2021 ANNUAL FLOOD OUTLOOK (AFO)

NIGERIA HYDROLOGICAL SERVICES AGENCY

Water Resources Data for Sustainable Development

NIHSA

NIHSA

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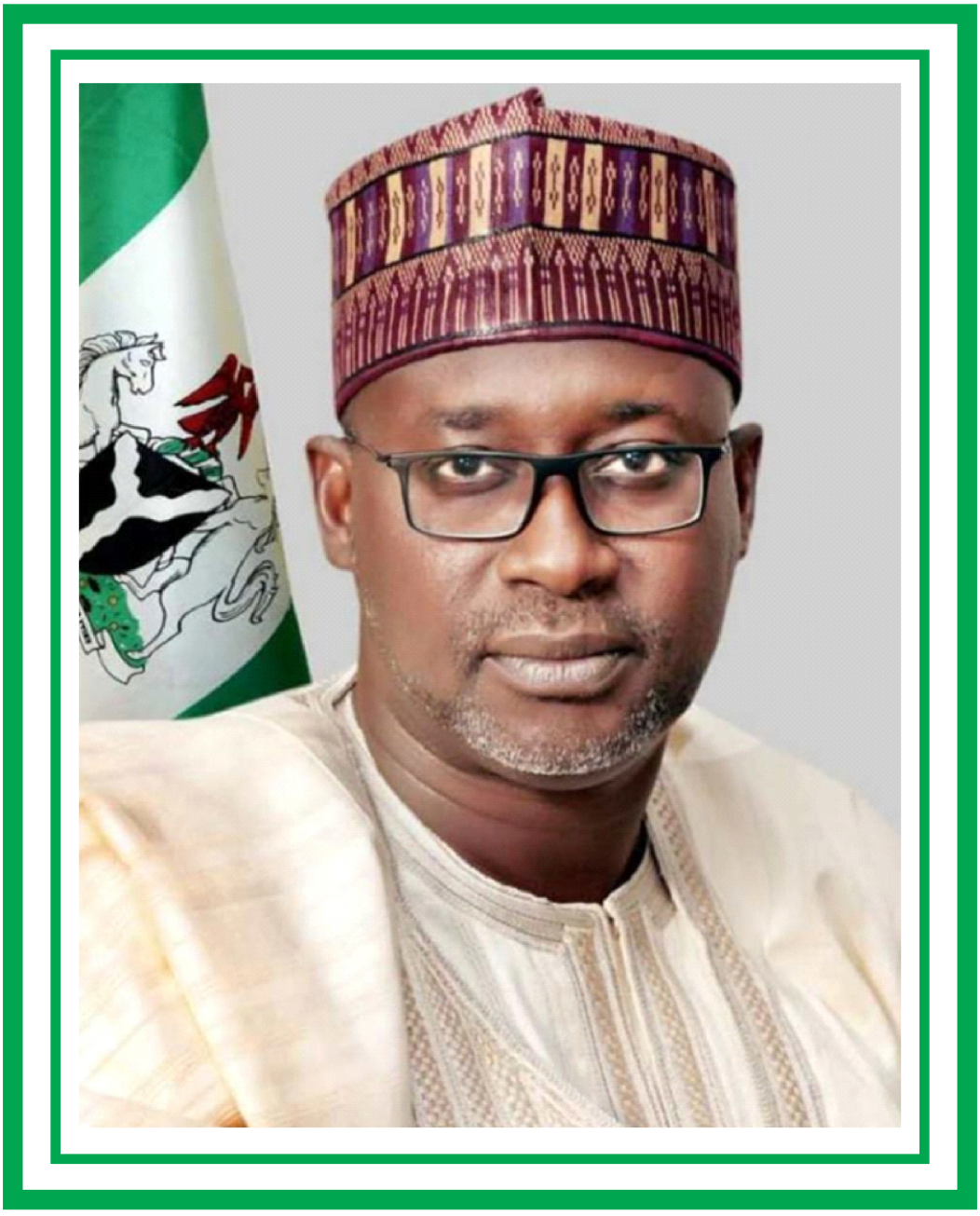

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NIGERIA HYDROLOGICAL SERVICES AGENCY (NIHSA)

FOREWORD

The Nigeria Hydrological Services Agency (NIHSA) has continued to provide needed information to the public on the occurrence of flood through its publication of Annual Flood Outlook (AFO) and possible management of same through its sensitization programmes.
The Agency's pro-activeness has to a large extent reduced the level of disaster occurrence as those who adhered to the warnings through organized sensitization programmes by NIHSA, averted the eminent risk of the flood.

A strong synergy has also been established with sister agencies such as Nigerian Metrological Agency(NiMet), National Emergency Agency (NEMA), National Space Research and Development Agency (NASRDA), Office of the Surveyor General of the Federation (OSGOF), National Water Resources Institute (NWRI), Nigeria Integrated Water Resources Management Commission (NIWRMC), and River Basin Development Authorities (RBDAs), over the forecast and management of the impacts of this hydrological extreme event(flood) on the society. It is hoped that more development partners will collaborate with NIHSA as the Agency is not relenting in continuous improvement of its level of accuracy in its prediction and has added early warning application in order to obtain real time data to increase relevance of its service to the public.

This year's AFO publication, along with the Flood Mobile App serves as measures to sensitize the populace and create awareness on the inherent dangers of flooding in order to minimise its negative impacts. It is also designed to inform people about locations that are prone to flood risk at a particular time and encourage them to take appropriate actions.

The AFO by NIHSA describes probable flood scenarios for the country, its implications for river navigation, agriculture, industry, infrastructure, communication facilities and socio-economic well-being. AFO presents the ways in which people in different locations may be at greater risk than other groups in the event of flood disasters and highlights the need to build resilience to flood and other natural disasters in the country, especially in the low-lying areas.

In 2020, we saw the devastating impact of extreme flood events across the country. The flood affected 36 States of the Federation and the Federal Capital Territory (FCT), 349 Local Government Areas (LGAs) within the 36 States were affected and over 2,353,647 people were displaced with a record of 69 deaths. Kebbi and Jigawa States were worst hit with regards to agricultural lands and houses destroyed. Apart from the physical damages, other indirect losses are often overlooked. These indirect and intangible impacts are generally associated with disruption to normal life as well as long term health issues and stress-related illnesses. However, the Federal Government through the National Emergency Management Agency (NEMA) provided support to those affected.

We must recognise that extreme weather and flooding events do happen and that we need to be well equipped to respond to them. I am confident that our communities, infrastructure and businesses will be better protected if due attention is given to the information contained in this 9th edition of the Annual Flood Outlook.

Engr. Suleiman H. Adamu, ***FNSE, FAENg.***
Honourable Minister of Water Resources
May, 2021.

ACKNOWLEDGEMENT

This 9th edition of Annual Flood Outlook (AFO) indexed the continuous support of the Honourable Minister for Water Resources, Engr. Suleiman H. Adamu, *FNSE, FAEng*, to the Agency. This is evidently showcased by the huge success, wide acceptability and recognition that have been recorded from the past five consecutive editions of AFO under his able watch.

We thank the Permanent Secretary, Federal Ministry of Water Resources, Mrs. Didi Esther Walson-Jack, mni, for encouraging the Agency's activities and the publication of this Annual Flood Outlook.

I wish to commend our consultants and technical experts for their availability and accurate analyses of hydrological and hydrogeological data as well as their interpretations for probable flood scenarios. I appreciate our sisterAgencies such as the Nigerian Meteorological Agency (NiMet), National Emergency Management Agency (NEMA), National Space Research and Development Agency (NASRDA), Office of the Surveyor General of the Federation (OSGOF), National Water Resources Institute (NWRI), Nigeria Integrated Water Resources Management Commission (NIWRMC), River Basin Development Authorities (RBDAs), professional and Non-governmental organisations among othersfor their unquantifiable support.

We also recognise the intervention of developmental partners such as Nigeria Erosion and Watershed Management Project (NEWMAP) for continuous upgrading of the Hydromet system across the country as well as support for hydrological equipment. The hydrological data reception centre put in place at NIHSA Headquarters by the Transforming Irrigation Management in Nigeria (TRIMING) project for seamless data acquisition from hydrological installations within the project catchment areas have also aided flood forecasting capabilities.

My profound gratitude goes to the management and staff of Nigeria Hydrological Services Agency (NIHSA) for their unflinching support towards the realization of AFO publication from inception to date.

I am hopeful that this 2021 Annual Flood Outlook (AFO) will be of great importance to reservoir operators, water managers, technical experts, disaster risk managers, policymakers and flood forecasting community for flood prevention and for providing information on flood early warning for mitigating flood risks in the country.

Engr. Clement O. Nze, FNAH,FNAHS
Director General/CEO
April, 2021.

FLOODRONA

by Shakwa Adam

Sometimes, it is as if
Nature is against us.
If not, why then the disastrous pandemics?

I'm in my house and scared of hunger.
If I go out, I can die because of corona virus.
Haven't I suffered enough, is hell all out now?

I am locked down, away from family,
I can't go out, I don't see my friends.
Even my job, unless I am blind, is at stake.

No one knows when this will end,
But nature turns deaf to hear,
After all, we have always been blind to her.

And trust me when I say she's not over.
The rains will come soon, so does the flood
Do we still want to act ignorant?

Just check your drainage, is it safe?
Or in ignorance you still play?
I mean these are things we ought to do.

Make sure the gutters are clean
Remember your rivers and streams are not dustbin
So stop making them your trash bin.

These are simple things we can do
But we wait for disasters before we act.
We want to die before we react?

Every year, we lose our farm produce
Our homes, animals, property and lives
But we won't listen, we prefer the sad game.

Leaving the flood plains is hard
But trust me, gasping for breath is harder
But nature won't seek your permission before it acts.

She takes what belongs to her by will or force
So stop your ignorance and arrogance
And give Caesar, what belongs to Caesar.

As we try our best to be safe from corona virus
Don't forget the flood will soon run too
Be wise! be safe! I drop my pen now.

EXECUTIVE SUMMARY

The Annual Flood Outlook (AFO) of the Nigeria Hydrological Services Agency (NIHSA) is in line with its statutory mandate which amongst other functions is to issue forecasts on flood, sensitize Nigerians on flood management towards mainstreaming disaster reduction efforts for sustainable socio-economic development. This is intended to sensitize the general public particularly those living in the coastal and riverine areas, including cities and communities along the trans-boundary Rivers Niger and Benue that are often at high risk of flooding.

The AFO through location-based approach to flood forecasting has created awareness and proffered mitigation measures which has resulted into significant reduction in loss of lives, and damage to goods and property, and also enhanced development of infrastructure and socio-economy over the last eight years in Nigeria. It has also established beyond the precipitation input into the fluvial dynamics across the country, the perennial flood hotspots in the context of the physical and human complexities that shape the country's annual flood scenarios. This 2021 edition of AFO is the ninth in the series.

The flood scenarios as presented in the 2021 AFO are derived from the application of three reliable models: HEC HMS Hydrological Model, the Soil and Water Assessment Tool (SWAT) and the HBV Model. These models utilize meteorological, hydrological and hydrogeological data, topographical and soil water balance indices, as well as Digital Elevation Model (DEM).

The results show that 121 LGAs in 28 States and FCT fall within the highly probable flood risk areas, while 302 LGAs in the 35 States of the Federation including the FCT fall within the moderately probable flood risk areas. The remaining 351 LGAs fall within the low probable flood risks areas.

Some coastal States, including Delta, Lagos, and Bayelsa are expected to experience coastal flooding due to rise in sea level and tidal surge which could impact fishing, habitation and coastal transportation.

Flash and Urban Floods are also expected to occur in some locations such as Birnin–Kebbi, Sokoto, Kaduna, Gombe, Yola, Makurdi, Abuja, Lafia, Asaba, Port Harcourt, Yenagoa, Lagos, Ibadan, Abeokuta, Benin City, Oshogbo, Ado-Ekiti, Abakaliki, Awka, Nsukka, Calabar, Owerri, Kano, and major cities with poor drainage systems.

The simulated hydrographs of gauging stations at Kainji, Ologbo, Kende, Geidam, Ikom, Lokoja, Malabu, Okitipupa, Onitsha, Siluko, Zungeru, Abeokuta, Dadin Kowa, Hadejia, Kafin Gana, Katsina-Ala, Makurdi, Shiroro, Afikpo, Ebba,Gassol, Baro, Kurawa, Umaishia, Otuocha, Wuya, Donga, Chokocho, and Ogun, show gradual increments in flood discharge, however, the predicted probable flood areal coverage in 2021 is expected to be similar to that of 2020.

This AFO contains useful information on the areas that are likely to be flooded and the severity of the expected flooding in 2021. The need to carry out aggressive sensitization and awareness campaigns cannot be over-emphasized. Similarly, consistent clearing of our water ways and maintenance of hydraulic structures such as dams and reservoirs are very essential as these will ensure free flow of runoff into the provided drainages and the natural courses.

Stakeholders, decision and policy makers, relevant federal and state government departments and agencies should take note of the information contained in the 2021 AFO and prepare in advance. Finally, it is advised that the predictions of flood for 2021 AFO be adhered to and all recommendations heeded

NIHSA

CHAPTER ONE

CHAPTER ONE

1.0 INTRODUCTION

1.1 PREAMBLE

The demand for flood forecast has increased in recent times due to the likelihood of occurrence of flooding on major rivers to a more definitive magnitude and timing at key locations. Forecasting is a necessary part of flood management, given that no preventive or defence measures can be completely effective. The reason for National Flood Forecasting and Warning is to alert authorities and the general public on eminent flood occurrence and its impact on society.

The impact of flood worldwide cannot be overemphasized. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Water Assessment Programme (WWAP), which provided a clear statement on the problem of flooding, of all water – based natural hazards (Landslide & Avalanche 9%, famine 2%, water-related epidemic 11%, drought 11% and flood 50%), flooding makes up a significant figure of 50% and accounts for 15% of all deaths related to natural disaster (WMO, 2011).

At this point, it has become imperative to adopt the Integrated Flood Management (IFM) concept, which is a process of promoting an integrated – rather than fragmented – approach to flood management. This approach integrates land and water resources development in a river basin, within the context of Integrated Water Resources Management (IWRM), and aims at maximizing the net benefits from the use of flood plains and minimizing loss of life from flooding.

Thus, in this 9thedition of AFO, a more holistic approach to the forecasting and warning of flooding has been adopted. The quality and quantity of both hydrometeorological and hydrological data have improved, and an additional model is being utilized with more functional flood warning systems put in place.

The Agency is also not relenting in ensuring that essential links or components of the integrated flood forecasting, warning and response system consisting of a data source, communications, forecasts, decision support, notification (often referred to as dissemination), coordination, and actions (or responses) are followed through by all concerned.

A technical platform on management of flood was also created by the Agency on one of its social media handles (WhatsApp) to include all stakeholders. Implementing the integrated flood management concept/strategy involves; Reducing, Flooding, Reducing Susceptibility to Damage, Mitigating the Impacts of Flooding and Preserving the Natural Resources of Flood Plains.

NIHSA by its mandate will not be able to implement all the strategies and options alone but will synergize with all relevant MDAs, CSOs and NGOs in achieving the desired goal of reducing the negative impact of flooding on society.

1.2 THE PHYSICAL SETTING

1.2.1. Location

Nigeria is located within the western coast of Africa, slightly north of the Equator. It lies approximately between latitudes 4°N and 14°N and between longitudes 3°E and 15°E, encompassing a vast geographical area of contrasting landforms, climatic conditions and vegetation belts.

1.2.2.Spatial Extent

The surface area of the country is approximately 923,800 sq. km with about 200 million people(UNDP,2020). It is bordered by the Republic of Cameroun to the east, Republic of Niger to the north, and Republic of Benin to the west. The southern boundary is formed by the 800 km Atlantic coastline, which includes the eastern sector of the Gulf of Guinea.

1.2.3.Geology and Topography

Nigeria is naturally divided into three regions, the north, west and east, by the valleys of its two principal rivers, the Niger and the Benue. The three regions consist of distinctive relief features including highlands and plateaux, uplands and plains, escarpments and valleys, and coastal wetlands and delta (Figure 1.1). Thus, the north has the Jos Plateau located in its eastern central area. It also has the Adamawa Mountains along the eastern border, north of the Benue valley. The west has the uplands and plains studded with inselbergs, while the eastern region has the escarpments and the Eastern Borderlands plateau and highlands (Bamenda Mountains and the Mambilla Plateau).

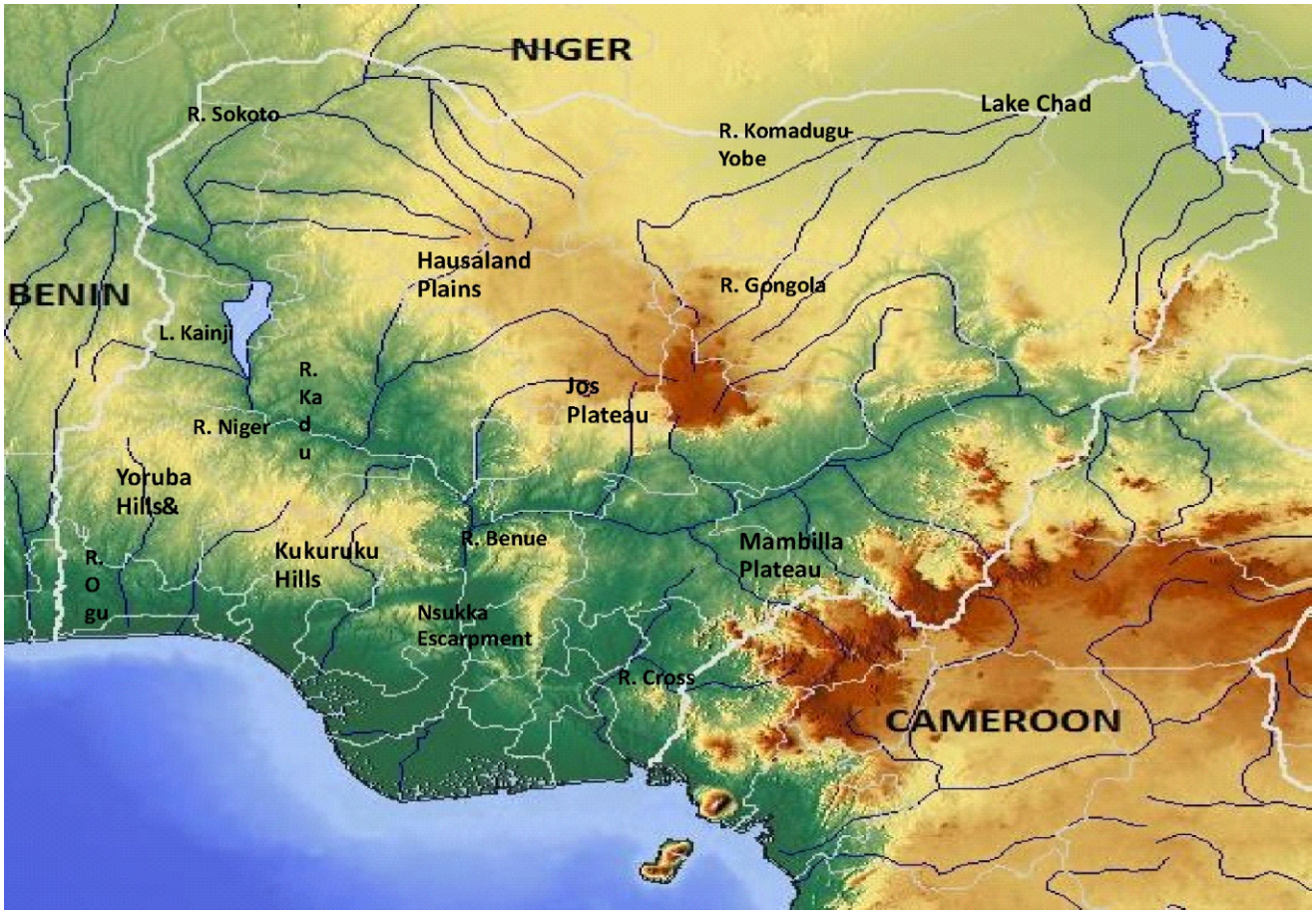


Figure 1.1: Generalized relief map of Nigeria.

The mountains, plateaux and highlands are made of igneous and metamorphic rocks. In general, the uplands and plains are denudation surfaces derived from the long-term denudation of crystalline rocks mainly of the Precambrian Basement Complex suite (granite, gneiss, quartzite, amphibolite and schist).

In the central north, the plains are called the High Plains of Hausa land, and they, along with the Jos Plateau, form a major headwater zone from where rivers radiate forming a radial drainage pattern. The Eastern Borderlands constitute headwaters for some of the tributaries of River Benue, Lake Chad and River Cross. In western Nigeria, the uplands comprise the Yoruba Hills and Ranges and its extension, the Kukuruku Hills. The ranges and hills constitute a major drainage divide separating the rivers running southwards into the Gulf of Guinea from those running eastwards and northwards into the River Niger. Most of these rivers run parallel to each other and the drainage pattern is trellised where it is structurally controlled or otherwise dendritic.

Another category of plains consists of aggradation land surfaces and are found in areas bordering the denudation land surfaces. The Sokoto Plain (in the northwest), and the Kerri–Kerri and the Gombe Hills (to the east of the Jos Plateau) belong to this category. They are composed of Cretaceous to Tertiary age sedimentary rocks. The Kerri–Kerri merges to the north with the Quaternary plains of the Chad Basin. The drainage pattern on these plains is centripetal with a focus on the Lake Chad in the east, and the Sokoto valley in the west.

Similar aggradation surfaces extend over the areas bordering the southern and eastern margins of the Yoruba/Kukuruku Hills and Ranges. These extend to the coast where they form coastal plains associated with barrier islands, and fresh water, brackish water and marine wetlands. The plains also extend eastwards across the Niger valley into eastern Nigeria where they constitute the Anambra and the Cross River plains. In central eastern Nigeria, the plains are composed of resistant rocks that form the Awka–Orlu, and the Nsukka–Okigwe escarpments. These latter constitute drainage divides separating rivers draining into the Niger (e.g., River Anambra) and the River Imo from those draining into the River Kwa Ibo and River Cross.

The coastal zone consists of four contiguous physiographic types, each terminating landward at the southern boundary of the Coastal Plains. These are the Barrier Beach–Lagoon complex; Transgressive Mud coast and associated wetlands and intertidal flats, Niger delta and its distributary system, characterized by barrier islands separated by tidal channels and backed by extensive mangrove swamps; andStrand Estuary complex consisting of narrow sandy beaches backed by coastal plains and rather limited wetlands.

1.3. CLIMATE

The climate at any location in Nigeria is directly related to the distance from the Atlantic coast (Figure 1.2), except where coastal upwelling on the one hand, and inland orographic effects on the other, provide counteracting influences. The climate type within 100 km of the coast is the Koppen's A_f humid tropical type, with mean rainfall ranging from 1800mm at Lagos in the west, to amounts in excess of 4000 mm in the area proximate to the River Cross estuary (Eket, Akwa Ibom). Landward, at distances

exceeding 200 km from the coast in western Nigeria, and 250 km in the east, the Koppen's A_{w1} wet and dry climate type prevails. The rainy season extends from April to October with mean annual rainfall in excess of 1200 mm. This is the zone referred to as the Guinea Savanna given its diagnostic floral composition. Between the Guinea Savanna and the Humid Tropical A_f climate or Rain Forest zone is an area described as Derived Savanna, an anthropogenic derivative from the Rain Forest but with characteristics similar to those of the Guinea Savanna.

The northern boundary of the Koppen'sA_{w1} region follows a line extending from the northern end of the Lake Kainji to the northern foreland of the Jos plateau, after which it dips southwards towards the Mambilla plateau. Northward of this region, the prevailing climate is the Koppen's A_{w2} Tropical Wet and Dry (Sudan type). The Koppen'sBshw (Sahel type) prevails in the extreme northeast of Nigeria. Mean annual rainfall in these two climatic zones varies from less than 400 mm in the distal northeast to approximately 1000 mm in the southwest, along the boundary with the Koppen's A_{w1} zone. The length of the rainy season varies from three months in the northeast (July – September) to six months (in the south) (May –October). The dry season lasts variously from October to May, during which, cold and dry Harmattan winds prevail, particularly between November and February. The rainfall and number of rainy–days both decrease rapidly northwards (Ogunkoya, 2017).

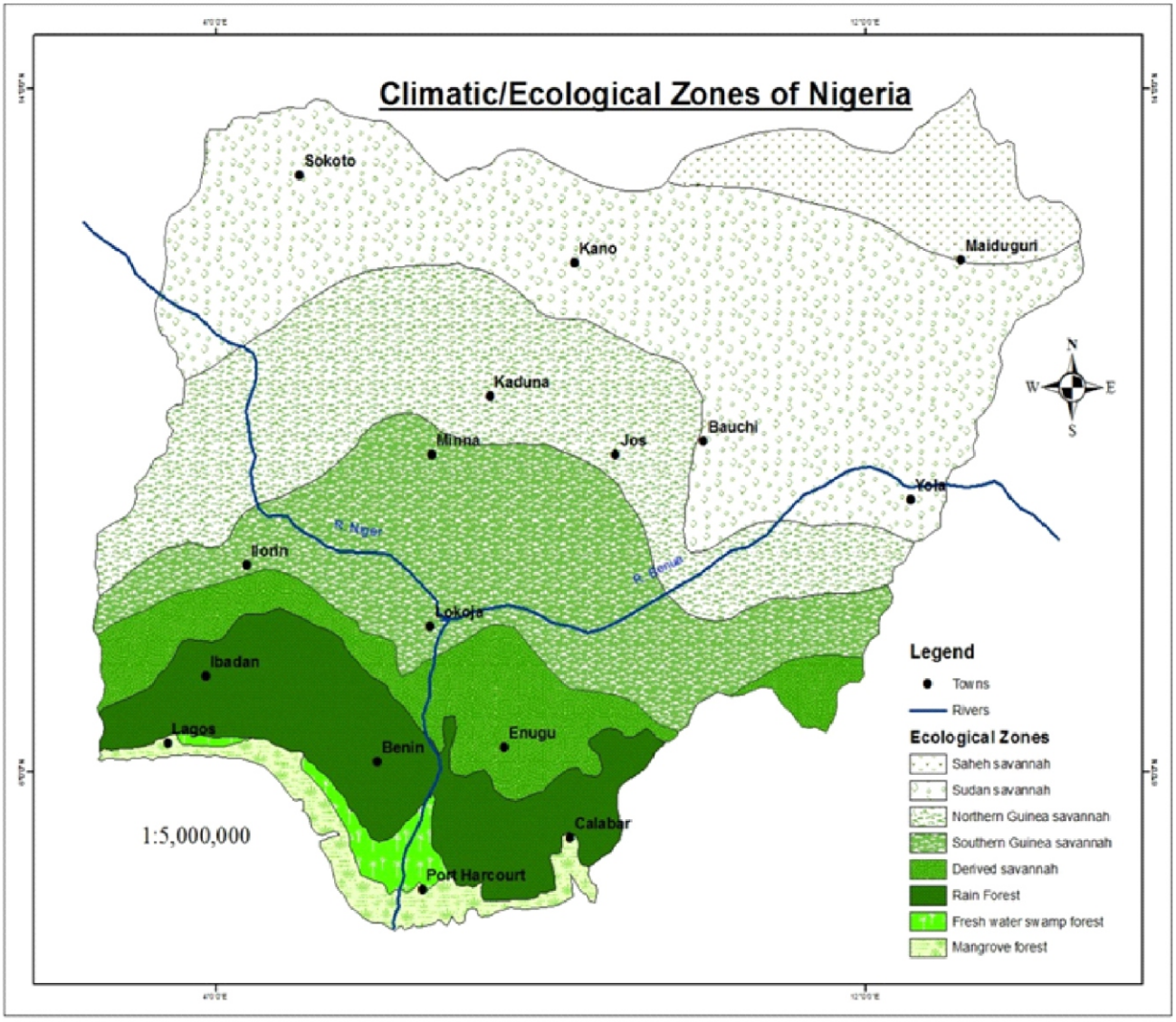


Figure1.2: Climatic/Ecological Zones of Nigeria

1.4. RIVER/ DRAINAGE SYSTEMS OF NIGERIA

The large number of high order rivers and the well–drained nature of the country present a picture of inexhaustible water resources (Figure 1.3). However, the climate over Nigeria imposes a regime on many of the rivers such that there is a rainy season of high water and a dry season of little or no water within the average year.
The rivers in Nigeria can be grouped into five drainage systems:

- Niger (i.e., the Niger and its tributaries apart from the Benue)
- Benue (the Benue and its tributaries)
- Chad (Lake Chad and its tributaries)
- Cross River/Imo/Qua-Iboe and all the short rivers draining the eastern littoral zone
- Western littoral rivers (the rivers of western Nigeria that follow more or less regular courses in the N – S direction.

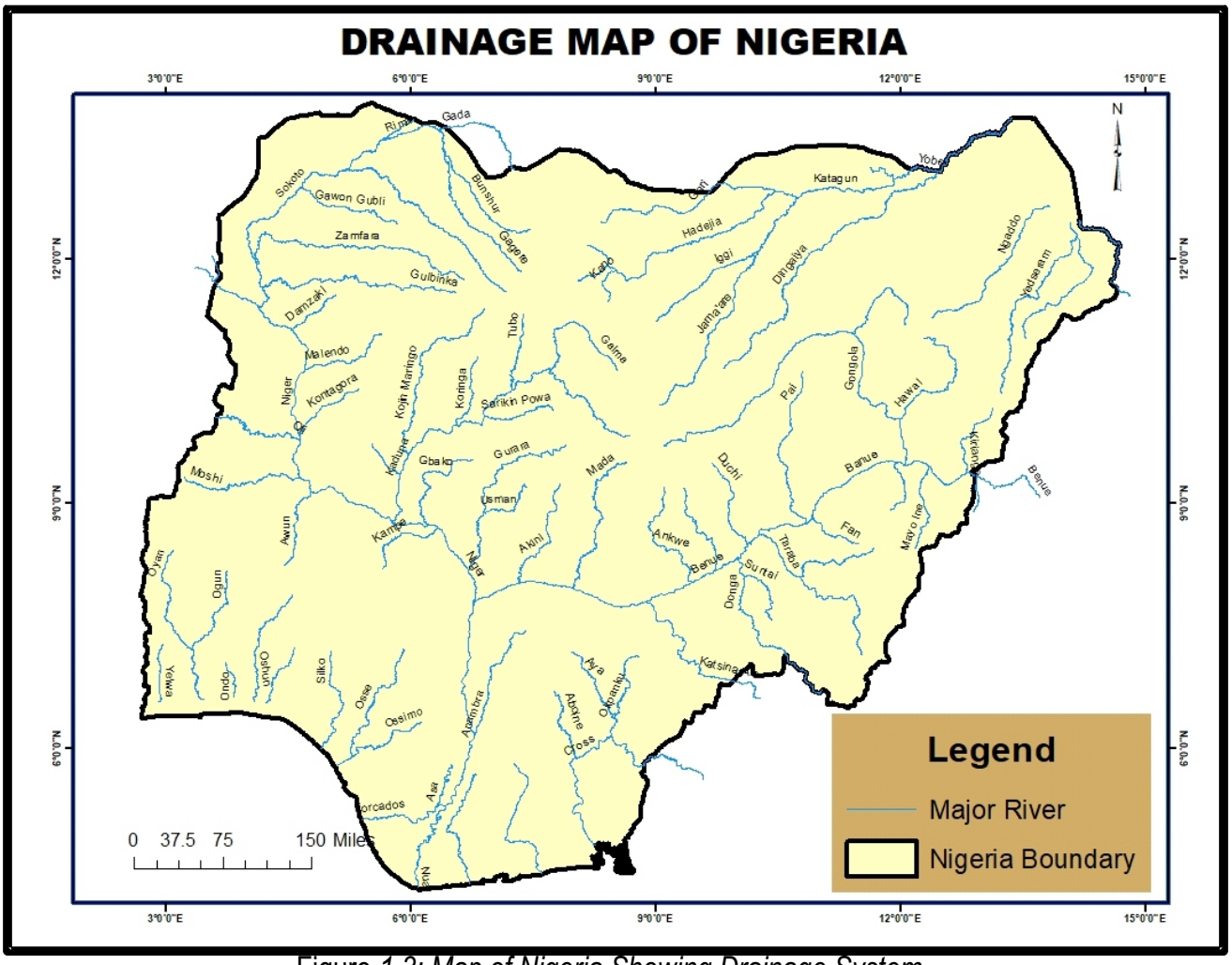


Figure *1.3: Map of Nigeria Showing Drainage System*

The division of these rivers into five groups is not based on any peculiar characteristic but that of proximity and similarity in the direction of flow. Except for the Chad drainage system, which is an endorheic drainage system, all the other drainage systems ultimately drain into the Gulf of Guinea. The rivers flowing into Lake Chad from Nigeria (mainly River Komadugu–Yobe, River Ngadda and River Yedseram) provide 10% inflows into the lake. The other tributaries of the Lake Chad originate from Cameroon, Chad and Central African Republic (including Chari and Logone), which provide 80% of the inflow, while precipitation provides the remainder 10%.

1.5. THE EIGHT HYDROLOGICAL AREAS

The Nigeria's drainage systems have been divided into eight Hydrological Areas or Basins based on the drainage patterns (Figure 1.4 and Table 1)

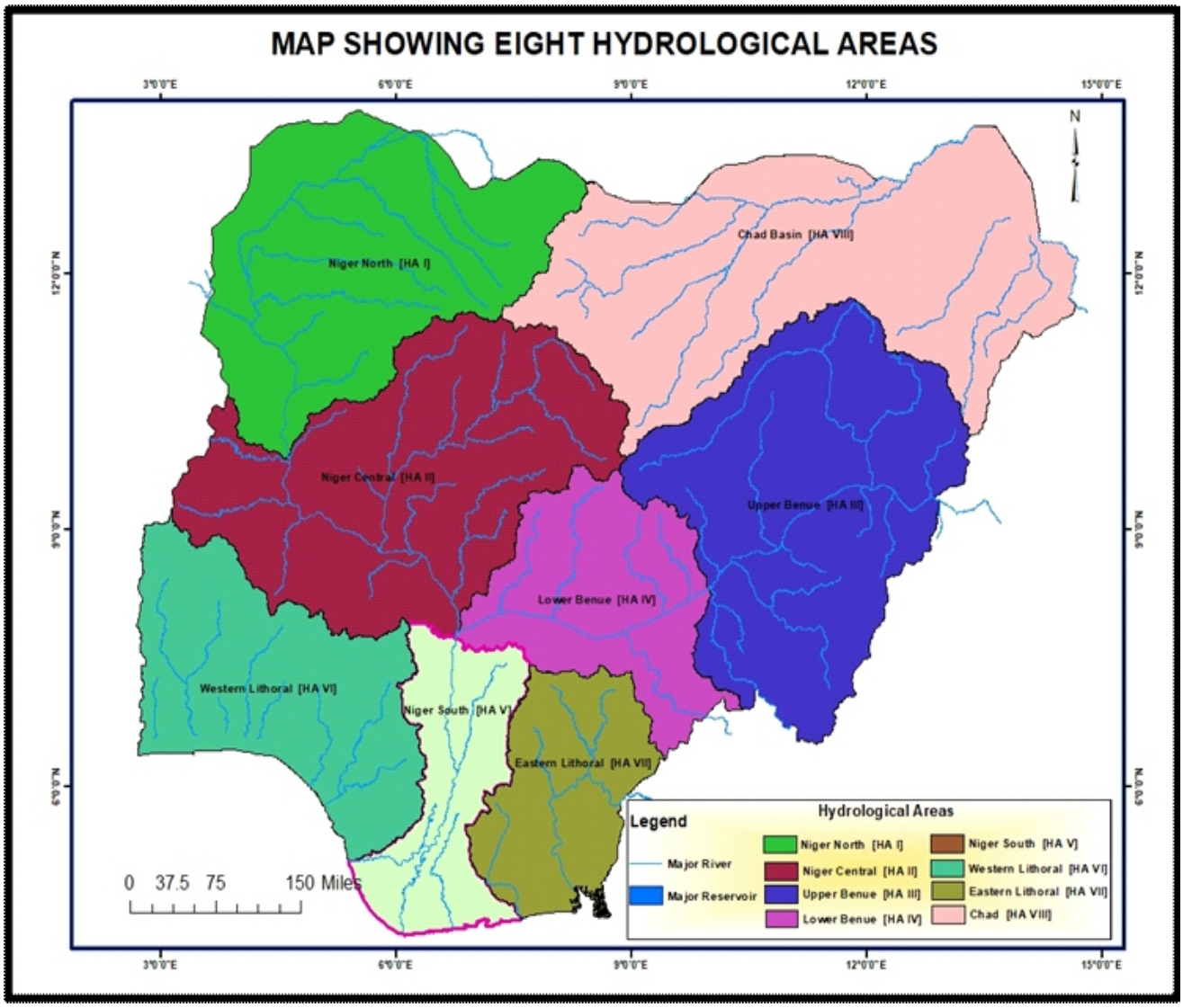


Figure 1.4: Hydrological Areas of Nigeria

Table 1: The Eight (8) Hydrological Areas – Principal drainage system

Hydrological Area	Drainage Area (Km^2)	Description
HA I: Niger North	131,600	Consists mainly of the Sokoto –Rima drainage basin and some relatively small drainage basins in the northwestern zone of the country. All the rivers drain directly or otherwise into River Niger.
HA II: Niger Central	158,100	Consists mainly of the Kontagora, Kaduna, Gbako, Gurara, Moshi, Oyi – Kampe and some smaller drainage basins discharging into the middle section of the River Niger (Kainji Dam – Lokoja).
HA III: Upper Benue	158,900	Mainly the Gongola, Donga and Taraba drainage basins though it includes numerous but small rivers draining directly into Benue.
HA IV: Lower Benue	73,000	Rivers Mada, Ankwe, Shemankar, Katsina Ala and many others that drain into the Benue from the north and south between the confluence with the Niger and some distance east of Makurdi.
HA V: Niger South	53,900	Consists of tributaries such as the Mimi, Orle, and the Anambra discharging into the main trunk of the Niger, and the Ase, Orashi and Sombreiro, which drain into Upper Niger Delta.
HA VI: Western Littoral	100,500	All the north –south flowing rivers in the southwestern zone of the country.
HA VII: Eastern Littoral	59,800	Consists of the rivers draining eastern Nigeria, including Cross River and River Qua-Iboe, which drain into the Gulf of Guinea.
HA VIII: Chad Basin	188,000	Consists of the rivers draining into the Lake Chad. The principal rivers are the Hadejia, Gana -Komadugu–Yobe, Ngadda and Yedseram.

