AN ASSESSMENT ON THE ENVIRONMENTAL EFFECTS OF FLOOD ON COMMUNITIES IN SOKOTO EASTERN ZONE OF NIGERIA

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ABSTRACT

In this work, a comprehensive assessment of the magnitude and intensity of the flood disaster was carried out in all the 8 Local Government Areas of the Eastern Senatorial Zone of Sokoto State. Information and data on flood-affected structures, farmlands, crops, livestock, and fisheries were obtained from the various local governments. Most affected areas were visited to validate the existing data obtained from the various local governments and found out that the information is correct. The details of the information obtained from respective Local Government Areas and observations made from the visitations revealed that the 2020 flood disaster negatively impacted almost all the local government areas within the Zone. Several farmlands were submerged, leading to losses in farm produce. Many communities were cut-off from their main towns by the flood due to roads been washed away. Recommendations were finally made of general and specific areas to mitigate these impacts at the advent of future flooding occurrences.

Keywords: Flood, Assessment, Intensity, Environment, Dam

INTRODUCTION

According to the National Flood Insurance Program (NFIP), a flood can be defined as "A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or two or more properties (at least one of which is the policyholder's property)." This inundation may include the overflow of inland or tidal waters, rapid accumulation of runoff, mudflow, or land collapse along a shore due to water that has exceeded anticipated cyclical levels (Craig and Roger, 2010). Floods are a result of excess water flowing on land that used to be dry. The occurrence of floods worldwide is considered the frequent naturally occurring hazard responsible for a more significant number of fatalities globally. (Caroline et al., 2019).

In the previous generation, the flood has been explicitly considered to be an engineering problem. Still, it has been viewed to be beyond the engineering challenge in recent times; instead, it includes the contexts of urban environmental planning, law, and socio-economic aspects (Paul, 2013). The occurrence of Flooding has become a yearly phenomenon globally in recent decades. Nigeria is inclusive; as the Nigerian authorities announce flood predictions yearly, such prediction comes to pass. The reason for this may not be far from any or all of the assertions from the three schools of thought. The first school of view made it that flood is occurring in recent times due to a concept referred to as global warming and climate change. The second school had it that they are consequences of human actions and inactions regarding the handling of infrastructures in place for free water flow. At the same time, the third school combined both the first and second schools' assertions (Nwigwe and Emberga, 2014). Olawuni

et al. (2015) stated that the frequency of flood occurrence in cities and towns in Nigeria has recently been of great concern and challenge to researchers and authorities.

Flood is one of the natural climatic disasters globally and has become more frequent in Nigeria, resulting in loss of lives, destruction of properties, and farmlands. Flood in the Sokoto Rima basin is an annual event, occurring during the rainy season. It is more frequent at the peak of the rainy season. The Nigerian Meteorological Agency (NiMet) and Nigeria Hydrological Services Agency (NIHSA), who are the agencies of the Federal government of Nigeria, charged with the responsibilities of advising the government on all aspects of meteorology and flood occurrence in March and May 2020, released the Seasonal Rainfall Prediction (S.R.P.) as well as Annual Flood Outlook (A.F.O.) for the year 2020 respectively. They predicted that some states, including Sokoto, will experience hefty rainfall and Flooding above the usual trend (NiMet, 2020).

This paper aims to assess the level of damage done by flood to the environment, engineering structures, and farmlands in the eastern Zone of Sokoto State to identify specific injuries, thereby proposing possible remedial steps and ways of achieving flood mitigations within the area.

CONCEPTUAL OVERVIEW OF FLOODING

Flood is termed as water overtopping but the natural and humanmade environment that was not typically submerged due to sudden heavy storms, which overwhelms soil infiltration capacity and urban drainage systems. It has been acknowledged globally that flood hurts human and animal lives, plants and vegetation, properties, and socio-economic activities. Researchers claimed that Flooding is the most widespread hazardous phenomenon on natural and humanmade environments, resulting in more than 40% of the total disasters globally (Nkwunonwo, 2016).

Causes and forms of Flooding

Generally, the causes of flood are of two types, natural causes or human causes. Natural causes are heavy or torrential rains/rainstorms, Oceans storms, and tidal waves, usually along the coast. Human causes include; a burst of water main pipes, dam burst leave failure, dam spills, etc. Flooding occurs throughout Nigeria in the following forms: Coastal Flooding, River flooding, Flash floods, Urban Flooding, Dam burst leave failures, and Dam spills (Nwigwe and Emberga, 2014).

