

# FROM CATCHMENTS TO REACHES: PREDICTIVE MODELLING OF FLOODS IN NIGERIA

**'LOLA OLAYINKA** PhD

presenting on behalf of **P. C. Nwilo** (Prof.) and **Ayila E. Adzandeh**

Department of Surveying and Geoinformatics  
Faculty of Engineering  
University of Lagos, Lagos.  
[dsaka@unilag.edu.ng](mailto:dsaka@unilag.edu.ng)



**FIG Working Week 2013**

6–10 May, Abuja, Nigeria

*"Environment for Sustainability"*



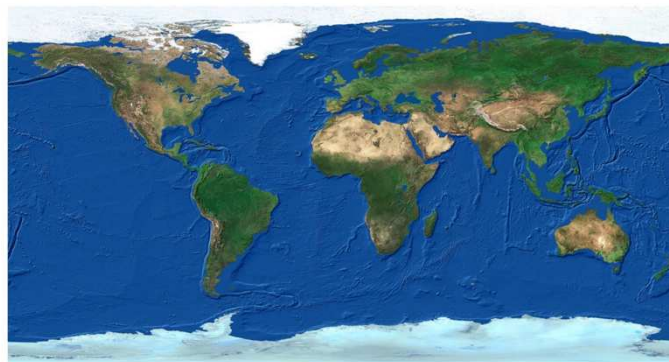
## Outline

- ❖ INTRODUCTION
- ❖ ASSESSMENT OF FLOODS IN NIGERIA
- ❖ CAUSES OF FLOOD(S) AND FLOODING
- ❖ MENACE/IMPACTS OF FLOODS: NIGERIA
- ❖ WHOSE RESPONSIBILITY IS IT?
- ❖ COMBAT MEASURES
- ❖ PREDICTIVE MODELLING OF FLOODS IN NIGERIA
- ❖ RECOMMENDATION
- ❖ CONCLUSION

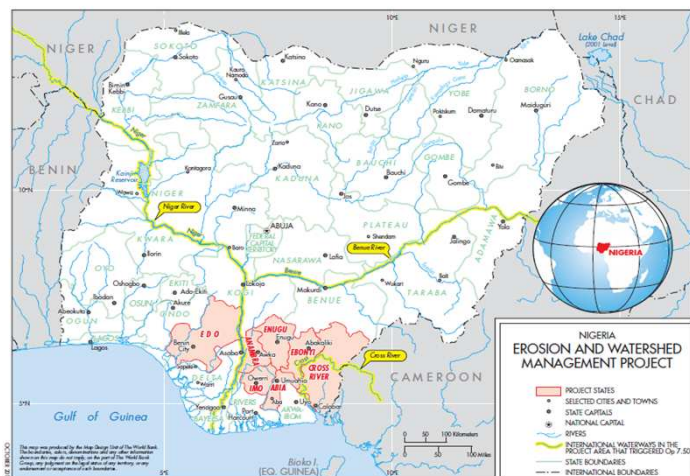


## Introduction

70% OF PLANET EARTH IS WATER.....

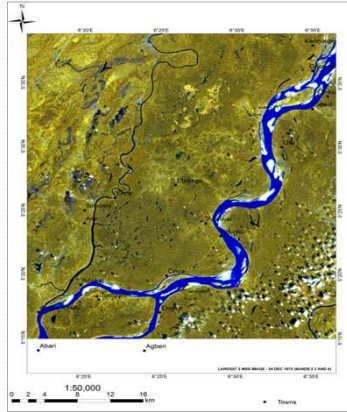


## Introduction cont'd..

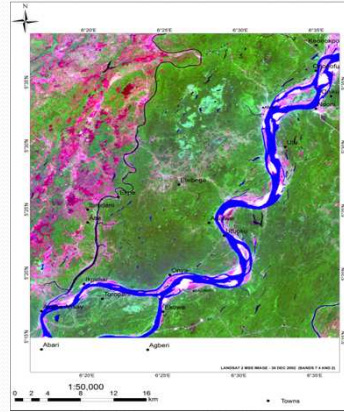


## Introduction cont'd..

THE RIVER SYSTEM IS DYNAMIC....