1.6 CAUSES OF FLOODING IN NIGERIA

The soil moisture regime of the lower lying plains during the peak of the rainy season, the prevailing extreme weather conditions presumed to be associated with climate change, dam operations particularly outside the nation's borders, and topography have promoted significant flooding in recent times. Floods have since become annual phenomena not only within flood plains, but also in urban and semi-urban areas.

Urban flooding is linked to inadequacies of drainage channels that have become too small to contain excess runoff, the use of river channels as waste repositories thus clogging the channels, poor compliance with or non-existence of land use zoning/building codes, poor waste management practices, and removal of vegetation that create resistance and minimize flood impact.

Coastal areas of Nigeria are not spared from flooding. A cause could be the continuing global warming and associated extreme events (IPCC, 2007). Rising temperatures cause glaciers to retreat and icecaps to melt promoting sea level rise by the added water from melting ice and the expansion of sea water as it warms. Also, mangroves that provided buffers to cushion flooding are being degraded along the Nigeria coastline, thus exacerbating flood impact. The flooding is always more severe during high tides when coastal drainage is occluded. Figures 1.5, 1.6 and 1.7 show some flood scenes in the country in 2020.

Figure 1.5: Houses destroyed by flood in Jigawa State 2020.

Figure 1.6: Houses submerged by flood in Abeokuta, 2020

Figure 1.7: Degrading Mangrove along the Nigerian Coastline in Rivers State, 2020.

Figure 1.8: Submerged Bridge due to flood effect in Kebbi State.

Figure 1.9: Effect of Flood in Adamawa State.

CHAPTER TWO

CHAPTER TWO

2.0 EVALUATION OF THE 2020 ANNUAL FLOOD OUTLOOK (AFO)

2.1 INTRODUCTION

Effective management of flood requires a good understanding of historical flood trends, future expectation, and identification of locations likely to be impacted by flood. In 2020, Nigeria faced numerous challenges such as COVID-19 pandemic, insecurity, inflation and flooding among others as it struggles to achieve the Sustainable Development Goals (SDGs) with flooding and COVID-19 pandemic being the most serious with wide-reaching impact.

More states in Nigeria are increasingly suffering from annual flooding due to climate change and anthropogenic factors. For instance, in 2020, water levels at the hydrological stations monitored in Niamey (Niger Republic) and Malan Ville (Benin Republic) reached the red alert zone due to torrential rainfall, and this resulted into flooding in Jigawa, Kebbi, Kwara, Sokoto, and Zamfara state, amongst other states, affecting 91,254 people (IFRC, 2020).

Nigeria is located downstream of River Niger and Benue, and therefore abounds with water resources that become a menace by causing flooding and flood disasters, the worst of which was experience in 2012 when hundreds of lives were lost, thousands of citizens rendered homeless with property loss running into billions of Naira including massive farm lands and crops. In addition to local rainfall, transboundary flows from River Niger and Benue have continued to aggravate flooding and flood disasters in the country. The devastating impact of 2020 flooding affected 36 states including FCT, 349 Local Government Areas and 2,353,647 people (69 fatality as recorded).

The total annual renewable water resources of Nigeria wereestimated at 286.2 billion cubic meters per year, out of which214 billion cubic meters per year constitutes surface water and 87 billion cubic meters ground water.The external water resources from River Niger were estimated at 65.2 billion cubic meters per year and the total extractable annual groundwater resources at 59.51 billion cubic meters (JICA,2014).

2.2 FLOW SITUATION IN RIVERS NIGER AND BENUE

The Rivers Niger and Benue are of particular interest because of their transboundary influence in Nigeria.Extreme and devastating flood was recorded along the River Niger in Niamey, Niger Republic, upstream of Nigeria in August, 2020. The flood observed on 28th August, 2020 had a maximum water level of about 6.80m corresponding to the discharge of 3,162 m^3/s. The flooding was unprecedented and the highest ever recorded in Niamey as shown in the comparative hydrographs of 2012/2013, 2018/2019, 2019/2020 and 2020/2021, Figure 2.1.

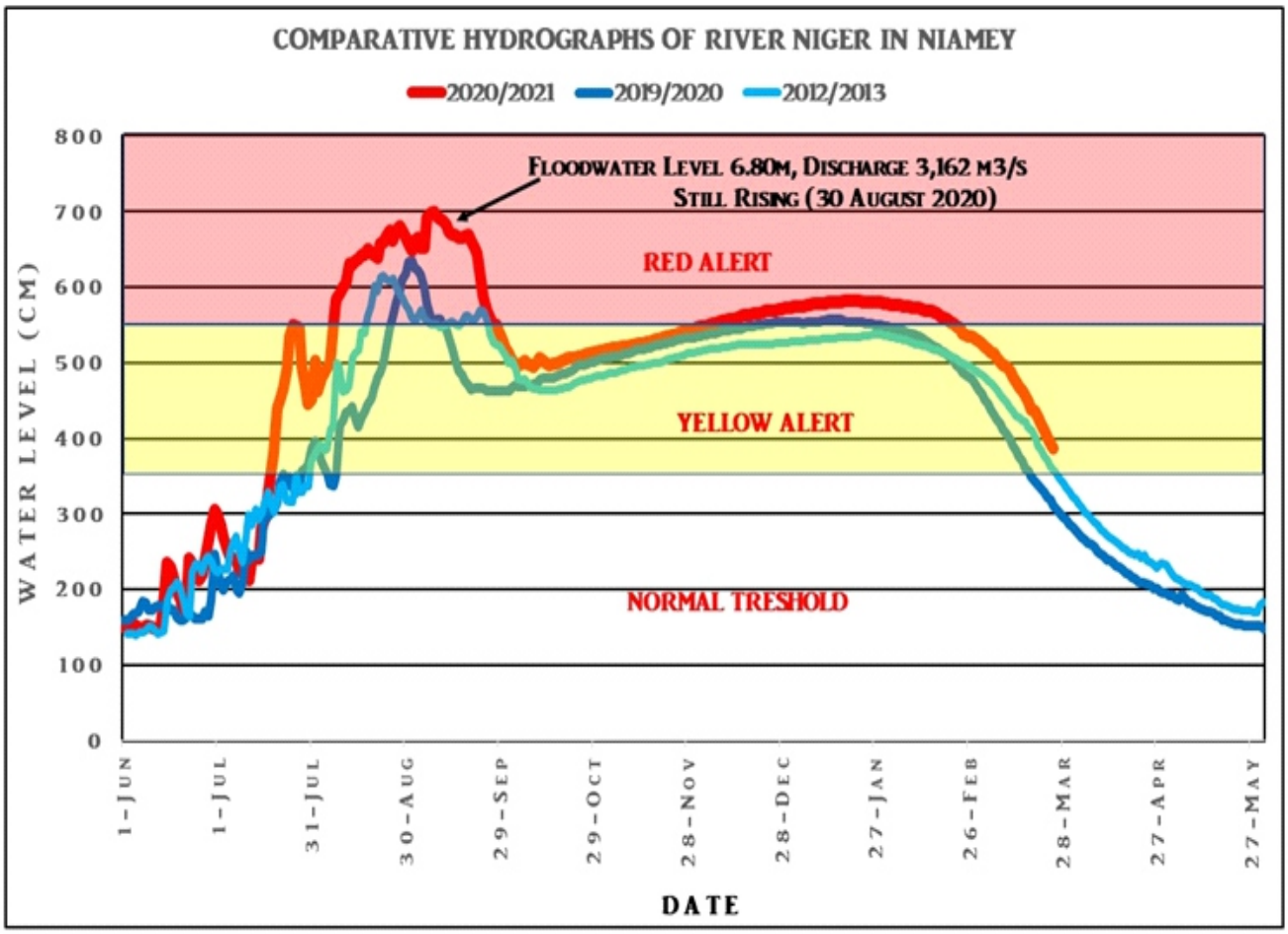


Figure 2.1: showing comparative hydrograph at Niamey

2.2.1 RIVER NIGER FLOW SITUATION AT JIDEREBODE, UPSTREAM KAINJI DAM

In 2020/2021, hydrological transboundary flood flow of River Niger consisted of the White and Black flood semanating from the 8 members countries of Niger Basin Authority (NBA). The White flood occurs during the rainy season. A maximum water level of 5.36m was recorded on the 16th September, 2020. This was recorded as being in the zone of the Red alert at NIHSA's hydrological gauge station located at Jiderebode, upstream of Kainji dam.

The Black flood, a dry season phenomenon in Nigeria, but comprising the previous rainy season's flood that was delayed at the Niger's inland delta near Timbuctoo, Mali continued arriving in Nigeria. A maximum water level of 3.55m was recorded on 28th February, 2021 as being within the zone of warning alert. The water replenishes Kainji and Jebba reservoirs. The 2020/2021 comparative hydrograph (Figure 2.2) showed a lower maximum flood flow when compared with those recorded in 2012/2013 and 2019/2020.

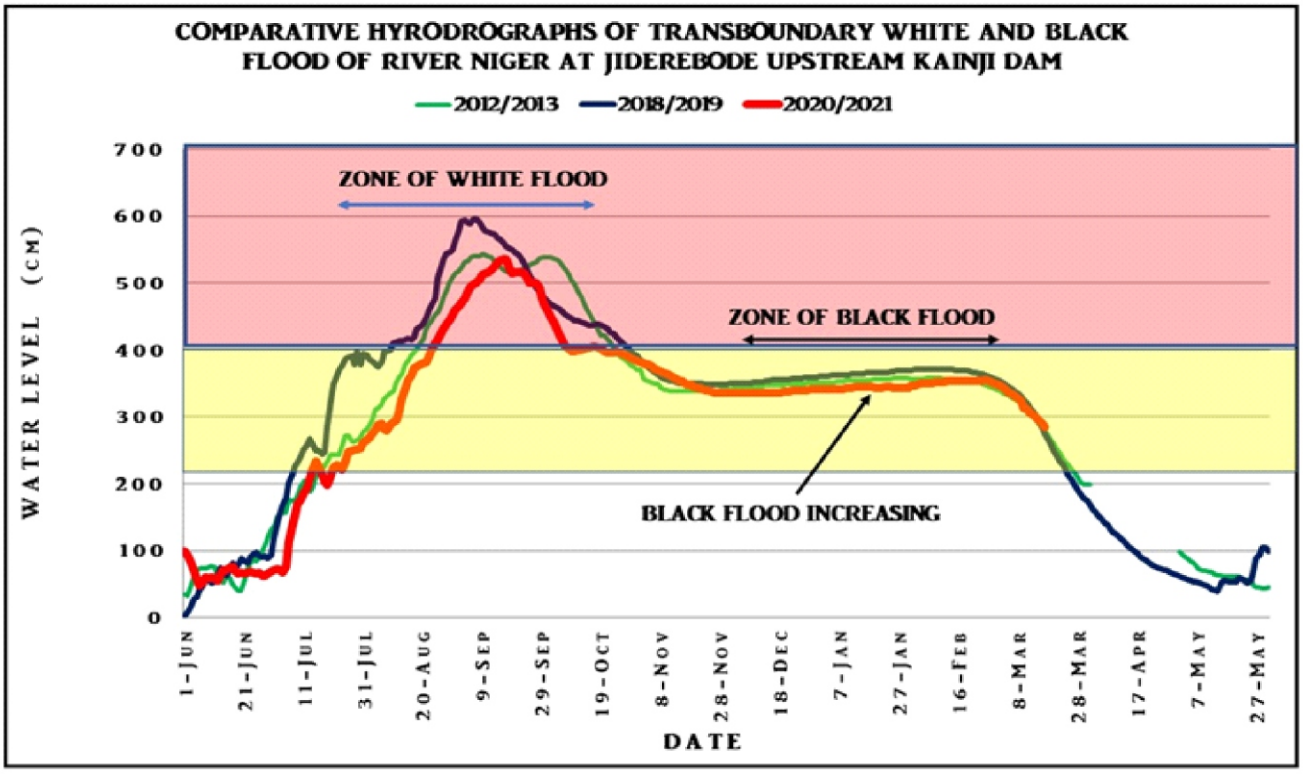


Figure 2.2: 2020/2021 comparative with 2019/2020 and 2012/2013.

2.2.2 RIVER NIGER FLOW SITUATION AT LOKOJA DOWNSTREAM KAINJI DAM

The flow situation of River Niger and Benue at Lokoja (Kogi State) in 2020/2021 Hydrological Year has a maximum Water Level (WL) of 11.89m corresponding to a discharge of 23,459 m^3/s recorded on 5th October 2020 as shown by the comparative hydrographs of River Niger and Benue at Lokoja. The 2020/2021 hydrograph indicates lower maximum flow in the zone of Red alert than those of 2012/2013 and 2019/2020 (Figure 2.3).

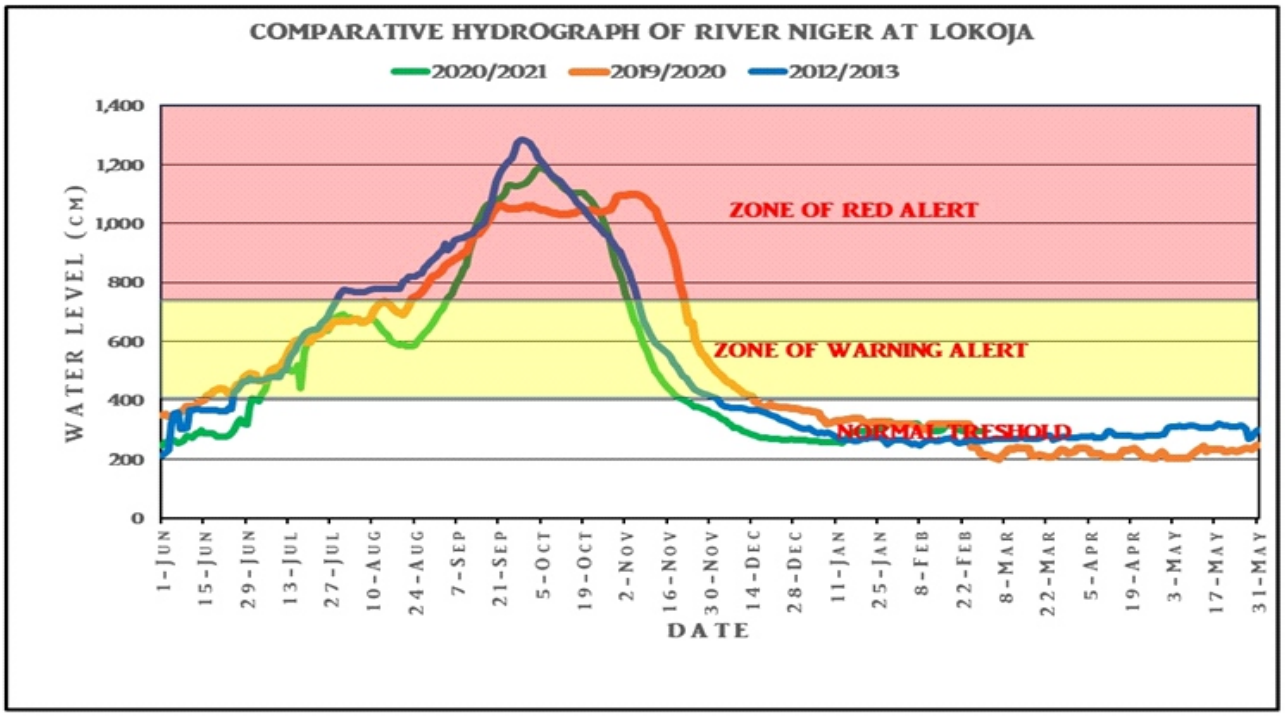


Figure 2.3: Comparative Hydrographs of Rivers Niger at Lokoja.

2.2.3 RIVER BENUE FLOW SITUATION AT MAKURDI

River Benue at Makurdi (Benue State) in the 2020/2021 Hydrological Year had a maximum water level of 10.08m on the 20th October, 2020 as shown in Figure 2.3 The comparative hydrographs of River Benue (Figure 2.4) showed that the maximum flow recorded in 2020/2021 Hydrological Year in the zone of Red alert was lower than those in 2012/2013 and 2019/2020.

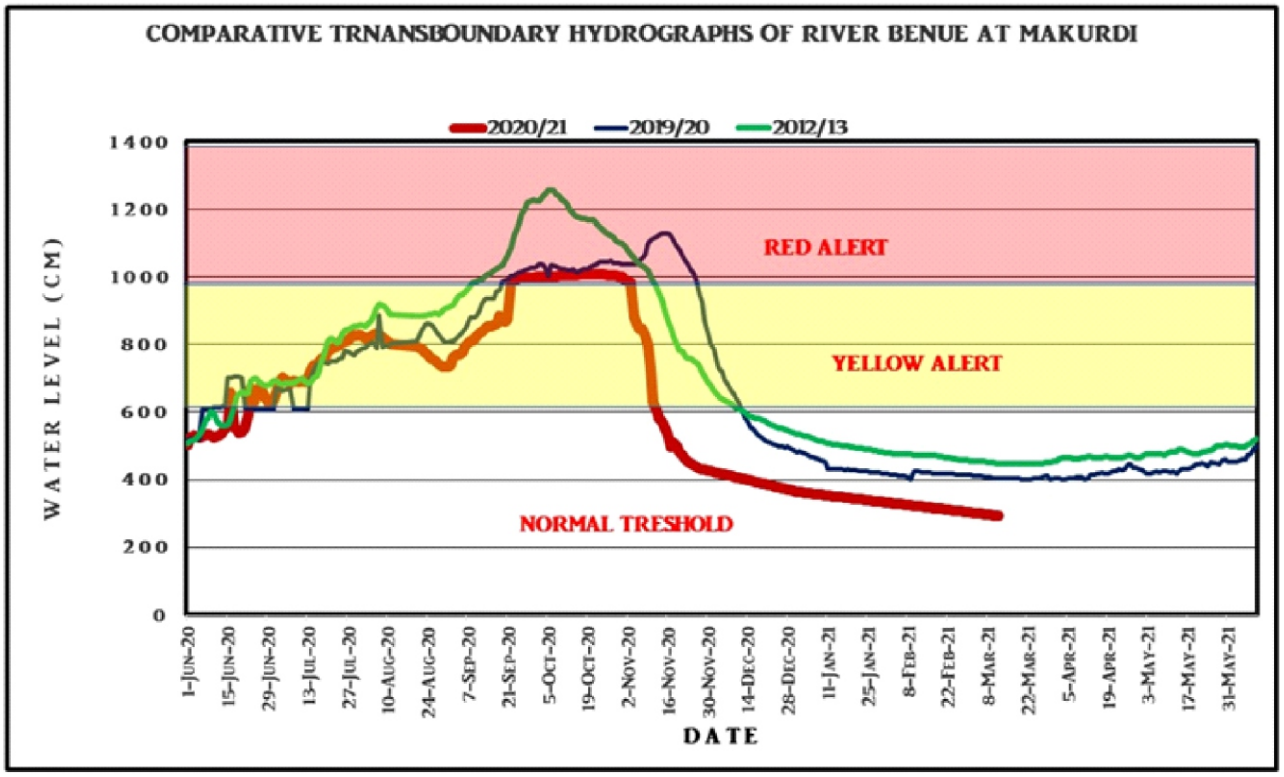


Figure 2.4: Comparative Hydrographs of River Benue at Makurdi

2.3. EVALUATION OF HYDROLOGICAL MODELS

The 2020 AFO used two (2) models namely: Geospatial Stream Flow Model (GeoSFM) and Soil Water Assessment Tools (SWAT). The GeoSFM has the capability to simulate hydrology in larger basins with the use of global data sets while SWAT model has the capability to run simulations for large watersheds without extensive monitoring data. Furthermore, the relevance of the models in use also depends on climatic and physical conditions of applications. Therefore, the models may be limited by factors such as the availability of recorded data and the observation of the physical processes.

The successes recorded from the use of these models informed the continuous application of the models for flood forecasting. However, the Agency evaluated the performance of the models using a purposive sampling technique to select gauge stations that are of interest to the Agency to quantify their efficiency for flood prediction. The aim is to evaluate, the two models by comparing observed and simulated flows for year 2020.

Figure 2.5 below, shows the comparative hydrograph of the simulated and actual flow at Makurdi. The GeoSFM model simulated a peak flow of 12,352 m^3/s, the SWAT simulated 3,787 m^3/s while the actual data recorded from the station is 9,147 m^3/s on 22nd October, 2020. Thus, there is deviation in the observed and the simulated flow.

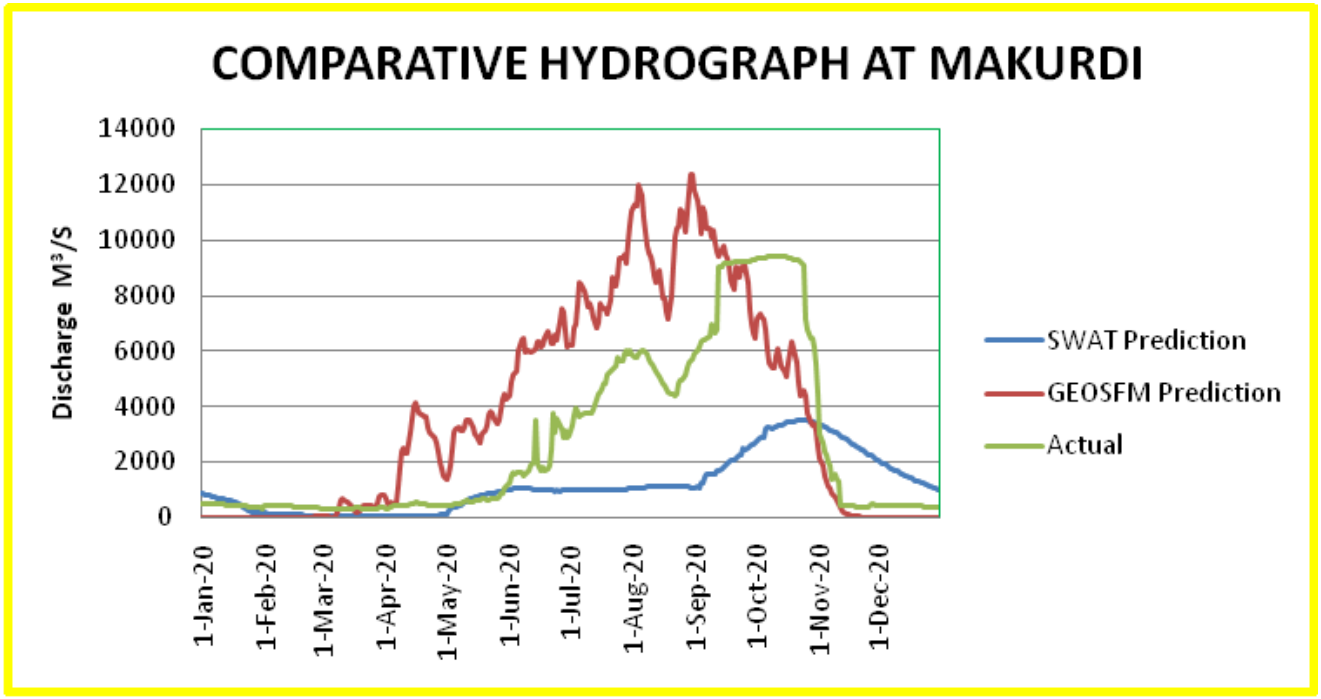


Figure 2.5. Comparative Hydrograph of Actual and Predicted Flow at Makurdi

However, in figure 2.6 below, it was observed that in Lokoja the SWAT model simulation reflects the actual flow rate which is slightly above 20,000 m^3/s as at 28th October, 2020. There is a significant deviation be
tween the flow simulated by GeoSFM and the observed data recorded.

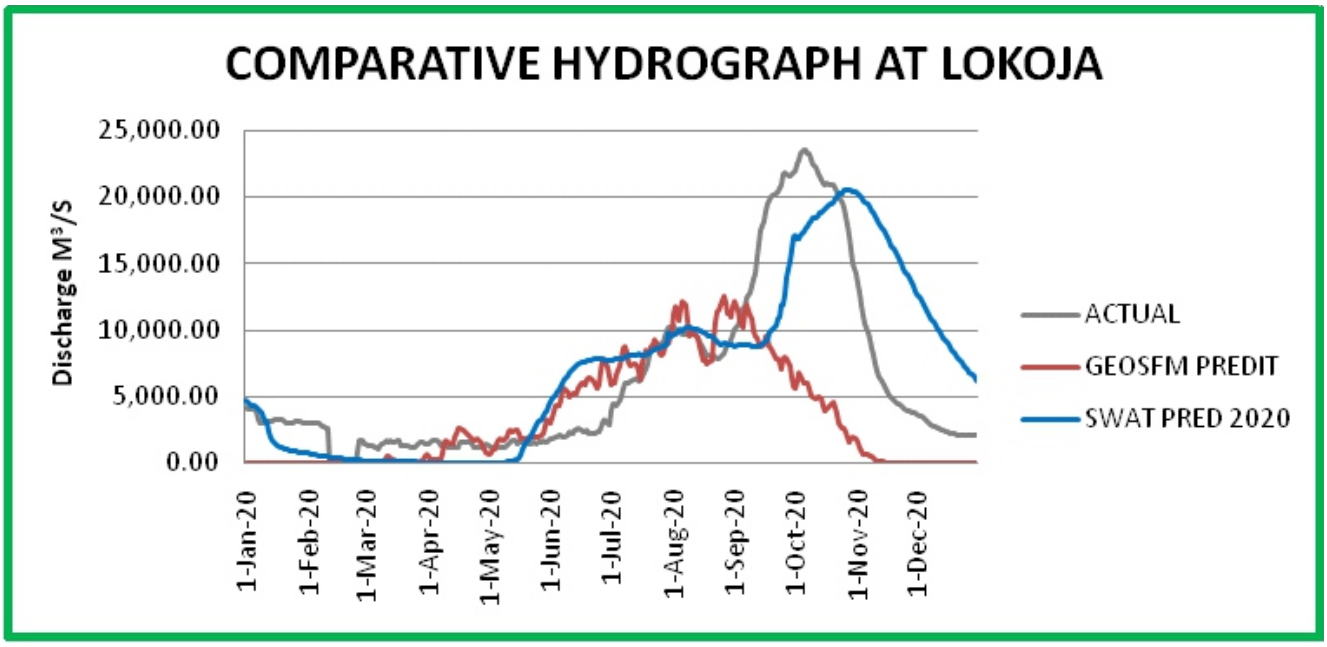


Figure 2.6Comparative Hydrograph of Actual and Predicted Flow at Lokoja

In Katsina-Ala, the two model simulation performed credibly as shown in Figure 2.7 below. Though the SWAT model predicted that the peak flow would be 2,443 m^3/sin October, the actual peak was 2,191.64 m^3/s in September.

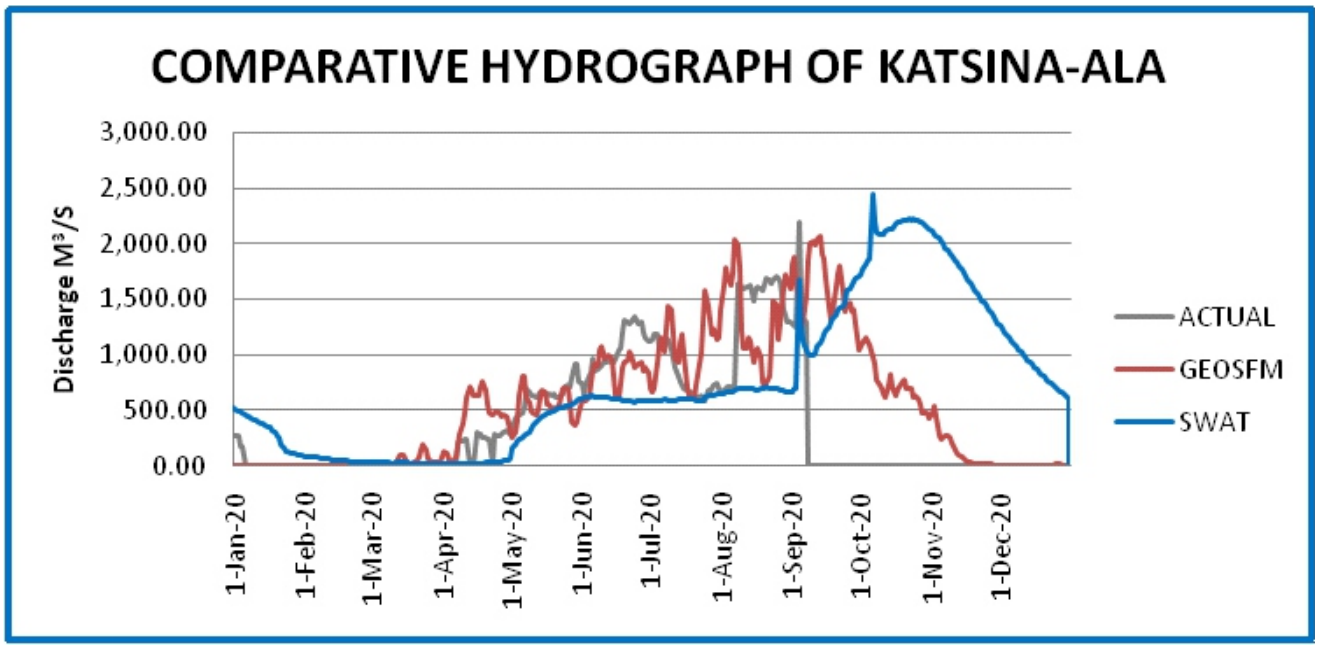


Figure 2.7 Comparative Hydrograph of Actual and Predicted Flow at Katsin-Ala

In Wuya, the SWAT model predicted peak flow of 3,082.24 m^3/s in September, 2020 while the actual peak flow was1,588 m^3/s in October 2020 as shown in figure 2.8, a very significant deviation.

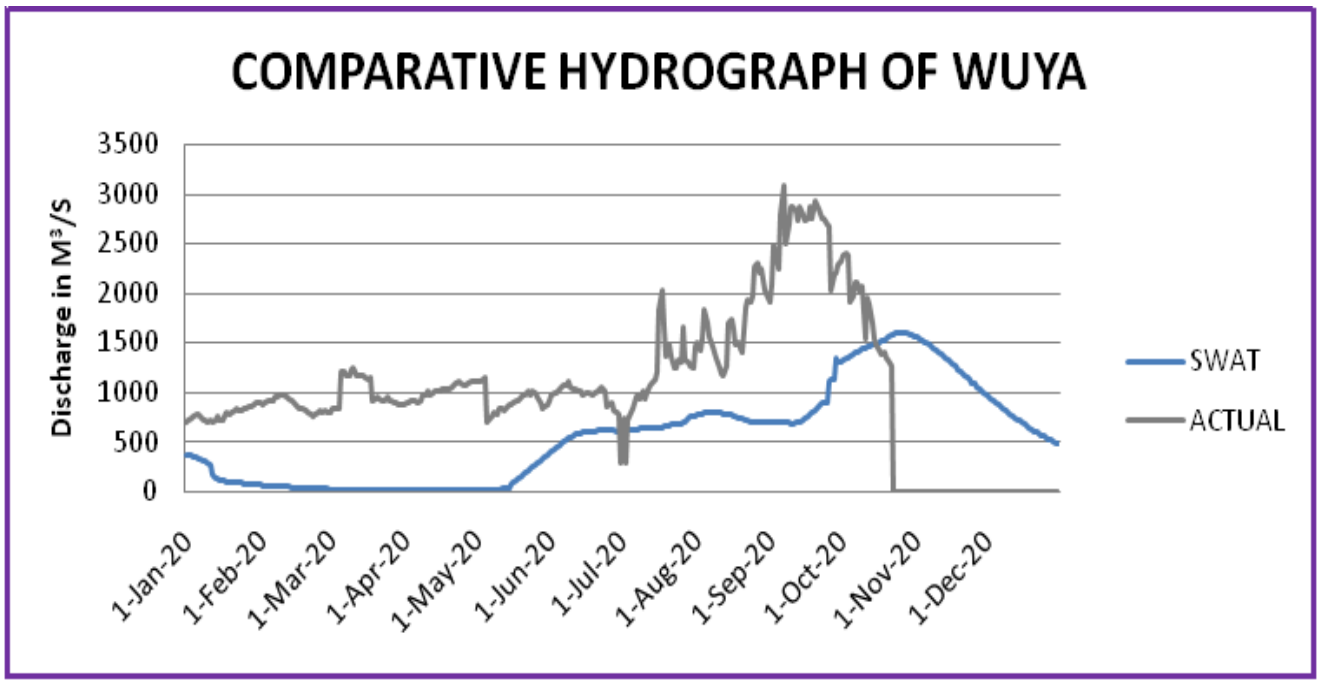


Figure 2.8. Comparative Hydrograph of Actual and Predicted Flow at Wuya

Despite the disparity between the actual and the simulated flow, the model's simulations has helped in mitigating the effects of flood within the country.

2.4 EVALUATION OF 2020 FLOOD INCIDENCES

It was observed that some of the worst flooding occurred in early October, causing severe destruction in Kebbi, Kwara, and Zamfara States affecting about 129,000 people (NEMA, 2020). Furthermore, flooding was also reported in southern parts of the country, affecting Anambra, Rivers and Delta among others.Damage to property and loss of lives were reported all over the country especially those living within flood prone areas (details in Table 2.2).

The 2020 flood forecast was classified into three (3) categories: Highly Probable, Probable and Less Probable Risk Areas. The actual floodedLGAs for 2020 are shown in Figure 2.9 while Table 2.1 shows the analysis of 2020 flood occurrence in Nigeria

Figure. 2.9: Picture of Flooded farmland inKebbi State(NEMA, 2020)

Figure 2.10: Picture showing Houses submerged in Ikorodu, Lagos State.

