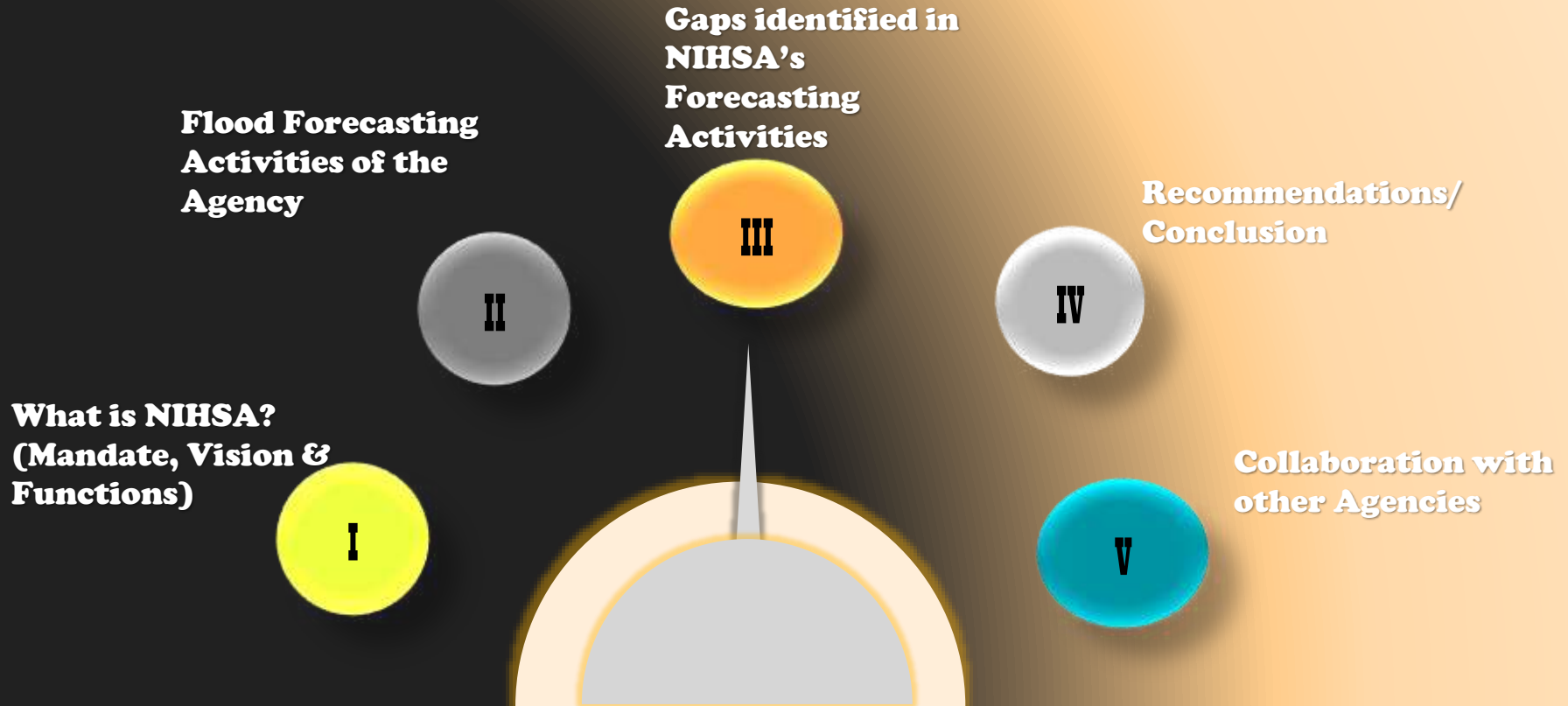


# **NIGERIA HYDROLOGICAL SERVICES AGENCY'S EFFORTS TOWARDS FLOOD FORECASTING IN NIGERIA**

By  
**HADIZA AMINU TUKUR**  
**NIGERIA HYDROLOGICAL SERVICES AGENCY (NIHSA)**

# Outline



# About the **Agency**



## **Our Mandate**

To provide the services required for assessment of the Nation's surface and groundwater resources in terms of quantity, quality, distribution and availability, in time and space; for efficient and sustainable management of water resources.



## **Some Function of the Agency**

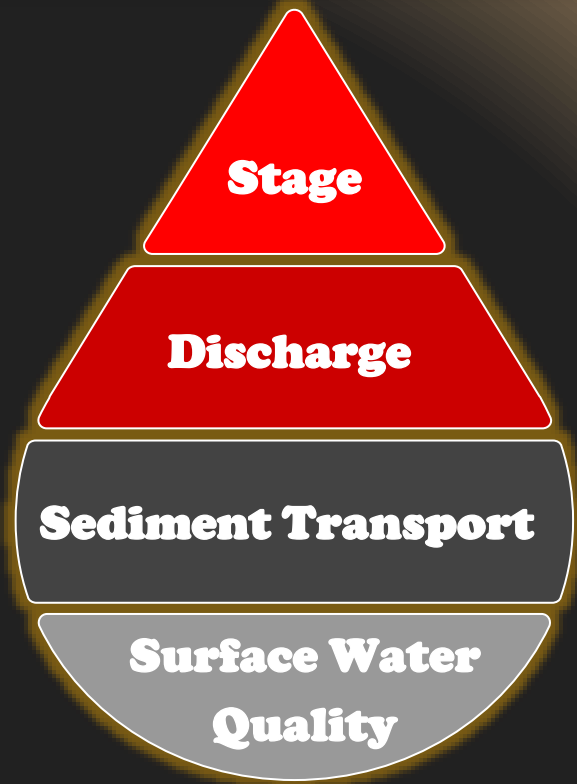
The Agency operates and maintains Hydrological Stations nationwide

The Agency issues Flood & Drought Monitoring, and Forecasting

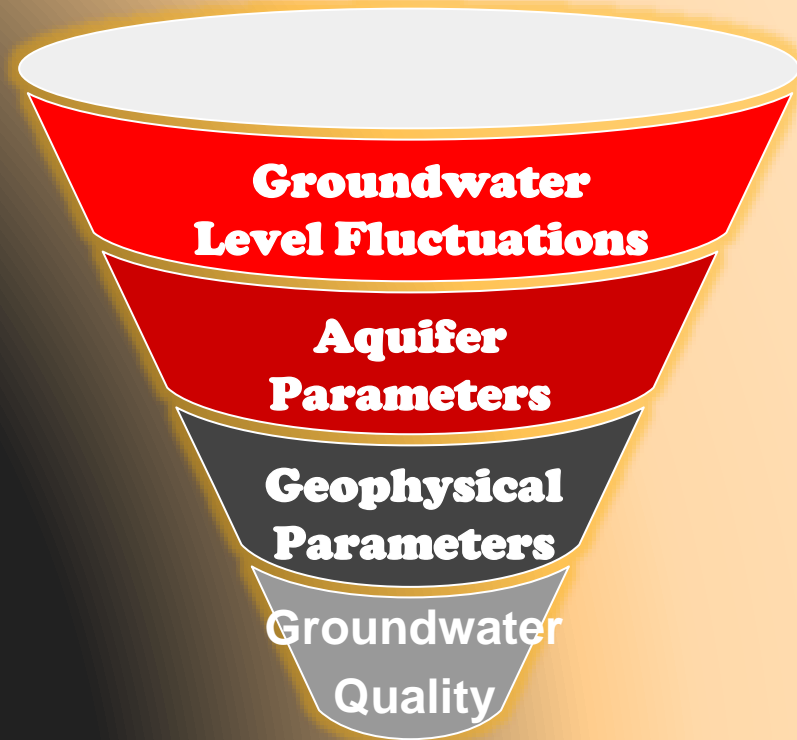
The agency provides information on the status & trend of Water Resources

Groundwater exploration.