1975

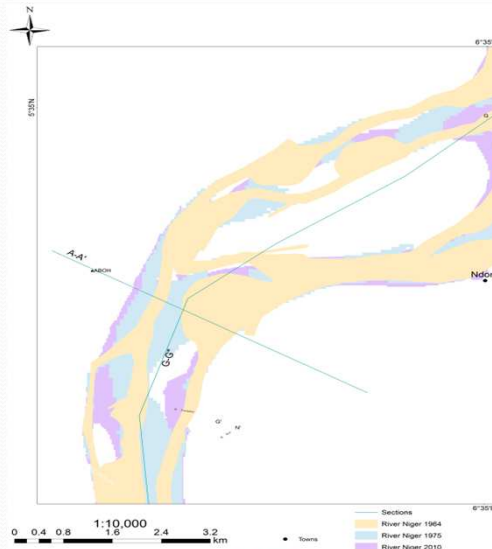


2002



## Introduction cont'd..

THE RIVER SYSTEM IS DYNAMIC....





## Introduction cont'd..

Flooding is among the most devastating natural hazards in the world claiming more lives and causing damage to property and infrastructure than any other natural phenomena.

*(Nwilo et al., 2011, Ologunorisa, 2006; Alcira and Martha, 1991).*

The great floods reduced Nigeria's crude oil production drastically by 500,000 barrels per day (bpd) in the Niger Delta.

*(Osun Defender, 2012).*

The rate of spread, number of internally displaced persons and magnitude of losses counted in the affected States have attracted the attention of the Federal Government of Nigeria.



## Introduction cont'd..

In an intervention speech presented by President Goodluck Jonathan on the flood situation, based on the impact assessment, the affected States were categorized into four Federal Government aid groups A to D.

- ☐ Category A (Oyo, Kogi, Benue, Plateau, Adamawa, Delta, Bayelsa, Anambra);
- ☐ Category B (Jigawa, Kano, Bauchi, Kaduna, Niger, Nassarawa, Taraba, Cross-River, Edo, Lagos, Imo);
- ☐ Category C (Kwara, Katsina, Gombe, Ogun, Ondo, Ebonyi, Abia, Rivers)
- ☐ Category D (Sokoto, Kebbi, Zamfara, Yobe, Enugu, Ekiti, Osun, Akwa-Ibom, Borno, FCT).



## Introduction cont'd..

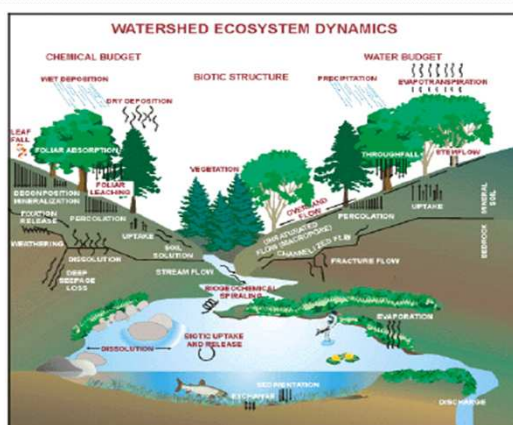
The flood disasters which started as flash flooding in different parts of the country since the onset of the rainy season in April suddenly became intensive by late August, with unprecedented flooding in most states in Nigeria between 2010 and 2012.

By mid-September, dams were overwhelmed giving way to flooding that inundated many communities that hitherto lived peacefully in more than twenty states of the country.



## Introduction cont'd.

### FROM CATCHMENTS TO REACHES...



Source: Environment Protection Agency, 2010



## Causes of Flood(s) and Flooding: Nigeria

CLIMATE CHANGE  
(Incessant and  
Heavy Rainfall,  
Saturated Soil  
Moisture)

FAILURE OF  
STRUCTURAL  
DESIGNS

SUBSIDENCE  
(NATURAL AND  
ANTHROPOGENIC)

POOR RIVER  
CHANNEL  
MAINTENANCE

**FLOODING**



## Causes of Flooding: Nigeria cont'd

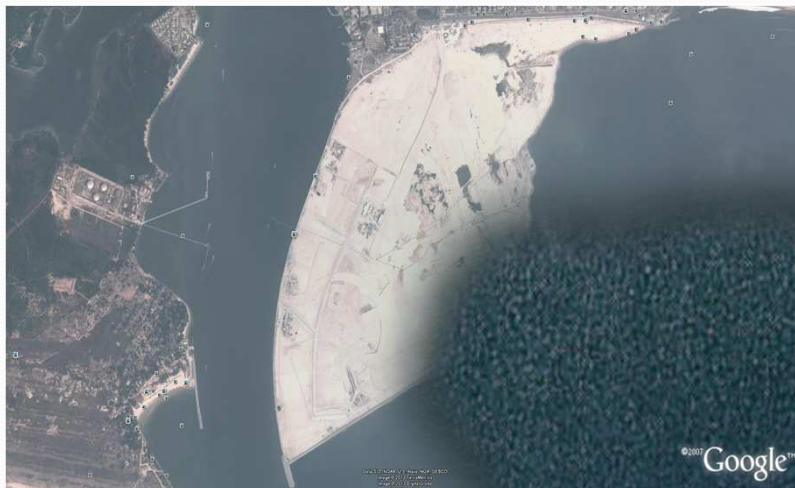
?