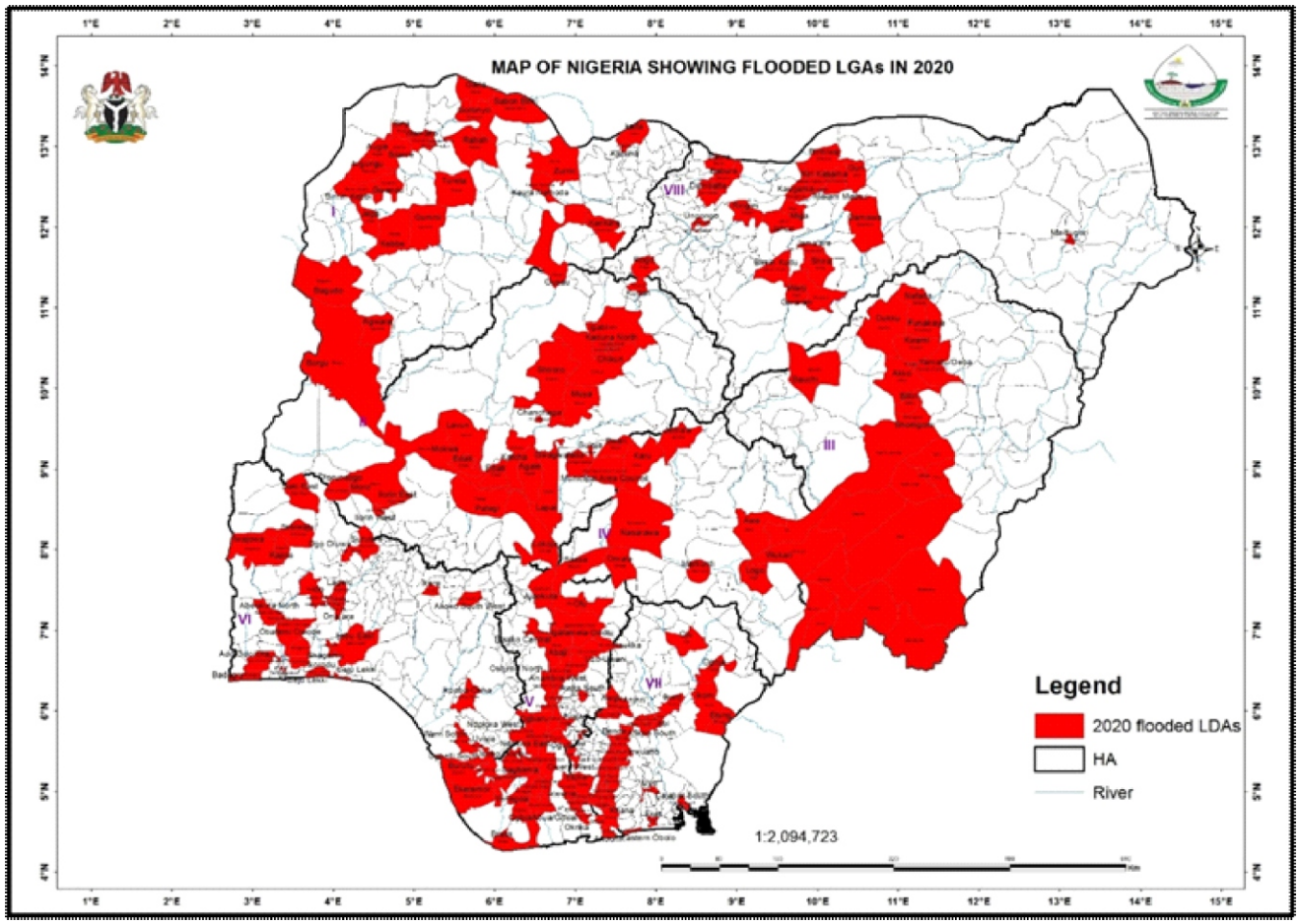


Figure 2.11 Flooded Local Government in 2020/2021 Hydrological Year

Table 2.1 Comparative Analysis of 2020 Flood Occurrence

Serial	Flood Scenario	Number of Affected Local Government Area
1.	Predicted	363
2.	Actual (reported)	222
3.	Occurred Not Predicted	77
4.	Predicted Not Occurred	216
5.	Predicted Occurred	145

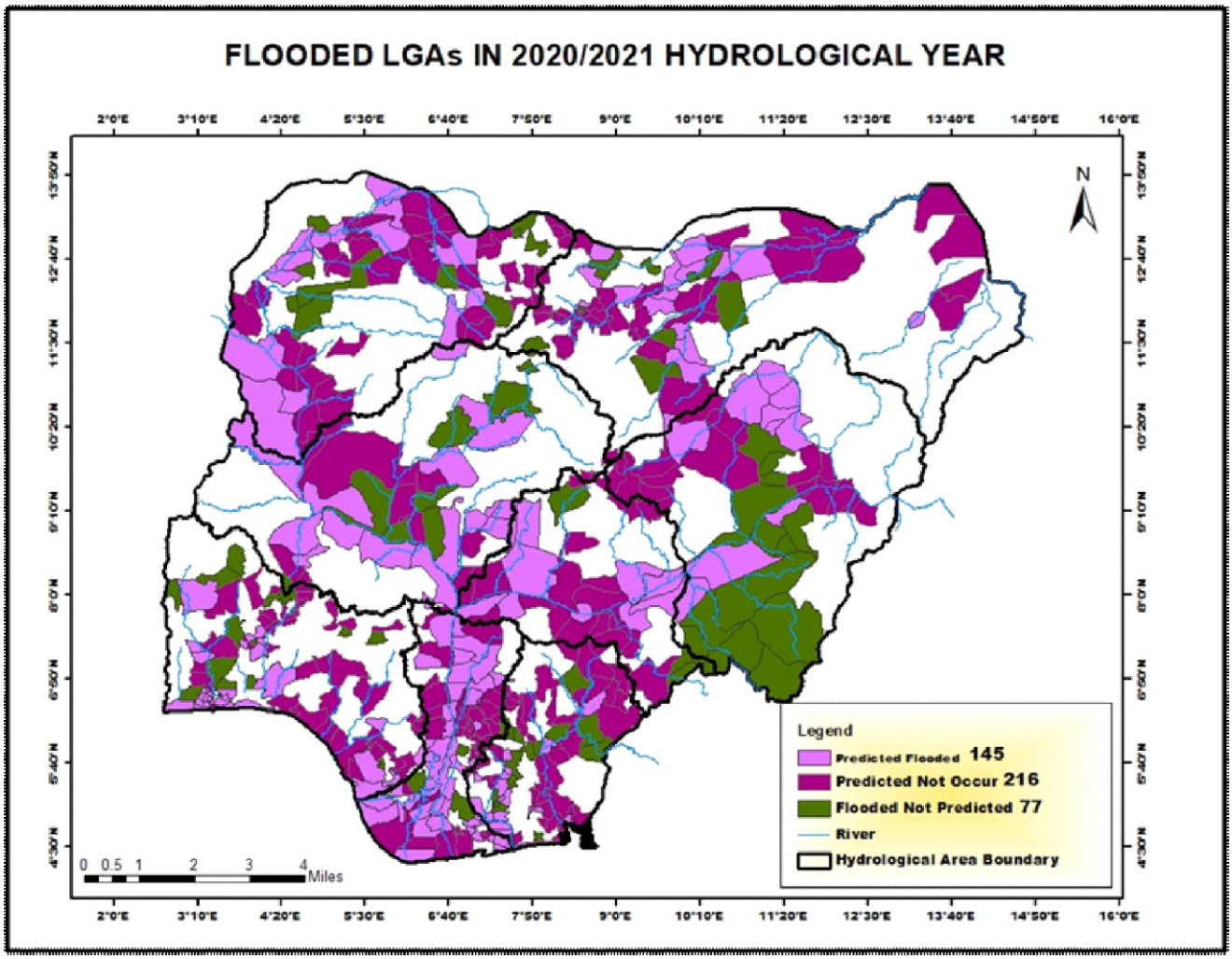


Figure 2.12. Overview of 2020 Flood occurrence in Nigeria

Table 2.2 Effect of 2020 flood in Nigeria

Serial	Effect	2019	2020
1.	Affected Population	130,936	2,353,647
2.	Number of Deaths	126	69
3.	Number of persons Displaced	48,114	865,829
4.	Damages to farmlands	-	979,054
5.	Number of States affected	34 States including FCT	36 States and FCT

Source: NIHSA field assessment, NEMA 2020 flood report, <http://floodlist.com/africa/nigeria-floods-october-2020>

From Table 2.2 above, a total of 363 LGAs in 36 states including FCT were predicted to be prone to flooding in 2020, while a total of 222 flood occurrence was reported (See Appendix 1). Additionally, a total of 77 LGAs experienced flooding that was not predicted by 2020 AFO. It should however be noted that several factors could be responsible for the variation in 2020.

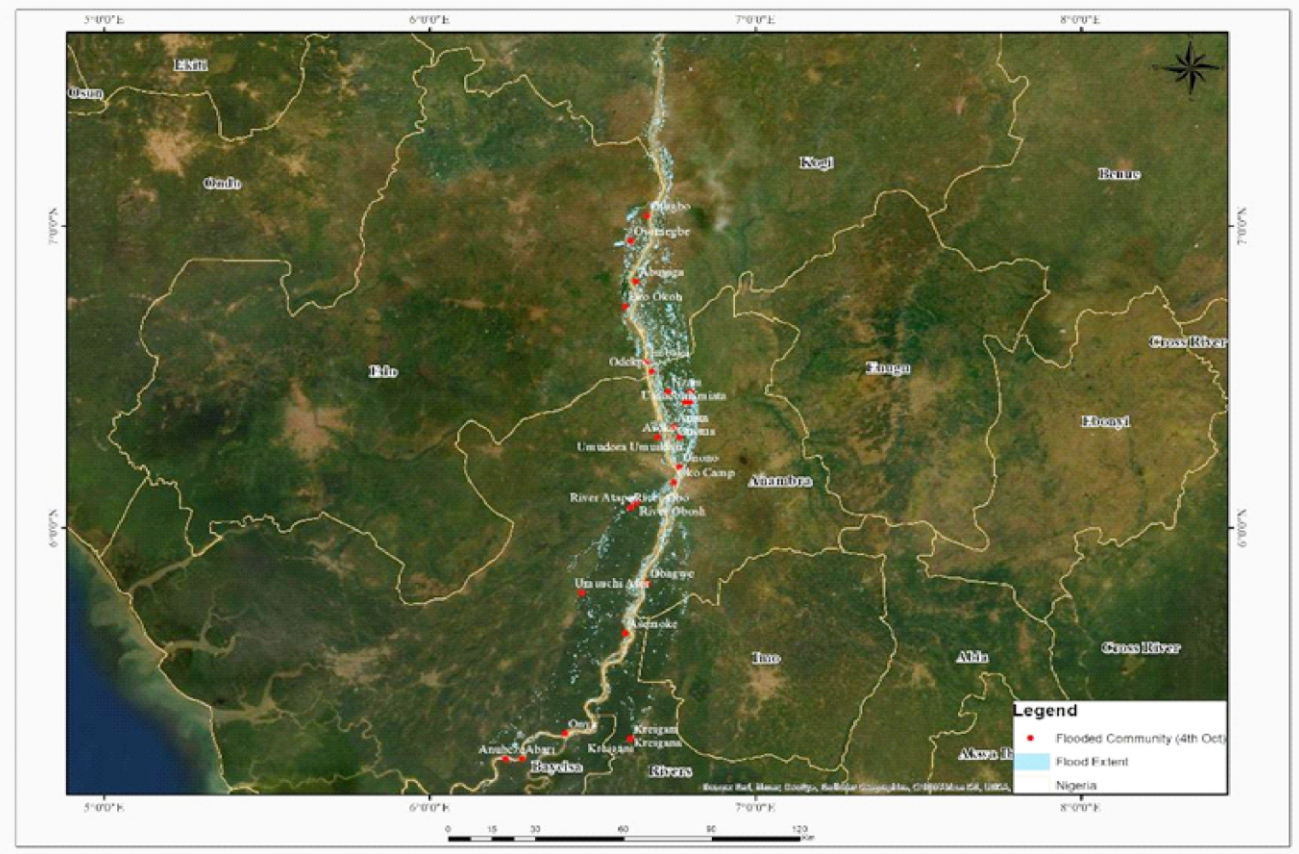


Figure 2.13: Satellite imagery of flooded communities along upstream River Niger, (NARSDA October 4th 2020)

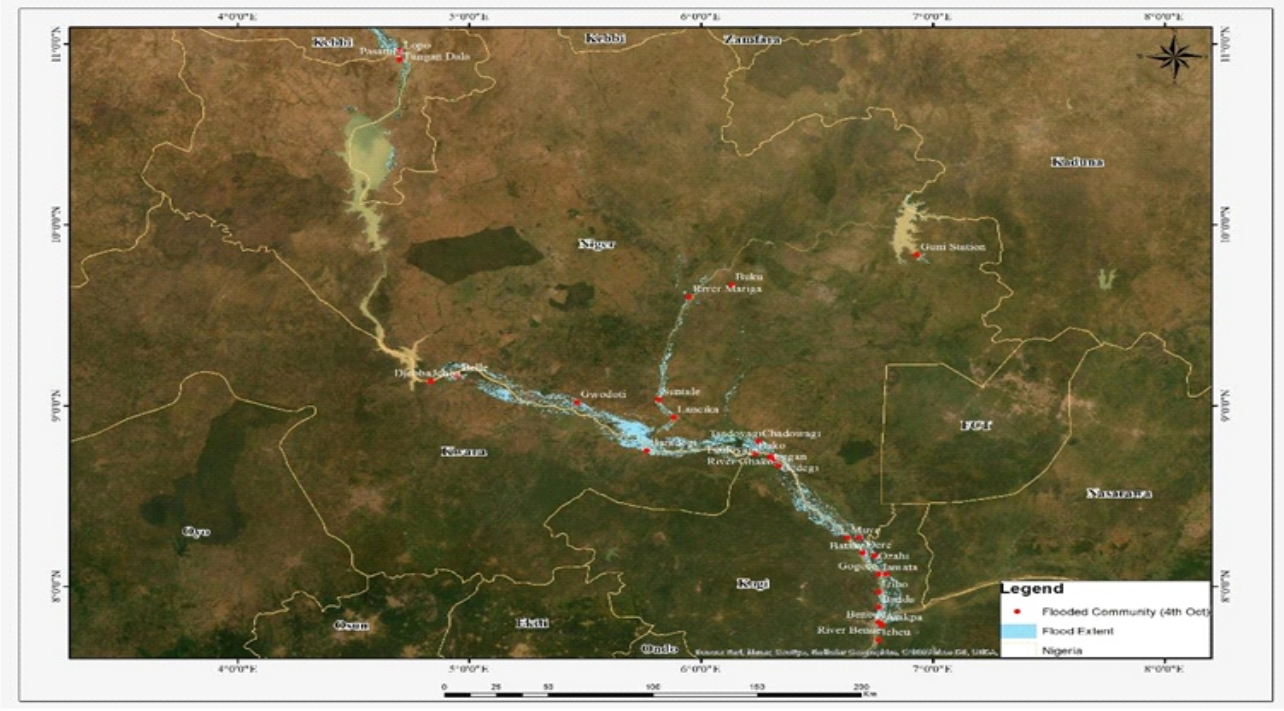


Figure 2.14: Satellite imagery of flooded communities downstream River Niger, (NARSDA October 4th, 2020)

CHAPTER THREE

CHAPTER THREE

3.0 2021 ANNUAL FLOOD OUTLOOK (AFO)

3.1 Preamble

Hydrological models are simplified, conceptual representations of a part of the hydrological cycle. They are primarily used for hydrologic predictions and for understanding of hydrologic processes. They are also useful tools for studying the effects of human activities and climate change on hydrology.

In hydrological research, the performance of a hydrological model varies for different catchments as a result of distinct characteristics and scales. In order to obtain good results for hydrological research, suitable (well performing) hydrological models are required for different catchment sizes and data sets.

For the 2021 Annual Flood Outlook (AFO), three (3) models were adopted to simulate basins' hydrological processes. The models are: The Hydrologic Engineering Center, Hydrologic Modeling System (HEC-HMS), Soil Water Assessment Tools (SWAT) and Hydrologiska Byråns Vattenbalansavdelning (HBV) Models.

It should be noted that the Geospatial Stream flow Model (GeoSFM) used in previous years could have been used this year and subsequently. However, floods in Nigeria are not only generated by excessive rainfall but due to heavy contributions of external inflows from Jiderebode (River Niger) and Wuroboki (River Benue), which the GeoSFM is unable to handle adequately. Hence, the adoption of the Hydrologic Engineering Centre, Hydrologic Modeling System (HEC-HMS) this year in place of GeoSFM. HEC-HMS is able to accept external inflows that can be routed through the river system for accurate flood simulation.

Furthermore, the GeoSFM model is no longer supported by the United States Geological Survey Earth Resources Observation and Science (USGS EROS) Center, whereas, the HEC-HMS model is still actively developed to date by the United States Army Corps of Engineers (USACE).

The Soil and Water Assessment Tool (SWAT) Model is retained for the 2021 AFO because the model is able to simulate the quality and quantity of surface and ground water and predict the environmental impact of land use, land management practices, and climate change. SWAT is widely used in assessing soil erosion prevention and control, non-point source pollution control and regional management in watersheds.

The Hydrologiska Byråns Vattenbalansavdelning (HBV) Model is a semi-distributed conceptual rainfall-runoff model which simulates stream flow using rainfall, temperature and potential evapotranspiration (PET) as input. Precipitation and temperature data used were from NiMET and NIHSA stations. Runoff is taken from selected gauging stations in each of the Hydrological Areas (HAs). The HAs were used as catchments and further delineated into sub-catchments. The HBV model is being introduced to complement the results of the other models.

The three Models were selected based on their wide application in various parts of the world with satisfactory results. The models are simple to use, efficient in flood flows simulation, and are much more reliable using geologic and catchment factors in their applications.

The use of a single model can lead to simulation uncertainties especially in catchments of inadequate input data availability and in large scale modelling exercise. Using different models provide deeper insights to hydrological processes and the analysis of these models can reduce error with optimal bias and uncertainties within simulation of various components in the basin.

3.2 DATA USED AND SOURCES

- Daily flow records (stage and discharge) from stations at Dapchi, Apoje, Wuroboki, Jiderebode, Kainji, Jebba, Wuroboki, Wuya, Afikpo, Ikom, Okitipupa, Siluko, Katsina-Ala, Abeokuta, Shiroro, Baro, Umaisha, Wuya, Ebba, Kurawa, Zungeru, Malabu, Otuocha, Onitsha, Makurdi, Geidam, Kainji, Kende, Dadinkowa, Ologbo, Ogun, Chokocho, Tiga,Hadejia, Umuopara and Lokoja in the eight (8) Hydrological Areas of the country;

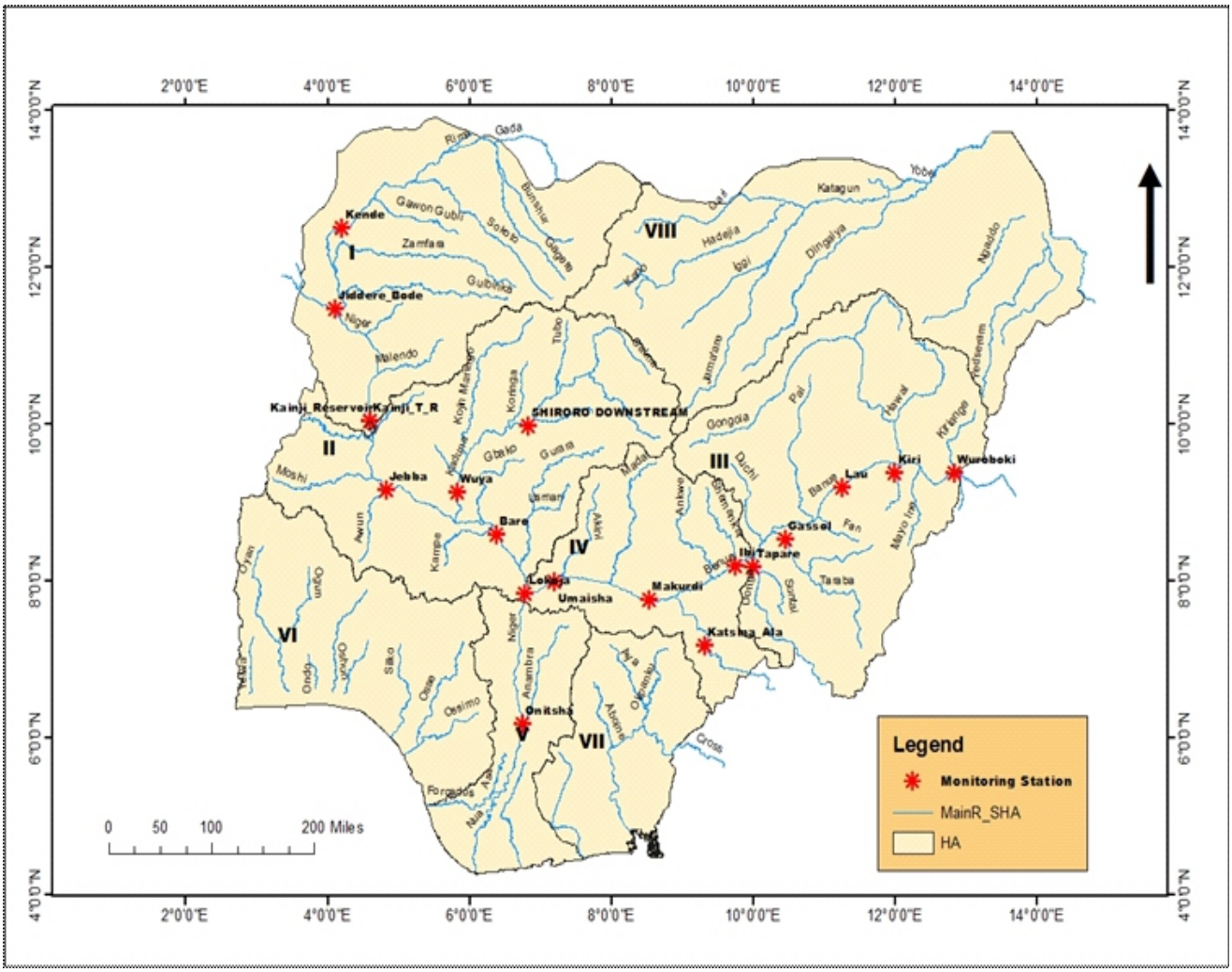


Figure 3.1: Map Showing the Location of Data Collection Platforms (DCPs) along Rivers Niger and Benue

- Daily, monthly and yearly rainfall records;
- The gridded daily rainfall data: Climate Hazards Group Infra–Red Precipitation with Stations (CHIRPS) data archive available from 1981 to 2020 at 0.05° resolution. The daily potential evapotranspiration (PET) based on the data produced by the Famine Early Warning Systems Network (FEWSNET);
- NiMet Seasonal Climate Prediction (SCP);
- The soil characteristics, topography (Shuttle Radar Topography Mission - SRTM) data with a vertical accuracy specification of +/- 5 metres, and available in resolutions of 3 arc–second (90m) data around Nigeria from the USGS website), land use and land cover data.

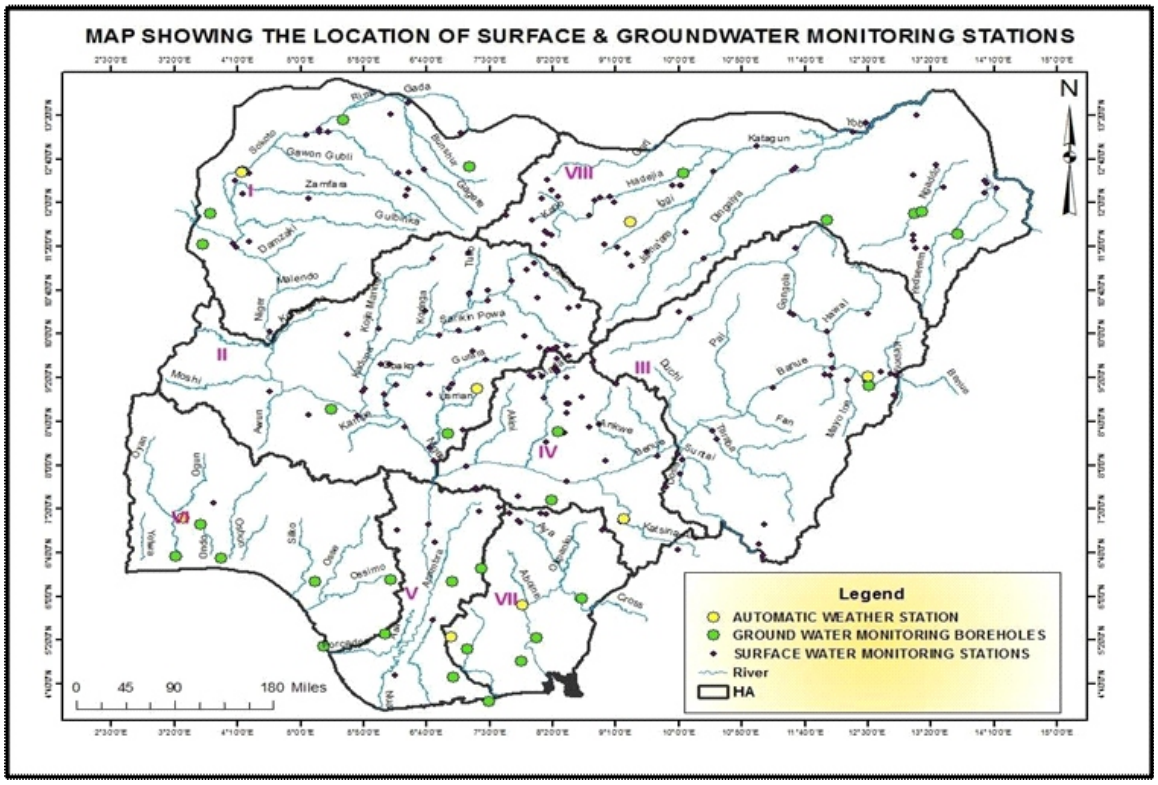


Figure 3.2: Network of NIHSA Ground water and Weather Stations

3.3 Overview of 2021 Annual Flood Outlook

In this section an overview of the eight (8) Hydrological Areas with their hydrological and hydrogeological features as well as flood simulations for 2021 will be examined and discussed below:

3.3.1 Hydrological Area I (Niger North)

Hydrological Area I (Figure 3.3) comprise of Kebbi, Zamfara, Sokoto, and parts of Niger and Katsina States and is drained mainly by the Rivers Niger, Sokoto, Rima, Gulbin Ka and Zamfara. It has two distinct geological features, mainly the Precambrian Crystalline Basement which covers 30% of the area and Sedimentary terrain which covers 70%.

The states that are categorised as Highly Probable in HA I are Kebbi, Sokoto, Zamfara and part of Niger. The details of the Highly Probable and Probable flood risk areas in Hydrological Area I are shown below in Figure 3.3, Tables 3.1 and 3.2.

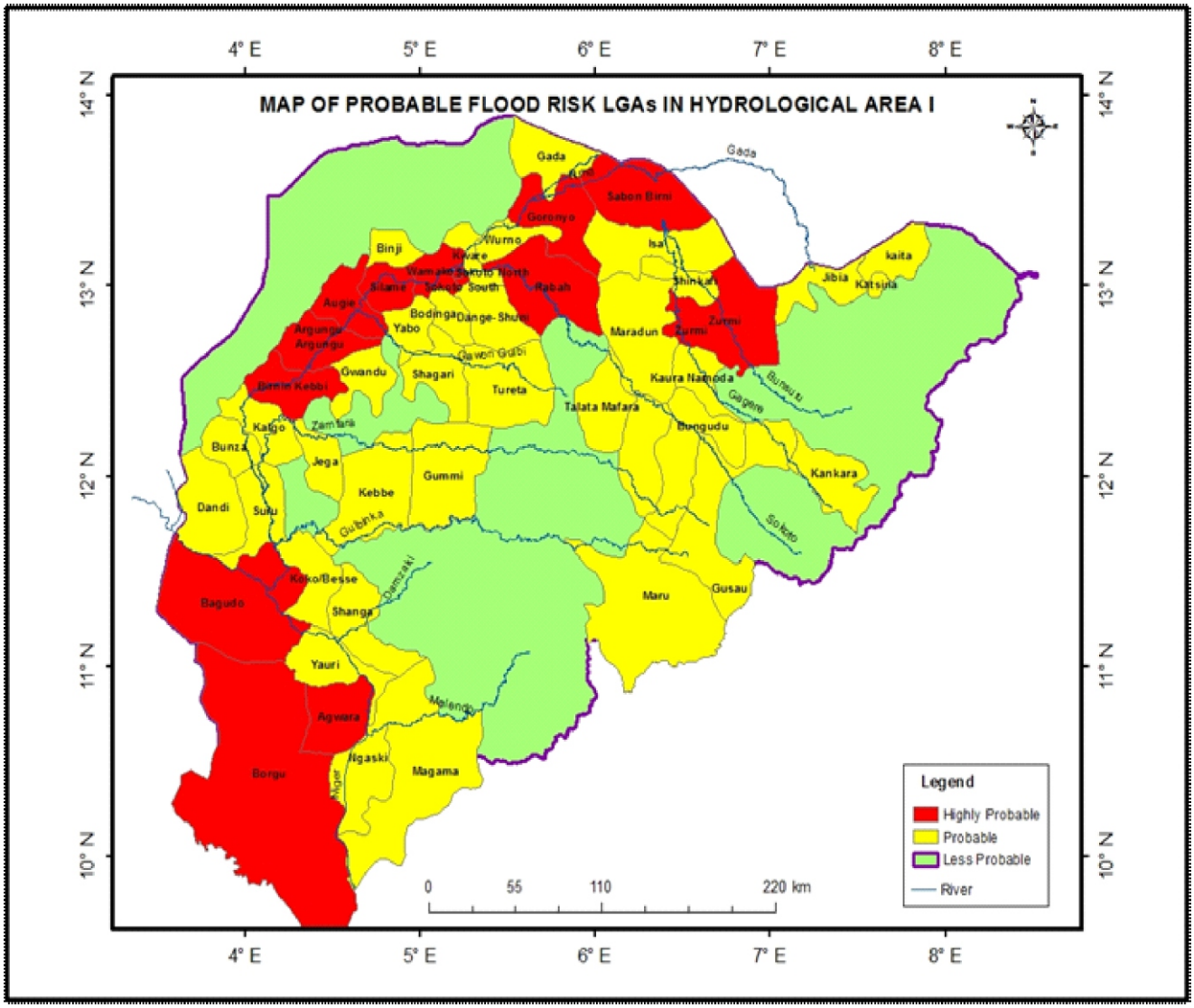


Figure 3.3: Probable Flood Risk LGAs in HA I (Upper Niger)

Table 3.1: Highly Probable Flood Risk LGAs in HA I

S/N	State	LGAs
1.	Kebbi	Argungu, Augie, Bagudo, Birnin Kebbi
2.	Niger	Agwara, Borgu
3.	Sokoto	Goronyo, Sokoto North, Sabon Birni, Rabah, Sokoto South, Silame, Wamako
4.	Zamfara	Zurmi

Table 3.2: Probable Flood Risk LGAs in HA I

S/N	State	LGAs
1.	Katsina	Jibia, kaita, Kankara, Katsina
2.	Kebbi	Argungu, Suru, Koko/Besse, Shanga, Gwandu, Jega, Dandi, Ngaski, Kalgo, Bunza, Yauri
3.	Niger	Magama
4.	Sokoto	Bodinga, Gada, Binji, Tureta, Isa, Shagari, Yabo, Dange-Shuni, Kware, Wurno, Kebbe
5.	Zamfara	Kaura Namoda, Maru, Maradun, Bungudu, TalataMafara, Gummi, Gusau, Shinkafi, Zurmi

3.3.2 Hydrological Area II (Niger Central)

Hydrological Area II covers Niger, Kwara, Kaduna, FCT and part of Kogi States. The geology of the Hydrological area II comprises of about 20% Sedimentary rocks and 80% Basement complex rocks. The main rivers in the area are: Niger, Kaduna, Gurara, Usuma, Kampe and Awun.

In Hydrological Area II, Kogi, Kwara, Kaduna, FCT and part of Niger are expected to be in the Highly Probable category. The details of Highly Probable and Probable flood risk areas are shown in Figure 3.4,Tables 3.3 and 3.4.

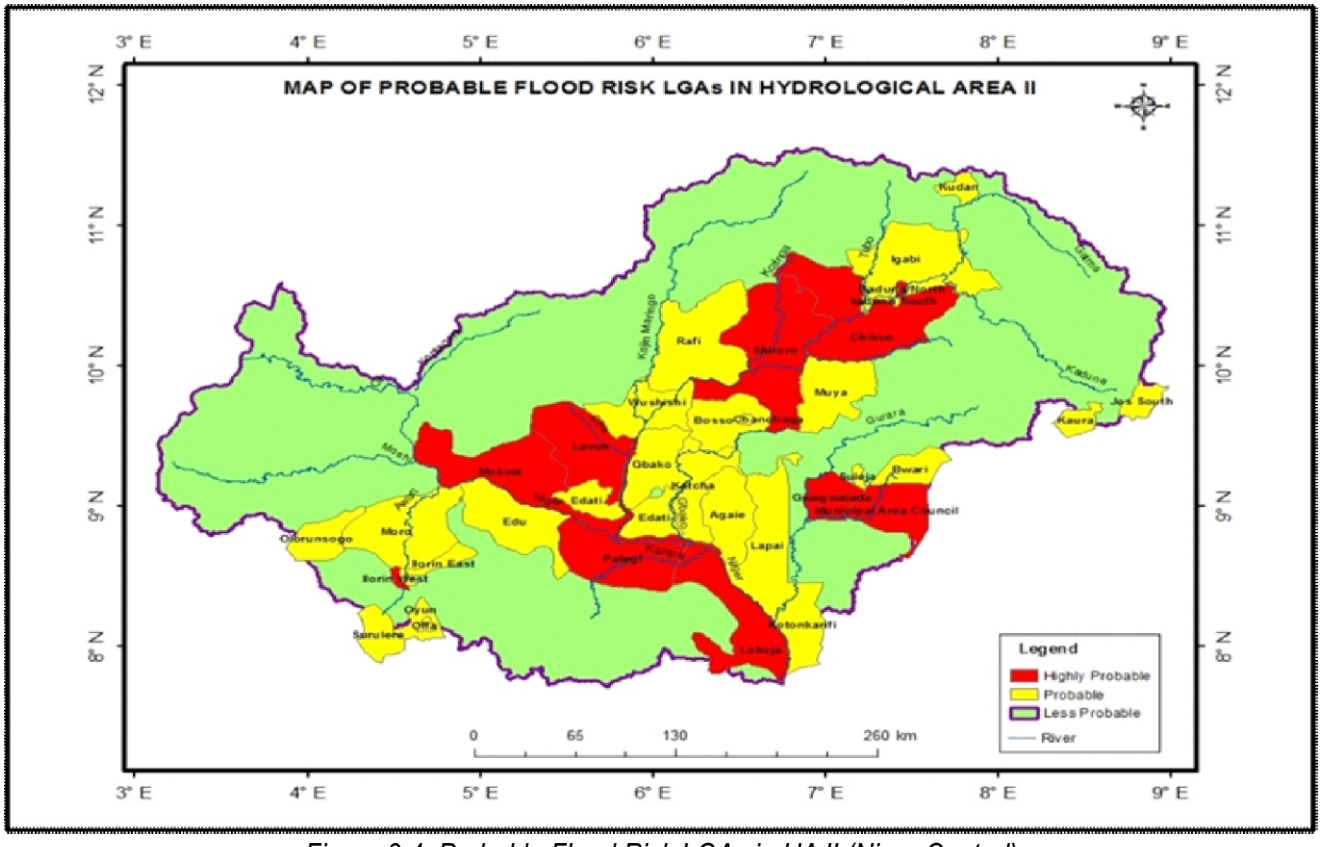


Figure 3.4: Probable Flood Risk LGAs in HA II (Niger Central)

Table 3.3: Highly Probable Flood Risk LGAs in HA II

S/N	State	LGAs
1.	Kogi	Lokoja
2.	Kwara	Ilorin West, Pategi
3.	Niger	Mokwa, Shiroro, Lavun
4.	Kaduna	Kaduna North, Chikun
5.	FCT	Municipal Area Council, Gwagwalada

Table 3.4: Probable Flood Risk LGAs in HA II

S/N	State	LGAs
1.	FCT	Gwagwalada, Kwali, Municipal Area Council, Bwari
2.	Kaduna	Igabi, kaduna South, Kudan, Kaura
3.	Plateau	Jos South
4.	Kogi	KotonKarfe
5.	Kwara	Offa, Edu, Moro, Ilorin East, Oyun
6.	Niger	Suleja, Katcha, Muya, Edati, Gbako, Agaie, Bosso, Wushishi, Chanchaga, Rafi, Lapai
7.	Oyo	Surulere, Olorunsogo

3.3.3. Hydrological Area III (Upper Benue)

Hydrological Area III (Figure 3.5) comprises Adamawa, Taraba, Gombe, Bauchi and part of Plateau and Borno States.

