FLOOD VULNERABILITYAND ITS EFFECTIN NMIATA- ANAM, ANAMBRA WEST LOCAL GOVERNMENT AREA OF ANAMBRA STATE, NIGERIA

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JUNE, 2017

CERTIFICATION

This is to certify that this project has been supervised, examined and approved for the award of a Doctor of Philosophy Degree (Ph.D) in Environmental Management in the Department of Environmental Management, Faculty of Environmental Sciences, Nnamdi Azikiwe University, Awka. To the best of our knowledge, this work is original and has not been submitted in part or full for any other degree of this or any other University.

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Duluora Joseph Oluchukwu Date

(Student)

DEDICATION

This work is dedicated tothe members of the Duluora family and also to the soul of late Mrs.Nwuche Cecilia DuluoraOkafor.

ACKNOWLEDGEMENT

First and foremost I acknowledge the Almighty God whose infinite love, kindness and guidance made this study a reality. I equally acknowledge all the members of my family who through their prayers and encouragement helped me achieve this aim.To my supervisor, Prof. S.U. Uchegbu, I adore my capfor his meaningful suggestions through his supervision, critical scrutiny of the work, fatherly advice and constructive criticisms helped reshape the work.

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ABSTRACT

Sequel to the incessant and increased incidence of flooding, accompanied by the loss of valuables, increase in transportation fare, damage to property, loss of lives and increase in the incidence of diseases in some parts of Anambra State, a survey was carried out in the Anambra West to find out the effects of Flood Vulnerability And Its Effect In Nmiata- Anam, Anambra West Local Government Area of Anambra State (Nigeria). With the aid of a structured questionnaire, three hundred and ninety respondents were randomly sampled using a simple random sampling technique in 2016. The generated data were analyzed using correlation, regression, Factor analysis and principal component analysis. Satellite image of the study area was equally obtained and analyzed using the ArcGIS 10.1 geo-processing and spatial analyst tools. The result of the survey showed that the study area experiences flood every year, there is no existing flood early warning system/ equipment in the area, there has not been any education on the workability of early warning equipment and the area does not have a flood map. A trend analysis of flood occurrence and malaria incidence revealed that the malaria is on the increase. Likewise, the trend analysis of flood occurrence and salmonellosis equally showed an increase in the incidence but that of malaria is more. A regression of damage and flood incidence showed that an increase in flood will result in a proportionate increase in damage of properties. A regression of flood occurrence and socio-economic values revealed a strong positive relationship. Also a regression of flood occurrence and environmental pollution equally revealed a positive

relationship. A product moment correlation of flood occurrence and public health showed that flood has a significant effect on public health. This is supported by the trend analysis. Equally the product moment correlation of flood occurrence and agricultural loose also revealed that flood has a positive effect on agricultural loss. The analysis of the satellite image reveals that most part of the studyarea always have water flowing into/to the area after every rain or during flood occurrence, that virtually every part of the study area experiences in flow of water leading in the accumulation of water in these areas, that NmiataAnam fall within the area that experiences the highest degree of over flow, that the area has a slope of between 0-6 degrees and that the area falls within the high vulnerability area within the L.G.A.The work suggests that Government should use the flood vulnerability map to determine the best areas to relocate the inhabitants of the area during flooding. Early warning systems and equipment should be provided inthe study area and the inhabitants of the study area should be educated on its workability.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The last four decades have witnessed a growing concern for environmental issues, and since the mid- 1980s these have been linked with calls for better approaches to development and modernization. Prior to 1972, when the United Nations convened the Stockholm Conference on the Human Environment, environmental problems were widely disregarded and environmental protection was commonly seen either as a luxury or to conflict with development, (Nnodu, 2008). Since after the industrial revolution, man has continued to modify the environment with impunity and reckless abandon. This recklessness has had its own consequences on man and his environment. Resource depletion, ozone layer depletion, flooding, loss of biodiversity, environmental pollution, problem of waste etc are some of the consequences of the activities of man on his environment which he is suffering from today.

The world's climate is changing and will continue to change into the coming century at rates projected to be unprecedented in recent human history. The risks associated with these changes are real but highly uncertain. Societal vulnerability to the risks associated with climate change may exacerbate ongoing social and economic challenges, particularly for those parts of societies dependent on resources that are sensitive to changes in climate.Assets at risk can include housing, transport and public service infrastructure, and commercial, industrial and agricultural enterprises. The health, social, economic and environmental impacts of flooding can be significant and have a wide community impact. Risks are apparent in agriculture, fisheries and many other components that constitute the livelihood of rural populations in developing countries. The potential consequences of climate change, according to Kolawole, Olayemi and Ajayi (2011), are profound, particularly on people in the less developed countries. The question is therefore not whether climate change is happening, but what to do about it. Over the last 20 years climate change has become an increasingly high profile issue both from a social and economic viewpoint. It is becoming increasingly well understood that climate change will impact on almost all facets of the hydrological cycle. Modelling and observational studies are finding evidence of change at the planetary scale, including large increases in atmospheric water vapour; changes to various circulation patterns resulting in shifts in the spatial distribution of precipitation; an increase in the frequency and intensity of extreme precipitation events; an increase in evaporation and changes to soil moisture; and the melting of snow and ice and an increase in ocean heat content which both are causing mean sea levels to rise (Kolawole, Olayemi, and Ajaymi (2011). In most cases, such changes support the expectation of an increase in flood risk (Westra, 2011).In recent years some countries have experienced serious flooding, for example in the UK in 1998, 2000 and 2007 and in central Europe in 1997, 2002 and 2005 (Darch, 2010). Floods themselves are an intrinsic part of life on floodplains and, in the absence of an increase in the trend of floods in the UK or Europe, the greater Climate change and future flooding in the UK vulnerability and losses can largely be attributed to the increase in population and capital located on the floodplain as well as modifications to hydrological systems (Darch, 2010). According to BBC Weather Centre (2009) the UK has experienced heavy floods over the past decade, which have affected thousands of people and caused millions of pounds worth of damage. The rainfall in June and July 2007 was about 20%

higher than ever seen before in records that go back to 1879. They further to note thataccording to the Environment Agency, at present 2.3 million homes and 185,000 businesses are at risk of flooding in England and Wales representing property, land and assets to the value of over £200bn. Royal Institute of British Architecture (RIBA) (2011) observed that flood risk is a particular problem for the UK. The two primary causes are climate change, resulting in increased severity and intensity of rainfall, and new developments on floodplains, which are themselves at risk of flooding, and which increase the risk of flooding downstream.It is estimated that:

i. 1.5% of the country is at risk from direct flooding from the sea.

ii. About 7% of the country is likely to flood at least once every 100 years from rivers

iii. 1.7m homes and 130,000 commercial properties, worth more than £200 billion, are at risk from river or coastal flooding in England.

Many more properties are also at risk from flash floods.

The effects of flooding, and managing flood risk, cost the UK around £2.2 billion each year: we currently spend around £800 million per annum on

flood and coastal defences; and, even with the present flood defences in place, we experience an average of £1,400 million of damages. The IPCC's most recent regional report according to The Economist (2007) certainly raises the spectre of rising mortality. It predicts a minimum 2.5°C increase in temperature in Africa by 2030; drylands bordering the deserts may get drier, wetlands bordering the rainforests may get wetter . Thepanel suggests the supply of food in Africa will be “severely compromised” by climate change, with crop yields in danger of collapsing in some countries.

The heavy rainfall amounts recorded in Nigeria between May and October 2012 according to Ezenwaji and Otti(2013) have given rise to flooding of unbelievable magnitude all over the country. Settlements along the courses of major rivers have been ravaged by rampaging floods.In Nigeria, the litany of floods as it affects the country in recent time is listed by Agada (2012) as follows: On July14, 2012, flood ravaged Cross-River communities after a four-day downpour. The cause of flooding was attributed to a landslide that blocked the River Kaala, a river traversing the communities.

Floods and attendant landslide rendered homeless, villagers in Sardauna Local Council of Taraba State, following a three-day downpour. This occurred On July 30 through August 2, 2012, (Agada, 2012).

Torrential rainfall on August 13, 2012 and the attendant flood led to the collapse of the Shendam Bridge in Plateau State. The rain fell throughout the weekend of that week and Monday night swelling rivers and streams to overflow Shendam and Langtang North and South which were worst hit. Mikang, Quan Pan and Wase local governments were also affected, (Agada, 2012).

Serious flooding hit Jimeta-Yola in Adamawa State after a heavy down pour on August 26, 2012. Cause of the flood was blamed on the release of water from Lagdo Dam in Cameroon. Floods in Kano State which swept through nine local governments on August 28, 2012, claimed 15 lives. Those local governments are Bagwai, Bebeji, Gabasawa, Garun Malam, Karaye, Nassarawa and Sumaila, (Agada, 2012).

Floods washed away over 220 houses, farmlands and livestock in Bauchi State as a result of heavy torrential rainfall in September, 2012. Misau, Giade, Shira and Jama' are some of the local governments affected in the state. September 1, 2012, due to heavy down pour, flooding of water channels and pathways claimed the lives of two siblings in Niger State. On the 3rd of September 2012, yet another flood hit Taraba State in Lau, Karim-Lamido and Gasol local government area of the state. On the 12th of September, 2012, flood sacked Bauchi and Kaduna communities. The flood is said to be caused by the overflow of River Katagum. Over 1500 residents in Kano State fled their homes when it was submerged by flood when Tiga Dam overflowed its bank on the 15th of September 2012, (Agada, 2012).

Over 20,000 residents of Kogi communities living along the bank of the Niger were on Sunday, 16th of September 2012 displaced by floods when the river overflowed its bank occasioned by the release of water from Kainj Dam, Jebba Hydro Power Plant and Shiroro dam. On September 21, 2012, flood disaster in Niger Sate claimed 47 lives and rendered thousand homeless. 500 communities and 14 local government areas were said to be affected. Edo State joined states affected by floods on Sunday 23rd September, 2012 when flood wreaked havoc in seven communities of Etsako-Central Local Government Area. Flood hit Delta State on Sunday 23rd September, 2012, submerging coastal villages and killing a 7-year-old girl, (Agada, 2012).

In Anambra State, the inhabitants are not exempted from the devastating effects and psychological traumas associated with the incidence of flood both in the rural and urban areas. It is on this basis that this study investigated flood vulnerability and its effects in Nmiata-Anam, Anambra West Local Government Area.

1.2 Statement of the Research Problem

Rainfall occurrence and presence of rivers have been essential for human survival since the existence of man on the planet earth. The onset of rainy season marks the beginning of planting season and in areas where the rainfall is insufficient for cultivation, irrigation channels from nearby rivers augment for the required water. In this case, the river serves as a source of water for cultivated crops and also for people living around. In other situation, rainfall may be too much and this may result in the river channel collecting more water than what is normal and overflowing its channel. This over flow of the river channel brings/ carries alluvial deposits to the nearby land area and is helpful for crop cultivation. This can be linked to the reason why most early settlements developed along river channels such as Egypt and Mesopotamia around rivers Nile and the Euphrates river respectively.

Various countries across the worldwide areexperiencing heavy rains, river overflows, hurricanes, typhoons and tsunamis, and theseevents are causing unexpected floodswhich destroy entirely or partly some localities in their locality. Floods can be included among the mostdevastating natural hazards that reoccur often and have various degrees of impact on humans and also cause severe economic damage the world over. Over the last 50 years, according to Guha-Sapir *et al*, (2004),there has been a growing body of evidence pointing to the effect of humanbehaviour on the global natural environment and on the possibility that certain types of natural disasterssuch as floods may be increasing as a direct consequence of human activity. In Africa, floods of different kinds are one of the most common type of disastrous events, and theyaccount for the biggest losses inflicted by natural disasters. Some countries affected include Tanzania, South Africa, Malawi etc., causing death and displacement. The UN Office for the Coordination ofHumanitarian Affairs (OCHA) recently stated that, compared with previous years, 2010 has seen thelargest number of people affected and dying from flooding. This is consistent with the dramatic rise inflood events that have battered the world, with West Africa being a case in point (Kissi, 2014).

Climate change has exposed the nation (Nigeria) to the dangers of extreme weather with frequent and more severe consequences to lives and the environment (Suleiman, 2011). From March (February in some states) to September, Nigeria has a rainy season and suffers from seasonal floods. These flash foods are sometimes lethal, especially in the rural areas or overcrowded slums, where drainage is poor or does not exist at all. Many Nigerian coastal and inland cities experience heavy rains, and flooding.Kogi, Imo, and Abia States among others have been affected, resulting in damage to structures, loss of properties and death also. Flooding in urban areas is not just related to heavy rainfall and extreme climatic events; it is also related to changes in the built-up areas themselves.

In Anambra State, there have been incidences of flooding in various parts and over the years. Four L.G.As., which included Ogbaru, Anambra West, Anambra East and Anyamelum were totally submerged (after the 2012 flood disaster) displacing an estimated 76,000 persons in about 200 communities in a manner the locals said they have never seen before. Over 20 camps were opened across the State to cater for the victims (Ahaoma, 2012). AnambraWest in which the study area lies is a relatively level area which is feed with great amount of alluvial deposits from both river Niger (which is a major river that flanks the western part of the Local Government and the Omambara River which is a tributary that traverses the interior of the Local Government and empties itself into the river Niger. Within the hinterland of the local government, various small rivers and streams abound. The presence of these rivers play a vital role in bringing alluvial deposits that are very essential for agricultural purposes, making the area a haven for farmers who cultivate annual crops such as cassava, potatoes, yam and even maize. Vegetables are also cultivated which include spinach, pumpkin, tomatoes and pepper.

But the location of the Local Government is without its problems because of the soil type, soil texture and also because of the presence of the rivers and streams that are found within and around it. During the middle of the rainy season, farmers rush to harvest their crops as any delays in harvesting results to either a partial or total loss of cultivated crops. These losses are as a result of the incessant flooding that occur within the Local Government. The inhabitants of the local government area always pour out their plight at every opportunity to anyone who is willing to listen. In an ideal situation, the area is supposed to be an agricultural field whose soil is very rich in nutrients and considered as farmers haven.

But this is not so presently because the area suffers from incessant flooding events that affects not only the farmers and their crops but also the general socio-economic activities of all the inhabitants of the area.This flood that occurred in the State over the years caused many problems such as displacement from homes, loss of valuable properties, loss of money, disease outbreak, destruction of food items and valuable documents, death of domestic and wild animals and also caused pollution/ contamination of sources of domestic water supply. Based on these, there is the need to carry out a study of the flood happenings in the area and try to improve the situation on ground and bring back hope to the inhabitants and also give them succor. This necessitated the need to assess the vulnerability and effects of the flood disaster, how the inhabitants have been coping in these incessantly flooded areas, hence this work.

1.3 Aim and Objectives

This work is aimed at assessing the vulnerability of flood and its effects on the study area. The aim will be achieved using the following objectives to:

1. Identify some of the immediate causative factors of flood disaster in the study area.
2. Determine the social, economic and environmental effects associated with flood occurrence in the study area.
3. Evaluate the health challenges associated with flood occurrence in the study area.
4. Analyse the level of vulnerability of the study area to flood occurrences using satellite images.

1.4 Research Questions

The following research questions were asked to guide the researcher attain the aim of the research.

1. What are some of the immediate causes of the flood disaster in the study are?
2. What are the social, economic and environmental effects associated with flood occurrence in the study area?
3. What is the effect of flood on the prevalence of diseases such as malaria and typhoid in the study area?
4. What is the level of vulnerability of the study area to flood occurrences?

1.5 Research Hypotheses

For the purpose of this research work, six research hypotheses were stated. The hypotheses include

(1) H_O: There is no significant effect between flood occurrence and damage to environmental components.

(2) H_O: There is no significant effect between flood occurrence and the disruption of the socio-economic activities of society.

(3) H_O: There is no significant effect between flood occurrence and environmental (water) contamination.

(4) H_O: There is no significant effect between flood occurrence and outbreak of disease.

(5) H_O: There is no significant relationship between flood occurrence and loss of agricultural yield/food security.

(6) H_O: There is no significant relationship/effect between the environment and flood vulnerability.

1.6 Significance

This work is carried out in order to bring to lime light the fact that people in the riverine areas of Anambra State are at risk of flood and that these flooding activities are affecting the people adversely. This work will go a long way in helping the government of the day in taking decisions as regards issues of flooding such as development plans, construction activities, flood channeling and other issues and as such benefit the inhabitants of the area since they will be guided aright on how to use their environment.

While to the environmentalist/manager this work will serve as a medium for environmental education and awareness when it comes to issues of climate change and flood control. It will equally be a reference material to students at various level of their studies when they are working on flood or related issues. And to the lay man on the street, this work will give him a sense of belonging since it studied the effects flood has had on him and also provided ways of making his environment better.

1.7 Scope

The scope of this study covered the flood that occurred in Anambra West of Anambra State, Nigeria since after the 2012 flood (it is a post disaster assessment of the flood event).

1.8 Overview of the study

This work is divided into six chapters. Chapter one will deal with the introduction/statement of problem, need for the research. Chapter two will deal with conceptual framework and the review of relevant literature. Chapter three is where information on the study area will be presented. Chapter four will look into the methodology which will be used to achieve the aim and objectives of the work. Chapter five will deal with the presentation of data and discussion on findings while Chapter Six will be where the summary, recommendation and conclusion will be presented.

1.9 Limitations of the study

This study is without some limitations which were encountered and have made the work a near perfect one. Some of the limitations encountered include:

- The study used medical records that covered the period from January 2014 to June 2016.
- Only two types of ailments were considered/used in the course of the study.
- The hospital data used is only for thirty months (from January, 2014 to June 2016).
- There was the limitation of availability of hospital data on other ailments like cholera, schitosomiasis and dysentery.

- There was also the problem of getting the exact current population of the study area, hence the researcher has to extrapolate and project the population of the study area based on the 1991 population data from National population commission.

CHAPTER TWO

THEORETICAL FRAMEWORK AND REVIEW OF LITERATURE

This chapter deals with the conceptual/ theoretical frame work and equally looks at the review of related works done in the field of flood/ flooding.

2.1 Theoretical Framework

For the purpose of this study, this work will be hinged on the systems theory. The flooding scenario is an ideal representation of the systems theory which has an input and output components. The system theory helps to isolate a section or part of a whole (e.g. the earth or the body) to be studied separately as a smaller unit (e.g. the drainage basin or water cycle and the respiratory system). With this in view, a system becomes whatever the observer defines it to be as long as it contains the attributes of a system which include the **inputs**, **throughflow** and the **output**. So a system is only a concept where the limit is chosen for convenience of the study. Systems can be complex or simple, large or small. Different types of systems have been identified and used in environmental science studies. Those systems include: the closed system, the open system and the isolated system.

A closed system is one in which there is an input and transfer of energy or matter within the system. The energy or matter of the system is not transferred to the outside. The boundaries of the system do not give chance or allow energy and/ or matter to leave the system. An example of a natural closed system is the universe; others are man-made such as an oven. The open system is that which allows for the transfer or input and output of matter between systems. An open system's boundary allow for matter and energy to enter the system and leave the system. An example of such is the earth and atmosphere relationship. Here there is exchange of energy with outer space. Another example is the drainage basin which receives energy and mass from sunlight, the elevation of the land and from precipitation.

An isolated system is that in which there is neither an input nor output of matter and energy to the system. The boundaries of an isolated system do not allow any exchange of matter or energy within its surroundings. In reality there is hardly an isolated system since existing systems either allow energy or matter or both to either enter or leave. From the perspective of open system, flooding can be seen as such. The input of energy into the environment comes from the various precipitation events that occur (such as rain, snow, glacier), from out flow of surrounding water body (such as streams, rivers, oceans etc) and also from the melting of glaciers (avalanche) and polar ice. The input for the purpose of studying flood occurrence using the system theory can also include the seasonality of rainfall in the area, the amount of rain received, susceptibility of the area to flood.

Output sources from the environment include infiltration, and percolation, channel flow from drainages, evaporation from the soil and water bodies and evaporation from trees. For the purpose of studying flooding using the system theory, output can be viewed from the psychological effects experienced by the inhabitants and they include issues such as forced migration, attempted suicide or committing suicide, traumatic effects as a result of the aftermath of the flood incidence. An area is said to be flooded when the rate of input of water as flood into the area is greater than the rate of output thereby resulting in the inundation of the area. As such, the homeostatic state of the environment has tilted to one side, there by disrupting the equilibrium state of the environment. This can be diagrammatically represented thus

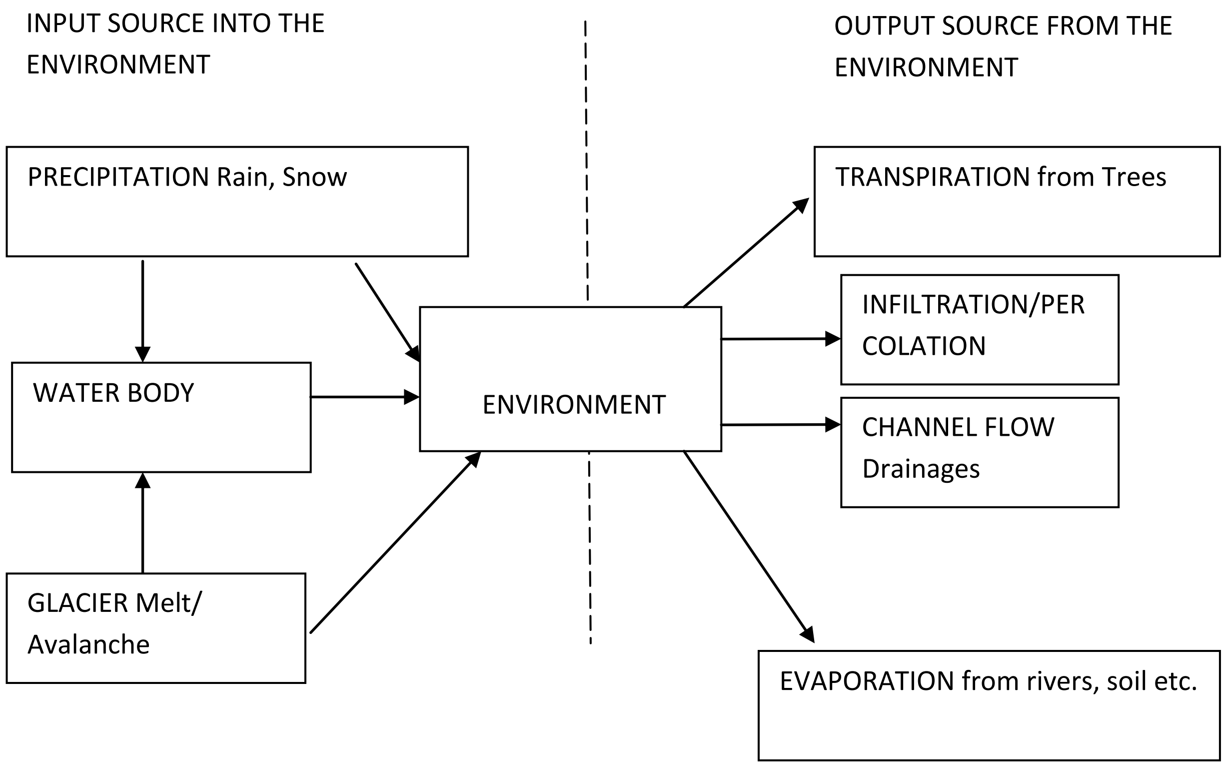

Fig.2. 1: Diagram of input and output of flooding water in the environment
Source: Researcher 2017

Figure 2.1 can be modified to suit the assessment of flood's effect on the inhabitants of the area were the flood occurred. The input has to do with rainfall amount, seasonality, duration and susceptibility of the area to flood. The throughput has to do with the inundation of areas such as playgrounds, farmlands, churches and other religious centres, educational areas, business areas and transportation routes. The output sources from the system theory include destruction of properties, environmental pollution, forced migration, psychological effects and trauma. This is presented in Fig.2.2

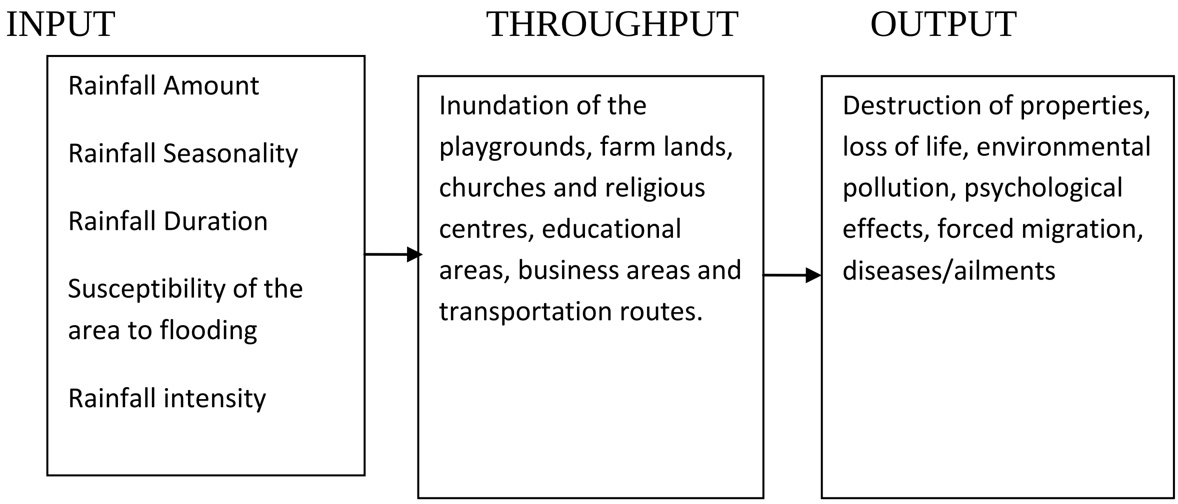

Fig 2.2 Modified systems input /output of flood on humans/environment

Based on figure 2.2 we can equally see the various interactions going on in the environment. All these interactions result to the damaging effects of flood in the environment. A damaging flood according to Pielke and Downton (2000) is the joint product of societal and climatological factors (as well as ecological, geological, etc.). The multiple factors that lead to damaging floods have led to a number of different explanations for the increasing trend in losses. For instance, some have speculated that the trend is indicative of a change in climate, some blame population growth and development, others place the blame on federal policies, and still others suggest that the trend actually distracts from the larger success of the nation's flood policies. Empirical evidence from a range of cases clearly shows that climate, population growth and development, and policy each play a role in trends in flood damage.

Policy makers face difficulties in assessing the magnitude and causes of the flood problems that they face and in evaluating the effectiveness of past responses. Fig. 2.3 shows a conceptual framework for understanding the multiple interactions of human and human- influenced processes related to damaging floods. An integrative framework has broad relevance to understanding the role of development, population growth, and policy in shaping actual and potential outcomes.

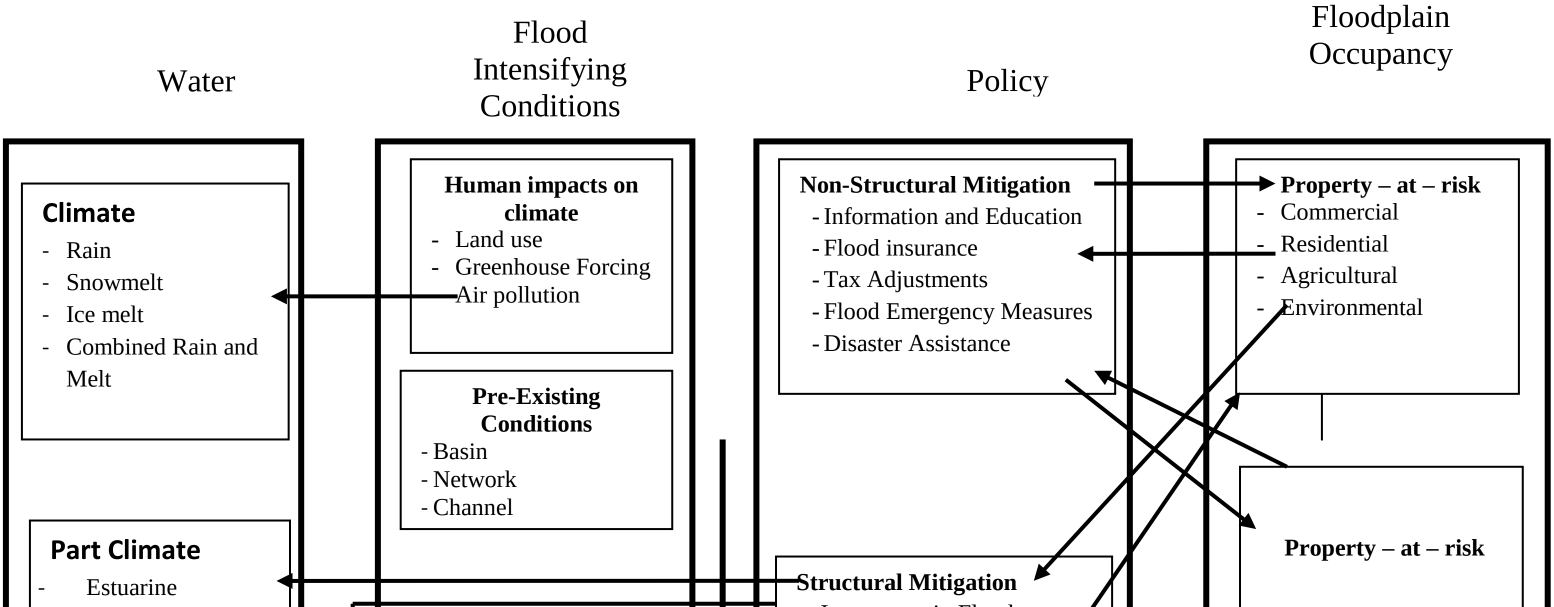

Fig2.3. Framework for understanding the inter-related factors responsible for the occurrence of damaging flood.

