International Journal of Economics, Commerce and Management
United Kingdom ISSN 2348 0386 Vol. VII, Issue 9, September 2019

http://ijecm.co.uk/

PERENNIAL FLOODING AND INTEGRATED FLOOD RISK MANAGEMENT STRATEGY IN NIGERIA

Chinedu Okoye
National Institute for Policy and Strategic Studies (NIPSS), Kuru, Nigeria
okoyeseeyou@gmail.com

Abstract

The challenge of perennial flooding and the impact felt across Nigeria cannot be overemphasized. Loss of precious lives, source of livelihood, property and socio-economic infrastructure, are common end results witnessed across the length of the country. Unfortunately, there seems to be no end in sight to this malaise, year in year out, the nation is at the mercy of another round of devastation with increasing magnitude. This paper stimulates and enriches discourse around this problem, throwing up prospective solutions aimed at preventing uncontrolled flooding, and greatly mitigating its effects. This paper proffers an Integrated Flood Risk Management Strategy as a framework with which solutions can be provided while at the same time ensuring alternative but productive use of the nations abundant water resources in the area of farmland irrigation, transportation, hydro-electric power generation, mineral mining, recreation and tourism.

Keywords: Perennial, Flooding, Integrated, Flood Risk Management, Strategy

INTRODUCTION

Water is widely regarded as the most essential natural resource available in Nigeria. It is a basic resource that primarily supports human health, anatomy, means and livelihood. Additionally, and very importantly, water aids and is central to socio-economic sustenance and development. Nigeria has six (6) hydrological basins which are represented in; the flat dense rain forest, southern swamp forest, semi arid north, flat savannah grasslands, and the hilly lands in the middle belt. Average yearly rainfall in the country varies between 250 mm in the north and

4000mm in the south. Two major river systems demarcate Nigeria, namely, the River Benue which enters the country from the North East and the River Niger which enters the country from the North West. The two rivers meet at a confluence in Lokoja (Kogi State), from which it moves southwards into an extensive delta before eventually discharging into the Atlantic Ocean. While majority of the rivers in the south are perennial and flow all year round, many in the north are intermittent and have water only in the rainy season. At an estimated 267 billion m3/annum in surface water resources, and 52 billion m3 in groundwater potential, Nigeria is no doubt abundant in water resources. However, despite this huge resource, Nigeria has not been able to keep up pace in developing a water management strategy that equitably harnesses this resource while at the same time ensuring a robust solution to the perennial flood challenge facing many parts of the country, (Obeta, 2014). A major fallout of the lack of a robust water management strategy is the problem or challenge of perennial flooding ravaging large parts of the country during the rainy seasons, causing serious damage, loss of life and property worth billions, (Oladokun & Proverbs, 2016). Flooding and its effects can be greatly mitigated if there is an understanding of specific structural, land and climatic conditions, and then based on this knowledge, strategic steps are taken to address the ineffective measures or complete lack of measures, that should right from the onset, have been in place to prevent or greatly limit the impact and damaging effects of flooding, (Plate, 2002).

A close study of Nigeria's National Water Policy, and Water Resource Management Strategy over the last decade (2007 - 2017), indicates a consistent primary focus on Hydro-electric power generation, Irrigation, Water Supply and Sanitation, with minimal regard for Flood Control and Management and other factors like poor erosion control and drainage, respectively.

Flooding in Nigeria is caused by a variety of factors. Majorly, flooding occurs when river channels are no longer able to further contain surging discharge. Storm surges, heavy or consistent rain falls, failure or excessive release from dams, blocked river channels and drainage greatly exacerbate flooding incidents, worsening its impact and effect, (Agbonkhese et al, 2014). Additionally, improper land use has led to the deforestation of river catchment areas. The presence of forests in river catchment areas leads to a high infiltration capacity and transmissibility in these areas - and this means these risk prone areas enjoy protective vegetation of the river banks, hence, greatly limiting surface run offs, (Oladokun & Proverbs, 2016). As can be seen today, Rivers Niger and Benue hardly have any vegetative cover/protection at its catchment areas, rather human activities like the growing of crops up to the edges and slopes of these rivers are preponderant, clearly visible and evident even to the most casual observer.

