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Flood disaster and its mitigation strategies in Ilaro Formation, Eastern Dahomey Basin, southwestern Nigeria

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ABSTRACT

Flooding is one of the most common natural hazards, causing disastrous impacts in Nigeria. Based on a systematic review of previous research work, this study highlights the causes of flood disaster and its effective mitigation strategies in Ilaro formation, Dahomey Basin southwestern Nigeria. The findings revealed that in most cases in Nigeria, flood disaster is caused by natural and human activities such as excessive rainfall, poor drainage facilities, poor waste disposal practices and weak policy implementation by institutions concerned with flood management. The study further revealed that increasing deforestation, and inability of land developers to adhere to physical development plans and schemes also caused flood disaster in the study area. The study concludes that flood disaster in Ilaro Formation affect physical developments such as houses, roads and other structures. In cases of serious flooding, lives can be lost in the process. This study recommends more community-based approaches to help raise environmental awareness and support the affected community residents through grants from government and donor agencies as this would enhance their coping strategies for curbing the problems and indeed remediating the flood disaster in the area. It was also suggested that land development control activities should be taken seriously to avoid the erection of developments on flood plains and flood prone areas.

Keywords: Flood disaster, Ilaro Formation, mitigation strategies, Dahomey Basin, flood impacts, southwestern Nigeria

1. INTRODUCTION

Flood is a condition by which a dry land is covered with water for a given period, which may be as a result of rainfall and runoff, an overflow from the streams, rivers and seas underground seepages or discharges from domestic pipes and reservoirs (Viesman, et al., 1989). It is a serious global issue that has an impact on several towns and countries (Kumar, et al., 2023; Weday, et al., 2023). Flood problems are common in low-lying areas and flood plains of the world (Aris, et al., 1979). Studies show that the flood problem affects both developed and developing countries (Kablan, et al., 2017; Danhassan et al., 2023). Flood has been reported to be one of the key environmental disasters that significantly affects both the environment and public property (Hossain and Meng 2020).

Flood is the most common global natural disasters that leads to loss life and property (Balasbaneh et al., 2019; Dias et al., 2021; Al-Aizari et al., 2022; Chen 2022; Cheung et al., 2022; Grigorieva et al., 2022; Stefanidis et al., 2022). This natural disaster, mainly caused due to the existence of poor drainage facilities, blocked drains, improper road construction, and poor maintenance, culture and the various activities of humans on flood plains. A situation where there is no provision of drains to convey flood waters to suitable outlets induces flooding or the drainage facilities are poorly designed and installed. In many urban areas, some of the existing drains on the roads have been turned to refuse dumps. Also, as a result of the perennial flooding of our highways, potholes are covered with water and motorist experience difficulties moving from one point to another.

In the last three decades flood alone affects over 2.3 billion people, accounting for 74% of all recorded natural disasters, and responsible for 43.5% all death in 2019 from natural disaster globally (Suhr et al., 2022). It has wreaked havoc on development infrastructure, crops and increased human casualties all over the world (Monirul Qader Mirza 2002; Danhassan et al., 2023).

Floods may have disastrous effects on the economy and society, and rehabilitation and reconstruction can be expensive (Svetlana et al., 2015). Flooding has already damaged the economy and infrastructures in developing countries as the poor people are less equipped and insufficient drainage system. Among infrastructures, bridges are the most vulnerable to flood. Due to the increasing occurrence of climate extremes like flooding, bridge failures are likely to increase. Failures of bridges due to floods have been reported in different countries (Tan et al., 2020; Mitoulis et al., 2021; Michalis et al., 2022; Pejovi'c et al., 2022).

Previous studies have confirmed that flooding not only destroys roads, but also destroys walls and collapses roofs (Giannaros et al., 2020; Yusmah et al., 2020; Tiepolo et al., 2021). Uncontrolled waste disposal by urban residents can block waterways and increase the risk of flooding. Due to technical problems, flood channels in some cities are not able to prevent flood related disasters. Unplanned urban development is another threat to urban environment. For instance, unplanned urban development can increase the risk of urban flood in African countries (Di-Baldassarre et al., 2010).

The increase in human settlements and economic assets in floodplains and coastal areas, along with the alteration in flood magnitude and frequency due to climate change, leads to a higher degree of flood (Hirabayashi et al., 2013; Craciun et al., 2022; Cheung et al., 2022; Stefanidis et al., 2022; Grigorieva et al., 2022). Thus highlighting the need to adopt national and local risk reduction and adaptation strategies to improve the resilience of communities to the negative impacts of floods (Hammond et al., 2015; Nofal and van de Lindt 2022).

Recently, several national and international research programs have been devoted to investigating extreme flood events and promoting advances in methods, strategies, and flood simulation techniques to enhance flood management (FloodRISE: UCI, 2022; FLOODsite: FLOODsite, 2009 and Samuels et al., 2009; KULTURisk: KULTURisk, 2011; IMPACT: Morris and Hassan 2005). Many programs were put in place to combat the flood threat in Nigeria. These include The National Disaster Response Plan (NDRP), National Disaster Management Framework (NDMF), National Flood Preparedness Plan (NFPP), and National Environmental (soil erosion and flood control) Regulations, 2011.