Source :Pielke and Downton ,2000

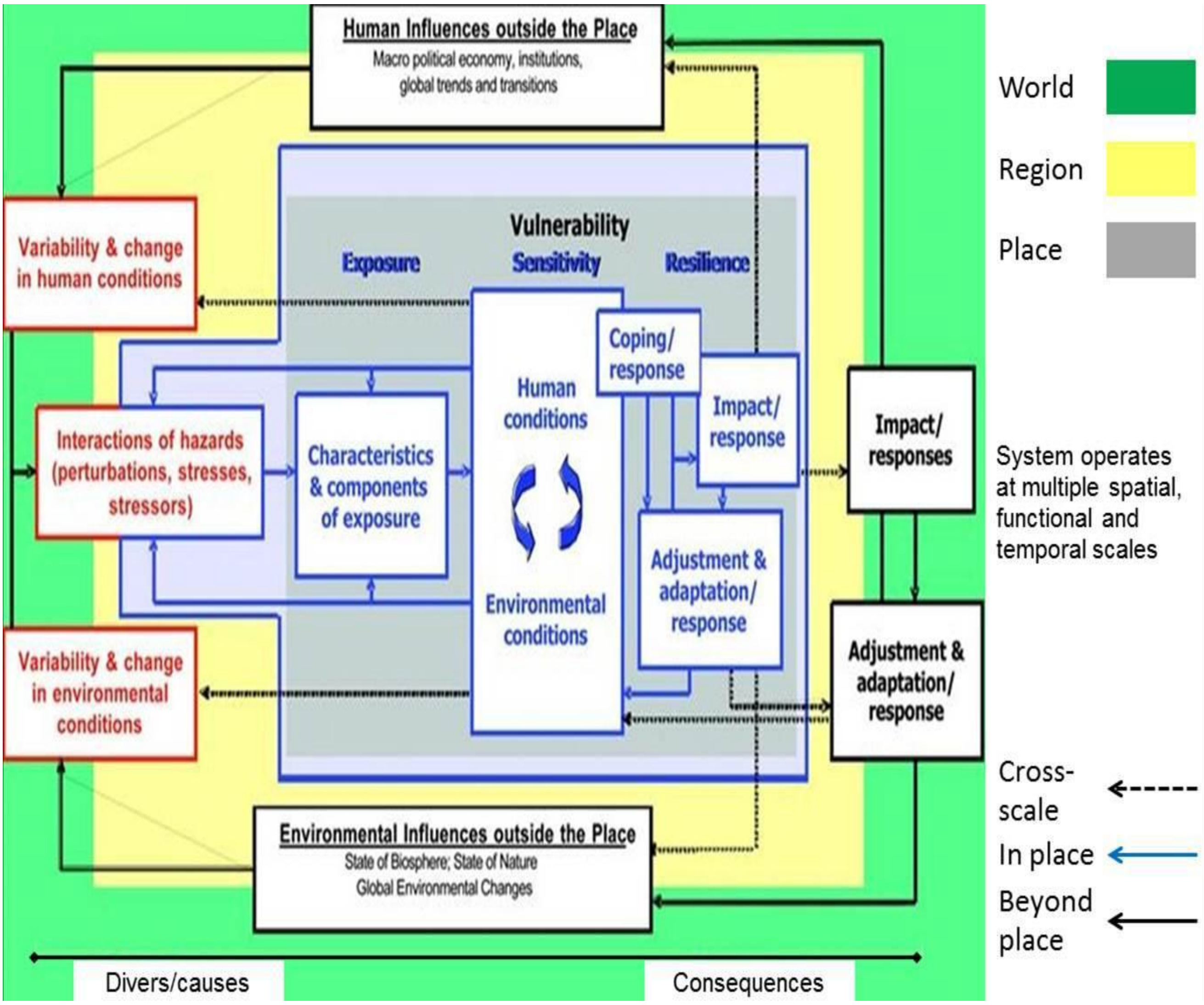

Fig 2.4: SUST Vulnerability Framework.
Source: Turner II et.al. 2003

The systems theory was adopted for this work because flood occurrence follows the three stages of the system theory which include the input, through flow and output. The input covers the factors that bring about the presence or occurrence of the flood, the through flow which shows areas covered by the flood water and the output which covers the effects the flood has on the environment.

2.2Review of Related Literature

This section is divided into various sub-sections for easy comprehension.

2.2.1 Flooding and Physical Environment

Eni, Atu, Oko and Ekwok, (2011) did a study on Flood and Its Impact on Farmlands in Itigidi, Abi Local Government Area, Cross River State, Nigeria. In this study farm lands were divided into fifteen (15) plots for easy analysis. A quadrant of 50m x 50m was demarcated and the different types of crop cultivated in the study area were identified. The depth of inundation of river water was measured using a meter rule of 100meters. Soil samples were collected and taken to the laboratory to determine the soils physical properties. A semi Structured interview was held with 50 farmers. The interview covered topics such as farm characteristics, causes of floods, types of crops destroyed and factors influencing flood. The result revealed that plot 8 with degraded vegetables covered a total area of 175 hectare, also the crops was inundated to a depth of 15m. Crops such as water leaf, tomatoes, melon and cucumber were highly devastated. Cassava, pepper, potatoes and tomatoes were cu1tivated in soils with 69% sand content and has a textural class known as sandy loam. The mean of sand, silt and the clay content in the study area was 494.5, 18 and 15.8 respectively. P_H value ranged from 5.10 -6.70. The result showed that flooding had a significant impact on soil physico-chemical properties because organic matter and nutrients were leached down the soil.

Musah and Oloruntoba (2013) did a study on Effects of Seasonal Floods on Households' Livelihoods and Food Security in Tolon/Kumbumgu District of the Northern Region, Ghana. The study focused on how flood disasters affected livelihood systems in Tolon/Kumbungu District. The study was carried out in six sampled communities namely Tampia, Nawuni, Adayili, Afayili, Kuli and Shegbini. It examined the nature of floods, damage caused and their effects on livelihoods and food security and their coping mechanisms after floods. Twenty-two disaster prone communities where purposively selected and the simple random technique was applied to select the six communities out of the twenty-two and descriptive statistics was used in the analysis using SPSS version 17. The study discovered that floods in the district were seasonal occurring in August/September every year and mainly caused by the opening of the Bagre Dam in Burkina Faso. It was also realised that floods destroyed farmlands of the people in the study area every year leading to instances of total crop destruction and failure. Few respondents 21.7% out of 120 indicated that floods caused erosion that resulted in the creation of galleys in the communities and on their farmlands or wash away soil nutrients which led to crop failure. A chi square test shows a significance level and relationship of 0.001 of the variables of yields before and after flooding which contributes to low crop productivity and food security.

Ezin, Yabi, Kochoni and Ahanchédé (2014) studied the effects of flooding and salinity as a result of climate change on tomato production in the coastal zone of Benin. A survey was conducted in this region to know the impact of change in climate on tomato production. Two types of flooding conditions are prevalent: flash flooding and severe flooding where water remains stagnant for weeks. The results also show that climate change is exacerbating the existing abiotic factors (flooding and salinity) by significantly affecting tomato development, growth and yield and yield components as reported by farmers. Flooding and salinity pose a serious threat to some producers and forced them to abandon their agricultural lands in severe cases. The repeated yield losses in some other areas caused tomato producers to move from their field close to the sea to the field far away. The producers said that flooding conditions commence at the end of June till middle of August. The producers previously grew their tomato in the areas of study in May but because of repeated flooding every year they were compelled to shift their sowing calendar. A total of 16 tomato varieties were recorded in the areas of study. Gbamingbo variety was moderately resistant to flooding conditions while Aclinkonkoui and Petomèche varieties appear to be moderately tolerant to salinity due to their average performance in terms of yield and yield components.

Striker, Insausti and Grimoldi (2008) in a work titled Flooding Effects on Plants Recovering from Defoliation in Paspalum dilatatum and Lotus tenuis. They noted that flooding and grazing are major disturbances that simultaneously affect plant performance in many humid grassland ecosystems. The effects of flooding on plant recovery from defoliation were studied in two species: the grass Paspalum dilatatum, regrowing primarily from current assimilation; and the legume, Lotus tenuis, which can use crown reserves during regrowth. Plants of both species were subjected to intense defoliation in combination with 15 days of flooding at 6 cm water depth. Plant recovery was evaluated during a subsequent 30 days growth period under well-watered conditions. Plant responses in tissue porosity, height, tiller or shoot number and biomass of the different organs were assessed. Flooding increased porosity in both P. dilatatum and L. tenuis, as expected in flood-tolerant species. In P. dilatatum, defoliation of flooded plants induced a reduction in plant height, thus encouraging the prostrated growth response typical of defoliated plants rather than the restoration of contact with atmospheric oxygen, and most tillers remained submerged until the end of the flooding period. In contrast, in L. tenuis, plant height was not reduced when defoliated and flooded, a high proportion of shoots being presented emerging above water (72 %).

In consequence, flooding plus defoliation did not depress plant recovery from defoliation in the legume species, which showed high sprouting and use of crown biomass during regrowth, whereas in the grass species it negatively affected plant recovery, achieving 32% lower biomass than plants subjected to flooding or defoliation as single treatments. The interactive effect of flooding and defoliation determines a reduction in the regrowth of P. dilatatum that was not detected in L. tenuis. In the legume, the use of crown reserves seems to be a key factor in plant recovery from defoliation under flooding conditions. Akankali and Jamabo (2012) studied the Effects of Flooding and Erosion on Fisheries Resources in Niger Delta, Nigeria. The study reviewed the fisheries potential of the Niger Delta area in relation to the flooding and erosion statistics of the region. The adverse impacts of flooding and erosion on the regions aquaculture, capture fisheries, ecological implications for fisheries and the various associated socioeconomic issues were stated. This include reduced natural fish yield in the wild and from aqua cultural productions. This results in food insecurity.

Banerjee (2010) examined the Impact of Floods on Agriculture in Bangladesh and argues that, although severe inundation destroys crops in the monsoon flood months, monsoon floods act as an open-access resource in supplying irrigational input to agriculture. District-level rice and jute productivity data for the period 1978-2000 are analyzed to investigate the long-term impacts of floods in terms of agricultural performance, comparing "more" flood-prone districts with "less" flood-prone districts. In addition, the short-term impacts of floods are analyzed on crops grown in the flood months and in subsequent, post-flood months. The results show that the area under cultivation and agricultural productivity are higher in the "more" flood-prone districts of Bangladesh. They also show that, while yield rates decline when floods assume "extreme" proportions, productivity increases during "normal" floods and in the post-flood months. In their own part, Wagner, Neuwirth and Janetschek (2009) observed that when it comes to evaluating the flood sensitivity of agricultural lands, the flood frequency is equally taken into account to identify those lands that are especially at risk, as it is primarily the latter that should be adapted in their use. Within flood zones, a higher percentage of risk crops – i.e., risk with respect to high surface run-off – are often cultivated on such lands, and these risk crops (e.g., corn, sugar beets and sunflowers) additionally yield higher marginal returns. Therefore, by changing the crop rotation, it is possible to positively influence surface run-off, while at the same time reducing the economic damages in the event of flooding. On the other hand in years of no flooding the yield for farmers is reduced in most cases.

Akpoveta, Osakwe, Ize-Iyamu, Medjor and Egharevba (2014) studied Post Flooding Effect on Soil Quality in Nigeria. Their study focuses on the post effect of flooding on soil quality parameters in agricultural farmlands in Asaba and Onitsha, Nigeria. Soil samples were collected from farmland in Alihame Agbor, Ika South local government area of Delta state, Okwei in Asaba, Oshimil South local government area of Delta state and Fegge in Onitsha South local government area of Anambra state. Farmlands in Asaba and Onitsha were used for the post flooding study, while farmland in Agbor served as control since it was not affected by flooding. Soil physicochemical parameters such as pH, electrical conductivity, total organic carbon, total organic matter, total nitrogen, total phosphorus, cation exchange capacity, moisture content and metals (Cd, Pb, Cu, Mn, Ni and K) which were used as index for assessing the effect of flooding on soil quality were analyzed using standard methods. Significant effect of flooding was observed on soil properties on the flood affected farmlands when compared to the control farmland, which was statistically justified at 95% confidence limit ($p \leq 0.05$). There were considerable decreases ranging from 4% to 53% at $p \leq 0.05$ in the values of pH, total organic carbon, total organic matter, total nitrogen, total phosphorus and cation exchange capacity on the flood affected farmlands when compared to the control farmland; except for electrical conductivity where an increase of 54% and 92% at the flood affected farmlands in Asaba and Onitsha respectively was observed when compared to the control.

Higher moisture contents were also recorded of up to about 17% and 45% at the flood affected farmlands in Asaba and Onitsha respectively, when compared to the control. Reduced concentrations ranging from 25% to 49% of essential micronutrients such as Mn, Ni and K were observed on the flood affected farmlands, reflecting the negative impact of the flood. Undesirable effect of the flood was also observed in the flood affected farmlands when compared to the control farmland as increased concentrations ranging from 18% to 114% of Cd, Pb, and Cu, were recorded. The findings of this study revealed significant impacts of the resulting flood on soil quality of the affected farmlands with major attendant effect of the flood felt on farmland in Asaba. As a consequence, measures should be put in place by government and concerned agencies to avoid future flooding of farmlands so as not to further expose the natural quality of these farmlands to the degradative and devastating effect of such flooding.

Mungai, Njue, Abaya, Said and Ibembe (2011) did a work on Periodic flooding and land use effects on soil properties in Lake Victoria basin. In the study, surface (0 to 20 cm) soil samples were collected at three locations along Sondu Miriu (Kenya) and Simiyu-Duma (Tanzania) rivers. Samples were collected from fields that were periodically flooded (1-28 d) and those that never flood, either under grass or crops. Samples were analysed for soil texture, organic carbon (OC), total nitrogen (TN), pH, extractable phosphorus (P), exchangeable potassium (K) and β-glucosidase activities. β-glucosidase activities, clay and P contents were higher in some of the soils that flood, while OC, exchangeable K and sand contents were lower at $P < 0.05$ in flooded soils.

Observed differences account for 11% of comparisons in the two river basins. Soils under grass had higher β-glucosidase activities and silt content but lower sand content than cultivated soils in 6% of samples in the two basins. However, conversion of natural ecosystems to grassland or cropped lands resulted in a 17 to 113% reduction in OC, TN, and exchangeable K in Sondu, and a 129% decline in TN in Simiyu. Soil properties exhibited clear but different patterns from upstream to downstream in the two basins. OC, TN, clay and β-glucosidase activities were higher in Sondu upstream, while OC, TN, extractable P and exchangeable K were lower in Simiyu upstream. Observed difference across each basin underscore the importance of inherent soil characteristics in influencing soil properties compared to short-term flooding or short duration changes in land use.

2.2.2 Flood Risk

Pagneux, Gísladóttir and Jónsdóttir, (2011) worked on the public perception of flood hazard and flood risk in an Icelandic town prone to ice-jam floods. Awareness of the population regarding historical inundations, self-estimation of flood risk and worry was considered. The factual knowledge of the residents was deconstructed in flood hazard parameters accessible to the lay population: number of events, dates, genesis and boundaries. The performance of the respondents was rated for each parameter and the influence of several predictors evaluated. The research shows three significant patterns: there was poor awareness and little worry about historical inundations in the area; experience of the past flooding events in town was the most effective source of knowledge; awareness, risk estimation and worry were not correlated.ten Veldhuis (2011) in his studied of How the choice of flood damage metrics influences urban flood risk assessment attempted to quantify tangible and intangible flooddamage according to two different damage metrics thus monetary values and number of people affected by flooding.

The data used were representative of lowland flooding incidents with return periods up to 10 years. The results show that monetisation of damage prioritises damage tobuildings in comparison with roads, cycle paths and footpaths. When, on the other hand, damage is expressed in terms of numbers of people affected by a flood, road flooding is the main contributor to total flood damage. The results also show that the cumulative damage of 10 years of successive flood events is almost equal to the damage of a singular event with a T = 125 years return period.Morss, Wilhelmi, Downton, and Gruntfest, (2005) initiated an interdisciplinary study of climate variability, scientific uncertainty, and hydro-meteorological information for flood-risk decision making, focused on Colorado's Rocky Mountain Front Range urban corridor. They began by investigating scientific research directions that were likely to benefit flood-risk estimation and management, through consultation with climatologists, hydrologists, engineers, and planners. In doing so, they identified several challenges involved in generating new scientific information to aid flood management in the presence of significant scientific and societal uncertainty. They concluded by proposing a modification to the “end to end” approach to conducting societally relevant scientific research.

Porter and Demeritt (2012) explored the institutional conflicts over the use of the Environment Agency (EA) Flood Map to support decision making by English local planning authorities (LPAs), whose local political mandate, statutory obligations, and professionalized planning culture put them at odds with the narrower bureaucratic imperative of the Agency to restrict developments at risk of flooding. The paper shows how the Flood Map was designed to standardize and script the planning process and ensure that LPA decisions were aligned with EA views about avoiding development in zones at risk of flooding without actually banning such development outright. The paper documents how planners accommodated and resisted this technology of indirect rule. Their concerns about sterilizing areas depicted as being at risk of flooding and about the difficulties of actually using the Flood Map for speedy and defensible development-control decisions were crucial in its eventual replacement by a new decision-support technology, Strategic Flood Risk Assessments, which then led to the descripting of the Flood Map to influence a new set of users: the public. The paper closes with some wider reflections on the significance of the case for risk-based governance.

Buchecker, Salvini, Di Baldassarre, Semenzin, Maidl, and Marcomini (2013), worked on the role of risk perception in making flood risk management more effective. The work aimed to explore a procedure that allows the inclusion of stakeholders' perceptions of prevention measures in risk assessment. It proposes to adopt methods of risk communication (both one-way and two-way communication) in risk assessment with the final aim of making flood risk management more effective. The proposed procedure not only focuses on the effect of discursive risk communication on risk perception, and on achieving a shared assessment of the prevention alternatives, but also considers the effects of the communication process on perceived uncertainties, accepted risk levels, and trust in the managing institutions. The effectiveness of this combined procedure was studied and illustrated using the example of the participatory flood prevention assessment process on the Sihl River in Zurich, Switzerland.

The main findings of the study suggest that the proposed procedure performed well, but that it needs some adaptations for it to be applicable in different contexts and to allow a (semi-) quantitative estimation of risk perception to be used as an indicator of adaptive capacity.Maidl and Buchecker (2014) worked on raising risk preparedness through flood risk communication. The study was intended as a contribution to a better understanding of the factors influencing flood risk preparedness, with a special focus on the effects of such a one-way risk communication strategy. They conducted a standardized mail survey of 1500 property owners in the hazard areas in Zurich. The questionnaire comprised items measuring respondents' risk awareness, risk preparedness, flood experience, information seeking behaviour, knowledge about flood risk, evaluation of the information material, risk acceptance, kind of property owned, attachment to the property, trust in local authorities, and socio-demographic variables. Multivariate data analysis revealed that the average level of risk awareness and preparedness was low, but their results confirmed that the campaign had a statistically significant effect on the level of preparedness. The main factors influencing the respondents' intention to prepare for a flood were the extent to which they evaluated the information material positively and their risk awareness.

Those who had never taken any interest in floods previously were less likely to read the material. For future campaigns, they therefore recommend repeated communication of relevant information tailored to the needs of the target population.

Ejikeme, Igbokwe, Ezeomedo, Aweh, Akinroye, (2015), worked on Analysis of Risks and Impacts of Flooding with Satellite Remote Sensing. They classified Landsat-7ETM+ of 2012 and resampled Shuttle Radar Topography Mission (SRTM) image of 2000 to 28.5m resolution of Landsat image. This was used to generate the Digital Elevation Model (DEM) and slope gradient of the study area. The DEM and slope gradient map were reclassified and combined through series of analysis to generate different levels of flood risk. The different land cover classes were overlaid with the flood risk map in order to know the land cover type that will be mostly affected in the event of flood disaster. Their work was able to identify areas with very high, high, moderate, low and no risk of inundations within the study area. They recommended among others that communities that fall within the very high risk flood inundation should be identified and possibly relocated to higher ground elevation.

Kundzewicz, Kanae, Seneviratne, Handmer, Nicholls, Peduzzi, Mechler, Bouwer, Arnell, Mach, Muir-Wood, Brakenridge, Kron, Benito, Honda, Takahashi and Sherstyukov (2014) in their work on Flood risk and climate change: global and regional perspectives assessed the literature included in the IPCC SREX report and new literature published since, and includes an assessment of changes in flood risk in seven of the regions considered in the recent IPCC SREX report—Africa, Asia, Central and South America, Europe, North America, Oceania and Polar regions. Also considering newer publications, this article is consistent with the recent IPCC SREX assessment finding that the impacts of climate change on flood characteristics are highly sensitive to the detailed nature of those changes and that presently we have only low confidence in numerical projections of changes in flood magnitude or frequency resulting from climate change.

Wallace, Poole and Horney (2014) in their study on The Association between Actual and Perceived Flood Risk and Evacuation from Hurricane Irene in Beaufort County, North Carolina, interviewed 205 households in Beaufort County, NC, to assess the association between perceived and actual risk of flooding and evacuation. Crude and adjusted prevalence differences were calculated among households within areas of known flood risk. Households in the 100- and 500-year flood plain were more likely to evacuate than those in non-flood areas prior to Hurricane Irene, but perceived risk was not associated with evacuation, even after adjustment. Perceptions of flood risk did not align with actual risk of flooding in the majority of respondents. Actual flood risk is an important environmental cue in the construction of risk perception and in the decision to evacuate prior to hurricanes.

Chiadikobi, Omoboriowo, Chiaghanam, Opatola, and Oyebanji (2011) did a study on Flood Risk Assessment of Port Harcourt, Rivers State, Nigeria. This study examined the flood risk in Port Harcourt using rainfall data, soil texture and other factors. The proportions of clay slit and sand particles in the soils were determined. Permeability result obtained is within the range of low-very low permeability (10-4 – 10-6 cm/sec).

Years with high rainfall events which correspond to years of high flood risk in Port Harcourt include 1998, 2000, 2002, 2003, 2004, 2006 and 2007. The percentages of rain events with high intensities in these years are; 39.4%, 52.7%, 32.7%, 40%, 35.8%, and 44.6% respectively. Rainfall intensity obtained is within the range of 53.8 – 20.4% for high to low intensities. It was observed that rainfall intensity is high in Port Harcourt due to climatic changes such as high rainfall volume and duration. The result of this study showed that the risk of the occurrence of potentially damaging flood in Port Harcourt increases with increasing rainfall intensity. Also, the risk of flood is bound to increase in the future with increasing urbanization hence the need to demarcate the flooded areas for effective flood mitigation.

2.2.3 Flood Management

Correljé and Broekhans (2013) in their paper on Flood risk management in the Netherlands after the 1953 flood: a competition between the public value(s) of waterreconstructed how the process of policy making and implementation had sought to balance these multiple values of achieving full safety, controlling the probability of flooding with high dikes and a shorter coastline, landscape preservation and economic activities over time. The paper showed that public values did not develop linearly into concrete standards and practices. Processes of re-articulation and political renegotiation of the meaning and importance of water safety took different paths with regard to both the river systems and the coastline. Curves in these paths can be seen as feedback mechanisms that verify the robustness of flood risk management measures and/or respond to changes in the character of the public values involved. Morss, Wilhelmi, Downton and Gruntfest, (2005) investigated the scientific research directions that were likely to benefit flood-risk estimation and management, through consultation with climatologists, hydrologists, engineers, and planners. They identified several challenges involved in generating new scientific information to aid flood management in the presence of significant scientific and societal uncertainty. They proposed a modification to the "end to end" approach to conducting societally relevant scientific research.

Pagneux**,** Jónsdóttir and Gísladóttir, (2010) assessed the Public preferences in the management of flood risk in an Icelandic municipality that has been prone to severe inundations in the recent past. The survey sought a public rating of governance style, technical options, and restrictions in land use planning. The aim of the study was to provide a first set of information on public preferences in the management of flood risk in Iceland. Preferences were analysed in the light of the socioeconomic profile of the respondents and of their perception of flood risk. In the analysis, an emphasis was put on the jurisdictional, institutional, and spatial scales and levels at which the coping options take effect. Survey results on governance indicate definite support of the municipal authorities and pronounced defiance towards central government by a significant part of the respondents. Although expressed preferences on levels of regulation indicate important opposition to the principle of compulsory measures, strong approval of restrictions in land use planning reveals that the principle of flood risk zoning is well accepted by the population surveyed.

According to Cassel and Hinsberger (2013) in their work on Flood Partnerships: A Participatory Approach To Develop And Implement The Flood Risk Management Plans, noted thatflood risk management comprises a wide variety of aspects, ranging from the reduction of the probability of occurrence of a flood to the reduction of the potential damage. These aspects according to them rest in the common responsibility of the official agencies at the state and community level, as well as the affected population. To facilitate an effective exchange between these actors, national and transnational flood partnerships (FPs) were initiated within the European INTERREG IV A – Project 'Flood and Drought Management in the transnational Mosel and Saar Watershed' (FLOW MS), spanning different regions in Germany, France and Luxembourg. The FPs are voluntary partnerships among communities, local authorities, emergency services, water management departments, professional associations, non-governmental organisations and public action groups in a common watershed.

The tools system dynamics and group model building were used in a set of workshops to establish an increased participation of relevant actor groups and the public to achieve a bottom-up approach contributing to the Flood Risk Management Plans of the EU Floods Directive. Interactive planning here implies inculcating the public which supports the idea presented in the works of Correljé and Broekhans (2013) and that of Cassel and Hinsberger (2013).

Saher, Nasly, Kadir, Yahaya and Wan Ishak (2013) in their work on Managing flood water of hill torrents as potential source for irrigation presented an integrated methodology for sustainable development planning to conserve the excess water resources. This developed methodology takes advantage of geographic information systems software to integrate its strength to manage the flood impacts. This approach is of dual purpose: first, to reduce the flash flood hazard of hill torrents; and second, to make use of flood water as a source of irrigation by conserving flood water in an earthen reservoir. The developed integrated methodology works as a decision-making system for selection of best site for earthen reservoir. The results for three potential sites for earthen reservoir supports in a decision-making process for best site for reservoir by analysing calculations for storage capacity, earthen works, and lengths of canals from reservoirs to agricultural land. This study revealed that the tools of geoinformatics have the potential to resolve the engineering challenges linked with mitigation of flood hazards. It is evident from the study that practical considerations for future turn the study into an informational tool to mitigate flood.

Hartmann and Driessen (2013) worked on Flood Risk Management Plan: Towards Spatial Water Governance. The work's contribution analyses how this mode of governance distinguishes from prevalent approaches. Spatial planning and water management in Europe were explored in terms of their actor relation, their institutional context, and their approach to the object. These three characteristics of the modes of governance are compared with the governance requirements that flood risk management demands. It was concluded in the work that the governance of flood risk management in Europe should strike a balance between comprehensive and hierarchical planning on the one hand, and interactive planning on the other hand, leading to a spatial water governance. Raza, Ahsan and Ahmad (2014) did a study on Rapid Assessment of a Flood Affected Population through a Spatial Data Model. The study used a spatial model which was developed for the assessment of the flood-affected population in a near real-time scenario. A flood extent vector, extracted from MODIS daily images, was superimposed on a LandScan population grid to estimate the population count living in the flooded area, aggregated by their respective administrative level. The methodology was found, both time and cost efficient for riverine floods. The model was tested for its accuracy using an on-ground initial vulnerability assessment and the figures matched to within 80-90%. This model can be used with a confidence level of ±10% for riverine floods

Holstead, Kenyon, Hopkins and Galán- Díaz (2014) in their work on Natural Flood Management from The Farmer's Perspective: Criteria That Affect Uptake. They aimed to explore farmers' perceptions of natural flood management (NFM) and identify the criteria influencing decision-making in natural flood management (NFM) implementation. Using findings from a workshop, qualitative interviews and a national survey carried out in Scotland, the paper identified six key criteria that farmers consider when implementing NFM: economics, availability of advice and support, public perception, joined-up policy, catchment planning and traditions. While a number of these criteria are consistent with the agri-environment literature and other NFM-specific studies, their study makes some novel findings regarding farmer perceptions of NFM. They concluded that installation could be encouraged through one-to-one advice with a trusted facilitator and long-term financial incentives that compliment other farm payments. This should be combined with a catchment approach to flooding which highlights shared responsibility for reducing flood risk.

Liao (2012), in his work titled A Theory on Urban Resilience To Floods—A Basis For Alternative Planning Practices, applied resilience theory to address system persistence through changes, he developed a theory on "urban resilience to floods" as an alternative framework for urban flood hazard management. Urban resilience to floods is defined as a city's capacity to tolerate flooding and to reorganize should physical damage and socioeconomic disruption occur, so as to prevent deaths and injuries and maintain current socioeconomic identity. It derives from living with periodic floods as learning opportunities to prepare the city for extreme ones. The theory of urban resilience to floods challenges the conventional wisdom that cities cannot live without flood control, which in effect erodes resilience. To operationalize the theory for planning practice, a surrogate measure—the per cent floodable area—was developed for assessing urban resilience to floods. To enable natural floodplain functions to build urban resilience to floods, flood adaptation is advocated in order to replace flood control for mitigating flood hazards.

Ogtrop, Frederik, Hoekstra and Meulen (2005) did a study on Flood Management in the Lower Incomati River Basin, Mozambique. The aim of their work is to compare two views of flood management and thus add to the present thinking of living with floods as opposed to the traditional approach of flood control. The traditional pathway has widely been adopted in developed countries and aims to control floodwaters by means of dams and dikes. The alternative pathway tends towards a policy whereby society lives with the floods by being prepared and having the right damage reduction measures in place. In this paper two pathways were tentatively compared for the Lower Incomati Basin, Mozambique. In the design cultural theory was considered, as is how the design of each path may look according to different management perspectives. The Lower Incomati Basin provides an interesting case study as it is in a relatively undeveloped state. Hence, it is an ideal area for conducting research into the application of alternative flood management strategies. The preliminary results suggest that both pathways are feasible. However, they observed that considering recent hydrological extremes such as the 2000 floods, the resilient pathway may ultimately be a more appealing flood management strategy.

