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AN APPRAISAL ON HYDRO-CLIMATIC IMPACT ON FLASH FLOODS INCIDENCES AT HADEJIA RIVER VALLEY WATERSHED IN NIGERIA

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ABSTRACT

Frequent occurrence of flash flood is an issue of concern in Nigeria which requires prompt attention. The global worming which triggers the climate change phenomenon is believed to be one of the major causes of flooding. This study reviewed several research works conducted on flood incidences in Nigeria, particularly the Hadejia river valley watershed. The updated and more recent literatures were visited, analyzed and discussed. It was found that for the last decades, there is increasing frequency of flash flood incidences in the study catchment which resulted into displacement of the inhabitants, loss of lives and properties. Substantial portion of the affected places were occupied by people which have been given flood alert and warning previous by climate scientists. Such awareness focused the preparedness and possible relocation in the event of flash flood occurrence. In conclusion, this study has disclosed that there is evidence of increasing rate of flood occurrence at Hadejia river valley catchment. Thus, more effort should be intensified on creating awareness and public enlightenment on how to mitigate the potential damage and loss of life and properties.

Keywords: Global warming, Climate change, Hydrology, Watershed, Flood warning

INTRODUCTION

Flash flood is one of the deadliest natural disasters in the world that claimed more lives and wreck more property than any other natural occurrence (Shafaei et al. 2017). Devastating effects of flood are threat to environmental sustainability since they are happening too frequently around the world. Nigeria is among the nations on planet with the best water resources (Odunuga *et al.* 2011). However the water scarcity and flooding are environmental issues that require attention to assure sustainability. This is particularly true of the majority of wetlands around the globe. Among the causes of this is the rise of global sea water level as a result of global warming (Nasidi *et al.* 2021). More so, there is saturation in many wetlands around the world, including those in Hadejia valley. Thereby increasing the frequency of floods on several rivers in the country. River overflows have the advantage of depositing sand, silt, and debris on the surrounding area as flood waters surge into the banks. The elements that were deposited will assist the land become richer or more fruitful after the river water has receded and resumed its usual flow. Therefore, the minerals and organic compounds that the river water deposits help to maintain the soil's fertility and productivity (Ahmad and Tajuri 2018; Shuaibu 2020). When a stream or river reaches an extremely high stage, a flood happens. This is a result of runoff from precipitation that occurred in amounts that were too large to be contained in the stream's or river's typical water surface heights. This might be the outcome of an exceptional confluence of weather elements. It is crucial to know how often a flood event of a certain size is likely to occur because practically all activities in a specific flooded area could be governed by for a variety of engineering issues, including planning for weather-related catastrophes, reservoir management, pollution control, and insurance risk calculations, flood frequency analysis with varied risks of exceedance is required (Ibrahim, 2017). Flooding is becoming a frequent occurrence in Nigeria, and it occasionally has disastrous repercussions on both the growth of infrastructure and human livelihoods. In general, flooding is a significant problem that demands the attention of all parties involved in order to prevent and address its negative impacts, which pose a threat to human existence.

Additionally, flooding may be defined as the temporary rise in the level of a stream, river, lake, or sea that causes an area that is ordinarily dry to become submerged in water. In addition to having a significant negative influence on the ecosystem, including aquatic flora and fauna and bank erosion, flooding poses a serious risk to riverside people and floodplains (Zakari et al. 2017). It is an instance of extreme weather that happens naturally as a result of rising global temperatures, which also cause glacier melt, torrential rain, and ocean thermal expansion. As a result, the sea level rises, inundating coastal areas with salt water Flooding, the most common environmental issue, adversely affects roughly 75 million people globally and consistently results in over 20,000 fatalities each year. All around the world, flooding has posed a major threat to people's lives and property. Floods are responsible for about one-third of all natural disaster-related fatalities, injuries, and property losses (Oyebande and Odunuga 2010). In order to be resilient to climate change, flood risk management is essential. The Hadejia River basin is notable for its frequent and catastrophic floods, which have destroyed farms and structures and claimed numerous lives. This study developed a GIS-based flood risk and vulnerability mapping assessment using the Analytical Hierarchical Process (AHP) in order to find scenarios that reduce risk and vulnerability associated with floods in the Hadejia River basin. The risk mapping of the basin combined seven hydro-geomorphological indicators (elevation, mean annual rainfall, slope, distance from rivers, soil type, and drainage density) that affect extreme events with six socio-economic vulnerability indicators (population density, female population density, literacy rate, land use, employment rate, and road network). In this study, the average annual rainfall data from 36 years was used to map the floodplains (Ismail et al., 2021).