2. LOCATION AND GEOLOGY OF THE STUDY AREA

The Nigerian sector of the Dahomey Basin is located within the Gulf of Guinea (Figure 1) and covers the southwestern part of Nigeria between longitudes 2°30'E and 5°00'E, and latitudes 6°00'N and 7°00'N, cutting across three different states including Lagos, Ogun and Ondo States (Figure 2). The northern edge of the basin is defined by the Basement Complex rocks of south western Nigeria, which is part of the West African Shield (Rahaman 1976; Oluyide 1988). To the east, it is limited by the Okitipupa Ridge (supposedly a continental extension of the Chain Fracture Zone) which forms a wedge that separates its Cretaceous – Cenozoic sediments from the Tertiary sediments of the Niger Delta. The Dahomey Basin extends westerly through Benin and Togo into Ghana where the boundary is defined by the Ghana Ridge (supposedly a continental extension of the Romanche Fracture Zone). The southern limit is the Atlantic Ocean. As part of the West African pericratonic basin system (Guiraud and Maurin 1992; Burke et al. 2003; Bumby and Guiraud 2005; Brownfield and Charpentier 2006), the Dahomey Basin covers much of the continental margin of the Gulf of Guinea.

Tectonic evolution of the Dahomey Basin has been related to the Late Jurassic trans current movements along oceanic fractures zones which resulted in the opening-up of the South Atlantic and subsequent separation of the African and South American Plates (Omatsola and Adegoke 1981; Mascle et al. 1988; Onuoha and Ofoegbu 1988; Brownfield and Charpentier 2006; Omosanya et al. 2012; Kaki et al. 2013; Fadiya and Ojoawo 2015). Basement tectonics and block faulting comprised the intra-cratonic (pre- drift), syn-rift (or rift) and post-rift (drift) stages which resulted in the formation of east to west oriented structural basins. The boundaries of each of these structural basins are defined by the east – west transform fault systems (Akande et al. 2012). Hence, the observed principal basement structures in the basin are related to Early Cretaceous rifting, dominated by normal faults bounding a series of linked half-grabens. The major structures appear to have formed in the Neocomian to Barremian (Oladele and Ayolabi 2014).

The general geology and tectonostratigraphic sequences of the Dahomey Basin (Figure 3) which span from Cretaceous to Recent, and have been studied extensively by many researchers (Adekeye et al. 2019; Omatsola and Adegoke 1981; Billman 1992; Jan Duchene 1998; Omosanya et al. 2012; Kaki et al. 2013; d'Almeida et al. 2016; Akande et al. 2018). This includes the Cretaceous Abeokuta Group, which comprise the Ise, Afowo and Araromi Formations; the Palaeocene Ewekoro Formation; the Late Palaeocene to early Eocene Akinbo Formation; the Eocene Oshosun and Ilaro Formations and the Pleistocene to Recent Benin Formation (Figure 4). Ilaro Formation is underlain by limestone, clay and sands. It has a typical

climate marked with significant rainfall between April and October. The raining season is long and has high impacts most especially on the environment. The annual rainfall is 2150 mm, and temperature is averagely 28 °C. The average humidity and dew point are 62% and 22 °C, respectively.

