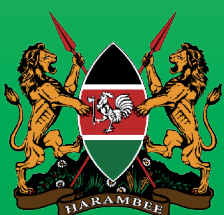


TANA RIVER COUNTY

Hazard Atlas



Empowered lives.
Resilient nations.

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List Of Abbreviations And Acronyms

LIST OF ACRONYMS AND ABBREVIATIONS

ALRMP	Arid Lands Management Project
ASAL	Arid and Semi-Arid Lands
CFSPH	Centre for Food Security and Public Health
CRA	Commission on Revenue Allocation
EEN	Environmental Emergencies News
FAO	Food and Agriculture Organization of the United Nations
GOK	Government of Kenya
ICPAC	IGAD Climate Prediction and Implementation Centre
ICT	Information Communications Technology
IMF	International Monetary Fund
IPA	Innovations for Poverty Action
IPCC	Intergovernmental Panel on Climate Change
IRIN	Intergrated Regional Information Networks
IUCN	International Union for Conservation of Nature
KNBS	Kenya national bureau of statistic
OIE	World Organization for Animal Health
MOMS	Ministry of Medical Services
MOPHS	Ministry of Public Health and Sanitation
MOH	Ministry of Health
UNDP	United Nations Developmen Programme
UNISDR	United Nations Office for Disaster Risk Reduction
NCCAP	National climate change action plan climate
NDMA	National Drought Management Authority
NEMA	National drought Management Authority
SIF	Secours Islamique France
SID	Society for International Development
TARDA	Tana and Athi Rivers Development Authority
UNICEF	United Nations Children’s Fund
WHO	World Health Organization

Preface

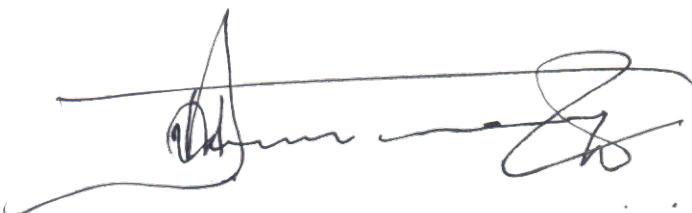
One of the principal obligations of any government is to protect its citizens from harm. The Fourth Schedule of the Constitution of Kenya 2010 allocates disaster management to the two levels of government, underlining the fact that both have important contributions to make. Given their proximity to populations at risk, the devolved authorities have a particular responsibility to ensure that they are equipped to respond in a timely and appropriate manner.

The purpose of this hazard atlas is to improve our efforts to reduce disaster risk and respond effectively when disaster strikes. The atlas is a visual tool which brings together basic information about the various hazards faced by the people of Tana River. Unless we are conscious of these hazards and deal with them appropriately, our security, development and prosperity as a county will all be compromised.

As a government, we will use the atlas to guide the design and implementation of programmes and integrate measures that reduce disaster risk in our policies, strategies and plans. We hope that our partners in the county will also make use of the atlas so that we are all operating from a common base of knowledge.

The content of the atlas was generated through consultations with relevant parts of the County Government, supplemented with information from other sources where required, and validated by the relevant institutions. We welcome feedback on the document so that future editions can be improved.

I would like to thank the National Drought Management Authority for their support in developing the atlas, which they have done as part of their wider efforts to strengthen the county's capacity in disaster risk management. I also thank the many other institutions involved in the process, and all our partners who work with us to improve the well-being of our people.



H.E. AMB. HUSSEIN T. DADO
GOVERNOR
TANA RIVER COUNTY

Foreword

Like all counties in Kenya, Tana River faces a particular combination of threats associated with different hazards. This atlas has been produced in order to increase our understanding of these hazards and improve our management of the risks they pose.

The mandate of the National Drought Management Authority concerns drought, but we recognise that individual hazards should not be considered in isolation. Drought and conflict, for example, are mutually reinforcing: each exacerbates the other, while an improvement in one can reduce the risk posed by the other. For this reason we are pleased to be associated with a publication which places drought risks within this wider context.

The Authority is a State Corporation tasked with leading and coordinating the government's efforts to manage drought. This can only be done through a collaborative partnership between the national and county governments. Our teams in each county work closely with the devolved authorities in ways which strengthen the capacity of the County Governments to manage the risks they face. This atlas is an example of that assistance, provided through a project financed by the United Nations Development Programme.

The atlas focuses on the specific hazards prioritised by the county: drought, floods, disease and conflict. There is a chapter on each of these, as well as a concluding chapter on the underlying factors that cause and perpetuate vulnerability to disaster. Dealing with vulnerability is key to reducing disaster risk, and is why the solution to the suffering currently caused by disasters lies in sustainable and equitable development.

The profile of risk changes over time, and therefore the process of identifying, mapping and analysing hazards should be a dynamic one. Moreover, different hazards are experienced by different population groups in different ways, which reinforces the importance of mapping being done in participatory ways. I hope that readers of this atlas will share their feedback on this first edition, and that the pool of those involved in shaping its content will gradually widen and deepen.



James Oduor
Chief Executive Officer, National Drought Management Authority

Acknowledgement

The National Drought Management Authority acknowledges with gratitude the contributions of all those involved in the production of this Hazard Atlas for Tana River County.

The process and final publication was financed by the United Nations Development Programme through the Governance for Disaster Risk Reduction in Kenya Project.

The County Government of Tana River has been central to this project, with several of its institutions providing data, technical advice and guidance.

The contributions of all other partners, who took part in workshops or contributed information, is also gratefully acknowledged.

Finally, the Authority thanks the Regional Centre for Mapping of Resources for Development and appreciates the professional role they played in the production of this document.

Chapter One

Context And Background To The Disaster Atlas Map, Tana River County

1.1 Introduction

Tana River County takes its name from River Tana which is the longest river in Kenya. It covers an area of 35,375.8 square kilometers (13,658.7 sq. mi) and a population of 262,684 according to the 2009 census (County government of Tana River, 2015). The administrative headquarter of the county is Hola. The County has three sub-counties; Tana North, Tana Delta and Tana River, it borders Kitui County to the West, Garissa County to the North East, Isiolo County to the North, Lamu County to the South East and Kilifi County to the South. The county lies between latitudes $0^{\circ}00'53''$ and $2^{\circ}00'41''$ South and longitudes $38^{\circ}025'43''$ and $40^{\circ}015'$ East.

The County is generally dry and prone to drought. Rainfall is erratic, with rainy seasons in March–May and October–December. Riverine forest, woodland, grassland, bush

lands, lakes, open river channels, sand dunes, mangroves and coastal waters contribute to making Tana River County one of the most ecologically diverse habitats and a tourist attraction in the country (county edition Kenya, 2012). Besides the Tana River, there are several seasonal rivers, popularly known as 'lagas' in the district. These are found in the area west of River Tana in northeastern part of the county. These rivers flow in a west-east direction from Kitui, Makueni and Mwingi County draining into River Tana and eventually into the Indian Ocean.

The dominant ethnic groups are the Pokomo, many of whom are farmers, and the Orma and Wardey, who are predominantly nomadic. Other tribes include the Waata and Boni who are culturally Hunters and gatherers, the



Wailwana /Malakote and the Bajuni.

1.2 Hazard Profile in Tana River County

Like most of the ASAL region in Northern and North Eastern Kenya, Tana River County is vulnerable to acute human suffering and loss of development assets brought about by disasters caused by both natural and human induced hazards, and frequently by a combination of both. Aside from the foremost natural hazard of drought, other 'slow-onset' hazards include environmental degradation, the consequences of which can be equally disastrous to food supply. Major 'sudden-onset' natural hazards such as floods, epidemics, pest infestations and livestock diseases.

With nearly half of the sub-county's population chronically food insecure, disasters threaten food security through disruption of cropping, pastoralist and marketing activities. In recent decades, episodes of drought-induced food shortage and famine associated with conflicts have resulted in many casualties, internally displaced persons and refugees, posing dilemmas for long-term solutions. Such conflicts-related or 'complex' emergencies have created need for massive and prolonged relief operations, and require the heavy use of social and economic assets in mitigation, thus derailing the region's aspiration for sustainable economic and social development. The main hazards which cause disasters in the counties are the following:

Drought: The national climate change action plan climate (NCCAP) notes that climate will lead to more droughts with Tana river county not being an exception, with impacts in terms of lives lost and livelihoods disrupted falling most heavily on the poor. It is particularly true in the ASALs, where communities are vulnerable to climate change and have the highest incidence of poverty in the country (UNDP, 2013)

Floods: Floods are short-lived events that can happen suddenly, sometimes with little or no warning. They usually are caused by intense storms that produce more run-off than an area can infiltrate and store or a stream can carry within its normal channel. In Tana River county floods are the major causes of severe loss of life (human and livestock) and property, destruction of infrastructure, disruption of the communication networks and large losses to the economy making it a costly natural disaster. They have also been associated with land degradation (soil erosion), silting of the Indian Ocean. The recoveries from the effects of these weather-related phenomena take a long time.

Conflicts: Conflicts exist in every group or society if two or more parties have incompatible or contradicting interests. In the Tana delta, a wetland area at the Kenyan Coast with the biggest area falling under Tana River County, different ethnic groups live together. The underlying problems of the conflicts in the Tana delta are multiple associated mainly by the fact that the groups living in the area are culturally,

religiously, economically and politically divided. Conflicts in the Tana delta have existed since the 19th century, however, with time the patterns and players of the conflicts have changed. Tension usually increases if the number of cattle rises drastically due to the influx of foreign pastoralists who are looking for pasture and water in the delta during dry seasons (katja, 2013).

Human and Animal diseases: All diseases have the potential to adversely affect human and livestock populations by reducing the quantity and quality of food, other livestock products (hides, skins, fibers) and animal power (traction, transport) that can be obtained from a given quantity of resources and by reducing people's assets (FAO). Of these, transboundary animal diseases tend to have the most serious consequences on livestock as well as human. These diseases which cause a high morbidity and mortality in susceptible animal populations constitute a constant threat to the livelihood of livestock farmers. The same case applies to human diseases which greatly affect their productivity.

1.3 Need For Disaster Mapping and Atlas Development

A disaster occurs when normal social life is disrupted by a hazard of unusual scale. Disasters occurring in such scale may have serious impacts on society and the economy at large, resulting in significant national loss. Preventing the adverse impacts of disasters is one of the most important priorities of governments. Although, it is difficult to avoid impacts of hazards and related disasters, it is essential to understand their behavior and how we can reduce their impacts and by strengthen our ability to deal with their effects. Understanding hazards and related disasters and vulnerabilities starts by answering such questions as:

- What hazards are likely to occur?
- Where do they occur?
- How significant are they in scale?
- When are related disasters likely to happen?
- And what elements are most at risk?

The purpose of hazard maps is to provide a set of information in a form of visual presentation concerning hazards and related disasters prevailing in a given geographic area for subsequent use in systematically addressing underlying risk factors and taking necessary measures to reduce potential adverse impacts on their geographic location so that disaster prevention activities and measures could be undertaken.

Depending on the details they provide, hazard maps therefore would be important tool for enhancing early warning, preparedness, contingency planning and implementing relief, early recovery, and rehabilitation interventions. As importantly hazard maps could be used for planning and implementation of preventive measures including building resilience and adaptive capacity.

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Chapter 2 : Tana River Climate Profile



Figure 2.1: Map of Tana River County

2.1 Introduction:

Rainfall and Temperature variability and reliability are the major concerns raised by many people especially the scientific community together with the debate on climate change. It is argued that climate change has greatly contributed to unpredictable weather conditions in many parts of the world and Kenya as a whole. Some regions in Kenya are believed to have been more affected than others due to the fragile ecosystem such as in Arid and semi-arid areas (ASALs). In fact, climate projections suggest that variability is likely to increase in the future and extreme weather events might become more frequent in sub-Saharan Africa (Hulme et al., 2001; Cooper et al., 2008; Field, 2012, Omondi et al., 2013a).

Therefore it is crucial to understand climate trends and magnitude so as to be able to mitigate the impacts of climate change and variability. A clear understanding would guide communities to make strategic and long-term decisions that would shape their future well-being. The studying of trends and changes in rainfall and temperature will help policy makers and the communities to better prepare for climatic and weather extremes and reduce the loss of life and property. This Chapter was designed to bring out Tana River rainfall and temperature trends and seasonal changes over the last 30 years.

2.2: General Climate

2.2.1: Temperature

Tana River falls in the arid and semi-arid region of Kenya, characterized by warm and hot climate. The temperatures range between 20°C and 30°C (Ministry of Lands, Agriculture, Livestock and Fisheries, Tana River County). Tana River lies within four agro-ecological zones namely: Coastal Land 3 Coconut – Cassava zone (non-ASAL), Coastal Land 4 Cashew nuts- Cassava zones where the main economic activity is subsistence mixed farming; Coastal Land 5 Lowland Livestock zone and Coastal Land 6 Lowland Ranching zones where the locals are involved in pastoral activities (Ministry of Lands, Agriculture, Livestock and Fisheries, Tana River County).

Effects of Increased Temperature include:

- Accelerated depreciation of forage due to high rate of evapotranspiration.
- Drying up of surface water sources.
- Absconding of bees and failure of vegetation to flower.
- Heat stress on livestock.

2.2.2: Rainfall

Tana River County is greatly affected by the Inter Tropical Convergence Zone (ITCZ) an area of low atmospheric pressure that forms where the northern and southern trade winds meet just near the equator. In East Africa, ITCZ covers a greater distance therefore; rainfall is low, bimodal, erratic and conventional in nature in Tana River County. The total annual rainfall ranges between 400 mm and 750 mm with short rains occurring from March to May, long rains in October to December with November being the wettest months (Ministry of Lands, Agriculture, Livestock and Fisheries, Tana River County). Figure 2.2 below shows rainfall variability for the year 2013 against the long term average rainfall for the years 2008-2012. Average rainfall for 2013 was way below the long term average for the five-year period (2008-2012).

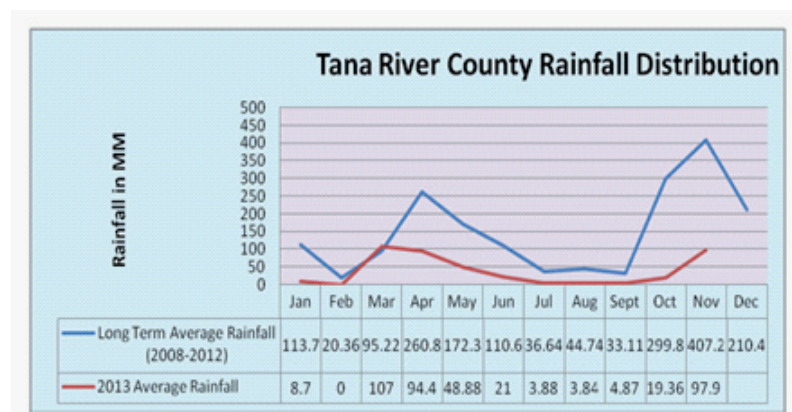


Figure 2.2: Tana River County Rainfall Distribution for 2013 (Source: NDMA bulletin November 2013)

2.2.3: Recent Climate Trends

Rainfall trends in Tana River County are extremely unpredictable, observation for the last 32 years from 1981-2013 show that rainfall is not consistent. Figures 2.3 and 2.4 show that the long rains mean is 155mm but in some years Tana River experienced less than that. Mean for the short rains season is 236mm but in some years like 2005 and 2011 the region recorded rains lower than the seasonal average. Tana River County relies on short rains as it is more reliable and the amount of rain received is more than that of long rains season.

- Temperature increase will affect production of some crops
- All the above lead to huge economic losses and adversely impacting food security in the County

2.3: Climate Change effects on Agriculture and Pastoralism

About 82.2 % of the Tana River County's population is dependent on agriculture and livestock (Ministry of Lands, Agriculture, Livestock and Fisheries, Tana River County). Incidence of extreme floods and droughts, which are largely aggravated by climate change and its variability are being

Figures 2.2 and 2.3 show Tana River seasonal rainfall variability for both long and short rains from 1981-2013 respectively. The trends show that short rains have been increasing by a few millimeters while long rains have been decreasing over the years.