2.2.4 Flood Vulnerability

Nwosu, Olayinka and Nwilo (2013) did a study on generation of flood maps and drainage basin of Umueze Anam. In the study, a triangular irregular network (TIN) was created. The resulting triangulation satisfies the Delaunay triangle criterion, which ensures that no vertex lies within the interior of any of the circumcircles of the triangles in the network. They used a topographic data to model flood kinematics in Umueze Anam and environs. The result revealed the flow direction of flood water in the area. This has shown that the numerical terrain descriptor method is effective in modeling flood water motions. Saldajeno, Florece, Lasco and Velasco, (2012) worked on Vulnerability Assessment of Upland Communities in Sibalom Natural Park, Antique, Using Capital-based Approach. Three upland communities in Sibalom Natural Park (SNP) were surveyed and key informants were interviewed to assess the communities' social vulnerability. They computed social vulnerability index

(SVI) from thirty nine indicators representing human, natural, social, financial, and physical capital assets. Thy found out that there is high vulnerability owing to the low capital assets among households. They recommended that it is vital to strengthen education, access to government support, regularity and quality of income sources; increase crop production; and provide basic infrastructure such as roads and bridges to minimize vulnerability.

Armah, Yawson, Yengoh, Odoi and Afrifa, (2010), reviewed the Impact of Floods on Livelihoods and Vulnerability of Natural Resource Dependent Communities in Northern Ghana. The paper explores the impact of floods on natural resource dependent communities in Northern Ghana. They used simplified causal loop diagrams to conceptualise flood-induced coping strategies in the study area. The results indicate that some characteristics of the socio-cultural environment appear to mitigate risk and reduce vulnerability. In this context, the role of social networks in enhancing livelihood security is essential. The paper concludes that both in case of seasonal variations in agricultural output and floods, individuals that have effectively diversified their livelihoods, both occupationally and geographically, are less sensitive than individuals who mainly achieve entitlement to food via crop cultivation.

Korah and López, (2015) carried a study on Mapping Flood Vulnerable Areas in Quetzaltenango, Guatemala using GIS. The study sought to map flood vulnerable areas in the city of Quetzaltenango, Guatemala using GIS. The hydrology and weighted overlay (spatial analyst) techniques were used to analyse the materials for the study. The results showed the whole city was at risk of being inundated. The areas at high risk of flooding were at the core of the city whereas the no and low flood vulnerable areas were non-habitable. The study recommended the recovery of forest through afforestation among others as some flood mitigation strategies.

Balica, Douben and Wright (2009) worked on Flood vulnerability indices at varying spatial scales. In their paper, they described a methodology for using indicators to compute a Flood Vulnerability Index which is aimed at assessing the conditions which influence flood damage at various spatial scales: river basin, sub-catchments and urban area. The methodology developed distinguishes different characteristics at each identified spatial scale, thus allowing a more in-depth analysis and interpretation of local indicators. This also pinpoints local hotspots of flood vulnerability. The final results are presented by means of a standardised number, ranging from 0 to 1, which symbolises comparatively low or high flood vulnerability between the various spatial scales. The Flood Vulnerability Index can be used by international river basin organisations to identify and develop action plans to deal with floods and flooding or on smaller scales to improve local decision-making processes by selecting measures to reduce vulnerability at local and regional levels.

Mayomi, Dami and Maryah (2013) carried out a study on GIS Based Assessment of Flood Risk and Vulnerability of Communities in the Benue Floodplains, Adamawa State, Nigeria.The focus of the study was to assess the

2012 floods incidence that swept the communities along the coastal areas of Nigeria as well as those along the valleys of the major rivers in the country. It was observed in the study that the floods at the valleys and downstream of River Benue were seriously devastating following the release of water from the Lagdo dam that was located at the upstream of River Benue in the Republic of Cameroon. The method of data collection employed in the study was the application of Geo-information techniques which involves the use of Global Positioning System (GPS) to capture the coordinates of 120 communities which cut across the seven L. G. As. located along the valleys of River Benue in Adamawa State. These communities were linked to a generated digital map of River Benue valley using ArcGIS software to assess each of the communities for flood vulnerability. Vulnerability was classified into four: highly vulnerable, vulnerable, marginally vulnerable and not vulnerable. The major findings revealed that all the 120 communities in the area were described as vulnerable to flood, that is, they are either highly vulnerable, vulnerable or marginally vulnerable. 29 communities representing 32.5% were located on highly vulnerable areas, 35 communities (representing 29.17%) were found to be located within the Benue Basin but outside the buffer zones which are classified as vulnerable areas, while the remaining 46 communities (38.33%) were located on the plains which were classified as marginally vulnerable areas. Escape routes and good sites for refugee camps during floods were also identified while database creation and analysis for flood vulnerability were also developed. They therefore recommended that all the settlements that were highly vulnerable be relocated to higher grounds to prevent future occurrence, while the communities that are located within the Benue Basin but outside the buffer zones should employ the use of GIS tool for effective planning and proper early warning systems.

Villordon, (2014) carried out a research on Community-based Flood vulnerability index for urban Flooding: Understanding social vulnerabilities and risks. The research was an exploratory step towards assessing vulnerability particularly to fluvial flooding. It was a rapid assessment of the Knowledge, Attitudes, and Practices (KAP) of the community people towards flood vulnerability and resilience and their exposure to microorganisms such as E.coli, Leptospirosis and the Dengue Fever mosquito which could pose an outbreak after a typhoon event. Appropriate community-based indicators were formulated and developed. Their socio-demographic profile, housing conditions, physical environment and governance were also included. These are important factors to be assessed in order to establish correlations and relationships in understanding social vulnerabilities and risks using local indicators which can be incorporated later in hydro-informatics. The survey was done from March 2013 to July 2013 to capture the dry and wet season for sampling. A total of 357 household respondents from the 12 communities and 30 respondents from the LGU and NGO were surveyed. Results of the study revealed an overall Flood Vulnerability Index (FVI) of 39.34%. Barangay

Tabuctubig (53.39%) topping from all the 12 communities surveyed using the newly developed 36 community-based flood vulnerability indicators with its corresponding 5 major components namely; hydro-climatic, social, economic, socio-behavioral and the politico-administrative. The research also reveals the most vulnerable communities from each of those 5 major components surveyed. It was noted that Flood Vulnerability Index (FVI) remained low even though the exposure indicators are high. The low FVI can be attributed to the community's high resilience in its coping and adaptation strategies. In the research work, the Flood Vulnerability Index was significantly sensitive to susceptibility and flood resilience variables.

2.2.5 Other Impacts of Flood

Adebayo and Jegede (2010) studied the Environmental Impact of Flooding on Transportation Land Use in Benin City, Nigeria. Data for this study were collected through the administration of 200 questionnaires, using the random sampling technique on respondents and through the physical survey of the study area. Simple percentages were used to analyze the data. Two hypotheses were formulated. The student's 'T' test statistical method was used to test the hypotheses. Results from this study show that illegal disposal of refuse on drainage channels, high intensity of rainfall, the absence or infective drainage channels, poor construction of roads and building of houses on stream channels were identified as the causes of flooding on transportation land use in the study area. The study recommends that good road construction works, controlled dump sites, and timely response of the Town Planning Authority to flooding menace should be carried out as a matter of urgency to tackle the environmental problems of flooding on transportation land use in Benin City, Nigeria.

Garbero and Muttarak (2013) worked on the Impacts of the 2010 droughts and floods on community welfare in rural Thailand. Based on the Thai government surveys of the living conditions and life quality of 68,343 rural villages for the years 2009 and 2011, they investigated the impacts of floods and droughts in 2010 on community welfare, i.e., consumption and income in 2011 at the village level. Using difference-in-difference methods, they analysed how differential demographic composition and education could reduce or increase economic vulnerability to natural disasters. They found out that floods and droughts do not produce a negative effect either on food and non-food consumption, investment in agriculture and education, or on income. However, this applies mainly to communities with higher educational attainment partly because these communities can better secure government financial aid for flood and drought affected areas. Education thus may have an important role in reducing economic vulnerability.

Wilby and Keenan (2012) did a study on Adapting to flood risk under climate change. This study reviewed steps being taken by actors at international, national, regional and community levels to adapt to flood risk from tidal, fluvial, surface and groundwater sources. They refered to existing inventories, national and sectoral adaptation plans, flood inquiries, building and planning codes, city plans, research literature and international policy reviews. They distinguished between the enabling environment for adaptation and specific implementing measures to manage flood risk. Enabling includes routine monitoring, flood forecasting, data exchange, institutional reform, bridging organizations, contingency planning for disasters, insurance and legal incentives to reduce vulnerability.

All such activities are 'low regret' in that they yield benefits regardless of the climate scenario but are not cost-free. Implementing includes climate safety factors for new build, upgrading resistance and resilien of existing infrastructure, modifying operating rules, development control, flood forecasting, temporary and permanent retreat from hazardous areas, periodic review and adaptive management. They identified evidence of both types of adaptation following the catastrophic 2010/11 flooding in Victoria, Australia. However, significant challenges remain for managing trans boundary flood risk (at all scales), protecting existing property at risk from flooding, and ensuring equitable outcomes in terms of risk reduction for all. Adaptive management also raises questions about the wider preparedness of society to systematically monitor and respond to evolving flood risks and vulnerabilities. Paranjothy et al. (2011) worked on Psychosocial impact of the summer 2007 floods in England. They carried out a health impact assessment using population-based surveys to assess the prevalence of and risk factors for the psychosocial consequences of this flooding in the United Kingdom. Surveys were conducted in two regions using postal, online, telephone questionnaires and face-to-face interviews. Exposure variables included the presence of flood water in the home, evacuation and disruption to essential services (incident management variables), perceived impact of the floods on finances, house values and perceived health concerns. Validated tools were used to assess psychosocial outcome (mental health symptoms): psychological distress (GHQ-12), anxiety (GAD-7), depression (PHQ-9) and probable post-traumatic stress disorder (PTSD checklist-shortform). Multivariable logistic regression was used to describe the association between water level in the home, psychological exposure variables and incident management variables, and each mental health symptom, adjusted for age, sex, presence of an existing medical condition, employment status, area and data collection method.

The result showed that the prevalence of all mental health symptoms was two to five-fold higher among individuals affected by flood water in the home. People who perceived negative impact on finances were more likely to report psychological distress (OR 2.5, 1.8-3.4), probable anxiety (OR 1.8, 1.3-2.7) probable depression (OR 2.0, 1.3-2.9) and probable PTSD (OR 3.2, 2.0-5.2). Disruption to essential services increased adverse psychological outcomes by two to three-fold. Evacuation was associated with some increase in psychological distress but not significantly for the other three measures. It was concluded that the psychosocial and mental health impact of flooding is a growing public health concern and improved strategies for minimizing disruption to essential services and financial worries need to be built in to emergency preparedness and response systems. Public Health Agencies should address the underlying predictors of adverse psychosocial and mental health when providing information and advice to people who are or are likely to be affected by flooding.

Mason et al (2010) worked on the psychological impact of exposure to floods. The aim of the study was to examine the psychological impact of flooding in the UK. A cross-sectional survey was used to investigate the psychological symptoms associated with the aftermath of the flood amongst adults living in the affected communities. A questionnaire battery including the Harvard Trauma Questionnaire (trauma and symptoms associated with PTSD), Hopkins Symptom Checklist (anxiety and depression), Coping Strategies Questionnaire and a range of questions addressing sociodemographic characteristics and factors relating to the flood was administered to households in flood-affected areas. Four hundred and forty four completed questionnaires were returned. 27.9% of participants met criteria for symptoms associated with PTSD, 24.5% for anxiety and 35.1% for depression. Females had higher mean scores on PTSD, anxiety and depression than males. Most frequently reported coping strategies were rational, detached and avoidant, with the least frequent being emotional coping. Having to vacate home following flood, previous experience of flooding and poor health were associated with greater psychological distress. Detached coping appeared to be related to less distress. Although it is not possible to determine whether the symptoms were a direct consequence of the flood, symptoms of distress are significant issues amongst communities affected by environmental events warranting further attention to prevent chronic distress.

2.3 GAPS IN LITERATURE

In the course of reviewing the various literature, some gaps were observed which when filled, will help to advance knowledge and practice of environmental management. Some of the gaps observed in the course of the review of literature include the following:

- Few works on flood vulnerability and susceptibility and their effects have been carried out in the study area.

- Most of the works on flood in the state are done for the urban areas and so there is need to do more in the rural areas.

- Most of the works on flood vulnerability did not consider the prevalence of diseases such as typhoid, malaria, cholera etc.

This work seeks to fill these gaps and advance knowledge in those directions.

CHAPTER THREE

STUDY AREA

3.0 Introduction

This chapter discuses on the area were the study was carried out. The discussion is broken down into sub topics for a clearer understanding of the area.

3.1 Location

This work is carried out in Nmiata –Anam of Anambra West Local Government Area in Anambra State of Nigeria.Anambra West Local Government Area falls within latitude $6^{O}15^{I}$ N - $6^{O}45^{I}$N and longitude $6^{O}40^{I}$E - $6^{O}60^{I}$ E. Broadly speaking Anam towns are classified into two according to geographical contiguity: Ezi and Ivite. While Umueze, Umudora, Umuikwu, Oroma, and Umuenwelum constitute the Ezi Anam, Nmiata, Iyiora, and Umuoba-Aboegbu constitute the Ivite Anam. Nmiata-Ovia-Nwagboo and Umuoba-Oboro-Igbo are outside this classification, having permanently fused with Otuocha, the headquarters of a neighbouring Anambra East Local Government Area (Nwosu, Olayinka, and Nwilo, 2013). Anambra West is bounded in the north east by Ayamelum L.G.A., in the south east by Anambra East L.G.A., while in the north east it has a boundary with Kogi State. Anambra State is located within latitudes 5^{0} 45^{1}N and 6^{0} 45^{1}N and longitudes 6^{0} 40^{1}E and 7^{0} 15^{1}E. Anambra State as shown in Figure 3.2 is located in the South Eastern geopolitical zone of Nigeria as shown in figure 3.1. while Anambra West is located within latitude 6^{o} 13^{I} N and 6^{0} 45^{1}N and longitudes 6^{0} 40^{1}E and 7^{0} 00^{1}E.

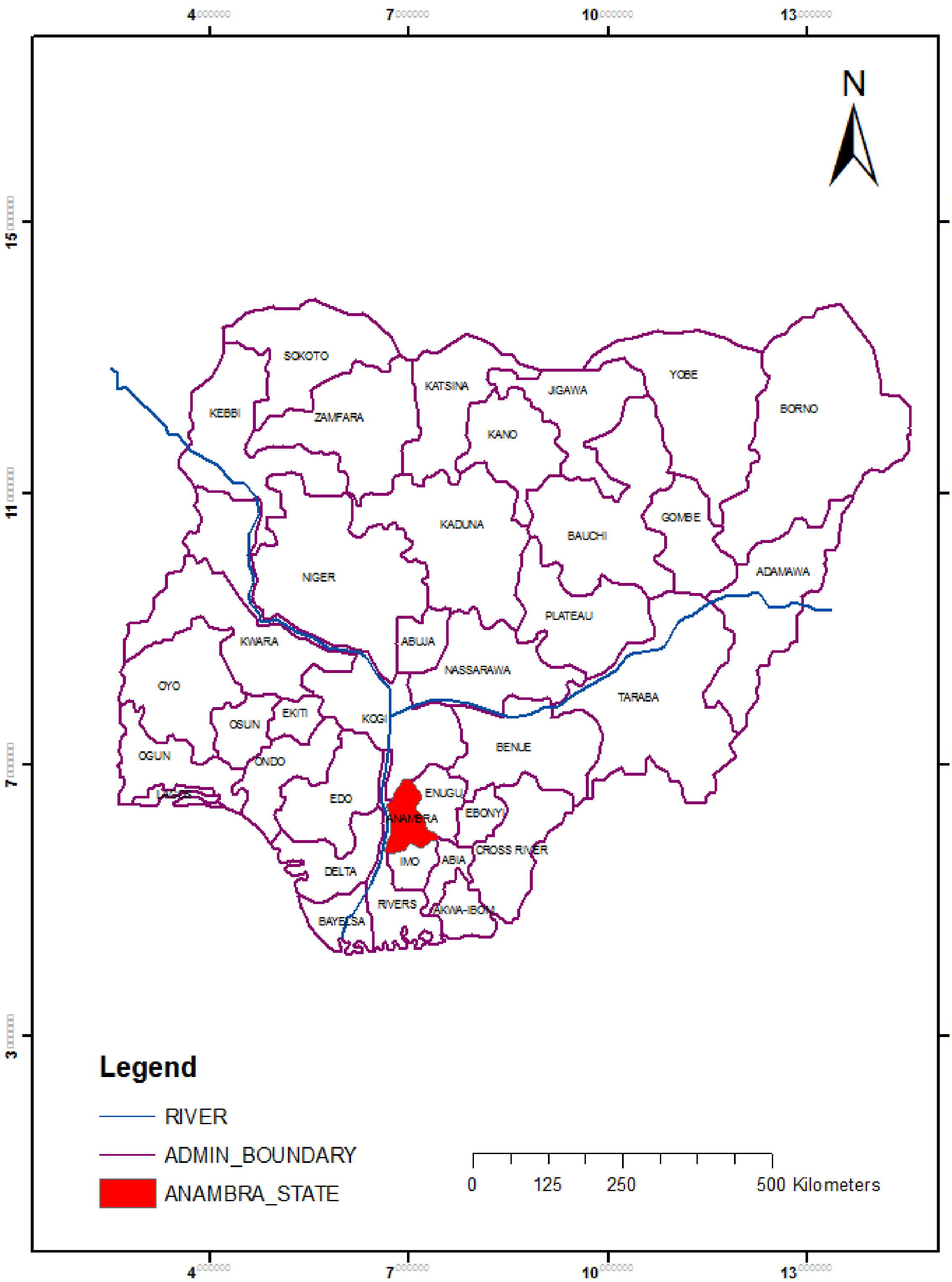

Fig. 3.1: Nigeria showing Anambra State.
Source: Survey Department,NAU, Awka, 2015

3.2 Demography

Anambra State has 21 Local Government Areas. The Local Government Areas include Aguata, Awka North, Awka South, Anambra East, Anambra West, Anaocha, Ayamelum, Dunukofia, Ekwusigo, Idemili North, Idemili South, Ihiala, Njikoka, Nnewi North, Nnewi South, Ogbaru, Onitsha North, Onitsha South, Orumba North, Orumba, South and Oyi.

The indigenous ethnic groups in the State are the Igbo (which make up 98% of the population) and the Igala (which make up 2% of the population). The population density of the state according to the 2006 census is 863/km^2, one of the highest in Nigeria (NPC, 2006 in Anyanwu, 2012).

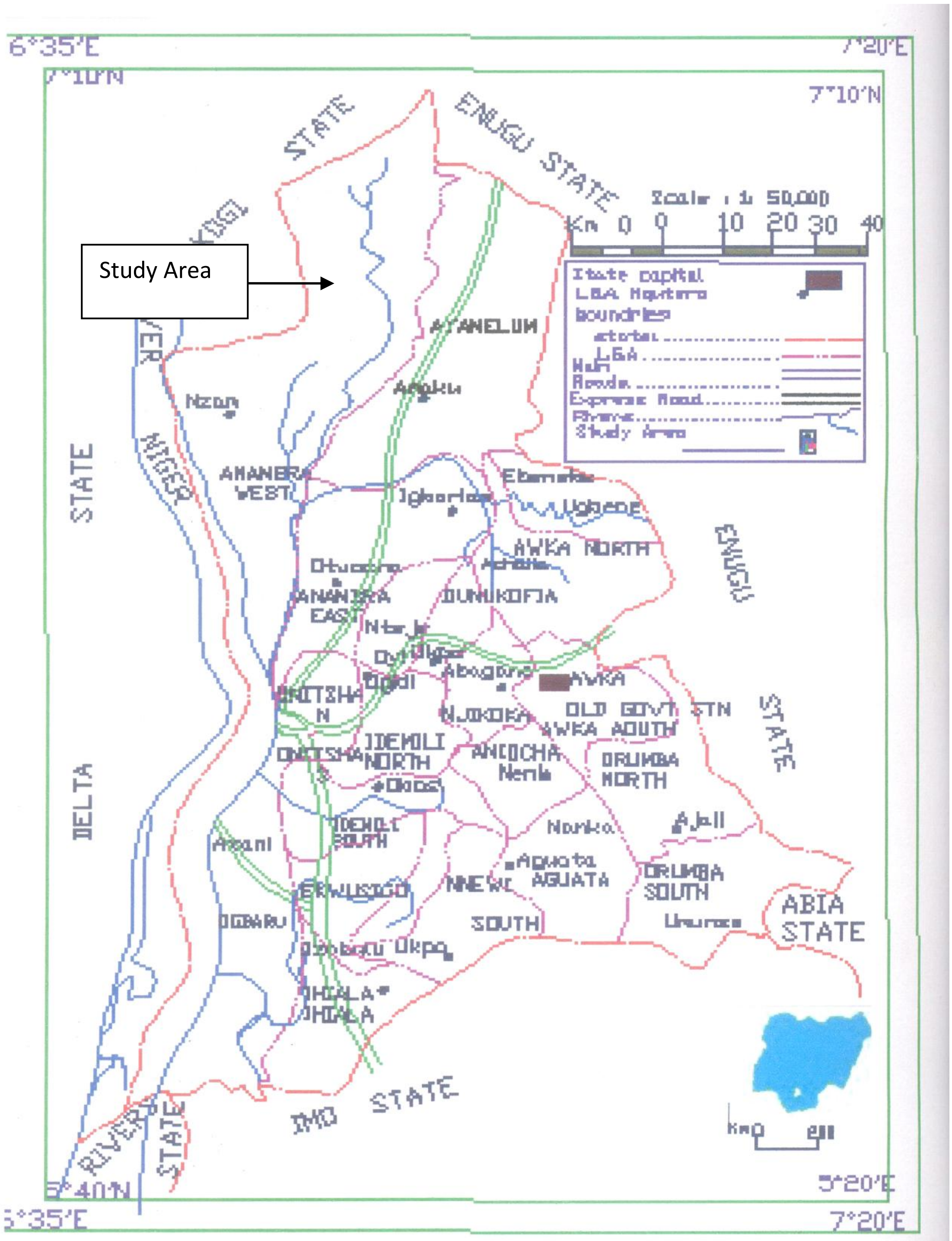

Fig 3.2 Anambra State showing the L.G.As.
Source: Survey Dept. NAU, Awka, 2015.

3.3 Geology and Minerals Resources

Anambra State lies in the Anambra Basin, the first region where intensive oil exploration was carried out in Nigeria. The Anambra Basin has about 6,000m of sedimentary rocks (Olusola, Ajiboba and Samuel, 2003). Geologically, Anambra state is underlain by sedimentary formations of varying ages: Nanka sandstone, Ogwashi-Asaba formation and Ameki formations (Onyeagocha, 1980). Sandstone is a good aquifer of high economic value. Anambra State is rich in natural gas, crude oil, bauxite, ceramics and almost 100 per cent arable soil. Most of its natural resources remain largely untapped (Anyanwu, 2012). The major escarpment in the area is the North-South trending Awka-Orlu escarpment, which runs from Awka in Anambra State through Ekwulobia to Orlu in Imo State (Onwuka, 2010).

3.4 Drainage

The area is drained by several rivers including the River Niger, Anambra River and their tributaries. The natural flow pattern of the rivers and their tributaries is of dendritic pattern (Onwuka, 2010). There are many gullies at the head streams of the rivers that flow down the cuestas. The head streams carve their valleys deep into the deeply weathered red earth, developing dendritic patterns of gullies. The many rivers and streams in the state serve as sources of water for the population, many of whom depend on them for their livelihood.

3.5 Climate

The climate of the area is purely a tropical climate. Two major climatic seasons exist in Anambra State namely the rainy season (from March to October) and the dry season (from November to March). The rainy season is characterized by heavy downpours accompanied by thunder storms, heavy flooding, soil leaching, extensive sheet out wash, ground infiltration and percolation (Egboka and Okpoko, 1984). Rainfall records of between 5.87mm monthly (at the beginning of rainy season) to 289.95mm monthly (at the peak of rainy season). This increases the volume of water vapour in the atmosphere and eventually leads to high relative humidity, heavy thunderstorms and high rainfall intensity except sometimes during the month of August when there is noticeable drop in rainfall. Anambra State has an annual rainfall of around 2700mm

This phenomenon is often referred to as short dry season and locally called "August break". The dry season on the other hand begins when the dry continental north-eastern wind blows from the Mediterranean sea across the Sahara Desert down to Southern Nigeria. It is characterized by extensive aridity and a lot of particulate and dust generation. The dry season is characterized by chilly and dry Harmattan wind. There is equally a marked lowering of water table and intense leaf fall (Egboka and Okpoko, 1984). The area lies within the zone characterized by relative warm temperatures. Although the temperatures vary slightly, depending on the period of the year, the dry season has high temperatures and lower humidity.

The temperature is generally between 26^0C and 30^0C monthly, while the wet months with high relative humidity have lower temperatures of between 22^0C and 26^0C monthly. The relative high temperatures give rise to increased evapo –transpiration. Temperatures are low especially in December and January. The main features of the dry season are excessive evaporation, low relative humidity (26%), low rainfall and general dryness (Egboka, 1993).

3.6 Vegetation

Anambra state lies within the evergreen rainforest of southeastern, Nigeria. The natural vegetation in Anambra State is predominantly dry or deciduous forest, which in its pristine state is made up of tall trees with numerous climbers and thick undergrowth. The land is covered with vegetation except in areas where there is bare vegetation due to excess cultivation and farming practices. The typical trees shed their leaves in the dry season.Oil palm trees are common and swampy areas have thick cover of raffia palms. This typical tropical rainforest vegetation is disappearing in many parts of Anambra state, giving way to derived savannah vegetation of scrubland and bushes. This is due to high rate of human activities in form of deforestation as lands are cleared for farming and construction purposes (Egboka, 1993). The trees have luxuriant foliage.

3.7 Economic Activities

In addition, industrialization of varying types and scales abound in the area particularly in places like Onitsha, Awka, Nnewi, Ekwulobia, etc.

(Onwuka, 2010). In Anambra State majority of the inhabitants of rural areas engage in subsistence agriculture. They cultivate more of cassava, yam, maize and cocoyam. The planting season in most cases starts around March in the hinterland while in the riverine areas, cultivation starts as early as the month of November. In the urban areas, inhabitants engage in both secondary and tertiary activities in as much as agricultural activities go one in very small scale.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.0 Introduction

This chapter will take a look at the methodology used in carrying out the research. It highlights the research design, method of data collection and the statistical method used to analyze the data.

4.1 Research Design

The research design applied in this study includes the survey design method and the analytical method. A survey of the study area was carried out in other to enable the researcher to gather the required information/data from the field. An analysis of the satellite imagery of the study area was also done.

4.2 Sources of Data

The data for this research work was collected from both secondary and primary sources. The primary data sources were collected by the use of questionnaire administered to respondents in the field during the field survey.

The secondary sources of data include published textbooks, journals and periodicals, while some unpublished thesis and dissertations were consulted as well. Other secondary data includes the Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model (otherwise known as ASTER GDEM-V2) data of 2011. Only one scene, in which Anambra West Local Government Area lies in, was used to obtain the area of interest.

4.3 Method of Data Collection

Data needed for this research work was collected in various ways which include

(a) Administering of questionnaire: This was done using well-structured questionnaire that was administered to a sample of the population of study. It provided information such as age, level of education, number of years one has been living in the study area, compensations received etc. This was done in 2016.

(b) Going through/ hospital records: This was where the data on ailments (malaria and typhoid) were gotten from. This covers the period from Jan 2014 to May 2016.

(c) Accessing Satellite imagery: This provided the satellite imagery used to carry out analysis that relates to the topography and the vulnerability analysis.

4.4 Sample Frame

The sampling frame for this research work is the entire areas in Anambra West Local Government Area of Anambra State. Sample Frame is a list of the members of the population under investigation and is used to determine the sample size (Osuala, 2007).

4.5 Sampling Technique

The sampling technique used for this study was the simple random sampling method. In this method, every member of the population will have an equal opportunity to be sampled or selected for the study.

4.6 Sample Size/ Population

For the purpose of this work, a total of three hundred and ninety respondents were selected using the Taro Yamani formula [$n = N/1+N(e)^2$]. Where n= sample size, N= total population, e= the margin error But from Appendix VII, the three quarters that made up Ifite Anam have a population of 30,540. This population was divided by three and one of the parts projected to 2016 to get 15,270.

$n=15270/1+15270 \times (0.05)^2 = 389.70$. This was approximated to 390.

This formed the population base for the research. The researcher used this population after projecting the available population to 2016 from the population of Nmiata-Anam, Anambra West Local Government as provided by the National Population Commission census figure for 1991 (since that is the only population data that contains the study area but did not record each town's population individually / separately as shown in appendix V). Based on the population sample chosen, the researcher administered his questionnaire randomly, using the simple random technique. This the researcher did by dividing the study area into two zones based on the major road that traverses the area from North to South and randomly administered a total of one hundred and ninety five (195) questionnaires on each side of the study area by the help of well-trained research assistants

4.7 Methods of Data Analysis

1. Descriptive statistics such as tables, graphs, frequencies and percentages were used to present the perception of the respondents. The perceptions includes gender distribution of respondents, age distribution of respondents, frequency of flood occurrence, presence of early warning equipment etc.
2. Regression analysis was used to analyze flood occurrence and damage to environment, flood occurrence and socio-economic values of the environment and flood occurrence and water pollution. Correlation was used to analyze flood occurrence and socio-economic values of the environment and flood occurrence and loss of agricultural yield, the T-test was used to also analyze flood occurrence and damage to environment, flood occurrence and water pollution and also flood occurrence and loss of agricultural yield. Principal component analysis was used to (used to determine the components with the highest effects in causing flood among the outlined causes of flood) and time series analysis (used to analyze the hospital data) were used as the statistical tool to analyze and test the formulated hypotheses for their validity.