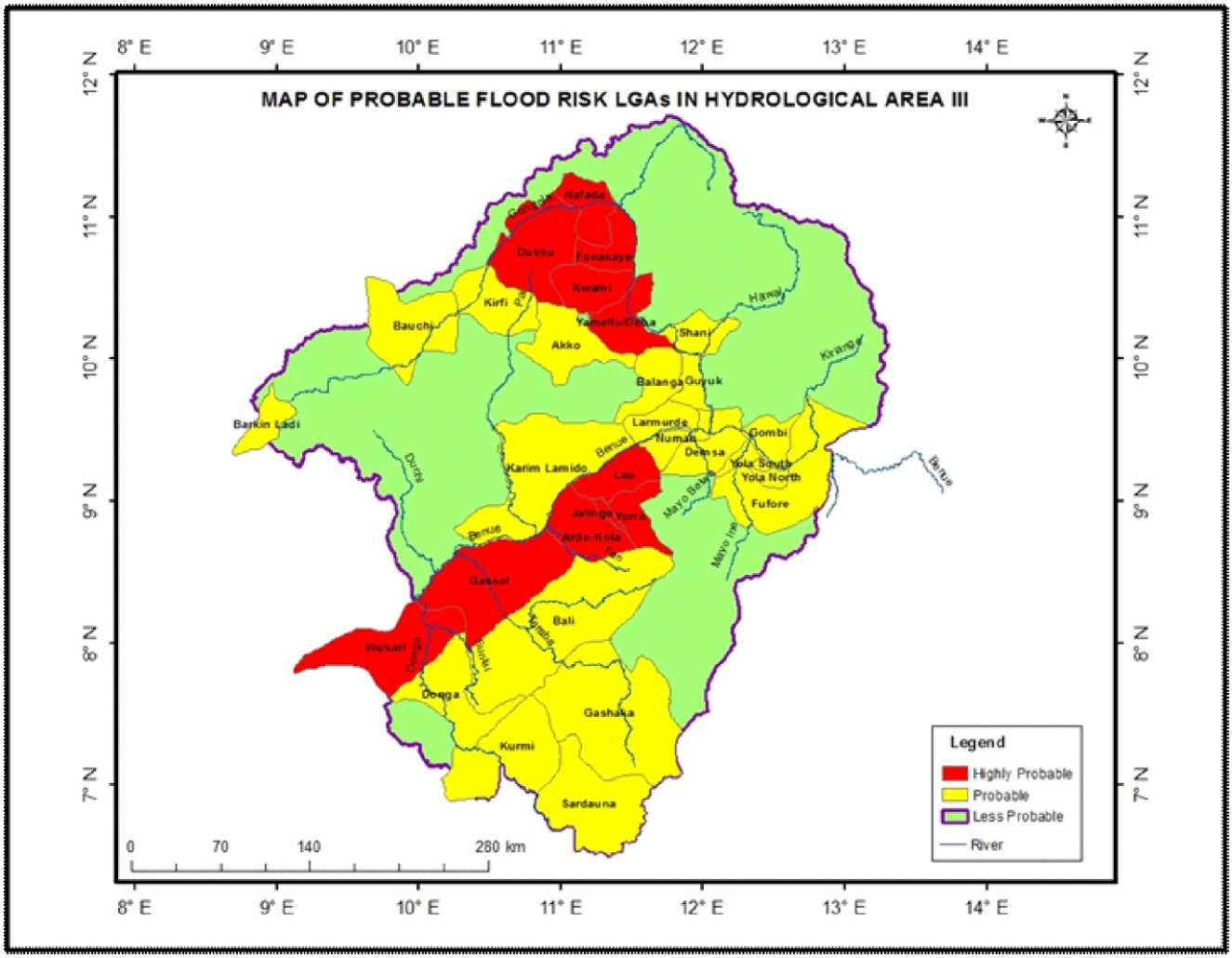


Figure 3.5: Probable Flood Risk LGAs in HA III (Upper Benue).

It is made up of about 70% Sedimentary and 30% basement. The major rivers are Benue, Gongola, Taraba, Donga, Faro, and Mayo-Kebbi

.

The Highly Probable States are Gombe and Taraba, while the States under the probable risk areas are Adamawa, Borno, Gombe, Plateau and Taraba. The details are shown in Figure 3.5 above as well as Tables 3.5 and 3.6.

Table 3.5: Highly Probable Flood Risk LGAs in HA III

S/N	State	LGAs
1.	Gombe	Nafada, Kwami, Yamaltu/Deba, Dukku, Funakaye
2.	Taraba	Yorro, Gassol, Ardo-Kola, Lau, Jalingo, Wukari

Table 3.6: Probable Flood Risk LGAs in HA III

S/N	State	LGAs
1.	Adamawa	Yola North,Yola South, Numan, Larmurde, Guyuk, Fufore, Gombi, Demsa
2.	Borno	Shani
3.	Gombe	Akko, Balanga
4.	Plateau	BarikinLadi
5.	Taraba	Gashaka, Bali, Karim Lamido, Kurmi, Donga, Sardauna
6.	Bauchi	Bauchi, Kirfi

3.3.4: Hydrological Area IV (Lower Benue)

Hydrological Area IV (Figure 3.6) covers Plateau, Nasarawa, Benue, Taraba and parts of Kogi and Kaduna States. The Highly Probable States consist of Benue, Kogi, Nasarawa and Taraba. The details of Highly Probable and Probable flood risk areas in Hydrological Area IV are shown in Figure 3.6as well as Tables 3.7 and 3.8.

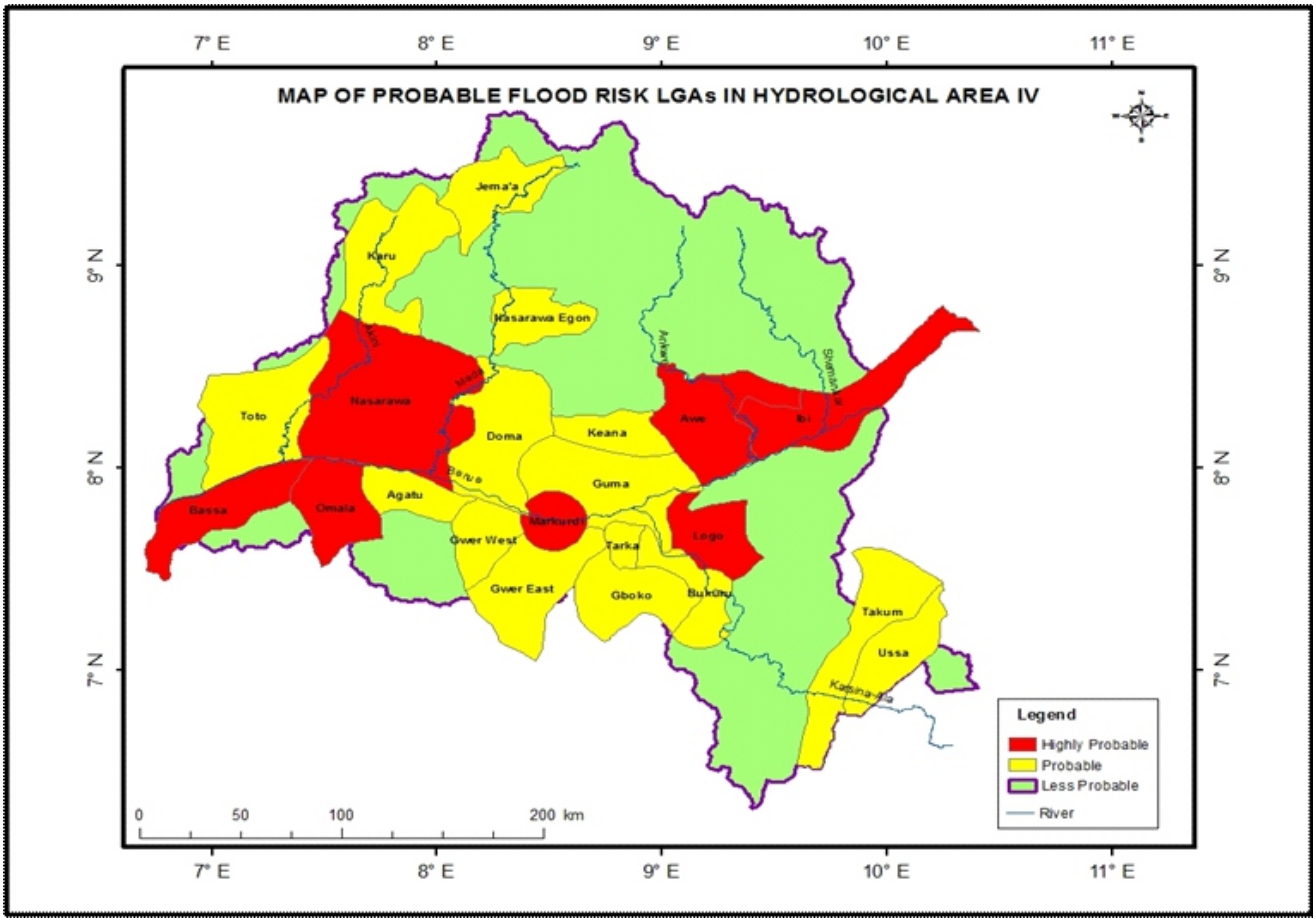


Figure. 3.6: Probable Flood Risk LGAs in HA IV (Lower Benue).

The area is covered by 50% Sedimentary and 50% Basement and is drained mainly by Rivers Benue, Katsina–Ala, Dep and Mada.

Table 3.7: Highly Probable Flood Risk LGAs in HA IV

S/N	State	LGAs
1.	Benue	Makurdi, Logo
2.	Kogi	Bassa, Omala
3.	Nasarawa	Nasarawa, Awe
4.	Taraba	Ibi

Table 3.8: Probable Flood Risk LGAs in HA IV

S/N	State	LGAs
1.	Benue	Buruku, Agatu, Gboko, Gwer East, Tarka, Gwer West, Guma
2.	Taraba	Takum, Ussa
3.	Kaduna	Jema'a
4.	Nasarawa	Nasarawa Egon, Keana, Toto, Doma, Karu

3.3.5 Hydrological Area V (Niger South)

Hydrological Area V includes: Anambra, Bayelsa, Delta, Edo, Enugu, Imo, Rivers and parts of Kogi State. The geology is 90% Sedimentary and 10% Basement. The major Rivers are: Niger, Anambra, Ase, Orashi, Nun and Forcados.

The States expected to be Highly Probable are Anambra, Bayelsa, Delta, Imo, Kogi and Rivers. Details of Highly Probable and Probable flood risk areas in Hydrological Area V are shown in Figure 3.7as well as Tables 3.9 and 3.10

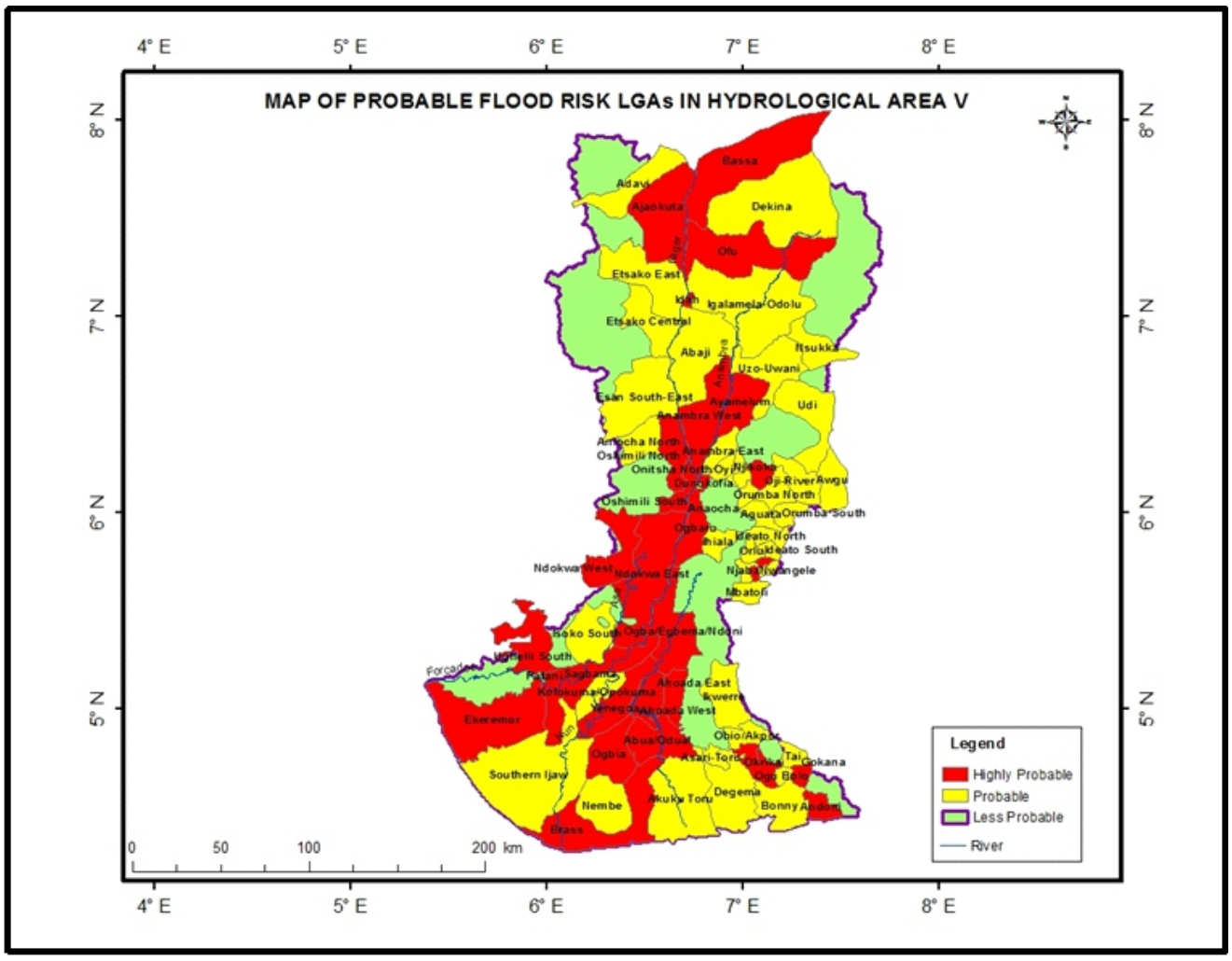


Figure. 3.7: Probable Flood Risk LGAs in HA V (Niger South).

Table 3.9: Highly Probable Flood Risk LGAs in HA V

S/N	State	LGAs
1.	Anambra	Ogbaru, Onitsha North, Ayamelum, Awka South, Anambra West
2.	Bayelsa	Ekeremor, Yenegoa, Sagbama, Brass, Ogbia
3.	Delta	Ndokwa West, Oshimili South, Patani, Ndokwa East, Ughelli South, Oshimili North
4.	Imo	Nkwerre, Isu
5.	Kogi	Idah, Bassa, Ajaokuta, Ofu
6.	Rivers	Ahoada East, Ogba/Egbema/Ndoni, Andoni, Ahoada West, Abua/Odual, Port-Harcourt, Gokana, Okrika

Table 3.10: Probable Flood Risk LGAs in HA V

S/N	State	LGAs
1.	Anambra	Ihiala, Anaocha, Oyi, Anambra East, Orumba South, Njikoka, Orumba North, Aguata, Onitsha South, Dunukofia
2.	Bayelsa	Southern Ijaw, Kolokuma/Opokuma, Nembe
3.	Delta	Aniocha North, Isoko South
4.	Edo	Etsako East, Esan South-East, Etsako Central
5.	Enugu	Udi, Nsukka, Uzo-Uwani, Awgu, OjiRiver
6.	Imo	Ideato South, Ideato North, Njaba, Mbaitoli, Nwangele, Orlu
7.	Kogi	Dekina, Igalamela-Odolu, Ibaji, Adavi
8.	Rivers	Degema, Ogu-Bolo, Akuku-Toru , Bonny, Obio-Akpor, Ikwerre, Tai, Asari -Toru

3.3.6 Hydrological Area VI (Western Lithoral)

Hydrological Area VI comprises of the following States: Lagos, Ogun, Oyo, Osun, Ondo, Edo and parts of Delta and Ekiti States. The Area is 60% Basement and 40% Sedimentary and is drained by Rivers: Yewa, Ogun, Osun, Shasha, Omi, Owena, Osse and Ossiomo

The Highly Probable States are Delta, Lagos, Ogun and Oyo. The details of the Highly Probable and Probable flood risk areas in Hydrological Area VI are shown in Figure 3.8 as well as Tables 3.11 and 3.12 below.

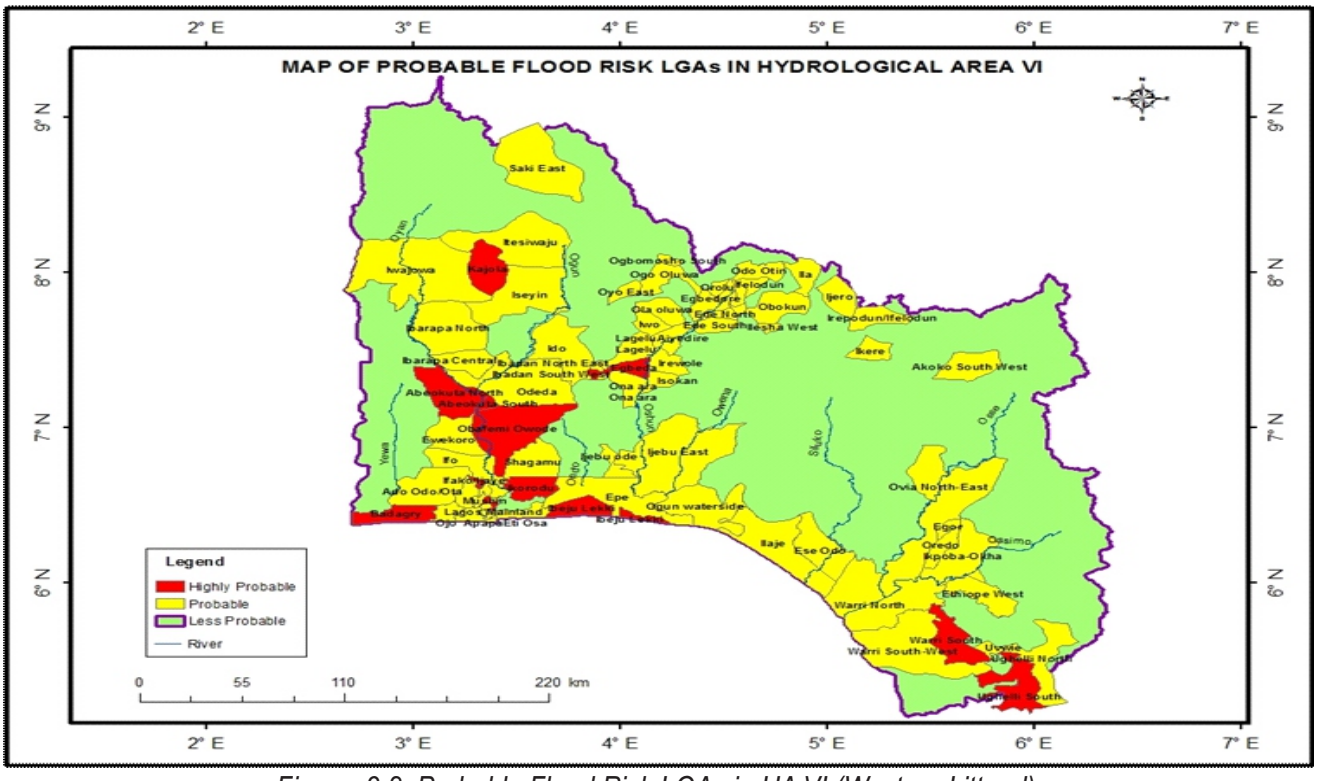


Figure. 3.8: Probable Flood Risk LGAs in HA VI (Western Littoral).

Table 3.11: Highly Probable Flood Risk LGAs in HA VI

S/N	State	LGAs
1.	Delta	Warri South, Ughelli South
2.	Lagos	Lagos Mainland, Mushin, Ibeju-Lekki, Agege, Ikorodu,Ifako-Ijaye, Badagry
3.	Ogun	Abeokuta South, Abeokuta North, Obafemi-Owode
4.	Oyo	Ona Ara, Lagelu, Kajola, Egbeda, Ibadan North-East,Ibadan South-West

Table 3.12: Probable Flood Risk LGAs in HA VI

S/N	State	LGAs
1.	Delta	Warri South-West, Ughelli North, Ethiope West, Warri North, Uvwie
2.	Edo	Ikpoba-Okha, Egor, Oredo, Ovia North-East
3.	Ekiti	Ikere, Ijero, Irepodun/Ifelodun
4.	Lagos	Lagos Island, Alimosho, Amuwo-Odofin, Ikeja, Kosofe, Eti-Osa, Apapa ,Ojo, Oshodi-Isolo, Epe, Surulere, Shomolu, Ajeromi-Ifelodun
5.	Ogun	Ewekoro, Odeda, Ado-Odo/Ota, Ogun waterside, Shagamu, Ijebu ode, Ijebu East, Ifo
6.	Ondo	Ilaje, Ese-Odo, Akoko South West
7.	Osun	Odo Otin, Irewole, Obokun, Isokan, Irepodun, Ilesha West, Ola Oluwa, Olorunda, Orolu, Ila, Iwo, Osogbo, Ede North, Ifelodun, Ede South, Aiyedire, Egbedore
8.	Oyo	Ogo Oluwa, Ona Ara, Lagelu, Ibarapa Central, Oyo East, Saki East, Ogbomosho South, Iwajowa, Ibadan North, Ido, Itesiwaju, Iseyin, Ibarapa North, Ibadan North-West, Ibadan South-East

3.3.7 Hydrological Area VII (Eastern Littoral)

Hydrological Area VII comprises of Abia, Anambra, Imo, Enugu, Ebonyi, Cross–River, Akwa–Ibom and Rivers States. The area is covered by 90% Sedimentary and 10% Basement and drained by Imo, Qua–Iboe, Calabar, Ivo, Asu, Cross River and Ebonyi Rivers. The States under the Highly Probable category are Abia, Akwa-Ibom, Cross River, Ebonyi, Imo and Rivers. The details of Highly Probable and Probable flood risk areas in Hydrological Area VII are shown in Figure 3.9 as well as Tables 3.13 and 3.14.

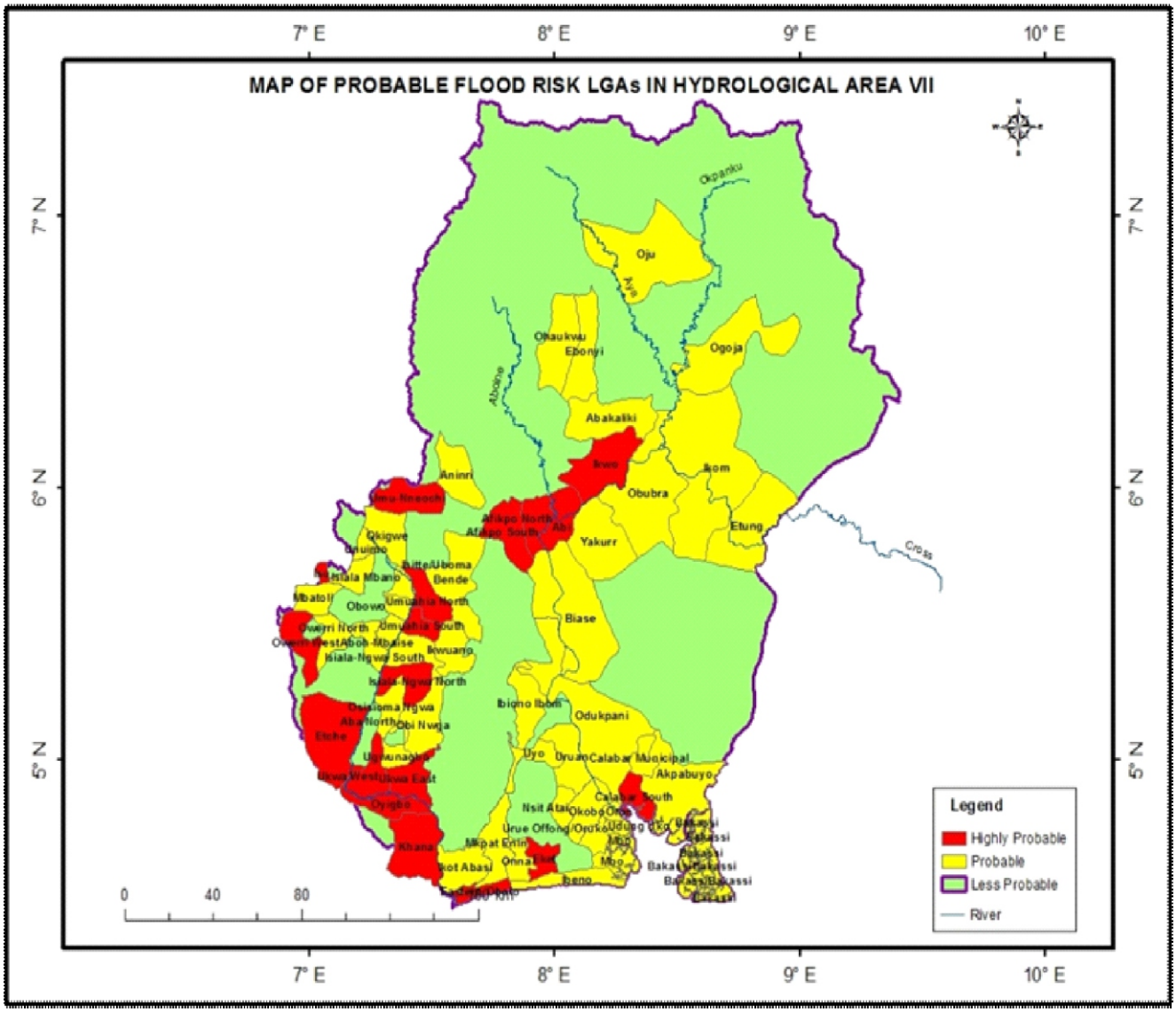


Figure 3.9: Probable Flood Risk LGAs in HA VII (Eastern Lithoral).

Table 3.13: Highly Probable Flood Risk LGAs in HA VII

S/N	State	LGAs
1.	Abia	Umu-Nneochi, Umuahia South, Umuahia North, Ukwa East, Ukwa West, IsialaNgwa North
2.	Akwa-Ibom	Eket, Eastern Obolo
3.	Cross River	Calabar South, Abi
4.	Ebonyi	Ikwo, Afikpo North, Afikpo South
5.	Imo	Owerri West, Isu
6.	Rivers	Oyigbo, Etche, Khana

Table 3.14: Probable Flood Risk LGAs in HA VII

S/N	State	LGAs
1.	Abia	Osisioma Ngwa, Obi Nwga, Aba North, Bende, Ugwunagbo, Isiala-Ngwa South, Ikwuano
2.	Akwa - Ibom	Mkpat-Enin, Nsit-Atai, Okobo, Mbo, Udung-Uko, Onna, Oron, IkotAbasi, Ibiono-Ibom, Uruan, Uyo, Ibeno, Urue, Offong/Oruko
3.	Benue	Oju
4.	Cross River	Yakuur, Calabar Municipal, Akpabuyo, Obubra, Bakassi, Ogoja, Biase, Etung, Odukpani, Ikom
5	Ebonyi	Ebonyi, Ohaukwu, Abakaliki
6	Enugu	Aninri
7	Imo	Owerri North, Mbaitoli, Okigwe, Unuimo, Ihitte/Uboma, EzinihitteMbaise, Isiala Mbano, Aboh-Mbaise, Obowo

3.3.8 Hydrological Area VIII (Chad Basin)

Hydrological Area VIII (Figure 3.10) comprises of Kano, Jigawa, Yobe, Borno

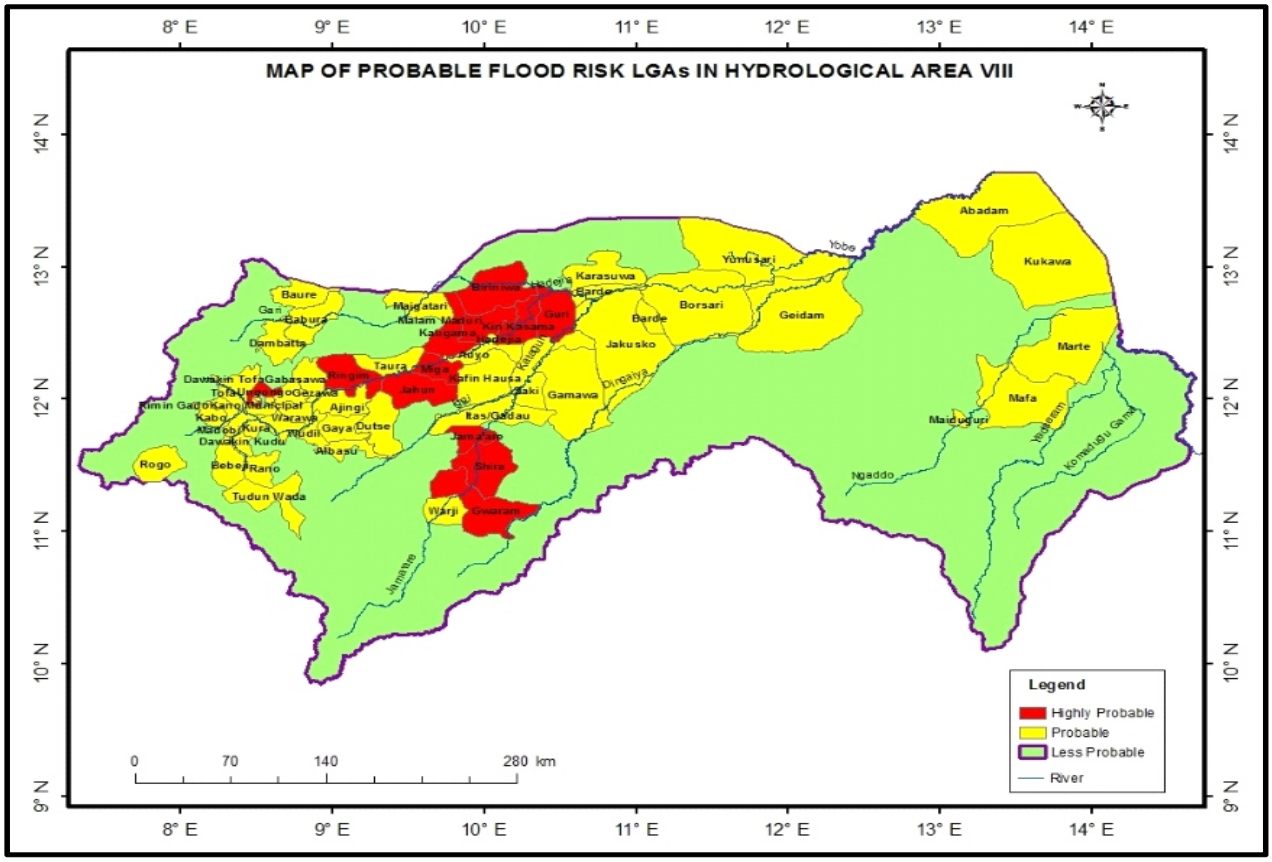


Figure 3.10: Probable Flood Risk LGAs in HA VIII (Chad Basin)

The geology is made up of 80% Sedimentary and 20% Basement rocks. Major rivers in the area are: Hadejia, Jama"are, Komadugu–Yobe, Yedseram, Ngadda and Dingaiya.

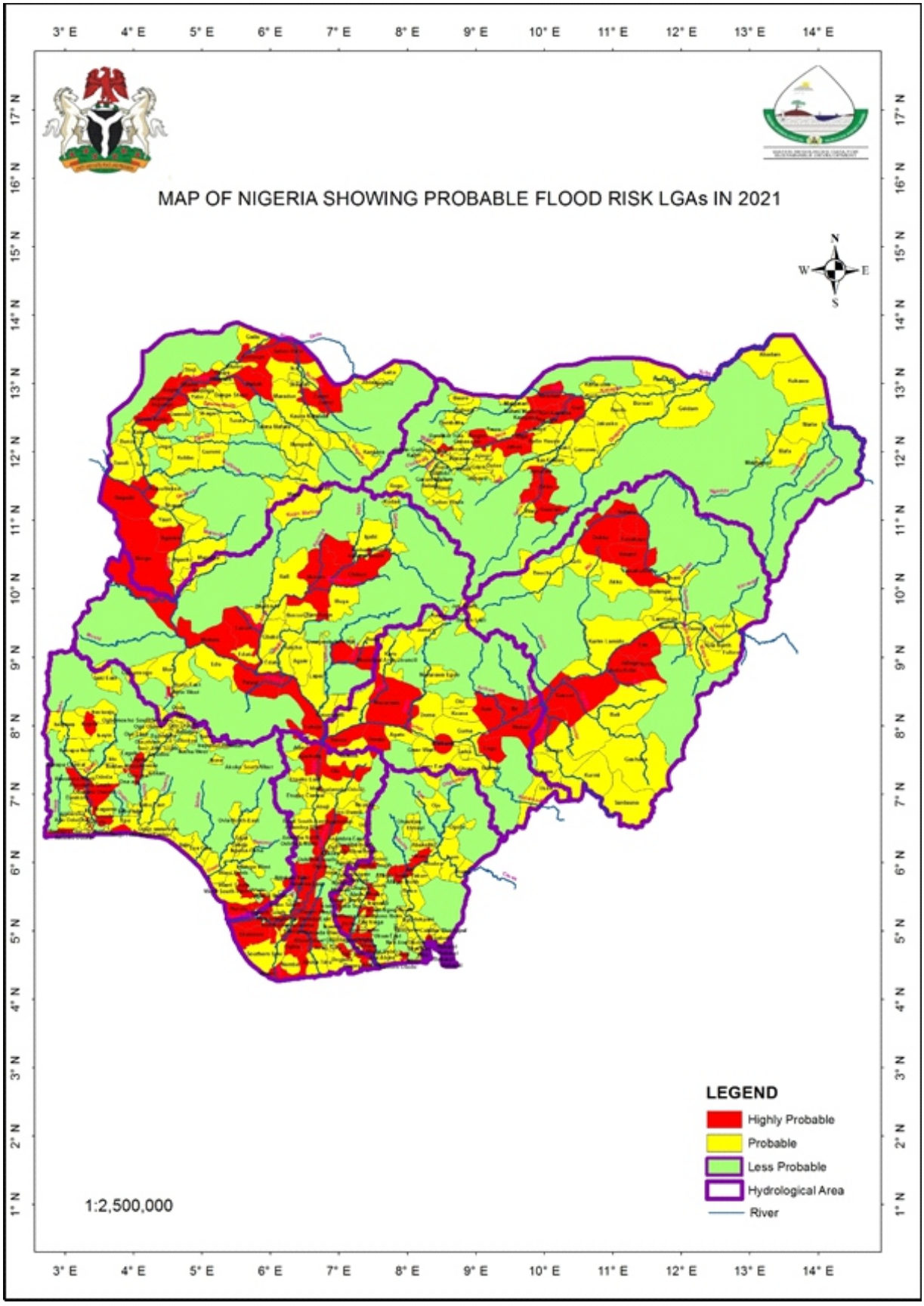
The States under the Highly Probable category are Bauchi, Jigawa and Kano. The details of Highly Probable and Probable flood risk areas in Hydrological Area VIII are shown in Figure 3.10 as well as Tables 3.15 and 3.16.

Table 3.15: Highly Probable Flood Risk LGAs in HA VIII

S/N	State	LGAs
1.	Bauchi	Jama'are, Shira
2.	Jigawa	Kaugama, Guri, Kiri Kasama, Gwaram, Miga, Malam-Madori, Ringim, Biriniwa, Jahun
3.	Kano	Ungogo, Kano Municipal

Table 3.16: Probable Flood Risk LGAs in HA VIII

S/N	State	LGAs
1.	Bauchi	Itas/Gadau, Gamawa, Warji, Zaki
2.	Borno	Marte, Maiduguri, Abadam, Mafa, Kukawa
3.	Kano	Tofa, Gabasawa, Dawakin Tofa, Dawakin Kudu, Dambatta, Dala, Bebeji, Kabo, Wudil, Tudun Wada, Rogo, Kura, Madobi, Nassarawa, Albasu, Kano Municipal, Kumbotso
4.	Katsina	Baure
5.	Jigawa	Taura, Babura, Hadejia, Dutse, Auyo, Maigatari, Kafin Hausa
6.	Kano	Garum Mallam, Ajingi, Rimin Gado, Gaya, Gezawa, Gwale, Rano Tofa, Gabasawa, Dawakin Tofa, Dawakin Kudu, Dambatta, Dala, Bebeji, Kabo, Wudil, Tudun Wada, Rogo, Kura, Madobi, Nassarawa, Albasu, Kano Municipal, Kumbotso
7.	Yobe	Geidam, Bade, Jakusko, Bursari, Karasuwa, Yunusari


MAP OF NIGERIA SHOWING PROBABLE FLOOD RISK LGAs IN 2021
3° E
4° E
5° E
6° E
7° E
8° E
9° E
10° E
11° E
12° E
13° E
14° E
17° N
16° N
15° N
14° N
13° N
12° N
11° N
10° N
9° N
8° N
7° N
6° N
5° N
4° N
3° N
2° N
1° N
N
W
E
S
LEGEND
Highly Probable
Probable
Less Probable
Hydrological Area
River
1:2,500,000

The expected areas of river flooding in 2021 are located in the following drainage basins: Benue, Niger, Anambra–Imo, Niger Delta, Sokoto–Rima, Komadougu–Yobe, Ogun–Osun, Cross River and other sub–basins of the country. The predicted probable flood areal coverage in 2021 is expected to be higher than that of 2020 (Figure 3.11).

3.4 Flood Vulnerability

River channels across the nation were subjected to proximityanalysis (buffering) and areas within a radius of 1km, 2km, and 3km were categorized as high, medium and low zones of flood vulnerability respectively (Figure 3.12). Using, bottom up grided population estimate for Nigeria, (Version 1.2), a proximity analysis was carried out within 1km radius of the major rivers that traverse the country and 7,714,019 people fall within Highly Vulnerable zone. Summary of vulnerable communities in each of the Hydrological Area is in Tables 3.51 – 3.58.