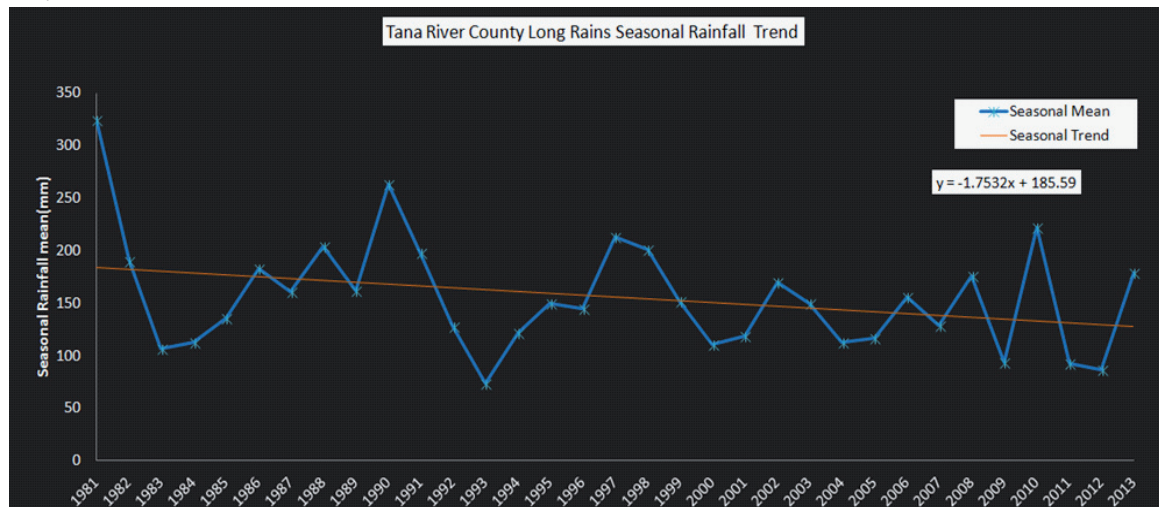


Fig 2.2: Tana River long rains variability (1981-2013) (Source: GEOCLIM)

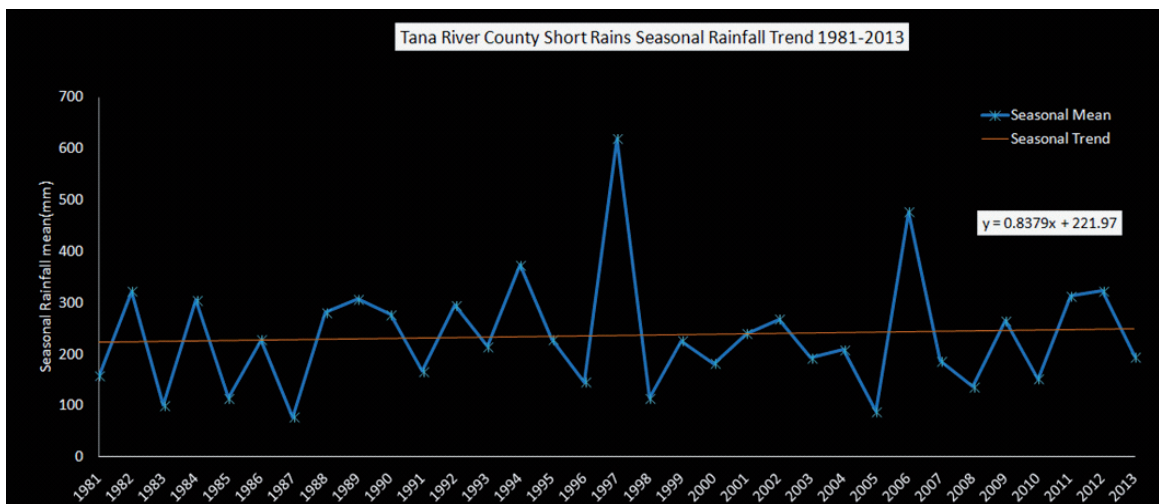


Fig 2.3: Tana River short rains variability (1981-2013) (Source: GEOCLIM)

2.2.4: Climate change Impacts

Kenya's climate condition has been changing in many parts of the country and it is becoming more unpredictable every season and year. Some of the impacts of climate change include:

- Prolonged droughts
- Hailstorms
- Extreme Flooding
- Drying of rivers and other wetlands
- Displacement of pastoralists into and out of the County resulting in conflicts over natural resources.
- Widespread disease epidemics
- Sea level rise

experienced more frequently than ever before in many parts of Kenya with serious consequences in arid and semi-arid regions (ICPAC). The uncertainty of rainfall and uneven temporal and spatial distribution is posing huge challenges to decision makers. Majority of farmers in the arid and semi-arid areas of Kenya like Tana River County grow crops and keep livestock under the mixed farming system and are highly susceptible to variations in the climate. Communities and leaders in areas with fragile environment require detailed climate information regarding the climate change trends and their potential impacts so as to incorporate appropriate agricultural adaptation measures (ICPAC).

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Chapter 3: Drought

3.1 Introduction

Tana River is a drought prone County. Tana River receives annual rainfall varying between 400mm and 750mm with a mean annual temperature ranging between 20°C and 30°C (Ministry of Lands, Agriculture, Livestock and Fisheries, Tana River County). This amount of rainfall coupled with high temperatures leads to reduced water levels in streams and other water bodies.

According to Tana River residents who participated in a workshop organized by RCMRD in Hola, historically there used to be ‘miaka iliyo nona’ after 5,6 or 7 years between April to September. Rainfall experienced during this period was high and favored agricultural activities in the County. Droughts were said to have taken place within an interval of ten years but currently the period has reduced to a span

Rainfall Seasons in Tana River County are as follows

Table 3.1: Rainfall seasons in Tana River County (Source: NDMA)

Short dry spell	Long rains	Long dry spell	Short rains
January	April	July	October
February	May	August	November
	June	September	December

of 7 years.

3.2 Types of drought In Tana River County

There is no a universally accepted definition of drought but there are several types of drought recognized globally. According to EEN (2004) there are various types of drought experienced in the County and classified based on their effects, they include:

- Meteorological Drought,
- Agricultural Drought,
- Hydrological Drought.

Meteorological Drought: Is caused by the absence or deficit of rainfall from the normal. It is the least severe form of drought and is often identified by sunny days and hot weather. According to NDMA In December 2014, in Tana river county there is a slight increase in rainfall in 2014 from previous year 2013. Long term average highest rainfall from 2010 – 2013 was in the month of November.

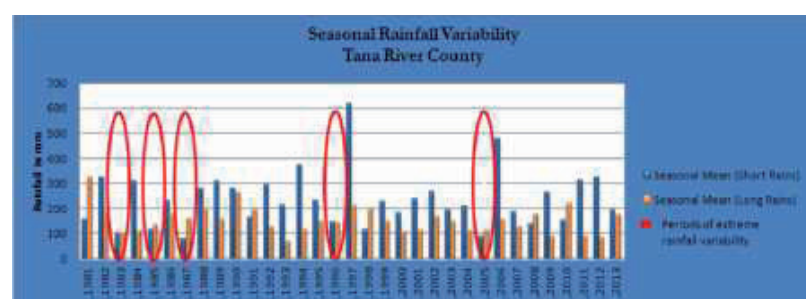


Figure 3.1: Tana River County Rainfall Variability 1981-2013 (Source: GEOCLIM)

Figure 3.1 above shows that rainfall is variable in Tana County. In the years 1983, 1985, 1996 and 2005 extremely low amounts of rainfall were recorded. The figure above also shows that periods of high rainfall are preceded by periods of very low rainfall. For instance, before the 1997 El-nino, Tana River County recorded very low rainfall in the year 1996. The case is similar to 2005 and 2006 where the County experienced very low and very high rains respectively.

Hydrological drought: This is usually caused by the effects of Meteorological drought leading to reduction of natural stream flows or groundwater levels, plus stored water supplies. It's also caused by depleted amounts of available water in watersheds, Rivers, etc. In Tana River this type of drought causes a decrease in the volume of water in rivers and water points.

Unlike the short rains season that have had a slight increase in rain, the long rains have been recording a decline. In early 1980s the amount of rain received was more than the current amount. Long rains are as well unpredictable and unreliable.

Agricultural drought: This form of drought occurs when moisture level in soils is insufficient to maintain average crop yields. Initial consequences are in the reduced seasonal output of crops & other related production. An extreme agricultural drought can lead to a famine. When soil moisture becomes a problem, the agricultural industry is in trouble with drought. Shortages in precipitation, changes in evapotranspiration, and reduced ground water levels can create stress and problems for crops.

Figure 3.2 shows vegetation condition index (VCI) expressed in percentage for the years 2001-2014. Lower and higher values indicate bad and good vegetation state conditions respectively. Tana faced severe drought in January and February in 2001, February, March and April 2006, April 2009 and between January and May in 2011. Prolonged drought was in 2011.

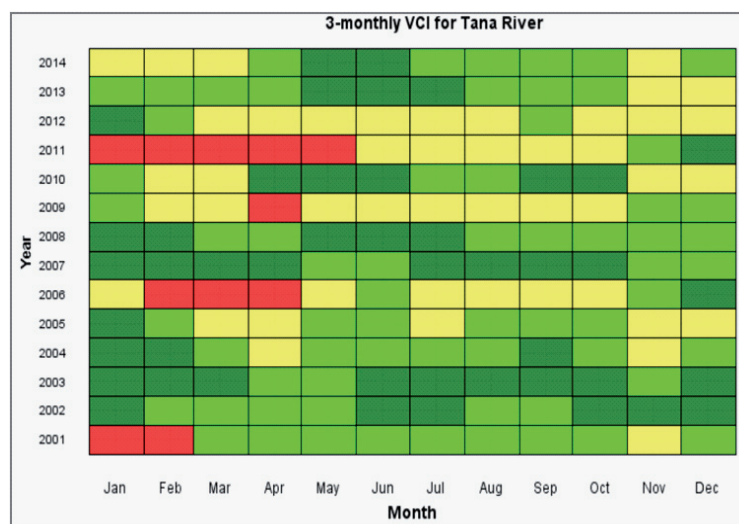


Figure 3.2: Vegetation condition index (VCI) for Tana River County. (Source: NDMA bulletin December 2014)

<10	Extreme drought
10-20	Severe drought
20-35	Moderate drought
30-50	Normal conditions
>50	Very good conditions

3.3 Causes of droughts in Tana River County

The northern part of Kenya is known to be the main drought prone region in the country, which extends to southern part where Tana River County lies. Researchers have attributed this mainly to the country's recent abnormal eco-climatic conditions resulting from global warming. This has resulted to continuous fail or low amounts of rainfall during long and short rains.

Adverse societal factors such as poor land-use practices (deforestation and overgrazing) lead to siltation of water reservoirs. Other issues like conflicts, poverty, poor communication infrastructure and lack of (or poorly implemented) traditional coping mechanisms are also major catalysts of drought disasters in the County.

Rampant movement of the pastoralists with their livestock within and from outside the County in search of pasture and water is partly responsible for the severity of drought.

3.4 Impacts of drought

Some of the major impacts caused by drought in Tana River County;

- Pastoralists' livestock are tremendously reduced. Large numbers of the livestock irrespective of their range are severely affected by the drought. Majority of the animals are lost due to starvation related mortality. Remaining animals are severely emaciated and the price of their meat or hides and skins decline drastically.
- Farming communities are greatly affected from lack of water to maintain their crops till harvest; this means high crop failure resulting in high decline of food production hence shortage of food for the families.
- Acute food shortage and increased migration by pastoralists communities due to depletion of pasture and water for livestock; a situation which normally spark off conflict over struggle for dwindling pasture and water resources with hosting communities.
- School drop-outs increases significantly with male pupils abandoning learning to become migrant herder's in order to keep their livestock populations alive while the girls attend school irregularly as they are responsible for their siblings.

- Cheap disposal of household assets and livestock as a way of making money for food and also to prevent deaths of animals.
- Water shortages due to drying up of wells and dams.
- Disease incidences due to lack of balanced diet in both humans and animals. Diseases eventually affect production as it leads to emaciation and finally death.
- Livestock and wildlife conflicts increase as these two compete for insufficient water and food. For instance, pastoralists may drive their livestock into parks as they look for pasture, subsequently, wildlife may attack their animals.

3.5 Initiatives

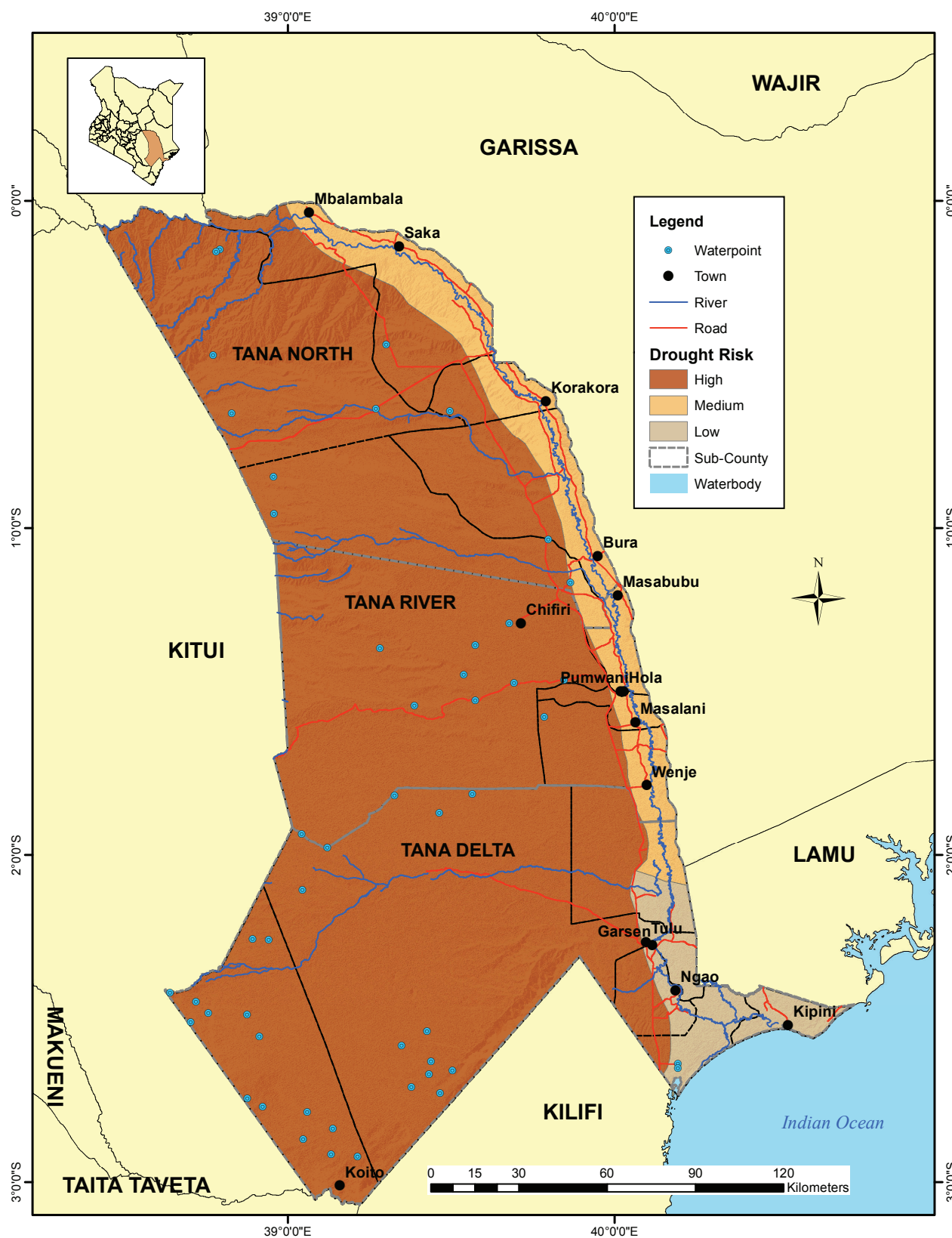
The following are some of the ongoing initiatives in the county:

- Multi-year food and cash mechanisms based on early warning and food security data.
- Emergency water supply , water trucking and building of earth dams.
- Early responses in the livestock sector: Destocking or purchase of animals by the government for a fixed price, with animals slaughtered and meat distributed among needy families; animal health campaigns; and animal feeding.
- Reconstruction of destroyed assets with improved, climate-resilient standards.
- Establishing resilient community-based water and sanitation systems.
- Fodder conservation and alternatives livestock feed sources/supplement
- Introduction of irrigation and drought tolerant crop
- Relief food programmes
- Livestock off takes
- Nutritional surveillance and provision of nutritional commodities and supplements
- Livestock vaccination
- Child immunization (integrated medical outreach services)
- Peace building and conflict management initiatives
- Increased security vigilance and patrols
- Low-cost boarding schools
- Increasing food resources, encouraging food for asset and food for activities and consumption of less preferred food