Coastal Flooding is typically associated with storm surges. The storm surge is said to be the rising water level that occurs due to wind forces pushing water towards the land Within the tropical weather systems. During a hurricane, the storm surge's height is governed by the intensity of the hurricane and the slope of the continental shelf. Storm surges for hurricanes can exceed 25 feet and are typically accompanied by dangerous, battering waves on top of the surge. Riverine Flooding is the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. Flooding occurs when the flow of runoff exceeds the capacity of the natural drainage system. The recurrence interval of the projected flooding event defines the severity of the flood. 100- a year flood is an event with a 1 percent probability of occurring in a given year, while a 500-year flood has a 0.2 percent probability of appearing in a given year. Urban Flooding is a phenomenon that occurs where there have been humanmade

developments within the existing floodplains or drainage areas. For instance, newly developed residential communities, retail establishments, commercial buildings, parking lots, etc. The changes may either increase the amount of runoff or reduce the capacity of the natural drainage channels. In the form of asphalt or concrete pavement, the addition of impervious surfaces increases the speed of runoff water, which overwhelms the drainage systems. Changes made to the shape, slope, or direction of the natural drainage channels to better suite development may reduce the channel's capacity (Craig, 2010).

Effects of Flooding

Flood affects human lives and other creatures either directly or indirectly. Its effect on urban settlements is quite different from that of rural settlements. The flood effect is characterized by destructions of homes, infrastructures, disruption of private and public transports, etc. At the same time, that of rural settlements affects agricultural lands, livestock, and fish farms. Vast agricultural lands are over flooded, destroying the crops, animals drowning, and fish ponds destroyed. Flood also causes water pollution in some cases resulting in water-borne diseases (Qomariyatus et al., 2020).

On the effect of Flooding on engineering structures, whether the Flooding at a building results from storm surge, riverine Flooding, or urban Flooding, the floodwaters' physical forces act on the system are generally divided into three load cases. These load cases are hydrostatic loads, hydrodynamic loads, and impact loads. These load cases can often be exacerbated by the effects of water scouring soil from around and below the foundation. As the floodwaters rise, the higher water on the exterior of the building acts inward against the building walls. Similarly, though less common, a rapid drawdown of exterior floodwaters may result in outward pressures on a building's walls as the retained indoor floodwater tried to escape. Sufficient lateral pressures may cause permanent deflections and damage to structural elements within the building. Should a rapid rise or drawdown occur at a relatively tightly constructed building, there may be enough elevation difference between the interior and exterior water surfaces to damage the walls or foundation of the building.

The Study Area

This study was conducted in Sokoto East Senatorial Zone of Sokoto State, Nigeria. Sokoto State, located in the North-west geopolitical Zone of Nigeria, was created in 1976 after Niger State was created out of the North-western States, which has existed since 1967. It is located within the Sudan Savannah zone between latitudes 13°35'N to 14°0'N and longitudes 4°E to 6°40'E. It shares borders with the Niger Republic to the North, Kebbi state to the West, and Zamfara state to the East and South (Ekoh, 2020). It has twenty-three (23) local government areas, namely Binji, Bodinga, Dange-shuni, Gada, Goronyo, Gudu, Gawabawa, Illela, Isa, Kware, Kebbe, Rabah, Sabon-Birni, Shagari, Silame, Sokoto-North, Sokoto-South, Tambuwal, Tangaza, Tureta, Wamakko, Wurno, and Yabo. Sokoto State has a population of 3,696,999 million people based on the 2006 census. Both primary and secondary sources of data were employed for this research. Sokoto East Senatorial Zone consists of eight (8) Local Government Areas in Sokoto State. These include; Isa, Sabon Birni, Goronyo, Wurno, Gada, Rabah, Ilela, and Gwadabawa Local Government Areas.