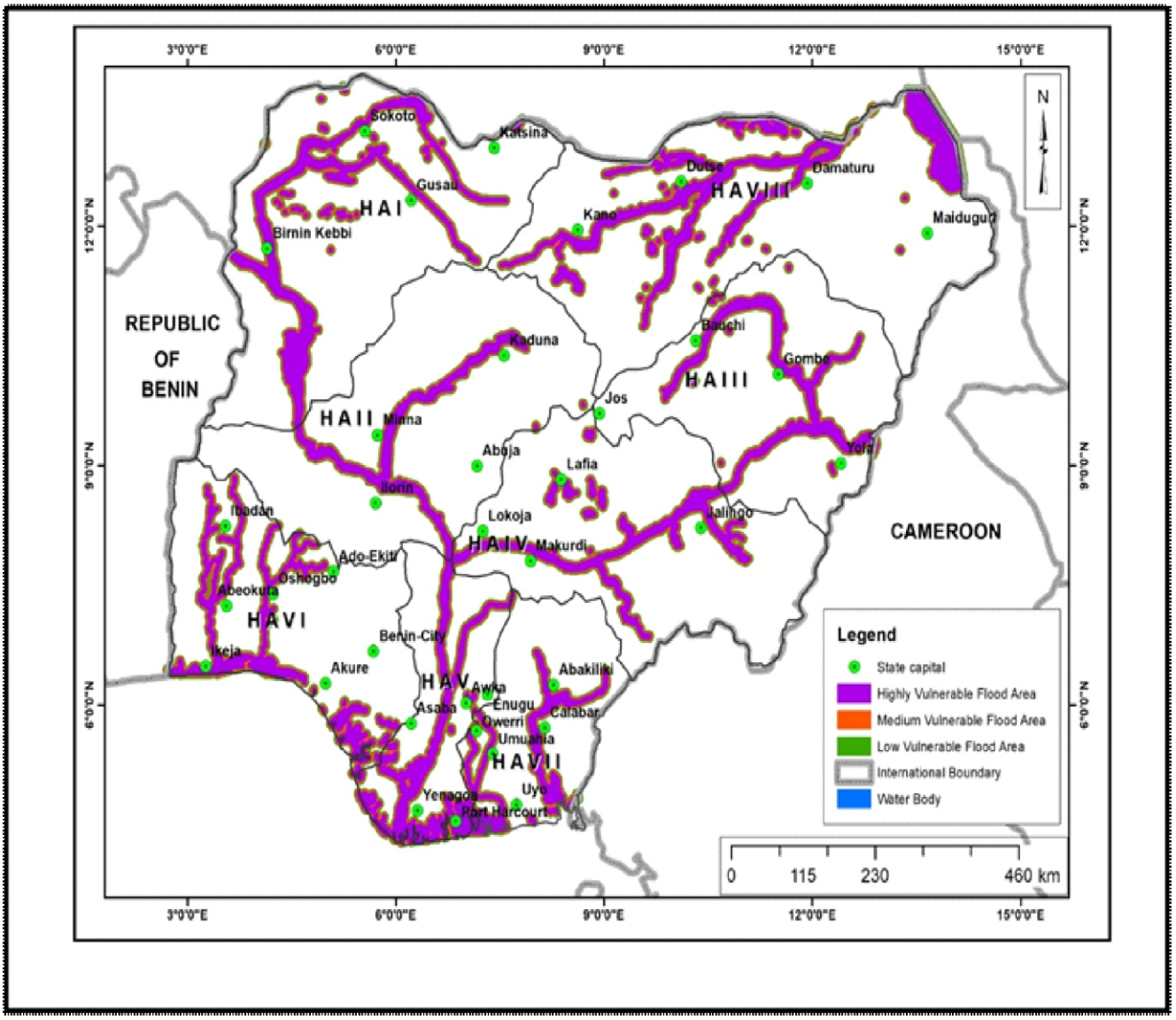


Figure 3.12: 2021 Flood Zone Vulnerability Map

Table 3.17: Communities/Villages Vulnerable at different level of Vulnerability in HA I

No. of Vulnerable Communities						
S/N	State	No. of LGA	High (1km)	Medium (2km)	Low(3km)	Total
1.	Katsina	1	0	0	0	1
2.	Kebbi	12	413	77	65	567
3.	Niger	4	79	16	14	113
4.	Sokoto	14	162	47	37	260
5.	Zamfara	7	45	20	21	93
	Total	**38**	**699**	**160**	**137**	**1034**

Table 3.18: Communities/Villages Vulnerable at different level of Vulnerability in HA II

No. of Vulnerable Communities						
S/N	State	No. of LGA	High (1km)	Medium (2km)	Low(3km)	Total
1.	Ekiti	1	0	0	0	0
2.	FCT	2	0	0	0	0
3.	Kaduna	3	41	12	15	68
4.	Kogi	2	29	10	8	47
5.	Kwara	5	19	9	11	39
6.	Nassarawa	2	0	0	0	0
7.	Niger	8	171	27	25	223
8.	Osun	1	0	0	0	0
9.	Plateau	1	1	1	3	5
10.	Zamfara	1	0	0	0	0
	Total	**26**	**261**	**59**	**62**	**382**

Table 3.19: Communities/Villages Vulnerable at different level of Vulnerability in HA III

No. of Vulnerable Communities						
S/N	State	No. of LGA	High (1km)	Medium (2km)	Low(3km)	Total
1.	Adamawa	8	179	35	32	246
2.	Bauchi	1	28	0	0	28
3.	Borno	1	66	16	17	99
4.	Gombe	6	119	26	26	171
5.	Plateau	2	0	0	1	1
6.	Taraba	5	13	9	6	28
	Total	**23**	**405**	**86**	**82**	**573**

Table 3.20: Communities/Villages Vulnerable at different level of Vulnerability in HA IV

No. of Vulnerable Communities						
S/N	State	No. of LGA	High (1km)	Medium (2km)	Low(3km)	Total
1.	Benue	9	75	38	23	136
2.	FCT	1	0	0	10	10
3.	Kaduna	1	0	0	0	0
4.	Kogi	4	24	8	10	42
5.	Nassarawa	7	41	22	14	77
6.	Plateau	2	4	0	0	4
7.	Taraba	3	61	9	7	77
	Total	**27**	**205**	**140**	**64**	**409**

Table 3.21: Communities/Villages Vulnerable at different level of Vulnerability in HA V

No. of Vulnerable Communities						
S/N	State	No. of LGA	High (1km)	Medium (2km)	Low(3km)	Total
1.	Anambra	14	47	20	24	91
2.	Bayelsa	8	177	26	32	235
3.	Delta	9	72	21	16	109
4.	Edo	2	2	3	1	6
5.	Enugu	1	0	0	0	0
6.	Imo	8	0	0	1	1
7.	Kogi	11	57	7	9	73
8.	Rivers	10	90	9	1	100
	Total	**53**	**445**	**86**	**84**	**615**

Table 3.22: Communities/Villages Vulnerable at different level of Vulnerability in HA VI

No. of Vulnerable Communities						
S/N	State	No. of LGA	High (1km)	Medium (2km)	Low(3km)	Total
1.	Delta	8	55	17	12	84
2.	Edo	4	6	3	0	9
3.	Ekiti	2	0	0	0	0
4.	Kwara	2	7	2	3	12
5.	Lagos	20	253	51	23	327
6.	Ogun	7	186	79	66	331
7.	Ondo	2	22	10	11	43
8.	Osun	17	103	69	59	231
9.	Oyo	14	177	107	105	389
	Total	**77**	**809**	**338**	**279**	**1426**

Table 3.23: Communities/Villages Vulnerable at different level of Vulnerability in HA VII

No. of Vulnerable Communities						
S/N	State	No. of LGA	High (1km)	Medium (2km)	Low(3km)	Total
1.	Abia	6	12	15	11	38
2.	Akwa Ibom	15	60	33	40	133
3.	Anambra	2	0	0	0	0
4.	Benue	2	0	0	0	0
5.	Cross River	9	181	43	31	255
6.	Ebonyi	5	73	24	20	117
7.	Imo	16	20	5	1	26
8.	Rivers	11	64	25	15	104
	Total	**66**	**410**	**145**	**118**	**673**

Table 3.24: Communities/Villages Vulnerable at different level of Vulnerability in HA VIII

No. of Vulnerable Communities						
S/N	State	No. of LGA	High (1km)	Medium (2km)	Low(3km)	Total
1.	Bauchi	4	49	7	18	74
2.	Borno	4	7	6	10	23
3.	Jigawa	14	120	43	35	198
4.	Kano	25	93	31	39	163
5.	Yobe	6	85	21	14	120
	Total	**53**	**354**	**108**	**116**	**578**

3.5 Highly Probable Flood Risk Basins

The probable high flood risk basins are: Sokoto–Rima, Upper and Lower Niger, Upper and Lower Benue, Anambra–Imo, Niger–Delta, lower fringes of Ogun–Osun part of Cross River, and Komadougu–Yobe. A total of one hundred and twenty-one (121) LGAs are predicted Highly Probable for 2021/2022 Hydrological Year,(Appendix 2).

3.6 Probable Flood Risk Areas

The level of floods in this category is expected to be moderate in terms of impact on the people. Three Hundred and Two(302) LGAs are predicted to fall within this category;(detail list is in Appendix 3).

3.7 Coastal Flooding

Some coastal States: Rivers, Cross River, Delta, Lagos, Ondo and Bayelsa are expected to experience coastal flooding due to rise in sea level and tidal surge which would impact on fishing, habitation and coastal transportation.

3.8 Flash and Urban Flooding

Flash and Urban Flood is also expected to occur in some locations such as: Birnin–Kebbi, Sokoto; Lokoja, Kaduna, Suleja; Gombe, Yola, Makurdi, Abuja, Lafia; Asaba, Port Harcourt, Yenagoa, Lagos, Ibadan, Abeokuta, Benin City, Oshogbo, Ado-Ekiti, Abakaliki, Awka, Nsukka, Calabar, Owerri, Maiduguri, Kano, and other cities with poor drainage systems.

3.9 Simulated Hydrographs at selected stations

The simulated hydrographs of gauging stations at Tiga, Kainji, Ologbo, Kende, Geidam, Ikom, Lokoja, Malabu, Okitipupa, Onitsha, Kende, Abeokuta, Okitipupa, DadinKowa, Hadejia, Katsina-Ala, Makurdi, Shiroro, Afikpo, Ebba, Gassol, Baro, Wuya,Chokocho, Ibi, Apoje, DapchiOmuoparaand Ogun, are shown in Figures 3.13 – 3.48 for SWAT, HEC-HMS and HBV models.

The peak flood flow for the year 2021 is expected to be significantly lower than that of year 2012 (reference flood events at all stations).

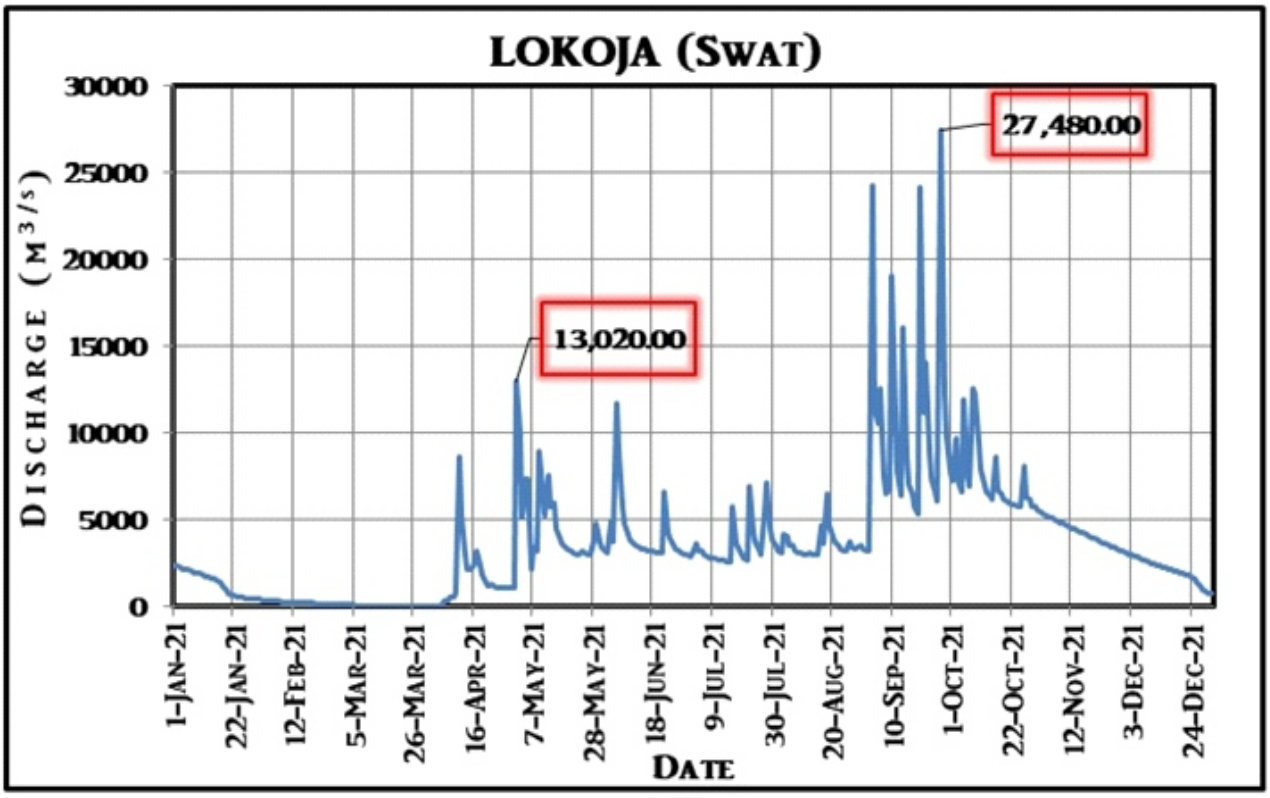


Figure 3.13: Simulated Flows at Lokoja, River Niger

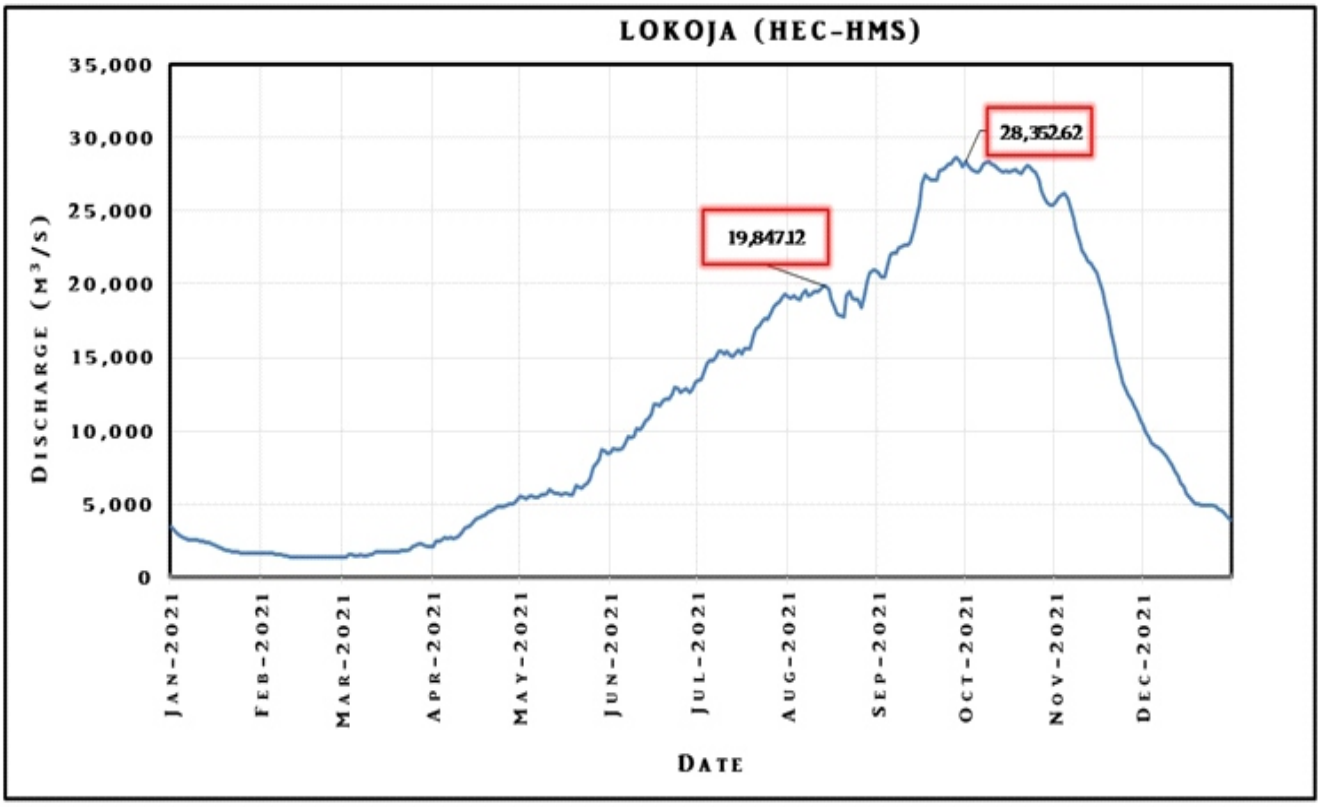


Figure 3.14: Simulated Flows at Lokoja, River Niger.

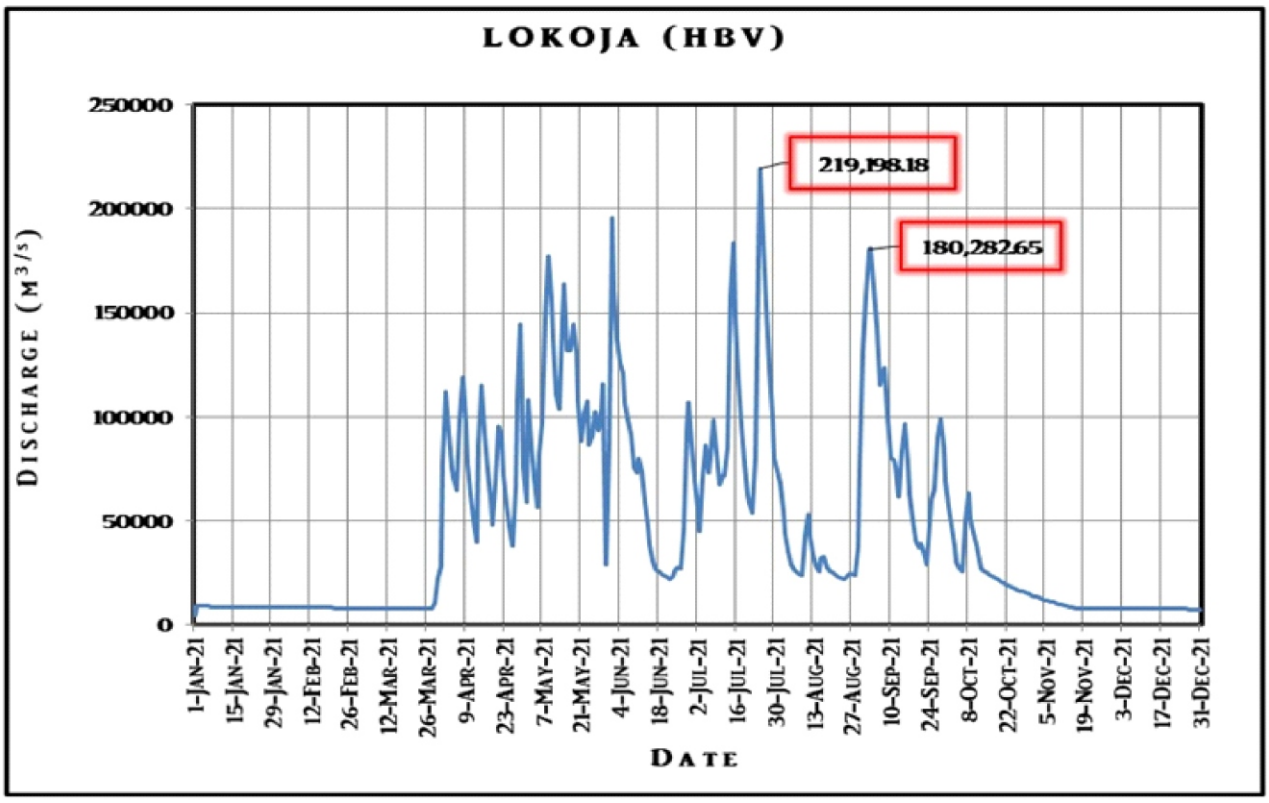


Figure 3.15: Simulated Flows at Lokoja, River Niger.