Nigeria's flood disaster in the year 2012, was unprecedented for over three decades. It left in its wake huge destruction to both rural and urban infrastructure, including roads, buildings, power lines, grid, farmlands, and crops. It also had devastating health implications on communities, consequently increasing cases of acute malaria, and waterborne diseases like Cholera. Mostly affected were central and adjoining States along the Rivers Benue and Niger. Despite the havoc caused in 2012, little remains to be seen in terms of a harmonized solution, strategic plan or concrete steps designed towards effectively mitigating and managing flood control in Nigeria, (Adedeji et al, 2012). If anything, it is more of hazard warnings through press-media releases on TV as the rainy season approaches. There remains nothing concrete put in place as a Strategy. For an Integrated Flood Risk Management Strategy to be effective and wide reaching, it should be robust enough to provide or proffer encompassing measures that address all flood triggers, symptomatic factors and consequential effects.

Problem Statement

Flooding in Nigeria are of three forms, River Flooding, Urban Flooding and Coastal Flooding. Floods which periodically sweep across the River Niger and Benue banks down the Atlantic Ocean, emanate from the Lagdo Lake and Dam in Cameroon. Seasonally, excess water is released from the Lake to protect the dam from bursting, and the consequence has always been an overwhelming and destructive effect on the surrounding towns and villages and far beyond. The dam was built in 1982 by the Chinese to provide electricity, potable water and farmland irrigation in and around the Northern Cameroun province. Having anticipated the flood flashes that will be engineered once water is let off the lake, a feasibility study was carried out the same year (1982) by the Nigerian authorities, after which it was decided that a water holding dam be built in Daisin Hausa, Furore Local Government Area of Adamawa State, to curtail, hold and limit most of the overflowing water coming from Lagdo Lake in Cameroun. The Daisin Hausa Dam project never took off hence nullifying the reason for which it was conceptualized. Nigeria has since experienced seasonal floods over the last three decades, orchestrated primarily and to a large extent by the unrestricted flow from Lagdo, (Rasheed, 2018).

The Lagdo Dam case study, is illustrative of the lack of adequate strategies, measures and proactive steps put in place to address the issues that drive flooding (River Flooding especially). The Federal Ministry of Water Resources has also identified over 100 other flood limiting dams that were also abandoned over the last three decades by successive administrations. If the relevant state institutions were proactive enough and ensured the construction, completion and effective functioning of these strategically located dams, numerous

loss of lives and property worth billions of dollars to flooding, would have been prevented, or mitigated to a large extent, (Rasheed, 2018).

This paper examines the problem that is Flooding in Nigeria, the inability so far to present a holistic and integrated framework of solutions, capable of tackling or greatly mitigating this devastating yearly challenge. This paper identifies and evaluates critical factors that have a direct impact on occurrence and after effects of flooding as a whole i.e. causative, symptoms and consequences, and proffers strategic steps and implementation strategies aimed at tackling the problem effectively.

METHODOLOGY

In investigating this research problem, this paper adopts the Case study method. Case study method is an in-depth study of an entity (or entities), with the view to discovering specific or distinct features, functions or attributes that characterize them. This research method is qualitative, and consists a narrative description of these features, functions and attributes. The Case Study Method has an advantage in its flexibility - enabling further discoveries, high level detail, focus, ability to combine both subjective and objective data to stimulate in-depth understanding, and most importantly - answer the research problem question of 'how' and 'why' (Creswell, 2013).

The four (4) Case Study methods are namely, Exploratory, Cumulative, Illustrative and Critical Instance. The method to be adopted and used depends to a large extent on the research question/problem. A variety of Case Study approaches can be used to collect data, including review of documents and records, field studies, interviews, transcript analysis and direct observation. On determining data collection approach, a strategy for analyzing the collected data has to be devised. Case Study research data is either interpreted holistically or though coding. While the holistic approach reviews the data as a whole, drawing conclusion based on the data, the coded approach assigns numeric codes that enable the data to be analyzed with the aid of quantitative or statistical methods (Bernard & Bernard, 2012).