## What Type of Data does the Agency **Collect**?



**Surface Water Data**



**Groundwater Data**

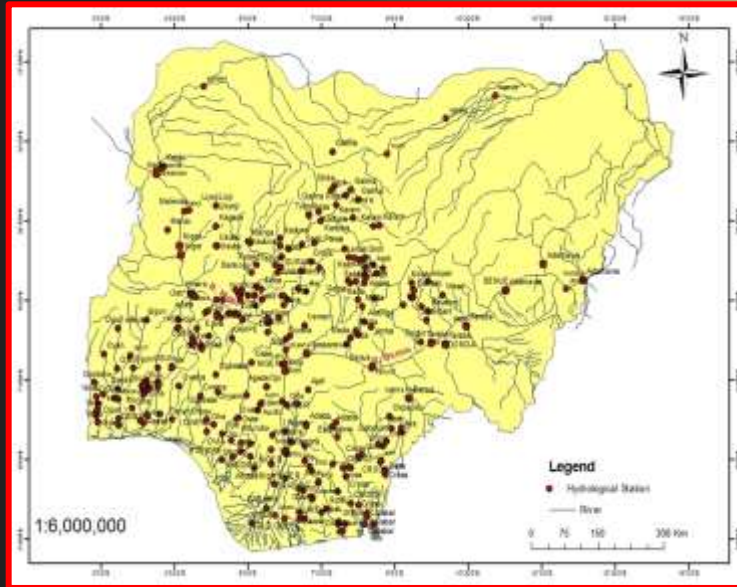
# Geographical Spread of NIHSA Hydrological Stations

**273**

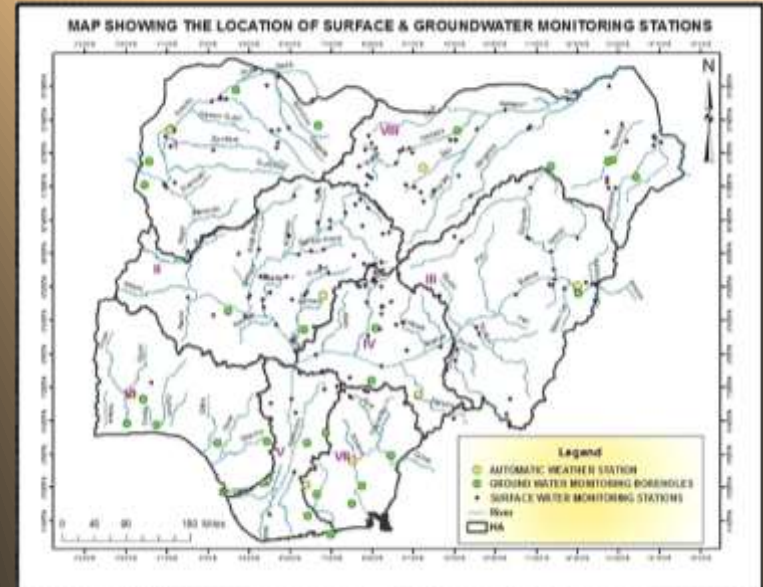
Hydrometric  
River Gauging  
Stations

World  
Meteorological  
Organisation  
(WMO)  
Recommended  
Standard

**482**



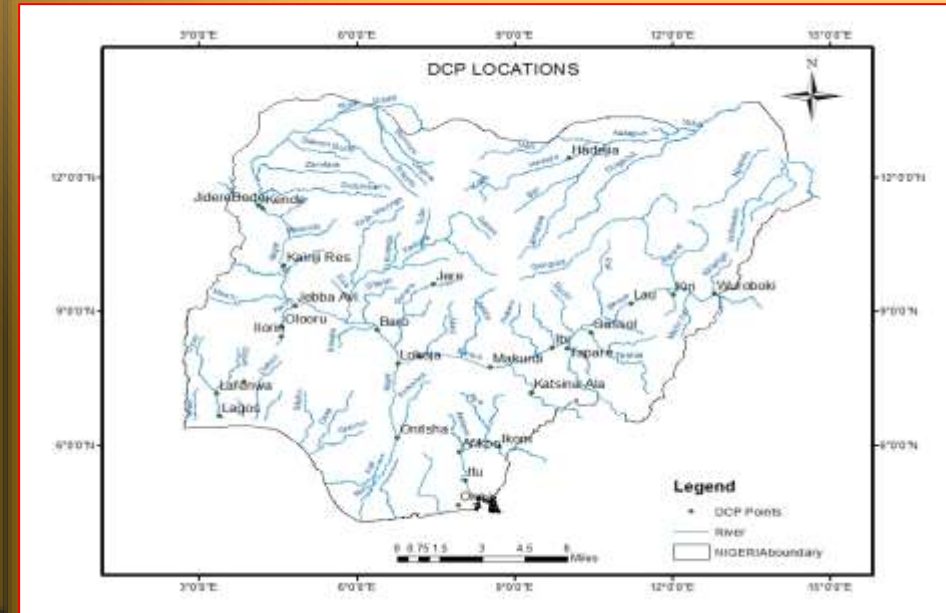
***Location of Hydrological Stations***



***Network of NIHSA Ground water  
Monitoring and Weather Stations***

# Geographical Spread of NIHA Hydrological Stations (**Cont'd**)

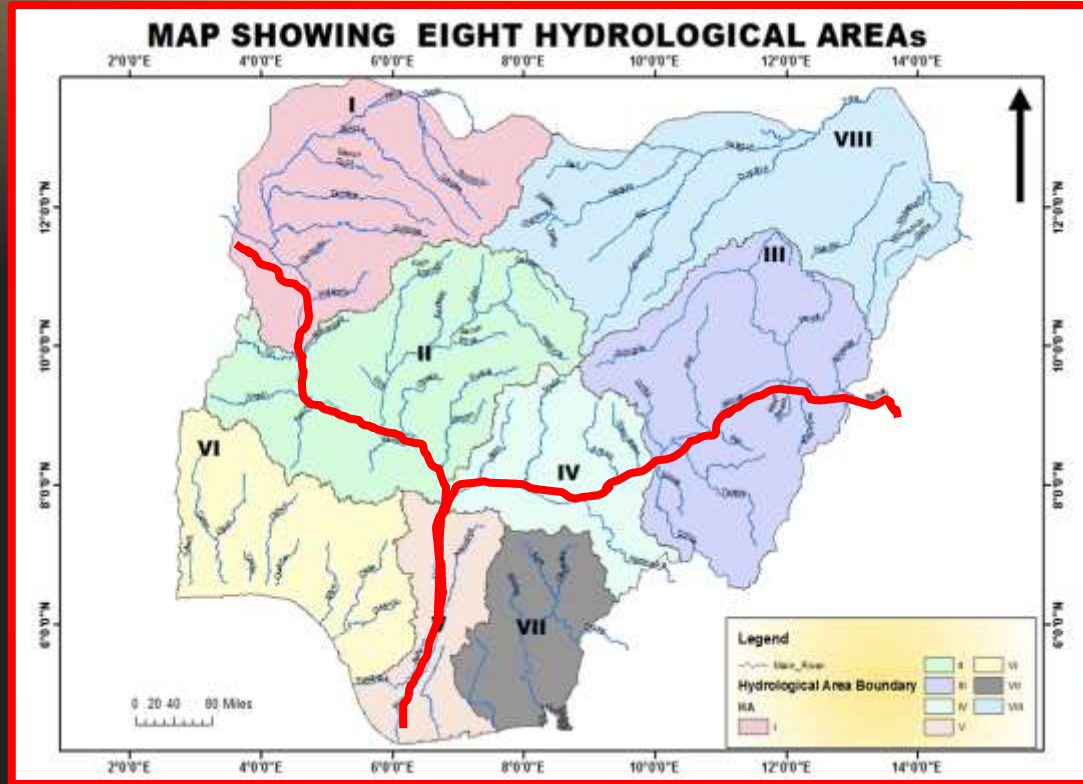
## Telemetry Data Collection Platform Stations (**DCPS**)





# Nigeria Drainage Basin and Hydrological Areas

■ The Nigeria Drainage System have been divided into Eight (8) Hydrological Areas (HAs) based on the drainage patterns. The HAs are being used for evaluation and assessment of the nation's vast water resources potentials and to create the disaster risk management programme for flooding in the country.



# Activities of the Agency in relation to Flood Monitoring and Forecasting in Nigeria

## Annual Flood Outlook (AFO)

The aim of AFO is to present probable flood scenarios in a given year. The 2022 AFO was presented in three (3) Scenarios:

- ❑ **Scenario 1 (months of April – June) AMJ**
- ❑ **Scenario 2 (months of July – Sept.) JAS**
- ❑ **Scenario 3 (months of Oct. – Nov.) ON**