EKO ATLANTIC CITY PROJECT

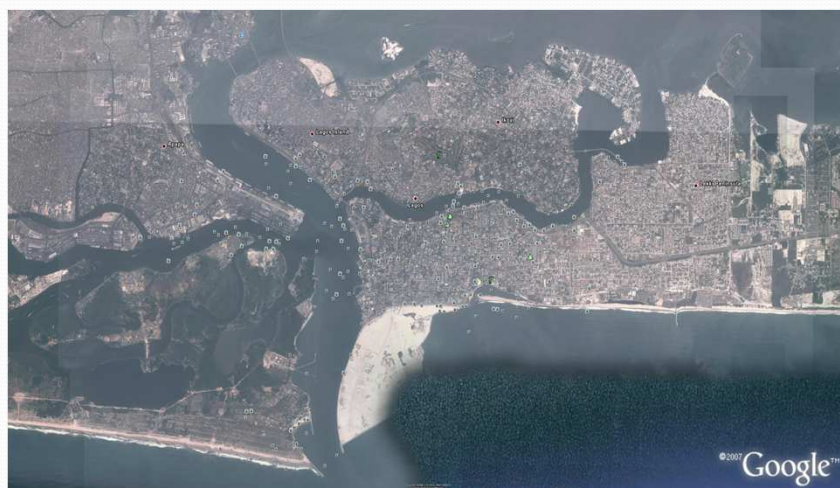




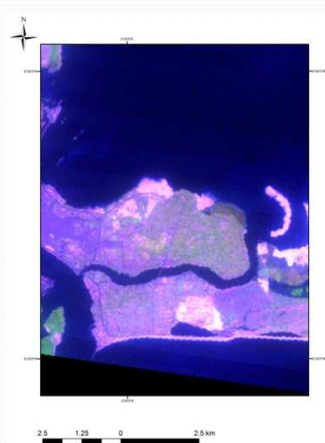
## Causes of Flooding: Nigeria cont'd



## Causes of Flooding: Nigeria cont'd



## Causes of Flooding: Nigeria cont'd



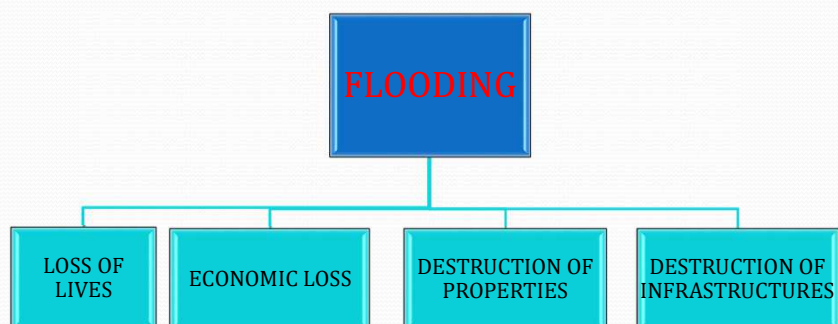
Banana Island, 1984



Banana Island, 2006



## Menace/Impacts of Flooding





## Menace/Impacts of Flooding



## Whose Responsibility is it???



OYAN DAM, OGUN STATE



ELEIYELE DAM, IBADAN



## Whose Responsibility is it???



The Bridge at Oluyole structurally designed without consideration for width of the floodplain, channel size and maximum water level. The widths of the outlet (Green), Retainer Wall (Red) and Floodplain (blue).

Source: Olayinka et al. (2012)



## Whose Responsibility is it???



Blocked Odo Ona, Ibadan, Oyo State



Submerged Houses at Meme Bridge, Lokoja





## Whose Responsibility is it???



SUBMERGED HOUSES IN BENUE STATE



## Whose Responsibility is it???

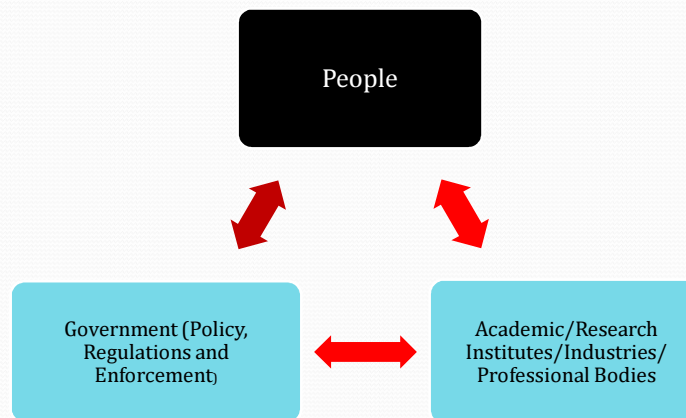


SUBMERGED HOUSES IN KOGI STATE (CONFLUENCE HOTEL)





## Whose Responsibility is it???



## COMBAT MEASURES

Having known the specific causes of the floods, the question now is what are the sustainable combat measures?