3. The ArcGIS 10.5 geo-processing and spatial analyst tool was used to analyze the satellite image used in the study. The flow chart is shown in figure 4.1. The satellite image used was that of Anambra West L.G.A. acquired from LandSat.

4.8 Validation and Reliability of Instrument

The questionnaire used for the collection of data from the field was given to three statisticians for validation to ensure its effectiveness and validity of each question for the research. A test-retest approach was applied to ensure the instrument (questionnaire) was valid.

The reliability of the instrument for decision making was gotten using the Cronbach's Alpha. The Alpha value was 0.978 and this implies the responses were reliable for decision making.

CHAPTER FIVE

DATA PRESENTATION, ANALYSIS AND DISCUSSION ON FINDINGS

5.0 Introduction

This chapter presents the data collected from the field during field studies. The data collected were presented in tables, charts and graphs. Also the presented data were analyzed and findings from the analysis were discussed.

5.1 Data Presentation

5.1.1 Bio data on Respondents

One questionnaire was prepared and reproduced into three hundred and ninety pieces. These were administered to respondents in the field and the researcher was able to all collect the administered questionnaire from the respondents. This gave a 100% in the collection/return of the questionnaire.

From Table 5.1, it will be noticed that 181 respondents were male while 209 respondents were female. This implies that 46.41% of the sampled population were male while 53.59% of the sampled population were females.

Table 5.1: Gender Distribution of Respondents

Gender/Sex	Frequency	Percentage
Male	181	46.41%
Female	209	53.59%
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

From Table 5.2, it was observed that seven people who made up 1.79 percent were between the ages of 16-20. The age bracket 21-25 had a frequency of twenty (20) and a percentage of 5.13. The frequency for respondents between ages 26-30 is thirty eight and their percentage is 9.74 while age group 31-35 had a frequency of one hundred and thirteen (113) and a percentage of 28.97. For the age group 36-40, the frequency is one hundred and twenty two (122) while its percentage is 31.28. Age group 40-45 had a frequency of 59 and a percentage 13.07 while age group 46 and above had 31 respondents as its frequency and a percentage of 7.95.

Table 5.2: Age Distribution of Respondents

Age Distribution	**Frequency**	**Percentage**
16-20	7	1.79
21-25	20	5.13
26-30	38	9.74
31-35	113	28.97
36-40	122	31.28
41-45	59	13.07
46 and above	31	7.95
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

From Table 5.3, which is on the frequency of occurrence of flood in the study area, it will be noticed that 20 respondents representing 5.13 percent were of the view that flood occurs after every rain, 350 respondents making up 89.64 percent agree that flood occurs once every year, 20 respondents which is equal to 5.13 percent believe that flood occur sparingly. From further probing/

discussion with the respondents, it was seen that the inhabitants of study area do consider inundation of their environment as something normal since it occurs almost at the same period each year and they call it “Iji” which they say/believe brings nutrients to their soil.

Table 5.3 Frequency of Flood

Flood Occurrence	Frequency	Percentage
Every Rainy season	0	0.0
After every rain	20	5.13
Once every year (specified period)	350	89.74
Sparingly	20	5.13
Never except the 2012 flood	0	0
Total	**390**	**100%**

Source: Researcher’s field analysis, 2016

Table 5.4 shows the response of respondents to the volume/height of the flood water. 89 respondents which is equal to 22.82% answered that the flood reaches the knee level,125 respondents representing 32.05% were of the view that the flood water reaches the waist level while176 respondents which is equal to 45.13% believes that the flood exceeds the waist level. On further probing, the respondents explained that the 2012 flood covered most of the buildings up to the lintel level and some up to the roof.

Table 5.4: Volume/Height of the Flood Experienced Yearly

Volume/Height	**Frequency**	**Percentage**
Ankle level	0	0
Knee level	89	22.82
Waist level	125	32.05
Above waist level	176	45.13
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

From Table 5.5, it was noticed that 96.66% which is equal to 377 respondents were of the view that there was some level of warning from the government on future / major flood events after the 2012 flooding in as much as no flooding of the degree of the 2012 flood disaster has occurred. To the respondents, they believe that the billboard erected at strategic positions were avenues for government workers to siphon money since no flood of the 2012 magnitude has occurred even after the warning. 3.33% of the sampled population which is equal to 13 respondents were of the view that no prior warning comes before any flood, that if there was any of such, it may have been done at a higher level which did not trickle down to the very low class in the society.

Table 5.5 Warning Prior to Flood After 2012 Event

Warning	Frequency	Percentage
Yes	377	96.67
No	13	3.33
Total	390	100

Source: Researcher's field analysis, 2016

From Table 5.6, it was seen that no new or old early warning system or equipment has been in existence or has been recently installed in the study area. This can be seen from Table 5.6 as all respondents answered in the negative to the installation of early warning system /equipment (EWS/EWE). The respondents also confirmed that the neighboring communities do not have early warning systems installed in their communities. The implication is that the residents of the area will not move away from their location or habitation on time in the event of flood occurrence.

Table 5.6 Installation of New Early Warning Equipment

New EWE	Frequency	Percentage
Yes	0	0
No	390	100%

Source: Researcher's field analysis, 2016

From table 5.7, it was noticed that no education on early warning system on flood has been carried out in the study area as all the respondents answered in negative. This implies that the inhabitants of the area will always be caught unawares whenever flood of high magnitude occurs even though the government may be carrying out sensitization on the media (radio) as most of the respondents claim they do not always listen to radio adverts.

Table 5.7 Education on Workability of EWS/EWE

Education on EWS/EWE	Frequency	Percentage
Yes	0	0
No	390	100%
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

Table 5.8 shows that none of the respondents had insurance for their property. This is so in as much as some of the respondents have knowledge of various insurance types or policies. Based on this, the people will always look on to the Government to help alleviate their sufferings and compensate them after every devastating flood.

Table 5.8: Property Insurance

Insurance	Frequency	Percentage
Yes	0	0
No	390	100%
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

From table 5.9, it will be noticed that 52.14% of the respondents have an idea about property or life insurance while 47.86% do not know about it; but surprisingly, none of the respondents have their property insured.

Table 5.9: Knowledge of Property/Life Insurance

Knowledge	Frequency	Percentage
Yes	203	52.05
No	187	47.95
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

From table 5.10, it will be noticed that the whole respondents declined knowledge of the availability of any flood map for the area. Based on this finding, there is a need for the Government of the day to consult this work and adapt the flood map for the study area as provided in this study and use it as a guide or base for any further decision making in the area.

Table 5.10 Flood Maps Availability for the Area

Flood Maps Availability	Frequency	Percentage
Yes	0	0
No	390	100%
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

From Table 5.11, it was observed that all the respondents are of the view that no flood map has been developed or provided for the study area. From their responses, they think or believed that the government does not care about them and that is why there are no flood maps provided for their community.

Table 5.11: Flood Maps for the Study Area

Flood Maps	**Frequency**	**Percentage**
Yes	0	0
No	390	100%
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

Table 5.12 shows that from the knowledge of the respondents as at the time of the study, no arrangements have been made to develop flood maps for the study area. This can be seen from the number of respondents who answered to the negative on arrangements to provide flood maps for the area. But there is a need for that since flood occurs there yearly.

Table 5.12: Arrangement to Provide Flood Maps

Provision of Flood Maps	**Frequency**	**Percentage**
Yes	0	0
No	390	100%
Total	**390**	**100%**

Source: Researcher's field analysis, 2016

Table 5.13 shows the medical records collected from Rex Hospital which is the only registered private hospital in Nmiata Anam in Anambra West L.G.A. The Table shows the number of patient that reported sick for ailments such as

Malaria and Typhoid. The results provided were as available from January 2014 to June 2016. From Table 5.13, it will be noticed that for the month of Jan, 2014, the medical records show that nine people suffered from Malaria (*Plasmodiasis*) while four people suffered from Typhoid (*Salmonellosis*). In Feb, 2014, seventeen (17) people were afflicted with *plasmodiasis* while ten people had *salmonellosis*. In March, 2014, the number of people who were afflicted with *plasmodiasis* increased to twenty while that of *salmonellosis* increased to thirteen. The month of April, 2014 saw twelve people suffering from malaria and seven people reporting of Typhoid. In May 2014, the hospital data showed that twelve people suffered from Malaria, while only five people suffered from Typhoid. In June 2014, the numbered of people who suffered from malaria rose to sixteen while that of Typhoid was eight. In July 2014, there were eleven and seven cases for Malaria and Typhoid respectively. In August 2014, thirteen

cases of Malaria were recorded while five cases of Typhoid were recorded. The month of September 2014, recorded eleven Malaria cases and three Typhoid cases. In October 2014, the ailment cases reported were six Malaria cases and three cases of Typhoid. November 2014 had a record of four Malaria cases and seven Typhoid cases. The month of December 2014, recorded fourteen Malaria cases and ten Typhoid cases.

In January 2015, eighteen malaria cases were recorded while thirteen typhoid cases were recorded. In February 2015, the number dropped to sixteen malaria cases and ten typhoid cases. March 2015 saw an increase in malaria from sixteen to twenty while salmonellosis continued to drop to seven. In April 2015, the cases of *plasmodiasis* increased by more than half from twenty to thirty three while *salmonellosis* increased to ten from seven. In May 2015, *plasmodiasis* recorded twenty six cases while *salmonellosis* recorded nine cases. In June 2015, thirty seven cases of malaria were recorded while only five cases of typhoid were also recorded. July 2015 saw a record of the highest malaria cases with a total of sixty cases while typhoid cases recorded was seven. For the month of August 2015, the recorded cases of malaria dropped to thirty two while that of typhoid was six. In September 2015, twenty nine cases of malaria were recorded while only three cases of typhoid were reported. The month of October 2015 had a record of twenty six malaria cases and seven typhoid cases while November 2015 recorded twenty seven malaria cases and six typhoid cases. In December 2015, the reported malaria and typhoid cases increased to thirty eight and eleven respectively while in January 2016, the reported cases dropped to twenty seven and eight respectively.

February 2016 had twenty seven cases of malaria while six cases of typhoid were reported. In March 2016, the malaria cases dropped to twenty one while typhoid cases maintained six cases while in April 2016, malaria cases increased to twenty nine and typhoid cases were ten. In May 2016, the incidence of malaria rose to forty three while typhoid rose to thirteen and in June 2016, malaria cases dropped to thirty six and typhoid eight.

Table 5.13 Data on Monthly Record of Flood Related Ailments

Month/year	**Plasmodiasis Malaria**	**Salmonellosis typhoid**
Jan, 2014	9	4
Feb, 2014	17	10
March, 2014	20	13
April, 2014	12	7
May, 2014	12	5
June, 2014	16	8
July, 2014	11	7
Aug, 2014	13	5
Sept, 2014	11	3
Oct, 2014	6	3
Nov, 2014	14	7
Dec, 2014	14	10
Jan, 2015	18	13
Feb, 2015	16	10
March, 2015	20	7
April, 2015	33	10
May, 2015	26	9
June, 2015	37	5
July, 2015	60	7
Aug, 2015	32	6
Sept, 2015	29	3
Oct, 2015	26	7
Nov, 2015	27	6
Dec, 2015	38	11
Jan, 2016	27	8
Feb, 2016	27	6
March, 2016	21	6
April, 2016	29	10
May, 2016	43	13
June, 2016	36	8

Source: Researcher's field analysis of Hospital Records, 2016

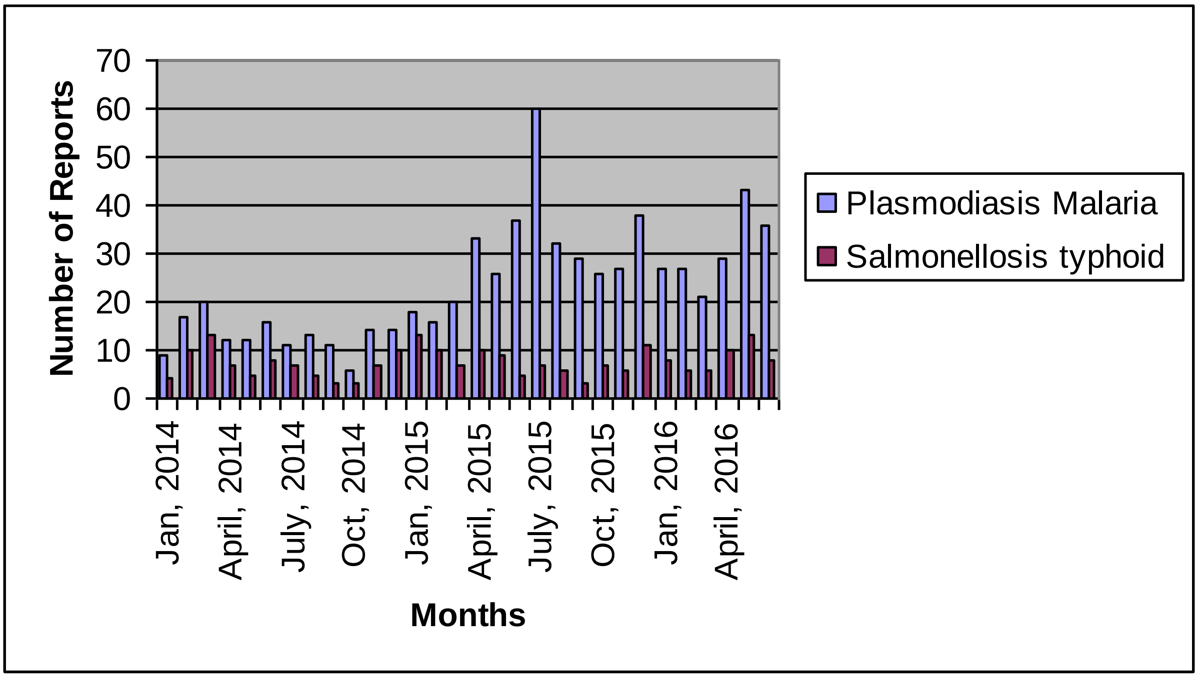

Fig 5.4 Monthly records of Flood Related Ailments (2014-2016)

From Table 5.14, the data showed that July, 2015 has the highest record of Malaria with a total number of sixty (60) cases while October, 2014 has the least number of Malaria cases with only six (6) patients being recorded. It will also be noted that in general, more malaria cases were recorded in the year 2015 than the previous and subsequent years.

Table 5.14 Table of incidence of Malaria in the Study Area

Month/year	Plasmodiasis (Malaria)
Jan, 2014	9
Feb, 2014	17
March, 2014	20
April, 2014	12
May, 2014	12
June, 2014	16
July, 2014	11
Aug, 2014	13
Sept, 2014	11
Oct, 2014	6
Nov, 2014	14
Dec, 2014	14
Jan, 2015	18
Feb, 2015	16
March, 2015	20
April, 2015	33
May, 2015	26
June, 2015	37
July, 2015	60
Aug, 2015	32
Sept, 2015	29
Oct, 2015	26
Nov, 2015	27
Dec, 2015	38
Jan, 2016	27
Feb, 2016	27
March, 2016	21
April, 2016	29
May, 2016	43
June, 2016	36

Source: Researcher's field analysis of Hospital Records, 2016

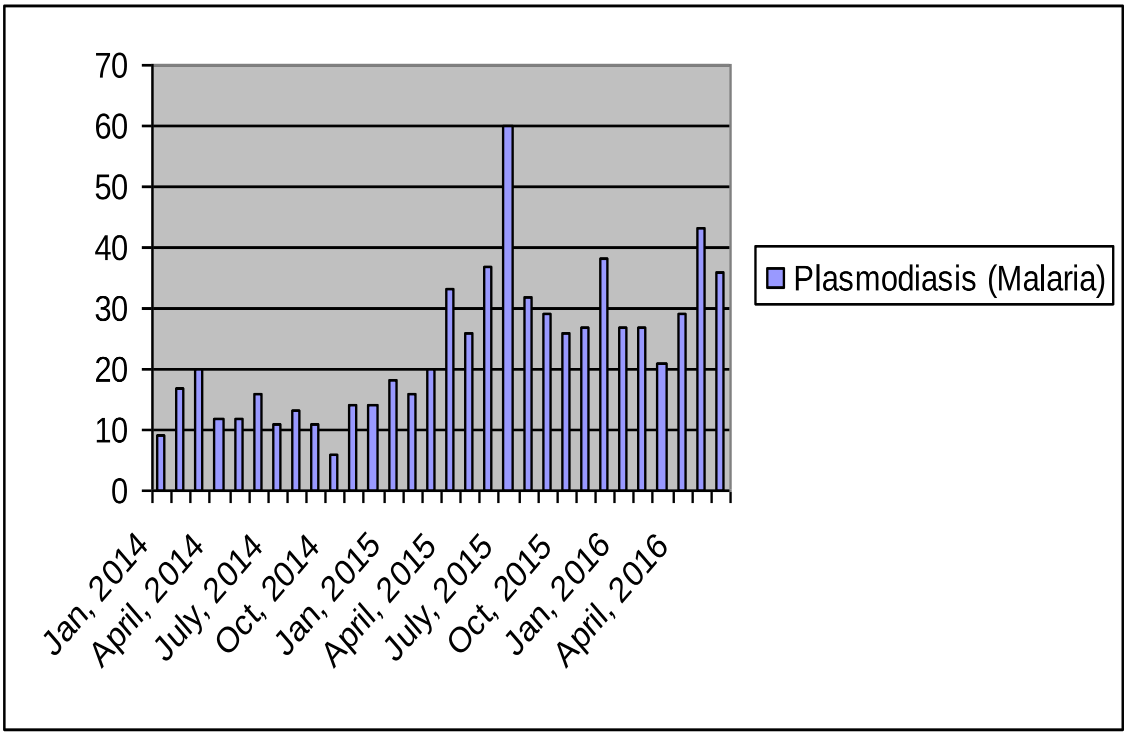

Fig.5.5 Graph of Malaria prevalence over the study period.

Table 5.15 shows the incidence of typhoid in the study area as recorded by the hospital present in the study area. From the table it will be noticed that the highest number of incidence which is thirteen (13) cases was recorded for the months of March 2014, January 2015 and May 2016 while the least number of incidence which is three (3) was recorded for the months of September and October, 2014 and September 2015.

Table 5.15 Table of incidence of Typhoid in the Study Area

Month/year	Salmonellosis (typhoid)
Jan, 2014	4
Feb, 2014	10
March, 2014	13
April, 2014	7
May, 2014	5
June, 2014	8
July, 2014	7
Aug, 2014	5
Sept, 2014	3
Oct, 2014	3
Nov, 2014	7
Dec, 2014	10
Jan, 2015	13
Feb, 2015	10
March, 2015	7
April, 2015	10
May, 2015	9
June, 2015	5
July, 2015	7
Aug, 2015	6
Sept, 2015	3
Oct, 2015	7
Nov, 2015	6
Dec, 2015	11
Jan, 2016	8
Feb, 2016	6
March, 2016	6
April, 2016	10
May, 2016	13
June, 2016	8

Source: Researcher's computation from Hospital Records, 2016

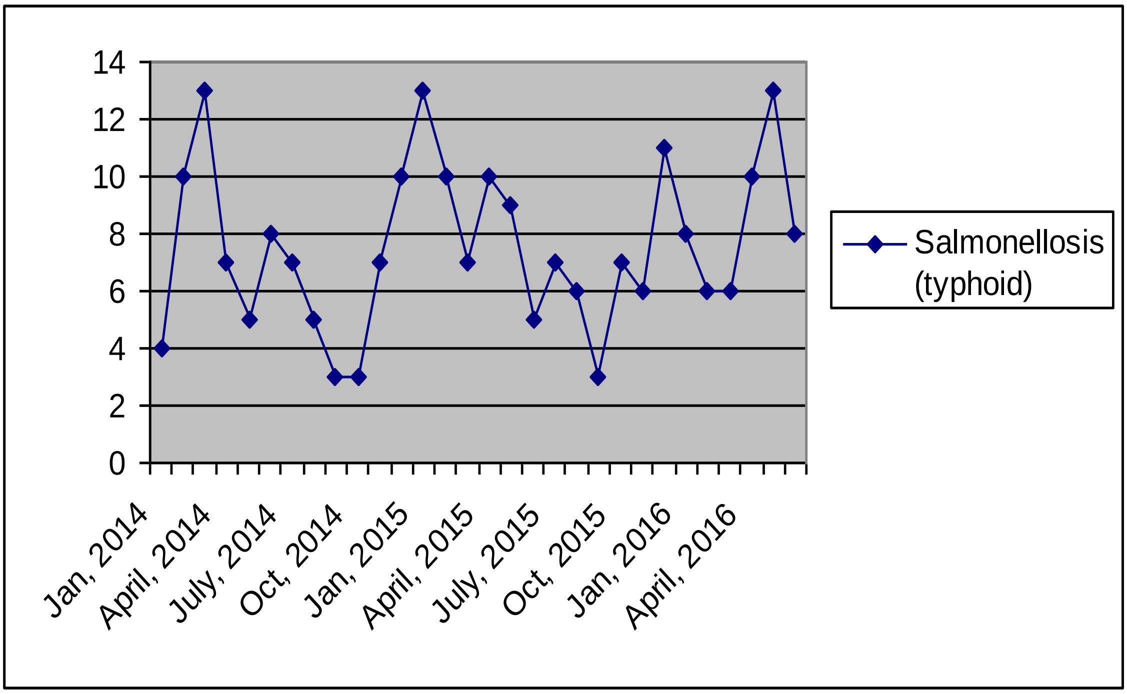

Fig.5.6 Graph of Typhoid prevalence over the study period.

5.2.0 Analysis of Questionnaire Items

In Table 5.16, the weighted-mean was used to analyze the questionnaire items and mean value greater than 3.0 implies agree and less than 3.0 is an indication of disagree. For instance, the weighted-mean of item 59 is 1.1857 which is less than 3.0. This implies that most of the respondents disagree with the statement.

5.2.1 Analysis of Data: This section deals with the analysis of the data collected from the field and other relevant data used in the research.

Table 5.16, shows the effect of deleting an item among the list of items in the questionnaire. Since the values are less than 0.978, it implies all items are necessary in the questionnaire and that any item deleted from the questionnaire will affect its use in decision making.

5.2.2 Testing Hypothesis One (1)

H_O: There is no significant relationship/effect between flood occurrence and damage to environment/ecosystem (displacement of flora and fauna, displacement of settlement, damage to buildings and to other properties).

Items used: For Flood occurrence (1, 3, 4, 7, 8, 10, 11, 12, 13, 16 and 17), the items were rated using weighted-mean and correlated with mean rating of damage to environment/impact (2, 3, 5, 6, 7, 8, 11, 12, 13, 14, and 20). The digits/numbers shown in brackets are are the questionnaire item numbers used on the questionnaire.

Table 5.16 Questionnaire Items Used for Analysis of Ho

S/N	FLOOD	DAMAGE
1	1.65	4.95
2	1.78	4.30
3	2.00	4.74
4	1.98	4.74
5	1.86	4.73
6	1.76	2.74
7	2.00	4.68
8	1.76	2.72
9	1.87	4.74
10	1.76	4.92
11	1.87	2.28

Source: Researcher's computer analysis

To test for significance relationship between variables, correlation or regression analysis can be used. In this study, regression analysis was used.

Interpretation

From the model, flood has direct effect on extent of damage in the study area. This implies increase in rate of flooding would lead to increase in the extent of damage. The model formulated is significant with P-value of 0.046

and the percentage of variation in extent of damage in the location as a result of flooding is 74 percent. Since the model is significant, there exist enough evidence to conclude that there is significant relationship/effect between flood occurrence and damage to environment/ecosystem. Based on this we rejected the null hypothesis and accepted the alternative hypothesis. The alternative hypothesis **(H_1)**is there is a significant relationship/effect between flood occurrence and damage to environmental components (displacement of flora and fauna, displacement of settlement, damage to buildings and to other properties).

Testing Hypothesis Two (2)

H_O: There is no significant relationship/effect between flood occurrence and socio-economic values of society (transport, social life, business activities and infrastructure).

Table 5.17 Questionnaire Items Used for Analysis of Ho

S/N	FLOOD OCCURENCE	SOCIO-ECONOMIC VALUES
1	1.65	4.64
2	1.78	4.64
3	2.00	4.74
4	1.98	4.72
5	1.86	3.00
6	1.76	4.34
7	2.00	4.00

Interpretation

From the model, SOCIO-ECONOMIC VALUES = 1.66 + 1.29 FLOOD

flood has direct effect on extent of damage in the location. This implies increase in rate of flooding would lead to increase in the extent of damage of socio-economic values. The model formulated is significant with P-value of 0.036 and the percentage of variation in extent of damage of socio-economic values in the location as a result of flooding is 71 percent. Since the model is significant, there exist enough evidence to conclude that there is significant relationship/effect between flood occurrence and socio-economic values of society.

Testing Hypothesis Three (3)

H_O: There is no significant effect between flood occurrence and environmental pollution.

Table 5.18 Questionnaire Items Used for Analysis of Ho

S/N	FLOOD	Env. Pollution
1	1.65	4.66
2	1.78	3.78
3	2.00	4.89
4	1.98	3.78
5	1.86	4.89
6	1.76	4.89

Interpretation

From the model,Env Pollution = 5.47 + 0.54 FLOOD, flood has direct effect on environmental pollution occurrence in the study area. This implies increase in rate of flooding would lead to increase in the extent of environmental pollution. The model formulatedis significant with P-value of 0.003 and the percentage of variation in extent of environmental pollution in the location as a result of flooding is 81.7 percent. Since the model is significant, there exist enough evidence to conclude that there is significant effect between flood occurrence and environmental pollution.

Testing Hypothesis Four (4)

H_O: There is no significant effect between flood occurrence and outbreak of disease/ public health.

Table 5.19 Questionnaire Items Used for Analysis of Ho

S/N	FLOOD	Public Health
1	1.65	4.00
2	1.78	4.67
3	2.00	4.00

Since the number of item is not more than 5, the most appropriate statistical tool for the hypothesis is product moment correlation.

Output

Correlations: FLOOD, Public Health

Pearson correlation of FLOOD and Public Health = 0.906
P-Value = 0.006

Interpretation

The correlation value is greater than 0.5 which implies high correlation and the value is positive which can be interpreted as increase in flood leading to increase in challenges of health of the people. The P-value of the correlation is less than 0.05 which implies the correlation value is significant and there exist enough evidence to reject the null hypothesis and conclude that there is significant effect between flood occurrence and outbreak of disease/ public health.

Testing Hypothesis Five (5)

H_O: There is no significant relationship between flood occurrence and loss of agricultural yield/food security (55 to 59).

Table 5.20 Questionnaire Items Used for Analysis of Ho

S/N	FLOOD	Agricultural Loss
1	1.65	4.89
2	1.78	3.00
3	2.00	4.00
4	1.98	5.00
5	1.86	1.186

Since the number of item is not more than 5, the most appropriate statistical tool for the hypothesis is product moment correlation.

Output

Correlations: FLOOD, Agricultural Loss

```
Pearson correlation of FLOOD and Agricultural Loss = 0.998
P-Value = 0.002
```

Interpretation

The correlation value is greater than 0.5 which implies high correlation and the value is positive which can be interpreted as increase in flood leading to increase in the damage on the farmland. The P-value of the correlation is less than 0.05 which implies the correlation value is significant and there exist enough evidence to reject the null hypothesis and conclude that there is significant relationship between flood occurrence and loss of agricultural yield/food security.

The researcher went further to carried out a t-test analysis on hypothesis 1,3 and 5 to determine further if the tested hypothesis should be accepted or rejected. The t-test is presented below.

Table 5.20 B Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Flooding	1.8445	11	.11475	.03460
	Damage	4.1400	11	1.02205	.30816
Pair 2	Flooding	1.8383	6	.13541	.05528
	Environmental pollution	4.4817	6	.55076	.22485
Pair 3	Flooding	1.8540	5	.14519	.06493
	Agricultural	3.61520	5	1.578792	.706057

Table5.20 B presented the paired samples statistics for flood occurrence and damage to environment/ecosystem; flood occurrence and environmental pollution; and then flood occurrence and agricultural loss. It shows that the first average (mean) of flood occurrence is 1.8445; the standard deviation is 0.03460; the mean of damage to environment/ecosystem is 4.1400 and standard deviation of 1.02205.

Then the second mean of flooding is 1.8383 while the standard deviation is

0.13541. The corresponding mean and standard deviation for environmental pollution are 4.4817 and 0.55076 respectively. The other mean and standard deviation for flood occurrence are 1.8540 and 0.14519 respectively. For the agricultural loss, the mean and standard deviation are 3.61520 and 1.578972 respectively.

Table 20 C Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Flooding & Damage	11	.205	.546
Pair 2	Flooding & Environmental pollution	6	-.132	.803
Pair 3	Flooding & Agricultural	5	.002	.998

Table 20C shows the correlations between flooding and damage to environment; flooding and environmental pollution and then flooding and agricultural loss. From the table, we see that the correlation are 0.205, -0.132 and 0.002; with sig. (p – values) of 0.546, 0.803 and 0.998 respectively. This means that none of the correlations is significant, that is no significant correlation exists among each pair of observation.

Table 20 D Paired samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Flooding – Damage	-2.29545	1.00485	.30297	-2.97052	-1.62039	-7.576	10	.000
Pair 2	Flooding - Environmental pollution	-2.64333	.58425	.23852	-3.25646	-2.03020	-11.082	5	.000
Pair 3	Flooding – Agricultural	-1.761200	1.585209	.708927	-3.729497	.207097	-2.484	4	.068

Hypothesis: The hypotheses include

H_O: There is no significant relationship/effect between flood occurrence and damage to environmental components.

H_O: There is no significant effect between flood occurrence and environmental (water) contamination.