Accordingly, and considering the aim and objective of this paper, the Case Study method was adopted to understudy an equally flood prone but developed Country (United States of America), which maintain efficient and effective management and control of their yearly flood challenge, ensuring to a large extent the mitigation of its damaging effects, loss of lives, property, etc. The Case Study approach best evaluates the peculiar flood challenge facing this country, analyzing the practices and strategies deployed with the view to adopting and proffering them as a viable alternative solution for the Nigerian flood challenge. This paper is characterized by a narrative description of this case study, and is clearly Illustrative in approach,

(Gomm et al, 2000). Data collection is via review of documents and records which in this case is a literature review of articles, papers and journals detailing historical US flood challenge and steps taken to address them.

CASE STUDY: FLOODING IN THE UNITED STATES OF AMERICA

The United States of America, despite being a foremost global superpower, unfortunately has been and is plagued by a high number of natural disasters mostly floods, and hurricanes, leading to loss of lives and property worth billions of dollars, (Lauber, 1996). The worst flood in U.S. history, and one of the deadliest natural disasters experienced in the country to date was the Johnstown Flood of 1889. Known as the Great Flood of 1889, it was caused by the collapse of the South Fork Dam which could no longer contain the pressure exerted by rising water levels of the reservoir. Spillways clogged by debris, and heavy 10 inch rainfall on the rivers upstream sector played secondary but key roles in the collapse. The unfortunate incident took an estimated 2,209 lives, and cost an estimated $453 million in infrastructural and property damage, (Law, 1997).

The failure of the Saint Francis Dam, located in Los Angeles County, California, led to the worst flooding experience in California's history to date. The dam which collapsed 12th March, 1928, unleashed more than 12.4 billion gallons of water with debris and fragments across 0.75 miles downstream to the community settlements. Due to the colossal level of impact and destruction, up to 431 people lost their lives in the unfortunate incident, (Rogers, 1995).

The Ohio River Flood in 1937, was classed the third deadliest in U.S. flood history. Heavy rainfall in the river's upstream caused the river's water levels to rise in a manner unprecedented, consequently leading to flooding that consumed $8.7 billion in property damage and loss of up to 385 lives, (Welky, 2011).

The common denominator in these flooding cases, is and can be attributed to collapsed, defective or poorly functioning dams, brought about by poor engineering and civil construction work, (Changnon et al, 1983).In strategic response, the U.S has over the decades invested heavily in proper dam construction and engineering practices. The result is the presence today of strong durable dams, and in effect, a drastic reduction in cases of dam collapse for about a century. The role dams and drainages play in flood prevention, control and management cannot be overemphasized.

Besides defective dams, there is a Climate Change angle to flooding in the United States. Researchers report increasing ocean temperatures which they tie to increasing carbon emissions. Hotter oceans means increased levels of water evaporation from ocean surfaces. Hurricane are empowered by this heat which drives its speed and intensity. Storms and flood

work hand in hand; the longer the storm in a particular area, the more rainfalls in the area, and the inevitability of a flood occurrence. With factors like poor drainages thrown into the mix, complications driving flooding even gets worse, (Dinan, 2017).

Historically, the City of Houston has been plagued by extreme floods. Poor city planning is majorly liable for this increasing risk. Poor drainage planning and its related issues are responsible for one third of the flooding in the city. Research investigations, reveal devastating effects of Hurricane Harvey, was worsened by poor city planning and drainage issues.

As a flood control measure, Houston City plans to invest up to $4.5 billion in ongoing preventive measures in and around the region, (York, 2018). 237 projects have been identified for execution, a significant number of which are currently being executed towards meeting this overarching objective. Some of these projects are namely :

i. Drainage improvements.
ii. Promoting awareness and knowledge among the populace.
iii. Flood proofing high risk areas through more meticulous urban and landscaping design and implementation.
iv. Replacing concrete walls with dunes.
v. Relocation and construction of new homes and structures as integrated levees.
vi. Voluntary Government buyout of flood prone or vulnerable homes, and resettlement in less prone areas.
vii. Further excavation of storm water detention basins and bay widening.
viii. Construction of a third city reservoir and a coastal barrier.

