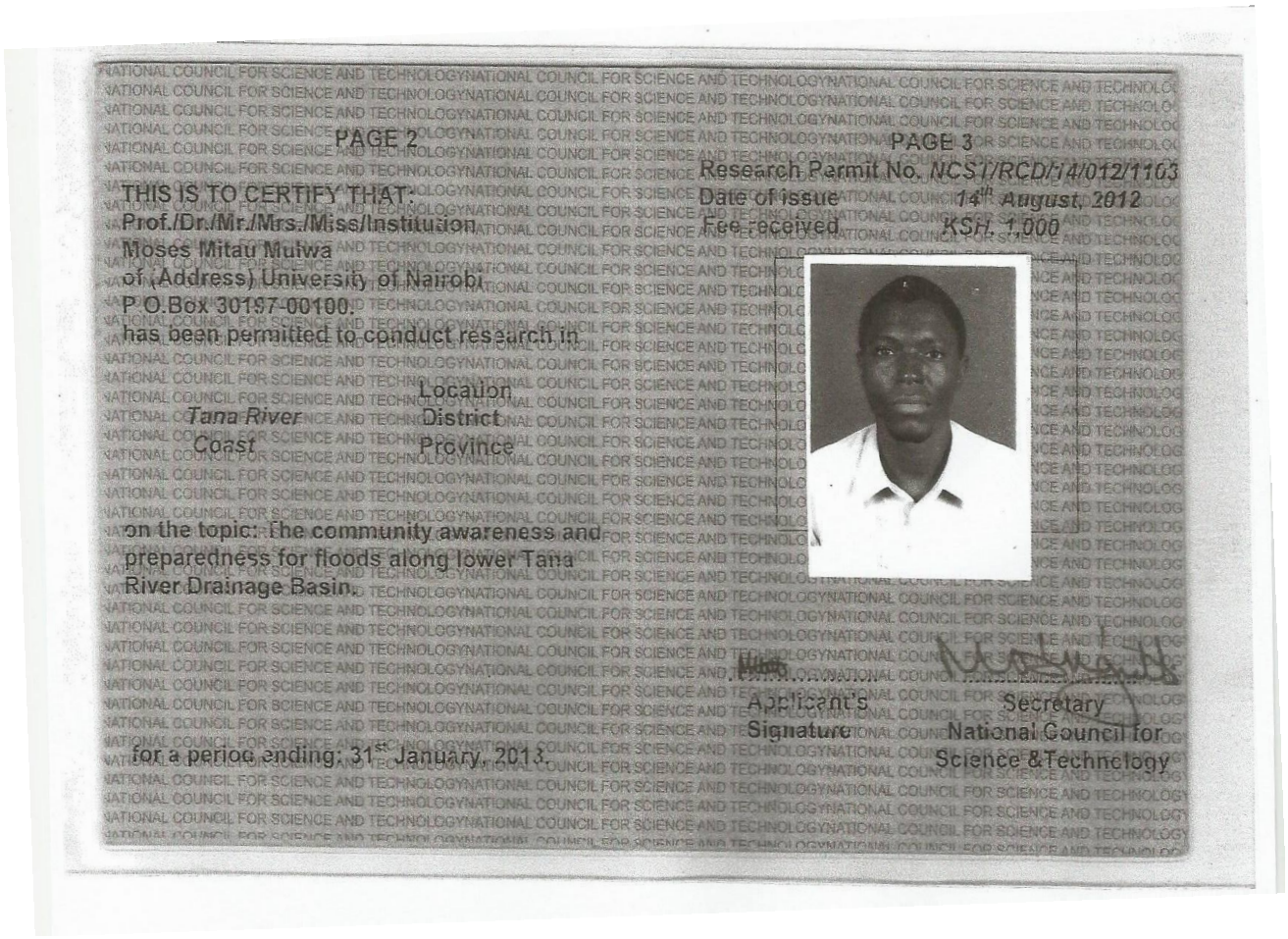
(b) If no, explain,

_____

_____

Appendix IV Research Authorization Documents

a) Research Permit



PAGE 2

THIS IS TO CERTIFY THAT:
Prof./Dr./Mr./Mrs./Miss/Institution
Moses Mitau Muiwa
of (Address) University of Nairobi
P.O.Box 30197-00100.
has been permitted to conduct research in

Location
Tana River
Coast
District
Province

on the topic: The community awareness and preparedness for floods along lower Tana River Drainage Basin.

for a period ending: 31st January, 2013.

Applicant's Signature

PAGE 3

Research Permit No. *NCST/RCD/14/012/1103*
Date of issue *14th August, 2012*
Fee received *KSH. 1,000*

Secretary
National Council for Science &Technology

b) Letter of Authorization from the MOE to Area Authorities

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telephone: 254-020-2213471, 2241349
254-020-310571, 2213123, 2219420
Fax: 254-020-318245, 318249
When replying please quote
secretary@ncst.go.ke

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: NCST/RCD/14/012/1103

Date: 14th August 2012

Moses Mitau Mulwa
University of Nairobi
P.O.Box 30197-00100
Nairobi.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "*The community awareness and preparedness for floods along lower Tana River Drainage Basin,*" I am pleased to inform you that you have been authorized to undertake research in **Tana River District** for a period ending **31st January, *2013.***

You are advised to report to **the District Commissioner and the District Education Officer, Tana River District** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. M. K. RUGUTT, PhD, HSC.
DEPUTY COUNCIL SECRETARY

Copy to:

The District Commissioner
The District Education Officer
Tana River District.

"The National Council for Science and Technology is Committed to the Promotion of Science and Technology for National Development."

c) Letter Authorizing Household Visits from the Area Officers (Tana Delta)

MINISTRY OF EDUCATION

Telegrams: "EDUCATION OFFICER", GARSEN

Telephone :020 801 1981
When replying please quote

DISTRICT EDUCATION OFFICE
TANA DELTA DISTRICT
P.O Box 61 – 80 201

GARSEN

DATE: 17/08/2012

Ref: TDD/ED/GEN/VOLI/125

TO WHOM IT MAY CONCERN

MOSES MITAU MULWA

This is to certify that the above named person has been permitted to carry research on the community awareness and preparedness for floods along lower Tana River Drainage Basin for the period ending 31st January, 2013.

Any assistance given to him will be appreciated in his research undertaking.

JELLE AHMED DIRIYE

For DISTRICT EDUCATION OFFICER

TANA DELTA DISTRICT

d) Letter Authorizing Household Visits from the Area Officers (Tana River)

MINISTRY OF EDUCATION

Telegrams: "EDUCATION OFFICER", Hola
Telephone: HOLA, 046-62226

When replying please quote

Ref No.TRD/ED/A5/F/276

DISTRICT EDUCATION OFFICE
TANA RIVER DISTRICT
P. O. BOX 13 - 70101
HOLA

17TH AUGUST 2012

MOSES MITAU MULWA
UNIVERSITY OF NAIROBI
P.O BOX 30197-00100
NAIROBI

RE: AUTHORITY TO CARRYOUT RESEARCH IN TANA RIVER DISTRICT

Following your letter dated 14th August 2012 of Ref No. NCST/RCD/14/012/1103 for the above mentioned subject, I hereby authorise you to proceed with your research.

I once again take this opportunity to welcome you to the District and wish you a nice stay.

BALOZI M. BASHORA
For: DISTRICT EDUCATION OFFICER
TANA RIVER DISTRICT

DISTRICT EDUCATION OFFICER
TANA RIVER
P. O. Box 13-70101 HOLA