H_O: There is no significant relationship between flood occurrence and loss of agricultural yield/food security.

Statistical tool: Paired samples T – Test.

Reason for choice of tool: Two related levels of observations were compared.

Decision Rule: Accept the null hypothesis if the p – value is greater than or equal to 0.05, otherwise, reject the null hypothesis.

Decision, Conclusion and Reason: From the table, since the p – value is 0.000, less than 0.05, it willbeconcluded that there is significant difference between flood occurrence and damage to environment/ecosystem (displacement of flora and fauna, displacement of settlement, damage to buildings and to other properties). In the same way, there is significant difference between flood occurrence and environmental pollution. This is because the p – value is 0.000, which is less than 0.05. But as for whether there is significant difference between flood occurrence and agricultural loss, there is none since the p – value is 0.068, which is greater than 0.05.

Hypothesis 2 and 4 were further subjected to correlation analysis to further determine their validity.

Table 20 E Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Flooding	1.8614	7	.13789	.05212
	Socio-economic values	4.2971	7	.63018	.23818
Pair 2	Flooding	1.8100	3	.17692	.10214
	Public health	4.2233	3	.38682	.22333

Table 20 F Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Flooding & Socio-economic values	7	-.062	.894
Pair 2	Flooding & Public health	3	-.147	.906

Table 20 G Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Flooding - Socio-economic values	-2.43571	.65345	.24698	-3.04005	-1.83138	-9.862	6	.000
Pair 2	Flooding - Public health	-2.41333	.44837	.25887	-3.52714	-1.29953	-9.323	2	.011

Hypothesis:

H_O: There is no significant relationship/effect between flood occurrence and the disruption of the socio-economic activities of society.

H_O: There is no significant effect between flood occurrence and outbreak of disease.

Statistical tool: Paired samples T – Test.

Reason for choice of tool: Two related levels of observations were compared.

Decision Rule: Accept the null hypothesis if the p – value is greater than or equal to 0.05, otherwise, reject the null hypothesis.

Decision, Conclusion and Reason: From the table, since the p – value is 0.000, less than 0.05, it willbeconcluded that there is significant difference between flood occurrence and socio-economic values of the society (transport, social life, business activities and infrastructure).

In the same way, there is significant difference between flood occurrence and public health. This is because the p – value is 0.011, which is less than 0.05.

Principal component analysis on causes of flood

From the Principal component analysis (as shown in appendix III), three components were extracted. The first component extracted has 51.771% of the total variance; the second component extracted has 35.786% of the variance while the third component extracted has 10.304% of the variance. The cumulative variance of the three components extracted is 97.861%. Variables extracted by the first component will be regarded as the major cause, followed by those extracted by the second and then the third component.

Explanation of the Rotated Component Matrix for causes of flood

Table 20 H Rotated Component Matrix for causes of flood

	Component		
	1	2	3
Soil Type	.969	.107	-.126
Topography	.957	-.050	-.172
Rainfall intensity	.866	-.409	-.204
Rainfall duration	.847	-.521	-.091
Lack of planning	-.190	.964	.093
Land use type	-.369	.062	.919
Increase in synthetic surfaces	-.703	.686	.127
Nearness to river	.901	-.409	-.066
Deforestation	.013	.936	.328
Land cover type	-.353	.926	-.127
Degree of urbanization	-.365	.826	-.429
Flow direction	.887	-.341	-.242
Ground water level	.941	-.309	.058

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

From the Table of the rotated component matrix (Table 20 H), the following variables have high loadings on the first component, they are: soil type, topography, rainfall intensity, rainfall duration, increase in synthetic surfaces, nearness to river, flow direction and ground water level. Then, the following variables loaded high in the second component, they are: lack of planning, deforestation, land cover type, and degree of urbanization. Finally, only land use type was extracted by the third component. This means that it is the least of the causative factors, while soil type which has the highest value as extracted by the first component is the highest causative factor.

Principal Component Analysis for Effects of Flood on the Environment

Table 5.21 Communalities(Effects of flood on the environment)

	Initial	Extraction
Loss of life	1.000	.249
Destruction of farmland	1.000	.927
Loss of properties (electronics, clothes etc)	1.000	.927
Disruption of transportation	1.000	.392
Disruption of social activities	1.000	.994
Disruption of religious activities	1.000	.990
Disruption of economic activities/ businesses	1.000	.962
Contamination/pollution of domestic/surface water	1.000	.993

Extraction Method: Principal Component Analysis.

From Table 5.22 (total variance explained), only one component was extracted and the cumulative percentage which it accounted for is 80.426% as can be seen.

Table 5.22 Total Variance Explained(effects of flood)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.434	80.426	80.426	6.434	80.426	80.426
2	.881	11.008	91.434			
3	.682	8.522	99.956			
4	.004	.044	100.000			
5	1.289E-15	1.612E-14	100.000			
6	1.803E-17	2.253E-16	100.000			
7	-1.690E-16	-2.113E-15	100.000			
8	-2.220E-16	-2.776E-15	100.000			

Extraction Method: Principal Component Analysis.

Since only one component was extracted, there was no rotated component matrix. So, from Table of component matrix (in appendix), it will be noticed that of all the variables, loss of life had a very low loading of -0.499 which is below 0.5 (0.5 is the minimum accepted). Then for the others, Disruption of social activities and Contamination/pollution of domestic/surface water are the highest effects, Disruption of religious activities follows, then Disruption of economic activities/ businesses after which Destruction of farmland and Loss of properties (electronics, clothes etc) come next and have the same effect, and the least is disruption of transportation

Table 5.23 Component Matrix[a]

	Component
	1
Loss of life	-.499
Destruction of farmland	.963
Loss of properties (electronics, clothes etc)	.963
Disruption of transportation	.626
Disruption of social activities	.997
Disruption of religious activities	.995
Disruption of economic activities/ businesses	.981
Contamination/pollution of domestic/surface water	.997

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Principal Component Analysis for Diseases/ailments

Table 5.24 Communalities (diseases/ailments)

	Initial	Extraction
Typhoid	1.000	.966
Dysentery	1.000	.869
Schoitomaisis	1.000	.610
Malaria	1.000	.983

Extraction Method: Principal Component Analysis.

From table 5.25 (total variance explained), only one component was extracted and the cumulative percentage which it accounted for is 85.690% as can be seen.

Table 5.25 Total Variance Explained(diseases/ailments)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.428	85.690	85.690	3.428	85.690	85.690
2	.513	12.826	98.516			
3	.055	1.381	99.898			
4	.004	.102	100.000			

Extraction Method: Principal Component Analysis.

5.26 Component Matrix[a] (diseases/ailments)

	Component
	1
Typhoid	.983
Dysentery	-.932
Schoitomaisis	-.781
Malaria	.991

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Since only one component was extracted, there was no rotated component matrix. So, from the component matrix above, we see that all the four variables had high loadings, but the highest was Malaria, followed by typhoid, dysentery and finally Schoitomaisis.

5.2.2 Trend Analysis of Occurrence of Diseases

From the trend analysis of malaria over the thirty months period, as shown in Figure 5.5, it was noticed that October, 2014 has the least incidence of malaria while July, 2015 has the highest prevalence value. The trend analysis shows that the occurrence of malaria is increasing steadily even though the plot of the records shows a fluctuation in monthly occurrence. After the highest incidence in the month of July, 2015, the incidence dropped but did not drop to below the initial month of January, 2014.

Interpretation: The analysis shows increase in the trend of malaria in the region.

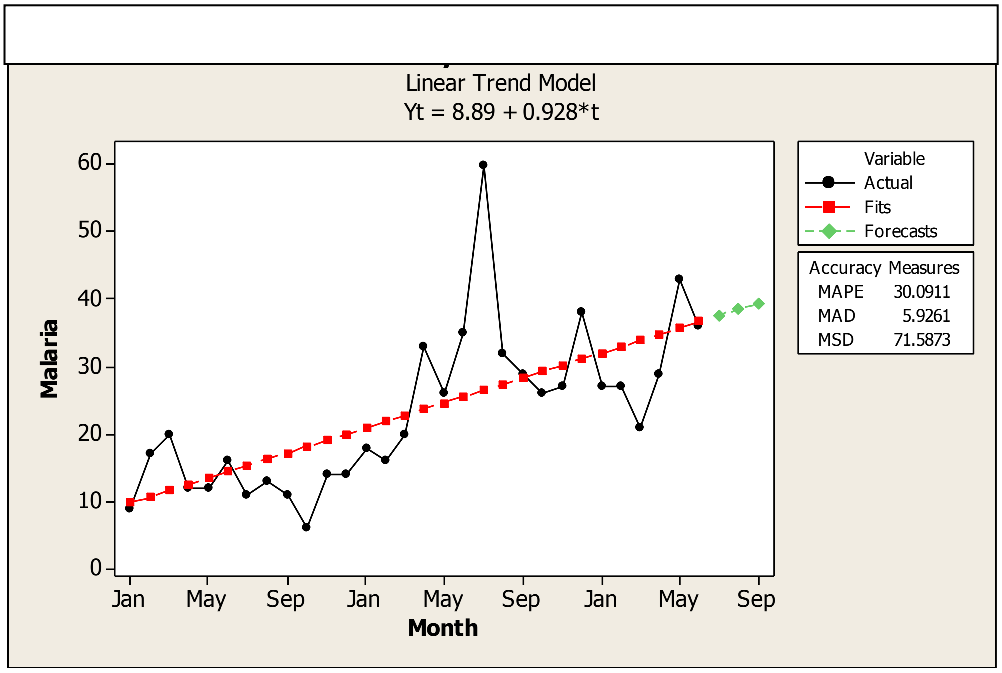

Fig.5.7A Trend Analysis For Malaria Over A Thirty Month Period,
Source: Researcher Computer analysis, 2016

Forecasts

Period	**Forecast**
Jul	37.6460
Aug	38.5737
Sep	39.5014

The researcher did a monthly mean trend analysis after getting the various monthly mean occurrences of malaria from January to December. The trend is shown in figure 5.7B. The trend showed that the month with the highest mean occurrence of malaria is July which coincides with the peak of rainy season in the study area,

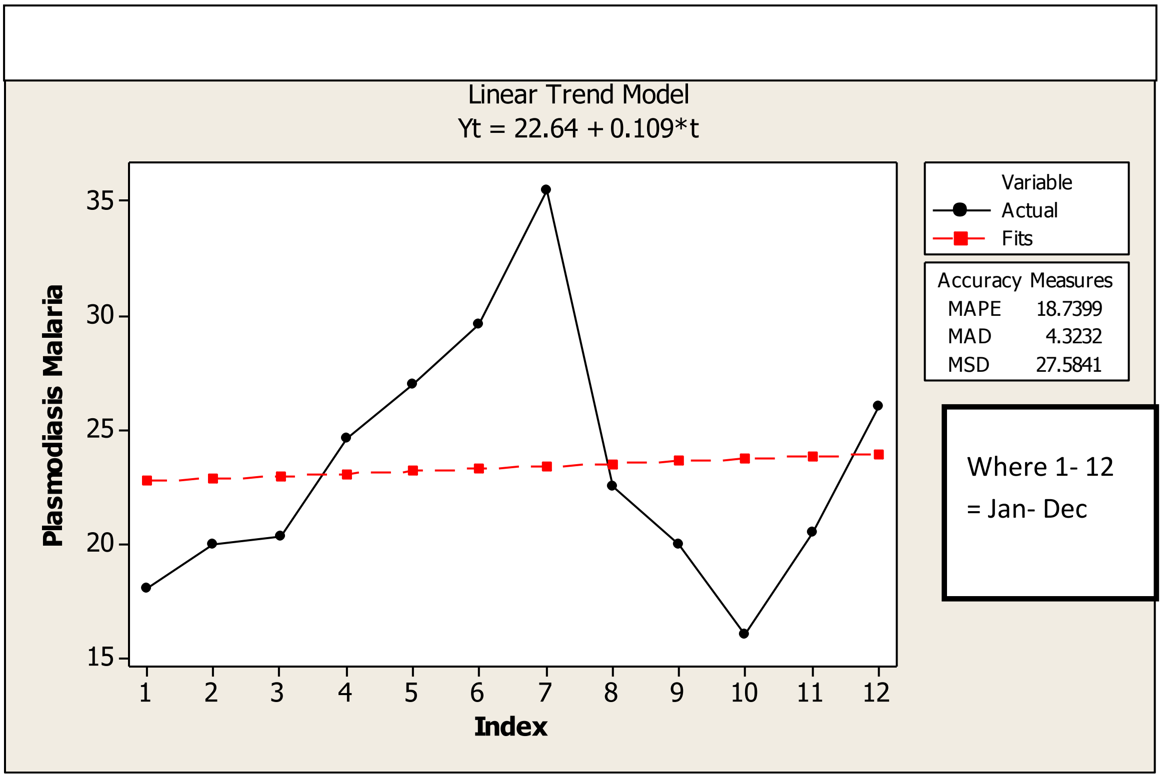

Fig.5.7B Monthly Mean Trend Analysis For Malaria
Source: Researcher Computer analysis, 2016

Plasmodiasis Malaria

Quadratic regression

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.249	.062	-.007	11.981

The independent variable is Month/year.

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	**256.688**	**2**	**128.344**	**.894**	**.421**
Residual	**3875.979**	**27**	**143.555**		
Total	**4132.667**	**29**			

The independent variable is Month/year.

This is the ANOVA table was used to know if the model is good or not. From the table, we see that the significance (p – value) is 0.421. This means that the model is not significant, and will not be used sufficiently to make further predictions in the work.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Month/year	**3.641**	**2.723**	**1.055**	**1.337**	**.192**
Month/year ** 2	**-.270**	**.208**	**-1.022**	**-1.295**	**.206**
(Constant)	**14.367**	**7.389**		**1.944**	**.062**

The model, that is the polynomial (quadratic) trend of malaria occurrence is given by: $Yt = 14.367 + 3.641t - 0.270t^2$.

From figure 5.7C, it was noticed that the poly trend of malaria occurrence showed a normal gentle curve but the distribution of malaria occurrence on the two sides of the curve (on top and below) does not show equal occurrence/ distribution.

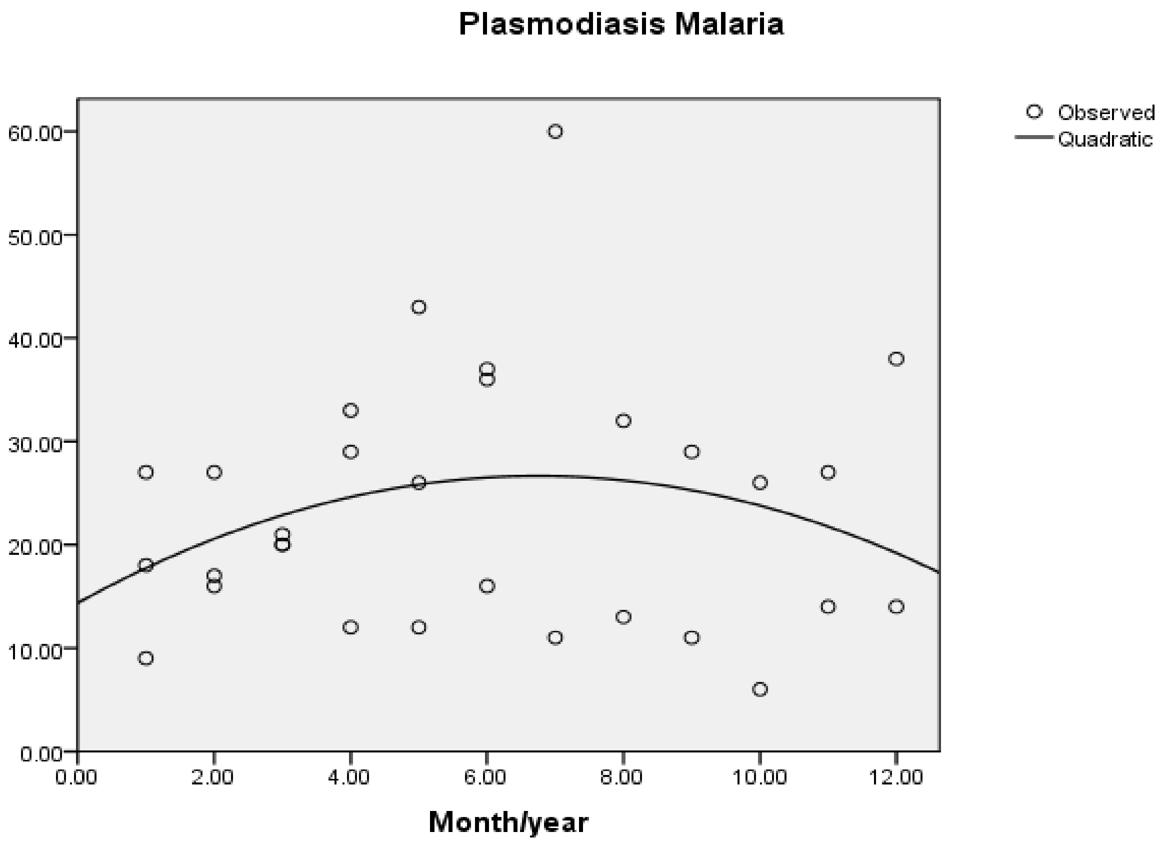

Figure 5.7C Poly trend of malaria in the study area

Source: Researcher's computation,2016

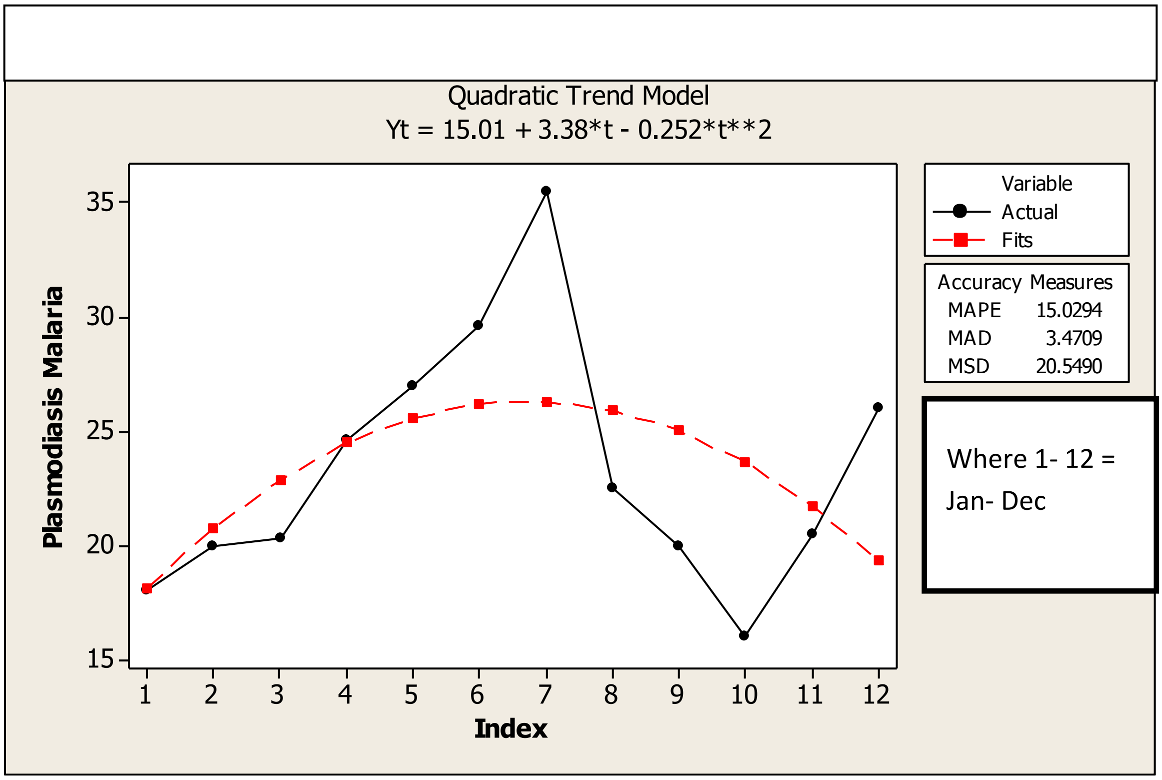

Figure 5.7D Poly trend of malaria and average monthly occurrence of malaria in the study area

Source: Researcher's computation,2016

TREND ANALYSIS FOR TYPHOID

From the trend analysis of typhoid, it was noticed that the months of March, 2014, January, 2015 and May, 2016, have the highest cases of occurrence of Typhoid in the study area while the the months with the least occurrence are the months of September,2014, October, 2014 and September,2015. In the first year (2014), there is a wide variation in the degree of prevalence while in the 2015, the degree of prevalence does not show much variation. It was equally noticed that there is always an increase in occurrence in the months considered to be dry with each year (that is the months of January, February, November and December).

Interpretation: The trend of malaria in the region is higher than that of typhoid. This implies malaria is more common than typhoid despite the flooding. But it should be noted that typhoid also has a very slight upward trend.

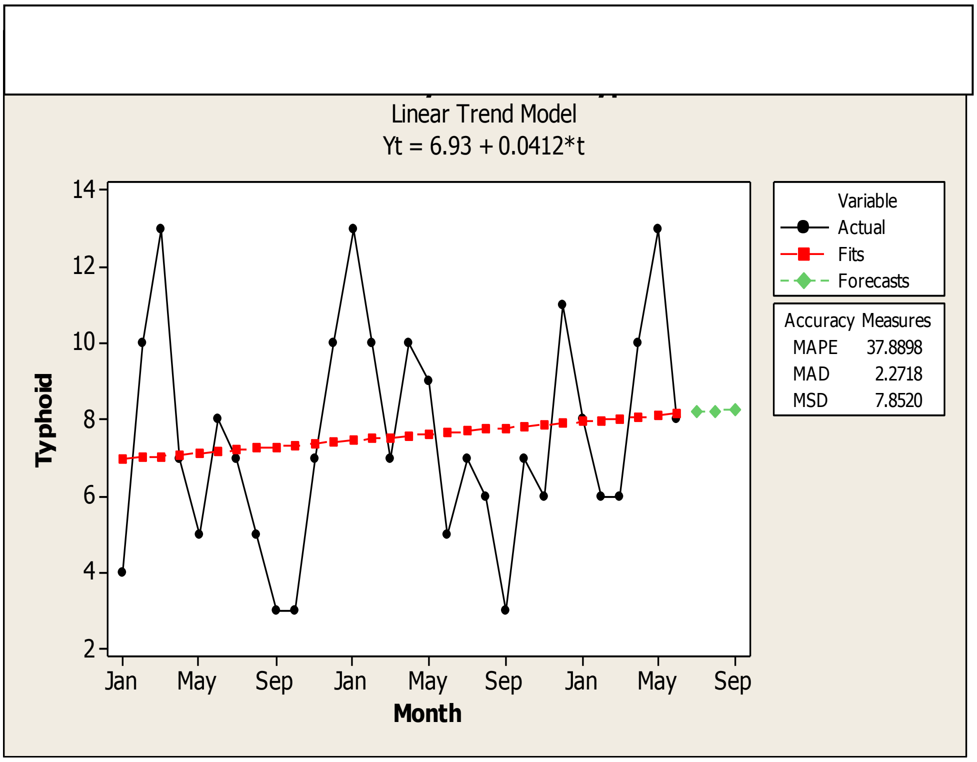

Fig.5.8A **Trend Analysis For Typhoid Over A Thirty Month Period**

Source: Researcher Computer analysis, 2016

Forecasts

Period	**Forecast**
Jul	8.20460
Aug	8.24575
Sep	8.28691

The researcher did a monthly mean trend analysis for typhoid after getting the various monthly mean occurrences of typhoid from January to December. The trend is shown in figure 5.8B. The trend showed that the month with the highest mean occurrence of typhoid is December while the month with the least occurrence is September.

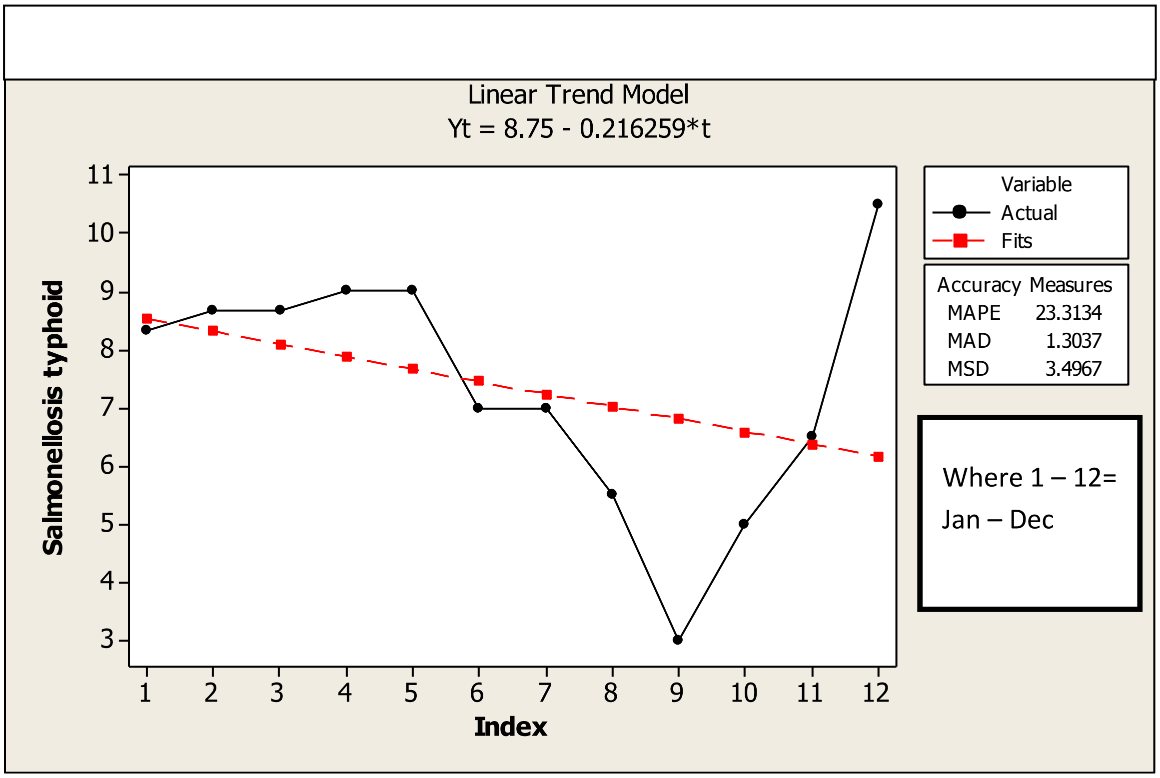

Fig.5.8B Mean Monthly **Trend Analysis For Typhoid**

Source: Researcher Computer analysis, 2016

Salmonellosis typhoid

Quadratic regression

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.353	.125	.060	2.785

The independent variable is Month/year.

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	29.910	2	14.955	1.928	.165
Residual	209.457	27	7.758		
Total	239.367	29			

The independent variable is Month/year.

This is the ANOVA table was used to know if the model is good or not. From the table, we see that the significance (p – value) is 0.165. This means that the model is not significant, and will not be used sufficiently to make further predictions in the work.