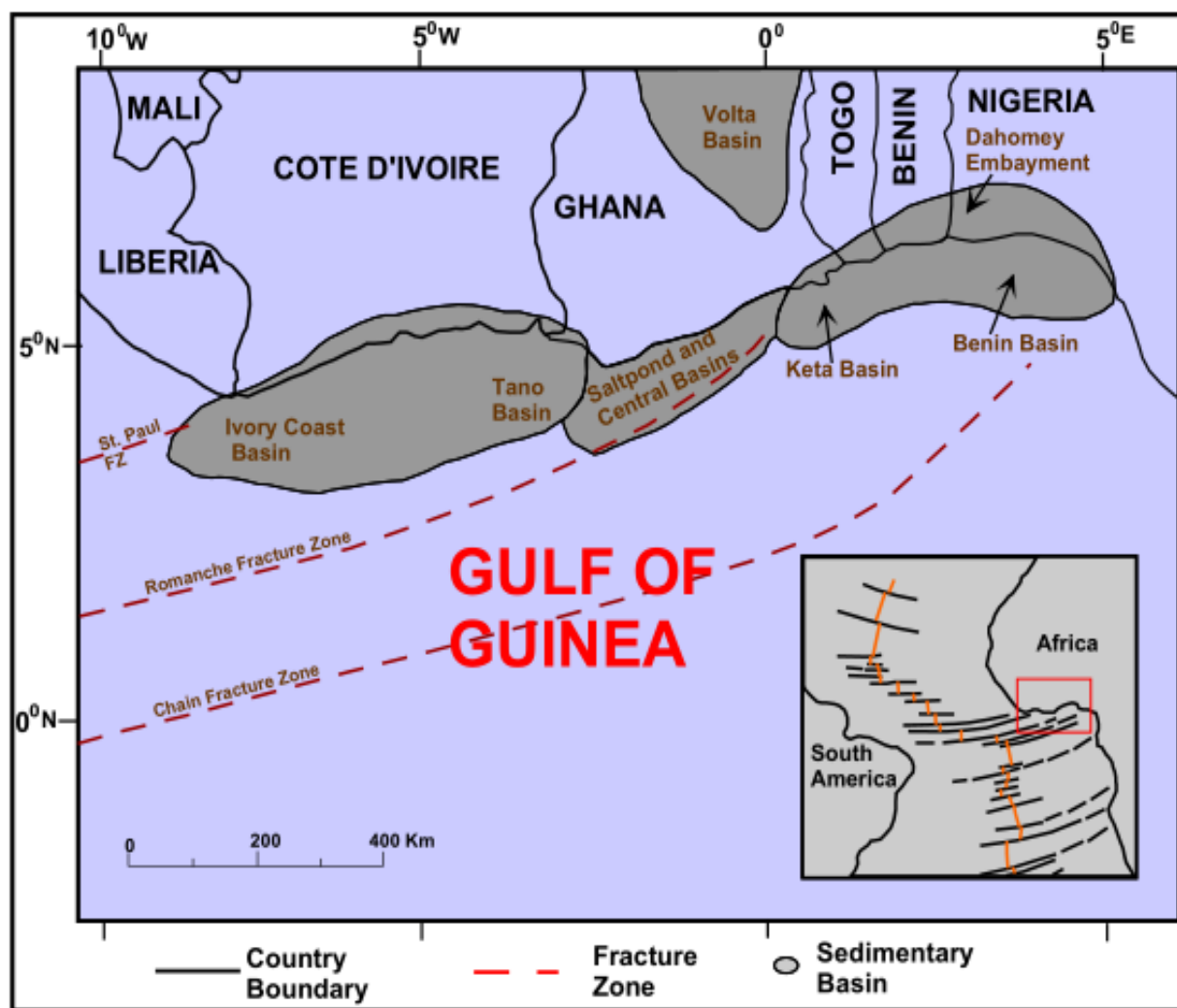


Figure 1. Regional map of the Gulf of Guinea showing the location of Dahomey Basin in relation to other basins (modified after Brownfield, et al 2006).

It has a relief of 200m above sea level. The study area is accessible through Ppapalanto-Ifo road towards Ilaro town. It is also accessible by major road, minor roads and several footpaths.

Ilaro Formation has little information on the environmental impacts of flood disaster. Therefore, flooding related information are needed to increase our knowledge and understanding, thereby Creating awareness on the impacts of flood disaster and its effective mitigation strategies in Ilaro Formation Nigeria which necessitated this study.

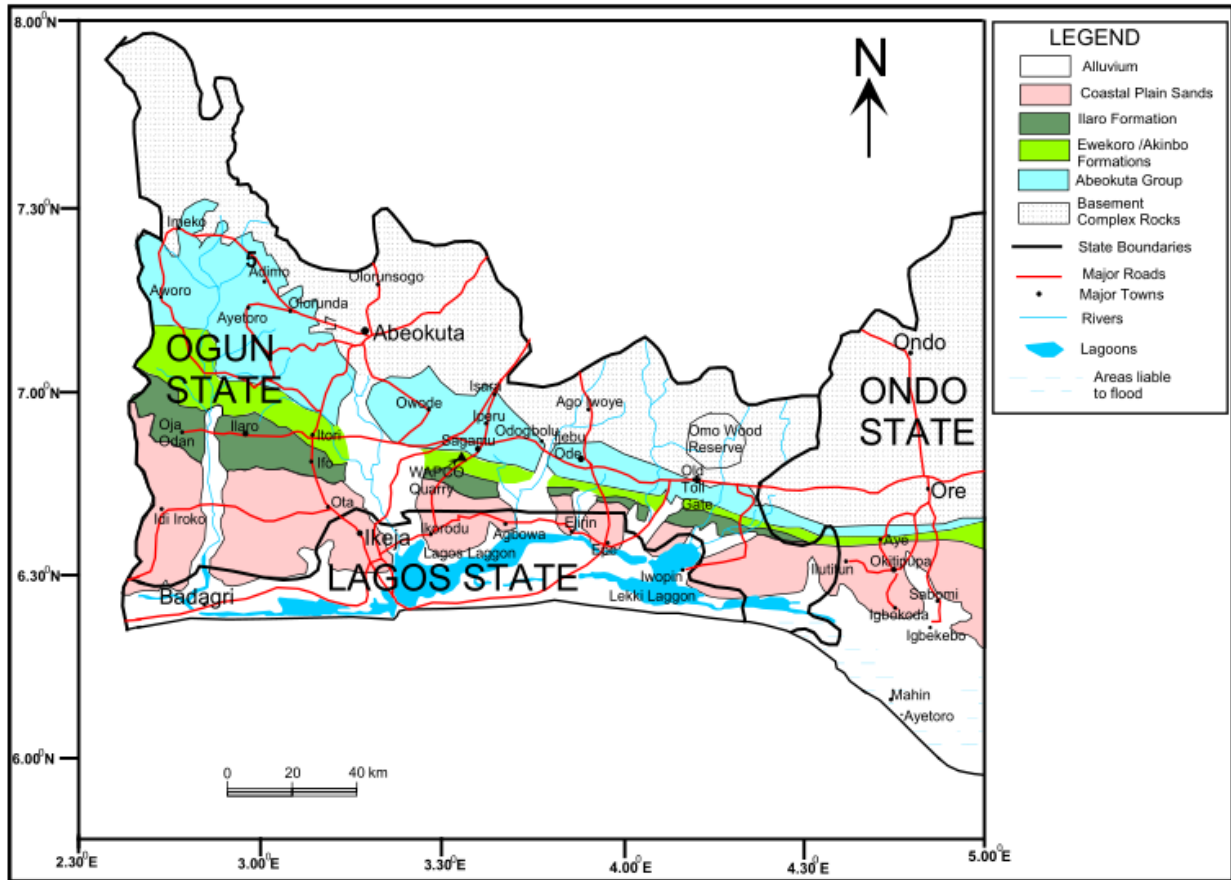


Figure 2. Geological map of Dahomey Basin in the Nigerian sector and the states located on the basin (modified after Jones, et al., 1964).

3. OCCURRENCES AND CAUSES OF FLOODING IN ILARO FORMATION NIGERIA

Flooding in Nigeria occurs in three forms; coastal flooding, river flooding and urban flooding also called flash floods. Coastal flooding occurs in the low lying belt of mangrove and fresh water swamps along the coast. River flooding occurs in the flood plains of the larger rivers while urban flooding is linked with rivers in the inland areas. It is often short-lived and the sudden heavy rains in the inland areas can change them into a destructive torrent (Scott 2007).