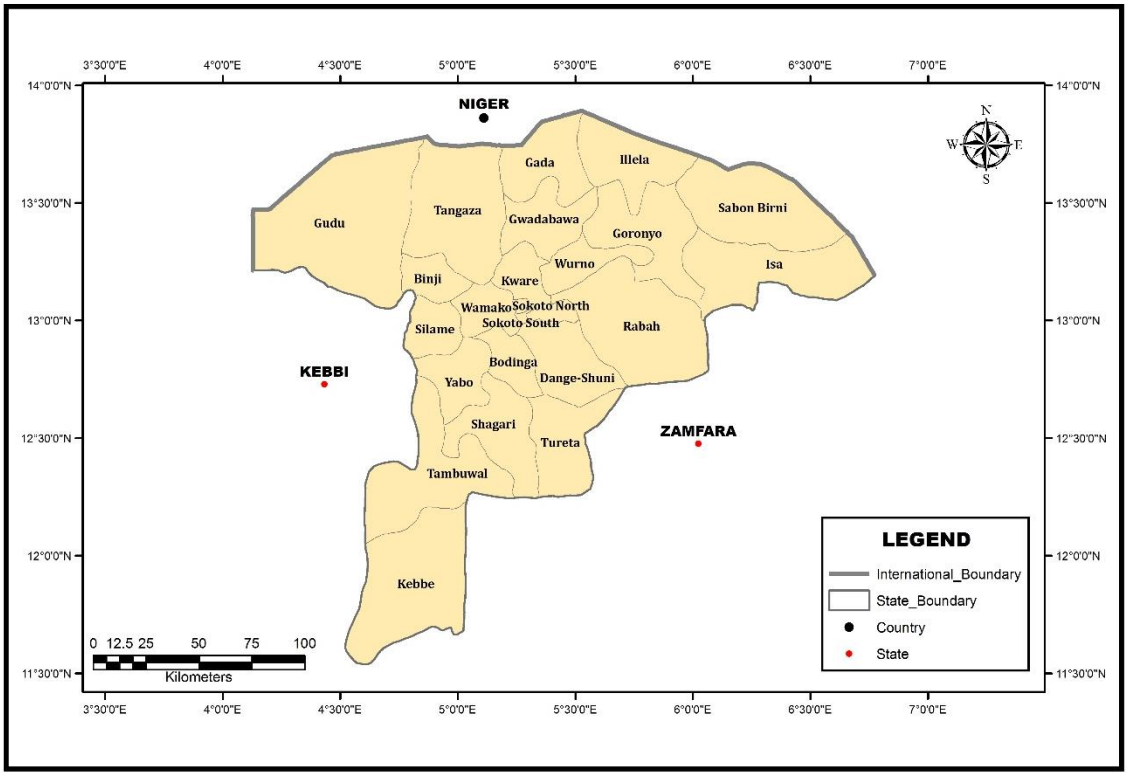

Figure 1: Map of Sokoto State (GAMERS, 2018)

MATERIALS AND METHODS

This research covers the flood disaster during the 2020 rainy season between July and August 2020. Even though the World Health Organization (WHO) categorized the 2012 flood as the worst case of Flooding in Nigeria (Carolin et al., 2019), that of 2020 could also be viewed as equal to or close to that of 2012. The primary data sources include physical observation of some flood locations at each local government area, investigations, and interactions with the community leaders and some flood victims. While the secondary data sources include published researches in the field, web pages, data from NiMet synoptic weather station at the Sultan Abubakar III Internation Airport, Sokoto, Automated Weather Observation System (AWOS) of Metreological unit of Geography Department, Usman Danfodio University, Sokoto and information from the local government authorities concerned. The information obtained from the field were used to evaluate the extent of damage done by the flood to the affected areas. Photographs of some of the affected areas were also used for the analysis.

FINDINGS AND DISCUSSIONS

This section presents information about the people and areas affected by the 2020 flood in the study area. Table 1 shows some information about the local government areas in the Zone, while figure 2 presents information about Sokoto State monthly rainfall. The table and the figure serve as a factor to determine the magnitude of the flood effect.