Also, the downstream and center upstream regions of the basin, which make up around 43.4% of the basin's area, have high-to-very high flood risk, according to the basin's combined flood hazard and socioeconomic vulnerability

indices (Shuaibu 2020). Areas with a very high danger of flooding include Auyo, Guri, Hadejia, Ringim, Kafin Hausa, and Jahun. The study also showed that numerous factors affect flood risk, including flood hazard and vulnerability indicators. The verified results are consistent with the basin's historical flood dispersion research. The development of strategic measures and policy modification by which the government and relief organizations may lessen the detrimental effects of floods in the Hadejia River watershed depend greatly on the findings of this research study. Researchers from various fields have made a number of attempts to evaluate floods in the Hadejia River basin, including. In some areas, a flood risk assessment was done utilizing questionnaires to evaluate the impacts of flooding on a few chosen settlements in the basin. HEC-RAS was used in 2013 to simulate floods in some river sections (Ismail *et al.* 2021). The authors described how levees were built in the overflowed part to prevent flooding in the research section. However, instead of simulating the entire river, the research study only considered a part of the river because there was a shortage of hydrological data. This paper built on earlier work by utilizing an approach for analyzing flood risk and vulnerability using multi-criteria evaluation techniques in conjunction with a GIS and the AHP in order to assess strategies to manage the risk and vulnerability associated with flooding in the Hadejia River basin (Abubakar et al. 2022). The goal of this project was to provide a review on the situation and evaluating flood risk and vulnerability related studies in the Hadejia River basin. The watershed is in semi-arid northern part of Nigeria is where the find the Hadejia River basin is located. The Hadejia River starts from the Kano highlands, whereas the Jama'are river system begins in the Jos plateau. Three of the biggest dams in the watershed are the Tiga, Watari, and Challawa Gorge dams; the Kafin Zaki dam is still at the initial stage.

About the Study Location (Hadejia River Valley)

Hadejia, the then Biram, is a Hausa town in eastern Jigawa State, northwestern Nigeria. Hadejia is currently the largest and most important commercial town in Jigawa State. The city has a population of over 450,000 people. The Hadejia of the then Kano State was divided into 3 Local Government Areas (Auyo, Guri, and Hadejia) and both are within the floodplain. Figure 1 shows the Hadejia River Valley Area showing 2 major dams and the Hadejia valley wetland (Shuaibu 2020). The types of data that are gathered and the process of data analysis are covered in this chapter. In determining the outcome of any scientific investigation, the research approach is of utmost importance. The goals of the study guide every strategy used in this investigation. The Hadejia River basin is situated between the longitudes of 8.07050.000 E and 10.01050.900 E and the latitudes of 11.32008.400 N and 12.26024.800 N, covering a total area of 30,569 km^2. It is located in the Federal Republic of Nigeria's semi-arid north-western region.