Holistically and beyond individual federating states efforts, the U.S. as a whole, has across the last ten years, ensured flood control and relief methods targeted at preventing or reducing the damaging effects of flood water across its federating states,(Dirmeyer et al, 2010; Lauber, 1996; Pielke & Downton, 2000; Schumacher & Johnson, 2006; Villarini & Slater, 2017).Strategically, flood risk management and control measures implemented by the U.S and its federating states are in harmony as enumerated below:

a. Dams and their reservoirs are designed with flood protection and control in mind. These dam reservoirs are designed to make room or space for flood water to fill during the rainy season. The standard and specification for building these dams are set, and designed by the American Army Corps of Engineers (USACE), the lead US flood control agency which also regulates. These design and specification ensure adequate flow rates that take stream flow, topography and soil data into consideration.

b. Diversion canals, sometimes called floodways, are built to receive excess flood water by diverting them into land that can absorb water or water bodies with low flooding risk - like

holding ponds. In the US, an example of land that absorb water are Vineyards or Orchards, fallow land deliberately built to serve as floodplains. The Morganza Spillway was constructed to divert water away from the Mississippi River, hence, preventing the potential flooding of Baton Rouge, New Orleans and major Mississippi cities, in the event of a Hurricane or sustained rainfall.

c. River defenses in the U.S. are built around rivers that are prone to flooding. Defenses measures like weirs, reservoirs, and levees are used to ensure rivers do not overcome their banks.

d. Coastal defenses are built in the U.S. to address the problem posed by coastal flooding. Some of these measures include built up barrier islands, sea walls, tide gates, culverts, and dykes.

e. Removal or relocation of buildings and community settlements from established flood-prone areas to low risk areas, and then rebuilding the former as open parks. A good example, is the US Federal Government buy out of up to 25,000 flood-prone properties after the Midwest floods in 1993, and eventual conversion into wetlands which soak up excess water.

f. Flood barrier projects are set up to protect assets and structures in cities from adverse effects of flooding. A good example, is the New York Metropolitan Transport Authority initiated - flood barrier projects, to protect city assets from being submerged, and subway entrances from being flooded, using the Flex Gate which is a deployable fabric cover system. The city of New Orleans, a third of which sits below sea level and prone to flooding, is protected by numerous flood barriers comprising flood gates and levees.

INTEGRATED FLOOD RISK MANAGEMENT STRATEGY: ANALYSIS& DISCUSSION

Flood duration, coverage area, flow velocity and water volume discharged per unit time, are key factors to be taken into consideration in planning an effective flood management/control measures from the scratch. Flood duration is a key factor in the length of time an area takes to discharge or run-off peak water. Some flood are known to rise and recede within a short time, while some remain high for several days. Having data on this is crucial in planning and implementing flood control mechanisms. Also, securing data on flood frequency is key, so also its velocity i.e. the speed at which flood water moves, usually calculated by measuring the flood water flow distance against the time duration of flow (Bedient & Huber, 2008).

Flood is an end result of both natural and man-made causes. Man-made causes like deforestation, urbanization in flood prone areas, and lack of effective flood control measures complement the natural phenomenon of heavy rainfall, storms, soil nature and climate change effects, (Vojinovic & Abbot, 2012). Heavy rainfall is usually experienced in tropical regions with

annual rainfall intensity of about 2000mm, making it difficult for tropical soil to fully infiltrate rain water. Urbanization which is characterized by paved surfaces like roads among others, make rain water soil infiltration difficult, consequently generating large volumes of flood water run-offs, (Li & Wang, 2009). Average soil in tropical West Africa reaches saturation at 200mm of maximum soil moisture storage. At 2000mm average annual rainfall intensity, there is bound to be low soil infiltration capacity hence a large volume of water is generated as run-off. Accordingly, low relief areas are most liable to flooding at the peak of heavy rainfall. Climate Change, plays a key critical role in the occurrence or exacerbation of floods, (Villarini & Slater, 2018). Climate Change is popularly defined as change in climate, attributed directly or indirectly to disruptive human activities capable of altering the global atmospheric composition and climate variability.