Table 1: Basic Technical Information on Sokoto East

S/N	L.G.A	Population	Land Area (Km^2)	Average Humidity (%)
1	Isa	149513	2158	24
2	Sabon Birni	273842	2354	24
3	Goronyo	149255	1704	31
4	Wurno	189713	685	28
5	Rabah	274812	2433	24
6	Gada	125945	1315	21
7	Illela	135098	1246	26
8	Gwadabawa	167098	991	26

Source: ManPower Nigeria, 2020

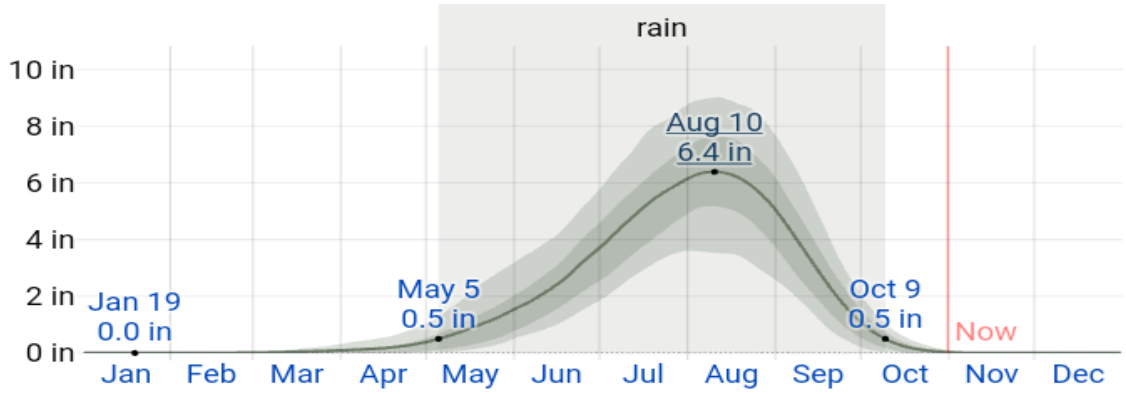

Figure 2: Average Monthly Rainfall in Sokoto State (WeatherSpark, 2020)

Areas and Persons

Table 2 presents a summary of all the affected areas, including persons, animals, and farmlands. In contrast, figure 3 illustrates the extent to which the land areas were submerged in water during the Flooding.

Table 2: Areas Affected by the Flood

S/N	Local Govt. Area	No. of House Holds	Farmlands affected (Km^2)	Houses Destroyed	Animals Affected	Engineering Structures Affected	Lives Lost
1	Isa	879	13.76	-	-	3	-
2	Sabon Birni	259	38.50	-	10	2	-
3	Goronyo	9120	32.50	-	-	2	-
4	Wurno	8716	208.55	235	20	2	-
5	Rabah	2665	74.82	1504	313	2	2
6	Gada	5295	5.00	1901	-	1	6
7	Illela	611	79.70	-	-	1	-
8	Gwadabawa	3367	74.82	185	-	-	-
	Total	**30912**	**697.70**	**3825**	**343**	**13**	**8**