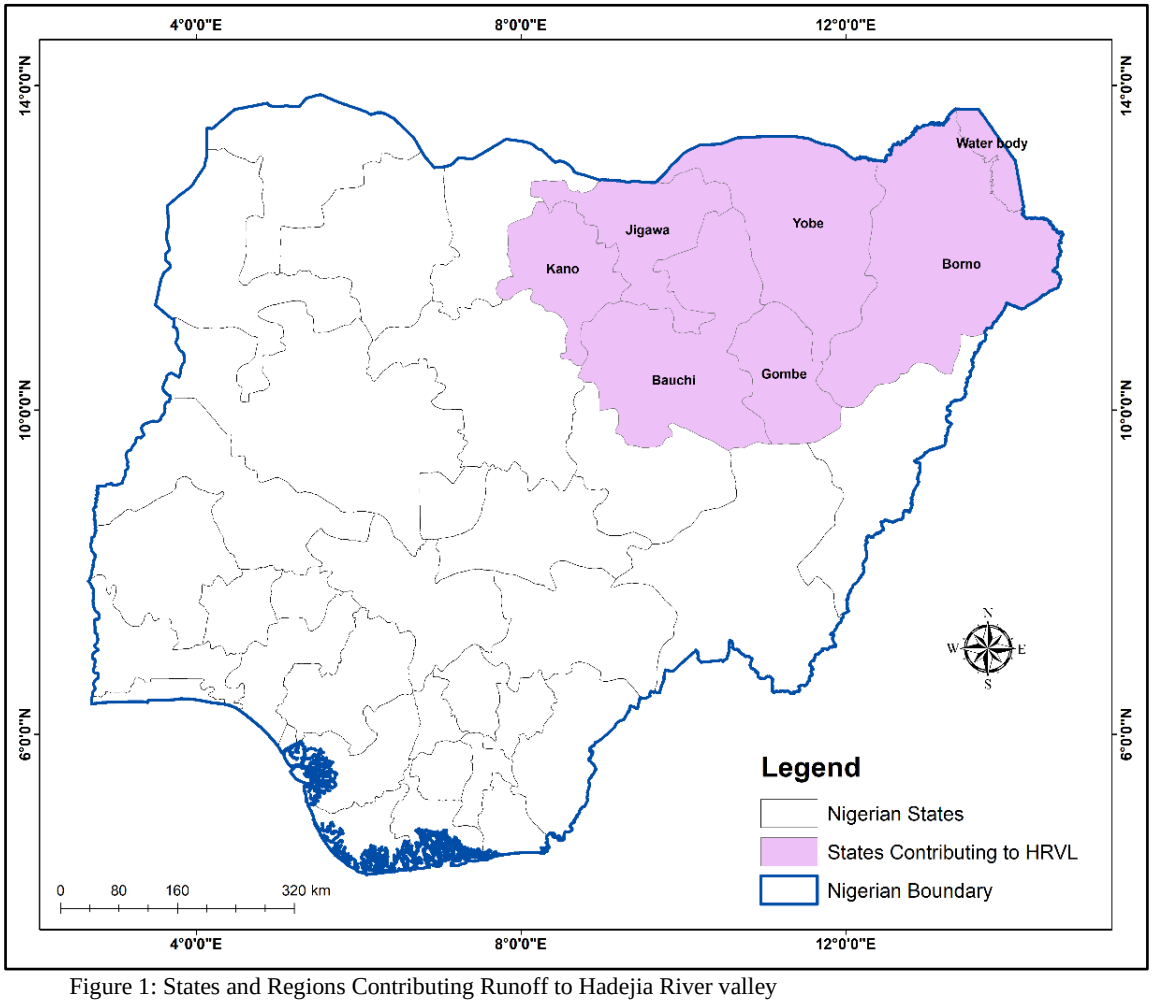

Figure 1: States and Regions Contributing Runoff to Hadejia River valley

Exploring Flood incidences in Hadejia River Valley

Flooding is the most common disaster in Nigeria. Due to increased rainfall brought on by climate change, the majority of Nigeria's states face floods during the rainy seasons more frequently each year. Contrary to some other natural disasters, rainfall flooding can be controlled with proper planning and the erection of the necessary infrastructure (Ismail et al. 2021). The majority of flooding in Nigeria is a result of human activity, with current poor urban planning methods and a lack of or inadequate environmental infrastructure both aggravating the issue. For instance, the absence of a comprehensive flood risk map or a national Flood Risk Management (FRM) plan are indications that the flooding issue in Nigeria is not receiving enough attention. (Ismail *et al.* 2021). This implies that developing and putting into practice sufficient FRM methods, which include good spatial planning and infrastructure, would aid in reducing floods, which negatively affect Nigeria's sustainable development (Odunuga *et al.* 2011). This implies that developing and putting into practice sufficient FRM methods, which include good spatial planning and infrastructure, would aid in reducing floods, which negatively affect Nigeria's sustainable development.

Causes of Flooding

The environment is created by the combination of resources and dangers (Odunuga *et al.* 2011). Whether they happen gradually over time or quickly, environmental changes are what cause these. There are numerous underlying reasons and a variety of secondary effects that have an impact on this change. Environmental changes may not only have an impact on the environment as a whole but also on its individual components. (Ismail et al. 2021). The occurrence of natural disasters is one of the risks brought on by environmental changes. In essence, natural calamities have happened continuously throughout history. According to archaeologists, prehistoric humans experienced the same hazards and dangers as modern humans do today, such as famine, criminal activity by other people, animal attacks, infections, and so forth. Living in caves was one way that people in that time tried to lessen or limit the risk of potential threats.