In Nigeria, a whole range or variety of factors pull together to impact flooding. Poor waste disposal in both rural and urban areas presents is a factor. Waste characterized by litter, debris, and sewages block drainages, preventing free flow of rain water. Another factor impacting flooding in Nigeria, is that of poor land use policy. Poor land planning and management in Nigeria has resulted in improper land use, improper citing of structures and buildings, (Adedeji et al, 2012). This has doubled the possibilities for floods to occur, and often rendered otherwise efficient control measure ineffective. As already illustrated in the introductory aspect of this paper, poor dam construction practices or the complete lack of dams and reservoirs poses a major challenge. Additionally, lack of flood control measures like flood barriers, diversion canals, rivers and coastal defenses, and increased urbanization and community settlements in high risk flood-prone areas play a major disadvantage in the whole mix impacting the nation, (Action Aid, 2006; Adeoye et al, 2009; Ali & Hamidu, 2014; Obi & Ubani, 2014; Rouhana & Bruce, 2018).

Water Resources, if properly integrated, managed and deployed will prove to be of fundamental importance in the socio-economic development of the nation. Building efficient and effectively performing dams enable the harnessing of water resources, and channeling of same into socio-economically beneficial initiatives like hydropower electricity generation, irrigation farming, mineral mining and processing, industrial manufacturing and production, construction, recreation and tourism. The benefits accruable to hydropower electricity generation, irrigation farming, mineral mining and processing, industrial manufacturing and production, construction, waste disposal and sanitation, recreation and tourism, can only be maximized if the risk presented by flooding is risk managed.

In view of the increasing challenge of floods to the nation, and its dire effects on the people and infrastructure, it has become imperative that an Integrated Flood Risk Management

Strategy is developed to incorporate a more robust solution to the challenge of perennial flooding across the country.

Floods can be mitigated by control measures that are structural and non-structural. Structural measures include investment in strategic building of new, or restoration of decrepit dams, reservoirs, retarding river basins, river channels, drainage works, river embankments and shore lines, respectively. Non-structural measures include the formulation of policies, enactment of laws and regulation that help enforce and guarantee maintenance, effective management and functioning of these flood control structures, and the laws that protect the river shore lines and embankments.

RECOMMENDATIONS

The recommendations below have been adapted from the review, analysis and discussion of the history, challenge, management and control of flooding in the U.S. They have been applied to suit the Nigerian flooding scenario and its peculiar challenges. These steps are aimed at ensuring an effective flood control and management mechanism, that ultimately mitigates uncontrolled occurrence of perennial flooding and its devastating effects on lives and property across the country.

These recommendations constitute what this paper refers to as an Integrated Flood Risk Management Strategy, which not only addresses the malaise of perennial flooding in Nigeria, but also ensures the harnessing of this resource for the socio-economic, agricultural and power generation benefit of the nation.

1. Institute legal and regulatory framework to further empower and strengthen institutions responsible for flood risk management and control so as to better enforce environmental standards and regulations.
2. Increase budgetary provisions and spending on flood defenses, management and control.
3. Proactively engage stakeholders, create awareness and build knowledge base around flooding patterns, flood risk and flood risk management measures.
4. Construction, and completion of effectively functioning dams e.g. the water holding Daisin Hausa dam and others of its like, strategically located on flood water path.
5. Strategic water resource management that empowers farmland irrigation, hydro-electric power generation, mineral mining, recreation, tourism and inland waterway transportation.
6. Construction of Diversion canals or floodways to divert water to purpose built flood retention ponds or low risk fallow lands that absorb water and reduce storm water runoff.

7. Erection of river defenses to protect rivers prone to flooding e.g. Rivers Ogun, Benue and Hadeja.
8. Widespread construction of urban and rural flood drainage channels.
9. Efficient waste management to prevent build up of waste and blocking of drainage channels.
10. Proper land use policy framework and guideline, and strict enforcement to prevent indiscriminate citing of buildings, properties on areas prone to flooding.
11. Flood proofing of high risk areas through more meticulous urban and rural landscaping and design that ensure structures are constructed above flood levels.
12. Creation of more Wetlands which act as sponges to soak up and slow down flood waters, reduce the impact of climate change on flooding.
13. Halt deforestation, as forest vegetation is proven to limit rainfall intensity enabling it to match the rate of soil infiltration.
14. Government investment into Flood Modeling, Flood Hazard/Risk Mapping, Flood Risk Assessment and early warning systems technology that improve the accuracy of weather reports, disaster warnings and meteorological alerts.
15. Government backed Public-Private Sector promotion of sustainable development in urban and rural communities, and Flood Insurance as a non-structural risk mitigating approach post-flood disasters.