- ❖ How do we prevent and control it?
- ❖ Knowledge of the following will be useful at this point:
- ❖ Has the natural floodplain been exceeded?
- ❖ What is the floodline like (spread)?
- ❖ What are the physical planning regulations for floodplains and water ways and to what extent are they implemented?



## COMBAT MEASURES

❑ PREDICTIVE – NUMERICAL MODELS

❑ PREVENTIVE MEASURES – NIMET, NEMA, ENVIRONMENT

❑ ADAPTATIVE MEASURES

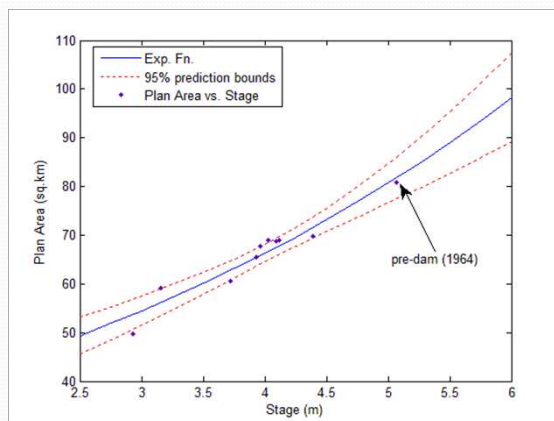


Source: Different



## COMBAT MEASURES

### PREDICTIVE MEASURES

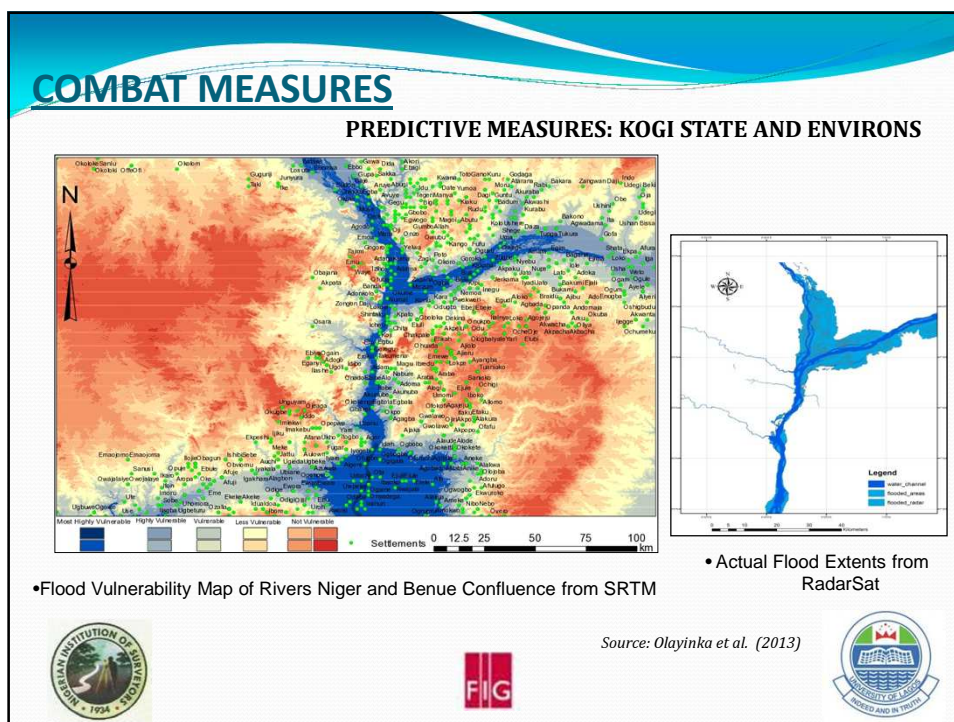
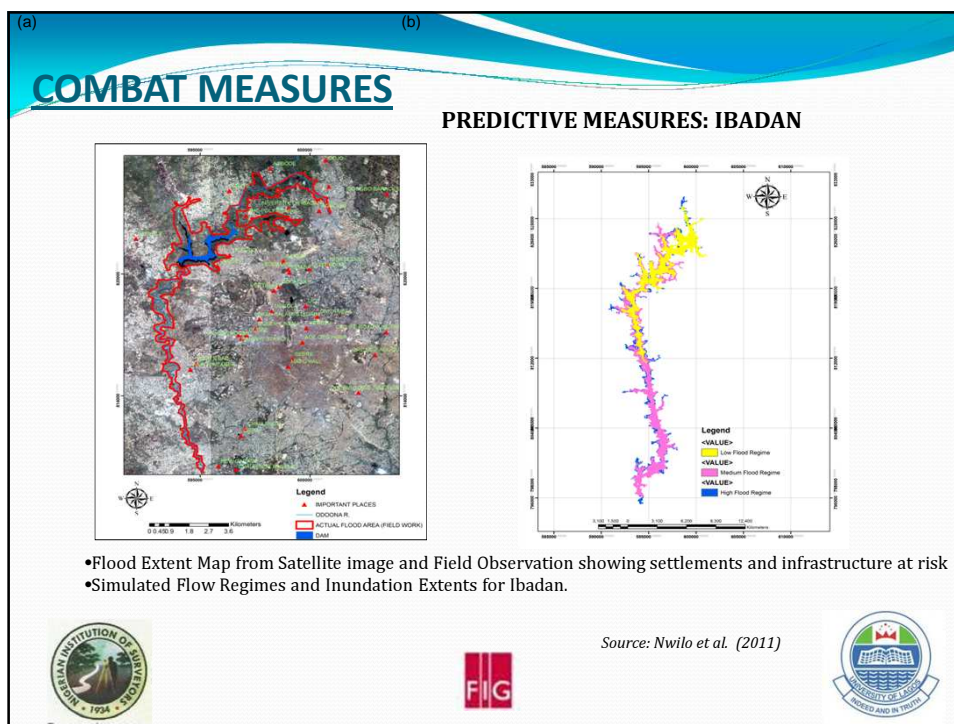