### Highly Probable Risk Areas

**April – June (57 LGAs)**

**July – Sept. (220 LGAs)**

**Oct. – Nov. (38 LGAs)**

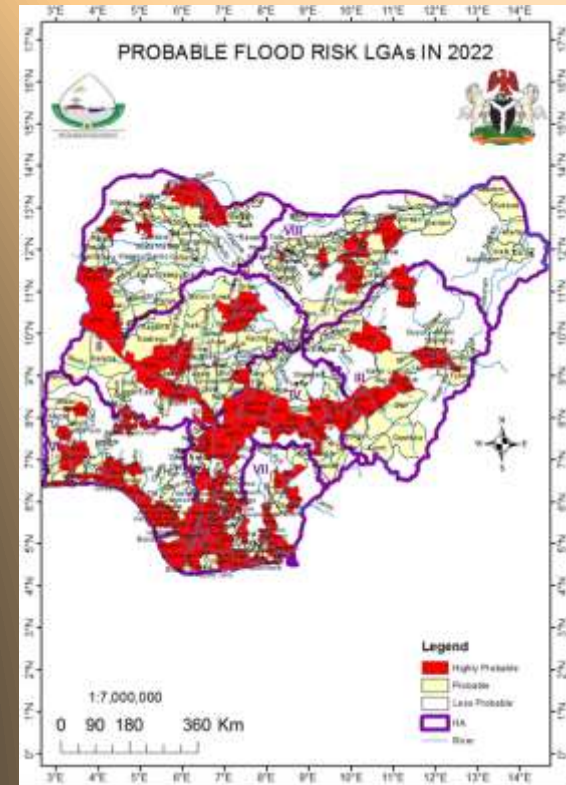
### Probable Risk Areas

**April – June (45 LGAs)**

**July – Sept. (140 LGAs)**

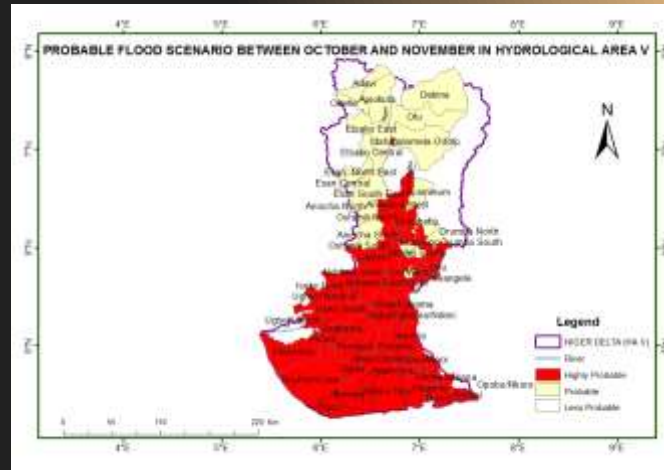
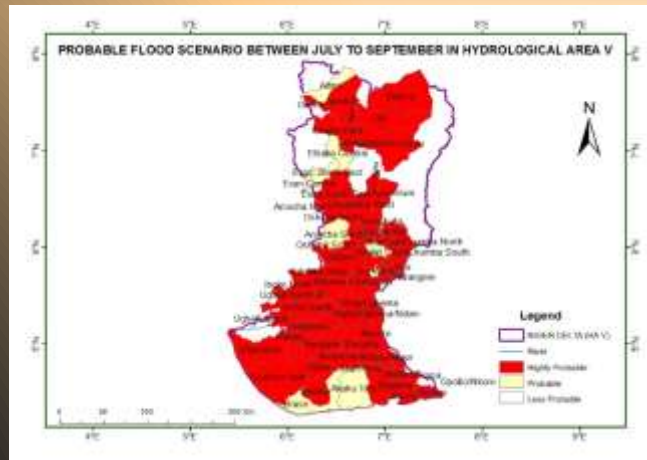
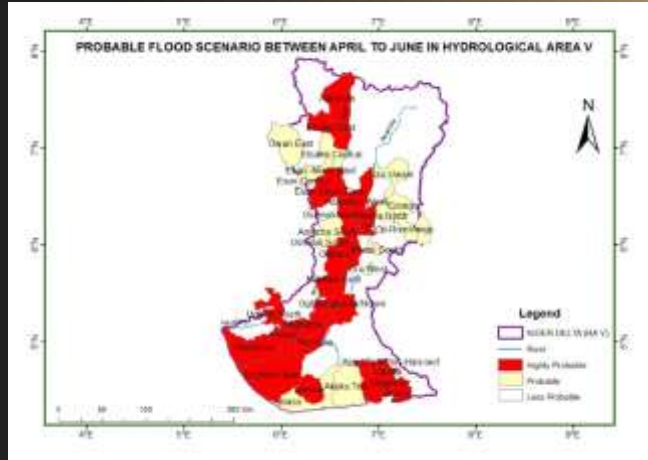
**Oct. – Nov. (54 LGAs)**

## 2022 Annual Flood Outlook (AFO)





# Scenarios of Probable Flood Risk Areas (HA V Niger South)



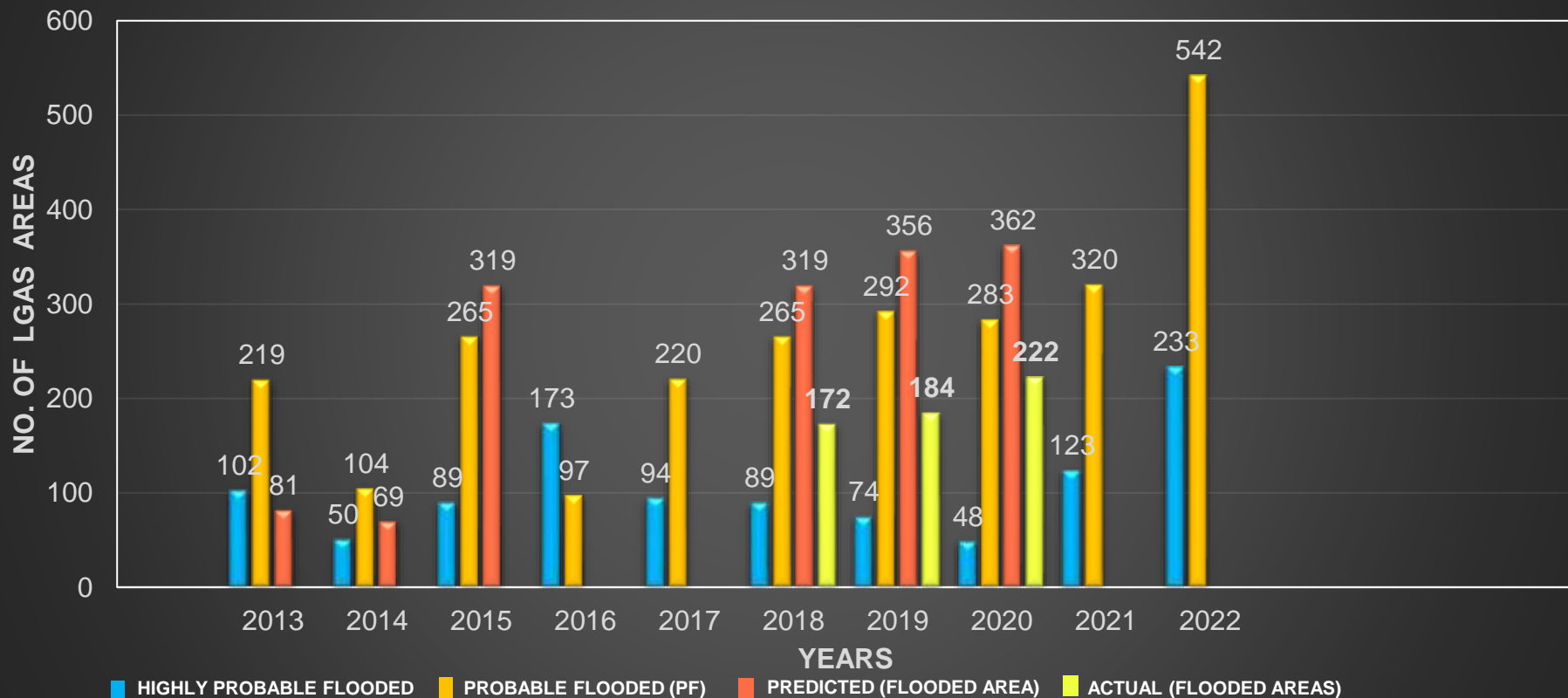
# Highly Probable & Probable Flood Risk Areas in HA V

S/N	State	LGAs		
		April – June	July – September	October – November
1.	Anambra	Ogbaru, Idemili North, Oyi Anambra East, Onitsha North, Onitsha South, Anambra West	Ihiala, Ogbaru, Anaocha, Idemili North, Oyi, Anambra East, Onitsha North, Orumba South, Njikoka, Orumba North, Ayamelum, Aguata, Awka South, Idemili South, Onitsha South, Anambra West	
2.	Bayelsa	Southern Ijaw, Ekeremor, Kolokuma/Opokuma, Yenegoa, Sagbama, Nembe	Southern Ijaw, Ekeremor, Kolokuma/Opokuma, Yenegoa, Sagbama, Ogbia, Nembe	Brass, Southern Ijaw, Nembe
3.	Delta	Oshimili South, Patani, Ndokwa East, Ughelli South, Oshimili North	Ndokwa West, Aniocha North, Oshimili South, Patani, Ndokwa East, Ughelli South, Ughelli North, Oshimili North, Isoko North, Isoko South	
4.	Edo	Etsako East, Esan South-East	Etsako East, Esan South-East	
5.	Imo		Oguta, Ideato South, Ideato North, Njaba, Nkwerre, Ohaji/Egbema, Nwangele, Isu, Orsu, Oru East, Orlu	Ideato North, Isu
6.	Kogi	Ajaokuta	Idah, Dekina, Igalamela-Odolu, Ajaokuta, Ofu, Okene	Dekina
7.	Rivers	Ogba/Egbema/Ndoni, Degema, Bonny, Port-Harcourt, Okrika, Asari-Toru	Ahoada East, Ogba/Egbema/Ndoni, Andoni, Degema, Ogu Bolo, Ahoada West, Bonny, Abua/Odual, Port-Harcourt, Obio/Akpor, Ikwerre, Gokana, Okrika, Asari-Toru, Eleme, Opobo/Nkoro, Emuoha	Dekina, Andoni, Degema, Ogu Bolo, Bonny, Port-Harcourt, Gokana, Okrika, Asari-Toru, Opobo/Nkoro, Akuku Toru