Nigerian flooding, both recent and previous Flooding is a common occurrence with wide-ranging effects in the Hadejia river basin (Nasidi, *et. al*, 2023). Nowadays, the regions of the draining toward Lake Card are experiencing heavy rainfall, which is the main cause of the floods. Nigeria saw the worst floods in recent memory in 2012. More than 2.3 million people were displaced, 363 individuals lost their lives, and another 16 million people were affected in various ways (Abubakar *et al.* 2022). The estimated total loss was US$16.9 billion. The size and nature of Nigeria's flooding prevent accurate estimation of the number of displaced people, property losses, and fatalities. Nigeria signed the UN SDGs, and many of the SDGs are impacted by flooding. Due to its detrimental effects on the economy, social life, ecology, and health, flooding poses a challenge to sustainability. Due to the disruption caused, the negative effects of flooding are not limited to a specific geographical area and impede achievement of the SDGs. However, due of its lower degree of development, emerging nations like Nigeria experience the negative effects more. There is now no clear legislative framework or flood control strategy to deal with this enduring issue (Nasidi *et al.* 2023). Nigerian flood causes While climate change has caused more rain than in the past, increasing the likelihood of floods, Nigeria's flooding is primarily caused by human activity and made worse by interactions between nature and humans (Nasidi *et al.* 2021). The human- nature interactions that cause flooding in Nigeria form the focus of this paper and include, but are not limited to:

Poor or Non-Existent Drainage Systems

This is a significant human-caused aggravator of the flooding in Nigeria. It is typical for buildings and other infrastructure to be built in a way that actually obstructs these drainage channels, which causes flooding during the rainy season (Odunuga *et al.* 2011). The majority of residential areas in Nigeria lack a drainage system and rely on natural drainage channels. Because to Nigeria's rising urbanization, a greater percentage of ground surfaces are now concreted, which prevents water from percolating and leaves inadequate drains in place to handle surface runoff. One of the main reasons for urban floods in Nigeria is a lack of drainage infrastructure. To address the flooding issue, drainage systems must be built immediately (Shuaibu 2020).

Poor Waste Management System

One of the anthropogenic elements aggravating Nigeria's already challenging flooding issue is poor waste management. Numerous studies have extensively highlighted how Nigerians have a terrible attitude toward disposing of their waste. In Nigeria's densely populated urban regions, drainage obstructions associated with subpar sanitation practices are frequent. A sizable section of the population routinely engages in roadside, canal, and rain-related dumping. During the wet season, this leads in blockage and flooding (Abubakar *et al.* 2022).

Unregulated Urbanization:

Flooding and urbanization are intimately related in both developing and developed countries. Nowadays, more than 50% of Nigerians live in urban areas. Without proper urban infrastructure and utilities, Nigeria is urbanizing at enormous rates. Agricultural fields are increasingly being turned into residential areas to accommodate the need for housing (Odunuga et al. 2011). The issue of flooding is made worse by development that occurs without the required infrastructure or rules in place. Numerous compliance problems make poor urban design, which is a significant cause of the flooding that is currently happening in Nigeria, worse. Therefore, Nigerian floods are inextricably linked to poor urban development practices.

Nigeria's present planning laws are conventional, but their development and application are inadequately supervised. This results in corruption. Understaffing, a lack of functional equipment, and political intervention in planning activities are all factors that have a detrimental impact on effective planning and the performance of planners' duties (Abubakar *et al.* 2022). Construction on natural floodplains and storm water pathways is permitted due to the lax enforcement of planning laws, which exacerbates the flooding issue and has negative effects on sustainability. Corrupt practice is another component (Shuaibu 2020). Town planning officials frequently accept payoffs and disregard issues like illegal land use, modifications to approved construction plans in areas that obstruct drains and natural waterways, or shoddy infrastructure construction, like bridges that later collapse during heavy rain. Debris produced as a result reduces the carrying capacity of the channels, resulting in floods and exacerbating the problem that was being addressed in the first place. In order to take advantage of the gap in ineffective development regulation, the residents frequently expand their buildings beyond the permitted limits, and in some cases they even go so far as to construct over drainages. When rules are

not followed, it is impossible to create sustainable urban expansion. It is impossible to achieve sustainable urban growth when regulations are not followed. The primary cause of reckless developments and their associated effects is poor planning and a lack of proper building approvals (Odunuga *et al.* 2011).