Coefficient

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Month/year	-.974	.633	-1.173	-1.539	.135
Month/year ** 2	.059	.048	.920	1.208	.238
(Constant)	10.603	1.718		6.173	.000

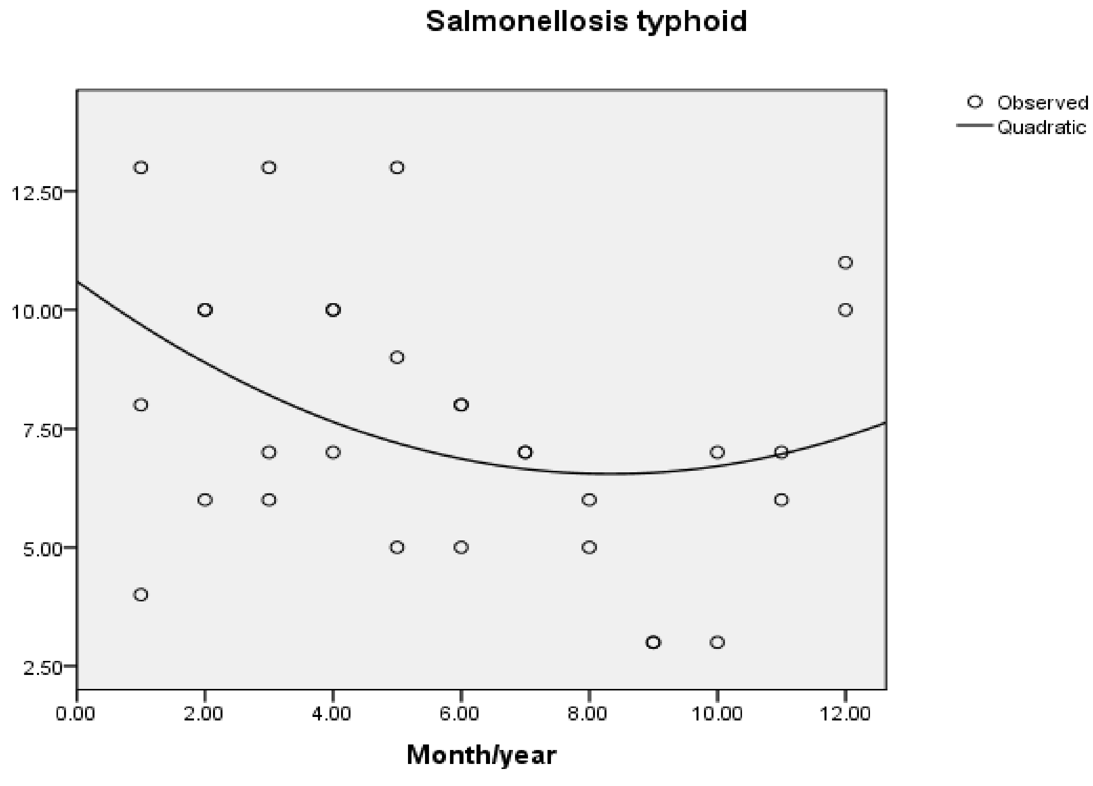

Figure 5.8C Poly trend of Typhoid in the study area

Source: Researcher's computation,2016

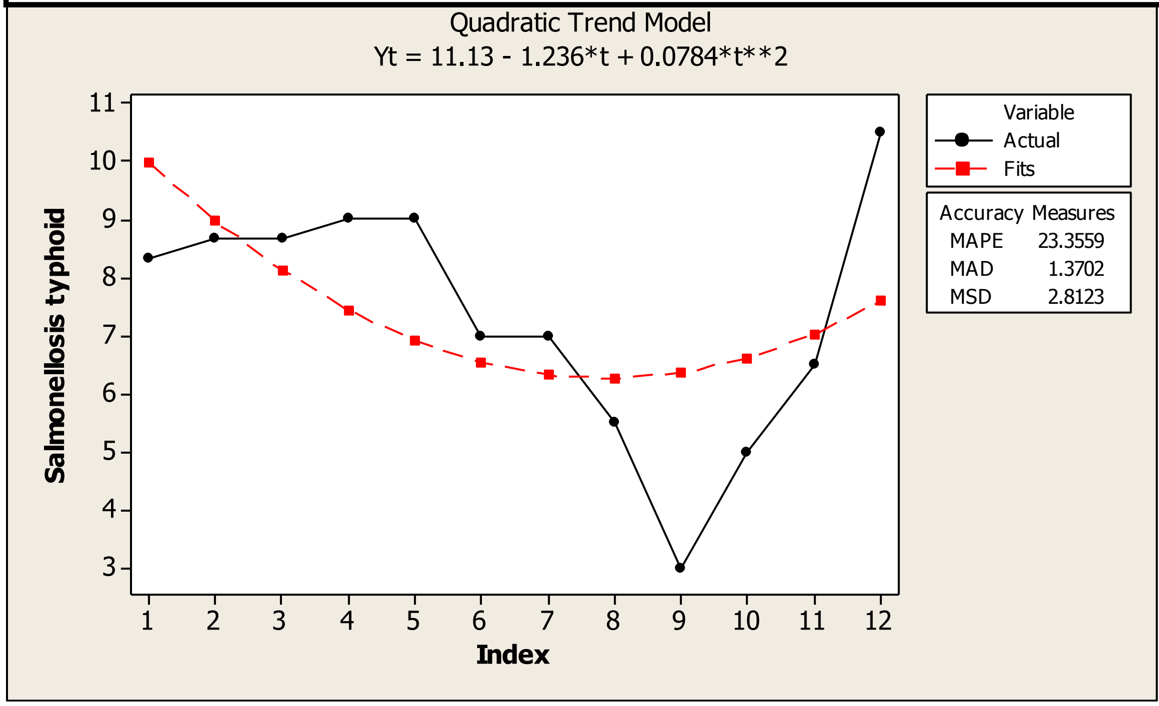

Figure 5.8D Poly trend of typhoid and the mean monthly trend of typhoid in the study area

Source: Researcher's computation,2016

5.3 SATELITE IMAGE ANALYSIS

a) Image Processing:

Remotely sensed data used for this assessment is the Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model (otherwise known as ASTER GDEM-V2) data of 2011, obtained from the United States Geological Survey (USGS) website (www.earthexplorer.usgs.gov). The ASTER GDEM data was preprocessed and resampled to 30 meters. This data aided the computation of slope and digital elevation model (DEM) of the area in a Geographic Information

System (GIS) environment. ArcGIS 10.5 software was deployed for this activity. The flow chart used for the GIS analysis is presented in Chapter four.

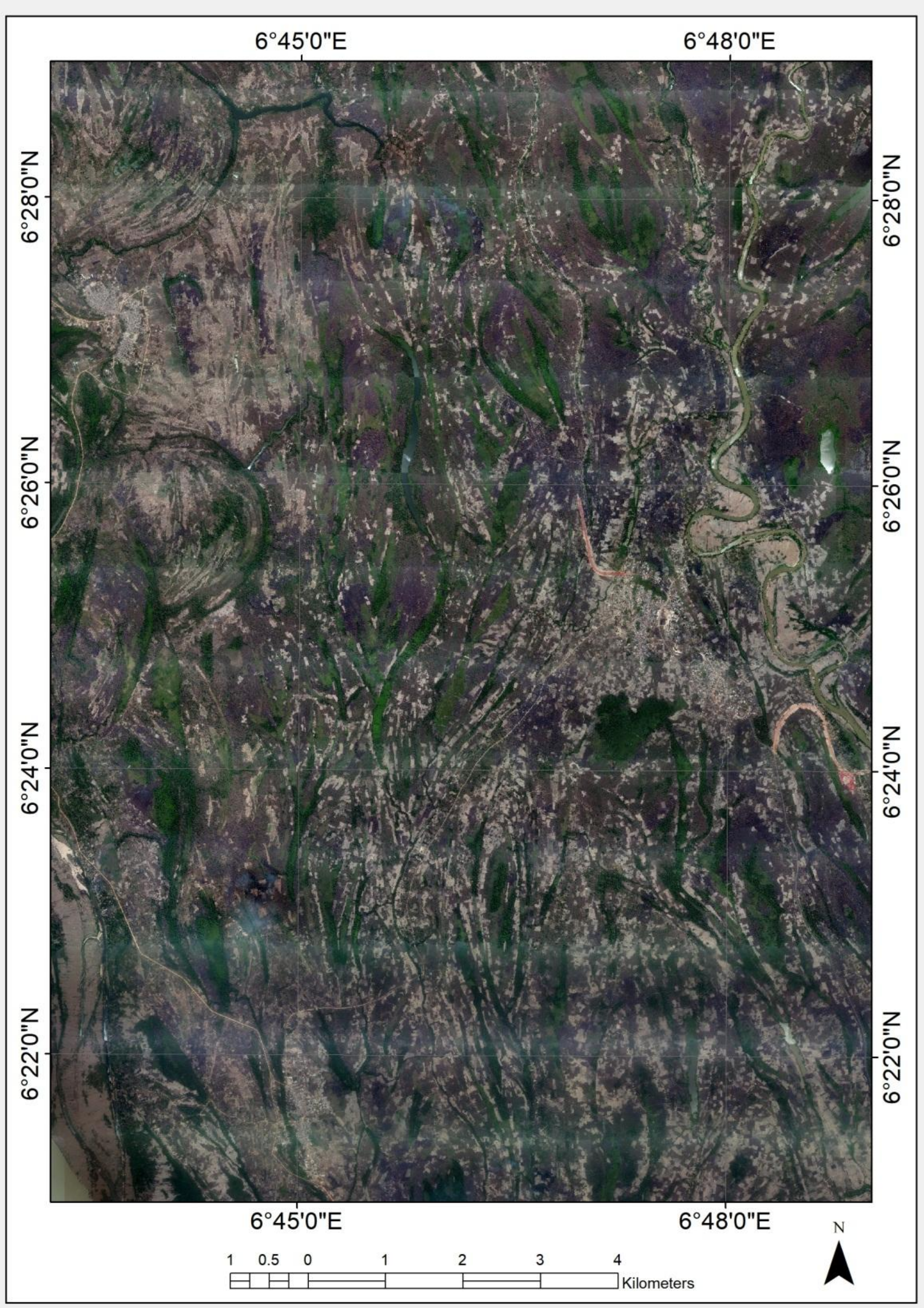

Figure 5.9 Satellite Image of Anambra West L.G.A
Source: Surveying and Geoinformatics Dept, NAU, Awka.

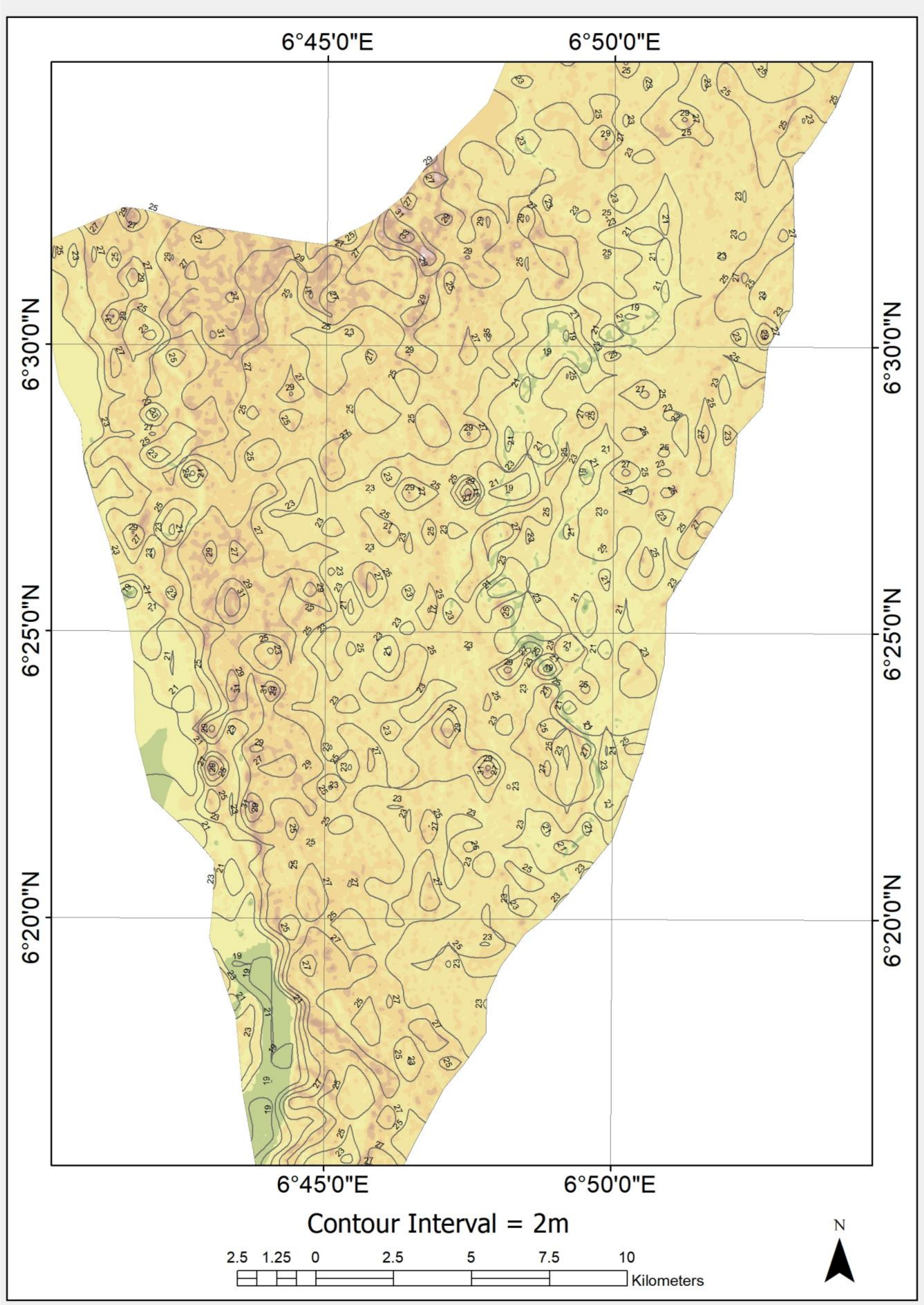

Figure 5.10 Contour Map of Anambra West L.G.A.
Source: Surveying and Geoinformatics Dept, NAU, Awka.

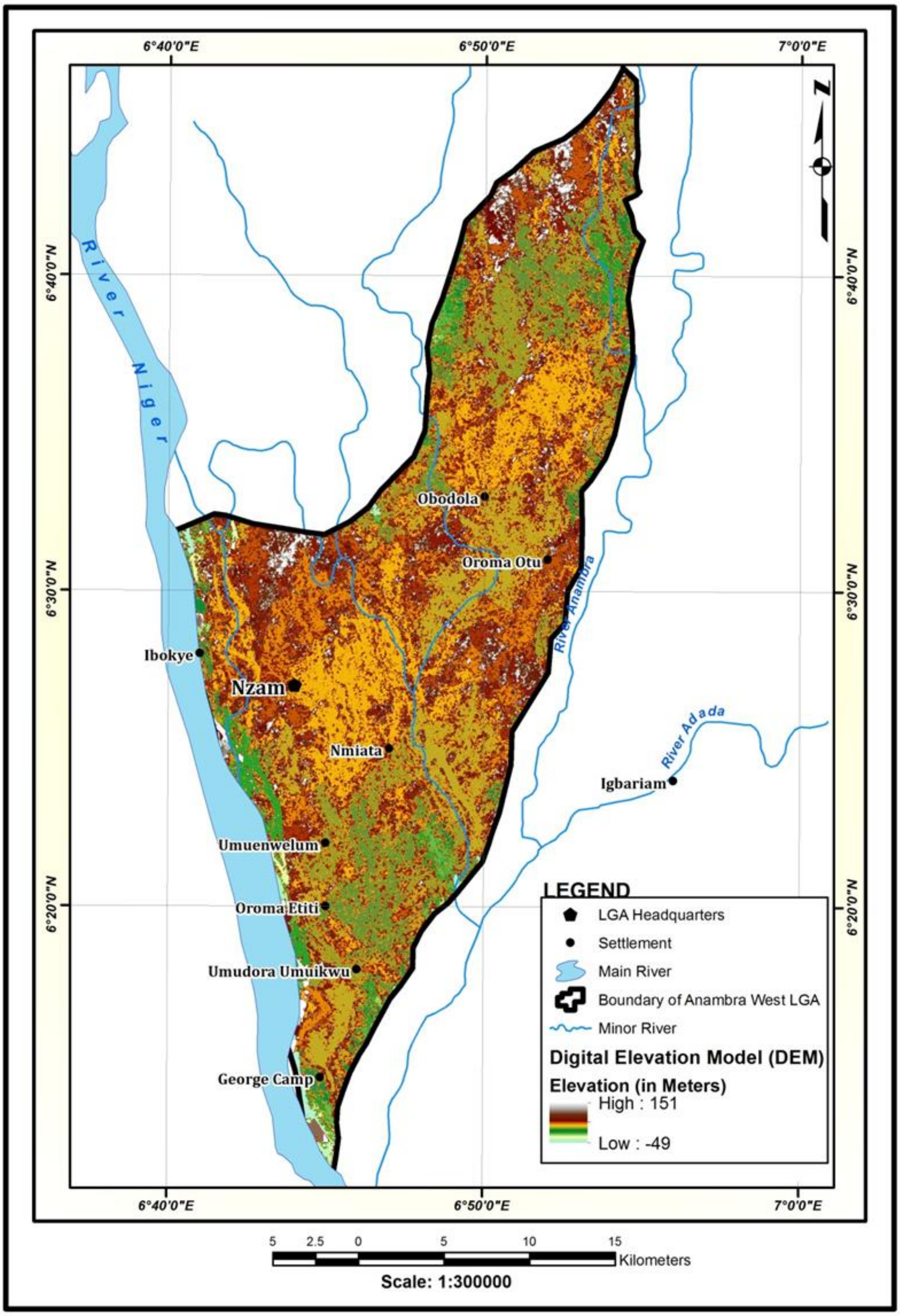

Figure 5.11: Digital Image of Anambra West L.G.A.
Source:ASTER GDEM-V2 data of 2011

From figure 5.11 which is the Digital Elevation Model of Anambra West L.G.A., it was noticed that the elevation of Anambra West falls above -49 meters to 151meters, with most of the central area (areas having the yellowish colour falling with the height of 51 meters. This elevation is not very favorable for an area situated around a river bank such as Ibokye, George Cap and Orama Etiti.

b) Spatial Analysis Techniques :

The hydrological analysis like the flowdirection, flow accumulation and stream networks were used to determine areas with high or low water accumulation rate and its tributaries. The analysis of the inundations areas was conducted by generating watershed map of the study area. The watershed map determines the spatial coverage or extent of areas liable for flooding in the event of overflow especially at the confluence. Surface Analysis was carried out to determine the slope, contour and TIN (Triangulated Irregular Network) of the study area.

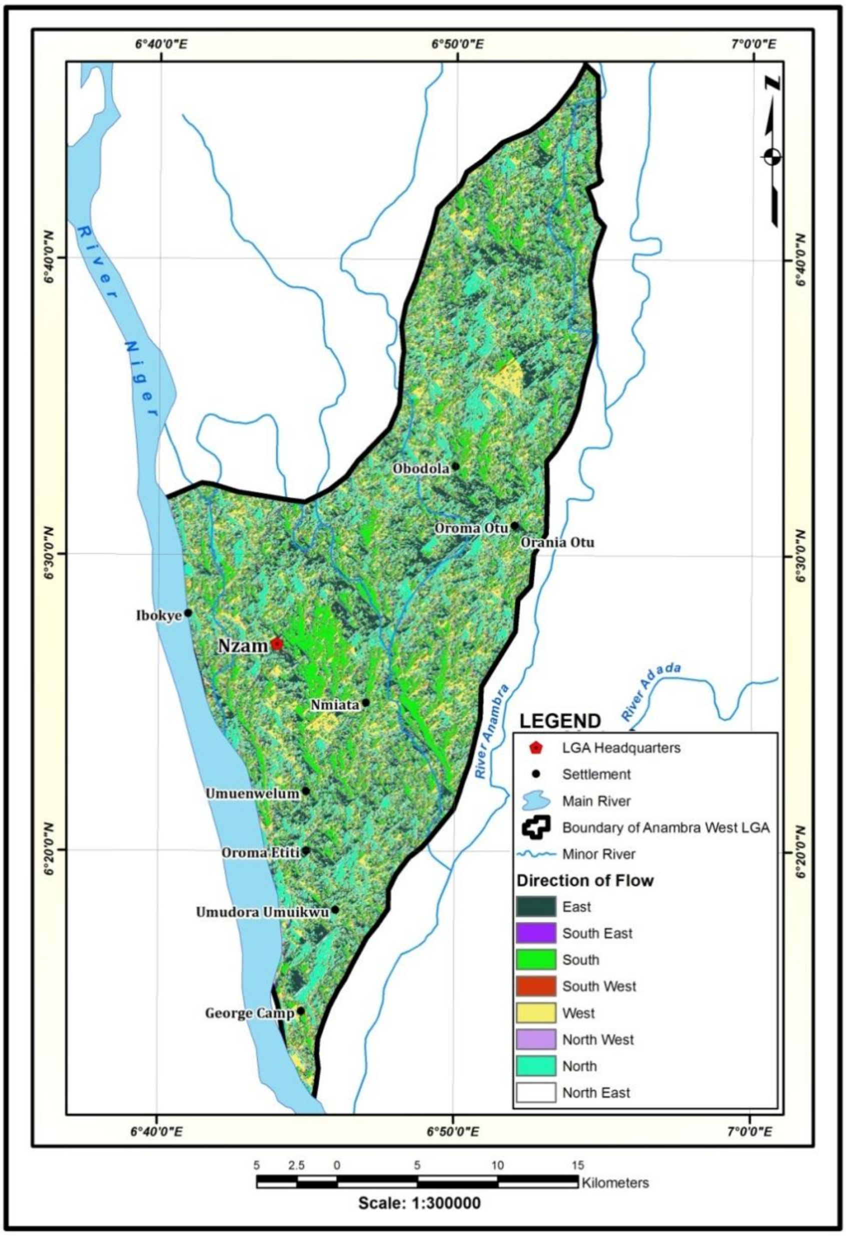

Figure 5.12: Flow Direction Map of Anambra West L.G.A.
Source: ASTER GDEM-V2 data of 2011

From flow direction map as shown in figure 5.12, it was noticed that more of the area within the study area (areas that appear in green) always have water flowing into/to the area after every rain or during flood occurrence. This implies that most of the water within the water watershed flows to the south. This could result in the area experiencing frequent inundation more than other areas.

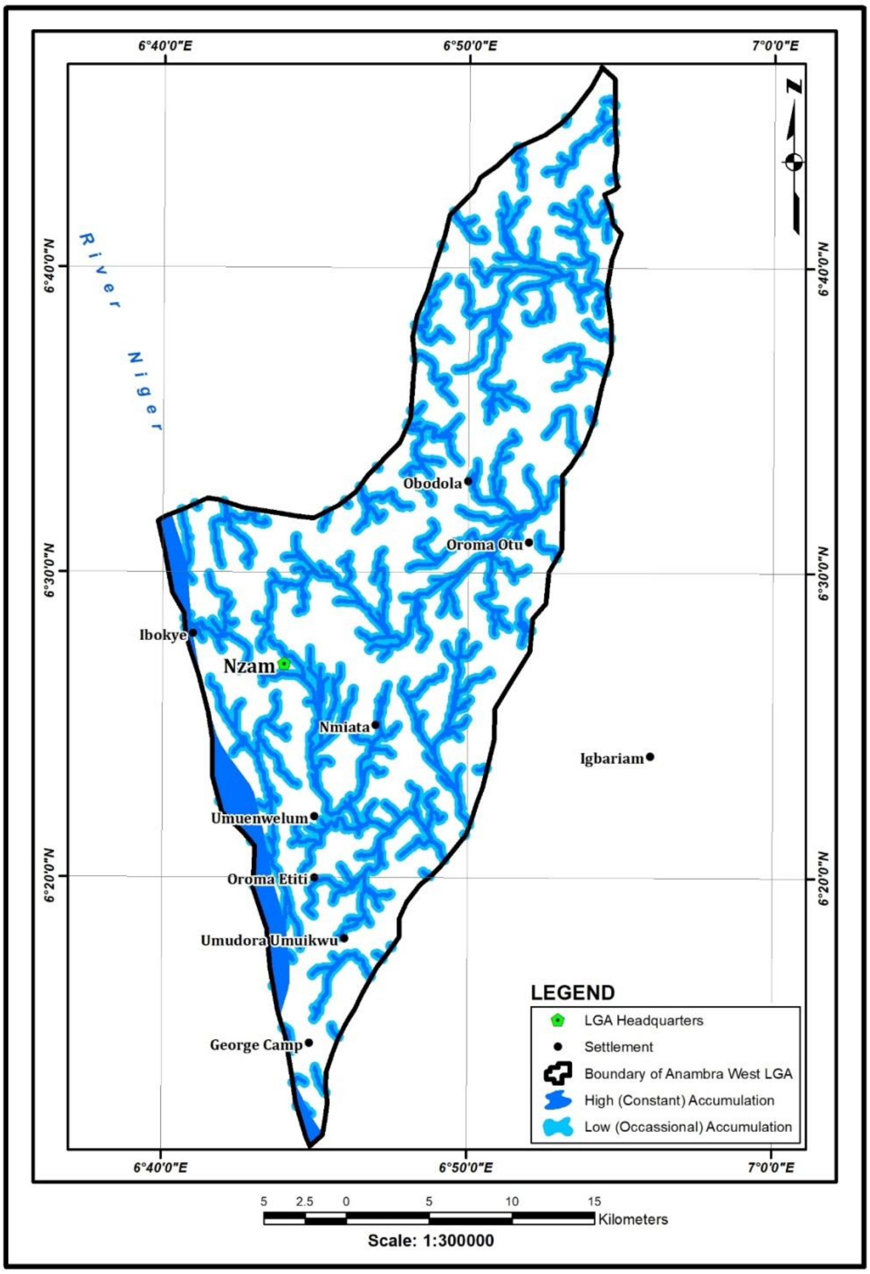

Figure 5.13 A: Flow Accumulation Map of Anambra West L.G.A

Source: ASTER GDEM-V2 data of 2011

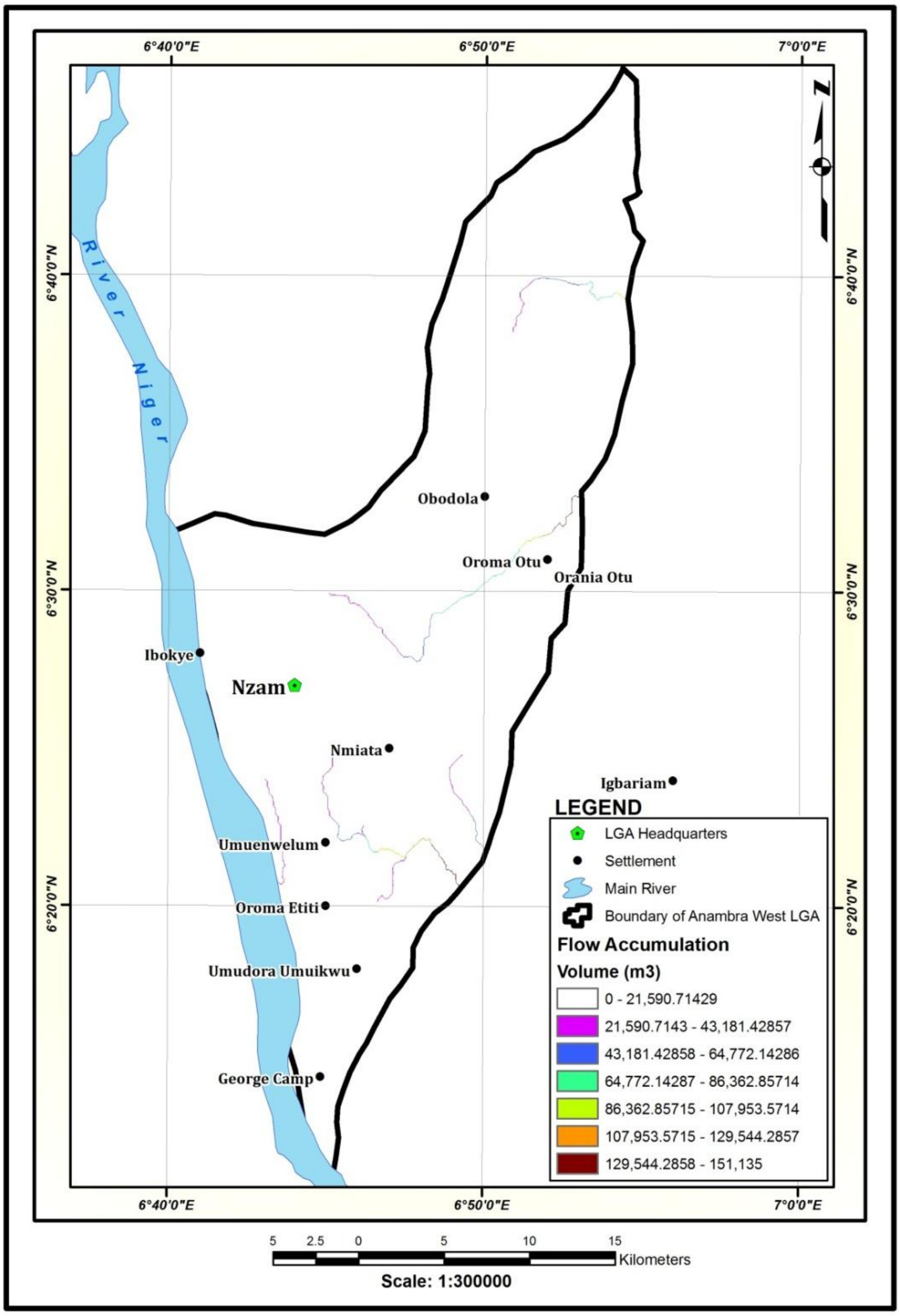

Figure 5.13 B: Flow Accumulation Map of Anambra West L.G.A
Source: ASTER GDEM-V2 data of 2011

From figure 5.13, it was noticed that water accumulates in most part of the Local Government**.** This results in flood water accumulation and as such the flood occurrence in most parts of the L.G.A., but the accumulation within the area of study and the L.G.A. as a whole ranges between 0 to 21,590 cubic meters as can be seen from figure 5.3. The presence of the streams/ rivers within the L.G.A. also has an effect on the flow accumulation.

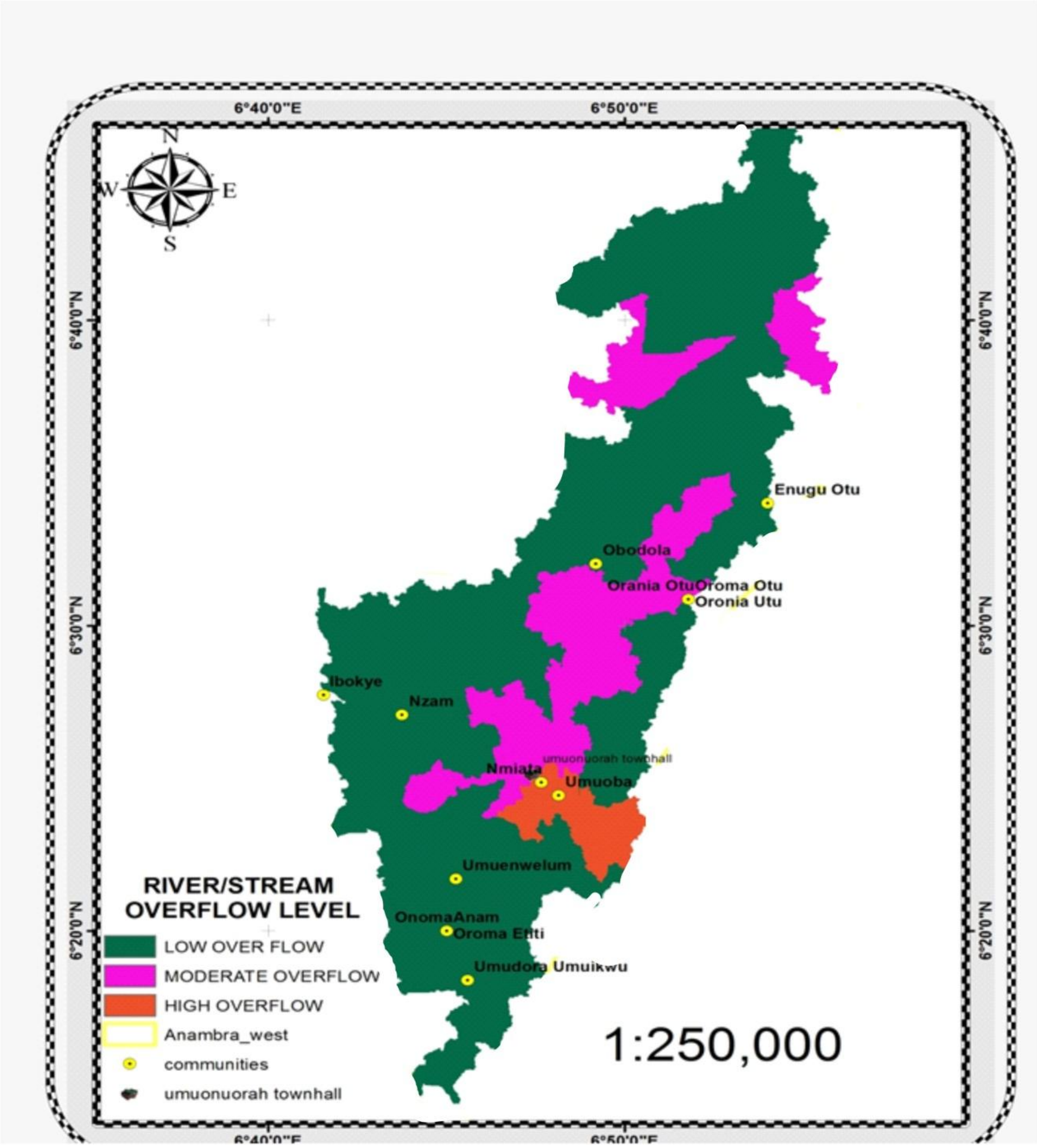

Figure 5.14: River Overflow Level
Source: Analysis of SRTM, 2016

Figure 5.14 shows the areas that experiences various degrees of overflow after excessive rains. From the map analysis, it was noticed that Nmiata Anam and Umuoba fall within the area that experiences the highest degree of over flow. This makes these areas susceptible to flood occurrence since the highest over flows are experienced in these places. The overflows are coming from the various streams and rivers that are located within the Local Government.