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Map 3.1: Drought Risk



Data sources: County DRR Platform

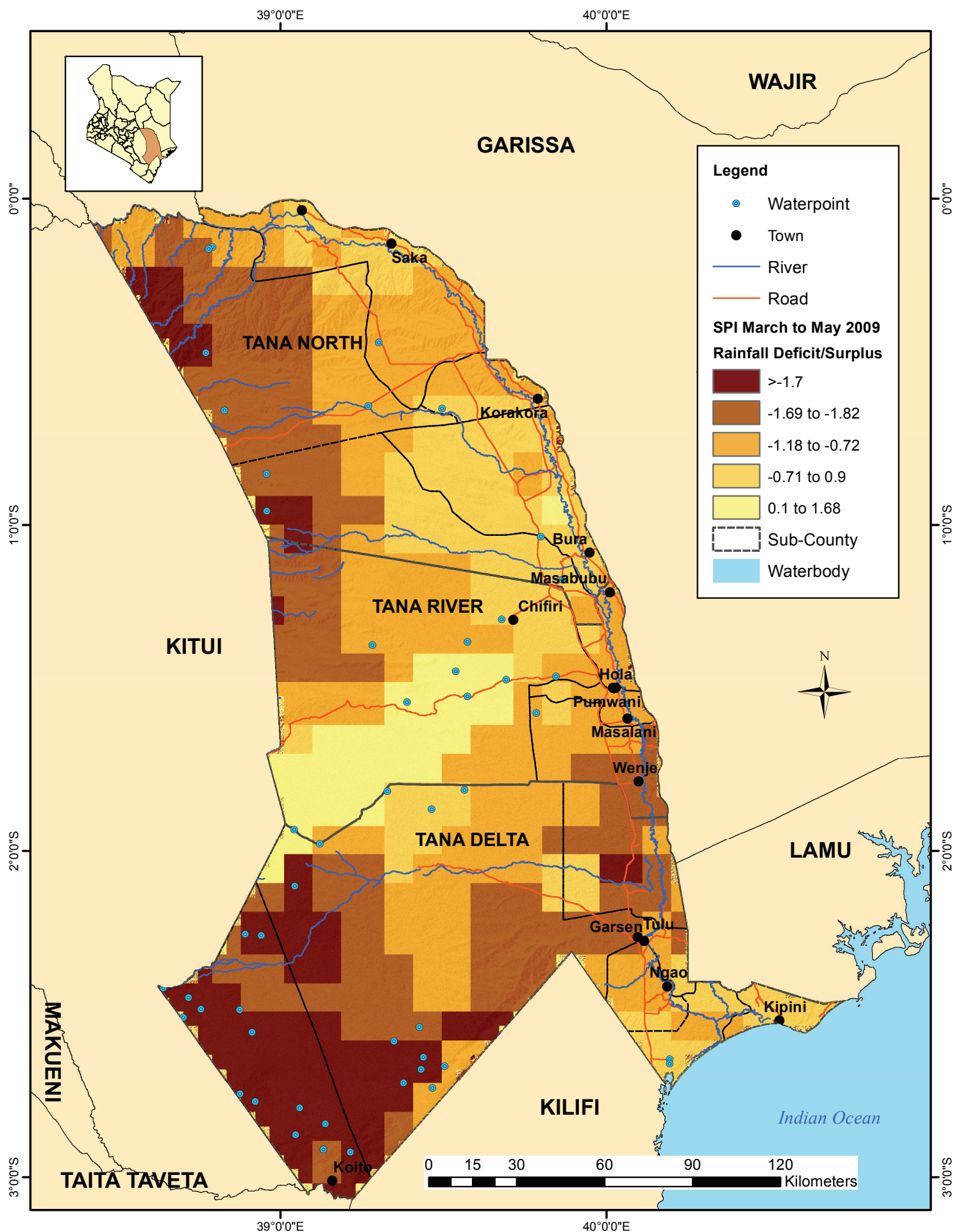
Data parameters: Coordinate System: WGS 84



Participatory mapping exercise by various Tana River County stakeholders at NDMA offices in Hola. (Source: RCMRD)

This map was developed after a participatory mapping exercise with various Tana River County stakeholders. It shows drought risk and distribution of occurrence in Tana River County. Classification was based on areas that are at high or low risk in the County. Areas hinterland bordering counties like Kitui, Kilifi and Taita Taveta are at high risk while areas along River Tana are of Medium and Low Risk. Tana delta that acts as a fall-back plan for Tana Residents has less drought risk

MAP 3.2: SPI Based Drought Severity Map



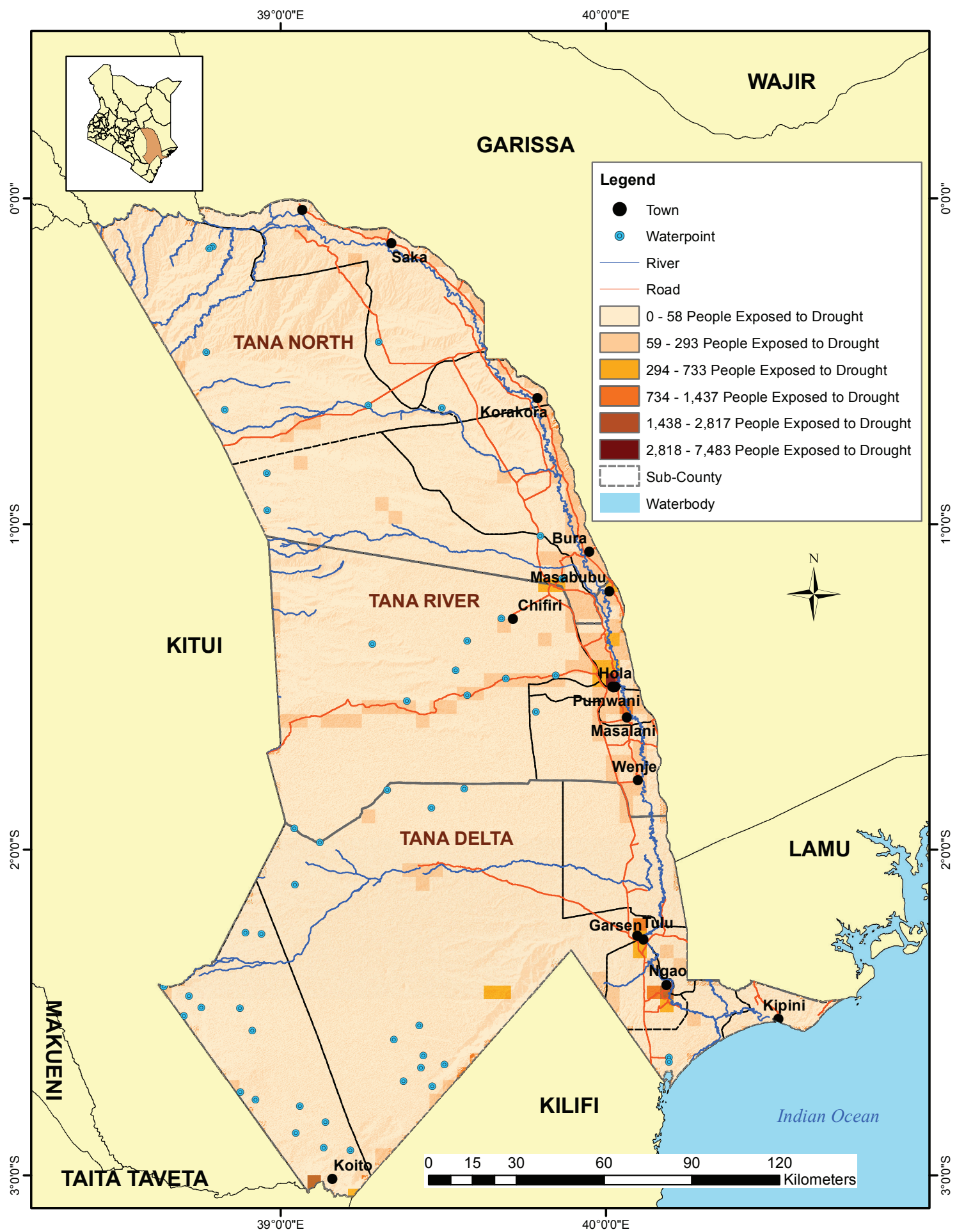
Data sources: GEOCLIM

Data parameters: Coordinate System: WGS 84

Droughts differ from one another in three essential characteristics: intensity, duration, and spatial coverage. This map shows drought severity in different parts of Tana River County chosen based on one of the recent big drought events in the region. Standard precipitation index was used to measure the drought intensity and spread in the county within the long rains season March to May. For drought analysis, a SPI < -1 indicates that the observation is roughly one-in-six dry event, and is termed “moderate”. A SPI < -1.5 indicates a one -in-fifteen dry event, and is termed “severe”. Values < -2 are

typically referred to as “extreme”. In 2009 most parts of the County experienced severe drought scenarios. In 2009 and 2010, when Tana River County experienced extreme drought, areas in Tsavo East national park and Garsen West were severely affected, followed by areas in Bura constituency. In 2010 Kipini wards in the delta were also greatly affected. This meant that the residents did not have an alternative source of pasture since there dry season grazing grounds had dried up.

MAP 3.3: Drought Physical Exposure



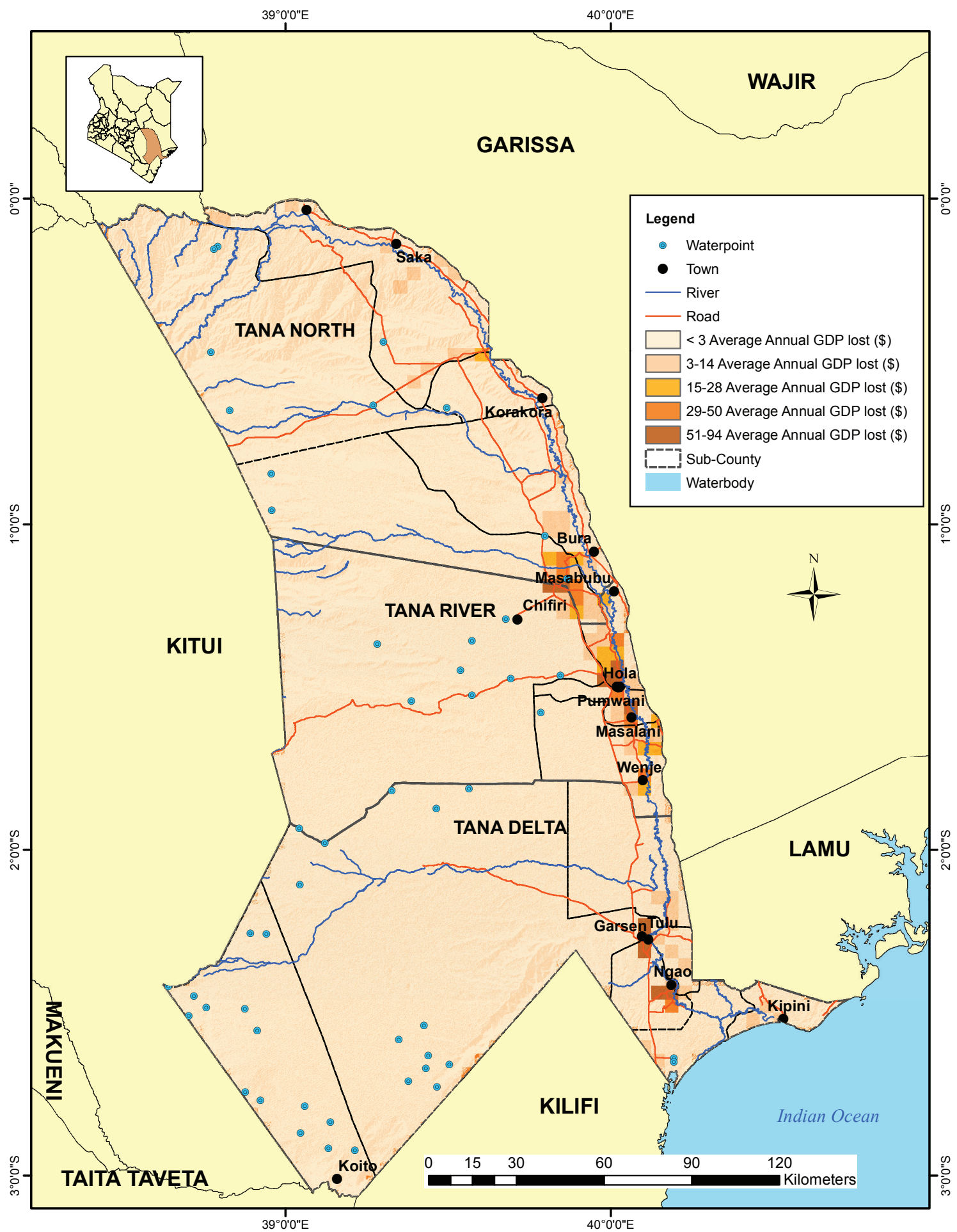
Data sources: UNEP/GRID

Data parameters: Coordinate System: WGS 84

This Map explains the variation of the approximated number of people that are exposed to drought annually. It considers the annual frequency of occurrence and degree of severity of drought events, population distribution within the region vis-à-vis their coping strategies in the event of drought. Urban areas like Holo, Garsen Ngao

and Tulu have high population distribution therefore more exposure to drought compared to hinterland. Other towns also affected include Wenje, Pumwani, Masabubu, Bura, Korokora and Saka.

Map 3.4: Drought Economic Exposure



Data sources: UNEP/GRID

Data parameters: Coordinate System: WGS 84

This map shows the annual economic exposition to drought in Tana River County. This is indicated in expected average annual Gross Domestic Product (GDP), which is a monetary value of all the finished goods and services produced within a country's borders, expressed in US dollars per year. It considers the annual frequency of occurrence and degree of

severity of drought events vis-à-vis economic drivers of a region. Main economic hubs affected in Tana River include the major towns such as Bura, Hola and Garsen. Other towns include Masabubu, Pumwani, Wenje, Tulu and Ngao.

Chapter 4: Conflicts

4.1 Introduction

In Tana River County, conflicts are a result of several intertwined and complicated factors. Conflict over natural resources especially access and utilization of the waters of the River Tana has been contentious for a while, leading to frequent clashes by pastoralists and farmers in the County.

4.2 Types of Resource conflicts in Tana River County

4.2.1 Resource Conflicts

Resource conflicts are common in all Sub-Counties in Tana River County. The wards that are mostly affected include Bangali, Madogo, Hirimani, Chewele, Chewani, Kinakomba, Garsen North, Garsen South, Kipini West and Kipini East. Some of the major causes of resource based conflicts in Tana County include:

- **Lack of land adjudication:** The land in Tana River County is either government land or trust land. Farmers occupy most of the trust land while herders roam the government land. The Farmers cultivate along the riverbank, often blocking the pastoralists' access to the river. So the Pastoralists drive their animals through the farms, this always causes conflicts between the communities.

Existence of many ranches which are not phased nor managed properly in Tana Delta sub-county, also fuels conflicts between pastoralists and farmers. Other land issue that is believed to exacerbate conflict is the creation of administrative units based on tribal locations, for instance, Kipawa and Ngao (Tana River County Workshop Participants).

- **Inadequate water and pasture:** Tana River falls in the Arid and Semi-Arid region of Kenya. During the dry season, the Tana River is the main source of water for pastoralists' livestock. Due to the large number of livestock dependent on the river during the dry season, some occasionally stray into the farms and destroy crops. This is often an immediate trigger of conflict in the area. Pastoralists from as far as Ethiopia and Somalia migrate into the delta with thousands of cattle thus increasing the pressure on resources. Some of the immigrants do not return to their original abodes even when the dry spell ends.

- **Lack of respect in relation to livelihoods:** It was noted during a workshop held in Hola, Tana River County that some conflicts arise due to lack of respect of each other's livelihood. Farmers believe that farming is more important than rearing of animals while pastoralists look down upon farmers. This has led to episodes where pastoralists graze on farms while farmers hinder pastoralists from accessing water.



Plate 4.1: People displaced after conflict in tana river. (Source: irin news)

- **Proliferation of small arms:** It is believed that people living in Tana River County have gained access to illegal fire arms. The more a group of people are better armed, the more disputes are registered with high fatalities.

- **Competition over limited resources:** Tana River is an arid and semi-arid region where resources such as land and water are scarce. Farmers and pastoralists fight for water while pastoralists from neighbouring counties compete with local pastoralists for pasture, especially in Tana Delta.

- **Climate Change:** Climate change as a potential conflict promoting factor has been recognized by researchers especially its impact on water and pasture. The rainfall pattern in the Tana Delta has changed over the last two decades causing a decline in water and pasture due to worsened aridity of the region. This variability coupled with poor implementation of appropriate natural resource management policies undermines livelihoods security of the local people especially the pastoralists. There is a correlation between the onset of the dry season and increased incidences of ethnic conflicts over competition for water and pasture.

4.2.2 Political Conflicts

Multi-party politics have brought in political machinations to the traditional conflicts. Such politically motivated and politician incited conflicts are for the purpose of removing supporters of opposing politicians/parties and building on own supporter base and thereby gain political control,

as well as for electoral fund-raising. Political conflicts are common in all wards in Tana River County.