Flood Risk Management (FRM) and Spatial Planning in Nigeria

According to Odunuga *et al.* (2011), "flood risk management" refers to a series of measures aimed at reducing the likelihood and impacts of flooding. It covers risk-reduction techniques, socioeconomic factors and their impacts, and flood risk forecasts. It is not a set approach; rather, it adapts to changing circumstances. The adoption of a certain flood risk management plan may be influenced by a variety of variables, including environmental (geographical characteristics of a place and the type of flood risk an area is prone to), socioeconomic, and structural and non-structural ones (Nasidi et al. 2021). Countries adopt policies that are effective for their particular geographic conditions. Nigeria has previously given post-disaster flood response precedence over control. However, it is seen as the most long-term approach to managing flood risk. A significant approach for reducing floods is the adoption of coordinated and sustainable spatial planning including pertinent authorities, planning professionals, and stakeholders. This is so that flood risks may be managed, and so that spatial planning can affect things like the kind, location, purpose, and design of developments. The Nigerian planning system is currently underdeveloped, and there is no integration of planning with the country's existing FRM. Given that Nigeria is situated in a geological region that is not prone to highly catastrophic natural catastrophe events like landslides, cyclones, and hurricanes that are uncontrollable, concentrating current flood risk management in Nigeria on spatial planning is best suited to the local environment. This eliminates the unknown of when the next geological disaster will occur (Oyebande and Odunuga 2010). Adopting contemporary spatial planning ideas, such as collaborative and sustainable planning that is flexible, involving the public, and incorporates environmental concerns, will help manage flooding effectively and take the lead in the process of urban growth (Shuaibu 2020). The integration of sustainable drainage systems into spatial planning as a FRM approach may also involve ICT/technological tools, such as applications that allow locals to contact the appropriate authorities in the case of an emergency or a blockage of a drainage system that causes floods. Controlling flooding and bringing Nigeria closer to attaining the SDGs both depend on the integration of spatial planning and FRM. ICT/technological tools, such as programs that let residents get in touch with the proper authorities in case of an emergency or a blocked drainage system that results in floods, may also be used to integrate sustainable drainage systems into spatial planning as a FRM strategy. Integrating spatial planning with FRM is necessary to control flooding and get Nigeria closer to achieving the SDGs.

Categories of floods occurring in Hadejia River Valley

Floods may be classified or named differently, for instance, Shuaibu (2020) classified floods as follows Tidal flooding, Fluvial flooding, Flash flooding, Groundwater flooding, Pluvial flooding and flooding from sewers. Descriptions of these types of floods are stated below:

Tidal flooding

Wherein a combination of low-pressure weather storms and peak high tides might overtop or breach both sea and river fortifications. Low pressure fronts and storms with significant wind speeds both produce large, forceful waves and raise sea levels above average. The lunar and solar cycles affect high tide levels, and when these fluctuations are added to other tidal variations, abnormally high tides are the consequence. These sea and tidal river floods frequently begin suddenly, and the powerful forces that cause them pose a serious threat to human life. Due to the predictability of the tide and the propensity of low pressure systems to track, it is frequently possible to predict this type of flood with some degree of accuracy. The cycle of the tides where drainage is accessible also limits how long this form of flooding lasts (Nasidi *et al.* 2019). According to its location, this kind of flood is a coastal flood, and depending on its duration, it may begin slowly, quickly, or even suddenly.

Fluvial flooding

When the capacity of water courses is exceeded due to rainfall or the melting of snow and ice in catchment areas farther upstream, flooding occurs in the floodplains of rivers. Obstructions in flood routes and water courses that may cause the water level to rise. Then, due to rising water levels, river defenses may be overrun or damaged by heavy debris carried at rapid water speeds. In some catchments with continuously rising water levels, the beginning of this type of flood can be quite slow. Considering the location, this type of flood is river-related, although it can also be flash or slow-onset based on the land's topography or the speed of the water.

Flash flooding

In steep catchments, flash flooding is a possibility and is far more severe. River flooding, in particular in established floodplains, is typically predictable with high accuracy. Flash floods caused by unexpected downpours, however, continue to limit the effectiveness of detection and forecasting technologies. In urban areas, water that is deeper than 250 mm may contain trash and be quite chilly. This makes even moving at a slow pace exceedingly dangerous for anyone caught in it.

Groundwater flooding

As ground water levels rise, low-lying regions resting above aquifers may occasionally flood. This kind of flooding is frequently seasonal and may be accurately predicted; it typically develops slowly.