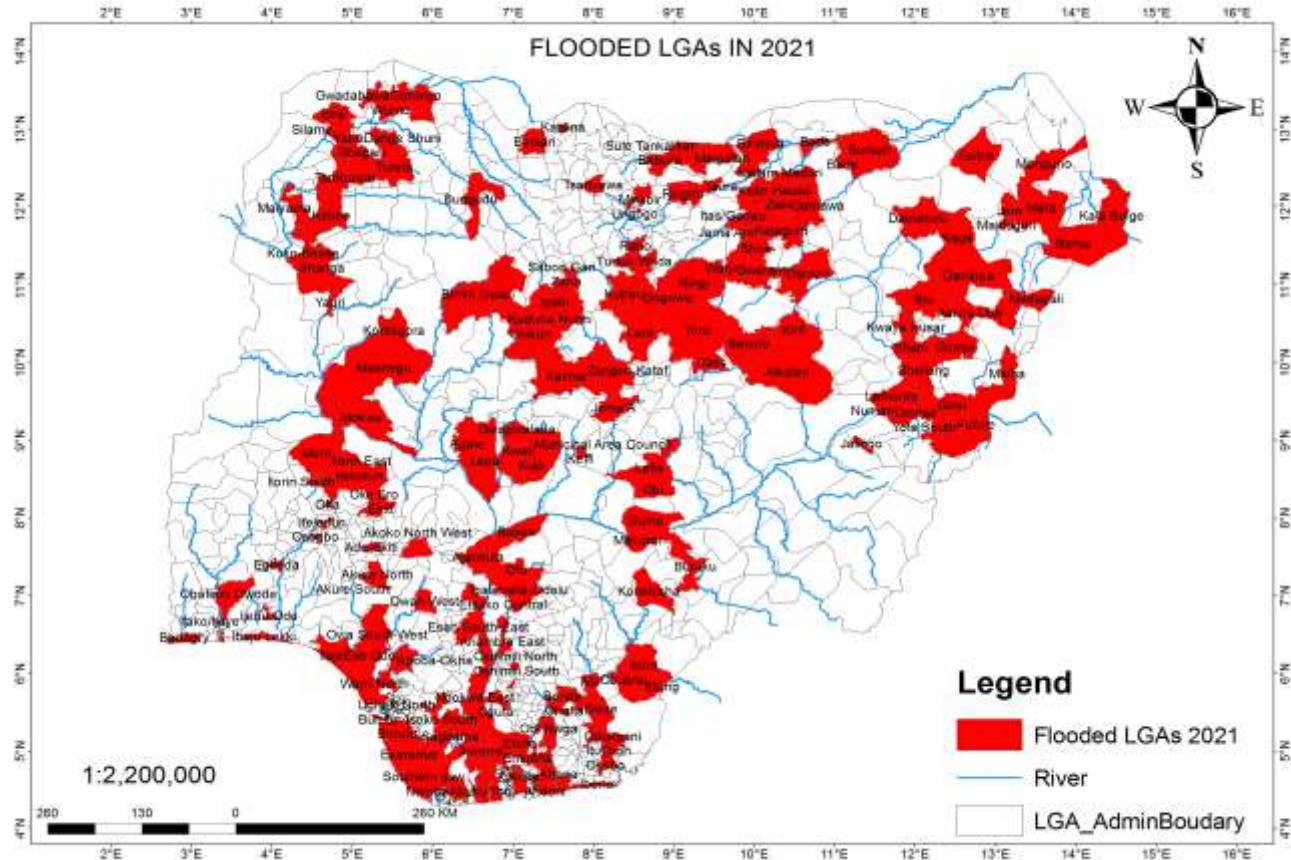
S/N	State	LGAs		
		April – June	July – September	October – November
1.	Anambra	Nnewi North, Nnewi South, Awka North	Nnewi North, Nnewi South, Ekwusigo, Dunukofia	Ayamelum, Awka South
2.	Bayelsa	Brass	Brass	
3.	Delta	Aniocha South	Aniocha South	Aniocha North
4.	Edo	Etsako Central, Esan Central, Esan North-East, Owan East	Etsako Central, Esan Central, Esan North-East	Etsako East, Esan South-East
5.	Enugu	Ezeagu, Uzo-Uwani, Awgu, Oji-River		
6.	Imo	Oru West	Oru West	Oru West
7.	Kogi		Adavi	Dekina, Igalamela-Odolu, Ajaokuta, Ofu, Okene
8.	Rivers	Akuku Toru	Akuku Toru	

## Comparative Flood Scenarios of Probable Flood Risk Areas 2013 – 2022

### Annual Flood Outlook: Comparative Flood Scenarios from 2013 - 2022



# Flood Incidence Map of 2021 – 2022 Hydrological Year



## Publication of Monthly Flood and Drought Bulletins

☐ **Monthly Flood and Drought Monitor (July – September, 22):**

[illegible]



## NIGERIA HYDROLOGICAL SERVICES AGENCY (NHSAS)

# MONTHLY FLOOD & DROUGHT MONITOR

AUGUST 2021




### NHSAS ADVOCATES FOR CONVERSION OF FLOODWATERS TO POSITIVE USE

**T**he Nigeria Hydrological Services Agency (NHSAS) is of a strong view that the incessant flood incidents being experienced in the country can be turned into advantage through the conversion of floodwaters into positive use for agriculture, hydropower, domestic water supply and recreational purposes. Nigeria is tremendously blessed with huge amount of surface and groundwater resources which if properly managed with the construction of small cottage dams to harvest the floodwater will enhance adequate all year round water for irrigated agriculture, rural water supply, grasslands for ranching and desertification control. Individuals should also be encouraged to develop cottage dams with the support from the Federal, States and Local Government Authorities by providing suitable environment and incentives.

The improvement of rivers, Niger and Benue channels will also enhance effective flood mitigation, drought and climate change control while timely clearance and freeing of the waterways, removal of structures from the floodplains and flood paths as well as clearing blockages in gutters and drainage systems will also enhance the mitigation of urban flood disasters in the country.






# NIGERIA HYDROLOGICAL SERVICES AGENCY (NWSA)

## MONTHLY FLOOD & DROUGHT MONITOR

### SEPTEMBER 2021



## TRANSBOUNDARY FLOODWATER SITUATION IN NIAMEY

**T**he transboundary floodwater WL is still rising in Niamey Niger Republic with a maximum of 4.73m corresponding to a discharge of about 1,304 m<sup>3</sup>/s attained on 30<sup>th</sup> September, 2021 and a minimum WL of 4.34m corresponding to a discharge of 1,036 m<sup>3</sup>/s on 0<sup>th</sup> September, 2021 with a mean WL of 4.64m corresponding to a discharge of 81.50 m<sup>3</sup>/s. These records are within the Normal Flood Situation as shown in figure 1.