Many factors are responsible for flooding which include; dumping of refuse in water bodies (David 2004), constructing buildings on flood plains and poor maintenance of drainage facilities (Ajayi 2012). Removal of vegetation, increase in the size of water channel and increase in erosion also contribute to flooding. Flooding has many extreme negative social, economic and environmental impacts (Apan et al., 2010). Some of the negative impacts of flooding include; damage to properties, crops and livestock, loss of human life, health problems, damage to roads, bridges, and power plants. There is also disruption of economic activities and livelihoods of victims (Ajayi, 2012).

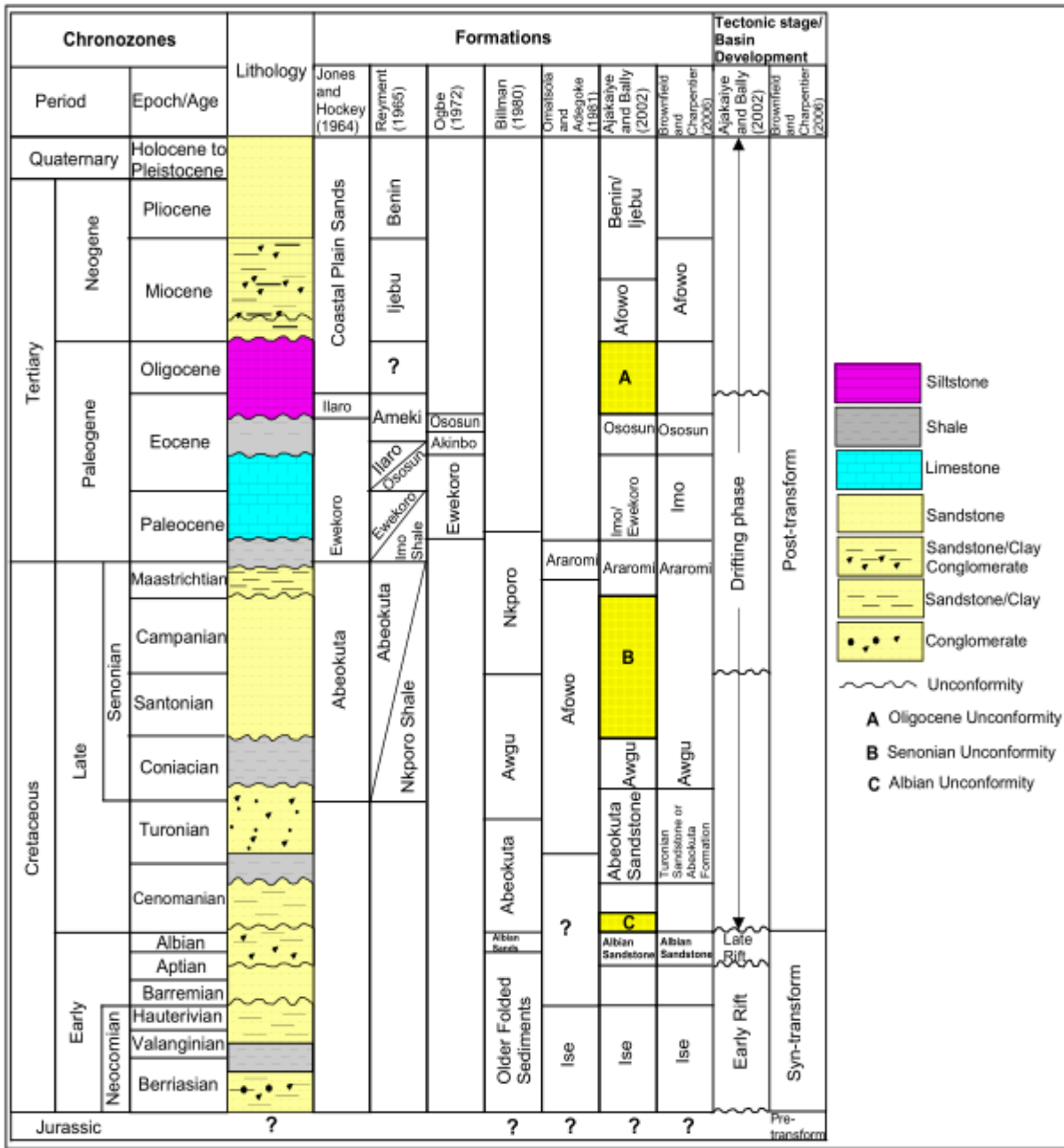


Figure 3. Generalized stratigraphic column showing age, lithology, and sequence of the formations and tectonic stage of basin development in the Nigerian sector of the Dahomey Basin.

Flooding has remained a prevalent environmental problem in Nigeria. Available studies have shown that there is frequent occurrence of flooding (Ishaya et al., 2009; Kolawole et al., 2011; Olajuyigbe et al., 2012; Ejenma et al., 2014; Komolafe et al., 2015; Nkwunonwo, 2016; Yesufu, 2016; Sule et al., 2016; Adetuji and Oleyele, 2018 and Onwuemele 2018; Bamidele and Badiora, 2019). Nigeria has experienced increasing numbers of extreme wet events,

resulting in severe flooding. The most notable occurrences were in 2002, 2003, 2005, 2006, 2007, 2008, 2009, 2010, 2012, up to 2022 (Chioma et al 2019; Umar and Gray 2022). In the states of southwestern Nigeria, flooding is an occurrence with wide ranging impacts.

The widespread flooding in Nigeria along with how to deal with associated challenges has received considerable attention, although more discussions focused on local communities, geopolitical regions and states within the country (Aderogba 2012a; Adeoye et al. 2009; Ali and Hamidu 2012; Bashir et al. 2012; Agbonkhese et al. 2014; Adedeji et al. 2012; Terungwa and Torkwase 2013; Obeta 2014; Ologunorisa 2004; Ojigi et al. 2013; Aderogba et al. 2012; Ogwuche and Abah 2014; Nwilo et al. 2012; Adelekan 2010).