Some of the causes of political conflicts include:

- Superiority complex among communities
- Nepotism and Tribalism
- High illiteracy level
- Lack of respect in relation to livelihood
- Selfishness
- Proliferation of small arms

4.3 Impacts of conflicts in the county

- Results to death of many innocent civilians and security officers, wanton destruction of properties, disruption of public services such as health and education.
- Displacement of hundreds of innocent civilians and increased vulnerability among people with disabilities, the elderly, women and children physically or sexually.
- The conflict brings about disruption of family life, psycho-social effects, disruption of identity and cultural crisis.
- Conflicts lead to increased food insecurity due to destroyed agricultural fields for the famers and reduced pasture for the pastoralist due to abandonment of grazing areas hence death of livestock.
- Most of the school programmes are disrupted during conflicts.
- Disease incidences increase as animals interact with others from neighbouring counties.



Plate 4.2: Security officer stands guard following a fresh attack at kipao village tana river district, kenyas coastal tana delta region, december 22, 2012 by reuters

- Brutal killing of livestock is witnessed during conflicts

4.4 Initiatives

There are a number of measures that have been taken to prevent, let alone manage, the conflicts. Some measures were suggested by Tana County stakeholders' workshop in Hola:

- Peace building and conflict management initiatives. National government should work with civil society and faith based organisations on the ground to preach sustainable peace.
- Introduction of low cost boarding schools will go a long way in ensuring that students do not have to drop out in case of conflicts. The schools being affordable will attract more students as big percentage of parents will be able to afford.
- Mobile schools should be established to bring resources to school children who are forced to relocate due to conflicts. This will give them a chance to be at par with other students in the republic.
- Land adjudication should take place in Tana River. Land in the county is communally owned and some individuals take advantage of this. Adjudication will aid in curbing cases of land grabbing.
- The government should provide the displaced with food and non-food items such as tents, mosquito nets and blankets during conflicts.

• Integrated medical outreach by the relevant health sectors will provide the much needed health services to locals in case of conflict. Hospitals and other health institutions become inaccessible during such periods.

• County government together with the national government should launch a plan on how to conduct disarmament exercise in the region. The locals who possess fire arms can be rewarded with capital for business whenever they surrender the weapons.

• Inter-marriages should be encouraged in the County. More marriages should take place between pastoralists and farmers. This promotes co-existence among the locals as people are hesitant to plan attacks against their kin.

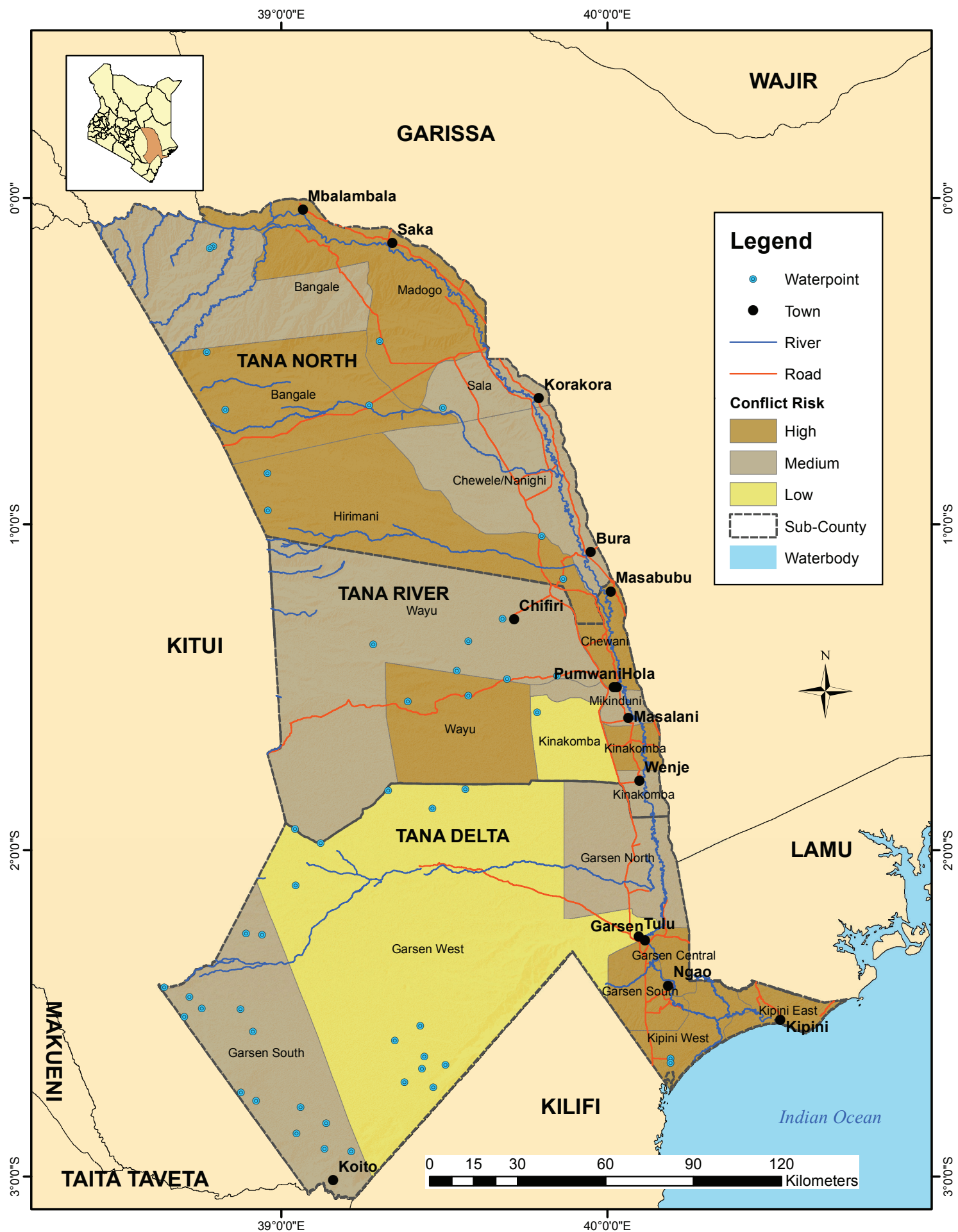
• Development and rehabilitation of destroyed infrastructure should be initiated by the government. This will improve communication and also open the County to more investors and businesses. The locals may adopt alternative livelihood in cases of drought so as to minimize conflicts. Good infrastructure also ensures that there is timely response in case of a dispute.

• Promotion of inter-cultural cohesion through activities such as sports leads to respect, understanding and embrace of different cultures in the County. A farmer will appreciate the way of life of a Pastoralist and vice versa.



Plate 4.3: Burnt houses after a conflict in tana river

Map 4.1: Conflict Risk



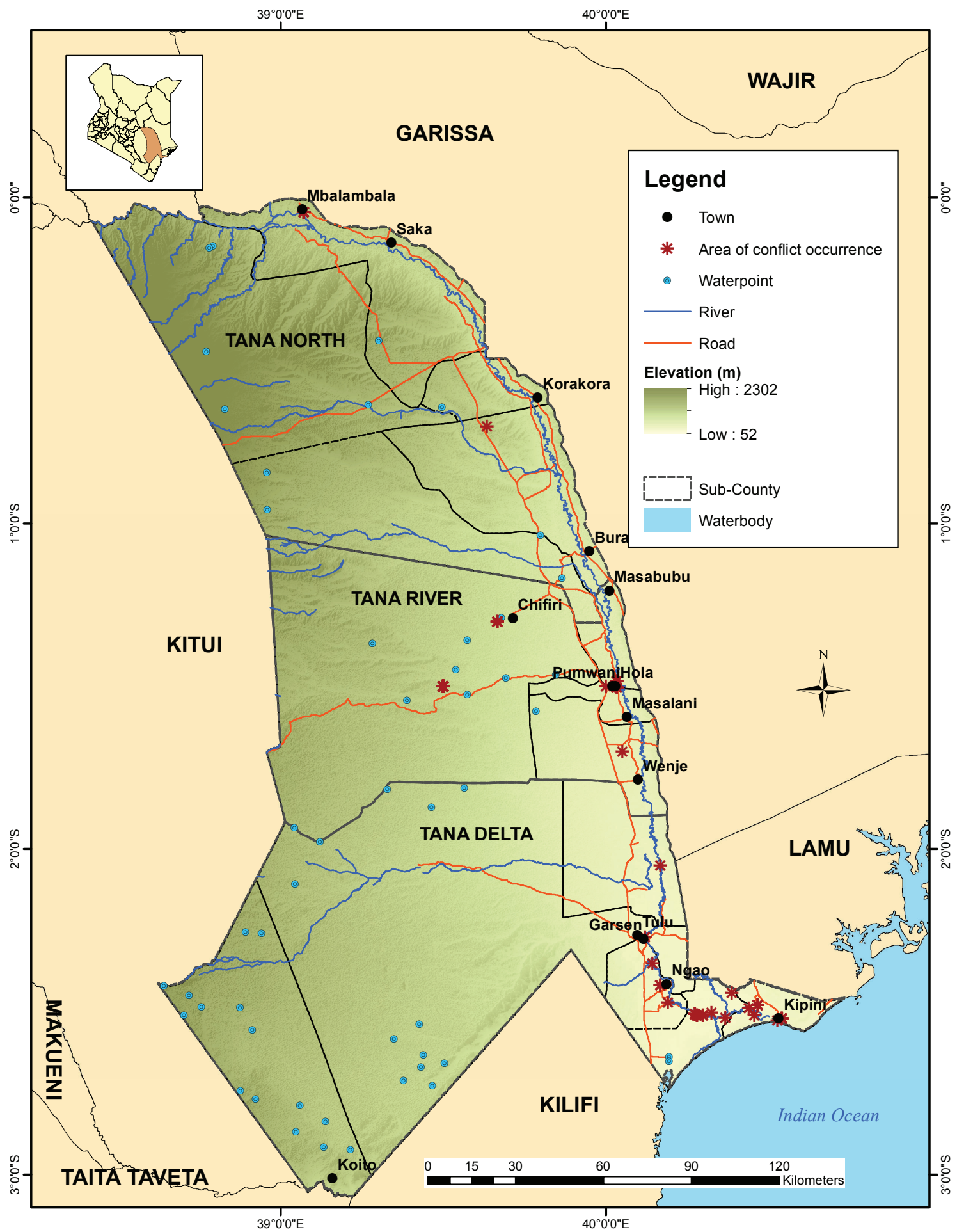
Data sources: UNEP & USGS

Data parameters: Coordinate System: WGS 84

This map was developed after a participatory mapping exercise with various Tana River County stakeholders. It shows conflict risk and occurrence in Tana River County. Classification was based on areas that are at high or low risk in the County. Areas in Hirimani, Madogo, Chewani,

Wayu, Kinakomba and Kipini have high conflict risk. Bangale, Chewele, Chifiri and Garsen have medium risks while parts of Garsen West and Kinakomba have low conflict risk.

Map 4.2: Conflict Prone Areas



Data sources: ACLED

Data parameters: Coordinate System: WGS 84

This map depicts areas where conflicts occurred and were reported. Just like the map developed after the participatory mapping exercise, conflict areas are mostly in the delta around Kipini East and West, Garsen South and Central, Kinakomba, Hola and Chifiri areas.



Plate 4.4: Burnt houses after conflict. (source: voice America)



Plate 4.5: people fleeing their homes (Source: Baraka Fm)

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Chapter 5: Floods

5.1 Introduction

Traditionally flooding in Tana River County was deemed a blessing since the farmers, especially rice farmers and fishermen maximized on this opportunity to plant their crops and fish; also with floods there was adequate water supply as dams and wells were refilled (HOLA Participatory Mapping Participants). However, with the increase in Kenya Electricity Generating Company (Kengen) dams and ecological disturbance in the catchment areas, flooding has become more of a curse to Tana residents (Tana River Validation Workshop Participants). Floods are nowadays a result of anthropogenic activities. Whenever water is released from dams it results in flooding in the Southern part of the County which makes the locals vulnerable.

5.2 Types of floods occurring in Tana River County

Flash floods: This mostly happens in Tana River County when there is heavy rainfall upstream in other counties in the Mt. Kenya region or due to opening of dams to ease pressure. All the three sub-counties in Tana are prone to this type of floods. The wards that are mostly affected include Chewani, Mikinduni, Kinakomba, Kipini West, Garsen West, Garsen South, Garsen North, Garsen Central, Chewele, Madogo and Sala.

River floods: This is one of the common causes of flooding caused by prolonged rainfall. When it rains for a long time, the ground becomes saturated and the soil will no longer

be able to store water leading to increased surface runoff. Rainwater enters the river much faster than it would if the ground was not saturated leading to higher discharge levels and floods. Just like flash floods, all the three sub-counties in Tana are affected. Wards that are most prone to river floods include Chewani, Mikinduni, Kinakomba, Garsen West, Garsen North, Garsen South, Garsen Central, Chewele, Madogo, Sala, Hirima and Kipini West.

5.3 Causes of floods in the County

- Tana River County receives an annual rainfall total of about 430 mm. Mount Kenya areas Meru and Embu receive an annual total of over 1300 mm. These Mt. Kenya areas happen to be the source of River Tana, which drains into the Indian Ocean. On its way it meanders through Tana River County and more than often causes flooding in the area when it bursts as a result of volumes of water gathered upstream (Kenya Meteorological Department, 2004). The flooding normally coincides with the two rainfall seasons in Mt. Kenya region (the long-rains and the short-rains).
- Several dams have been built up for generation of electricity in the country for example, along river Tana on the upstream. Too much water held up in the dam can cause it to break and overflow downstream. Excess water can also be intentionally released from the dam to prevent it from breaking and that can also cause floods.
- Cultivation of crops along slopes adjacent to the floodplains, causing massive erosion and destruction of



trees in the catchments.

5.4 Impacts of floods in the County

- **Agriculture:** Floods result in the inundation of productive agricultural land leading to destruction of crops. This has an impact on agricultural productivity leading to food insecurity in the areas directly affected and those that produce food consumed in other parts of the country. Floodwaters may also destroy harvested food that has been stored.

- **Public health and sanitation:** Floods result in the destruction of water for domestic use and sanitation infrastructure. This has negative impacts on public health as a result of coming into contact with contaminated water that increases the prevalence of water-related diseases such as cholera, diarrhoea and typhoid.

- **Infrastructure damage:** Major infrastructure that supports the county such as roads, bridges, houses, schools and water pipelines are prone to damages as result of floods. Floods seriously damage water supply infrastructure and transport networks across the county. The knock-on effects include shortages of food and other basic supplies across the county. Relief operations coordinated by the government and other relief and humanitarian agencies during the flood disaster are also affected due to destruction of transport infrastructure.

- **Human displacement:** People in the county flood-prone areas are displaced and rendered homeless following destruction of their homes leading to internally displaced persons. Buildings and business premises are also affected during floods. The most vulnerable people are the poor who are forced to settle in risky floodplains to make out a living

from agriculture, livestock farming and fisheries.

- **Environmental:** In addition to physical impacts on build environment, floods have a negative impact on the natural environment as well. Floods result to land degradation and increased soil erosion with consequent silting on rivers and dams.

5.5 Interventions

- Construction of dams to harness water for constructive use with proper management, e.g. hydroelectric power generation.

- Reforestation, improving land management practices, zoning of conservation areas for protection

- Preparing qualified nurses, drilling bore holes for safe drinking water and ensuring that sanitation is of a high standard and properly maintained to check for disease outbreaks. It is up to the Ministry of Works to ensure that roads are passable, since this can be a big impediment during rescue efforts.

- Provision of seedlings especially rice for planting during flooding. This will optimize water uses for the benefit of the community.