Figure 1: Floodwater Situation in Niamey

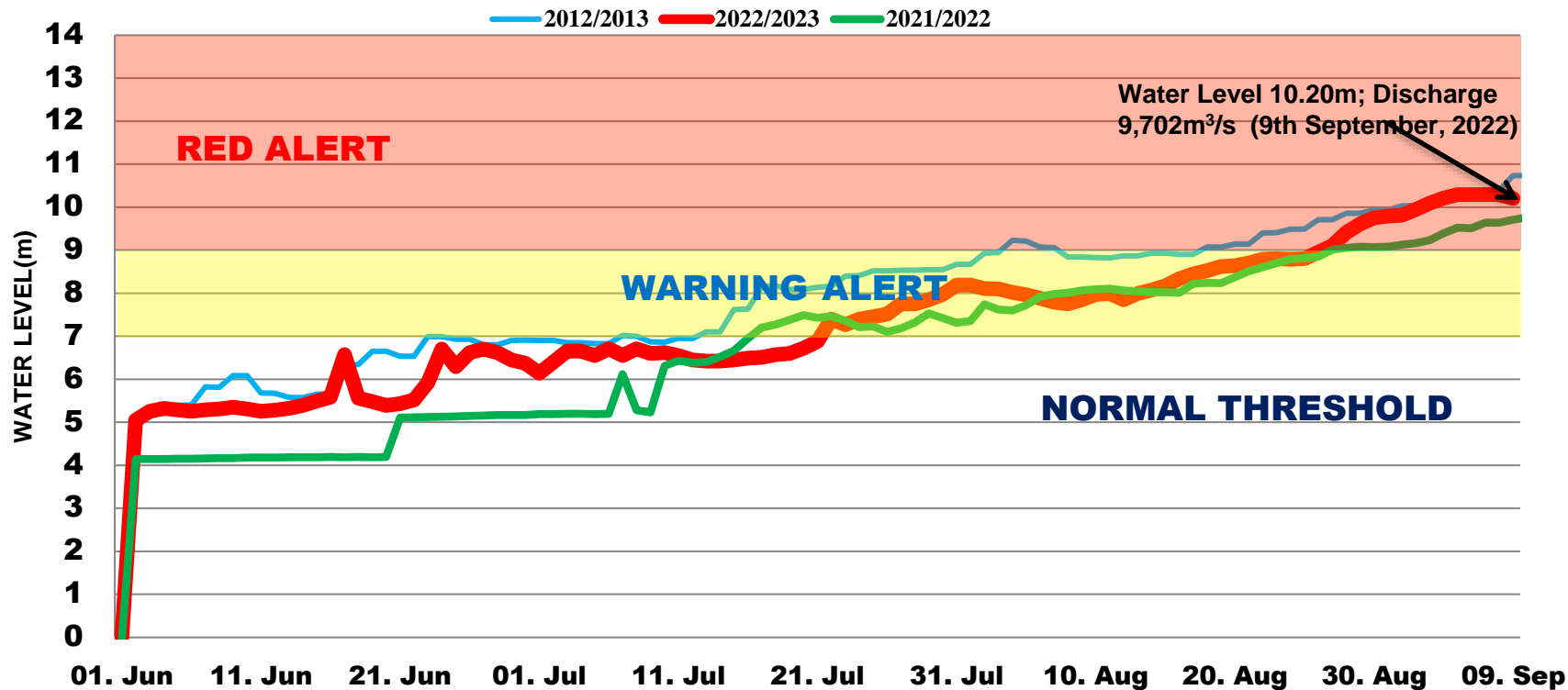
The incoming transboundary floodwaters from upstream Nigeria (if any) will be impounded at kungi dams hence, no significant level of flooding is anticipated downstream in the country, hence the Nigerian populace

are strongly advised to continue to take necessary precaution by avoiding waterways to prevent possible flood disasters.



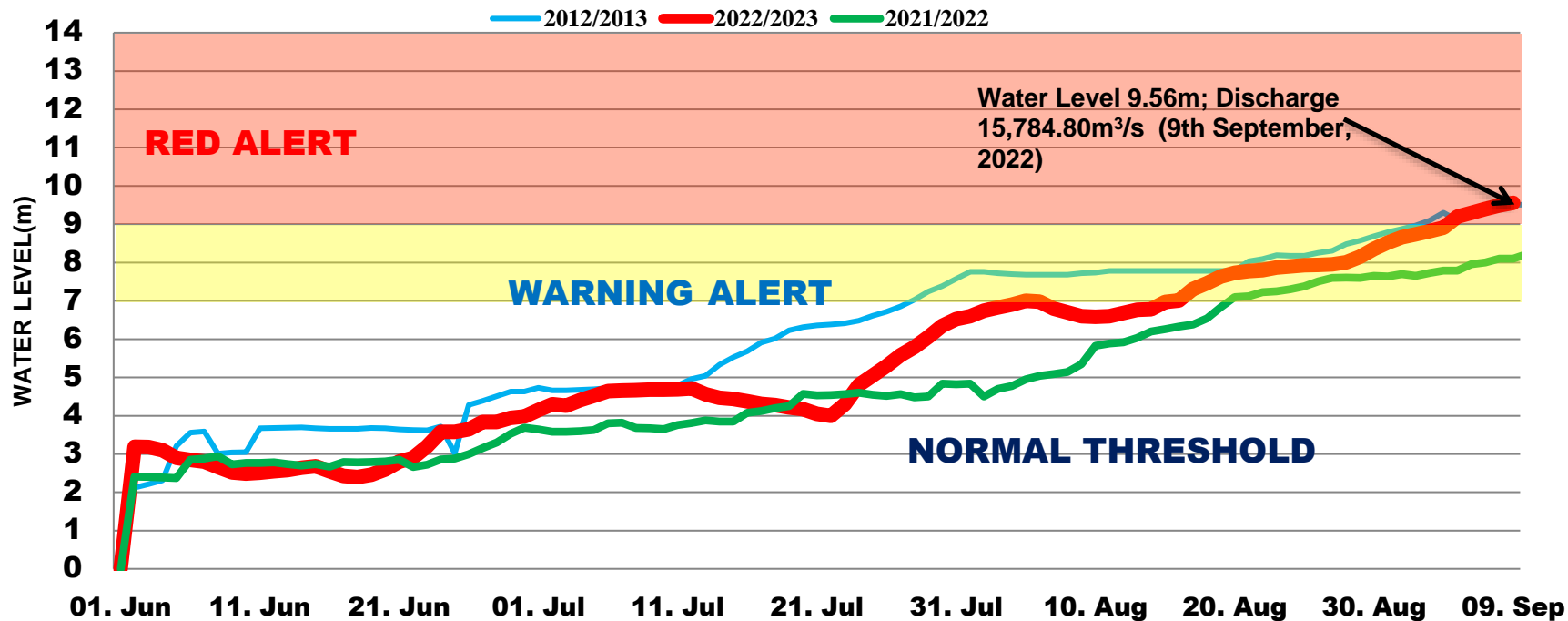
# Monthly Flood and Drought Monitor (July – September, 2022 at Makurdi, River Benue)

COMPARATIVE HYDROGRAPHS OF RIVER BENUE AT MAKURDI FOR 2012/2013, 2021/2022 & 2022/2023  
HYDROLOGICAL YEARS SHOWING DIFFERENT ALERT LEVELS