$$f(x) = Ae^{bx}$$

where  $f(x)$  = Plan Area and  $x$  = Stage.

Source: Olayinka (2010)







## COMBAT MEASURES

### ADAPTATIVE MEASURES:

- Demolishing of structures along the water ways (floodplain or drainage line).
- Town Planners to war against erection of illegal structures by riverside in the entire country.
- Illegal structures are instrumental to constant flooding during the rainy season, reasonable setback must be enforced.
- Information or early notice is necessary for Nigerian government from the Cameroonian authorities before releasing water from the lake. This has to be enforced to mitigate the impact of flooding from the Benue Channel.



## COMBAT MEASURES

### ADAPTATIVE MEASURES:

- All affected bridges to be reconstructed, high and with outlets wide enough (wide outlet width) to contain excess water.
- Dredging is recommended along the river channels in some area widen it up and give the channel the ability to contain excess water.
- Construction of more dams in the country to curtail excess water.
- An overhead bridge or fly over will be useful at the flood site along Abuja-Lokoja, a major route linking the north and southern part of the country.



## RECOMMENDATION

- ❖ Synergy/Collaboration between Professional Bodies – Surveyors, Engineers, Hydrologists, Remote Sensing and GIS Experts, Environmental Modellers and Hydrologist to mention but few in design and monitoring of roads, bridges and subsidence.
- ❖ Collaboration between Industries (as part of Corporate Social Responsibility) Academic, Research Institute and Government Agencies such NEMA, NASRDA and others.
- ❖ A Proactive Measure – Delineation and Mapping of all Floodplains in Nigeria.
- ❖ Efficient Monitoring and Maintenance of Dams and Artificial Reservoirs.
- ❖ Holistic Approach to Assessment of Major Sand filling and Dredging projects on the Gulf of Guinea.
- ❖ Establishment of Efficient Monitoring Stations (Parameters of the Dynamics of Coastal and Estuarine)



## CONCLUSION

- Flood problems in Nigeria were investigated in this presentation.
- Causes of the flooding are attributed to climate change, extraordinarily heavy rains and continued release of excess water from dams.
- The 2012 flood events in Nigeria exceeded the natural floodplains. Other reasons from findings in this study are poor channel maintenance and soil moisture saturation.
- Scenes of the flood show settlements and infrastructure such as road at risk during inundation.
- The impact is great on populations and infrastructure due to the encroachment of urban facilities on floodplain, poor enforcement of physical planning regulation with respect to floodplain management and waterway planning.
- Prevention and sustainable management options have been emphasized. The floodplains and their extents have to be mapped and well demarcated.
- This will create more awareness to the rural dwellers and urban improper settlers as well make it easy for enforcement agencies to enforce planning order across the country.