CONCLUSION

Current efforts at tackling the challenge of flooding in Nigeria is insufficient, limited, and mostly of ad hoc approach which comparatively fails to meet global best practices. In putting out this paper, the authors explore core issues that drive and impact flooding in Nigeria, while also assessing options for optimizing and harnessing Nigeria's abundant water resources. The paper advocates a national, state and local government shift in policy, from reactionary albeit belated flood response measures to preventive flood risk management and control that target the cause factors or symptoms that drive this yearly national challenge. The proffered recommendations and implementation strategies are well researched and considered strategic steps, which if implemented holistically, will drive a paradigm shift from the incumbent reactionary approach to the preventive. Additionally, this paper proffers a deliberate Water Resource Management Strategy that drives the recreational, agricultural, energy generation and transport potentials of the nation by harnessing and optimizing its abundant water resources for immense socio-economic benefits like tourism parks, farmland irrigation, hydro-electric power generation and a diversified inland water way transportation.

It is safe to conclude, that an Integrated Flood Risk and Water Resource Management Strategy, represents a viable twin approach at effectively tackling Nigeria's flood challenge while at the harnessing its abundant water resource potentials for the benefit of the socio-economy.

WAY FORWARD

Recommendations made above, underline an Integrated Strategy which if adhered to would ensure proper Flood Risk Management that would significantly mitigate or reduce the spate of perennial flooding and its impact across the nation, while also exploiting and harnessing the country's rich water resources/reserves for socio-economic benefit. Having drawn from applicable and positively yielding practices in the U.S, and re-crafted these, to proffer perennial flooding solutions in the Nigerian situational context, these recommendations need practical implementation steps which would serve as a vehicle to bringing them to fruition. These steps could come in the form of key policy implementation and enforcement processes or procedures that will work to actualize the recommendations - bringing them to positively impact the flood challenge.

As a way forward and in furtherance of the input made by this paper, it is imperative that further study is carried out to evaluate, investigate and establish viable steps, guidelines or frameworks that can be employed as vehicles to implementing and bringing these recommendations to full practical effect.

REFERENCES

Action Aid (2006) 'Climate Change, Urban Flooding and the Rights of the Urban Poor in African Cities'. A Report by Action Aid.

Adedeji, O., Odufuwa, B. & Adebayo, O. (2012). Building capabilities for flood disaster and hazard preparedness and risk reduction in Nigeria: need for spatial planning and land management. Journal of Sustainable Development in Africa. 14(1), 45-58.

Adeoye, N., Ayanlade, A., & Babatimehin, O. (2009). Climate change and menace of floods in Nigerian cities: Socio-economic implications. Advances in Natural and Applied Sciences. 3(3) 369-377.

Agbonkhese, O, Agbonkhese, E, Aka, E, Joe-Abaya, J Ocholi, M & Adekunle, A (2014) 'Flood Menace in Nigeria: Impacts Remedial and Management Strategies'. Journal of Civil and Environmental Research. 6(4) 32-40

Ali, D. & Hamidu, S. (2014). Environmental hazard: climate change and flooding, the impact on the built environment in Nigeria. Journal of Environmental Science and Resource Management. 6(1) 136-144

Ashley, S. T., & Ashley, W. S. (2008) 'Flood fatalities in the United States'. Journal of Applied Meteorology and Climatology. 47. 805–818.

Bedient, P & Huber, W (2008). Hydrology and Floodplain Analysis (4th Ed) Prentice-Hall: New Jersey.

Bernard, H & Bernard H (2012) Social Research Methods: Qualitative and Quantitative Approaches. Sage: California.

Changnon, S.A, Schicht, R.J & Semonin, R.G (1983) 'A Plan for Research on Floods and Their Mitigation in the United States'. Final Report to National Science Foundation.

Creswell, J (2013) Research Design: Qualitative, Quantitative and Mixed Method Approaches. Sage: California.