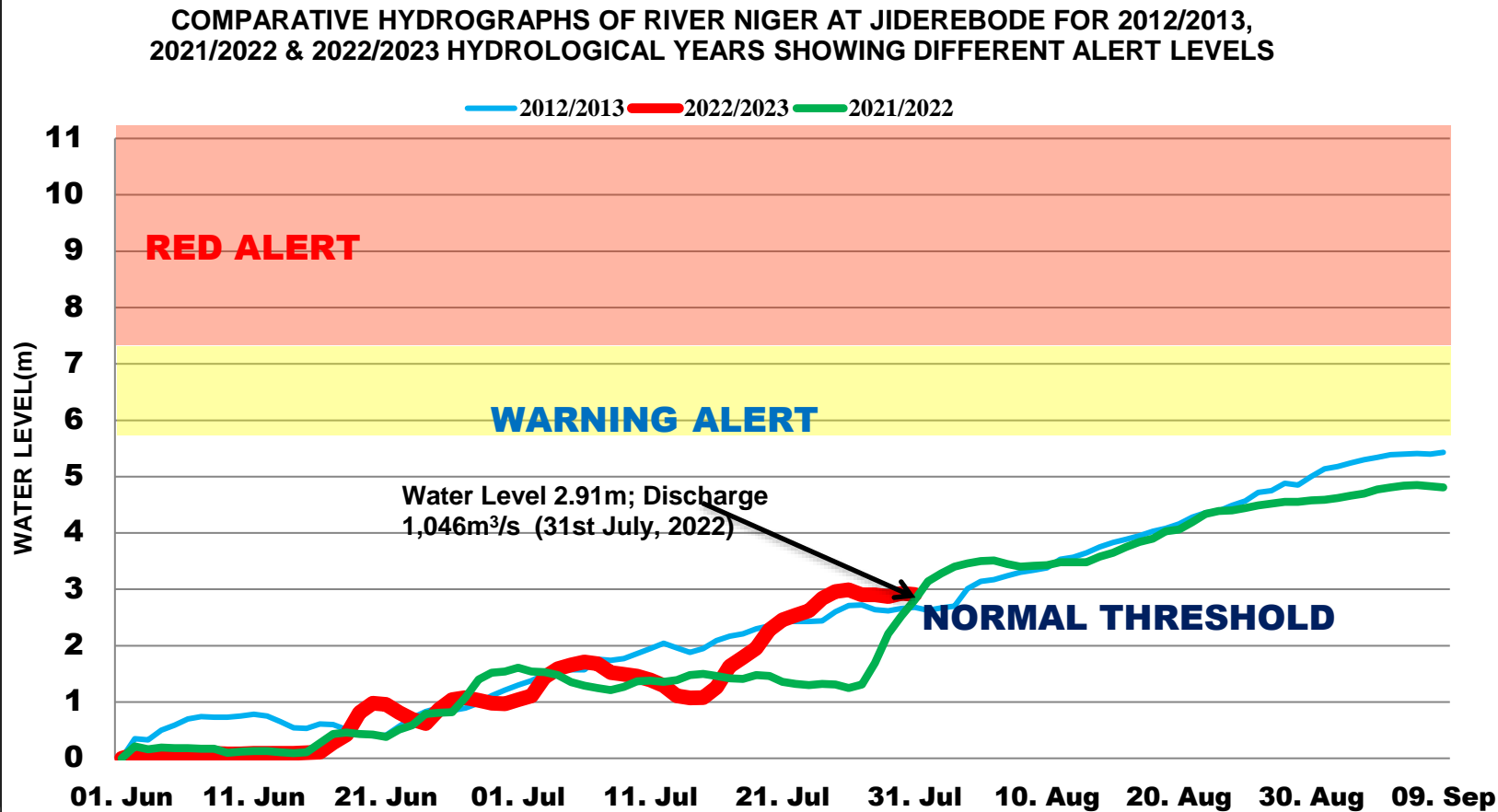


# Monthly Flood and Drought Monitor (July – September, 2022 at Lokoja, River Niger)

COMPARATIVE HYDROGRAPHS OF RIVER NIGER AT LOKOJA FOR 2012/2013, 2021/2022 & 2022/2023  
HYDROLOGICAL YEARS SHOWING DIFFERENT ALERT LEVELS

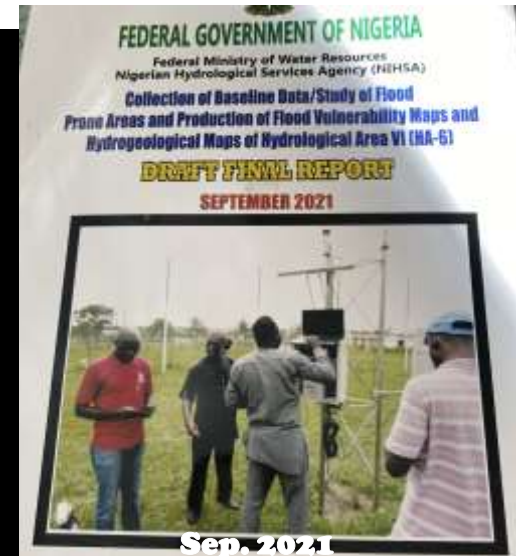
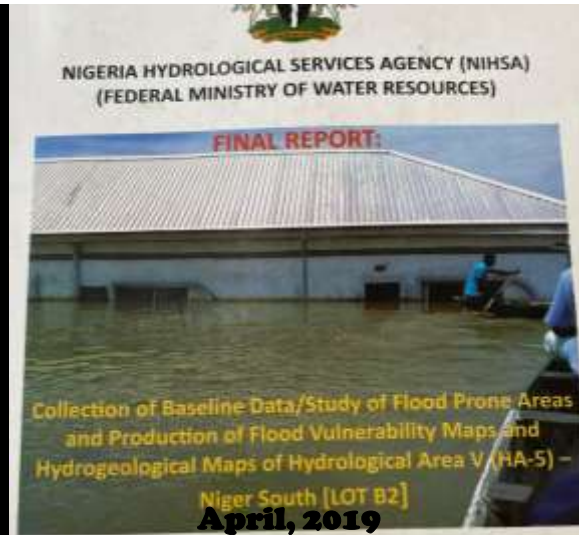


## Monthly Flood and Drought Monitor (July 2022) at Jiderebode, River Niger upstream



# Flood Vulnerability Mapping & Production of Hydrogeological Maps

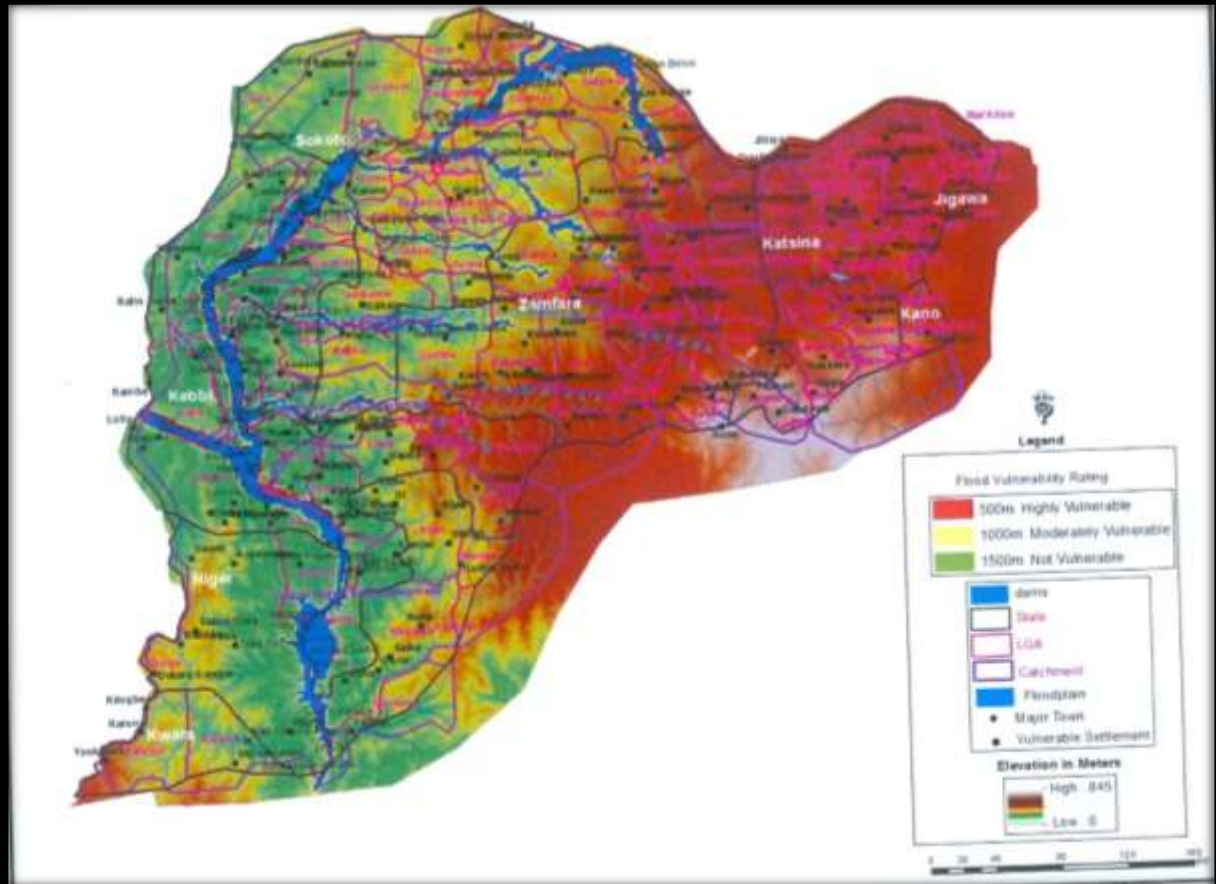
- ❑ **\*Aim\*** This study was designed to foster the collection of baseline data for the study of Flood prone areas, the production of Flood Vulnerability and Hydrogeological maps of HAs.
- ❑ **\*Scope\*** The study is expected to assemble Climatological, Hydrological & Hydrogeological data that may be used to identify areas with potential for flooding, and possible management and prevention of such disaster.
- ❑ **\*Outcome\*** This study has laid-out a framework for the collection of the climatological, Hydrological & Hydrogeological parameters required for the modelling of HAs.