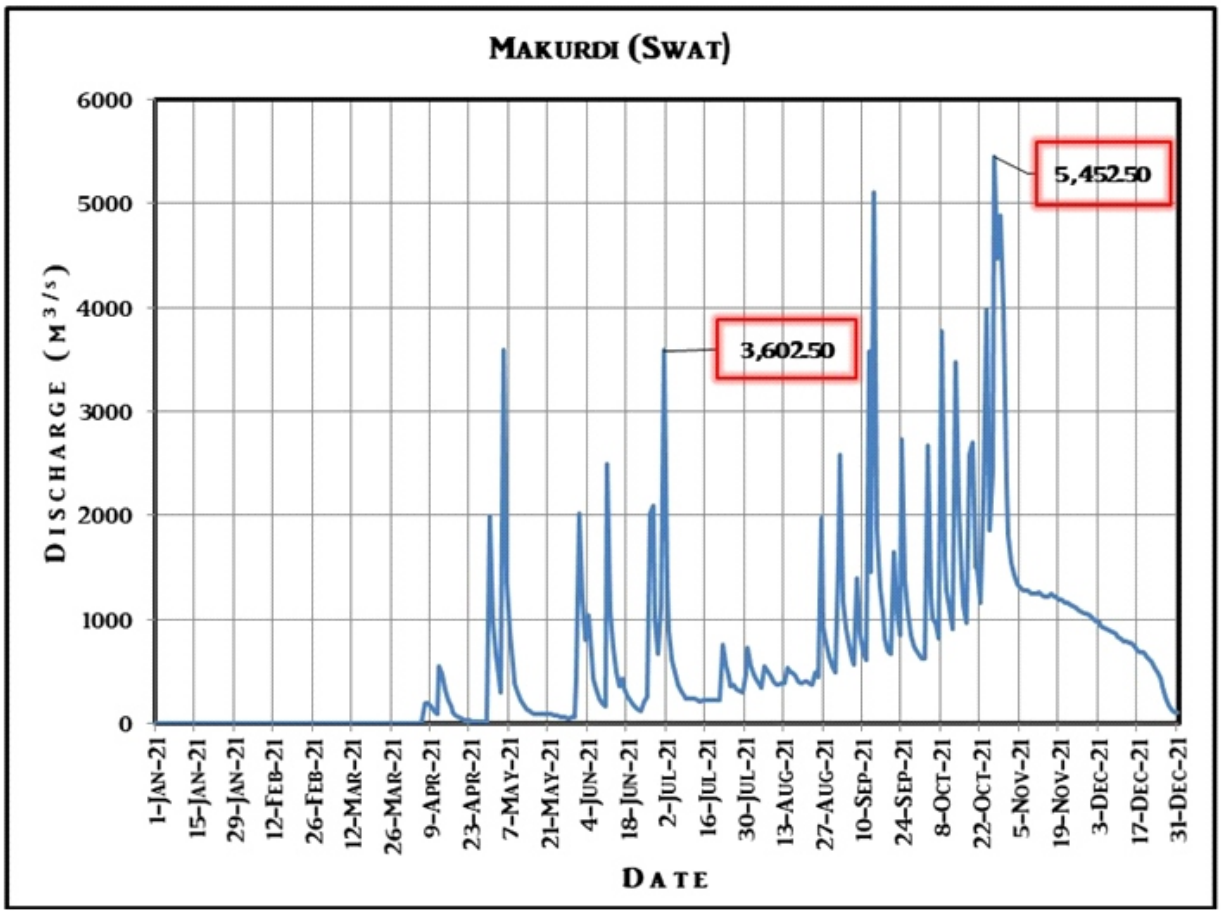


Figure 3.16: Simulated Flows at Makurdi, River Benue

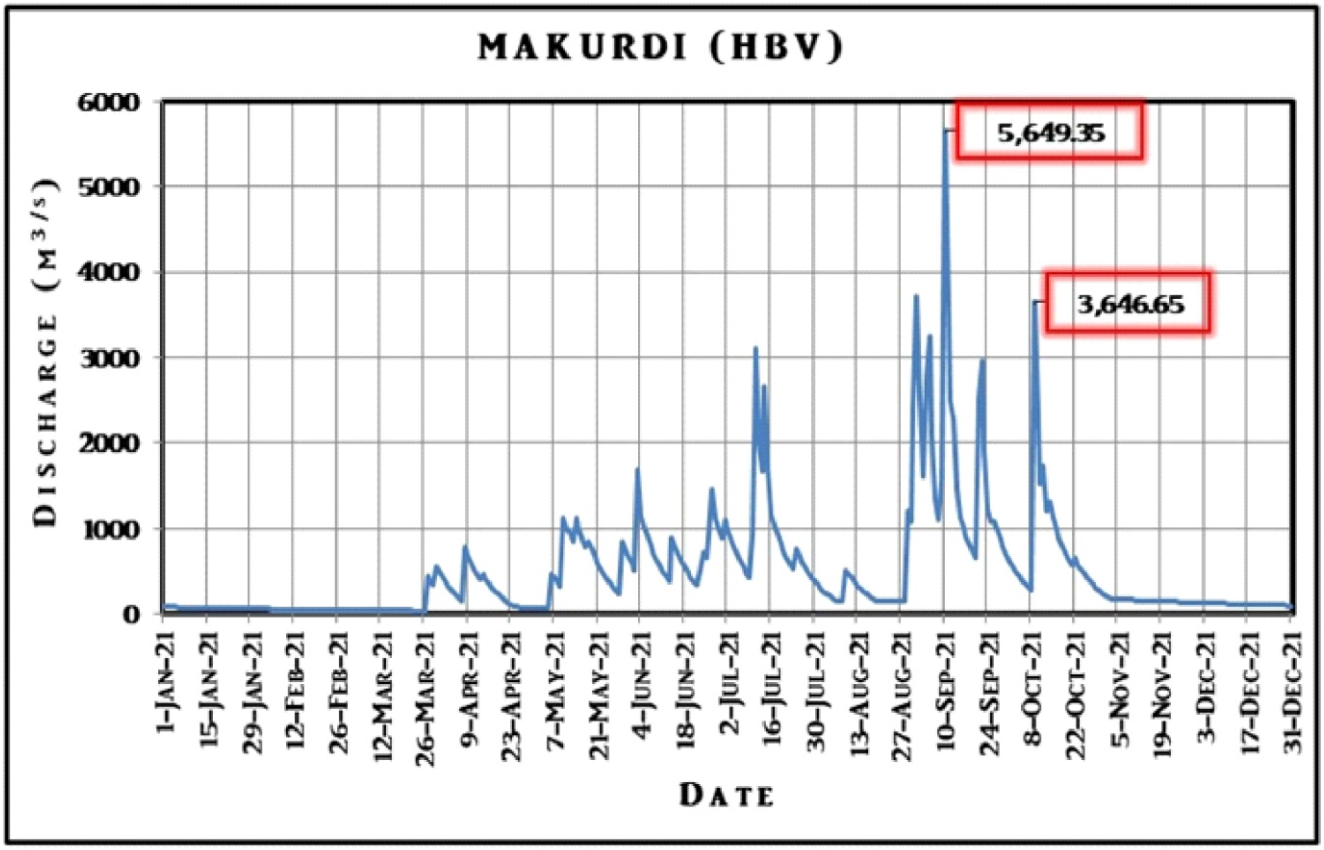


Figure 3.17: Simulated Flows at Makurdi, River Benue

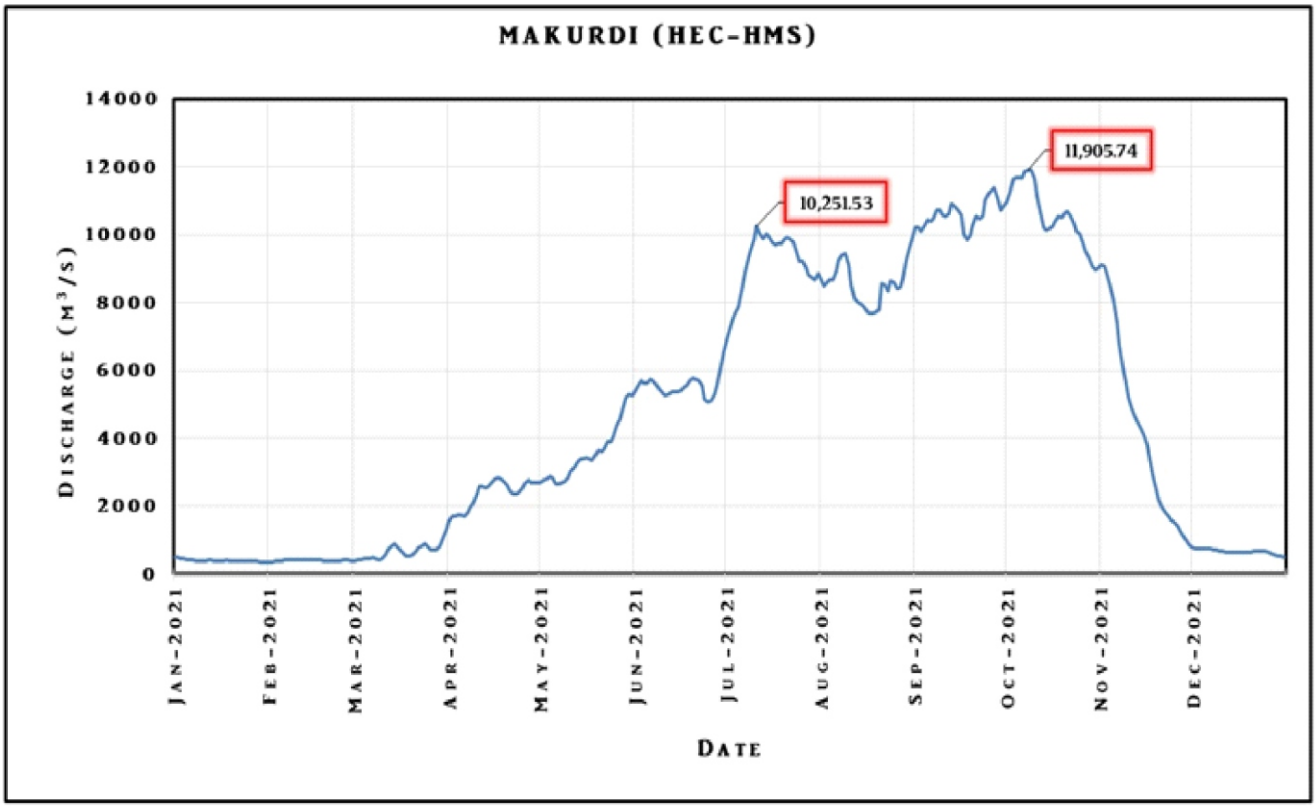


Figure 3.18: Simulated Flows at Makurdi, River Benue

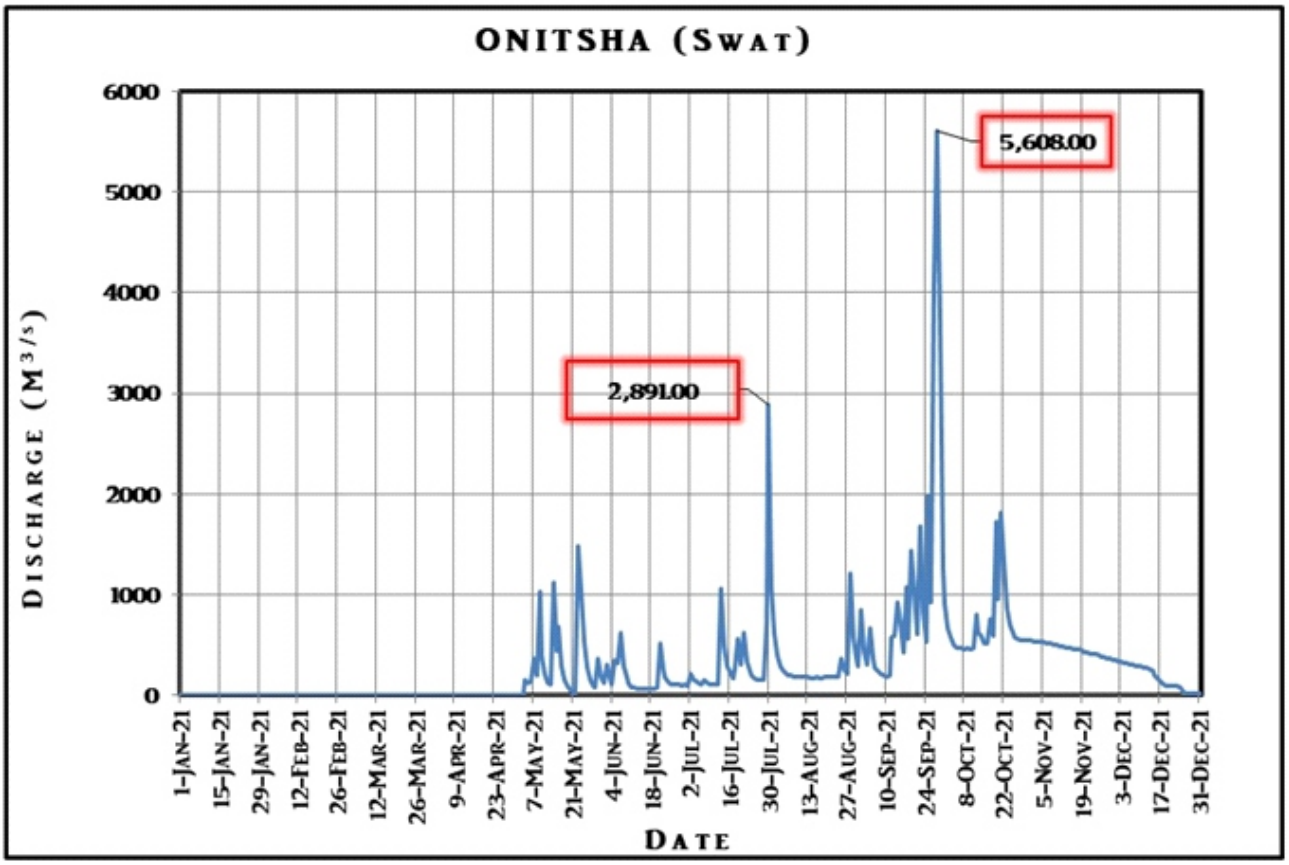


Figure 3.19: Simulated Flows at Onitsha, River Niger

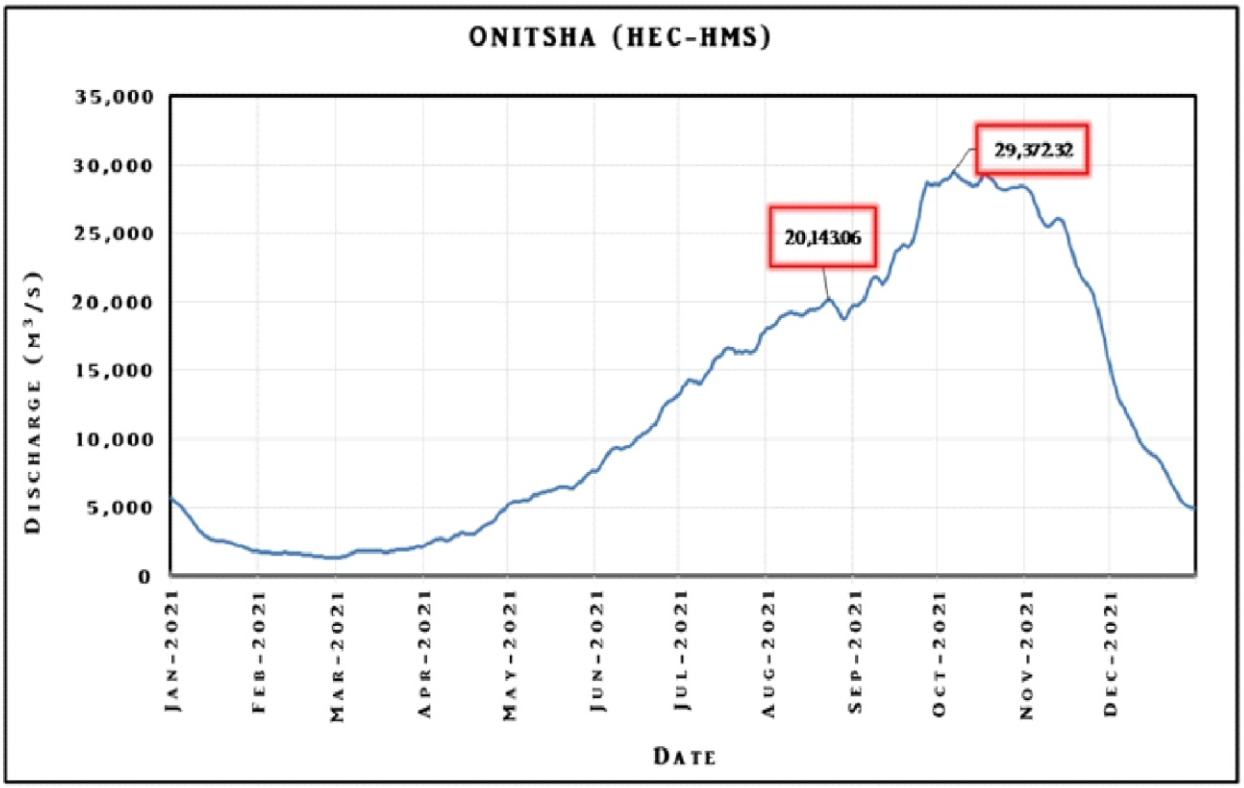


Figure 3.20: Simulated Flows at Onitsha, River Niger

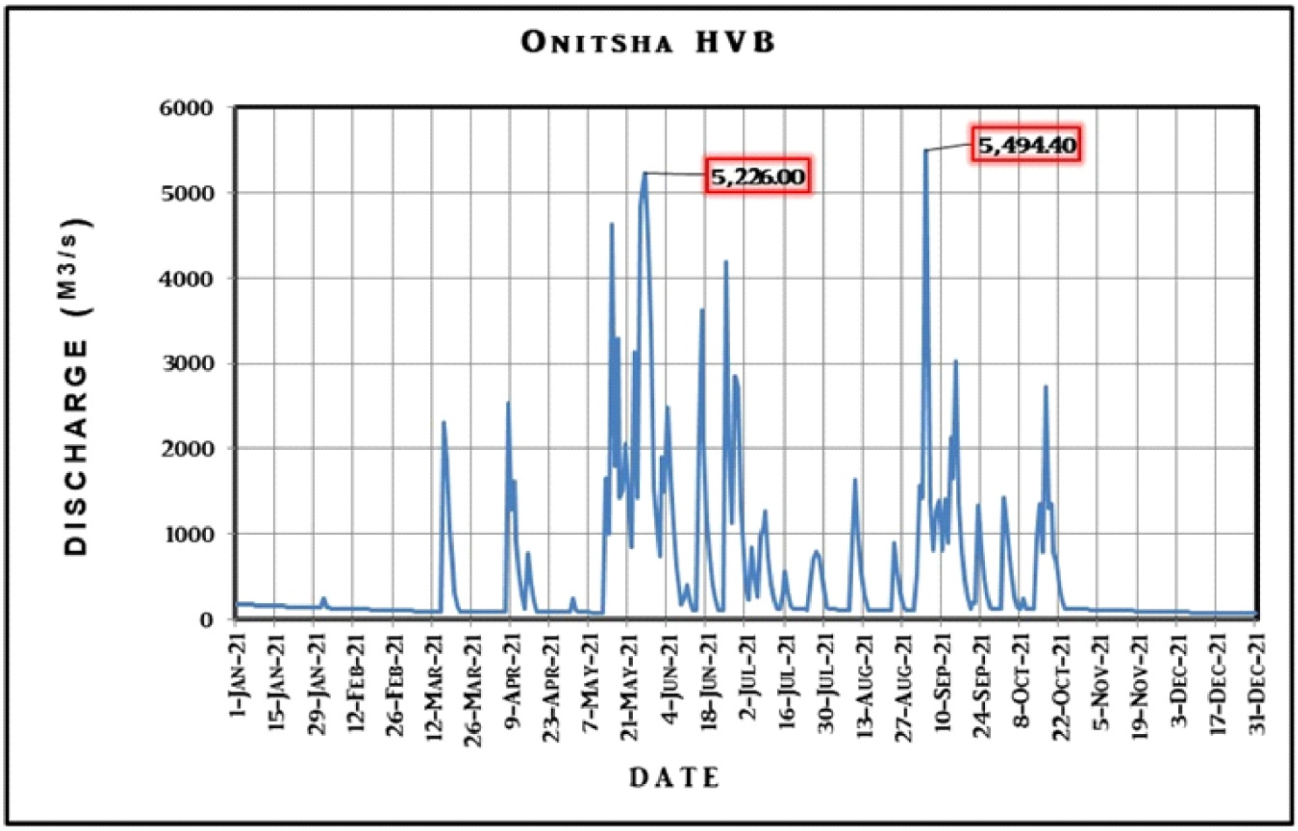


Figure 3.21: Simulated Flows at Onitsha, River Niger

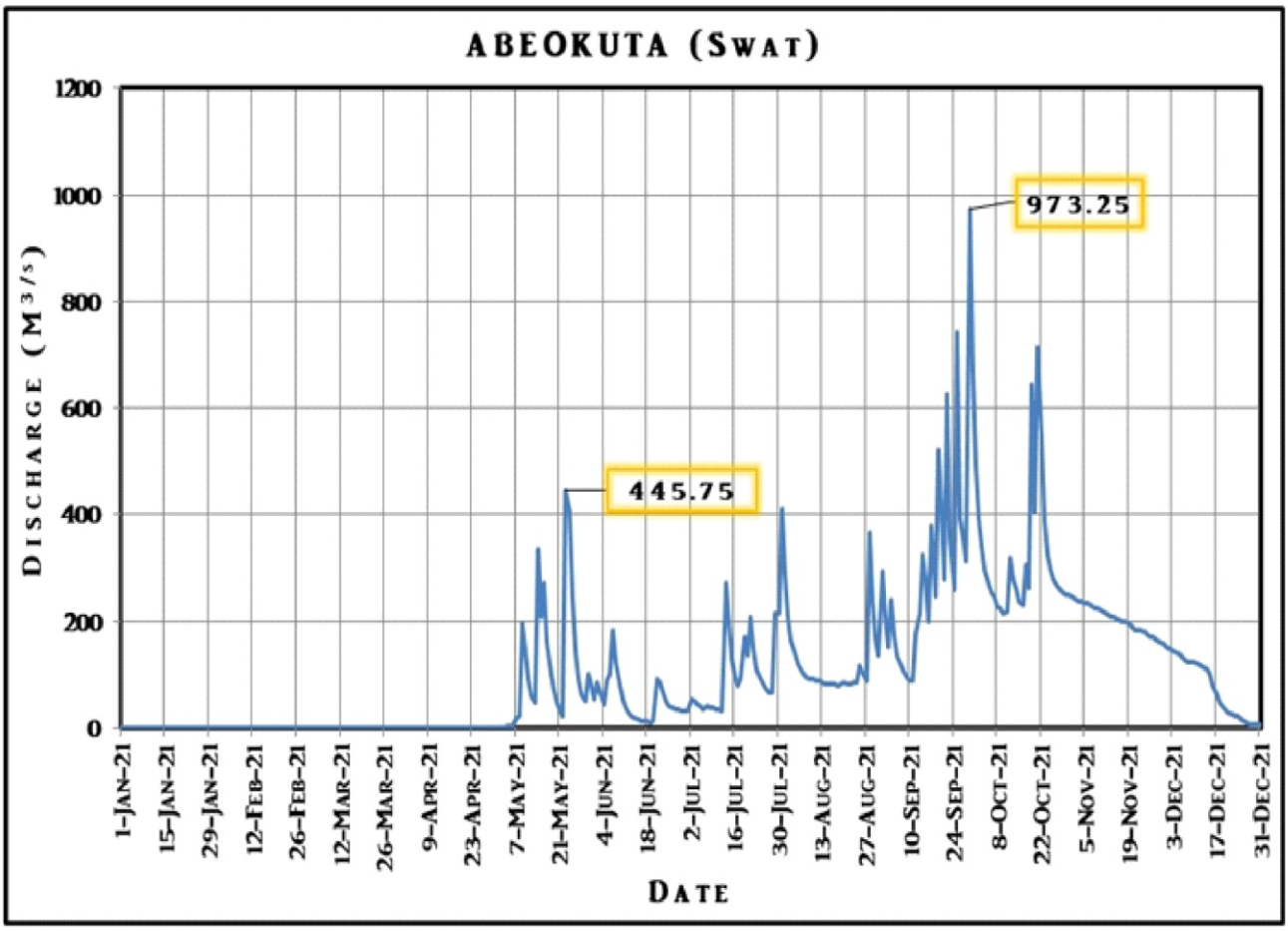


Figure 3.22: Simulated Flows at Abeokuta, River Ogun

Figure 3.23: Simulated Flows at Abeokuta, River Ogun

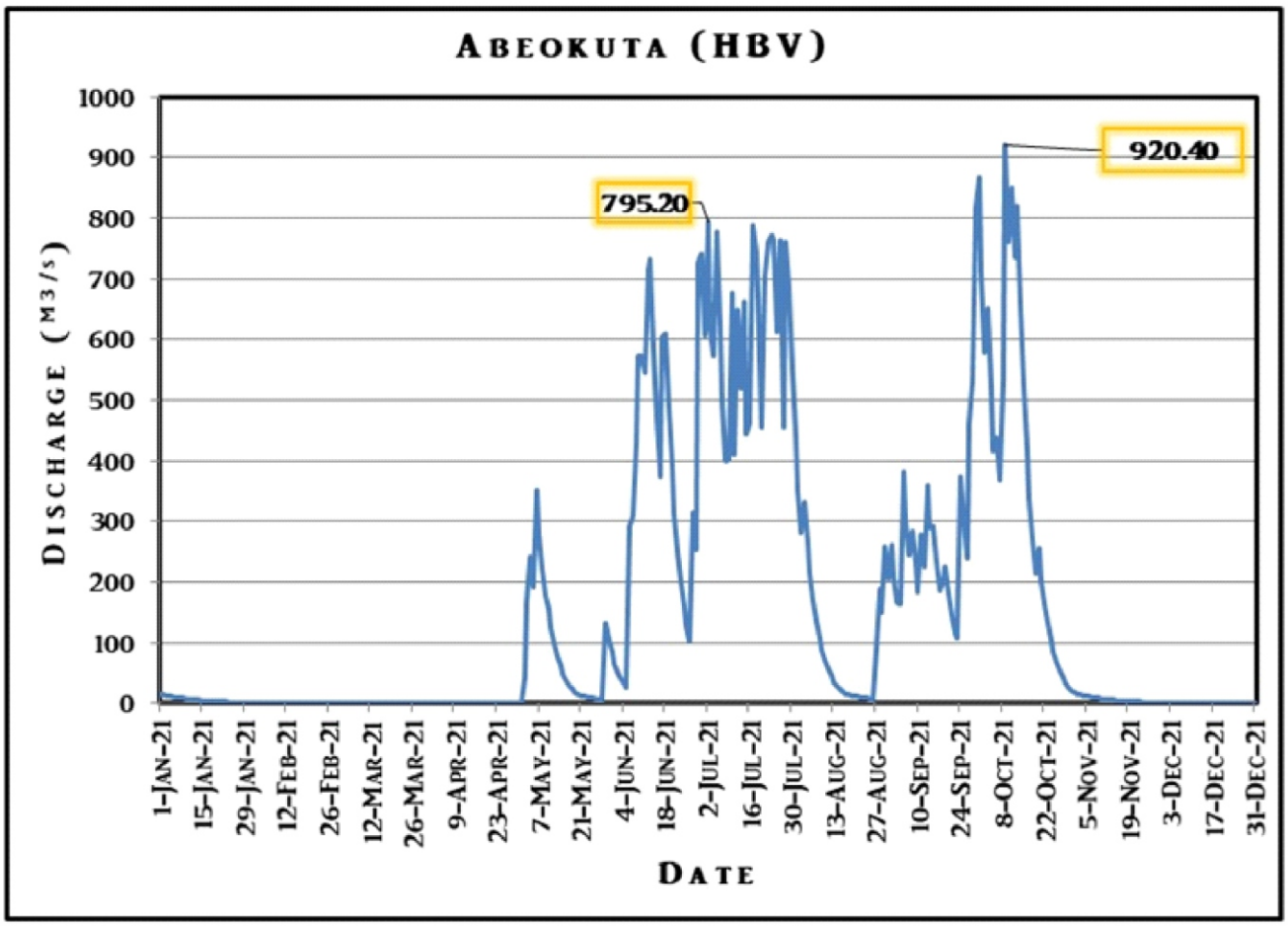


Figure 3.24: Simulated Flows at Abeokuta, River Ogun

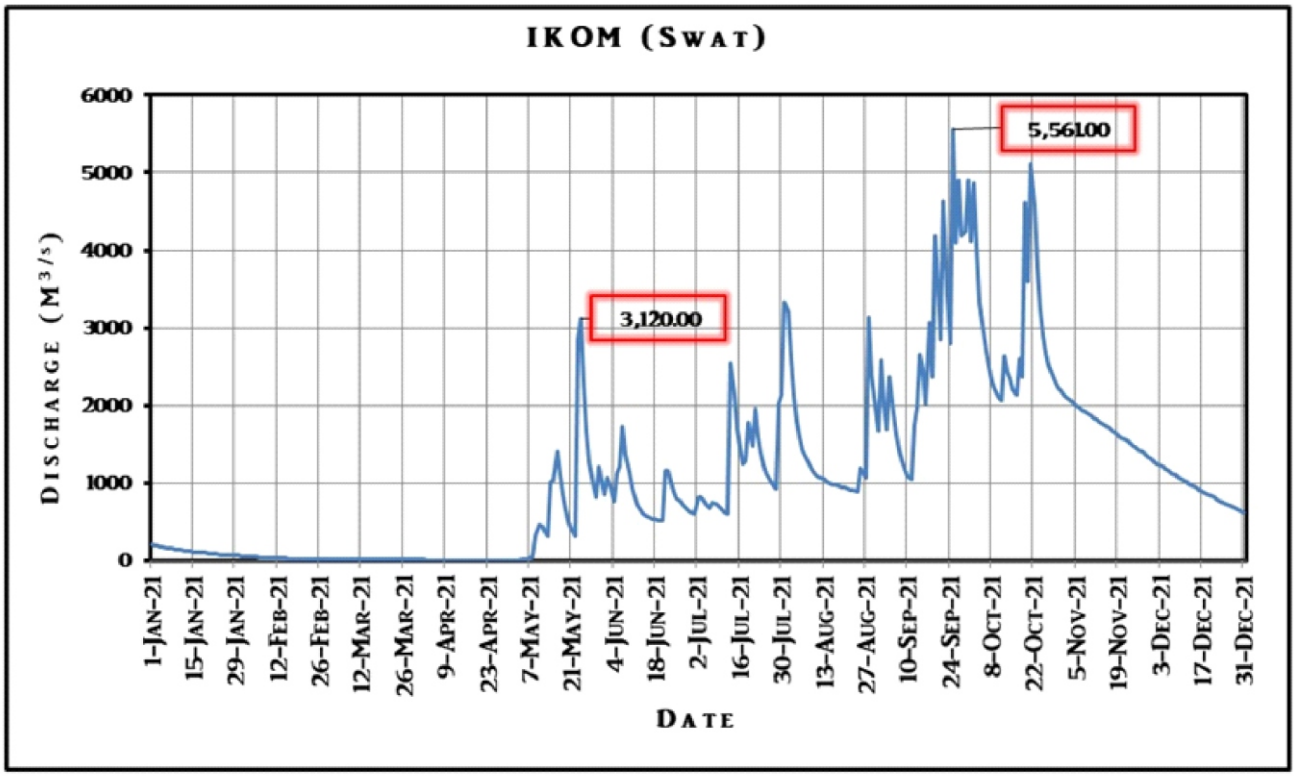


Figure 3.25: Simulated Flows at Ikom, Cross River

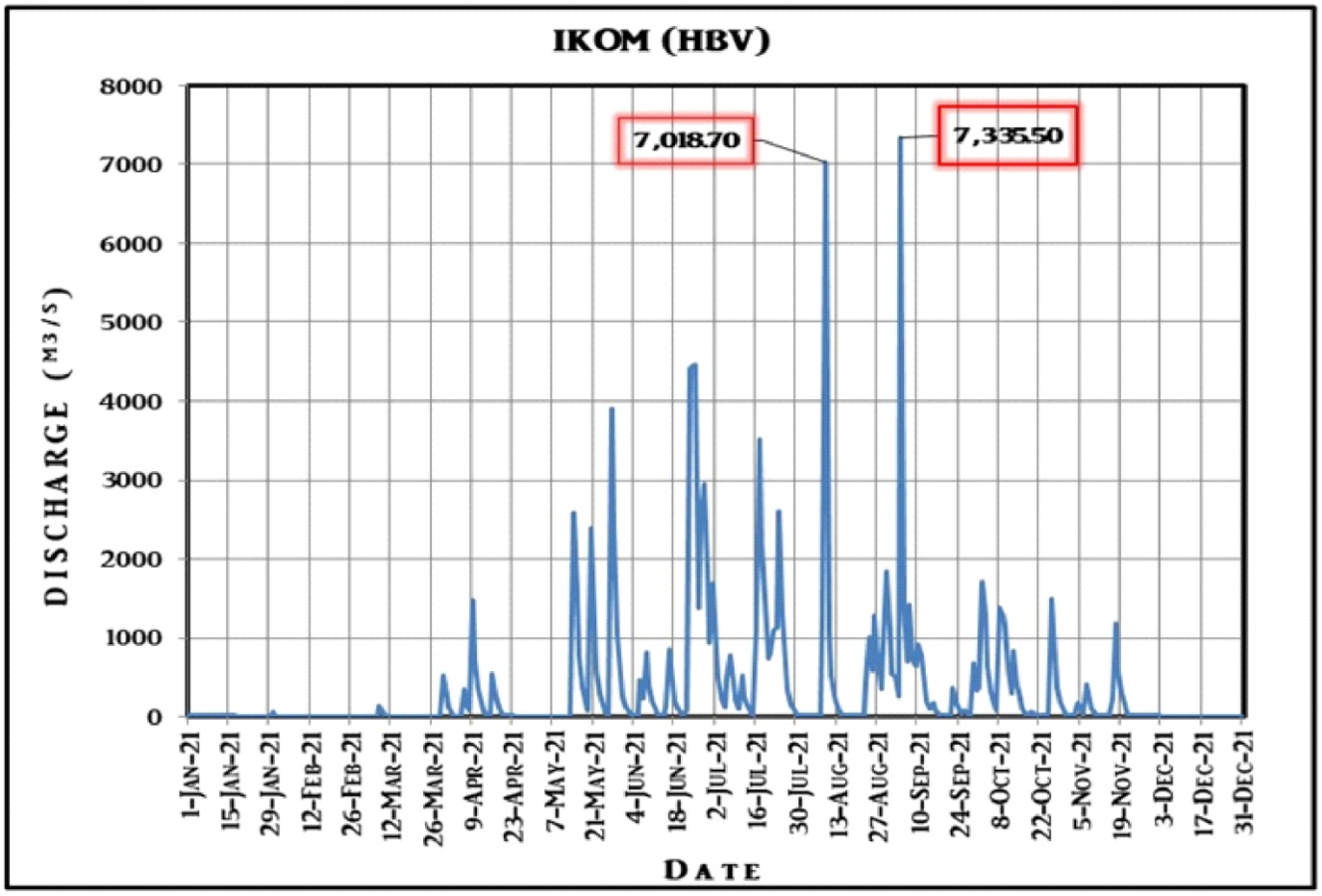


Figure 3.26: Simulated Flows at Ikom, Cross River

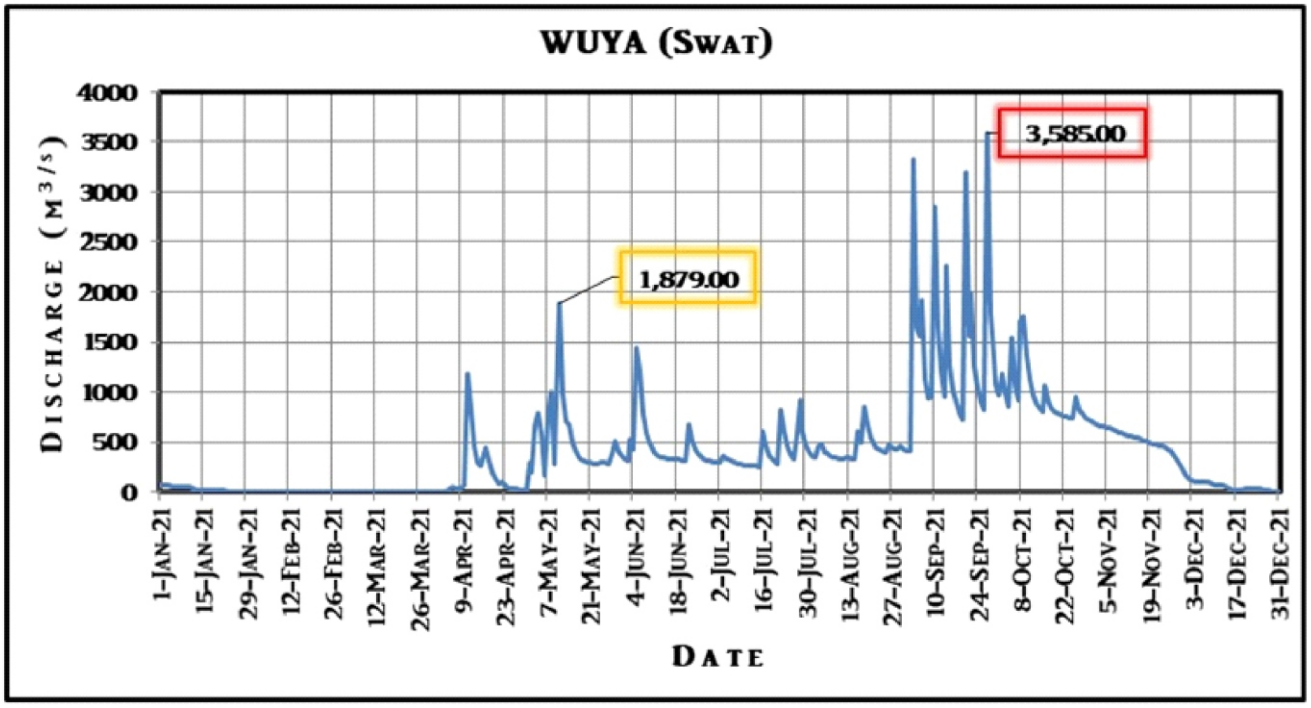


Figure 3.27: Simulated Flows at Wuya, River Kaduna

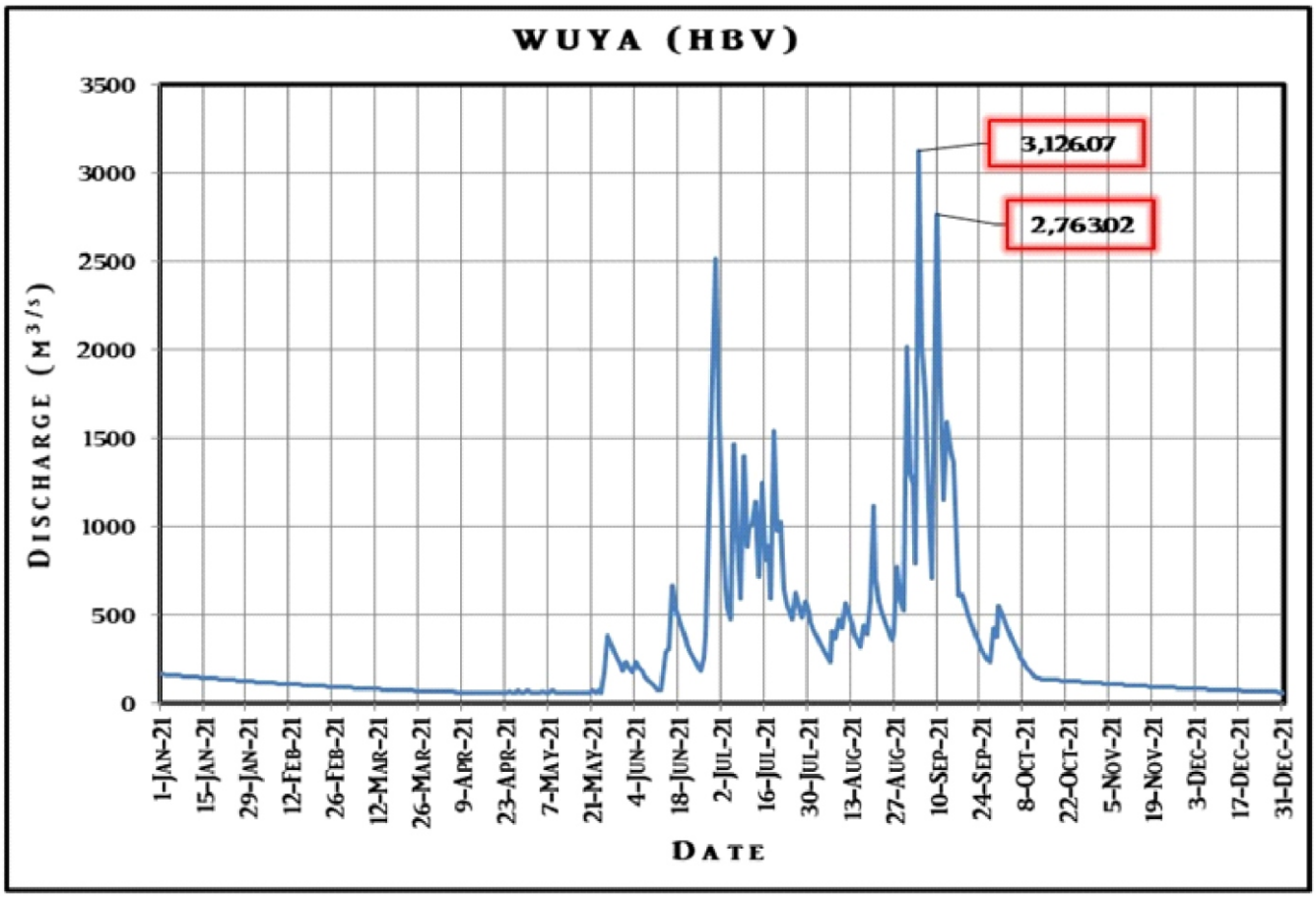


Figure 3.28: Simulated Flows at Wuya, River Kaduna

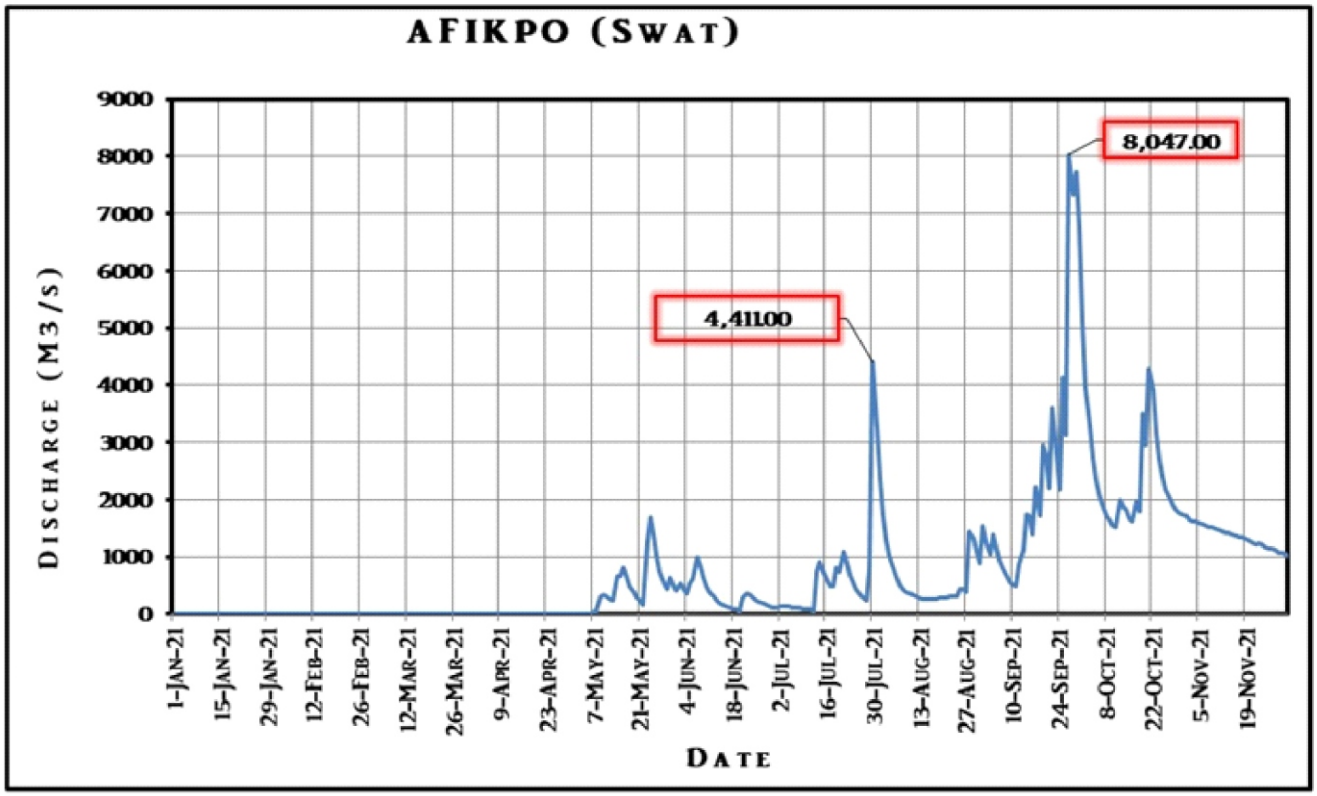


Figure 3.29: Simulated Flows at Afikpo, Cross River

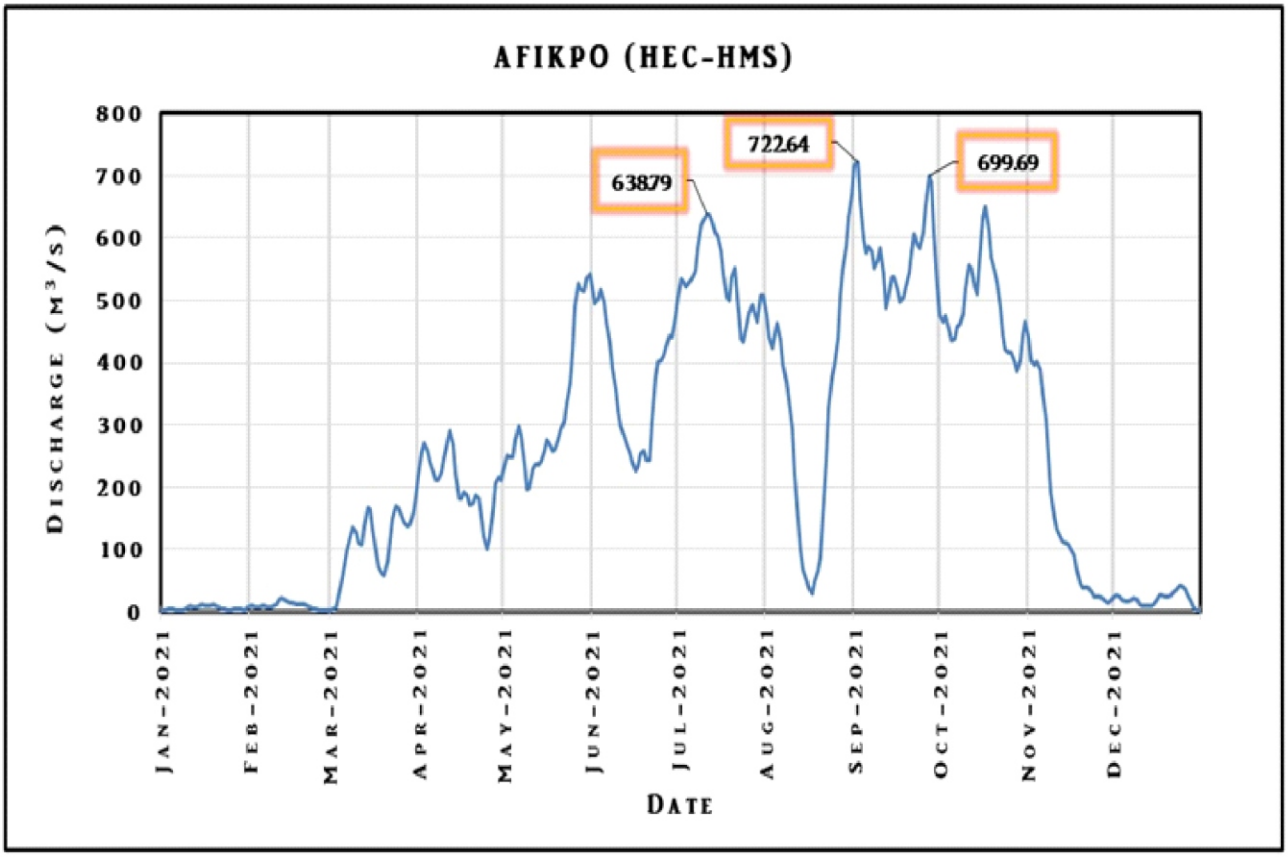


Figure 3.30: Simulated Flows at Afikpo, Cross River

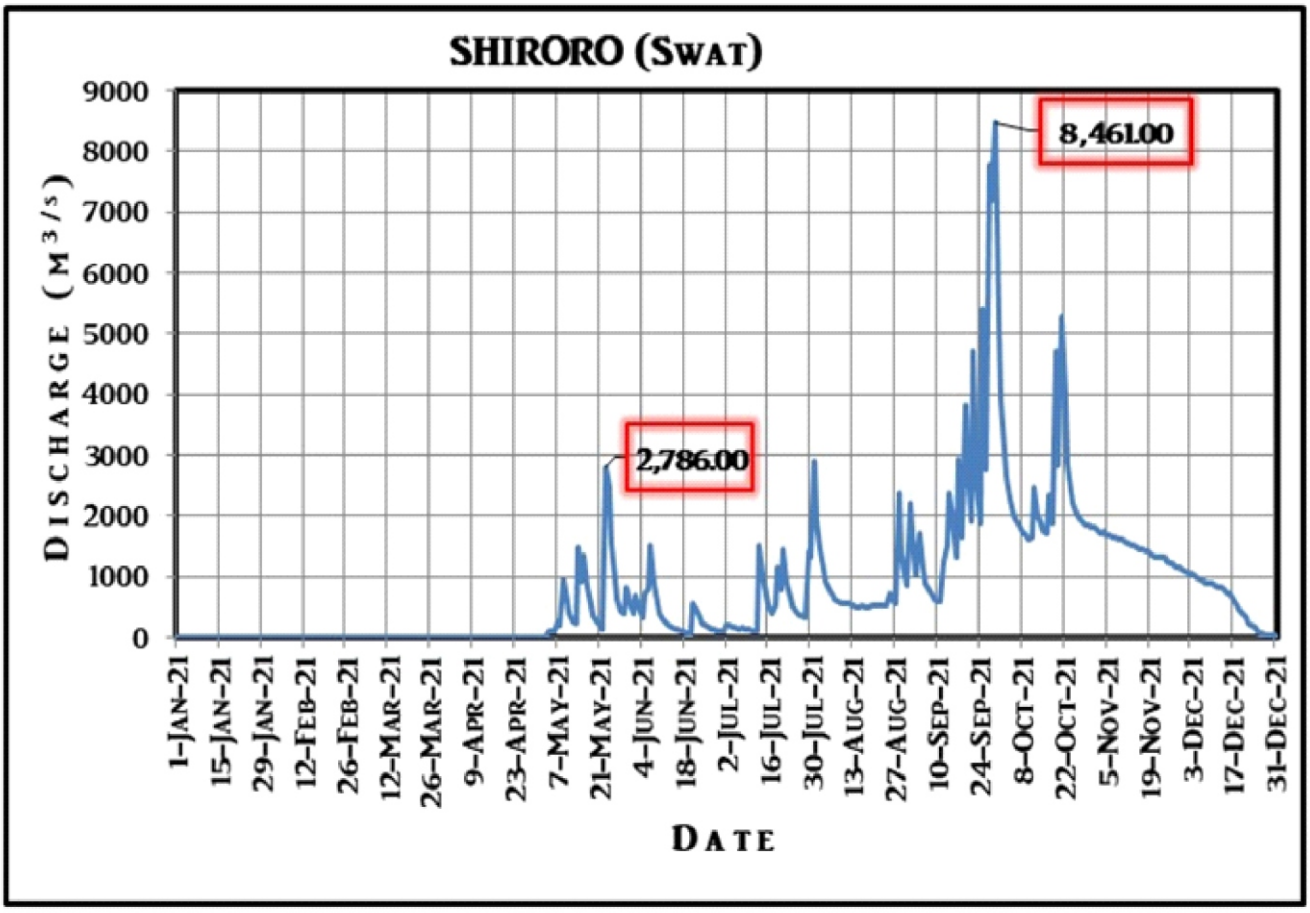


Figure 3.31: Simulated Flows at Shiroro, River Kaduna

Figure 3.32: Simulated Flows at Shiroro, River Kaduna

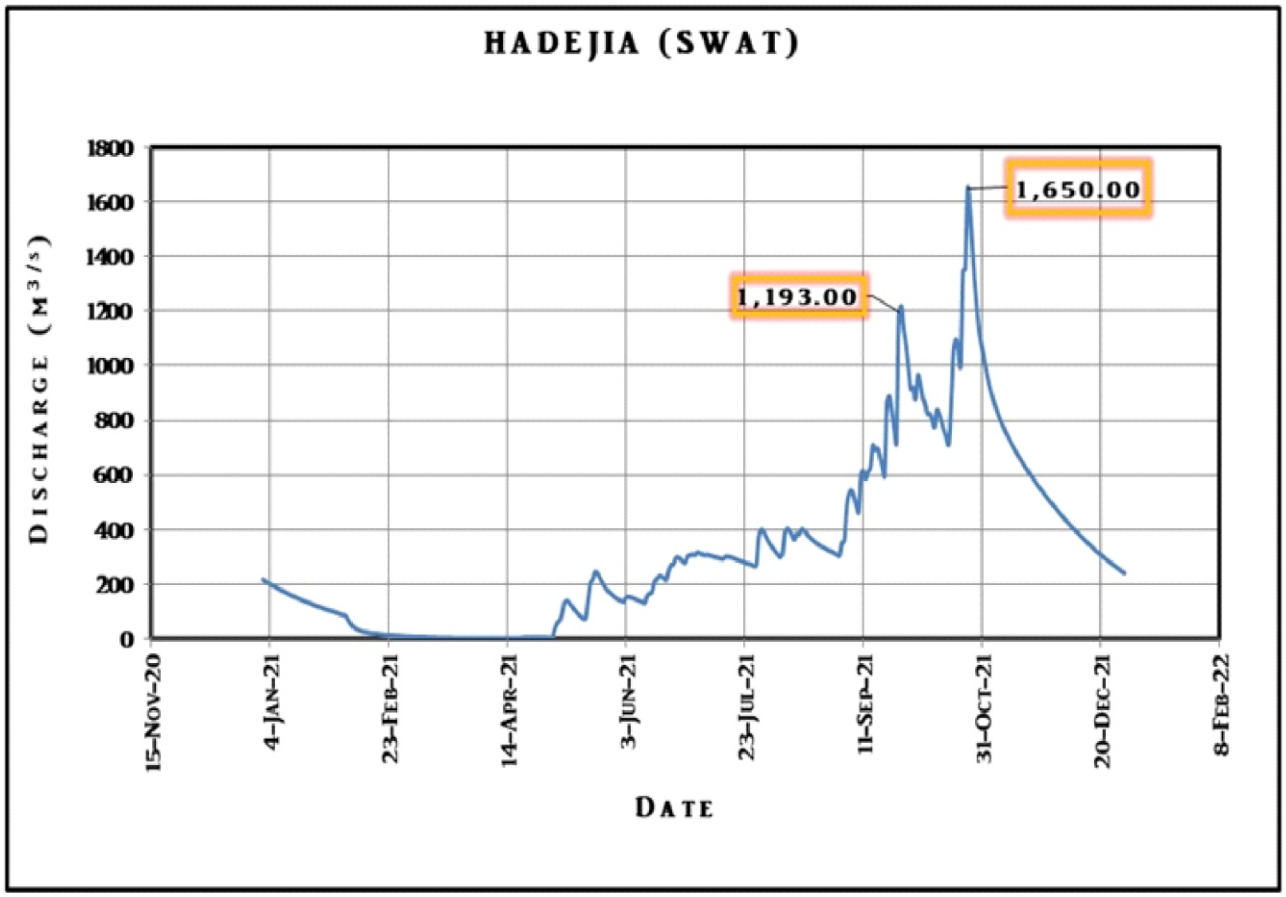


Figure 3.33:Simulated Flows at Hadejia

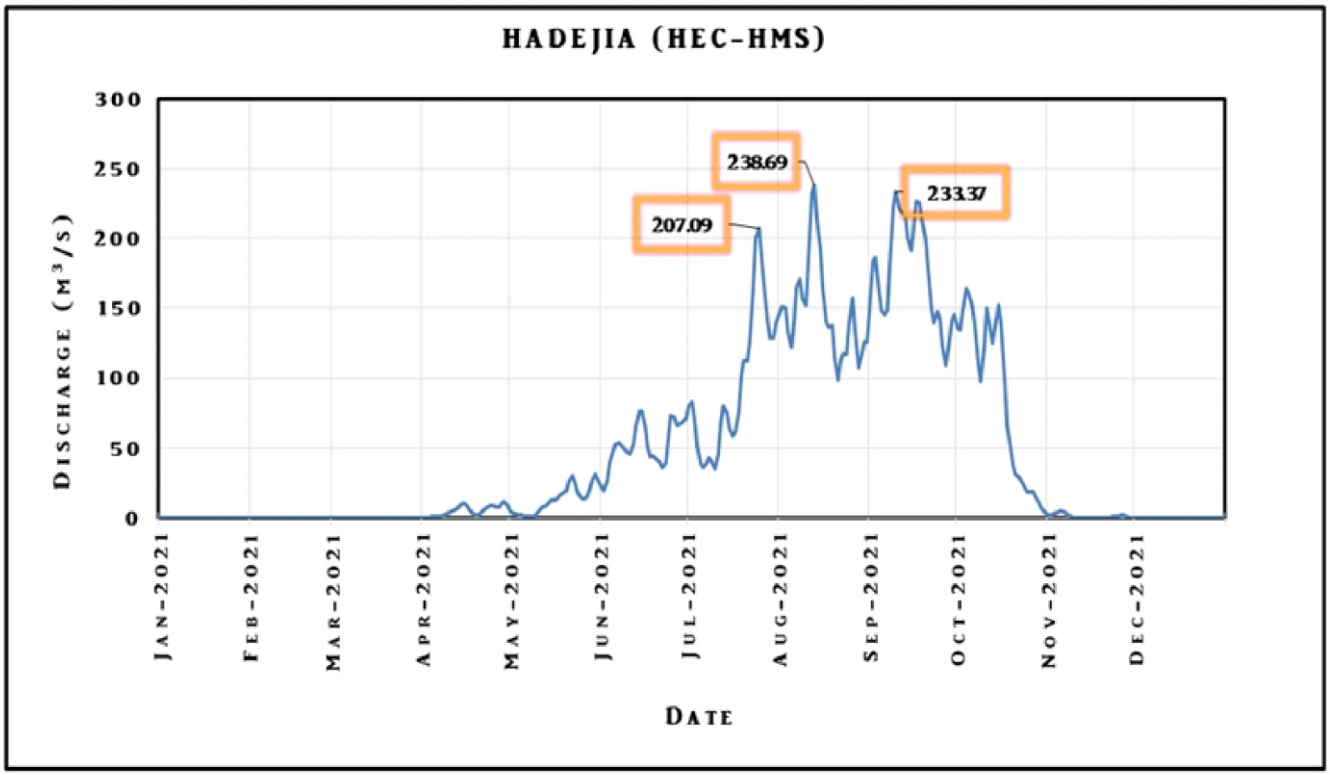


Figure 3.34:Simulated Flows at Hadejia

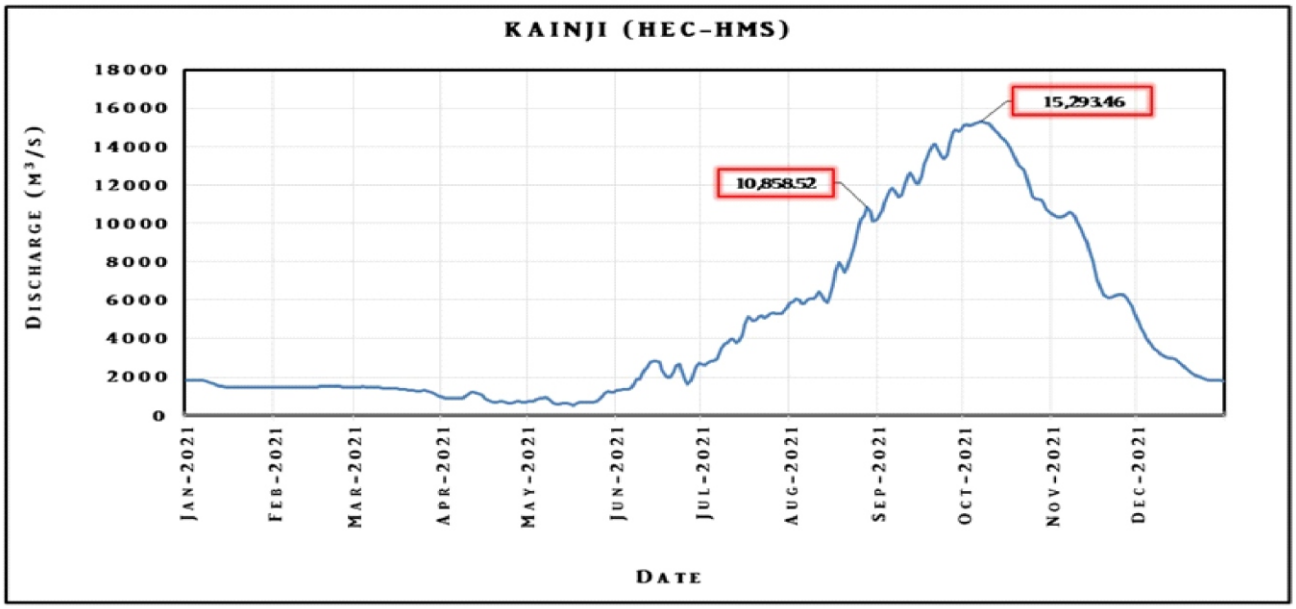


Figure 3.35: Simulated Flows at Kainji, Niger-River

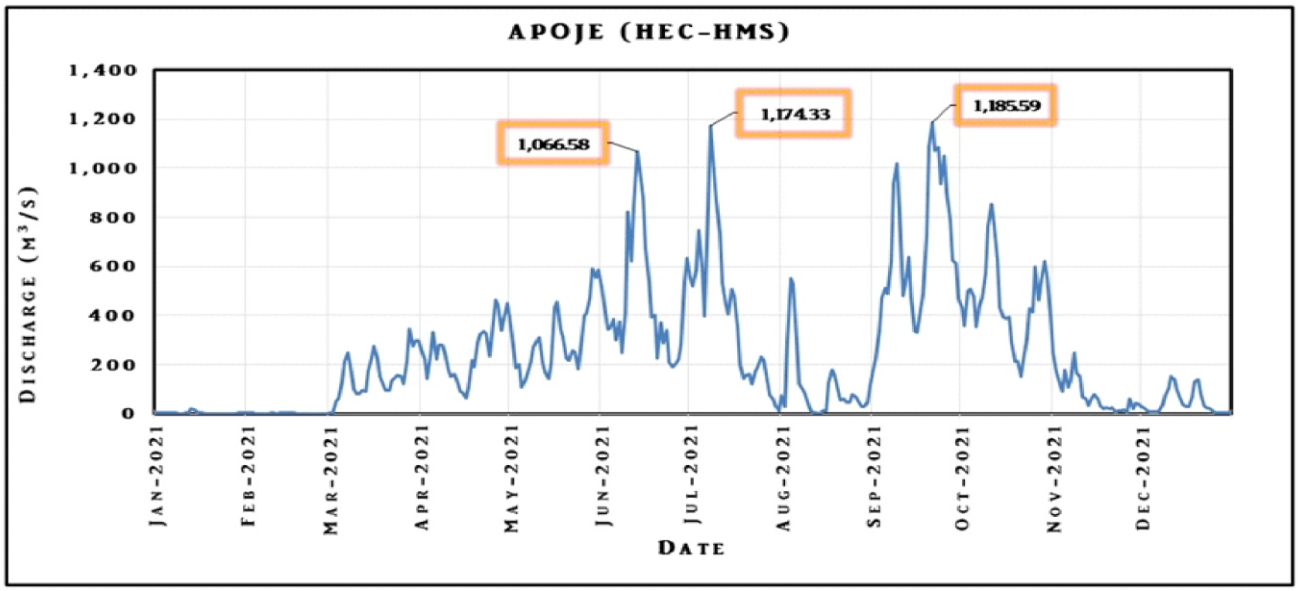


Figure 3.36: Simulated Flows at Apoje, River Oshun

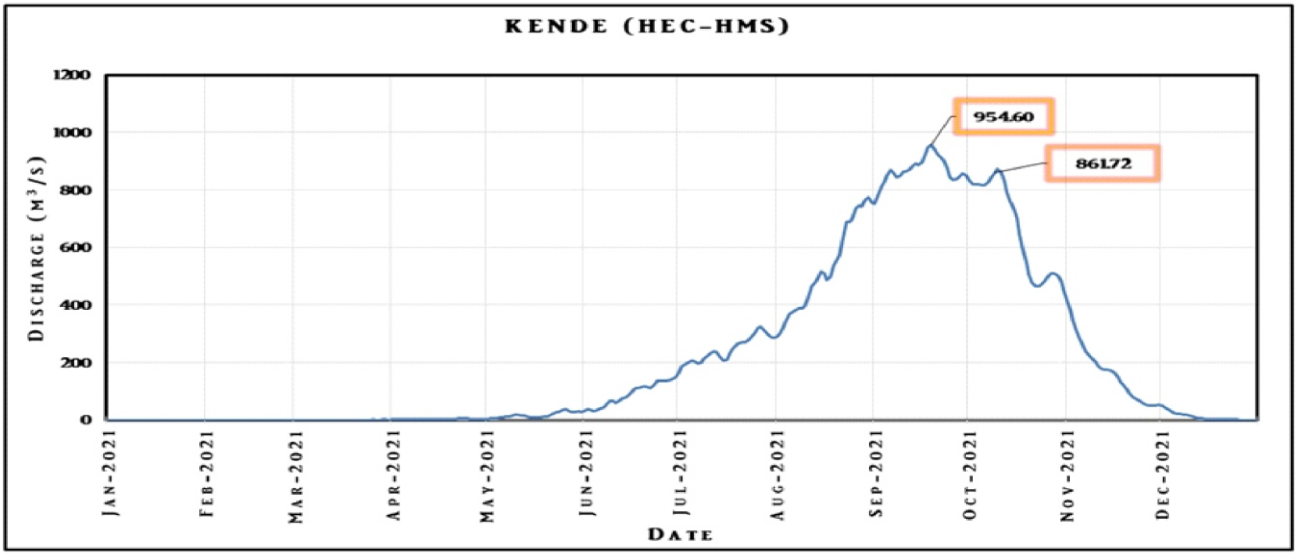


Figure 3.37: Simulated Flows at Kende, River Rima

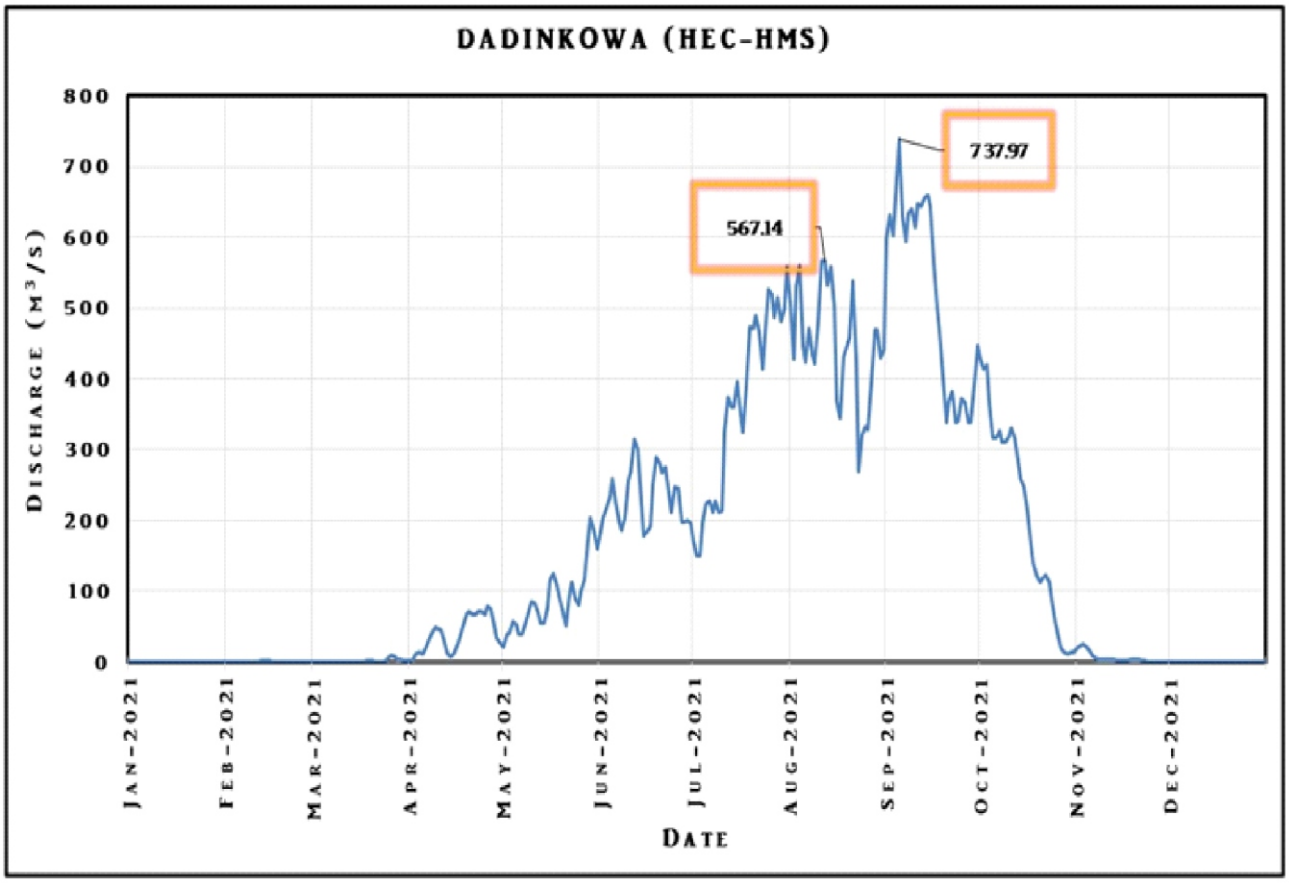


Figure 3.38: Simulated Flows at Dadinkowa, River Gongola

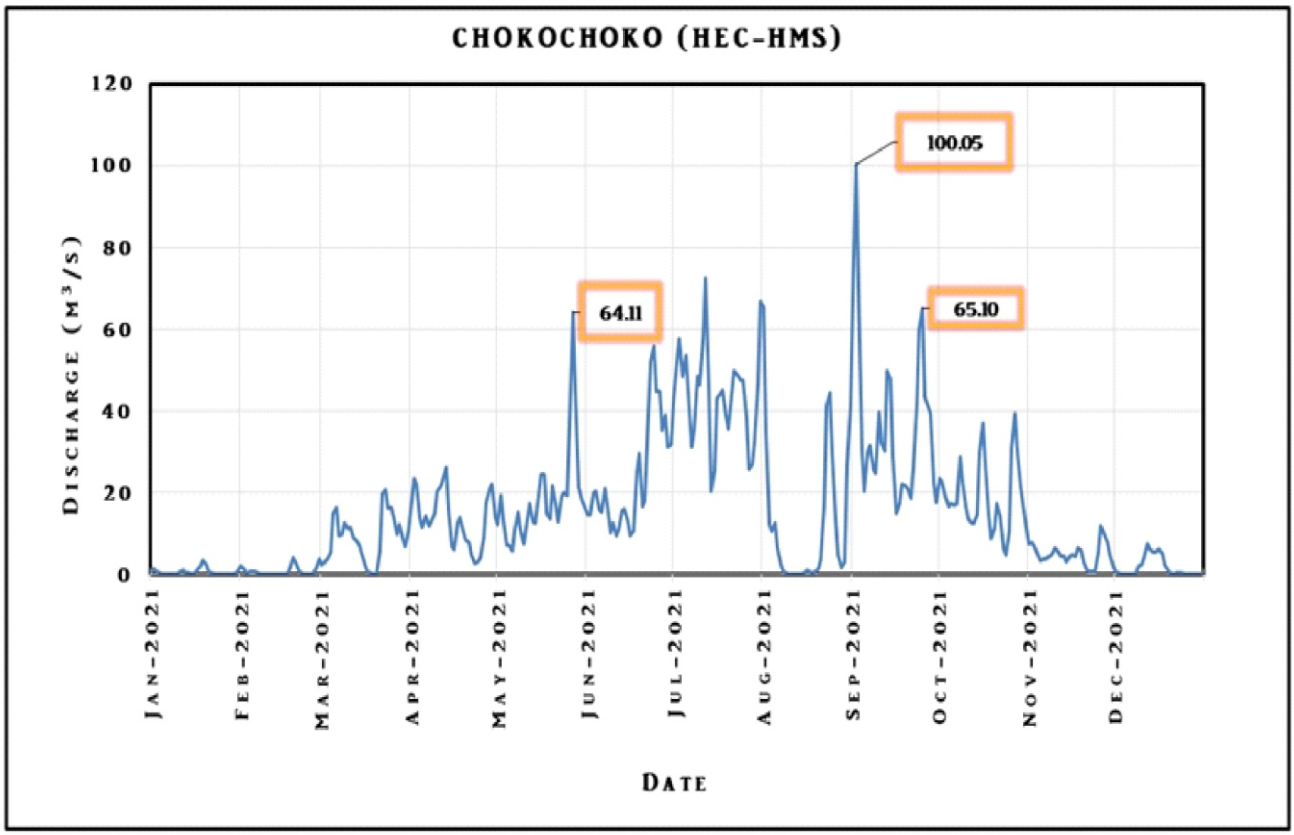


Figure 3.39: Simulated Flows at Chokochoko, River Otamiri

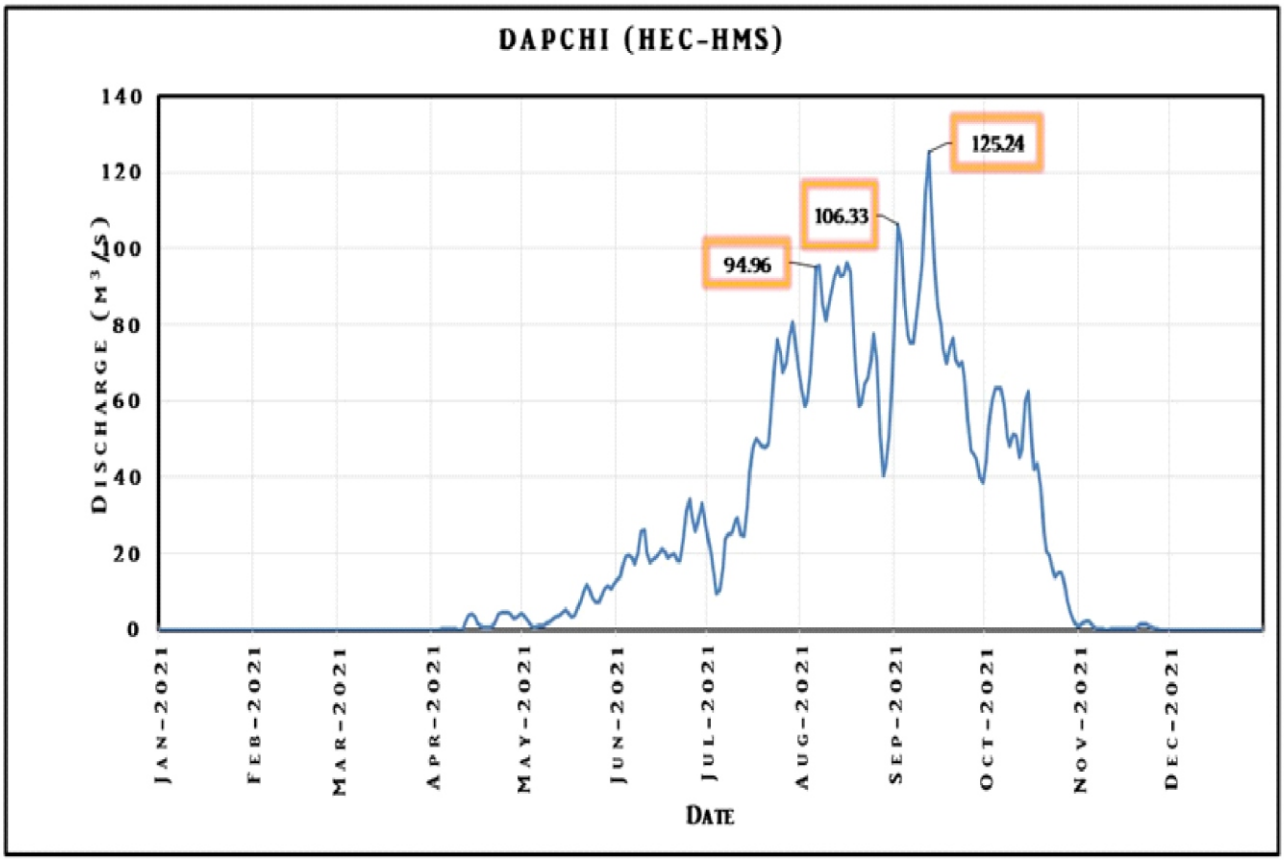


Figure 3.40: Simulated Flows at Dapchi, River Hadejia

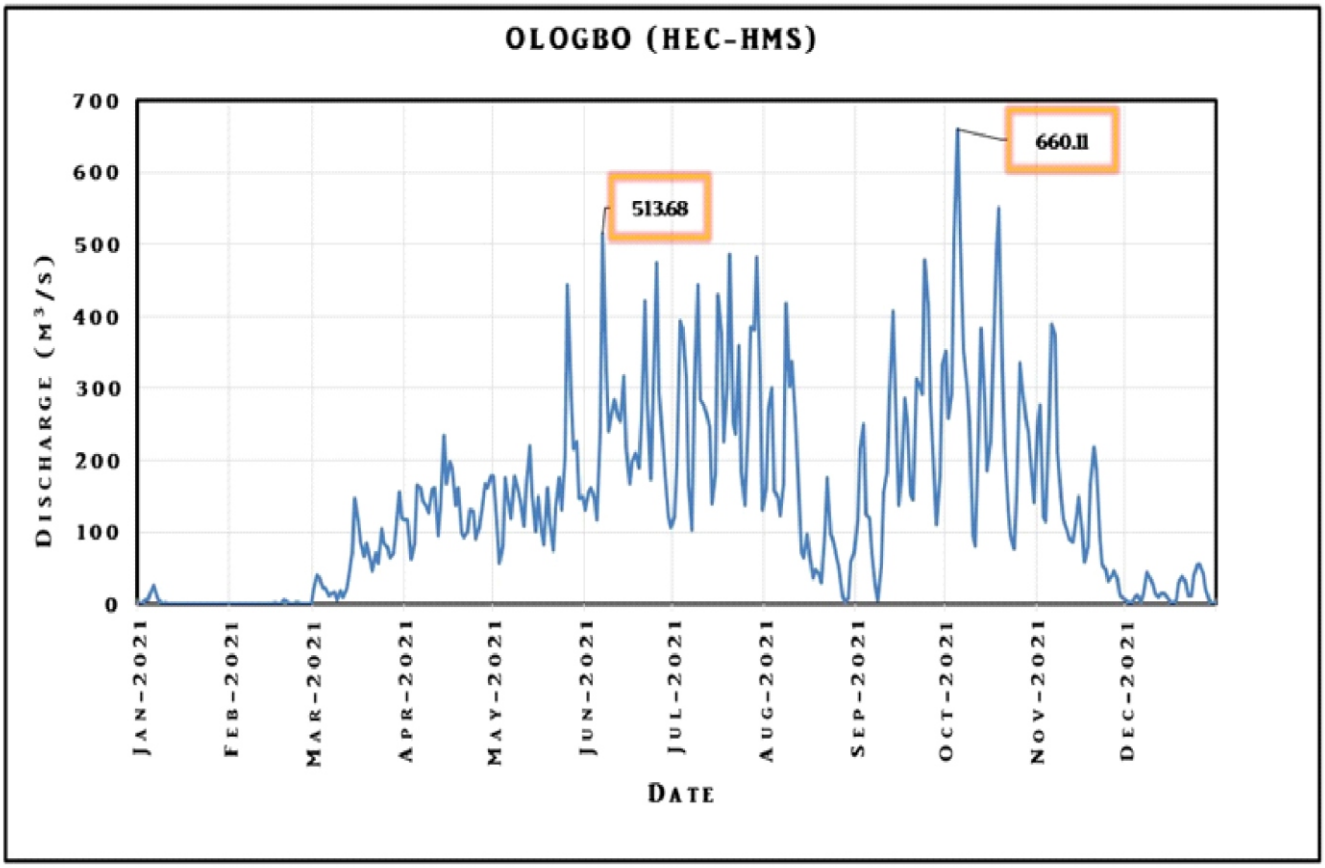


Figure 3.41: Simulated Flows at Ologbo, River Ossiomo

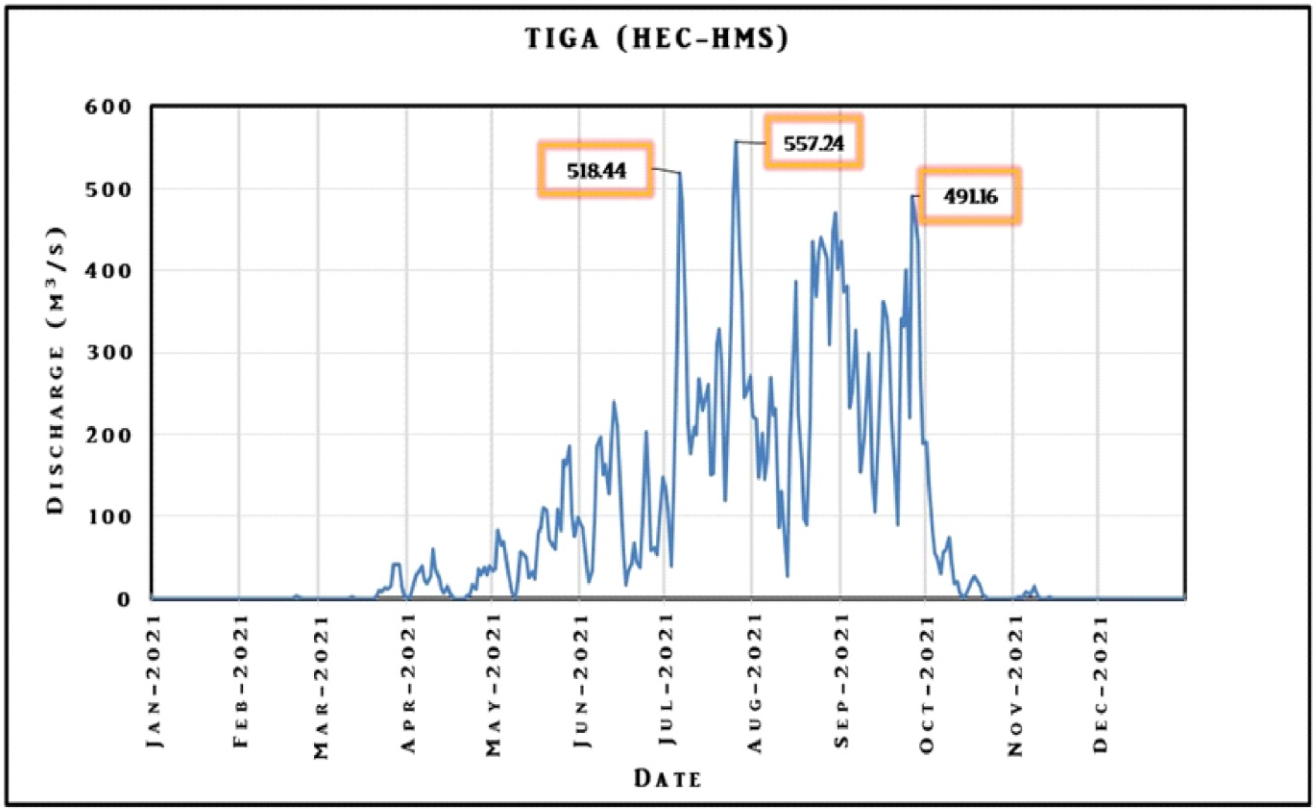


Figure 3.42: Simulated Flows at Tiga, River Kano

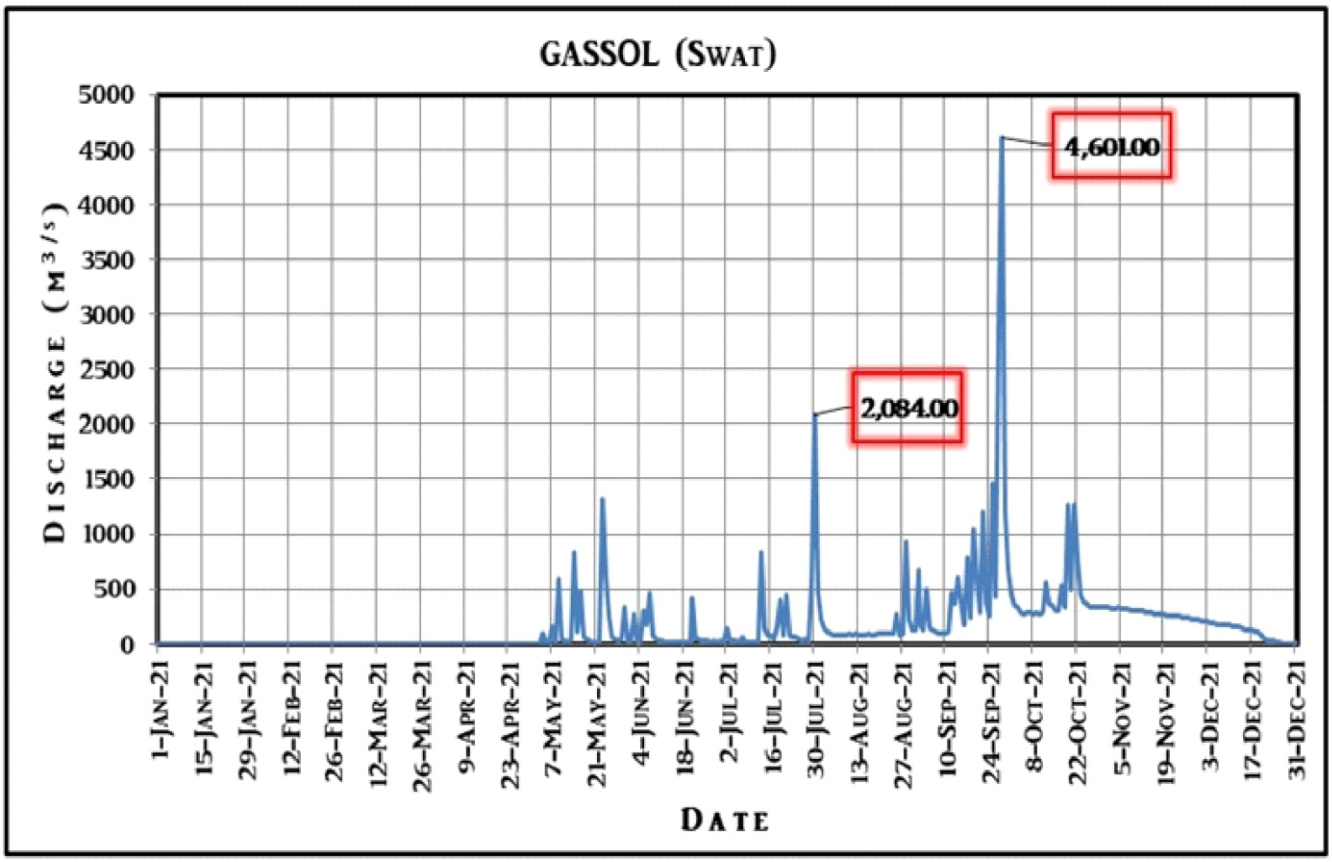


Figure 3.43: Simulated Flows at Gassol, River Taraba

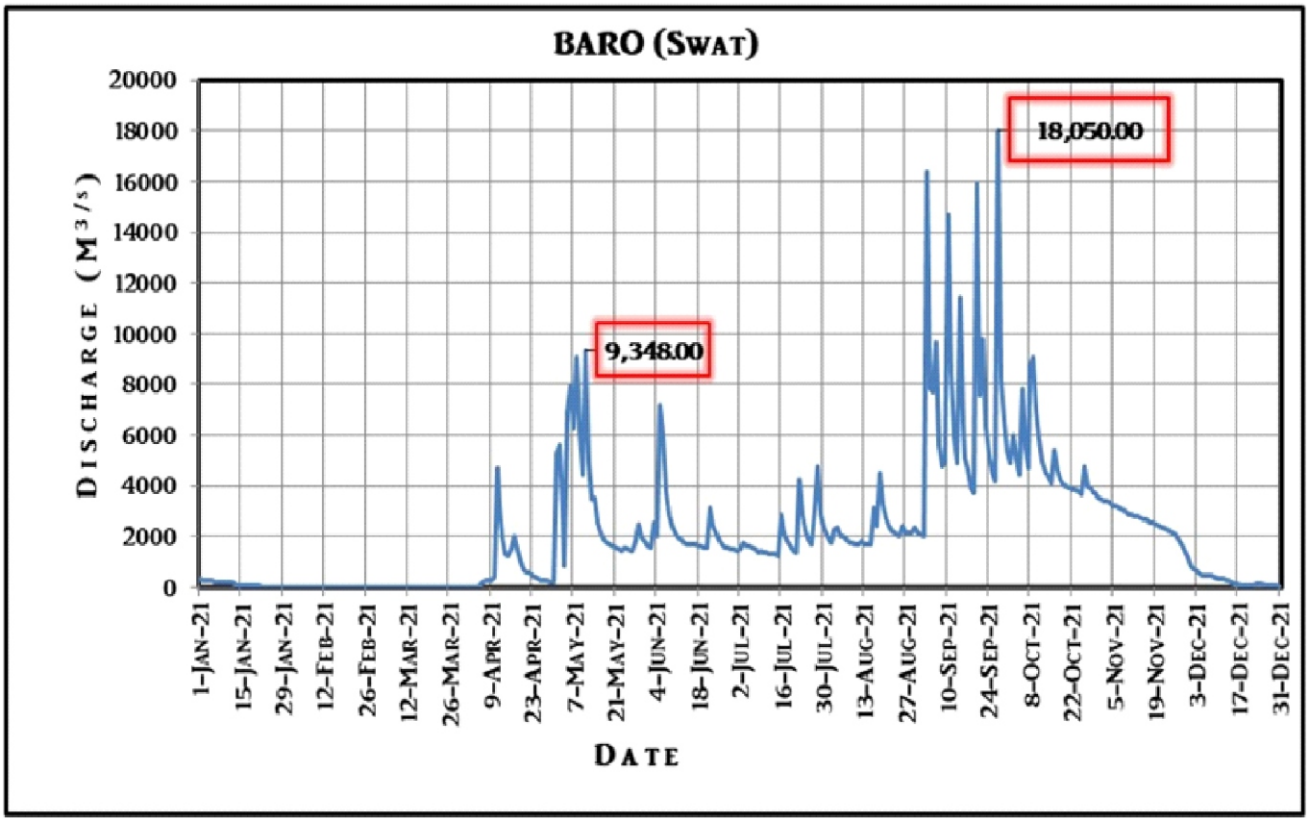


Figure 3.44: Simulated Flows at Baro, River Niger

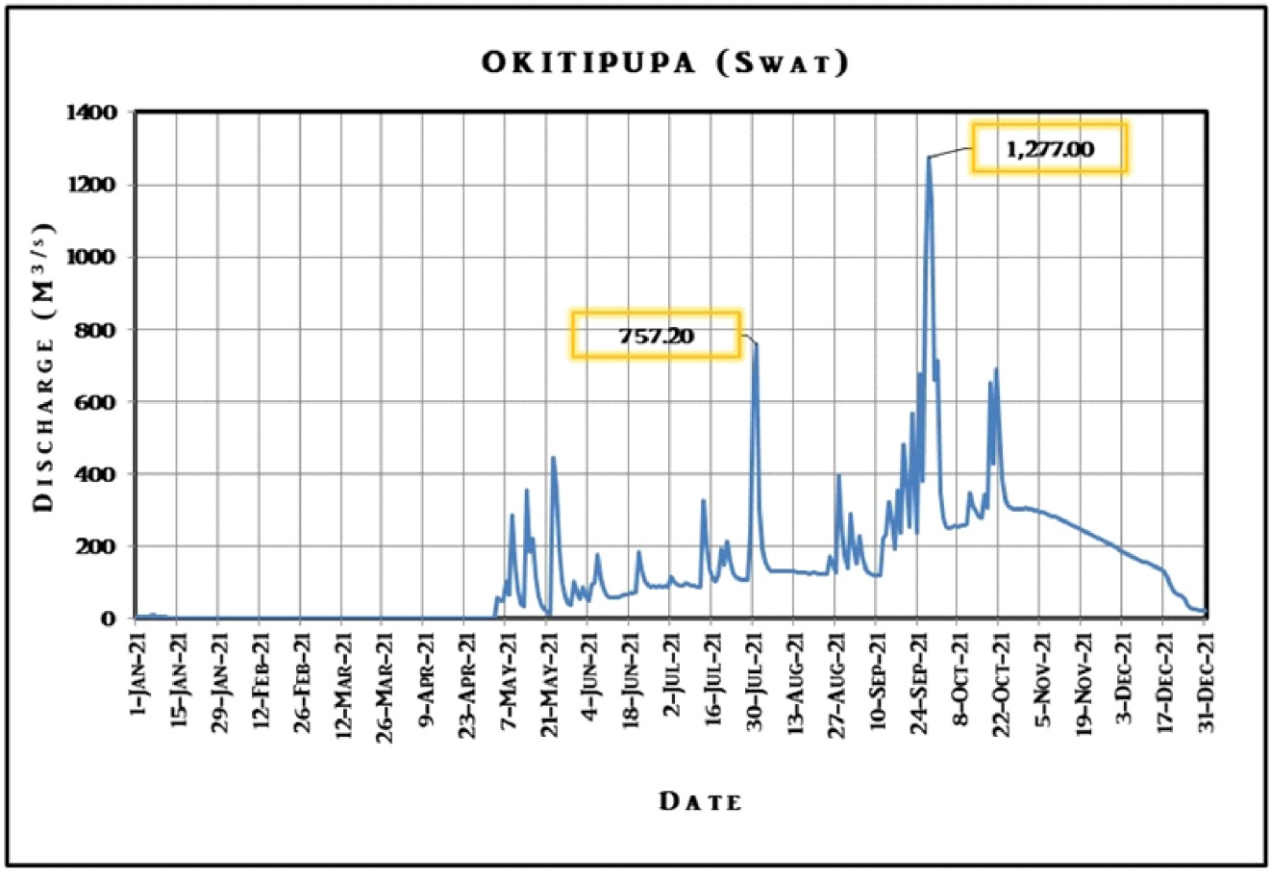


Figure 3.45: Simulated Flows at Okitipupa, River Omi Nla

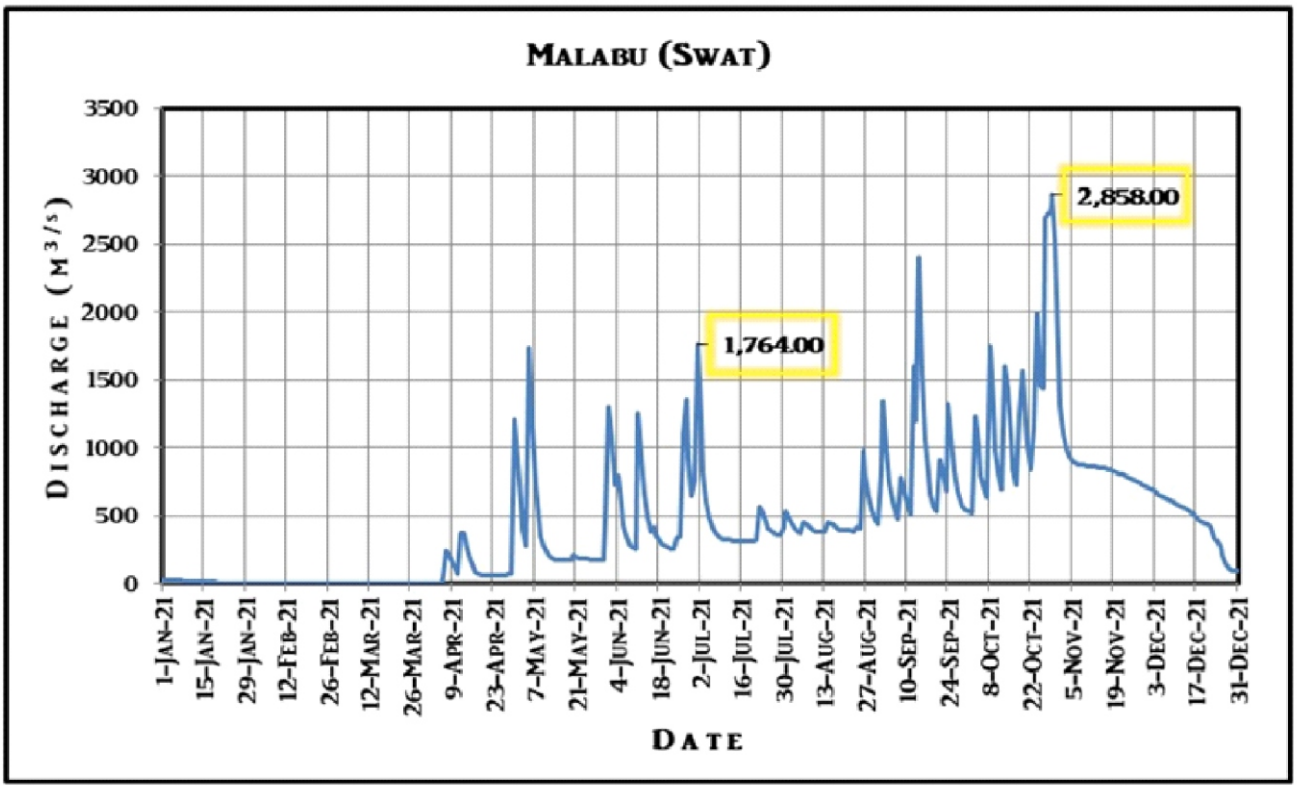


Figure 3.46: Simulated Flows at Malabu, River Niger

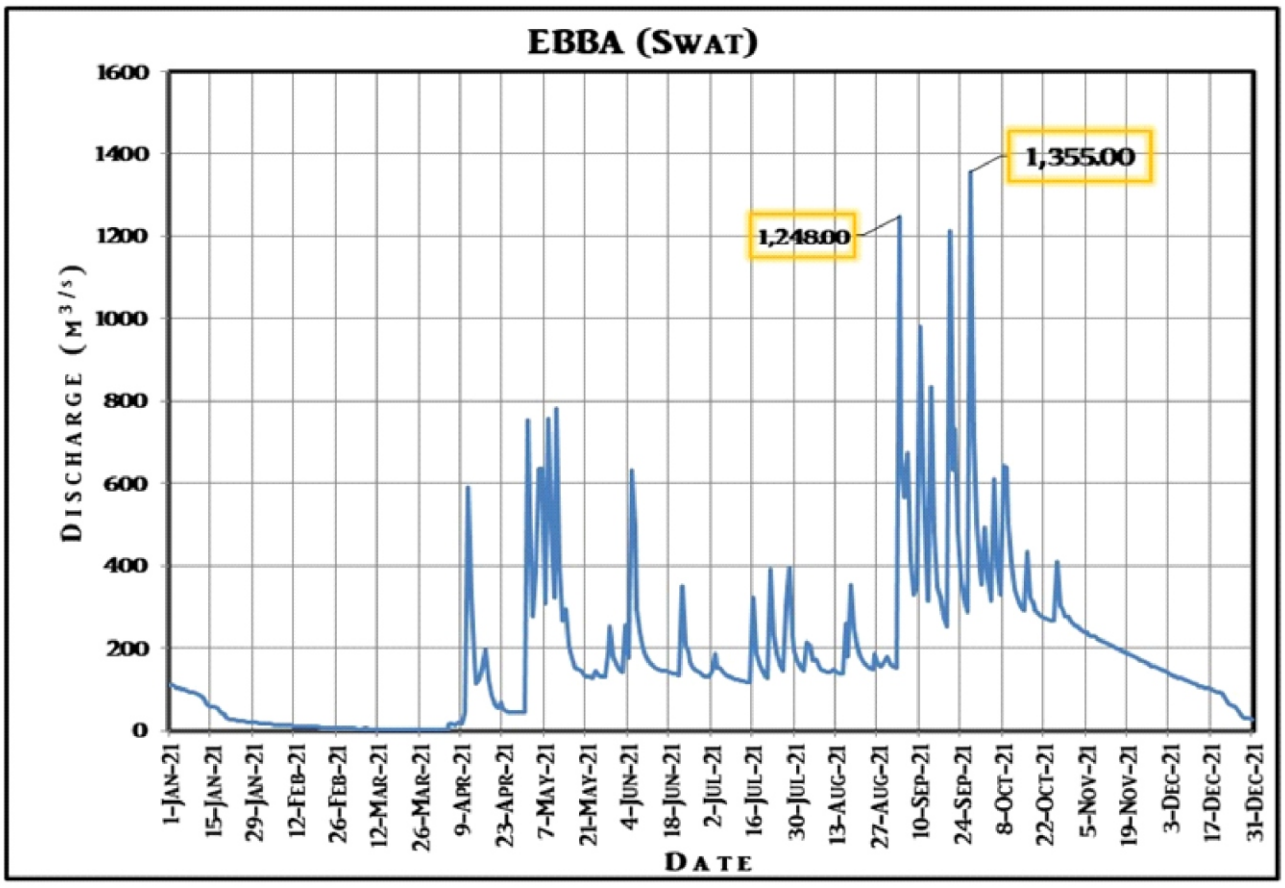


Figure 3.47: Simulated Flows at Ebba, River Gbako

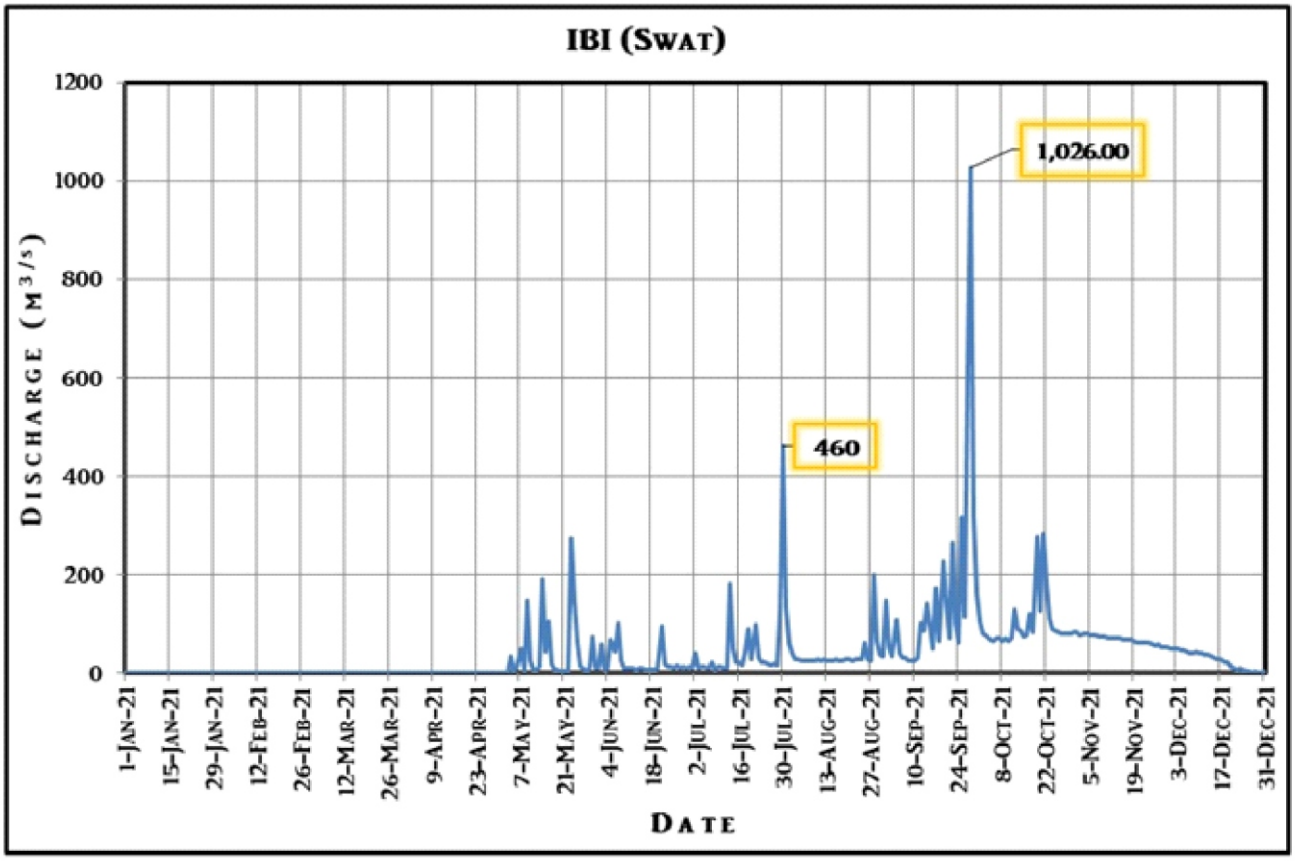


Figure 3.48: Simulated Flows at Ibi, River Ibi

From the hydrographs as seen in figures3.13 – 3.48", a steady rise in discharge rate and water level is expected from May, and a Peak flow between September and October along the major river channels.

NIHSA

CHAPTER FOUR

CHAPTER FOUR

4.0 CONCLUSION AND RECOMMENDATIONS

Flooding is multidimensional in causes and effects; it is a global phenomenon that has increased in frequency over years. Impending climate change and anthropogenic activities exacerbate flooding.

In predicting flood occurrence and mitigation of flood hazards, understanding the hydro-meteorological and catchment processes is essential. Imaginative and innovation management approaches should be encouraged and applied in the planning and management of flood. The most sustainable approach in dealing with flooding is to put in place measures to manage the hazards and eventually adapt and learn to live with floods. Hydrologic modeling and simulation are indispensable tools in water resources management and should continue to be adopted and applied in flood forecasting and risk management. In this 2021 edition of the publication of the AFO, Three (3) modeling tools have been appreciatively effective (HEC HMS, SWAT and the HBV Models).

The concept of AFO is an Adaption Benefits Mechanism (ABM) that mobilizes public sector support for climate change adaptation through the identification of flood risk hot spots in the country. It creates action that generate adaptation benefits in prominent decisions affecting planning and development processes of critical sectors of the economy namely: Agriculture, Aviation, Water Resources, Power, Health, Environment and Education.

The effective management of flood risk should be a collective responsibility of all stakeholders from the federal, state, and local to individual levels. The existing synergy between Nigeria Hydrological Services Agency, stakeholders and other collaborative agencies involved in flood management and disaster issues should be further strengthened.

Governments at various levels should also put in place measures for better town planning and effective land use zoning, effective flood disaster management in the changing environment, improved biodiversity and ecosystem management for the enhancement of rapid and sustainable development in the country.

The states should create retention basins for harvesting flood waters downstream of major rivers particularly, where there is scarcity of groundwater thereby using flood waters for possible groundwater recharge and other uses. By so doing, the fresh flood waters will not be lost to the sea.

From the prediction, all the states including the FCT are expected to experience different levels of flooding. Out of the 774 local government areas of the country, One hundred and Twenty-One (121) are predicted to be at highly probable risk of flood occurrence in 2021, while Three Hundred and Two (302) local government areas are under the probable areas of flood category, and Three Hundred and Fifty-One (351) are predicted to be under the less probable to flood occurrence category. This AFO contains useful information on the areas that are likely to be flooded and the severity of the expected flooding in 2021.

Finally, it is advised that th e predictions of flood for the year 2021 be adhered to and all recommendations heeded. Furthermore, considering the future modeling direction, NIHSA would like to adopt Hydraulic Modeling, Urban Flood Modeling, Reservoir Operations, and Realtime Flood Simulation for better flood prediction. The Agency is in partnership with an international organization, Computational Hydraulics International (CHI) Canada, to identify specific flooding problem areas and then develop a detailed Hydrologic and Hydraulic (H&H) computer model of such area.

4.1 RECOMMENDATIONS

The year 2021/2022 Hydrological Year is fast approaching with the usual flood disaster potential risks. The Agency hereby recommends that:

a) Agencies involved in the use of space-based technology and information for flood management should establish stronger synergy with NIHSA.

b) Stakeholders in the water sector should carry out River Training activities and maintenance of drainage areas by the removal of silt and sediment deposits in rivers to improve their conveyance capacities and from dams, lakes and reservoirs to increase their storage capacities for the containment of the incoming floodwaters.