Dinan, T (2017) 'Projected increases in hurricane damage in the United States: The role of climate change and coastal development'. Ecological Economics. 138.186– 198.

Dirmeyer, P. A., & Kinter, J. L.(2010) 'Floods over the U.S. Midwest: A regional water cycle perspective'. Journal of Hydrometeorology,.11, 1172–1181.

Ellis, B, Scholes, L, Revitt, M & Viavattene, C (2008) Risk Assessment and Control Approaches for Stormwater Flood and Pollution Management. (3rd Switch Scientific Meeting: Belo Horizonte, Brazil)

Gomm, R, Hammersley, M & Foster, P (2000) Case Study Method: Key Issues, Key Texts. Sage: California.

Komolafe, A, Adegboyega, S & Akinluyi, F (2015) 'A Review of Flood Risk Analysis in Nigeria'. American Journal of Environmental Sciences. 11(3). 157-166.

Lauber, P. (1996) 'Floods: Wrestling with the Mississippi. Washington, D.C.'. National Geographic Society.

Law, A. (1997) 'The Great Flood. Johnstown: Johnstown Area Heritage Association and the National Park Service.

Li, Y., & Wang, C, (2009). 'Impacts of urbanization on surface runoff of the dardenne creek watershed, St. Charles county, Missouri'. Physical Geography. 30(6). 556-573.

Nkwunonwu, U, Whitworth, M & Baily, B (2015) 'Flooding and Flood Risk Reduction in Nigeria: Cardinal Gaps'. Journal of Geography and Natural Disasters.

Obeta, C. (2014) 'Institutional Approach to Flood Disaster Management in Nigeria: Need for a Preparedness Plan'. British Journal of Applied Science & Technology. 4(33), 4575-4590

Obi, N & Ubani, O (2014) 'Analysis of Flood Risk Management in Nigerian Urban Environment'. Journal of Environment and Earth Science. Vol 4. No. 6

Oladokun, V & Proverbs, D (2016) 'Flood Risk Management in Nigeria: A Review of the Challenges and Opportunities. International Journal of Safety and Security Engineering. Vol 6. Issue 3. 485 - 497

Plate, E. (2002) 'Flood Risk and Flood Management'. Journal of Hydrology. 267(1), 2-11.

Pielke, J., & Downton, M. W (2000) 'Precipitation and damaging floods: Trends in the United States, 1932–97'. Journal of Climate. 13(20). 3625– 3637.

Rasheed, A (2018) 'Flood: The Terror from Lagdo Dam'. Published online 11th October, 2018 https://punchng.com/flood-the-terror-from-lagdo-dam/Punch Newspapers.

Rogers, J.D. (1995) 'A Man a Dam and a Disaster: Mulholland and the St Francis Dam'. Southern California Quarterly. Vol. 77. No. 1/2.

Rouhana, S & Bruce, I (2018) Creating a flood resilient city: Moving from disaster response to disaster resilience in Ibadan. Retrieved from https://blogs.worldbank.org/nasikiliza/creating-a-flood-resilient-city-moving-from-disaster-response-to-disaster-resilience-in-ibadan

Schumacher, R. S., & Johnson, R. H. (2006) 'Characteristics of United States extreme rain events during 1999 - 2003'. Weather and Forecasting. 21. 69–85.

Villarini, G & Slater, L (2017) 'Climatology of Flooding in the United States'. Oxford Research Encyclopedia.

Vojinovic, Z. & Abbott, M (2012) Flood Risk and Social Justice: From Quantitative to Qualitative Flood Risk Assessment and Mitigation. IWA Publishing: London.

World Bank (2014) Nigeria: World Bank to Support Flood Management, and Rebuilding of Infrastructure in the City of Ibadan. Retrieved from http://www.worldbank.org/en/news/press-release/2014/06/17/nigeria-world-bank-support-flood-management-rebuilding-infrastructure-ibadan

Willner, S, Otto, C., & Levermann, A (2018) 'Global economic response to river floods. Nature Climate Change'. 8(7) 594– 598.

York, D (2018) 'New Flood Prevention Strategies'. Published online 7th December, 2018 - http://climate.org/new-flood-prevention-strategies/ Climate Institute.