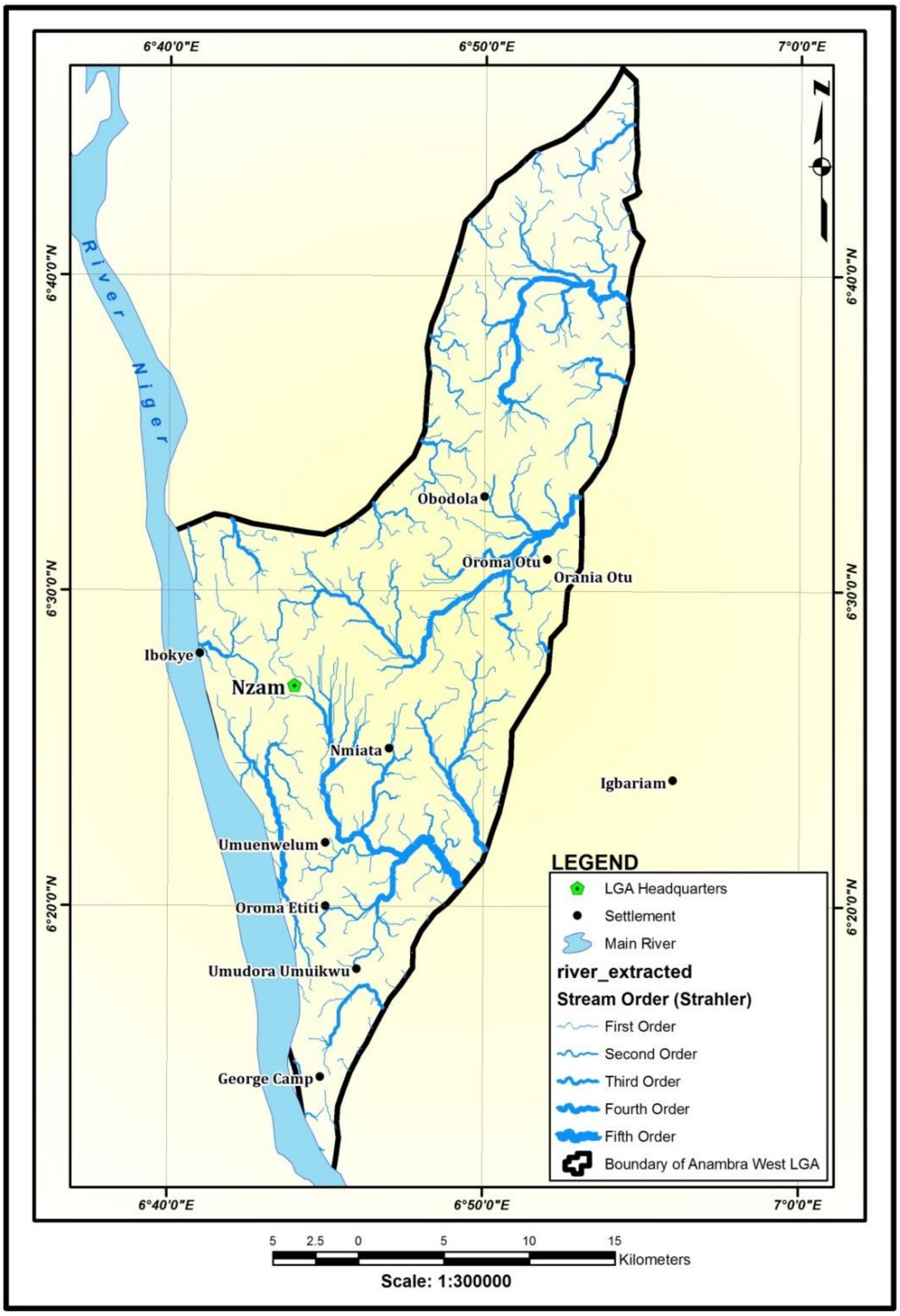

Figure 5.15 Map of Stream Network in Anambra West L.G.A.

Source: Analysis of SRTM, 2016

Figure 5.15 shows the various major and minor streams present in Anambra West L.G.A. From the map it was noticed that a high degree of the available streams are concentrated at the central part of the L.G.A., followed by stream concentration at the north. The southern part of the L.G.A. has the least concentration of streams.

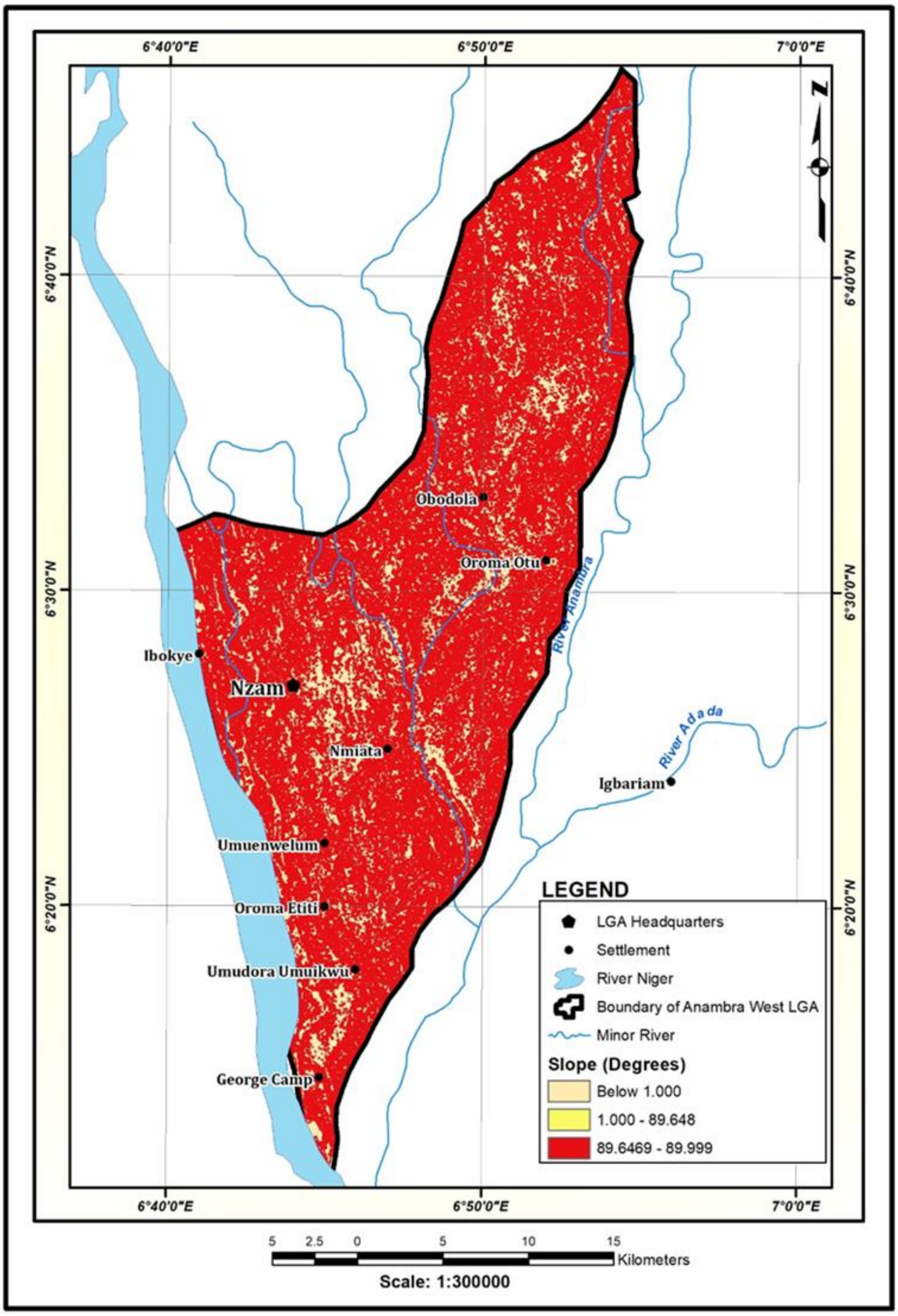

Figure 5.16 Map of Slope of Anambra West
Source: Analysis of SRTM, 2016

Figure 5.16 shows the slope map of Anambra West in degrees. The map showed that virtually every part of Anambra West falls within the slope 89.64 degrees to 89.99 degrees except very few areas that have slope degrees of less than 1 degree. These areas that have slopes less than 1degree tend to be easily flooded.The higher the degree of slope the less vulnerable a place will be. This is because water will find it difficult to flow out of a particular area when the slope is low or around 0^o.

c) Overlay Analysis:

This was carried out using weighted overlay method in which the Reclassified slope of the study area was overlaid on the watershed map of same area to generate Vulnerability Map of Anambra West L.G.A. which is categorized into low, moderate and high vulnerability level as shown in figure 5.17.The vulnerability of an area to flood (or flash flood) is related to so many factors however, four main parameters were considered in mapping the vulnerability of Anambra West LGA to flooding. These include elevation, slope and the proximity to river and streams in the area.

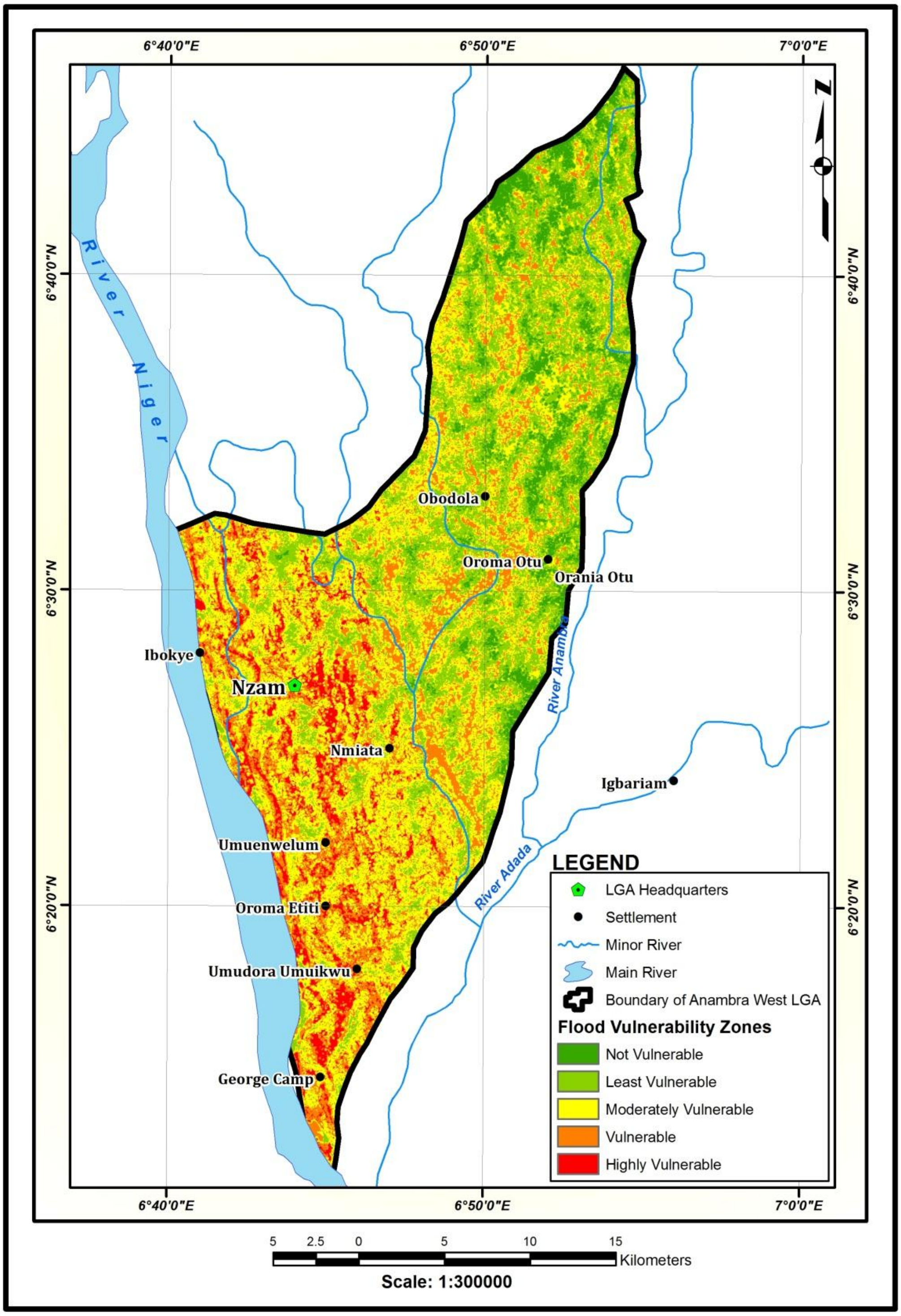

Figure 5.17: Flood Vulnerability map of Anambra West
Source: Researcher's Computer analysis of SRTM, 2016

The use of the reclassification algorithm in ArcMap made it possible to score each pixel (i.e. the smallest unit area (30m) considered) in this study. Reclassified slope was produced from the re-categorization of the slope map into different classes. The central areas are more or less flat and thus more vulnerable, if slope alone is considered. The final flood vulnerability map was produced from this slope classification as just an input.

Meanwhile, before such scoring was assigned to each pixel, their respective zones of vulnerabilities were defined based on certain assumptions. This can be seen in the Table 5.26. The final stage of the analysis was the use of a Multi-Criteria Evaluation (MCE) based on a Weighted Sum overlay algorithm to compute the overall score per pixel for each component/parameter considered by the study and upon which another re-classification was done, based on the same 5-point scale as shown in table 5.26. Hence, areas with much higher scores were termed to be highly vulnerable while areas of much lower values were rated as not vulnerable to flooding. Statistics for the flood vulnerability zones have been computed and attached to aid explanation.

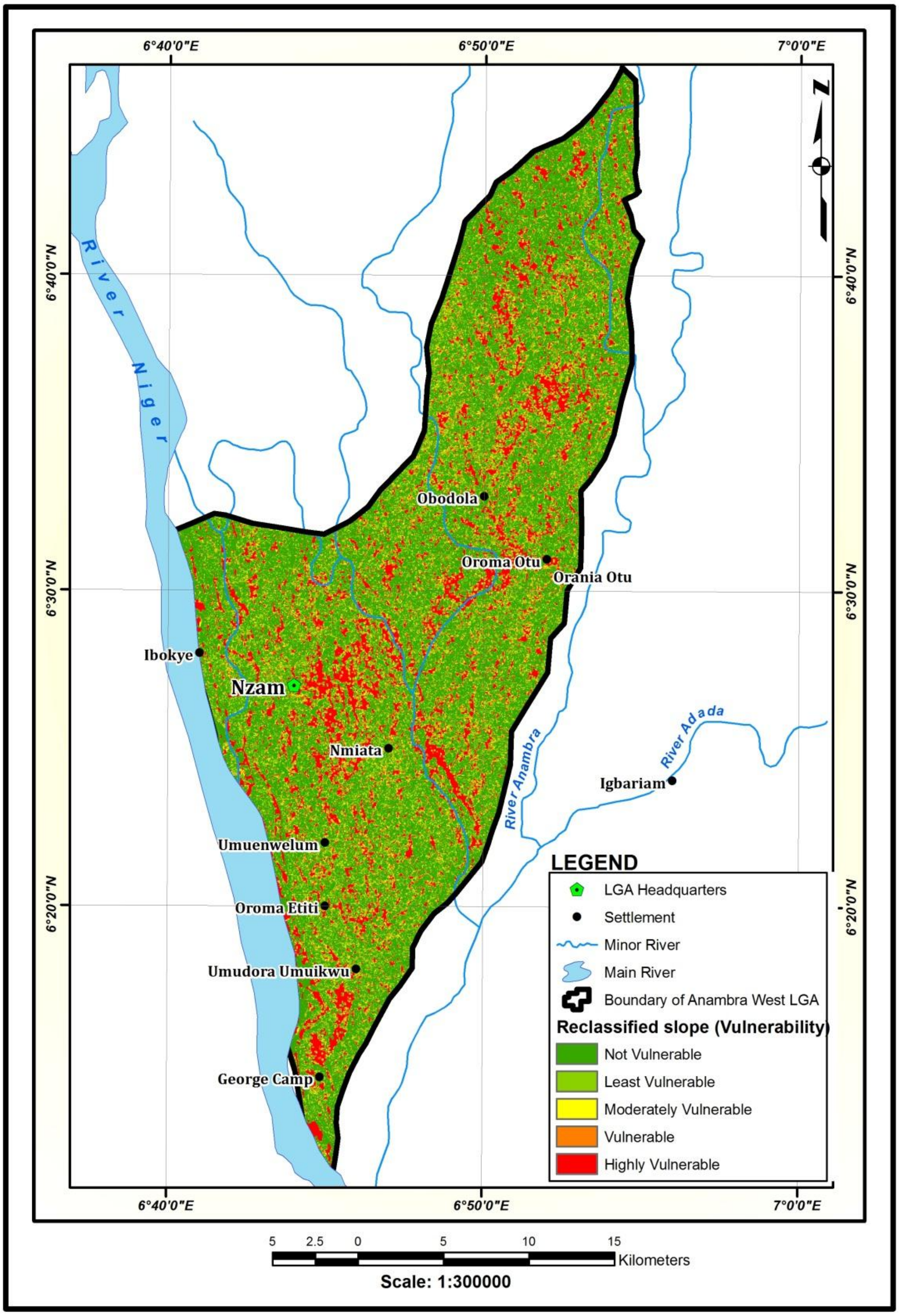

Figure 5.18 Reclassified Slope (Vulnerability)

Table 5. 26 Summary of the map analysis in a tabular form is presented in table 5.1 below

S/No.	Spatial Component	Gradation	Zone/Category	Reclassification Score	Assumption
1	Slope (Degrees)	0 - 20	Highly Vulnerable	5	The lower the slope, the more vulnerable the environment to flooding
		21 - 40	Vulnerable	4	
		41 - 60	Moderately Vulnerable	3	
		61 - 80	Least Vulnerable	2	
		81 - 90	Not Vulnerable	1	
2	River Niger (Kilometers)	5	Highly Vulnerable	5	Buffer analysis within specified radius
		10	Vulnerable	4	
		15	Moderately Vulnerable	3	
		20	Least Vulnerable	2	
		30	Not Vulnerable	1	
3	Streams (Meters)	300	Highly Vulnerable	5	
		600	Vulnerable	4	
		900	Moderately Vulnerable	3	
		1200	Least Vulnerable	2	
		1500	Not Vulnerable	1	
4	Elevation (Meters Above Sea Level)	Below 25	Highly Vulnerable	5	Lower terrains are more susceptible to flood than their surrounding higher areas
		26 -50	Vulnerable	4	
		51 - 75	Moderately Vulnerable	3	
		76 - 100	Least Vulnerable	2	
		Above 101	Not Vulnerable	1	

5.4 DISCUSSION ON FINDINGS

From the analysis of the data collected from the field it was noticed that most of the respondents were of the view that flooding occurs once every year as shown in Table 5.3. This is because of the locals/ respondents' perception or definition of what they assume to be flood. To the locals they consider flood to occur only when the river over flows its bank and inundate the area. They call it 'Iji' in their local dialect. This is why a higher number of the respondents chose above waist level as the height of the flood that occurs in their area as shown in Table 5.4.

It was also noticed from the answers provided by the respondents that no early warning systems or equipment has been installed in the study area and that there are no means of warning the populace on any impending flood except that which is broadcast on the radio.

On further probing, the researcher was able to find out that most if not all the respondents do not even have the time to listen to news on radio but some of them agreed to have seen very large sign posts mounted at some points which warns of impending flood after the 2012/ 2013 very devastating flood. It was also found out from respondents that there is no flood map for the study area and that there is no arrangement to provide the flood map for the study area soon. Since flood occurs in the area every now and then, there is the need to provide a flood map for the area since it will go a long way in helping advice the populace on the areas to avoid more. But no flood map exists for the area and neither the Government nor any organization has made any effort to provide one for the area.

From the testing of hypothesis one, it was found out that there exists a relationship between flood occurrence and damage to environment/ecosystem. The model formulated is significant with P-value of 0.046. This is supported by many researches such as Veldhuis,(2011), Agada, (2012) and many more that flood occurrence causes a lot of damage to the environment. This damage to the environment/ecosystem is even visible were trees are submerged, birds such as guinea fowls lose their eggs and other animals that burrow either die in their burrow or their young ones been drowned in the event of flood occurrence. This damage can be seen in Plates 5.9 and 5.10

Plate 5.9 A fence pulled by flood water

Plate 5.10 A Submerged Ecosystem

Based on the testing of the second Hypothesis, it was found out that flood occurrence has direct effect on the socio- economic values experienced in the study area with a P-value of 0.036. This can be seen in the hike in transportation fare by commuters during the event of flood (for those who dare to ply the route) as complained by the respondents. Flood occurrence also affects the social activities of the inhabitants of the area such as their traditional marriages, religious worship (in which case they either move their churches to other location or move their deities to places where they can perform their ritual processes). Most businesses are also affected and people experience loses, little or no patronage in their business as a result of flood occurrence. These loses are seen were cement dealers have their goods destroyed by the flood.

In testing hypothesis three, the researcher found out that there is a significant effect between flood occurrence and environmental pollution in the study area. The test has a P-value of 0.003. This is evident in the pollution of both the ground water and surface water as seen in the study area. Flood water inundates boreholes that serve as sources of water in the area. Equally soakaway pits are covered and their content mix with flood water to pollute nearby streams. This can be seen as shown in Plates 5.11 and 5.12.

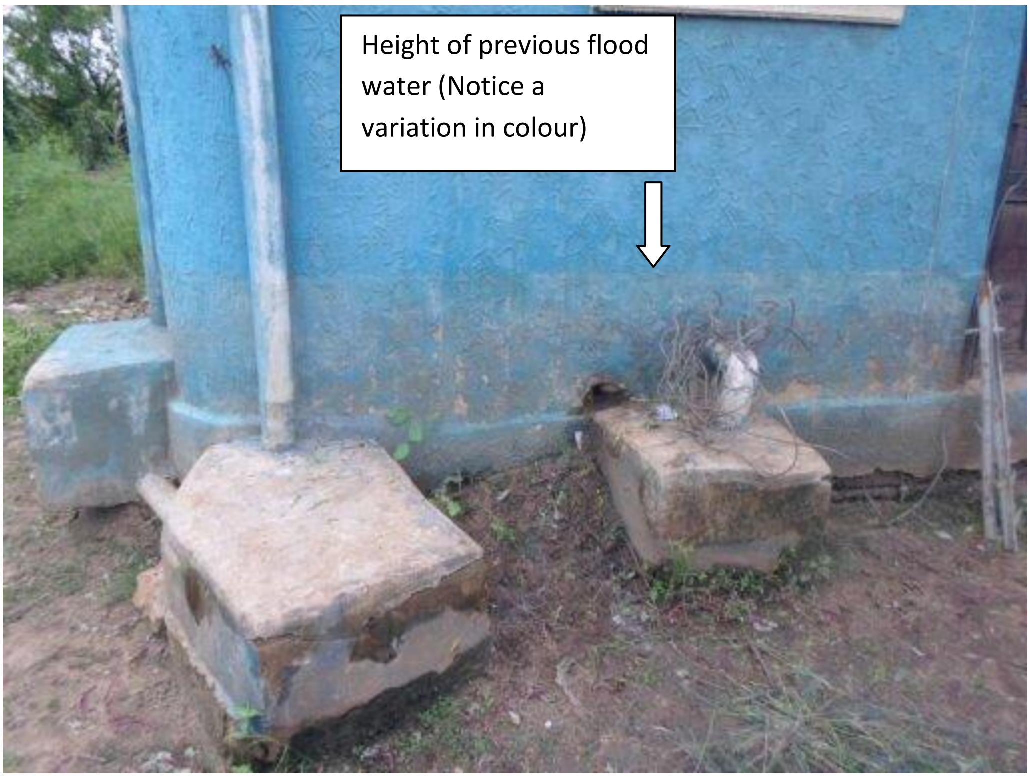

Plate 5.11 A Previously Covered Soakaway Chamber

Plate 5.12 A Soakaway Pit previously covered by flood water

None biodegradable pollutants such as polybags, plastic bottles and empty cans are also carried from dump site in various locations and deposited inside the houses, churches, shops, playground and even the locals sacred ground, defacing the areas.

For the fourth hypothesis, showed that flood incidence has a great impact on the agricultural output of the study area. The P- value being less than 0.05. This supports other researches in this field such as that carried out by Eni et al (2011), Musah and Oloruntoba (2013), Ezin et al (2014) and others. In other words, the fear of flood occurrence results in farmers in the study area cultivating their crops early enough before the rains start. This they do as early as November or December. This according to the respondents is to prevent flood ('Iji') from destroying their crops.

The results of the Principal component analysis (PCA) carried out showed that the component with the highest loading when it comes to the causes of flood in the study area is the soil type. This implies that the soil of the study area plays a major role in causing flood for the area. This supports what the mass movement direction map and the geologic map of Anambra portrays. It is also noticed that the PCA for the effects of flood in the study area showed to major effects of flood in the area which is the pollution/ contamination of surface water and the disruption of social activities while that of diseases showed that the major disease caused by the flood was malaria. This is also evident on the trend analysis on malaria which showed an upward trend.

In the analysis of hypothesis five, the correlation result shows a high positive correlation which implies that flood incidence results to a breakdown in public health. This can be seen in the trend analysis of the frequency of occurrence of malaria and typhoid. The trend analysis showed that both malaria and typhoid are on the increase even though there are fluctuations in the pattern of occurrence. The trend analysis showed that the trend of occurrence of malaria is higher than that of typhoid which implies that more people suffer from malaria than they suffer from typhoid. This could be because after the flood there will always be patches of stagnant water located at various places were mosquitoes can breed. Equally most empty containers will collect water that will also serve as breeding ground for the mosquitoes. The intake of the parasite that causes typhoid may have been reduced because of improved hygiene as a result of the consumption of sachet water or the boiling of water for consumption which the respondents say they do owning to the fact that they know that their sources of water has been compromised (polluted).

Plate 5.13 A Previously Covered Borehole

Plate 5.14 A Previously Covered Source of Pipe borne Water

The digital elevation map of Anambra West as shown in Plate 5.1 shows that most of the land mass of Anambra West Local Government Area of which Nmiata Anam is a part, fall within the area that has the black (darker) colour. This implies that most part of the study area has very low elevation especially within the central part of the L.G.A. The flow direction map of Anambra West L.G.A as shown in Plate 5.2 indicates that the central area has more of the green colour meaning that more water flows to the southern part of the study area. This invariably supports the digital elevation map which shows that the areas are relatively low.

Because more water flows into the study area in all direction, it tend to result in more water accumulating in virtually every part of the study area as shown in the flood accumulation map of plate 5.3. River/ stream over flow map of the study area as shown in Plate 5.4 indicate that the central area of the study site/area of which Nmiata Anam is a part falls under the area with moderate stream over flow. This can be likened to the high number of river tributaries present in the area as shown in plate 5.5.

From the flood vulnerability map of Anambra West which was generated by the overlaying of Reclassified slope map on watershed map of the area , it will be noticed that all parts of Anambra West is vulnerable or susceptible to flood occurrence. Over sixty percent of the land mass is moderately vulnerable to flood and this implies that every rainy season will see the area being flooded and the populace suffering from flood. This could be why the respondents see flood occurrence which they call 'iji' as something very normal when it occurs and they do not feel threatened by flood occurrence. They only feel threatened when flood with the magnitude of that which occurred in 2012/2013 befalls them and to the respondents that is what the real flood is.

CHAPTER SIX
SUMMARY, RECOMMENDATION AND CONCLUSION

6.0 Introduction

This chapter gives a summary of the research carried out, draws the conclusion and at last makes recommendation based on the findings of the work.