# Flood Vulnerability Mapping of (HA I Niger North)

## Hydrological Area (HA) I;

**Niger North:** This HA covers the Northern Sokoto Rima area and the upper sub – catchment to the south; comprising of six states: Sokoto, Zamfara, Katsina, parts of Jigawa, Kano & Niger. It has land area of about 131,506.859km.sq and a population of about 29.3 million (2006, Census)





# **Flood Vulnerability Mapping of HA I**

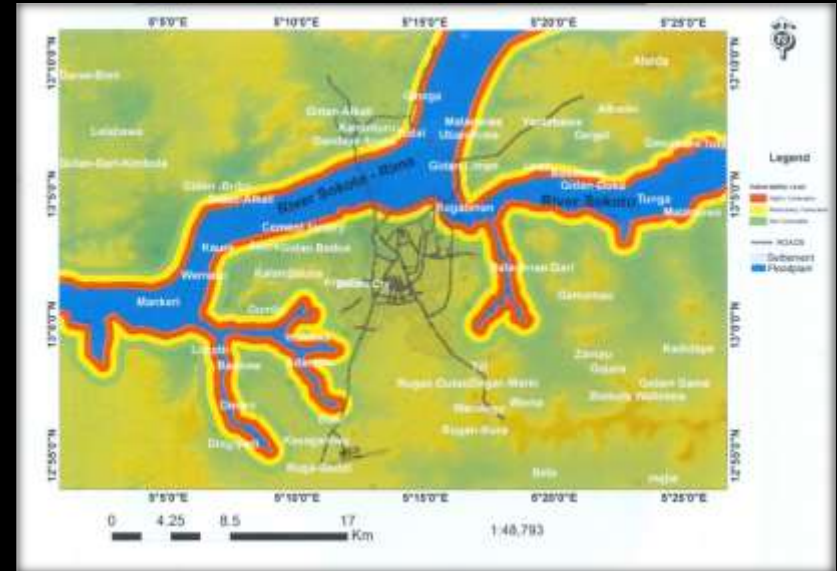
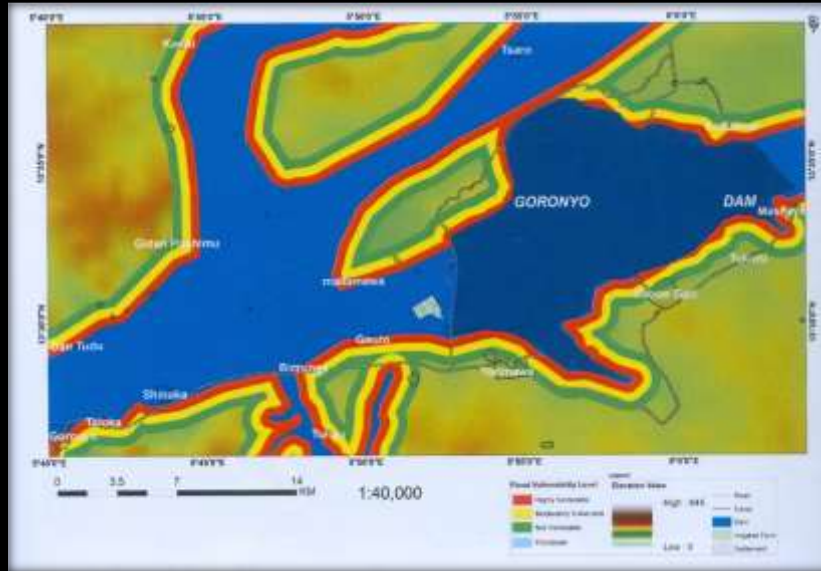
## **Causes of Flood in HA I**

- ☐ Climate Change/Hydrological/Geological factors, Topography or Slopes
- ☐ Poor engineering construction of dams (e.g. the Shagari, Gusau, Goronyo, and Bakalori dam and even Zauro polder project in 2010, 2012, 2014. failed spill water canals)
- ☐ Anthropogenic factors including urban development, disorganized farming practices, blockage of drains etc.

## **Areas of HA I that are most vulnerable to Flooding:**

- ☐ Upper Rima Flood Plain
- ☐ The Goronyo/Sokoto – Rima Flood Plain
- ☐ The Bakolori Flood Plain
- ☐ The Argungu/Birnin Kebbi
- ☐ River Niger/River Sokoto Rima Confluence including (Kende) and the downstream of the Kainji reservoir.

# Flood Vulnerability Mapping of HA I (Cont'd)

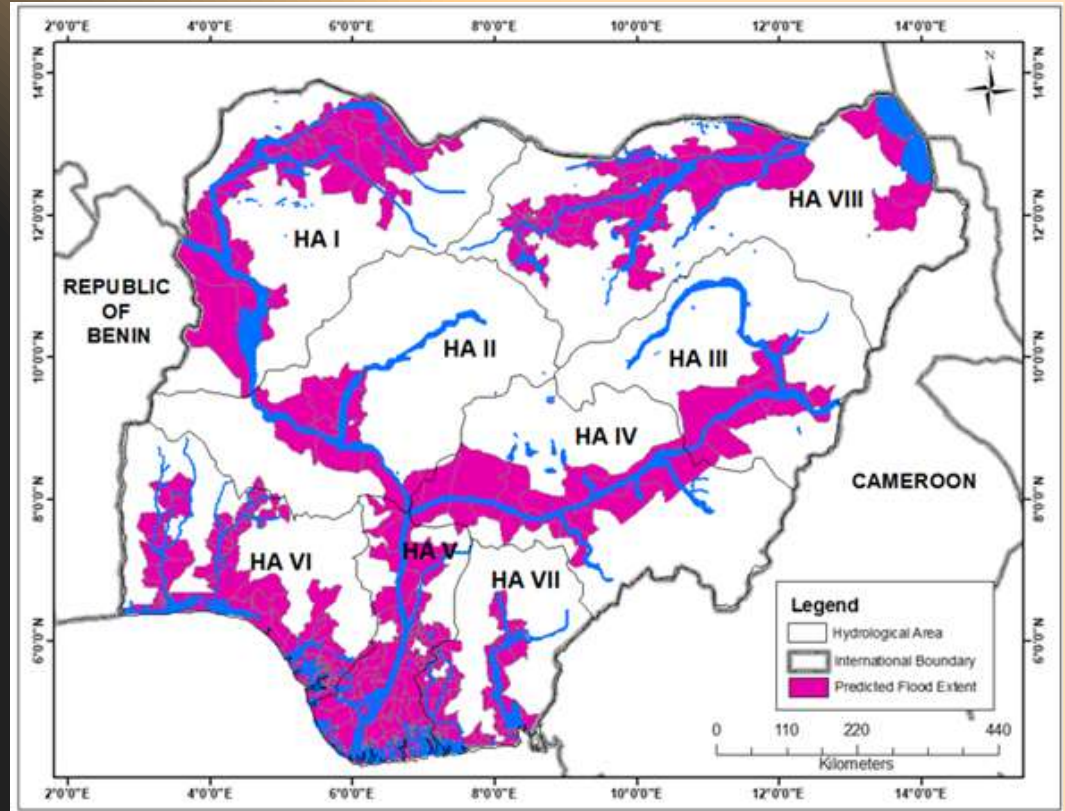


- ❑ **The Goronyo/Sokoto flood plain - appears most critical as a result of its broad low-level flood plains and its contiguity and proximity to the capital city urban development possibly attracting potentially the highest human and material collateral damage.**
- ❑ **Birnin Kebbi and Kende inland delta region, present another high-risk zone, as a result of the contributive and cumulative flow of all the discharges from the sub-catchments of the Sokoto Rima drainage network.**

## Production of Flood Vulnerability & Hydrogeological Maps

### Nigeria's 2022 Flood Risk Vulnerability Mapping:

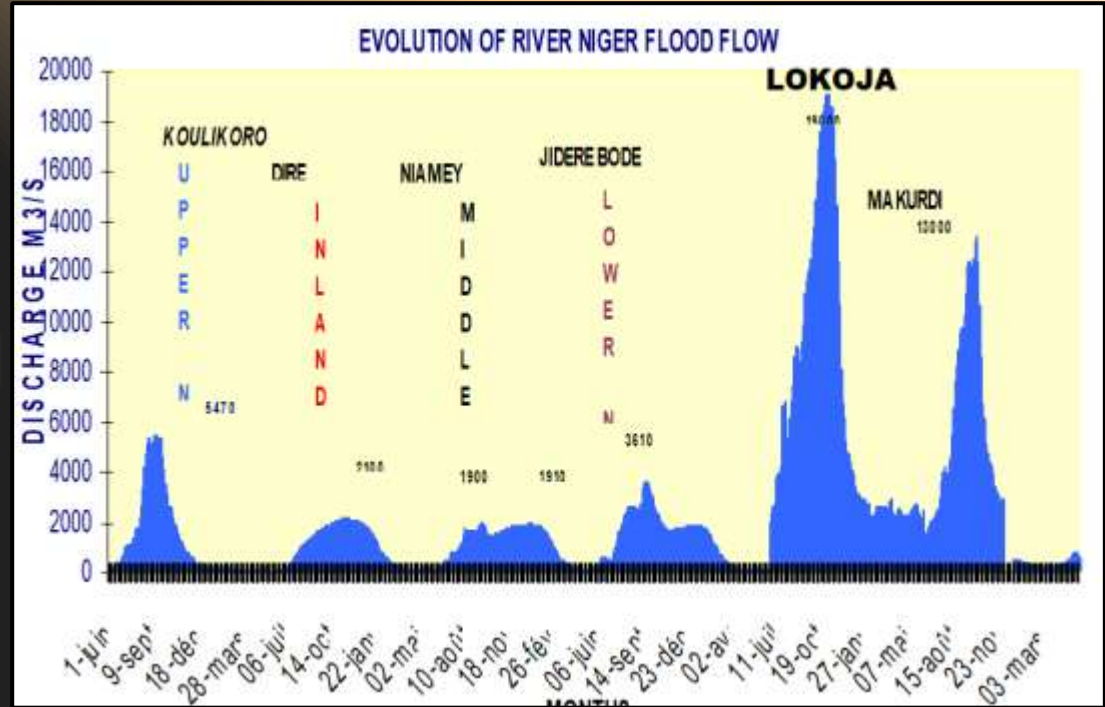
The map reflects the degree of variability in the level and areal extent of flooding across the country.