- Exploration of permanent underground water sources and frequent flashing of the existing water systems

- Rehabilitation of water structures and sanitation facilities in central places

- Increasing Disaster Risk Reduction strategies in Tana River County



Plate 5.1: Flooding in Tana River (Source: 24Tanzania.com)

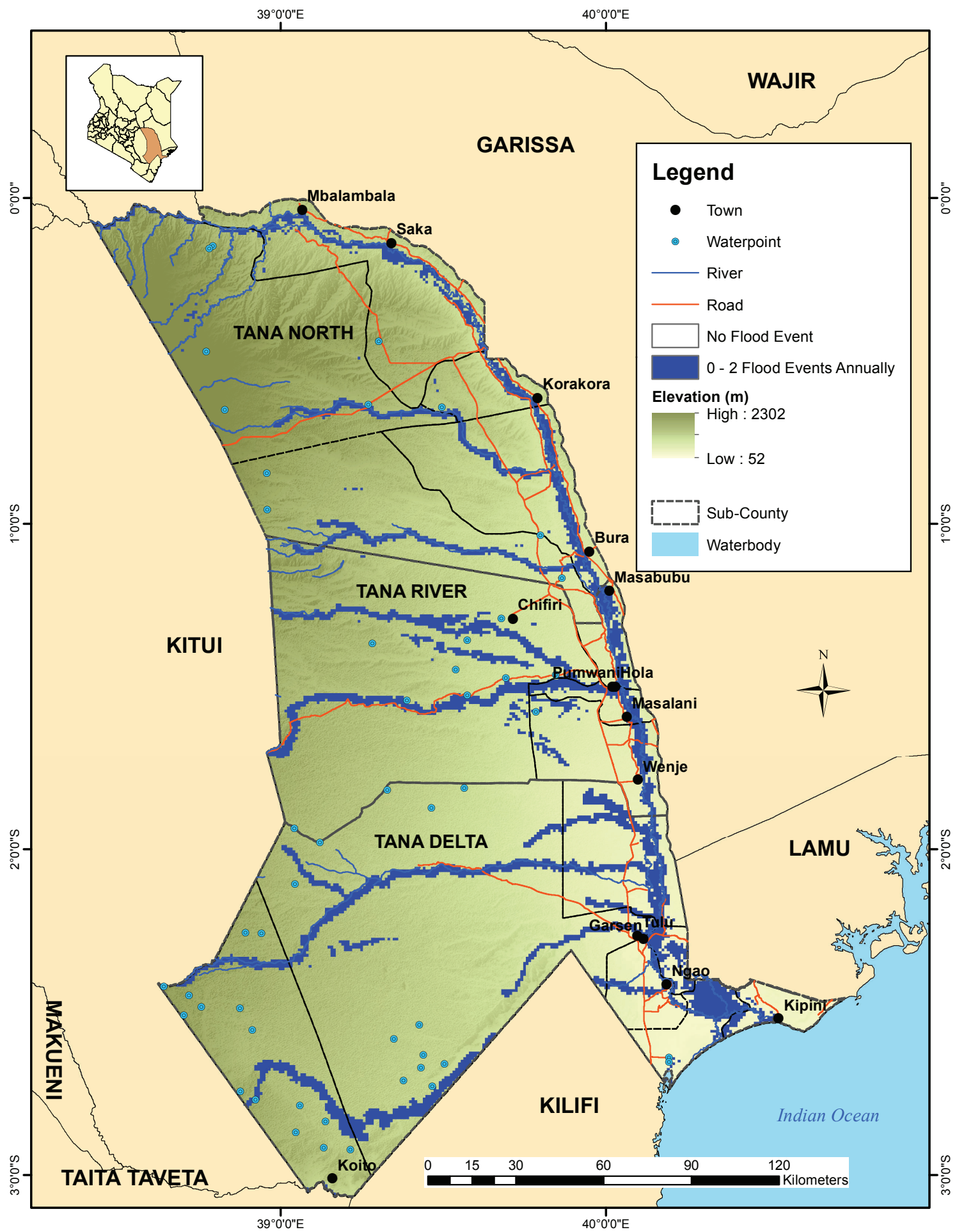
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Map 5.1: Flood Frequency

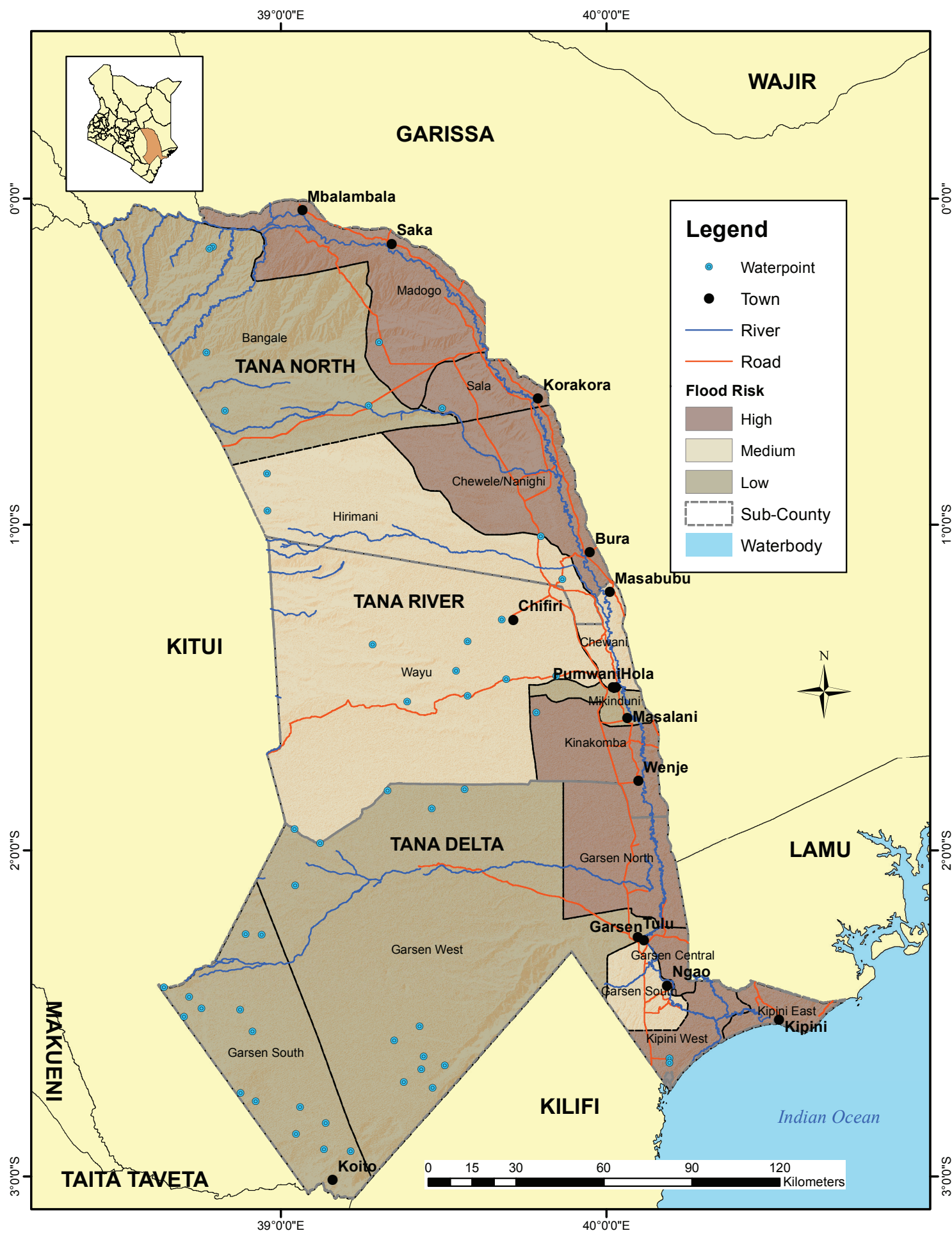


Data sources: UNEP & USGS

Data parameters: Coordinate System: WGS 84

This map shows areas in Tana River that have recorded 0 to 2 flood events annually over an 8 year period of observation 1999 – 2007

Map 5.2: Flood Risk



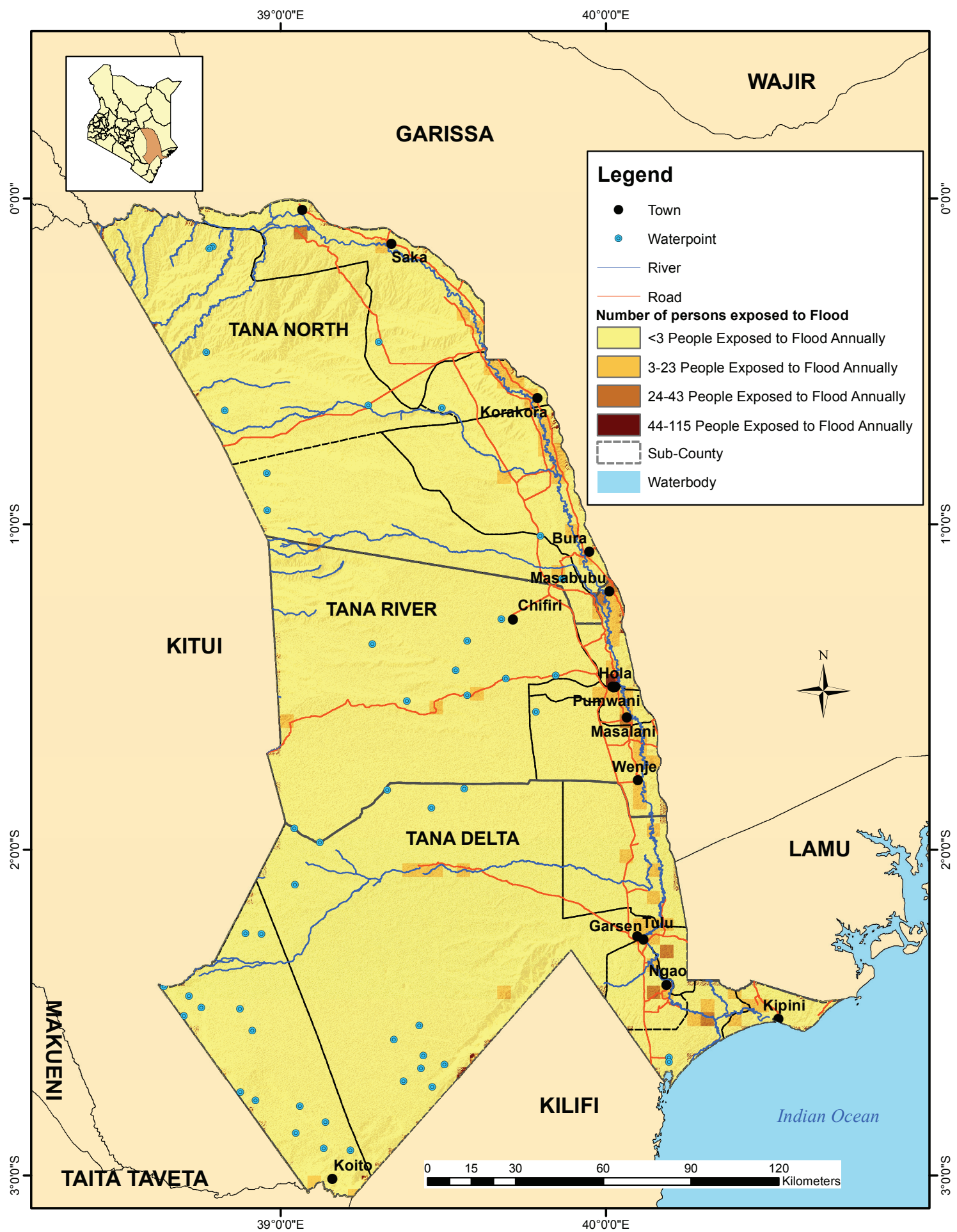
Data sources: County DRR Platform

Data parameters: Coordinate System: WGS 84

This map was developed after a participatory mapping exercise with various Tana River County stakeholders. It shows flood risk in Tana River County. Classification was based on wards that are at high or low flood risk in the County. Chewele, Sala, Madogo, Kinakomba, Garsen

North, Garsen Central, Kipini West and East are more prone to floods compared to the other wards. Bangale, Garsen South and West are the least prone to floods

Map 5.3: Flood Physical Exposure

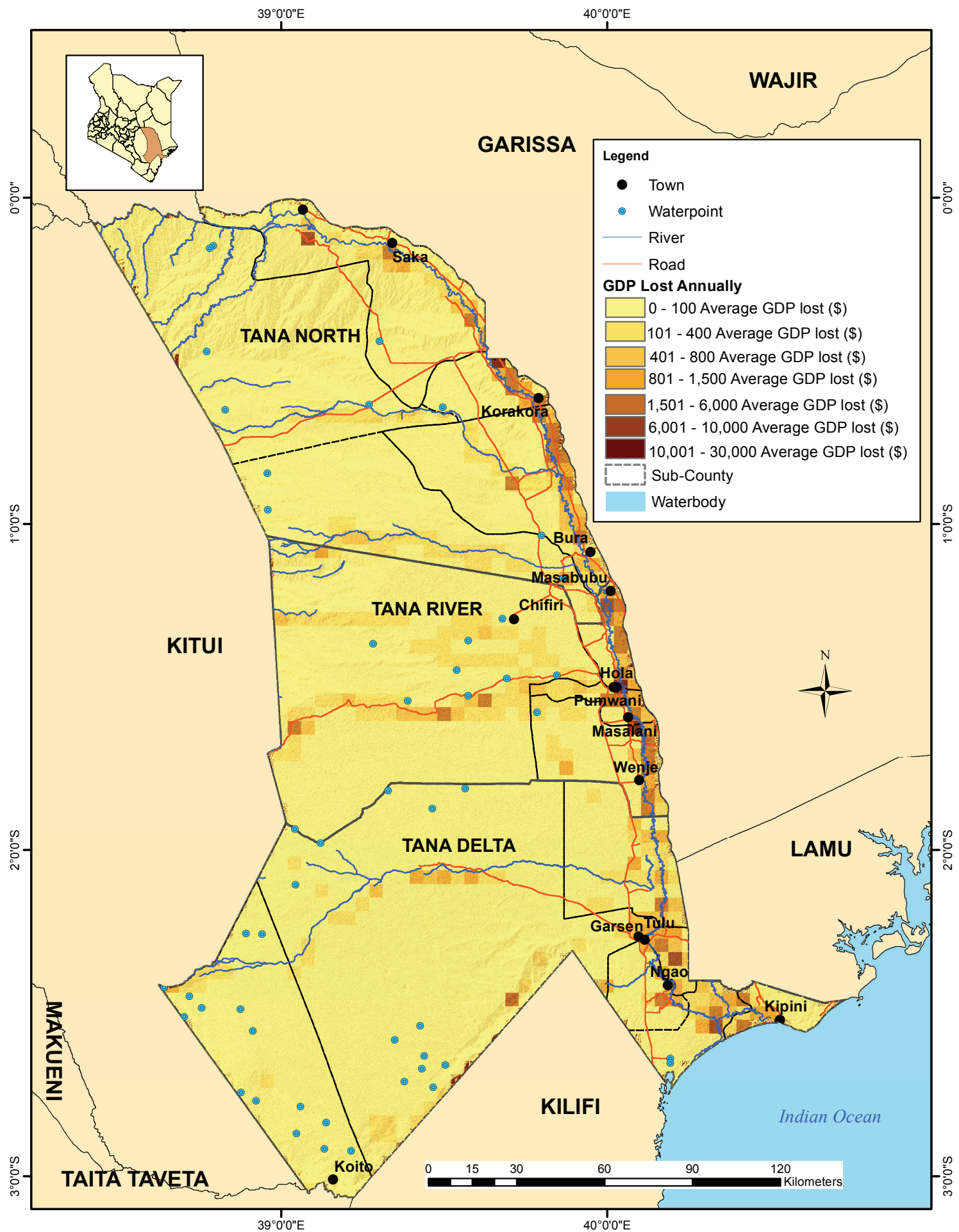


Data sources: UNEP & USGS

Data parameters: Coordinate System: WGS 84

Large numbers of persons exposed to floods in Tana River County are those who live along River Tana and in the delta. Other regions like parts of Garsen West and Wayu wards, experience flash floods in the events of erratic rainfalls that fill Lagas.

Map 5.4: Flood Economic Exposure



Data sources: UNEP & USGS

Data parameters: Coordinate System: WGS 84

This map shows the annual economic exposition to floods in Tana River County. This is indicated in expected average annual Gross Domestic Product (GDP), which is a monetary value of all the finished goods and services produced within a country's borders, expressed in US dollars

per year. It considers the annual frequency of occurrence and degree of severity of flood events vis-à-vis economic drivers of a region. Areas along River Tana are more affected. Masalani, Ngao and Kipini towns are the worst hit areas.

Chapter 6: Human And Livestock Diseases

6.1 Introduction

Diseases are known to generate into a potential disaster if not controlled in a timely manner. Some diseases affect both humans and animals and can be transmitted from animals to humans. Some hazards such as drought and floods often lead to disease outbreaks. Tana River County faces both human and animal disease challenges.

6.2 Major types of Human diseases in Tana River County

Disease epidemics can disrupt the way of life of a group of people. Some of the human diseases that affect Tana River people include malaria, sleeping sickness, respiratory diseases, skin disease, Diarrhoeal diseases, HIV/AIDS and Jigger infestation.

6.3 Major types of Livestock diseases in Tana River County

Pastoralism is the major source of livelihood for Tana River residents. Livestock diseases threaten the economic well-being of the Tana River communities. Some of the major livestock diseases are Trypanosomiasis (Nagana), Contagious Bovine pleural pneumonia (CBPP), Contagious Caprine pleural pneumonia (CCPP), Rift Valley Fever (RVF), Foot and Mouth Disease (FMD), Peste des Petits Ruminants (PPR), Black Quarters, East Coast Fever, Worm Infestation and Worm Infestation.

Table 6.1 below shows the various causes of the human diseases, impacts and intervention as highlighted by Tana River residents who participated in a workshop organized by NDMA/RCMRD in Hola.