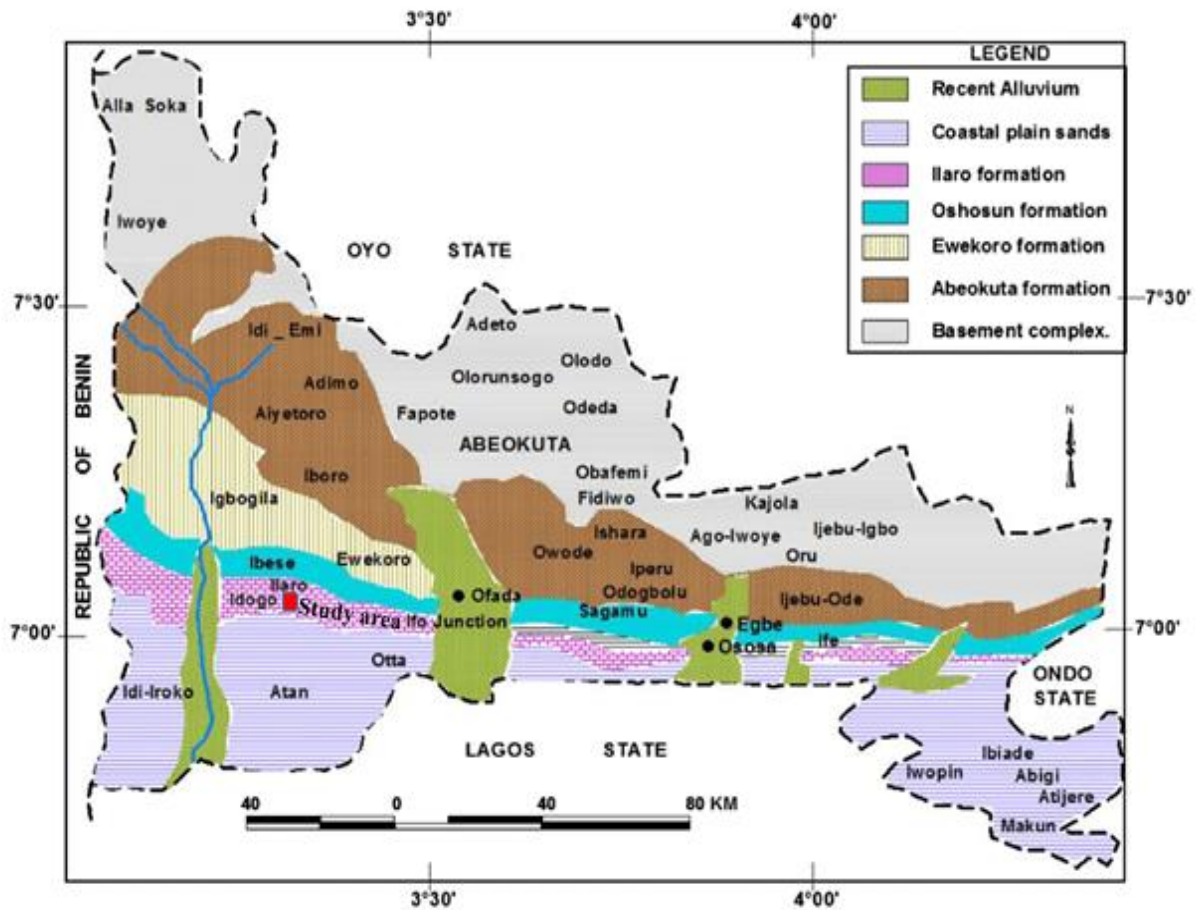


Figure 4. Geological map of Ogun state showing Ilaro Formation

In view of the causes of the flood hazard, climate change, poor urban planning and environmental management along with anthropogenic activities have been generally listed (Adeoye et al. 2009; Aderogba et al. 2012; Adeloye and Rustum 2011). Although the lack of definite measures and capacity to radically tackle the hazard within the country has been arguably overwhelming, concerted efforts in the form of environmental and infrastructural planning, policy directives, social responses, physical intervention and enhanced public enlightenment programmes have been extensively considered (Agbola et al. 2012, Ali &

Hamidu 2012, Bashir et al. 2012). Other measures considered are community based early warning systems (Agbonkhese et al. 2014), humanitarian aids from government and private sectors (Adeoye et al. 2009) and appropriate level of preparedness and capacity building (Adedeji et al. 2012).

The need for science and technology to embrace environmental education in Nigeria is highlighted (Terungwa & Torkwase 2013) while food hazard mapping as well as assessment of vulnerabilities of lives and properties which play key roles in building community resilience to flooding is considered (Adeaga 2008, Ajibade et al. 2013, Adelekan 2010, Ologunorisa 2004). There is complete agreement that the occurrence, extent, and intensity of extreme weather related events, such as extreme rainfall or temperature and storms, among others which cause natural disasters such as floods, will increase because of anthropogenic causes and climate change. Echendu (2021) identified anthropogenic causes as the main drivers of flooding in Nigeria, worsening the effects of heavy rainfall, but the effects of these can be mitigated by risk-management strategies and infrastructure planning. According to available studies, flooding in Nigeria is caused by weak implementation of planning policies, streams and channel obstruction due to indiscriminate waste disposal habits and human activities in flood plains (Ituen et al., 2014; Ekpoh 2015; Udoh 2015 and Evan et al., 2017; Abraham et al., 2021)

4. REVIEW OF SOME MAJOR EXISTING STUDIES REGARDING FLOOD IN NIGERIA

Umar and Gray (2023). Worked on flooding in Nigeria: a review of its occurrence and impacts and approaches to modelling flood data. The aim of the study was to understand the frequency and patterns of flooding and approaches to its modelling in relation to current practices globally. Their result revealed that the northern part of Nigeria is affected more by flooding than the south, their results also revealed that the use of remote sensing data with GIS techniques has been the most common approach to flood modelling in Nigeria.