Source: Local Govt. Authorities, 2020

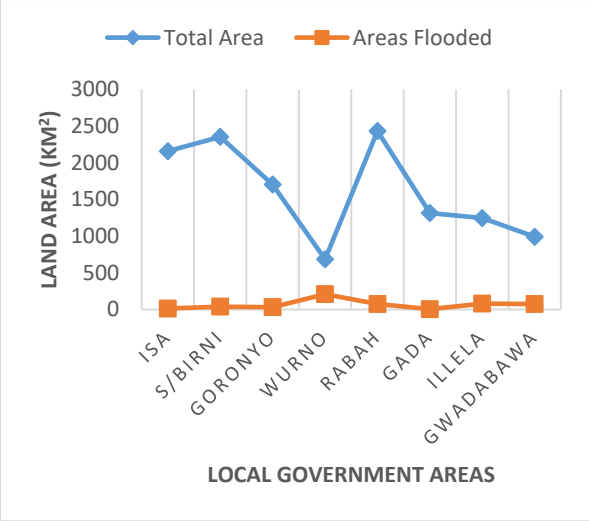

Figure 3: Areas Affected by Flood

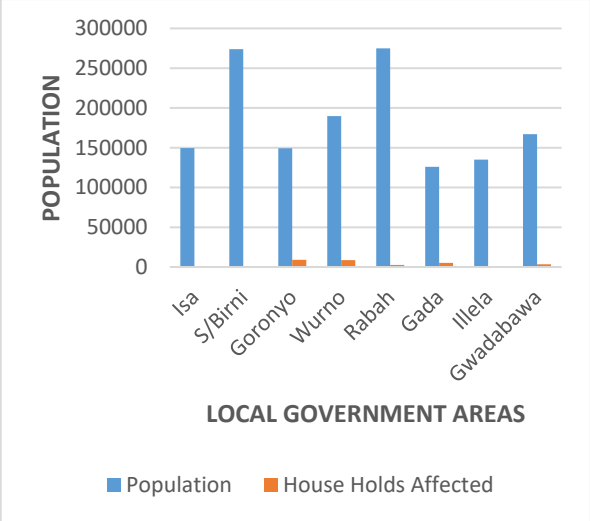

Figure 4: Population Affected

Figure 3 shows that Wurno L.G.A. is the worst hit by the flood in terms of landmass if the comparison is made between the flooded area and the area available for the L.G.A. While figure 4 shows that Goronyo and Wurno L.G.A.s have more populace affected than other L.G.A.s.

Photographs

Some of the affected areas visited were captured, and photographs resented in this section.

Plate 1: Washed away Road at Isa L.G.A.

Plate 2: Road under threat of being washed out at Sabon Birni L.G.A.

Plate 3: Washed away, Road at Wurno L.G.A.

Plate 4: Submerged Farm at Illela L.G.A.

Plate 5: Washed away Road at Sabon Birni LGA

Plate 6: Affected Irrigation Canal at Goronyo LGA

Discussions

From the investigations, it was cleared that the Sokoto east zone is the most vulnerable Local Government Areas to flood within the state. This is because they are the initial contact with river Bunsuru, river Gagare, river Maradi and Rima River, and outflow from Bakolori and Goronyo Dams. Section 2.1 of this paper states that there are two significant causes of the flood: natural and humanmade causes. It was carefully observed that both factors played specific roles in the flood that occurred in all the areas visited. It was observed that rivers Gagare and Bunsuru are the major causes of flood in Isa and Sabon Birni L.G.A.s due to the meandering and change of course from the two rivers. Specific activities of farmers along the river banks are also counted as contributing factors towards the transformation of these rivers. The consequence of that was the diversion of river Bunsuru to meet river Gagare which increased the volume of water carried to the channel of river Gagare.

It was also observed that the Niger Republic also constructed a dam across river Maradi, which supplies the Illela canal water. This development leads to a drastic supply of water to the canal for a while. Upon the release of water from this dam during the flooding period worsened the situation at Illela L.G.A.

CONCLUSION

From the investigation, it is concluded the 2020 flood in Sokoto eastern Zone was caused as a result of the following;

1. Specific problems associated with the management of dams contribute to menace of floods in Sokoto east.
2. Some of the major towns, especially local government headquarters within the Zone, are characterized by the flawed drainage system. They could easily allow a rapid build-up of the surface runoff, which could induce floods in those areas.
3. Poor town planning and lack of adherence to policies guiding town planning contributed to the flood menace in some areas. The building of houses and structures along waterways contributes to Flooding. Also, Indiscriminate dumping of refuse in trenches contributed to some extent.
4. Conversion of natural lands to agricultural or other uses also leads to changes in hydrological regimes of various catchments, leading to Floods. The creation of waterways by farmers during the dry season contributed immensely to flood.
5. The flood in Illela L.G was due to the overflow of Kalmalo Lake due to high inflow from upstream Dams in Niger republic. The Lake was dry for many years because the influx was cut-off, but high rainfall this year forced the Dams upstream to release water, resulting in the flood of farmlands.
6. Breakage and overflow of Jiccini Dam in Rabah L.G. caused Flooding in Rabah and environs.

RECOMMENDATIONS

The following have been recommended;

1. Flood forecasting and early warning systems through SMS (Disaster notification system). There should also be enhanced community education, awareness, and preparations.
2. Clearance of waterways & river channels across the State and De-silting of Dams/reservoirs to increase their carrying capacities, and rehabilitation of Lugu Dam in Wurno L.G. A.
3. The State government should collaborate with the Federal government to construct the Jiccini Dam in Rabah L.G.A. to serve as flood control, enhance irrigation, and water supply.
4. The government should look at the possibility of reconstructing the Isa-Bafarawa road, raise the barrier, and provide adequate culverts along the road.
5. There is a need for embankment protection at Kagara town in Goronyo L.G. and Rabah to reduce flood impact. There is also a need for a drainage network within Gada and Kyadawa towns.
6. Provision of the adequate drainage system and desilting of the existing ones in Gwadabawa L.G. A.

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