Type Of Human Diseases	Sub-County Affected	Ward Affected	Causes	Impacts	Intervention
Malaria	Tana River North, Galole, Tana Delta	All wards along Tana River line	<ul style="list-style-type: none"> Stagnant water Minimal use of mosquito nets within the community. Shortage of mosquito nets. Hot climatic conditions 	<ul style="list-style-type: none"> School drop out Low birth weight Anaemia during pregnancy High morbidity Mortality Low economic productivity 	<ul style="list-style-type: none"> Increase qualified staff Net distribution and education on proper use Health Education Bush clearing Improving drainage systems to clear stagnant water Spraying of houses Intermittent preventive treatment in pregnancy Advocating for treatment by qualified medical personnel when infected Strengthening maternal and child welfare
Diarrhoeal disease	All sub-counties Galole and Tana Delta	All 15 wards	<ul style="list-style-type: none"> Unsafe drinking water Poverty Unawareness of importance of drinking clean water Consuming poorly prepared food Lack of clean and safe drinking water 	<ul style="list-style-type: none"> High morbidity level Malnutrition High Mortality Increase in Medical expenses Low economic productivity 	<ul style="list-style-type: none"> Health Education Construction of latrines and sensitization on the importance of usage Use of safe drinking water Vaccination Proper hygiene practices Provision of zinc sulphates and Oral Rehydration Salts (ORS) to less than 5 years children. Strengthening referral systems
Respiratory Diseases	All	All wards along Tana River line	<ul style="list-style-type: none"> Dusty environment Poor ventilation Overcrowding Low social economic status Lack of awareness of disease prevention Poor health seeking behavior Vitamin A coverage 	<ul style="list-style-type: none"> Poor developmental milestones 	<ul style="list-style-type: none"> Vitamin A supplement Health awareness/ education Improve ventilation in houses Hygienic and clean environment Increase health outreach
Skin disease	All	All	<ul style="list-style-type: none"> Worm infestation Poor personal hygiene Poor living conditions Poor nutrition Low social economic status (sharing of clothes) 	<ul style="list-style-type: none"> Poor growth and developmental milestone School dropout increase and absenteeism Medical expenditure 	<ul style="list-style-type: none"> Deworming Health education on personal hygiene Strengthen school health program Micronutrient supplementation Medical outreach Strengthen community health strategy
Jigger Infestation	Tana Delta	All	<ul style="list-style-type: none"> Poor Hygiene Climatic condition Type of soil 	<ul style="list-style-type: none"> Stigma Low economic status School drop out Less mobility 	<ul style="list-style-type: none"> Sensitization on proper Hygienic practices Awareness campaigns on prevention such as putting on shoes.
HIV/AIDS	All	All wards	<ul style="list-style-type: none"> Lack of awareness on the use of condoms Cultural beliefs Unprotected sex Prostitution/ sex immorality Condom use coverage 	<ul style="list-style-type: none"> Stigma Orphans Spread of virus High mortality low economic status 	<ul style="list-style-type: none"> Awareness on proper condom use Advocating for voluntary testing and counseling Discouraging bad cultural beliefs such as wife inheritance Increasing condom distribution and availability Increasing health outreach

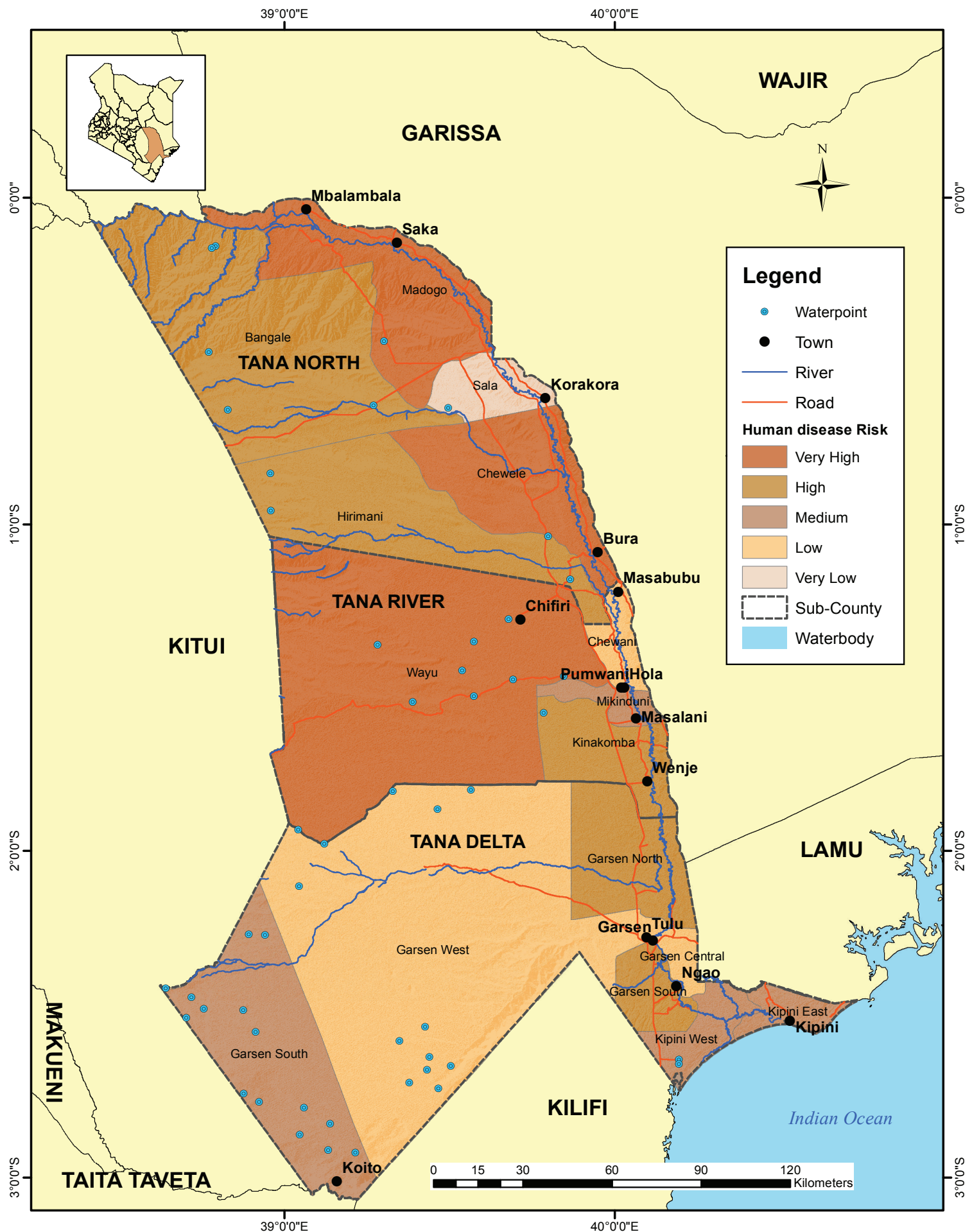
Table 6.2 below shows the various causes of the livestock diseases, impacts and intervention as highlighted by Tana River residents who participated in a workshop organized by NDMA/RCMRD in Hola.

Type Of Livestock Diseases	Sub-County Affected	Ward Affected	Causes	Impacts	Intervention
Trypanosomiasis	Tana North, Tana Delta, Galole	All	<ul style="list-style-type: none"> • Tsetse fly 	<ul style="list-style-type: none"> • Low livestock productivity(Milk) • Poor animal health • Economic loss at household level • Sleeping of animals 	<ul style="list-style-type: none"> • Prophylatic treatment • Tsetse fly traps • Actual treatment • I.T.K • Application of Spot on
Contagious Caprine pleural pneumonia/ Contagious Bovine pleural pneumonia (CCPP/CBPP)	All	All	<ul style="list-style-type: none"> • Viral 	<ul style="list-style-type: none"> • Low livestock productivity (meat, milk, income) • Poor animal health • Economic loss at H/H level 	<ul style="list-style-type: none"> • Vaccination • Treatment with antibiotics
Foot and Mouth Disease (F.M.D)	All	All	<ul style="list-style-type: none"> • Viral 	<ul style="list-style-type: none"> • Loss of body weight • Emaciation • Economic loss at H/H level 	<ul style="list-style-type: none"> • Vaccination • Treatment of secondary infection • Nursing and dressing of wounds • Quarantine
Rift Valley Fever (R.V.F)	All	All	<ul style="list-style-type: none"> • Viral 	<ul style="list-style-type: none"> • Loss in body weight • Emaciation • Economic loss at H/H level • Has impact on human (Zoonotic) 	<ul style="list-style-type: none"> • Vaccination • Treatment of secondary infection
P.P.R	Tana North Tana Delta Galole	All	<ul style="list-style-type: none"> • Viral • Common during flooding 	<ul style="list-style-type: none"> • Low productivity (meat, milk) • Poor animal health • Economic loss at H/H level • Has impact on human • Closure of livestock markets 	<ul style="list-style-type: none"> • Vaccination • Treatment of secondary infection • Quarantine
Black Quarters	All	All	<ul style="list-style-type: none"> • Bacterial 	<ul style="list-style-type: none"> • Poor animal health • Low productivity • Economic loss at H/H level • Death if not contained early enough 	<ul style="list-style-type: none"> • Isolation of infected and in contact animals. • Disposal of carcass either by deep burial or burning. • Proper disinfection of surgical instruments prior to operation. • Closure of affected grazing area.

					<ul style="list-style-type: none"> • Vaccination
Tick Borne Diseases (Anaplasmosis, Ehrlichiosis, Tick Paralysis and Heartwater)	All	All	<ul style="list-style-type: none"> • Ticks infestation 	<ul style="list-style-type: none"> • Low productivity • Poor animal health • Economic loss at H/H level 	<ul style="list-style-type: none"> • Spraying and dipping • Burning of pasture land • Physical removal
New Castle Disease	All	All	<ul style="list-style-type: none"> • Viral 	<ul style="list-style-type: none"> • Mass Deaths • Low of productivity of meals • Poor animal health 	<ul style="list-style-type: none"> • Vaccination • Treatment of secondary infection • Disposal of the stock
Fowl Typhoid	All	All	<ul style="list-style-type: none"> • Bacterial 	<ul style="list-style-type: none"> • Low productivity of meat and eggs • Poor health • Loss of income at H/H level 	<ul style="list-style-type: none"> • Treatment • Vaccination
Worm Infestation	Tana North, Tana Delta, Galole	All	<ul style="list-style-type: none"> • Infested pasture, water and bomas 	<ul style="list-style-type: none"> • Low productivity • Economic loss • Emaciation • Zoonotic 	<ul style="list-style-type: none"> • Deworming • Burning of rangeland • Rotational Grazing
Lumpy skin disease	All	All	<ul style="list-style-type: none"> • Viral 	<ul style="list-style-type: none"> • Low Productivity • Poor animal health • Economic losses 	<ul style="list-style-type: none"> • Vaccination • Treatment of secondary infection • Increasing skilled personnel • Wound dressing
					<ul style="list-style-type: none"> to prevent secondary infection • Proper feeding

(NB: H/H: Household)

Map 6.1: Human Disease Risk



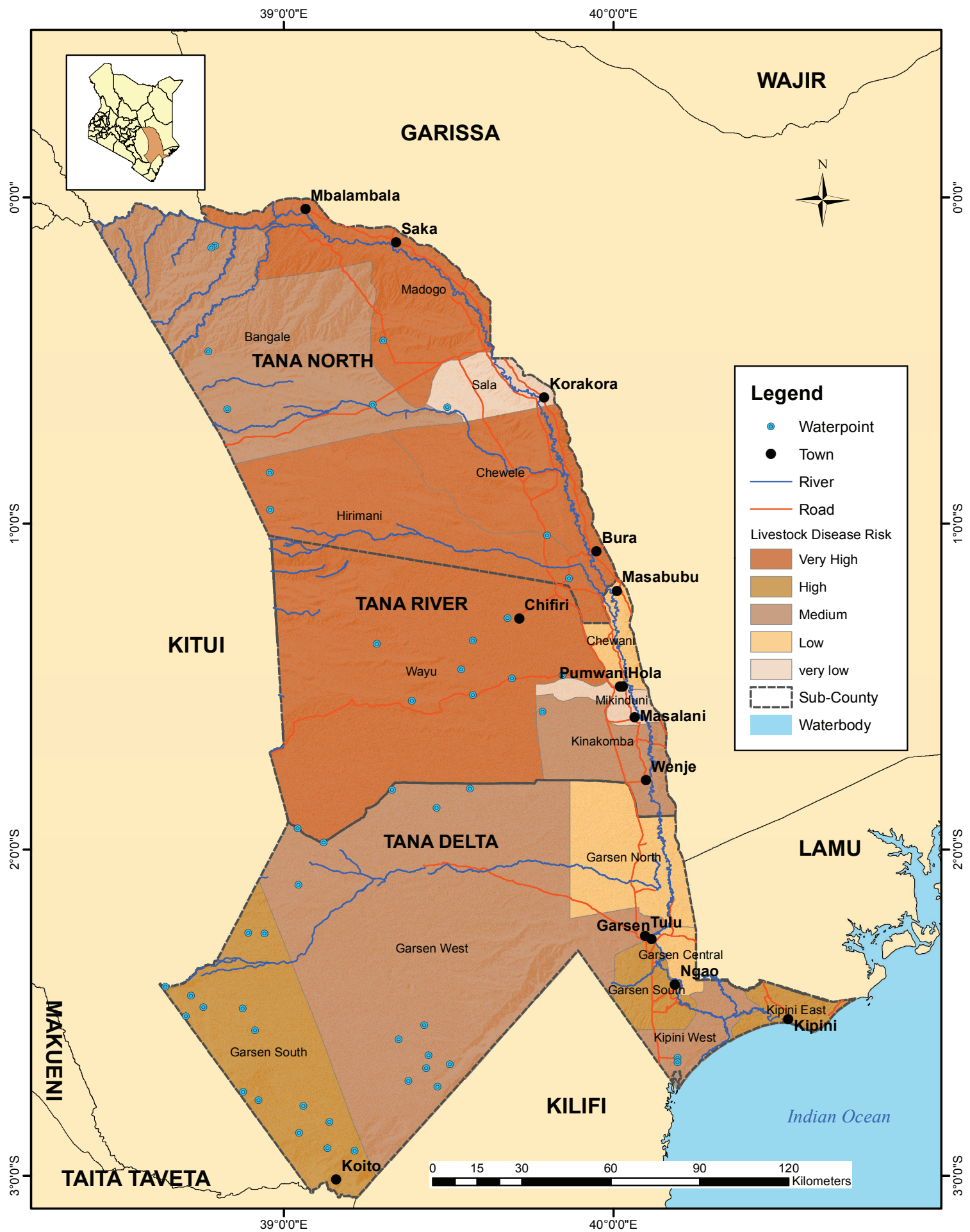
Data sources: County DRR Platform

Data parameters: Coordinate System: WGS 84

This map was developed after a participatory mapping exercise with various Tana River County stakeholders. It shows human diseases risk and distribution of occurrence in Tana River County at ward level. Classification was based on disease occurrence (number of diseases per ward). The higher

the disease incidence in a ward the higher the ward was considered to be at risk. Madogo, Chewele and Wayu are the worst hit wards followed by Bangale, Hirimani, Kinakomba and Garsen North. Sala was depicted as the ward that has very low disease risk

Map 6.2: Livestock Disease Risk



Data sources: County DRR Platform

Data parameters: Coordinate System: WGS 84

This map was developed after a participatory mapping exercise with various Tana River County stakeholders. It shows livestock diseases risk and distribution of occurrence in Tana River County at ward level. Classification was based on disease occurrence (number of diseases per ward). The

higher the disease incidence in a ward the higher the ward was considered to be at risk. Madogo, Hirimani, Chewele and Wayu are the worst hit wards followed by Kipini East and Garsen North. Sala and Mikinduni were depicted as the wards that have very low disease risk.