Adegun (2023). Worked on flood-related challenges and impacts within coastal informal settlements: a case from Lagos, Nigeria. The study aimed to consider climate impacts and environmental challenges (flooding and sea-level rise) in one of the coastal informal settlements in Lagos, Nigeria. The results illuminate negative corollaries at the intersection of informal urbanization and climate change in coastal settings. Flood-related impacts on the built and natural environment were significant.

Nkeki et al., (2013). Carried out a geospatial techniques for the assessment and analysis of flood risk along the Niger-Benue basin in Nigeria. The aim of the study was to assess the spatial impact of the October 2012 flooding of the Niger-Benue basin on the surrounding areas, their findings indicate that flooding along the Niger-Benue basin can be mitigated and monitored using geospatial methods.

Chioma, et al., (2019). Worked on the Impacts of flood disasters in Nigeria: A critical evaluation of health implications and management. The aim of the study was to review flood disasters in Nigeria and how they have been managed over the past two decades. This study found that flood related health indicators are poorly managed and that flood response and planning are not well coordinated

Echendu (2020). Worked on the impact of flooding on Nigeria's sustainable development goals (SDGs). The study aimed to highlight the impact flooding has on Nigeria reaching SDGs

and enumerates the specific SDGs most directly impacted. The results revealed that unregulated urbanization, poor planning laws, corruption, and a poor waste management system are the major causes of flooding in Nigeria.

Rameshwaran et al., (2021). Carried out a gender perspective on the impact of flood on the food security of households in rural communities of Anambra state, Nigeria. The aim of the study was to examine gender perspectives of the implications of the severe 2012 flood on household food security in rural Anambra state, Nigeria. Their findings revealed that households in Nigeria may be able to remain food secure after future floods by diversifying their income away from agriculture, building early warning systems, and improving women's education.

Danhassan et al., (2023). Carried out a research on flood policy and governance: A pathway for policy coherence in Nigeria. The objective of the study was to examine and understand how flood governance and policy coherence are approached, as well as institutional design and implementation for coherence in Nigeria. Their findings revealed that there is no single flood policy in Nigeria. Due to this, there is no focus and no defined objectives for flood governance, prevention, control, and management, and no imperative for the government to seek both short-term and long term flood solutions.

Buba et al., (2021). Worked on assessment of flood vulnerability in some communities in Lokoja, Kogi State, Nigeria, using participatory geographic information systems. The aim of the study was to conduct a vulnerability assessment in Lokoja as a pre-flood strategy that involves the communities. Their results revealed that there is a strong correlation between flood vulnerability and elevation, as well as land use, among other parameters.

Cirella and Iyalomhe (2018). Carried out flooding Conceptual Review: Sustainability-focalized best practices in Nigeria. The aim of study was to utilize a conceptual framework to assess and identify areas within Nigeria prone to flooding and examine possible means of alleviating damage and harm. Their results of this study indicate that several factors contribute to the frequency of flooding, including different precipitation patterns, urbanization, and increased paved surfaces.

Ajaero (2017). Carried out a research on the impacts of flood on food crop production and the adaptive measures among farmers in the northern guinea savannah of agro ecological zone of Kaduna state, Nigeria. The aim of the study was to analysis the impact of flood on food crop production and the adaptive measures among farmers in northern guinea savannah of agro ecological zone of Kaduna state. The findings revealed that flood has multidimensional impact on crop production. The impact is viewed differently by farmers.

Nkwunonwo et al., (2015). Assessed flooding and flood risk reduction in Nigeria with a view to determining the cardinal gaps. Their study observed that flooding has become a frequent hazard in Nigeria. They noted that factors such as rapid population growth, urbanization, poor urban planning and climate change especially increased frequency and intensity of rainfall had resulted in flooding in major parts of Nigeria. Specifically, they showed that between 1985 and 2014, flooding in Nigeria has affected 11 million lives resulting in 1100 deaths and properties being damaged to exceed US\$17 billion. According to them, Lagos state has recorded the largest percentage of flooding in Nigeria while Niger, Adamawa, Oyo, Kano and Jigawa states are also experiencing flooding. They argued that in spite of the growing scenarios of flooding and its potentials to affect lives and properties, little is done to stem the tide of flood occurrence in Nigeria. They suggested that more robust and scientific approaches to flood risk reduction

such as flood modeling and vulnerability assessment be employed in flood management in Nigeria.

Magami et al., (2014) assessed the causes and consequences of flooding in Nigeria. They revealed that flooding in Nigeria is caused by dam failure, over flowing of major rivers, coastal storms, ignorance of warning from Nigeria meteorological agency, delay in evaluation of flood victims and settlement of people at flood prone areas such as riverine areas and sea coast. Other causes of flooding that they observed were climate change, extraordinary heavy rains and continued release of excess water from artificial reservoirs. They also pointed out that poor maintenance of drainage channels coupled with indiscriminate waste disposal result in flooding in Nigeria.

Rufa'i (2020) assessed household preparedness to flood risk hazard in Nigeria. He noted that climate change which triggers severe rainfall results in flooding. While flooding is increasing in terms of occurrences in Nigeria, the preparedness of households have not been given attention. He based his study on review of existing literature which point to the fact that households are losing properties, lives and other valuables to flooding.