c) There is need for construction of weirs, small reservoirs on tributary, streams and rivers for conservation of flood water to be used during the dry season thereby preventing desert encroachment, increasing irrigation food crop production, improvement of grassland areas, nomadic settlement, peace and sustainable development by relevant government agencies.

d) Intensification of soil conservation measuring technics on the drainage areas to reduce soil erosion and increase ecosystem protection among others.

e) Enforcement of Town Planning Codes in the country to allow for the appropriate construction of houses, and drainage structures.

f) Constantly freeing the waterways from obstructions and provision of adequate refuse dumping facilities by relevant authorities.

g) Intensify action towards protection of wetlands and introduction of tree planting by relevant government agencies.

h) State and local government authorities should endeavour to restore rivers to their natural courses.

GLOSSARY

Annual rainfall amount – This is the total amount of rainfall observed and recorded in the year under reference.

Anthropogenic - It describes changes in nature made by people. If your town has rerouted water from the river for drinking water, that is an anthropogenic activity.

Basin - It is an area of land that is lower at the centre than at the edges, especially one from which water runs down into a river. It is also large, bowl shaped depression in the surface of the land or ocean floor.

Catchment -. A catchment, drainage basin or watershed is the entire area, with a clearly defined boundary, the drainage divide, that provides runoff to, and sustains part or all of the flow of a main stream and its tributaries.

Climate change – It is a non-random change in climate that is measured over several decades or longer, which may be due to natural or human-induced causes.
Coastal inundation – A type of flooding which occurs when water is driven onto land from an adjacent body of water such as the sea or lagoon.

Discharge - It is the volume rate of water flow per unit time, including any suspended solids (e.g. sediment), solute, and/or biological material (e.g. diatoms), which is transported by the water.

Flash flood - It is a rapid flooding of geomorphic low-lying areas: washes, rivers, dry lake sand basins. It may be caused by heavy rain associated with a severe thunderstorm, hurricane, tropical storm, or melt water from ice or snow flowing.

Flood - A flood is an event where the river channel becomes inadequate to contain the flow, leading to overtopping of banks and the unrestrained/sustainedinundation of parts of the environment. The term has been extended to situations where, due to high surface impermeability and relative low-lying nature of an area, overland flow stagnates in, and inundates such zones.

Flood plains -. A flood plain is the strip of very low relative relief alluvial plain that borders a river channel and is usually bounded on the channel side by levees – discontinuous, wedge-shaped ridges around active and abandoned channels, and on the landward side by bluffs and uplands. It is subject to periodic inundation particularly during seasonal floods, and comprises river channels, oxbow lakes, levees, and terraces.

Global warming – An overall increase in the world temperatures, which may be caused by additional heat being trapped by greenhouse gases mostly as a result of human activities.
Hydrology- Hydrology is the study of the occurrence, circulation and distribution of fresh water (i.e., water with total solute load less than 1000 mg L-1) on the surface of the earth. It also investigates the physical and chemical properties of the water and its interactions with man and his environment.

Inundation - It is the covering of the land by water as a result of flood or construction of a dam, barrage or weir across a river.

Meteorology - It is the interdisciplinary scientific study of the atmosphere. Meteorological phenomena are observable weather events which are explained by the science of meteorology. These events are produced by the variables that exist in Earth's atmosphere; temperature, air pressure, water vapor, and the gradients and interactions of each variable, and how they change in time. Different spatial scales are studied to determine how systems on local, regional, and global levels impact weather and climate.

Morphology - It is a scientific study of form and structure, usually without regard to function.

Permeability – It is a process whereby water percolates into the ground through the interconnected pores and spaces in a rock.

Precipitation - as any product of the condensation of atmospheric water vapour that falls to the earth under gravity. The main forms of precipitation include drizzle, rain, sleet, snow and hail. Precipitation occurs when a local portion of the atmosphere becomes saturated with water vapour, so that the water condenses and precipitates.

Surface Runoff – Surface runoff (also known as overland flow) is the flow of water that occurs when excess storm water, melt water, or other sources flows over the earth's surface. This might occur because soil is saturated. It can also occur because rain arrives more quickly than soil can absorb it.

Telemetric - It is a technology that involves the automatic measurement and transmission of data from remote sources.

Topography - This is a characteristic of the land surface in terms of elevation, gradient, and presence of water courses and their variations over space.

Trans boundary Aquifer Systems (TAS) - It can also be referred to as Internationally Shared Aquifer Systems. This is a situation where water bearing rock formations (aquifers) underlie two or more countries

ACRONYMS

ACMAD: African Centre for Meteorological Application for Development
AFO: Annual Flood Outlook
AGRHYMET: Agro–meteorology and Operational Hydrology and their Applications
AMESD: African Monitoring of Environment for Sustainable Development
ArcGIS: Arc Geographic Information System
AWOS: Automatic Weather Observation Station
CHIRPS: Climate Hazards Group Infra-Red Precipitation with Stations
DAR: Deviation of Length of Rainy Season
DCP: Data Collection Platform
DEM: Digital Elevation Model
FEWSNET: Famine Early Warning System Network
FME: Federal Ministry of Environment
FMWR: Federal Ministry of Water Resources
GeoSFM: Geospatial Stream Flow Model
HA: Hydrological Area
HBV: HydrologiskaByråns Vattenbalansavdelning model
HEC-HMS: The Hydrologic Engineering Center, Hydrologic Modeling System
HKYTF: HadejiaKomadugu Yobe Trust Fund
IPCC: Inter-governmental Panel on Climate Change
JICA: Japanese International Cooperation Agency
NASA: National Aeronautic and Space Agency
NASRDA: National Space Research and Development Agency
NBA: Niger Basin Authority
NEMA: National Emergency Management Agency
NIHSA: Nigeria Hydrological Services Agency
NiMet: Nigerian Meteorological Agency
NIWA: National Inland Waterways Authority
NIWRMC: Nigeria Integrated Water Resources Management Commission
NWRI: National Water Resources Institute
OSGOF: Office of the Surveyor General of the Federation
PET: Potential Evapotranpiration
RBDAs: River Basin Development Authorities
SCP: Seasonal Climate Prediction
SRTM: Shuttle Radar Topography Mission
SWAT: Soil and Water Assessment tool
USGS/EROS: United States Geological Survey Centre for Earth Resources Observation and Science