Plate 6.2 jigger infested foot (Source:www.jigger-ahadi.org)



Plate 6.3: Mosquito that transmits malaria (Source: www.kbc.co.ke)

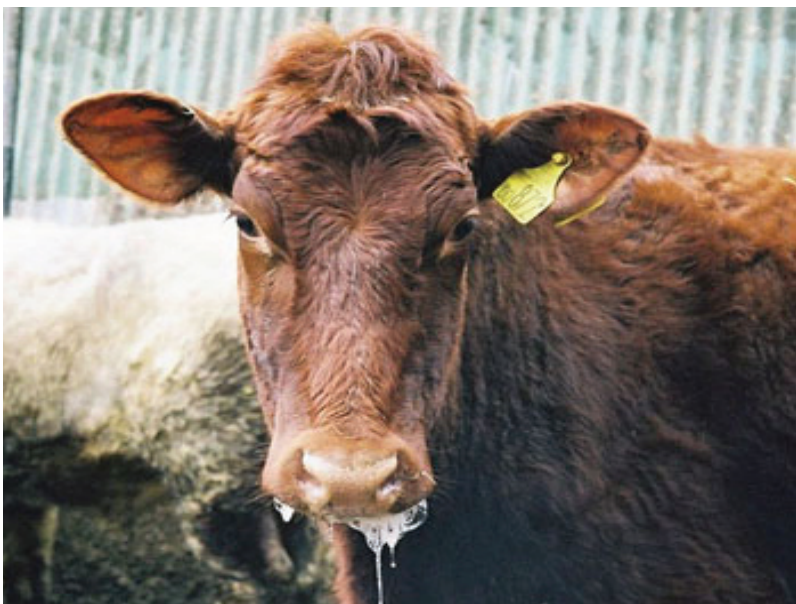


Plate 6.7: Cow stricken with foot and mouth disease (source:www.linlo.gov)



Plate 6.4: Skin disease (Source: www.researchgate.net)



Plate 6.5: Cow having difficulty in breathing due to CBPP (Source:www.foo.org)



Plate: 6.6: Cow suffering from lumpy skin disease (Source:www.monica-post.com)

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Chapter 7: Vulnerability Indicators

7.1 Introduction

Socio-economic well-being of the locals always gets crippled in case of a hazard. Some of the livelihood types in Tana River include Pastoralism All-species, Livestock farming, Formal employment, Agro-pastoral, Marginal mixed farming, Mixed farming, Mixed farming:

Figure 7.1 indicates the economic status of the county.

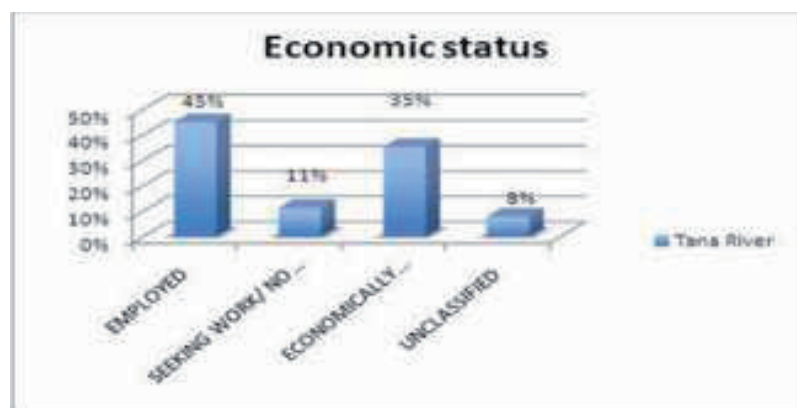


Figure 71: Tana River County's economic status (Source: KNBS census, 2009)

Key:

1. Employed- those people that are working
2. Economically inactive the non-working age that comprises of very old and young people in the population.
3. Not employed those people that are potential employees but have not secured any form of employment
4. Unclassified the population that had not indicated their economic category.

crops/cash crops, National park and Pastoral: camel/Goats/Shoats. Pastoralism All-species is the major livelihood in Tana River County. Agro-pastoral takes place mostly along the river Tana.

7.2 Hazards and Health, Water and Education

Tana River County faces hazards such as drought, floods, conflicts and human and livestock diseases that render the locals vulnerable when it comes to access to education, health and water.

7.2.1 Access to education

Kenya has made great strides in expanding education levels and enrolment rates since the introduction of free primary education in 2003. However, progress in the ASAL counties which Tana is part of has been way behind the rest of the country.

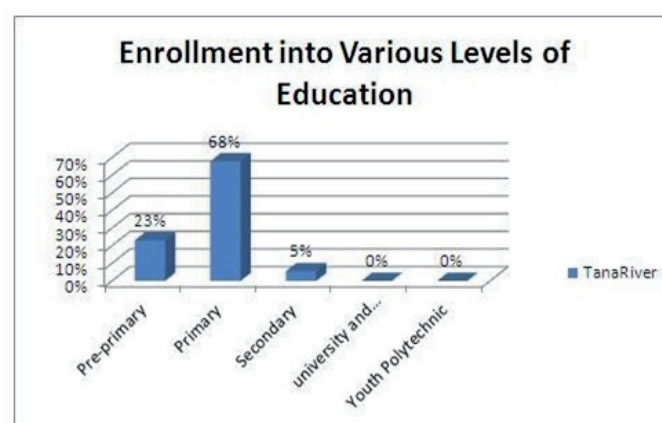


Figure 7.2: Enrollment levels at different levels of Education in Tana River (Source: CRA, 2011)

Tana River's education sector faces several challenges due to hazards and other factors. These affect both the boy and girl child. Insecurity is a major factor which affects education enrolment, access and quality to the detriment of the girl child (Allan, 2009) in Tana River County. Vulnerability of the girl child increases mostly during conflict times where, the girl can be raped, become head of family and takes over household roles which can keep her out of school. Boy child is also not spared from much; some of them have to take care of the animals when the older ones protect the families from attack by other communities.

Drought episodes cause students to drop out of school. Some are forced to join their parents in search of scarce food. It is also difficult for the children to focus in class when hungry. This affects their general performance in studies. Pastoral patterns of mobility in search of pasture do not correspond well with school terms therefore children cannot attend year round. Consequently, even where schools function, quality is poor.

Poor health due to various hazards has been shown to impede educational access, attainment, and achievement for students in the county (IPA, 2011). This is due to incapacitation or stigmatization. For instance, malaria renders the students too weak to attend classes. Jigger infestation causes pain when walking and the general perception on the diseases cause the children to shy away from school.

All these factors coupled with lack of enough teachers, schools and early marriages have affected enrollment and performance of students in Tana River County. According to KNBS and SID 2013, only 7% of Tana River County residents have secondary level of education or above. A total of 37% of Tana River County residents have a primary level of education only. A total of 56% of Tana River County residents have no formal education.

There's a lot that needs to be done so as to improve the education sector in Tana River County. In 2010 the

Government of Kenya spearheaded such initiatives by publishing its Nomadic Education Policy Framework. This recognizes the specific needs and rights of nomadic communities to all levels of education. The policy provides for innovation and flexibility in the education of pastoralists acknowledging the role and importance of informal schools and alternative approaches (GOK, 2011). Besides this, more teachers should be employed and more schools built.

7.2.2 Access to Health facilities

Tana River County has the following health facilities;

- County Hospitals (2)
- Sub-County Hospitals (None)
- Dispensaries (47)
- Health Centers (5)
- Medical Clinics (4)

According to CRA, 2011, 79.31% of the hospitals in Tana River County are public and are government owned.

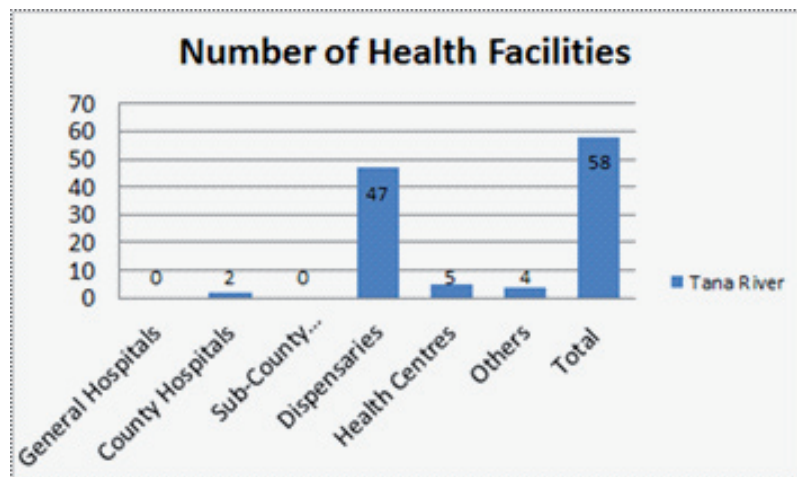


Figure 7.3: Number of Health facilities in Tana River County (Source: CRA, 2011)

Key Statistics

- Notable Hospitals: Hola District Hospital and Ngao District Hospitals
- Doctor to Population Ratio: 1: 95,500
- Infant Mortality Rates: 66/1000
- Under Five Mortality Rates: 80/1000

While the staff shortages have affected the health system countrywide, the status of human resource service coverage across the County generally has notably been worse, with a health worker to population ratio that has been largely inadequate and inequitable when compared to other regions (MOMS & MOPHS, 2009). The healthcare worker to population ratio in all of Northern and Southern Kenya counties has been worsened by the geographical spread mostly rural, low population density, and the nomadic lifestyle of many of its people. Poor telecommunication, infrastructure, and security (perennial intertribal/clan conflicts) contribute further to poor health care access and quality (MOMS&MOPHS, 2010).

In this region, shortage of health personnel is further compounded by mal-distribution, with a predominant urban

bias where majority of health workers are concentrated. In terms of health service provision, on average, 50% of the equipment in public health facilities and laboratories are obsolete or unserviceable (MOH, 2006). This situation intertwined with hazards in the County complicates the services that can possibly be delivered and their quality generally. Conflicts, floods, drought and disease outbreaks affect the health of the population.

7.2.3 Access to water

In Tana River County, 42% of residents use improved sources of water, with the rest relying on unimproved sources. There is no gender differential in use of improved sources as 42% of male headed households and 41% in female headed households use it. Garsen sub-county has the highest share of residents using improved sources of water at 54%. That is twice Bura sub-county, which has the lowest share using improved sources of water (KNBS& SID, 2013).

During floods and after, water can become contaminated with microorganisms such as bacteria, sewage, agricultural or industrial waste, chemicals and other substances that can cause serious illness. Tana River bursts its banks when it rains heavily upstream in Mt. Kenya region. Flowing water carrying pollutants find their way into water sources.

Water accessibility in various communities in Tana River County

Figure 7.4 below shows percentage of population per ward that has access to safe drinking water in Tana River County

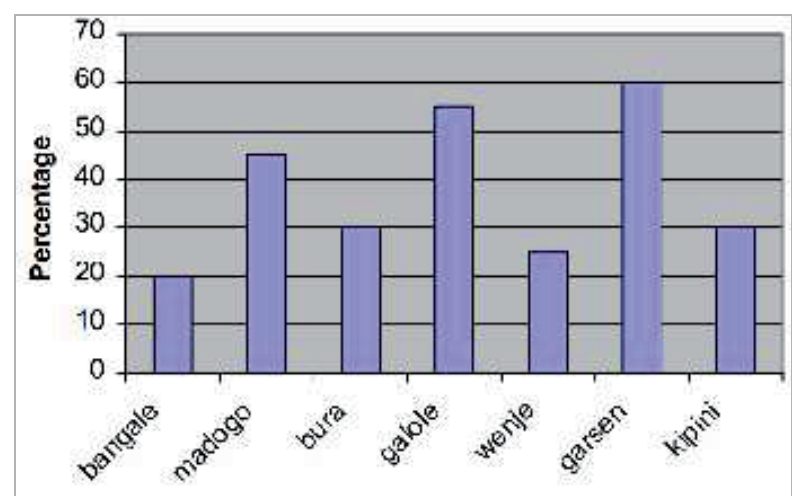


Figure 7.4: Percentage of population accessible to Safe drinking water, (Source: NEMA, 2009)

The lack of convenient and affordable access to water reduces a poor household's consumption of other commodities and services, leaves it consuming less than the optimum amount of water for good hygiene, and impacts health and labour productivity of the household members. It may also reduce income-generating opportunities of the household thereby further reducing income and consumption.

Key sources of Water include the following: (NEMA,2009)

- Springs - In the county- there are no well-defined springs.
- Shallow wells there are slightly over 350 shallow wells mostly serving population along the river line.
- Boreholes - Ground water surveys have not been carried out exhaustively but few boreholes which were sunk had saline water (e.g. by Catholic Diocese of Garissa), Lagha Tula, Oda etc.
- Rainwater- The county receives inadequate rain however some institutions have rain harvesting tanks e.g. plastic tanks and ferrocement tanks.
- Rivers- The county has one permanent source of water (River Tana) which covers a stretch of approximately 500 km in the county and other seasonal rivers (Laghas e.g. Kokani, Tula, Hirimani, Kamole etc.
- There is no permanent lake a part from Lake Shakababu which depends on flooding of river Tana.
- Pans/dams/sand dams — there are several pans in the hinterland which serves pastoralists and 2 sand dams along Lagha Gable.
- Wetlands — the only wetland is Tana Delta

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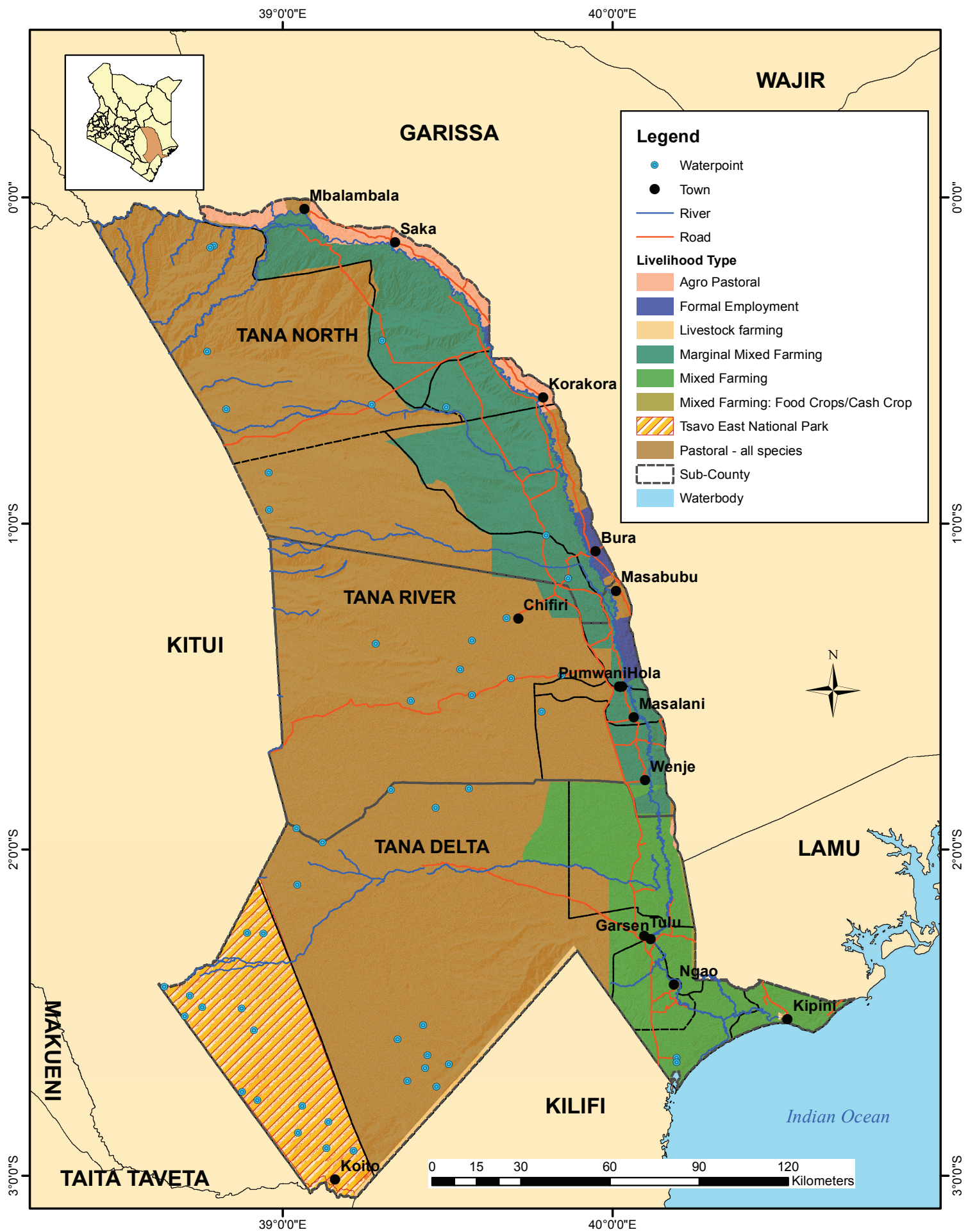
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Map 7.1: Livelihood Zones In Tana River County