Nnodim and Ezekiel (2020) examined the perceived impact of perennial flooding on livelihood activities of rural dwellers of Orashi Region of Rivers State. They adopted the descriptive survey design and collected data from rural dwellers in Orashi region. They used simple random sampling in selecting 150 rural dwellers in flood affected communities. Their findings revealed that the causes of flooding in rural areas of Orashi region were prolonged rainfall, overflow of rivers, continued release of excess water from artificial reservoirs, climate change amongst others. They also revealed that flooding submerge farmlands, destroy crops, destroy irrigation facilities, destroy harvested produce while also affecting fish farming through the spread of infection that causes diseases in fishes.

Yaode et al., (2020) carried out a vulnerability analysis of flood disaster in Ibadan, Nigeria. He obtained data through personal observations and questionnaire. They sampled respondents that have been affected by flooding in time past. They analyzed data using appropriate descriptive and inferential statistics. Their findings observed that rainfall is the highest cause of flooding. They also pointed out that terrain of the area is the least cause of flooding. Since rainfall account for most flood occurrences, they called for adequate channelization. This will help in reducing the hazards of flooding and it negative consequences on the residents of Ibadan. Oduwaye et al. (2010) investigate the socio-economic factors influencing the nature of housing in the urban area among the low income group in Makoko, Lagos State. Based on the administration and analysis of 254 questionnaires, the study finds that large proportion of the dwellers resides in plank- or bamboo-made houses as these are of low cost and represent affordable housing. Adelekan (2010) evaluates the risks and vulnerabilities associated with four selected urban poor communities near the coast in Lagos State, Nigeria. The study concludes that flooding exacerbated urban development and vulnerability. This is however traceable to the provision of social infrastructure and poor urban management of which the poor are the most affected.

5. THE IMPACTS OF FLOOD DISASTERS IN NIGERIA

Nigeria as in many developing nations, the impacts of flooding are observed to be more devastating due to the increased vulnerability of many communities. The National Emergency

Management Agency (NEMA) reported that the country experienced heavy floods between July and November 2012, which resulted in 363 death cases, over 2.1 million displaced persons, and about N2.6 trillion losses (Ogunlesi, 2016). The agency further noted that the floods affected over seven million people in 30 states of the federation and were described as the worst ever in the last 40 years. Further, available statistics estimate the number of people affected by floods and death cases at 1,222,370 and 522 between 2015 and 2020 in Nigeria (Anadolu Agency, 2020; BBC News, 2018; International Federation of Red Cross, 2019). In 2001 collectively 500 people died as a result of flood in Abia, Adamawa and Akwa Ibom states respectively (Bashir, et al 2012).

Recently in September 2022 flood claims lives of more than 300 and displaced over 100,000 people in Nigeria and the counting continues (Nigerian Info 16 September 2021). In 2011, 2105 buildings were destroyed by floods in Ibadan (Bashir, et al 2012). In September 2022, 97 people died from flood in Jigawa State (Daily Post. 23 September 2022). Approximately 43,155 people have been displaced by floods in Borno, Adamawa and Yobe states in 2022 (UN OCHA 2022). In Benue over 3274 people were displaced while about 1213 houses were destroyed in 2022 flood (UN OCHA 2022). Lagos alone loses about 3.9 billion dollars to flood yearly (Adelekan, et al., 2015; Adegun 2023). In Nigeria, in 2012 the total losses to flood were put at US\$16.9 billion (Echendu, 2020).

In Nigeria, flooding has become one of the major threats to deal with given the poor and limited infrastructure, and political-will. In addition, the lack of human and financial resources of local governments and a lack of coordination between relevant stakeholders contributing to the inadequate response to flood disasters (Adekola, et al., 2018; Chioma, 2019; Echendu 2020; Ifiok, et al 2022; Echendu 2022; Morgan et al 2015). Kawasaki et al. (2020) examined the extent to which floods impact household poverty levels by employing a survey design method administered in the city of Bago, Myanmar. The analysis of collected data based on multi-regression and spatial estimation techniques revealed that flooding aggravated poverty levels while the majority of the affected flood victims were the poor.

5. 1. The impacts of flooding on built environment in Ilaro Formation

The flood prone zones in Ilaro Formation include Gbogidi, Ikosi, Double Crown and Odo Fufu, Despite being a natural phenomenon, the impacts of flooding in densely populated and poor communities are particularly severe (Dewan, 2015; Egbinola et al., 2017). Flooding significantly impacts the community, the people, natural and built environment, including buildings, roads, and other available infrastructure (Figure 5 and Figure 6).

These affect livelihoods, health and well-being, and other aspects of life. When it rains, the road becomes difficult to ply because some of the road is not tarred, in many situations, floodwaters enter the buildings. For the impacted buildings, damage ranges from sinking foundation, damaged furniture and damage to walls defects in sub-structure. Heavy rainfalls in Ilaro Formation, which lead to flooding, are most times accompanied by windstorm which also affect buildings and infrastructure. Poor housing construction makes impacts of flooding and windstorm stronger.

The windstorm affects houses that are not well built, and the poor people lack resource to maintain their house and fence this led to collapse during flooding.

Apart from houses and the built environment, flooding disrupts the people's lives and livelihoods. Since some had to be removing water for like two to three days from their shops and houses. It affects people's work because it hinders them from going out.

The major occupation of Ilaro people is farming, thus flooding affects agricultural cultivation. Flooding also causes pollution of rivers and streams and destroy fishes and other aquatic animals.



Fig. 5. Impacts of flood in Odo Fufu, Ilaro Formation



Fig. 6. Impacts of Flood in Gbogidi Ilaro Formation

Flooding leads to contamination of water bodies and reduces access to potable water (Olanrewaju et al. 2019). It affects health, notably because this water (runoff) usually eat (infect) people foot, referred to as jomijomi. This is medical condition known as athlete's foot disease, a contagious fungal infection. Floods also cause a rise in the groundwater level which reduces the efficacy of the natural water purification process and increases risk of infections and vulnerability to dangerous chemicals (Nations 2010).