Pluvial flooding

Flooding of surface waters is brought on by rainfall and runoff from impermeable surfaces in both urban and rural areas. Increased urban development intensity has resulted in more non-permeable surfaces on the land, an issue that is frequently made worse by aging and overburdened drainage systems. Localized flooding may result from these conditions paired with heavy rain. It is particularly challenging to predict this type of flooding since it frequently happens outside of established floodplains and is brought on by localized weather conditions. It can also begin suddenly, and the flooding is extremely severe (Nasidi *et al.* 2020).

Flooding from sewers

Where there are integrated storm and foul sewers and their capacity is surpassed by a lot of surface water runoff in a short period of time, flooding from sewers can happen. Blockages in drainage systems can result from poor cleaning and

maintenance, which can potentially cause local flooding (Shuaibu 2020). This kind of flooding can happen extremely quickly, is difficult to forecast, and has serious sanitary repercussions for individuals who are affected.

Common Flooding from Man-Made Infrastructures

Water can overflow from canals, reservoirs, and other man-made structures, flooding communities downstream. Failures of water mains, pumping stations, and industrial operations can also result in flooding, however this is a rare occurrence. Floods are categorized by NOAA (2013) into five main categories.

Flash flood:

This particular flood type offers the shortest amount of notice. They are distinguished by a sudden, intense, and considerable rise in water level brought on by heavy rainfall. In places with steep slopes, these floods are more frequent when rainfall rates are so high that the ground cannot absorb the water quickly enough to prevent major runoff. Failure of a levee or dam can potentially cause flash floods. These floods can happen in less than an hour, and with little to no notice, they can demolish buildings, cut down trees, and wipe off highways (NOAA, 2013). Flash floods may not stay as long or cover as much ground as other floods, but because of their fast start and powerful water, they have the ability to wreak havoc in a matter of minutes.

River flooding:

This occurs repeatedly every year, but on a slower time scale than flash flooding, all across the world. They emerge as water runoff builds up in rivers and streams to the point that the banks eventually overflow (Shuaibu 2020). When this occurs, even if the communities downstream did not receive much rain, the flood might spread across a significant area and affect them. Even when river flooding is predictable, the effects can nevertheless be quite detrimental to riparian villages over time.

Coastal flooding:

When ocean water is forced inland, these floods take place. Large waves and sea level rise brought on by hurricanes and tropical storms can create storm surge near coastlines. Large amounts of water can be moved by earthquakes, causing tsunami waves to surge ashore. On a much smaller scale, moderate coastal flooding can be brought on by very high tides, which are occasionally related to a full moon (NOAA, 2013).

Urban flooding:

These can result from flash flooding, river flooding, or coastal flooding, but they are typically brought on by heavy rainfall over developed regions that are unable to absorb the water or by badly maintained drainage systems (Shuaibu 2020). Water runoff from urban areas can be up to 6 times greater than it would be on a natural surface. These floods may result in significant financial losses for homes and companies (NOAA, 2013).

Areal flooding:

Areal floods, which are very comparable to urban floods in many cities close to huge natural lakes, are the most frequent flood threat. Standing water develops in low-lying areas and open fields as a result of areal flooding. They frequently happen as a result of prolonged, heavy rain that falls across a wide area. A lengthy duration of rain can also cause severe flooding, frequently inundating low-lying places in a hazardous manner. These floods may cause agricultural losses. Moreover, stagnant water can act as a haven for disease and bug reproduction (Shafaei *et al.* 2017). According to Odunuga *et al*., (2011), flooding in Nigeria can occur three different ways: at the coast, in rivers, and in urban areas. Low-lying mangrove and freshwater marsh belts near the coast are impacted by flooding. River flooding occurs in the flood basins of the bigger rivers, but flash floods are associated with rivers in inland areas where sudden excessive rainfall can swiftly change them into destructive torrents. On the other hand, urban flooding occurs in towns, particularly on level or low-lying terrain where little or no provision has been made for surface drainage or where existing drainage has been choked with trash, degraded soil, and municipal waste (Shanono et al. 2022).