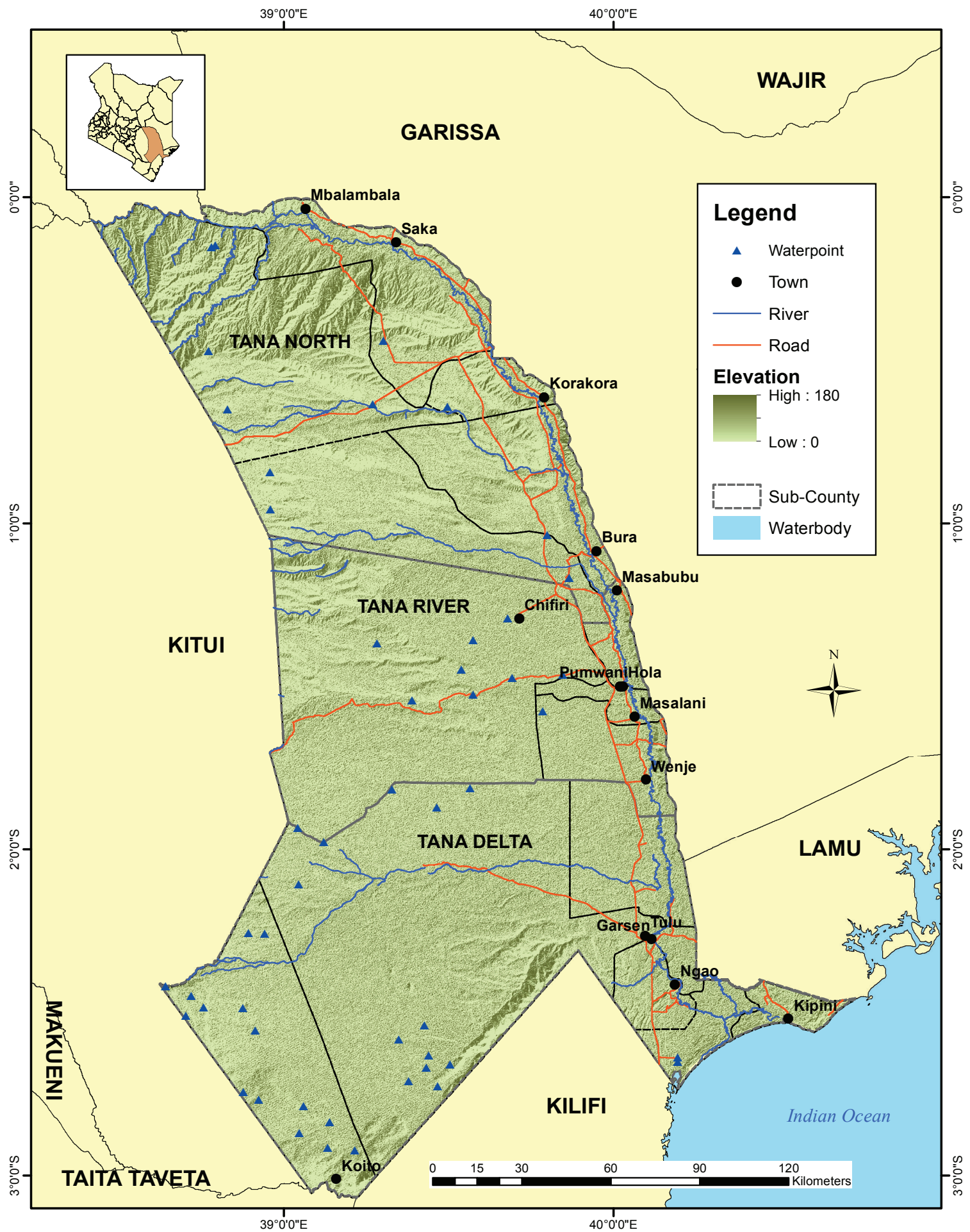
Data sources: NDMA

Data parameters: Coordinate System: WGS 84

There are several types of livelihood in Tana River County. Pastoral All-species is the main source of in the County. Marginal mixed farming, Agro-Pastoral and mixed farming are practised close to River Tana and

the delta. Tsavo East national park also serves as a source of revenue and income for locals. Formal Employment is common in major towns like Bura and Hola.

Map 7.2: Water Resources In Tana River



Data sources: *ILRI*

Data parameters: *Coordinate System: WGS 84*

This map shows the various water resources in Tana River County. These vary from water points representing dams, boreholes and water pans to rivers and Indian Ocean.



Plate 7.1: Rice planting in Tana delta (Source: www.naturekenya.org)



Plate 7.4: Man, Woman and children drawing water from a borehole (Source: stories.actionagaoinsthunger.com)



Plate 7.2: Fishing in Tana River (Source: <https://tanadailynews.wordpress.com>)



Plate 7.5: Women drawing water from a borehole (Source: stories.actionagaoinsthunger.com)



Plate 7.3: Pastoralism in Tana River (Source: www.the-star.co.ke Photo by: A lphonse Gari)



Plate 7.6: Tana River (Source: www.transauthority.go.ke)

Metadata

1. Mapping of Drought Hazard: Total failure or rainfall below expected levels is the major attribute to drought. Lack or excess precipitation directly affects the vegetation conditions. Climate Hazards Group Infrared Precipitation with Stations (CHIRPS) datasets were used to derive seasonal rainfall trends for the years 1981-2013 using GEOCLIM tool and Standard Precipitation Index (SPI) datasets from FEWSNET were used in mapping of drought. Long rains (March-June) and short rains (October- December) for the years 2000, 2009 and 2012 were used as a reference in mapping SPI.

- **Mapping of Standard Precipitation Index:** The Standardized Precipitation Index presents a rainfall anomaly as a normalized variable that conveys the probabilistic significance of the observed/estimated rainfall. By expressing anomalies in terms of their likelihood of occurrence it is easier to evaluate the rarity of the observed event, in the absence of a nuanced understanding of the rainfall regime at a location. This method offers a different, and complementary, perspective compared to anomalies (which can be relatively large, but not very significant in areas with highly variable rainfall) or percent of normal (which can be extreme, but not very significant in dry locations).

To evaluate the likelihood of occurrence, probability distribution functions (PDFs) are fit at each pixel for each accumulation interval. These PDFs are fit to the Collaborative Historical African Rainfall Model (CHARM), which provides a 36-year time series with which to estimate gamma distribution parameters. The CHARM data establishes the shape of the distribution, as well as an estimate of the variance. SPI values which are greater than zero indicate conditions wetter than the median, while negative SPI indicate drier than median conditions. For drought analysis, a SPI less than -1.0 indicates that the observation is roughly a one-in-six dry event, and is termed “moderate”. A SPI less than -1.5 indicates a one-in-fifteen dry event, and is termed “severe”. Values less than -2.0 are typically referred to as “extreme”, indicating the event is in the driest 2% of all events. For more information, please see: <http://earlywarning.usgs.gov/fews/africa/web/readme.php?symbol=sp>

- **Mapping of Rainfall Trends:** Rainfall trends map are the product of CHIRPS datasets. Climate Hazards Group Infrared Precipitation with Station data (CHIRPS) is a 30+ year quasi-global rainfall dataset. Spanning 50°S–50°N (and all longitudes), starting in 1981 to near-present, CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring. The CHIRPS datasets used in the rainfall trends mapping are products of USGS, CHG scientists, Agency for International Development (USAID) the National Aeronautics and Space Administration

(NASA), and the National Oceanic and Atmospheric Administration (NOAA). For more information, please see: <http://pubs.usgs.gov/ds/832/pdf/ds832.pdf>

- **Mapping of Drought Physical Exposure:** Drought Physical Exposure map is a product of dataset that includes an estimate of global drought annual repartition based on Standardized Precipitation Index. It is based on three sources: 1) A global monthly gridded precipitation dataset obtained from the Climatic Research Unit (University of East Anglia). 2) A GIS modeling of global Standardized Precipitation Index based on Brad Lyon (IRI, Columbia University) methodology. 3) A population grid for the year 2007, provided by LandScan TM Global Population Database (Oak Ridge, TN: Oak Ridge National Laboratory). Unit is expected average annual population (2007 as the year of reference) exposed (inhabitants). This product was designed by UNEP/GRID-Europe for the Global Assessment Report on Risk Reduction (GAR). It was modeled using global data. Credit: GIS processing UNEP/GRID-Europe. For more information, please see: <http://www.unisdr.org>

2. Mapping of Natural Resource Conflicts: Map of Conflict prone areas is a product of conflict dataset from Armed Conflict Location and Event Data Project (ACLED) and Range condition dataset from Virtual Kenya

- **Conflict Prone Areas:** Conflict prone areas data is a source of real-time data on political violence in African states, Media sources, access and coverage of conflict and human rights violations by civil society and international organisations. Information is designed for disaggregated conflict analysis and crisis mapping. Shows exact location, date and other characteristics of politically violent events in unstable and warring states. For more information, please see: <http://www.acleddata.com/>

- **Range Condition:** Range Condition map is a product of a shapefile which was obtained from the Range Management Handbook of 1992. It was slightly modified by the Turkana district resource persons to reflect the situation. The dataset shows areas of good, fair and poor range conditions in Turkana County. The range condition was overlaid over the access to water coverage (livestock water sources buffers of 10, 15 & 30km) to obtain the accessibility.

3. Mapping of Flood Hazard: Flood maps are products of models from regional earth observation datasets based on weighted overlay analysis of flood observation datasets.

- **Flood Economic Exposure:** This dataset includes an estimate of the annual economical exposition to flood. It is based on four sources: 1) A GIS modeling using a statistical

estimation of peak-flow magnitude and a hydrological model using HydroSHEDS dataset and the Manning equation to estimate river stage for the calculated discharge value. 2) Observed flood from 1999 to 2007, obtained from the Dartmouth Flood Observatory (DFO). 3) The frequency was set using the frequency from UNEP/ GRID-Europe PREVIEW flood dataset. In area where no information was available, it was set to 50 years returning period. 4) A population grid for the year 2010, provided by LandScanTM Global Population Database (Oak Ridge, TN: Oak Ridge National Laboratory). 4) A Global Domestic Product grid for the year 2010, provided by the World Bank. Unit is expected average annual GDP (2010 as the year of reference) exposed in (US \$, year 2000 equivalent). This product was designed by UNEP/GRID-Europe for the Global Assessment Report on Risk Reduction (GAR). It was modeled using global data. Credit: GIS processing UNEP/GRID-Europe, with key support from USGS EROS Data Center, Dartmouth Flood Observatory 2008. For more information, please see: <http://www.preventionweb.net/english/professional/contacts/v.php?id=2781>

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- **Flood Frequency:** This dataset includes an estimate of flood frequency. It is based on three sources: 1) A GIS modeling using a statistical estimation of peak-flow magnitude and a hydrological model using HydroSHEDS dataset and the Manning equation to estimate river stage for the calculated discharge value. 2) Observed flood from 1999 to 2007, obtained from the Dartmouth Flood Observatory (DFO). 3) The frequency was set using the frequency from UNEP/ GRID-Europe PREVIEW flood dataset. In area where no information was available, it was set to 50 years returning period. Unit is expected average number of event per 100

years. This product was designed by UNEP/GRID-Europe for the Global Assessment Report on Risk Reduction (GAR). It was modeled using global data. Credit: GIS processing UNEP/GRID-Europe, with key support from USGS EROS Data Center, Dartmouth Flood Observatory 2008. For more information, please see: <http://www.preventionweb.net/english/professional/ contacts/v.php?id=2781>

- **Flood Risk:** This dataset includes an estimate of the global risk induced by flood hazard. Unit is estimated risk index from 1 (low) to 5 (extreme). This product was designed by UNEP/GRID-Europe for the Global Assessment Report on Risk Reduction (GAR). It was modeled using global data. Credit: UNEP/GRID-Europe. For more information, please see: <http://www.preventionweb.net/english/professional/ contacts/v.php?id=2781>

- **Flood prone areas:** Flood prone areas map is a product of Dartmouth University - USGS. This product consists of individual GIS vector polygons which define the surface water detected by the MODIS 250 m bands and also depict a multi-temporal composite of the accumulating record of flooded land. These data are produced on a routine basis (1-2 day lag time) as part of the Observatory's flood measuring and mapping projects. When cloud cover and satellite coverage allows, vectors are produced from a single image for each flood event listed in the Archives (generally from 2000 forward). Vectors are also produced on a routine basis which shows rivers in in non- flood conditions. For more information, please see: <http://www.dartmouth.edu/~floods/DataProducts/MODIS/>

4. Mapping of Malaria Hazard: Malaria Hazard map is a product of Africamalaria mapping exercise. The methodology is based on household survey data interpolation and climatic suitability modeling. For more information on climatic suitability modelling approach, please see: http://www.mara.org.za/trview_e.htm

5. Mapping of Seismic, Volcanic and Earthquake activities: Seismic, Volcanic and Earthquake maps were derived from coverage showing the earthquake intensity zones in accordance with the 1956 version of the Modified Mercalli Intensity scale (MMI). The intensity zones describe exclusively the effect of an earthquake on the surface of the earth by integrating numerous parameters including acceleration, duration of earthquake, sub-soil effects, as well as historical reports. The seismic hazard grading is based on its expectation over a period of 50 years, which also corresponds to the mean service life of a modern building. The probability of the degree of intensity being exceeded in 50 years is 20% shown on the maps. GRID digitized the original maps on earthquakes at a scale 1:34,000,000 and further added the coastlines from PC World Databank-II (by ESRI, as modified by GRID)

The zone as provided by the MMI scale (probable of maximum intensity once in 50 years) is 0 – V and below, 1- VI, 2- VII, 3- VIII, 4- IX and above. The data was further validated by experts from the participating IGAD member states and by incorporating expert knowledge, the MMI scales were classified into four levels of seismic risk as follows: Very High (IX and above); High (VIII); Medium (VII) and Low (below VI). For more information, please see: http://www.geodata.grid.unep.ch/mod_download/download.php

6. Mapping of Livelihood Zone: Livelihood Zone map is a zones/an area within which people share broadly the same pattern of livelihood, including options for obtaining food and income and market opportunities. A livelihood zoning is essential for the following reasons:

- It provides geographic orientation of livelihood systems to inform food security analysis and assistance targeting
- It provides the basis for identifying geographically relevant food security monitoring indicators
- It provides a sampling frame for future on-the-ground assessments

Livelihood patterns clearly vary from one geographic area to another, which is why the preparation of a Livelihood Zone Map is a logical first step for livelihoods-based analysis. This dataset was sourced from NDMA and consists of livelihood types surveyed at sentinel levels.

Glossary/ Definition of Terms

Disaster: a serious disruption of the functioning of a community or society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community/ society to cope using its own resources.

Disaster contingency plan: to address a disaster or impending disaster within a fairly finite time, such as from early warning to response to recovery, including mechanisms for generation of disaster-specific operational plans.

Disaster preparedness strategy: a broad exercise, which sets out objectives for disaster preparedness in a country or region, reviews the current status of disaster preparedness capacities in relation to those objectives, and identifies what measures must be taken for maintaining and enhancing those capacities for the objective to be met.

Disaster Risk: the potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

Disaster Risk Management: the systematic process of using administrative directives, organizations and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

Disaster Risk Reduction: the concept and practice of reducing disaster risk 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.

Drought: Naturally occurring phenomenon that exist when precipitation has been significantly below normal recorded levels causing a serious hydrological imbalance that adversely affects land resource production systems.

Early warning: provision of early and relevant information on potential or actual disasters, and normally involved monitoring hazards, especially in relation to communities or areas known to be vulnerable to their effects, so that more timely and effective response measures is taken.

Emergency: An extraordinary situation in which people are unable to meet their basic survival needs, or there are serious and immediate threats to human life and well-being.

Hazard: A dangerous phenomenon, substance, human activity or condition that may cause the loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruptions, or environmental damage.

Impacts: specific effects of hazards or disasters also referred to as consequences or outcomes. Impacts and needs assessment: Assessing the nature and magnitude of a disaster once it occurs, its impact on affected populations, and the type and extent of emergency assistance that is required.

Agricultural drought: an agricultural drought is the impact of meteorological droughts and hydrological droughts on crop yields. This kind of drought is associated with extreme heat. It occurs when extended dry periods and general lack of rainfall result in a lack of moisture in the root zone of the soil. This severely damages the plants that live in the area.

Hydrological drought: occurs when there are critically low ground water tables and reduced river and stream flow. Hydrological drought is distinguished by a reduction in water resources in reservoirs, lakes, rivers, underground aquifers and streams.

Meteorological drought: A reduction in rainfall over a specific period, for example a day, month, season, or year. There is no agreement on what the lack of rain or the time without rain should be before it is considered a drought. Usually the area affected determines these especially in non-arid regions. Meteorological drought leads to depletion of soil moisture and this almost always has an impact on crop production.

Mitigation: short 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.

Preparedness: advance measures to establish capacities and mechanisms to minimize adverse impacts of disasters when they occur, and so reduce the intensity or scale of any resultant emergency.

Prevention: measures designed to prevent hazards (natural or socio/ political events and processes) from resulting in disasters.

Response: actions taken immediately before, during or directly after a disaster to reduce impacts and improve

recovery.

Risk: Combination of the probability of an event and its negative consequences. This is the probability of a harmful consequence or loss resulting from an interaction between natural hazards and vulnerable conditions of property and people.

Risk Assessment: a methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

Vulnerability: characteristics of circumstances of a community, system, or asset that makes it susceptible to the damaging effects of a hazard. 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 also refers to the 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.



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