Displacements due to flooding cause children in disaster areas to become educationally disadvantaged at the crucial school age, which sets them up for continued economic disadvantage and opportunities later in life.

There is evidence of overall poorer educational performances and outcomes, reduced level of educational levels, and general disadvantages that continue into adulthood (Erica, Jessie, and Stephanie 2018).

Also, disasters like flood bring severe hardship to poor families who might be forced to withdraw their children totally from school and push them into the labor market to work to help provide for their families basic needs which brings a halt to their formal education (Kousky 2016).

6. MITIGATING STRATEGIES OF FLOOD DISASTERS IN ILARO FORMATION NIGERIA

6. 1. The importance of public involvement in mitigation of flood disaster

Some scholarly literature suggests that participatory flood management can promote the adoption of effective responses to flooding disasters (Walker et al., 2010). By involving the public at various stages of flood management processes, including those where decisions are made, it becomes easier to encourage the public to accept responsibility for preparing for flooding events, and taking an active role in flood relief work during serious floods (Begg et al., 2015). However, it has also been pointed out that participatory processes aimed at promoting individual responsibility largely depend on contextual conditions, such as pre-existing decision-making structures and specific institutional arrangements (Begg et al., 2018; Kuhlicke 2014). Depending on how public involvement in flood management is practiced, such activities do not necessarily help to effectively facilitate individual engagement in flood management (Armaş 2012; Raška 2015).

(Wei 2011) has meant that government units at all levels have shown a lack of genuine initiative when it comes to facilitating public involvement in decision-making processes. Indeed, to the extent that there is no any public involvement, it mostly comes after policy decisions have already been made by local governments; hence the public is only loosely engaged in government-led activities (Johnson 2020).

The environmental impact assessment (EIA) legislation requires that environmental impact assessments should be conducted over flood control infrastructure projects prior to any decisions being made. While this procedure technically leaves room for public input in policy making, in reality EIA legislation is often implemented after decisions have been taken, thus rendering any public involvement as purely symbolic (Brombal et al., 2017). Therefore, empirical investigations are needed to shed light on the extent to which limited public involvement in Nigeria's flood risk management practices affects the willingness of individual citizens to take mitigation actions.

6. 2. The importance of public awareness in mitigation of flood disaster in Ilaro Formation

According to some scholars, public awareness of government flood risk management is found to have a relational link with the adoption of mitigation actions by individual citizens (Marschütz et al., 2020). This is because raising public awareness includes disseminating information to: a) prepare the public for increasing risks (Dieperink et al., 2016), often by helping the public to assess the seriousness of the impact of flood risks (Burningham et al., 2008; Neuwirth et al., 2000); and b) motivating the population at risk to be prepared for an emergency (Hagemeier-Klose and Wagner, 2009), such as by clarifying responsibilities in relation to the preparation of flood defence (Hagemeier-Klose & Wagner, 2009). Therefore, effective information sharing with the public about flood management options, including information about eligibility for public flood protection funding, and the efficacy and costs of self-protective measures, may motivate individuals to adopt flood mitigation actions as recommended by the government (Grothmann and Reusswig, 2006).

7. CONCLUSIONS

Flooding being a disaster is unavoidable but can be managed if appropriate measures are instituted. The causes of flood disaster in most cases in Nigeria includes excessive rainfall, poor environmental planning and management and weak policy implementation by institutions concerned with flood management. Flooding is also caused by increasing deforestation and inability of developers to adhere to physical development plans and schemes. However, flooding has negative implication on the environment, economy and social lives. As noted in this study, flooding affect physical developments such as houses, roads and other structures. In cases of serious flooding, lives can be lost in the process. With the observation that flooding is a serious environmental threat, it was suggested that appropriate measures be put on ground to stem the level of it occurrence in Nigeria. Specifically, the government should ensure that environmental management policies are properly enforced in the country. Development control activities should be taken seriously to avoid the erection of developments on flood plains and flood prone areas. Finally, regular environmental education should be given priority in the society. The following measures are suggested as possible strategies to assist the public, government, researchers, land developers and affected communities in mitigating the causes, development and consequences of flood disaster in Ilaro Formation southwestern Nigeria;

- i. Proper periodic inspection and monitoring of drainage systems to spot any problems and make repairs. Additionally, it is important to guard against the sedimentation and littering of drainage systems, and vegetation like trees whose root systems have a history of undermining the drainage system should be cut down or removed.
- ii. Establishment and proper enforcement of town planning regulations forbid the construction of structures or other activities in flood-prone areas.
- iii. Effective and lasting environmental and resource management methods to assist people in disaster-prone locations so as to experience less risk and vulnerability.
- iv. Establishment of gauge stations in the rivers that cross these cities. So as to allow the flow and level of the rivers to be measured. As without this data, a hydrologic or a hydraulic modelling (HEC-HMS and HEC-RAS, for instance) cannot be performed.
- v. Provision of adequate drainage facilities along with the construction of roads.

- vi. Adequate education should be provided to those who are frequently affected by flood threats to encourage them to adopt environmentally sound practices like properly disposing of their waste rather than into drainage channels because improperly disposed waste, such as discarded plastic, shoes, clothing, and other items, also clogs drains, particularly at their narrowed ends or points. This also causes the storm water to overflow or pour into the sewers, which can cause flooding that can enter houses and farms and harm crops and household goods.
- vii. Building partnerships amongst local communities, NGOs, volunteer organizations, and local and international donor organizations in order to manage floods.

Reference

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