USGS: United State Geological Survey
WFP: World Food Programm

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APPENDIX I

LIST OF FLOODED LGAs IN 2020

S/No	STATE_NAME	LGA_NAME
1	Abia	Aba North, Aba South, Aba South, Bende, Ikwuano, Isiala Ngwa North, Isiala Ngwa South, Obioma Ngwa,Osisioma, Ugwunagbo, Ukwa East, Ukwa West, Umuahia,Umuahia South, Umunneochi.
2	Akwalbom	Eastern Obolo, Eket, Uyo
3	Anambra	Aghamelum, Anambra West, Awka South, Ihiala, Ogbaru, Onitsha North, Anambra west, Akwa South, Ihiala, Ogu
4	Bauchi	Bauchi, Gamawa, Jama'are, Shira, Warji
5	Bayelsa	Brass, Ekeremor, Ogbia, Sagbama, Yenagoa
6	Benue	Logo, Makurdi, Oju,
7	Borno	Maiduguri
8	Cross River	Abi, Calabar South, Etung, Ikom, Ogoja
9	Delta	Burutu, Isoko South, Ndokwa East, Ndokwa West, Oshimili North, Oshimili South, Patani, Ughelli South, Uvwie, Warri South
10	Ebonyi	Afikpo North, Afikpo South, Ikwo
11	Edo	Etsako Central,Ikpoba Okha
12	Ekiti	Ikere Ekiti
13	Enugu	Chikun, Awgu, Nsukka, Uzo-Uwani
14	FCT	Bwari, Gwagwalada, Municipal
15	Gombe	Akko, Billri, Dukku, Funakaye, Gombe, Kwami, Nafada, Shongom, Yamaltu/Deba
16	Imo	Isu, Nkwerre, Oguta, Owerri-West
17	Jigawa	Babura, Birnin-Kudu, Birniwa, Gumel, Babura, Guri, Gwaram, Hadejia, Jahun, Kaugama, Kiri-Kasamma, Malam-Maduri, Miga
18	Kaduna	Ringim, Chikun, Igabi, Jema'a, Kaduna North, Kaduna South
19	Kano	Kudan, Dala, Danbatta, Fagge, Kano Municipal, Rogo
20	Katsina	Ungogo, Baure, Kaita, Kankara, Katsina
21	Kebbi	Mani, Argungu, Augie, Bagudo, Birnin Kebbi, Gwandu
22	Kogi	Jega, Ajaokuta, Bassa, Ibaji, Idah, Igala Mela, Kogi Lokoja, Ofu
23	Kwara	Omala, Edu, Ilorin West/East, Moro
24	Lagos	Pategi, Agege, Ajeromi Ifelodun, Alimosho, Amuwo Odofin, Apapa, Badagry, Etiosa, Ibeju Lekki, Ifako Ijaiye, Ikeja, Ikorodu, Kosofe, Lagos Mainland, Mushin, Ojo, Oshodi, Isolo, Surulere 1

25	Nasarawa	Awe, Karu
26	Niger	Nasarawa, Agaie, Agwar a, Borgu, Chanchaga, Edati, Katcha, Lapai, Lavun, Mokwa, Muya, Shiroro, Suleja
27	Ogun	Abeokuta North, Abeokuta South, Ado Odo/Ota, Ijebu East, Ijebu Ode, Obefemi-Owode, Sagamu
28	Ondo	Akoko South West
29	Oyo	Egbeda, Ibadan North, Ibadan North-East, Ibadan South-West, Ido, Itesiwaju, Iwajowa, Kajola, Lagelu, Ogo -Oluwa, Ona-Ara, Saki East
30	Rivers	Abua/Odual, Ahoada East, Ahoada West, Andoni, Etche, Gokana, Ikwerre, Khana, Obio/Akpor, Ogba/Egbema/Ndoni, Okrika Oyigbo
31	Sokoto	Port Harcourt, Binji, Gada, Goronyo, Kebbe, Rabah, Silame, Sokoto North, Sokoto South, Tureta
32	Taraba	Wamakko, Ardo Kola, Bali, Donga, Gashaka, Gassol, Wamakko, Ibi, Jalingo, Karim Lamido, Kurmi, Lau, Sardauna, Takum, Ussa
33	Yobe	Wukari
34	Zamfara	Yorro, Bade, Gummi, Gusau, Kaura-Namoda, Zurmi

APPENDIX II
LIST OF HIGHLY PROBABLE FLOOD RISK AREAS IN 2021

S/N.	STATE	LGAs
1	Abia	Umu-Nneochi, Umuahia South, Umuahia North, Ukwa East, Ukwa West, Isiala-Ngwa North, Aba North, Abia South, Abia North
2	Akwa Ibom	Eket, Eastern Obolo
3	Anambra	Ogbaru, Onitsha North, Ayamelum, Awka South, Anambra West
4	Bauchi	Jama'are, Shira
5	Bayelsa	Ekeremor, Yenegoa, Sagbama, Brass, Ogbia
6	Benue	Markurdi, Logo, Guma
7	Cross River	Calabar South, Abi
8	Delta	Warri South, Ughelli South, Ndokwa West, Oshimili South, Patani, Ndokwa East, Ughelli South, Oshimili North
9	Ebonyi	Ikwo, Afikpo North, Afikpo South, Ohaozara
10	Edo	Etsako Central
11	FCT Abuja	Bwari, Municipal Area Council, Gwagwalada
12	Gombe	Nafada, Kwami, Yamaltu/Deba, Dukku, Biliri, Gombe, Funakaye
13	Imo	Owerri West, Isu, Nkwerre, Isu
14	Jigawa	Kaugama, Guri, Kiri, Kasama, Gwaram, Miga, Malam Maduri, Ringim, Biriniwa, Jahun
15	Kaduna	Kaduna North, Chikun
16	Kano	Ungongo, Kano Municipal
17	Kebbi	Argungu, Augie, Bagudo, Birnin Kebbi
18	Kogi	Idah, Bassa, Ajaokuta, Ofu, Bassa, Omala, Lokoja, Ibaji, Igalamela-odolu
19	Kwara	Ilorin West, Pategi
20	Lagos	Lagos Mainland, Mushin, Ibeju Lekki, Agege, Ikorodu, Ifako/Ijaye, Badagry, Eti Osa
21	Nasarawa	Nasarawa, Awe
22	Niger	Mokwa, Shiroro, Lavun, Agwara, Borgu
23	Ogun	Abeokuta South, Abeokuta North, Obafemi Owode
24	Oyo	Ona ara, Lagelu, Kajola, Egbeda, Ibadan North East, Ibadan South West, Ibadan Municipal
25	Rivers	Oyigbo, Etche, Khana, Ahoada East, Ogba/Egbema/Ndoni, Andoni, Ahoada West, Abua/Odual, Port-Harcourt, Gokana, Okrika, Obiakpor
26	Sokoto	Goronyo, Sokoto North, Sabon Birni, Rabah, Sokoto South, Silame, Wamako
27	Taraba	Ibi, Yorro, Gassol, Ardo-Kola, Lau, Jalingo, Wukari
28	Zamfara	Zurmi

APPENDIX III

LIST OF PROBABLE FLOOD RISK AREAS IN 2021

S/N.	STATE	LGA
1	Abia	Osisioma Ngwa, Obi Nwga, Bende, Ugwunagbo, Isiala-Ngwa South, Ikwuano
2	Adamawa	Yola North, Yola South, Numan, Lamurde, Guyuk, Fufore, Gombi, Demsa,
3	Akwa Ibom	MkpatEnin, Nsit Atai, Okobo, Mbo, Udung Uko, Onna, Oron, Ikot Abasi, Ibiono Ibom, Uruan, Uyo, Ibeno, UrueOffong/Oruko
4	Anambra	Ihiala, Anaocha, Oyi, Anambra East, Orumba South, Njikoka, Orumba North, Aguata, Onitsha South, Dunukofia
5	Bauchi	Bauchi, Kirfi, Shani, Itas/Gadau, Gamawa, Warji, Zaki
6	Bayelsa	Southern Ijaw, Kolokuma/Opokuma, Nembe
7	Benue	Bukuru, Agatu, Gboko, Gwer East, Tarka, Gwer West, Oju
8	Borno	Marte, Maiduguri, Abadam, Mafa, Kukawa
9	Cross River	Yakurr, Calabar Municipal, Ak pabuyo, Obubra, Bakassi, Ogoja, Biase, Etung, Odukpani, Ikom
10	Delta	Aniocha North, Isoko South, Warri South-West, Ughelli North, Ethiope West, Warri North, Uvwie
11	Ebonyi	Ebonyi, Ohaukwu, Abakaliki
12	Edo	Etsako East, Esan South-East, Ikpoba-Okha, Egor, Oredo, Ovia North-East
13	Ekiti	Ikere, Ijero, Irepodun/Ifelodun
14	Enugu	Udi, Nsukka, Uzo-Uwani, Awgu, Oji-River, Aninri
15	FCT Abuja	Bwari
16	Gombe	Akko, Balanga
17	Imo	Ideato South, Ideato North, Njaba, Mbatoli, Nwangele, Orlu, Owerri North, Mbatoli, Okigwe, Unuimo, Ihitte/Uboma, Ezinihitte, Isiala Mbano, Aboh-Mbaise, Obowo
18	Jigawa	Taura, Babura, Hadejia, Dutse, Auyo, Maigatari, Kafin Hausa
19	Kaduna	Igabi, kaduna South, Kudan, Kaura, Jema'a
20	Kano	Garum Mallam, Ajingi, Rimin Gado, Gaya, Gezawa, Gwale, Rano, Tofa, Gabasawa, Dawakin Tofa, Dawakin Kudu, Dambatta, Dala, Bebeji, Kabo, Wudil, Tudun Wada, Rogo, Kura, Madobi, Nassarawa, Albasu, Kano Municipal, Kumbotso, Baure
21	Katsina	Jibia, kaita, Kankara, Katsina
22	Kebbi	Argungu, Suru, Koko/Besse, Shanga, Gwandu, Jega, Dandi, Ngaski, Kalgo, Bunza, Yauri
23	Kogi	Kotonkarifi, Dekina, Adavi
24	Kwara	Offa, Edu, Moro, Ilorin East, Oyun

25	Lagos	Lagos Island, Alimosho, AmuwoOdofin, Ikeja, Kosofe, Apapa, Ojo, Oshodi/Isolo, Epe, Surulere, Shomolu, Ajeromi/Ifelodun
26	Nasarawa	Nasarawa Egon, Keana, Toto, Doma, Karu
27	Niger	Magama, Suleja, Katcha, Muya, Edati, Gbako, Agaie, Bosso, Wushishi, Chanchaga, Rafi, Lapai
28	Ogun	Ewekoro, Odeda, Ado Odo/Ota, Ogun waterside, Shagamu, Ijebu ode, Ijebu East, Ifo
29	Ondo	Ilaje, Ese Odo, Akoko South West
30	Osun	Odo Otin, Irewole, Obokun, Isokan, Irepodun, Ilesha West, Ola oluwa, Olorunda, Orolu, Ila, Iwo, Osogbo, Ede North, Ifelodun, Ede South, Aiyedire, Egbedore
31	Oyo	Surulere, Olorunsogo, Ogo Oluwa, Ona ara, Lagelu, Ibarapa Central, Oyo East, Saki East, Ogbomosho South, Iwajowa, Ibadan North, Ido, Itesiwaju, Iseyin, Ibarapa North, Ibadan North West, Ibadan South East
32	Plateau	Jos South, Barkin Ladi
33	Rivers	Degema, Ogu Bolo, Akuku Toru, Bonny, Ikwerr e, Tai, Asari-Toru
34	Sokoto	Bodinga, Gada, Binji, Tureta, Isa, Shagari, Yabo, Dange-Shuni, Kware, Wurno, Kebbe
35	Taraba	Gashaka, Bali, Karim Lamido, Kurmi, Donga, Sardauna, Takum, Ussa
36	Yobe	Geidam, Barde, Jakusko, Borsari, Karasuwa, Yunusari
37	Zamfara	Kaura Namoda, Maru, Maradun, Bungudu, TalataMafara, Gummi, Gusau, Shinkafi, Zurmi