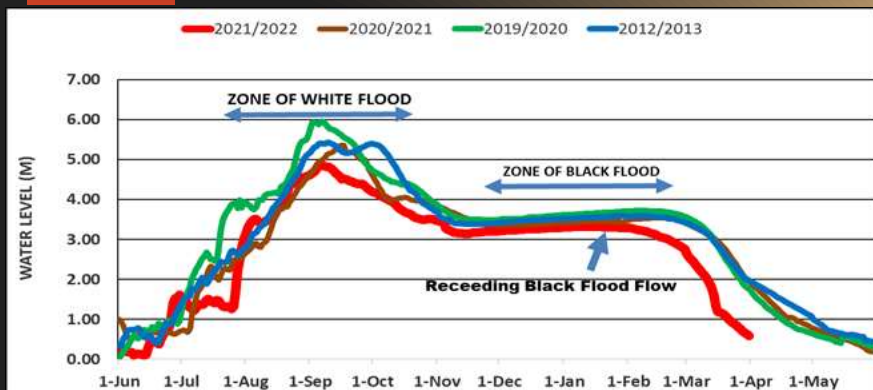
# Monitoring of Transboundary Flood Flow into Nigeria

## A Typical Flood Scenario along the River Niger

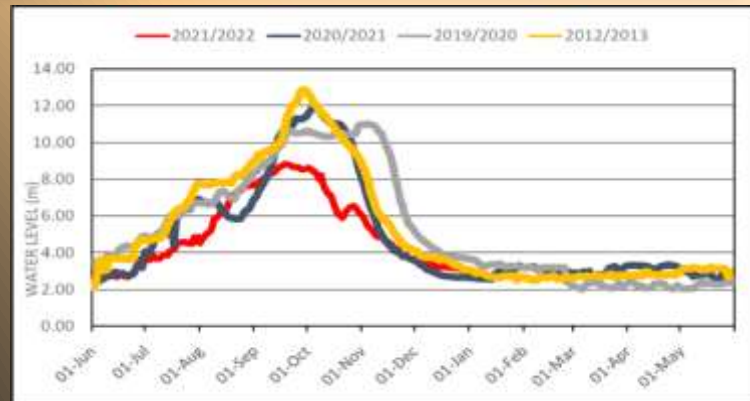
- ❑ The transboundary flood flow into Nigeria during the **2020/21** consist of flows from River Niger coming from Guinea and River Benue coming Cameroon and Chad.
- ❑ Two types of flood events along River Niger:
  1. White Flood (Rainy Season)
  2. Black Flood (Dry Season)



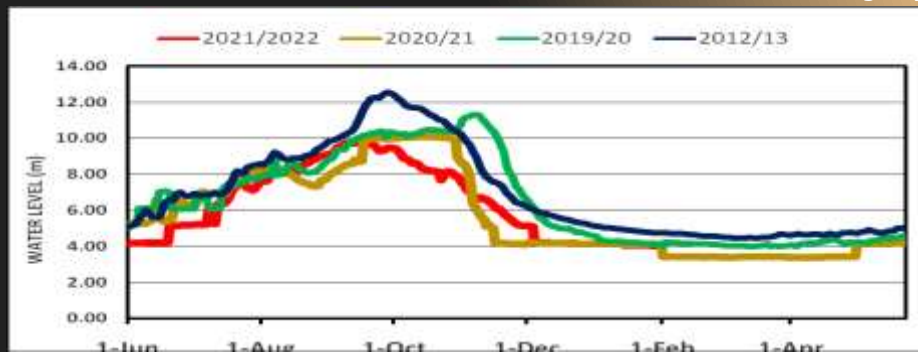
# Simulated Hydrographs at different gauge stations for Flood Monitoring



***Comparative Hydrographs of River Niger at Jiderebode (2012 - 2022)***



***Comparative Hydrographs of Rivers Niger at Lokoja (2012 - 2022)***



***Comparative Hydrograph of River Benue at Makurdi (2012 - 2022)***



### **Flood Early System (FEWS) Warning**

**NHISA Flood Early Warning System is based on the regular collection of Meteorological and Hydrological data to Monitor Flood event along the river channels. The Agency has four (4) FEWs stations at Jiderebode, Wuroboki, Makurdi, Lokoja & Kaduna**

## Flood Prediction App

**\* Aim \*** is to enhance early warning and improve communication between victims & emergency response Personnel during flooding.

The App consist of:

### ☐ **Flood Forecast:**

for actual locations of flood across Nigeria

### ☐ **Information Hub:**

Provides flood safety tips and graphical view of highly probable, Probable & Less Probable Flood risk areas in Nigeria, aiding timely evacuation plans, alternate travel route.

## Flood Prediction App (Cont'd)

### **\*Tell your story:**

**Users will share their experiences with videos and pictures of flooded areas in real-time.**

### **Help Centre:**

- 1. Will serve as an interface for distress call between population at risk of flood and relevant agencies during and after flooding**
- 2. Will provide users with quick access to NIHSA and other stakeholders for more information.**
- 3. Will serve as an interactive platform for direct communication between users and response personnel in order to get timely report.**

## **Gaps Identified in NIHSA's Forecasting Activities**

- 1. The AFO needs to be location specific with respect to flood hotspots**
- 2. There is a need to improve the spatial resolution, especially in urban environments so as to capture urban flood scenarios in detail;**
- 3. There is a need to downscale the forecast from HAs level into the micro-basins level within the HAs. This will allow for detailed coverage of flood scenarios within each of the HAs; and**
- 4. The use of satellite-based data especially for high-resolution of flood coverage for hotspot areas should be incorporated into the annual predictions.**
- 5. The AFO shows a static flood scenario based on peak flow and the estimation of the possible area of flood extends during the peak flow;**
- 6. The flood vulnerability mapping of the country is yet to be completed, currently it covers only four Hydrogeological Areas of the Country .**

## **RECOMMENDATIONS**

- **The AFO presents a general flood scenario. There is a need to downscale to some hot spots and urban centers for more impactful prediction; and**
- **The AFO in its present form meet the International requirement for an Annual Flood Outlook but more could be done to improve the spatial and temporal resolution for wider applications.**
- **The AFO needs a dynamic web-based flood that displays real-time flood scenarios and is interactive for an expert to feed in necessary data and get the flood extent of any part of Nigeria;**
- **There is a need to translate AFO into other languages.**
- **There is a need to complete the flood vulnerably mapping of the remaining four Hydrogeological area of the country.**
- **There is a need to increase our data coverage for better forecast.**



### **NATIONAL LEVEL:**

- NIMet, NEMA, NASRDA, OSGOF.

### **REGIONAL LEVEL:**

- Niger Basin Authority (NBA), Sahel observatory (OSS), Lake Chad Basin Commission (Lcbc).

### **INTERNATIONAL LEVEL:**

World Meteorological Organisation (WMO), United Nations Platform For Space based Information For Disaster Management And Emergency Response (UN-SPIDER)

### **INTERVENTION:**

- World Bank Assisted Nigeria Erosion and Watershed Management Project (NEWMAP), European Union-FANFAR Project for forecasting on trends OF river Niger in West Africa, Triming.

## Conclusion

- ❑ **Over the years, NIHSA has made concerted effort toward flood forecasting and mitigation in Nigeria through its various activities.**
- ❑ **The Federal Government of Nigeria and other foreign Agencies like the NBA has also made efforts to ensure that those within the flood prone areas are properly catered for.**
- ❑ **At NIHSA, we believe we can do more and possibly better in collaboration with Agencies at the national, regional and international level and other possible collaborators.**

## How to reach us

- ❑ **Listed below our website and other social media platforms through which information can be shared with the general public and other stakeholders.**
- ❑ **NIHSA website**  
**[www.nihsa.gov.ng](http://www.nihsa.gov.ng)**
- ❑ **Facebook:****[www.facebook.com/nihsa](https://www.facebook.com/nihsa)**
- ❑ **Twitter:** **[@nihsa.ng](https://twitter.com/nihsa.ng)**



**Thank  
You**