Moreover, coastal flooding, river flooding, flash floods, urban flooding, levee bursts, dam breaks, and dam spills are expected to occur across Nigeria (Shuaibu 2020). Flooding is a frequent natural phenomenon, and the frequency of flooding in a location is often represented by the typical interval (in years) between each occurrence. For instance, if a flood occurs roughly five times every twenty-five years (5-year flood), it is considered to have an average recurrence interval of five years. Additionally, the likelihood of such a flood occurring in any given year is one in five. Although much larger floods like 100-year floods are anticipated to occur seldom, there is still a one in 100 chance that one may occur in any given year (Emergency Management Australia, 2014). Flood disaster in Nigeria has posed a threat to individuals, groups, and institutions. Usmanu Danfodiyo University, Sokoto, and other areas of the state were damaged by flooding in 2010, which drove residents away and destroyed a large number of structures. In reality, the university requires students to stay at home for four months since the bridge—the sole route between the university and the city is damaged (Odunuga *et al.* 2011).

In Nigeria, flood disasters are not a recent occurrence. It occasionally has extremely strong destructive tendencies. According to studies, the Nigerian floods halted industrial plants, business establishments, and telephone lines for days while disrupting communications and travel (Odunuga *et al.* 2011; Shuaibu 2020). Many land regions were also submerged. Additionally, anytime there is a flood disaster in Nigeria, immeasurable misery is endured, especially by the most vulnerable groups (women and schoolchildren) (Odunuga *et al*. 2011; Oyebande and Odunuga 2010). This finding indicates that if all information on flood disasters in Nigeria were available, people might not be able to comprehend the devastation caused by flooding there. In the upper ranges of our river system network, the recent floods of 2012 in Nigeria destroyed more than 25 States to varied degrees. Numerous structures, including houses, farms, schools, and sources of our income, were destroyed by the floods. Nasidi *et all* (2019) argued that the impact of flooding disasters is influenced by three elements (a) Predictability level, (b) People's ability to successfully prepare for and respond to a flood will depend on how soon the water arrives and rises (c) The duration of the flood (Shuaibu 2020).

Other Consequences of Flooding

Among them is tainted water supplies (water pollution). As a result, there is a shortage of clean drinking water, which leads to unsanitary circumstances and the spread of water-borne diseases. Many "receptors" experience the impacts of flooding from the sources mentioned above. These encompass all of the natural world, as well as people, structures, infrastructure, agriculture, and open spaces for enjoyment. In extreme circumstances, flooding could result in fatalities. It is

currently believed that flooding in and around the city of Hadejia have claimed several lives. In August 2011, floods in northern Nigeria which includes Hadejia river valley claimed lives. Rains so intense that overflowed river banks, caused mud homes to collapse, and washed cattle away. Heavy rains prompted floodwater to break three bridges and overrun a dam, burying buildings throughout the cities. The majority of the victims were kids. Flooding can also have a significant impact on the economy. Loss of inventory, clientele, data, and production, as well as disruptions to the transportation and utility infrastructure, can have an impact on a larger area. Livestock, agriculture, and tourism can all be impacted.
Moreover, over 300 people were killed and over two million people were forced to flee their homes as communities in a record 30% of the country's geography were submerged by floods. A loss of life and property has resulted from the consequences of flooding over the past three decades as they have grown from major to hazardous dimensions. Although specific statistics on the losses incurred by urban residents and flood victims are not yet available. However, the Nigerian citizens have suffered irreparable harm as a result of what has now become a recurring natural disaster in our cities. In addition to destroying homes, flooding has also wrecked school buildings and bridges. Floods had a terrible impact on more than just homes and persons. Due to the loss of the entire harvest, the spoiling of grains when submerged in water, and the loss of animal feed, many farmlands, both arable and agro-forestry, were carried away when schools were submerged. Due to flooding caused by several bridge collapses and broken power poles, some animals perished (Abubakar *et al.* 2022; Odunuga *et al.* 2011).

CONCLUSION

Global worming which triggers the climate change phenomenon is attributed to the increasing rate of flooding. This study studied several research works conducted on flood incidences in the Hadejia river valley watershed and some part of Nigeria. The study has found that within the last few decades, there have been increasing cases of flash flood incidences in the study catchment which resulted into displacement of the inhabitants, loss of lives and properties. Considerable proportion of the affected areas is occupied with inhabitants which have been given flood alert and warning previous by climate scientists. Such awareness focused the preparedness and possible relocation in the event of flash flood occurrence. Thus, this study has disclosed that there is evidence of increasing rate of flood occurrence at Hadejia river valley catchment. Thus, additional commitment need to be intensified on creating awareness and public enlightenment on how to mitigate the potential damage and loss of both life and properties.

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