6.1 Summary of Findings

The following results were obtained

- flood has direct effect on extent of damage in the study area. This implies increase in rate of flooding would lead to increase in the extent of damage experienced in the area.
- flood has direct effect on extent of damage in the location. This implies increase in rate of flooding would lead to increase in the extent of damage of socio-economic values.
- there exist some evidence to conclude that there is significant effect between flood occurrence and environmental pollution.
- increase in flood leading to increase in challenges of health of the people and so there is significant effect between flood occurrence and outbreak of disease/ public health.
- there is significant relationship between flood occurrence and loss of agricultural yield/food security.
- The trend analysis shows an increase in the trend of malaria in the region

- the trend analysis of typhoid also showed an increase but the trend of malaria in the region is higher than that of typhoid.

From the analysis of the satellite image, the researcher was able to produce the map of the flow accumulation of flood water, the flow direction map, the mass movement map, the reclassified slope map, watershed map and the flood vulnerability map of Anambra West.

6.2 Recommendation

Based on the findings of this research work and to ensure a sustainable and better environment, the researcher makes the following recommendations:

- ✓ Anambra State Government should use the flood vulnerability map provided to determine the best areas were the inhabitants of the study area should be relocated to (may be to other LGAs) in other to prevent them from suffering from flood impacts. This can be achieved by paying compensation to those who agree to relocate.
- ✓ Early warning systems and equipment should be provided by the government in the study area to aid in warning the populace on time in the case of any flood occurrence. If provided, the people can be evacuated on time and the impact of flood mitigated or reduced.
- ✓ The inhabitants of the study area should be educated by the government on the workability of the early warning systems in case they are installed. This can be achieved by contracting NGOs or specialists in the use of the

equipment. This will go a long way in reducing the number of casualties that will be recorded in the advent of flood.

- ✓ The continued use of mosquito nets in the study area should be highly encouraged among the populace and the incessant fumigation to kill mosquito larva should equally be encouraged.
- ✓ If possible, the government should build embankments along the coast of the rivers that traverse the study area to reduce the up surge or over flow of the river into the hinterland.
- ✓ Farmers in the area should be encouraged to cultivate more of water tolerant crop species and crops species that can mature early enough so that they can be harvested on time. This can be achieved by providing farmers in the area with improved varieties from the Ministry of Agriculture.

6.2.1 AREAS FOR FUTHER RESEARCH

This research should be replicated in other parts of the state or country that experience flood to determine the degree of their vulnerability to flood. There is need to carry out a research on the resilience of the study area to flood disaster.

6.2.2 CONTRIBUTION TO KNOWLEDGE

From the findings of this research work, the researcher was able to contribute these following to knowledge

- The provision of the various levels of vulnerability of areas within Anambra West L.G.A.

- The provision of a map of the study area showing the degrees of slope of the area.

6.3 Conclusion

Based on the results of the various analysis carried out in this study, the study comes up the following conclusions that

- the spread / incidence of malaria and typhoid are on the increase in the study area as a result of flood occurrence as shown by the trend analysis.

- in as much as the residents of the study area think that flood water brings alluvial deposits to enrich the soil, its negative effects tend to outweigh the positive effects. Some of the negative effects which include environmental pollution, loss of some cultivated crops, loss of property and other valuables, discomfort to people when houses are flooded, increase in transportation fare, disruption of religious and social activities, desecration of sacred places and a lot more which in some cases may be very expensive to either clean up or bring to normalcy.

- there is also the psychological effects of people having to vacate their homes because it has been flooded, this affects students' performance in school and inter personal relationship within the house hold.

- the Reclassified slope map of the study area shows that the study area is a relatively flat area with most of the area having a slope degree of between 0- 6 which implies that as rain falls the runoff does not really flow out the area easily. This supports what the map of mass movement direction depicts.

-It should be noted that more flood water into the central area of the study area as was depicted by the flow direction map. This increases the vulnerability of areas. This is equally supported by the flow accumulation map of the study as shown.

-The stream network map (plate 5.5) showed that more streams are located within the area were we have more overflow level as shown in plate 5.4. This could be because most of the streams are silted. This can be supported from the map of mass movement direction (plate 5.8) were mass from the flow of flood water is carried in all direction including into the nearby streams thereby filling their channels. Based on this it can also be concluded that the high vulnerability of these areas to flood as shown in plate 5.7 is linked to this.

- the flood vulnerability map showed that the study area is purely a flood hazard prone area.

- finally in the management of flood in the study area, the general public should be integrated at all levels in other to know the best practice to implement. The integration should include the encouraging the populace to embrace planning ordinances, using the locals to sensitize the populace, getting information on the rate and time of flood occurrence and knowing the reasons why they do not want to relocate in case the need arises.

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APPENDIX I

Questionnaire

Dear Sir/Madam

I am a Ph.D student of Nnamdi Azikiwe University, in the department of Environmental Management carrying out a research on the post disaster effect of flood event in your locality.

Kindly provide responses/ answers to these questions as your responses will be treated with total privacy.

Thanks

Yours faithfully,

Duluora J.O

1. L.G.A/Town
2. Village
3. Age of respondent
4. Sex: Male Female

Flood Occurrence

1. How often does flood occur (a) every rainy season a very rain (c) once every year spa y n xcept the 2012 flood
2. What is the time lag of the flood
3. What is density/ height of the flood (a) ankle level (b) knee level (c) waist level) above the waist
4. What is the area always covered (a) the farmland areas (b) most part of the community the whole community
5. What where the things/valuable properties that you lost name them.

6. Can you estimate the value of the lost property/valuables.
7. Did you lose a loved one?
8. Where you or your loved one hospitalized
9. How many people was hospitalized in your family
10. Was there any warning prior to the flood occurrence
11. Has there been any new early warning equipment installed
12. Do you know it works or were you people educated on the workability of the early warning system
13. Have you/your community been educated on flood risk before or after the flood. Yes No
14. How many times.
15. Are your properties insured
16. Do you know about property, & life insurance Yes No
17. Are there any flood maps for the area Yes No
18. If no, are there arrangements for the provision of flood maps for the area.
19. The months prone to flood are Jan-March April-June , July-September, October-December

ENVIRONMENT IMPACTS

1	The flood affected the whole community	Strongly Agree	Agree	Not sure	Disagree	Strongly disagree
2	Food and farmlands were destroyed					

3	Domestic animals lost their lives					
4	It resulted in shortage of food					
5	The flood disrupted transportation system					
6	The flood disrupted business activities					
7	The flood destroyed houses					
8	The flood resulted in destruction/loss of electronics					
9	Most people were injured either seriously or partially					
10	Some people lost their lives					
11	The flood resulted in loss of plants/economic trees					
12	Aquatic lives were also lost or disrupted					
13	It affected all most of the social lives					
14	Pit toilets and soak away pits were affected/covered					
15	Wells/bore holes were also affected by the flood					
16	Rivers and streams were all covered/affected					
17	There was an outbreak of cholera/diarrhea					
18	The incidence of malaria increased					
19	There was a proportionate rise in number of people going to hospitals					
20	The flood resulted in psychological breakdown					
21	Government provided necessary assistant					
22	The assistance provided were timely					
23	The assistance provided were enough					
24	Early warning signals have been in existence					
25	Early warning signals were recently installed					
26	You believe in the work ability of the early warning system					
27	Training and sensitization of the EWA were given					
28	You live here because of farming and fishing activities					
29	The soil is very fertile for agriculture					
30	There is a nearby river that provides fish for sale and consumption					
31	Flooding always occur here					
32	Excessive rain always causes flood					
33	The flood occurs during dry season					
34	The flood occurs mainly during rainy season					

35	After the flood, business activities in these areas have decreased drastically					
36	The prices of landed property has decreased as a result of the past flood.					
37	People believe or have the fear that a more devastating flood will occur in future					
38	Water quality is compromised and thereby encourages the quick spread of water-borne diseases					
39	Due to high level pollution of water body from the high surface-run off into it, the quality of the aquatic life e.g. shell fishes, fish, snails etc. may be degraded and may be deleterious to health on consumption					
	Environmental /Ecological Risk Assessment (ERA)					
40	Various harms were done to the environment through ecosystem and bio-diversity losses after flooding					
41	There was displacement of fauna and flora from the water body e.g. some environmentally friendly water plants and animals					
42	Presence of physico-chemical and microbial indicators of faecal and effluent chemical pollution of the river as a result of the floods					
43	Displacement of indigenous aquatic life species thereby leading to stress.					
44	Displacement of settlements at close proximity to the water body as well as import of unwanted material into the water body					
45	Spreading and displacement of effluent hazardous, radioactive chemicals lodged in water body unto unrestricted areas of human reach thereby causing abnormalities in man and animals.					
	Socio-Economic Risk Assessment					
	There was increase in transportation fare					

	as a result of the flood.					
46	The flood made people to use their savings to purchase new properties to replace destroyed ones					
46	Nuisance to the communities at large occurs due to flood transportation delays.					
47	In most cases the flood rises over the bridges and disrupts transportation					
48	High cost of immediate remedial measures.					
49	People's exposure to natural hazards due to the lack of social infrastructure caused by the disaster.					
50	There is administrative distraction to government budgets thereby lowering the economic status of the state					
51	There is disruption of governmental land-use plans					
	HEALTH IMPACTS					
52	Infectious respiratory, water-borne and skin disease due to injuries as a result of contact with the flood water					
53	Pathogens and parasites may be conveyed in the flood water. E.g typhoid, dysentery, tetanus etc.					
54	Spatial and temporal transmission of disease vectors, including malaria, dengue fever, meningitis, cholera					
	AGRICULTURAL IMPACTS					
55	It destroyed the produce e.g crop, rice paddy, fruit tree and vegetables thereby posing the risk of hunger to those engaged in subsistence farming					
56	It posed a great loss to those farmers engaged at a commercial scale					
57	Indiscriminate point pollutions into the river affects the survival of aquaculture (e.g Fish) thereby leading to reduction in the available food proteins for the populace					
58	There is building setback from the river plain					
59	There is Building Plan Approval					

SECTION B

Some of these can be considered as immediate causes of flood in your locality					
Causes	S.A	A	N.S.	D	S.D.
Soil Type					
Topography					
Rainfall intensity					
Rainfall duration					
Lack of planning					
Land use type					
Increase in synthetic surfaces					
Nearness to river					
Deforestation					
Land cover type					
Degree of urbanization					
Flow direction					
Ground water level					
Some of the effects of flood in this area include					
Effects	S.A	A.	NS	D	S.D
Loss of life					
Destruction of farmland					
Loss of properties (electronics, clothes etc)					
Disruption of transportation					
Disruption of social activities					

Disruption of religious activities					
Disruption of economic activities/ businesses					
Contamination/pollution of domestic/surface water					
Some of the diseases caused by flood include these					
Diseases	SA	A	NS	D	SD
Typhoid					
Dysentery					
Schoitomaisis					
Malaria					

APPENDIX II

Reliability

Case Processing Summary

		N	%
Cases	Valid	390	100.0
	Excluded[a]	0	.0
	Total	390	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.978	.987	41

Alpha Value of 0.978 implies the responses are reliable for decision making.

Table 5.16 Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
VAR00001	167.5000	391.216	.649	.	.878
VAR00003	168.1500	367.380	.828	.	.878
VAR00004	167.7071	372.482	.780	.	.878
VAR00005	167.8071	366.070	.881	.	.877
VAR00006	167.8071	366.070	.881	.	.877
VAR00007	167.7071	372.482	.780	.	.878
VAR00008	167.7214	382.274	.826	.	.878
VAR00009	169.7143	374.954	.899	.	.877
VAR00010	169.7143	374.954	.899	.	.877
VAR00011	167.7714	380.408	.835	.	.878
VAR00012	169.7286	376.170	.912	.	.877

VAR00013	167.7071	382.424	.832	.	.878
VAR00014	167.5643	386.420	.825	.	.878
VAR00015	167.5286	388.711	.761	.	.878
VAR00016	167.5286	388.711	.761	.	.878
VAR00017	170.1714	371.639	.706	.	.878
VAR00018	167.9571	373.221	.907	.	.877
VAR00019	167.8000	377.902	.876	.	.878
VAR00020	167.6286	382.566	.860	.	.878
VAR00021	167.5286	388.711	.761	.	.878
VAR00022	167.5857	385.338	.847	.	.878
VAR00023	170.4071	368.272	.672	.	.879
VAR00029	167.4929	391.935	.610	.	.879
VAR00030	168.6643	361.347	.856	.	.878
VAR00036	170.9000	379.932	.551	.	.879
VAR00037	167.8071	373.696	.927	.	.877
VAR00038	167.7143	376.954	.906	.	.877
VAR00039	168.4571	346.869	.943	.	.878
VAR00040	167.7857	382.069	.787	.	.878
VAR00041	168.6714	357.877	.836	.	.878
VAR00042	167.5571	386.795	.818	.	.878
VAR00043	168.6714	357.877	.836	.	.878
VAR00044	167.5571	386.795	.818	.	.878
VAR00045	167.5571	386.795	.818	.	.878
VAR00046	167.5143	389.906	.711	.	.878
VAR00047	167.5643	385.154	.775	.	.878
VAR00048	167.5214	389.287	.738	.	.878
VAR00050	169.2357	373.922	.727	.	.878
VAR00053	167.7714	373.703	.924	.	.877
VAR00055	167.5571	386.795	.818	.	.878
VAR00059	171.2643	390.354	.337	.	.879

Source: Researcher's Computer analysis, 2016

Output

Regression Analysis: DAMAGE versus FLOOD

```
The regression equation is
```

DAMAGE = 0.78 + 1.82 FLOOD

Predictor	Coef	SE Coef	T	P
Constant	0.777	5.370	0.14	0.008
FLOOD	1.823	2.906	0.63	0.036

R-Sq = 74.2%   R-Sq(adj) = 70.9%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.438	0.438	0.39	0.046
Residual Error	9	10.008	1.112		
Total	10	10.446			

Output

Regression Analysis: SOCIO-ECONOMIC VALUES versus FLOOD

The regression equation is
SOCIO-ECONOMIC VALUES = 1.66 + 1.29 FLOOD

Predictor	Coef	SE Coef	T	P
Constant	1.662	6.837	0.24	0.013
FLOOD	1.287	3.700	0.35	0.036

R-Sq = 71.3%   R-Sq(adj) = 70.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.218	0.218	0.12	0.036
Residual Error	6	16.225	2.704		
Total	7	16.443			

Regression Output

Regression Analysis: Env Pollution versus FLOOD

The regression equation is
Env Pollution = 5.47 + 0.54 FLOOD

```
Predictor     Coef   SE Coef      T       P
Constant     5.468     3.714   1.47   0.015
FLOOD       -0.536     2.016  -0.27   0.003


R-Sq = 81.7%   R-Sq(adj) = 80.0%


Analysis of Variance

Source          DF       SS       MS      F       P
Regression       1   0.0264   0.0264   0.07   0.003
Residual Error   4   1.4903   0.3726
Total            5   1.5167
```

Appendix III

```
T-TEST PAIRS=Flood2 Flood4 WITH Socio Health (PAIRED)
  /CRITERIA=CI(.9500)

  /MISSING=ANALYSIS.
```

T-Test

Notes

Output Created		18-Jan-2018 11:16:06
Comments		
Input	Data	C:\Users\USER\Documents\Duluora\Hyp1-5.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	11
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax		T-TEST PAIRS=Flood2 Flood4 WITH Socio Health (PAIRED) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.
Resources	Processor Time	00:00:00.078
	Elapsed Time	00:00:00.156

[DataSet1] C:\Users\USER\Documents\Duluora\Hyp1-5.sav

T-TEST PAIRS=Flood1 Flood3 Flood5 WITH Damage Pollution Agric (PAIRED)

/CRITERIA=CI(.9500)

/MISSING=ANALYSIS.

T-Test

Notes

Output Created		
Comments		
Input	Data	C:\Users\USER\Documents\Duluora\Hyp1-5.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	11
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax		T-TEST PAIRS=Flood1 Flood3 Flood5 WITH Damage Pollution Agric (PAIRED) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.
Resources	Processor Time	00:00:00.047

Notes

Output Created		
Comments		
Input	Data	C:\Users\USER\Documents\Duluora\Hyp1-5.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	11
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax		T-TEST PAIRS=Flood1 Flood3 Flood5 WITH Damage Pollution Agric (PAIRED) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.
Resources	Processor Time	00:00:00.047
	Elapsed Time	00:00:00.063

[DataSet1] C:\Users\USER\Documents\Duluora\Hyp1-5.sav

Appendix IV

FACTOR

/VARIABLES VAR00001 VAR00002 VAR00003 VAR00004 VAR00005 VAR00006 VAR00007 VAR00008

/MISSING LISTWISE

/ANALYSIS VAR00001 VAR00002 VAR00003 VAR00004 VAR00005 VAR00006 VAR00007 VAR00008

/PRINT INITIAL CORRELATION KMO AIC EXTRACTION ROTATION

```
/CRITERIA MINEIGEN(1) ITERATE(25)

/EXTRACTION PC

/CRITERIA ITERATE(25)

/ROTATION VARIMAX

/METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		
Comments		
Input	Data	C:\Documents and Settings\ZINOX\Desktop\PCA Data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	5
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Syntax		FACTOR /VARIABLES VAR00001 VAR00002 VAR00003 VAR00004 VAR00005 VAR00006 VAR00007 VAR00008 /MISSING LISTWISE /ANALYSIS VAR00001 VAR00002 VAR00003 VAR00004 VAR00005 VAR00006 VAR00007 VAR00008 /PRINT INITIAL CORRELATION KMO AIC EXTRACTION ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.031
	Elapsed Time	00:00:00.031
	Maximum Memory Required	9080 (8.867K) bytes

Table 5.22 Communalities (Causes of flood)

	Initial	Extraction
Soil Type	1.000	.966
Topography	1.000	.947
Rainfall intensity	1.000	.959
Rainfall duration	1.000	.998
Lack of planning	1.000	.973
Land use type	1.000	.985
Increase in synthetic surfaces	1.000	.981
Nearness to river	1.000	.983

Deforestation	1.000	.984
Land cover type	1.000	.999
Degree of urbanization	1.000	1.000
Flow direction	1.000	.962
Ground water level	1.000	.985

Extraction Method: Principal Component Analysis.

Table of Total Variance Explained (Causes of flood)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.998	69.218	69.218	8.998	69.218	69.218	6.730	51.771	51.771
2	2.595	19.965	89.183	2.595	19.965	89.183	4.652	35.786	87.557
3	1.128	8.678	97.861	1.128	8.678	97.861	1.339	10.304	97.861
4	.278	2.139	100.000						
5	4.471E-16	3.439E-15	100.000						
6	2.101E-16	1.616E-15	100.000						
7	1.228E-16	9.445E-16	100.000						
8	5.225E-17	4.019E-16	100.000						
9	-3.253E-17	-2.502E-16	100.000						
10	-1.265E-16	-9.730E-16	100.000						
11	-1.570E-16	-1.208E-15	100.000						
12	-2.196E-16	-1.689E-15	100.000						
13	-5.004E-16	-3.849E-15	100.000						

Extraction Method: Principal Component Analysis.

Table of Component Matrix[a] (causes of flood)

	Component		
	1	2	3
Soil Type	.742	.633	.125
Topography	.827	.510	.057
Rainfall intensity	.962	.178	-.041
Rainfall duration	.997	.050	.050
Lack of planning	-.715	.659	.166

Land use type	-.452	-.366	.805
Increase in synthetic surfaces	-.978	.153	.041
Nearness to river	.973	.163	.100
Deforestation	-.564	.689	.437
Land cover type	-.799	.594	-.090
Degree of urbanization	-.713	.579	-.396
Flow direction	.945	.253	-.063
Ground water level	.933	.236	.243

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

Table of Rotated Component Matrix[a] (causes of flood)

	Component		
	1	2	3
Soil Type	.969	.107	-.126
Topography	.957	-.050	-.172
Rainfall intensity	.866	-.409	-.204
Rainfall duration	.847	-.521	-.091
Lack of planning	-.190	.964	.093
Land use type	-.369	.062	.919
Increase in synthetic surfaces	-.703	.686	.127
Nearness to river	.901	-.409	-.066
Deforestation	.013	.936	.328
Land cover type	-.353	.926	-.127
Degree of urbanization	-.365	.826	-.429
Flow direction	.887	-.341	-.242
Ground water level	.941	-.309	.058

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

II

```
FACTOR
  /VARIABLES var001 var002 var003 var004 var005 var006 var007 var008 var009 var010
var011 var012 var013
```

```
  /MISSING LISTWISE
  /ANALYSIS var001 var002 var003 var004 var005 var006 var007 var008 var009 var010 v
ar011 var012 var013
  /PRINT INITIAL CORRELATION KMO AIC EXTRACTION ROTATION
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX

  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Comments		
Input	Data	C:\Documents and Settings\ZINOX\Desktop\PCA Data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	5
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES var001 var002 var003 var004 var005 var006 var007 var008 var009 var010 var011 var012 var013 /MISSING LISTWISE /ANALYSIS var001 var002 var003 var004 var005 var006 var007 var008 var009 var010 var011 var012 var013 /PRINT INITIAL CORRELATION KMO AIC EXTRACTION ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.063
	Elapsed Time	00:00:00.266

Notes

Comments		
Input	Data	C:\Documents and Settings\ZINOX\Desktop\PCA Data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	5
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES var001 var002 var003 var004 var005 var006 var007 var008 var009 var010 var011 var012 var013 /MISSING LISTWISE /ANALYSIS var001 var002 var003 var004 var005 var006 var007 var008 var009 var010 var011 var012 var013 /PRINT INITIAL CORRELATION KMO AIC EXTRACTION ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.063
	Elapsed Time	00:00:00.266
	Maximum Memory Required	21700 (21.191K) bytes

III

FACTOR

/VARIABLES Typhoid Dysentery Schoitomaisis Malaria

```
/MISSING LISTWISE

/ANALYSIS Typhoid Dysentery Schoitomaisis Malaria

/PRINT INITIAL CORRELATION KMO AIC EXTRACTION ROTATION

/CRITERIA MINEIGEN(1) ITERATE(25)

/EXTRACTION PC

/CRITERIA ITERATE(25)

/ROTATION VARIMAX

/METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		17-Jul-2017 07:45:25
Comments		
Input	Data	C:\Documents and Settings\ZINOX\Desktop\PCA Data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	5
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.

	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Typhoid Dysentery Schoitomaisis Malaria /MISSING LISTWISE /ANALYSIS Typhoid Dysentery Schoitomaisis Malaria /PRINT INITIAL CORRELATION KMO AIC EXTRACTION ROTATION /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.047
	Elapsed Time	00:00:00.172
	Maximum Memory Required	2872 (2.805K) bytes

APPENDIX V

```
TSET NEWVAR=NONE.
CURVEFIT
  /VARIABLES=Malaria WITH Month
  /CONSTANT
  /MODEL=QUADRATIC
  /PRINT ANOVA
```

Notes

Output Created		
Comments		
Input	Data	C:\Users\USER\Documents\Duluora\Trend.sav
	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Cases with a missing value in any variable are not used in the analysis.
Syntax		CURVEFIT /VARIABLES=Malaria WITH Month /CONSTANT /MODEL=QUADRATIC /PRINT ANOVA /PLOT FIT.
Resources	Processor Time	00:00:00.671
	Elapsed Time	00:00:00.593
Use	From	First observation
	To	Last observation
Predict	From	First Observation following the use period
	To	Last observation
Time Series Settings (TSET)	Amount of Output	PRINT = DEFAULT
	Saving New Variables	NEWVAR = NONE
	Maximum Number of Lags in Autocorrelation or Partial Autocorrelation Plots	MXAUTO = 16
	Maximum Number of Lags Per Cross-Correlation Plots	MXCROSS = 7
	Maximum Number of New Variables Generated Per Procedure	MXNEWVAR = 60
	Maximum Number of New Cases Per Procedure	MXPREDICT = 1000
	Treatment of User-Missing Values	MISSING = EXCLUDE

	Confidence Interval Percentage Value	CIN = 95
	Tolerance for Entering Variables in Regression Equations	TOLER = .0001
	Maximum Iterative Parameter Change	CNVERGE = .001
	Method of Calculating Std. Errors for Autocorrelations	ACFSE = IND
	Length of Seasonal Period	Unspecified
	Variable Whose Values Label Observations in Plots	Unspecified
	Equations Include	CONSTANT

TREND ANALYSIS

```
For malaria
Data      Malaria
Length    30
NMissing  0


Fitted Trend Equation
Yt = 8.89 + 0.928*t

Accuracy Measures
MAPE  30.0911
MAD    5.9261
MSD   71.5873
```

Time	Malaria	Trend	Detrend
Jan	9	9.8151	-0.8151
Feb	17	10.7428	6.2572
Mar	20	11.6704	8.3296
Apr	12	12.5981	-0.5981
May	12	13.5258	-1.5258
Jun	16	14.4535	1.5465
Jul	11	15.3812	-4.3812
Aug	13	16.3089	-3.3089
Sep	11	17.2366	-6.2366
Oct	6	18.1643	-12.1643
Nov	14	19.0920	-5.0920
Dec	14	20.0197	-6.0197
Jan	18	20.9474	-2.9474
Feb	16	21.8751	-5.8751
Mar	20	22.8028	-2.8028
Apr	33	23.7305	9.2695
May	26	24.6582	1.3418
Jun	35	25.5859	9.4141
Jul	60	26.5136	33.4864
Aug	32	27.4413	4.5587

```
Sep         29   28.3690    0.6310
Oct         26   29.2967   -3.2967
Nov         27   30.2244   -3.2244
Dec         38   31.1521    6.8479
Jan         27   32.0798   -5.0798
Feb         27   33.0075   -6.0075
Mar         21   33.9352  -12.9352
Apr         29   34.8629   -5.8629
May         43   35.7906    7.2094
Jun         36   36.7183   -0.7183
```

```
TSET NEWVAR=NONE.
CURVEFIT
  /VARIABLES=Typhoid WITH Month
  /CONSTANT
  /MODEL=QUADRATIC
  /PRINT ANOVA
```

Notes

Output Created		17-Jan-2018 15:51:11
Comments		
Input	Data	C:\Users\USER\Documents\Duluora\Trend.sav
	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	30
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Cases with a missing value in any variable are not used in the analysis.
Syntax		CURVEFIT /VARIABLES=Typhoid WITH Month /CONSTANT /MODEL=QUADRATIC /PRINT ANOVA /PLOT FIT.
Resources	Processor Time	00:00:00.593
	Elapsed Time	00:00:00.563
Use	From	First observation
	To	Last observation
Predict	From	First Observation following the use period
	To	Last observation
Time Series Settings (TSET)	Amount of Output	PRINT = DEFAULT
	Saving New Variables	NEWVAR = NONE
	Maximum Number of Lags in Autocorrelation or Partial Autocorrelation Plots	MXAUTO = 16
	Maximum Number of Lags Per Cross-Correlation Plots	MXCROSS = 7

	Maximum Number of New Variables Generated Per Procedure	MXNEWVAR = 60
	Maximum Number of New Cases Per Procedure	MXPREDICT = 1000
	Treatment of User-Missing Values	MISSING = EXCLUDE
	Confidence Interval Percentage Value	CIN = 95
	Tolerance for Entering Variables in Regression Equations	TOLER = .0001
	Maximum Iterative Parameter Change	CNVERGE = .001
	Method of Calculating Std. Errors for Autocorrelations	ACFSE = IND
	Length of Seasonal Period	Unspecified
	Variable Whose Values Label Observations in Plots	Unspecified
	Equations Include	CONSTANT

Trend Analysis for Typhoid

```
Data      Typhoid
Length    30
NMissing  0
```

Fitted Trend Equation

Yt = 6.93 + 0.0412*t

```
Accuracy Measures
MAPE  37.8898
MAD    2.2718
MSD    7.8520
```

Time	Typhoid	Trend	Detrend
Jan	4	6.96989	-2.96989
Feb	10	7.01105	2.98895
Mar	13	7.05221	5.94779
Apr	7	7.09336	-0.09336
May	5	7.13452	-2.13452
Jun	8	7.17568	0.82432
Jul	7	7.21683	-0.21683
Aug	5	7.25799	-2.25799
Sep	3	7.29915	-4.29915
Oct	3	7.34030	-4.34030
Nov	7	7.38146	-0.38146
Dec	10	7.42262	2.57738
Jan	13	7.46377	5.53623

```
Feb        10  7.50493   2.49507
Mar         7  7.54609  -0.54609
Apr        10  7.58725   2.41275
May         9  7.62840   1.37160
Jun         5  7.66956  -2.66956
Jul         7  7.71072  -0.71072
Aug         6  7.75187  -1.75187
Sep         3  7.79303  -4.79303
Oct         7  7.83419  -0.83419
Nov         6  7.87534  -1.87534
Dec        11  7.91650   3.08350
Jan         8  7.95766   0.04234
Feb         6  7.99881  -1.99881
Mar         6  8.03997  -2.03997
Apr        10  8.08113   1.91887
May        13  8.12228   4.87772
Jun         8  8.16344  -0.16344
```

Appendix VI

Flood Vulnerability Zones	No. of Pixels	Area	Percentage
Not Vulnerable	18201	17.18	2.32
Least Vulnerable	121774	114.98	15.53
Moderately Vulnerable	388558	366.86	49.56
Vulnerable	141995	134.07	18.11
Highly Vulnerable	113513	107.18	14.48
Total	**784041**	**740.27**	**100**
Reclassified Slope Zones	**No. of Pixels**	**Area**	**Percentage**
Not Vulnerable	405792	383.14	51.76
Least Vulnerable	154093	145.49	19.65
Moderately	66844	63.11	8.53

Vulnerable			
Vulnerable	40011	37.78	5.10
Highly Vulnerable	117301	110.75	14.96
Total	**784041**	**740.27**	**100**
Stream Order	**No. of Segments**	**Distance (Meters)**	
1st Order	461	446332.623	
2nd Order	229	203046.436	
3rd Order	96	90823.335	
4th Order	55	61544.102	
5th Order	7	5866.293	