Hazard Assessment and Implementation Strategies for Mitigating of Flood and Erosion in Nigeria

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Abstract. There are notching unresolved issues and environmental hazards traceable to flood and erosion in major rural areas and notable communities in Nigeria. Researchers’ efforts on erosion control and flood mitigation have not yielded notable fruits due to inadequate planning and implementation strategies. Maintenance of roads and other infrastructures are the bed rock of any development round the globe. This paper assessed recent occurrence of flood and erosion. The study examined the causes, urban and regional planning of the affected area, construction practices, damages and maintenance practices. Questionnaires, field study and interview of experts were wont to elicit information from people within the affected location, officials from state and native government agencies charged with rehabilitation of affected areas. The research finding revealed that there are inadequate drainage systems, lack of enforcement of plan, corruptions, failure of systems, poor supervision, construction malpractices, lackadaisical attitude and lack of maintenance culture. Implementation strategies were highlighted to avert flood and erosion ravaging several areas of the country. The paper concluded that stakeholders, researchers, engineers should partner with government agencies within the planning, construction, management and maintenance of rural and concrete drainages for adequate funding and sustainable construction. It is recommended that strategies for alleviating flood and erosion should be implemented supported latest technology for sustainable infrastructural development. Periodic hazard assessment should be planned in various geopolitical zones especially Lagos, Niger delta and rain forest region of Nigeria. Land use control, landscape maintenance, weather stations, proper enforcement of construction works consistent with plan should be strategically put in situ for effective monitoring and alleviation of flood and erosion in Nigeria.

Key words: Environmental Hazards, Erosion Control, Flood Mitigation, Implementation Strategies, Infrastructural Development

1. Introduction
Flooding is a frequent incidence and common natural environmental hazards in various geopolitical zones in Nigeria. There is urgent need for a sustainable approach in Nigeria for flood management. Nigeria periodically experiences a large range of environmental hazards such as floods, windstorms, drought, desertification, landslides, wildfires, sandstorms, landslides, windstorms, heat waves, disease epidemics pest invasion, soil erosion, gully erosion, coastal erosion, and other types of erosion, volcanic eruptions, and related activities. Most of these are due to unethical practices, lack of implementation strategies and increasing vulnerability. The lack of functional public infrastructure and citizen based communal services in most communities has prioritized the look for a sustainable flood management regime publicly policy. The Flood management office of Federal Ministry of Environment should strengthen National Flood Management Act in Nigeria.
Critical assessment, disaster preparedness, prevention, strategic planning, establishment of mitigation measures are necessary. A hazard assessment could also be a radical check of the work environment.

Flood management requires input from numerous stakeholders, engineers, competitor alternatives and many others [1,2]. Potential structural damages occurred as a result of flooding, unplanned settlements and unforeseen natural hazards [3,4,5,6,7,8,9,10]. Hazard is dangerous to life, properties and atmospheric condition of an area [11]. Due to warming and global climate change normally, the length, magnitude, scale and frequency of climate-related risks area unit projected to increase and deteriorate [12]. Flood is additionally as a result of several conditions operating one by one and in natural process.

Intermittent floods occur on several rivers, forming a contiguous space mentioned because of the terrain, rural urban migration, percentage of yearly urbanization, mismanagement of solid wastes and land use [15,16,17,18].

Floods have displaced a lot of people than the other natural disaster [19,20]. North aspect of Federal Republic of Nigeria is prone to wind erosion. Insufficient vegetation has resulted into frequent sweeping away of soil. Borno, Kano, Sokoto, Zamfara and Yobe States area unit the foremost in danger of wind erosion and its impacts in Federal Republic of Nigeria. Disasters embrace dramatic, sudden, impromptu actions and other issues affecting life, societal growth and infrastructures [21,23,27,28].

Flooding has several impacts. It damages property and can be a threat to public health and safety and native multifariousness [22].

2. Methodology

Questionnaires, field study and interview of experts were used to obtain viable information from people in the affected location, officials from state and local government agencies charged with rehabilitation of affected areas. Secondary data from literatures were also used. Plate 1 is a typical flooded highway and infrastructures in a community.

Plate 1: Typical flooded highway and infrastructures in a community
Many property, system and life were broken because of flooding. There a lot of failure of pavements due to erosion. Figure 1 and 2 show the boundaries of state and native Government Areas clipped from Map [34]. Figure 3 indicates areas susceptible to flood in Federal Republic of Nigeria.

**Figure 1:** Boundaries of Owerri and native Government Areas

**Figure 2.** Watershed Municipal community in Owerri, Nigeria

**Figure 3.** Areas susceptible to flood in Federal Republic of Nigeria [33].
3. Results and Discussion
Most of these floods are traceable to construction of building along water ways, lack of adequate planning for major urban centers, inadequate weather stations and rainfall data in some locations. Causes of flood based on percentage is as follows: Opening of dam around rivers 75%, narrow stream or river channels 8%, indecent waste disposal 7%, heavy precipitation 6% and poor drainage system 4%. The research finding revealed that there are inadequate drainage systems, lack of enforcement of master plan, corruptions, failure of systems, poor supervision, construction malpractices, lackadaisical attitude and lack of maintenance culture. Implementation strategies were highlighted to avert flood and erosion ravaging several areas of the country.
Disaster risk can be computed using susceptibility, coping capability and danger (ISDR, 2004) by the formula:

\[
\text{Disaster risk (R)} = \frac{\text{Vulnerability (V) x Hazard (H)}}{\text{Capacity (C)}}
\]

Hazards are dynamic and with extremely varied potential impacts. Coastal erosion is increasing as a result of human activities like construction of harbour protective structures and jetties like within the Lagos Bar beach, sand mining, damming of rivers and dredging activities [31, 36].
Many of the first floods were within the North with the South being affected later within the months of August, September and October. Flooding has increased pressure on Federal and native budgets struggling to deal with emergencies. With 1 million potential fatalities (NEMA, 2012), the flood is certainly a National catastrophe. During the flood the costs of local foods rose by 200 -300% in certain areas (Puncha, 2012) and 80% of Bayelsa and other areas of Niger delta, the hub of the local refining industry was submerged.

Table 1 gives typology of disaster triggers. Figure 4 indicates typology that triggers disaster.

| Natural Hazards | Violent Conflict | Technological Hazards |
|-----------------|-----------------|----------------------|
| Earthquakes     | Mass violent civil disturbances | Nuclear contamination |
| Floods/Riverbank erosion | International conflict | Industrial disasters |
| Landslides      | Civil war         | Poisoning of water courses – chlorine, cyanide, mercury, lead, etc. |
| Cyclones/Typhoons/Hurricanes | Localized armed conflict | Environmental pollution |
| Tsunami/Tidal Waves | Terrorism | Dams and structure failures |
| Volcanic eruptions |                    |                       |
| Fire – forest, other |                    |                       |
| Unusually cold weather/winter emergencies |                    |                       |
| Emergencies |                    |                       |

Table 1: Typology of Disaster Triggers

Figure 4. Environmental, social and climate of disaster justice
4. Implementation Strategies of Flood and Erosion Mitigation in Nigeria

It very important to implement the following strategies for alleviating flood and erosion:

i. Recent technology such as geographic information systems (GIS) can be adopted for sustainable construction, erosion control, flood mitigation and infrastructural development.

ii. Periodic hazard assessment planning of varied geopolitical zones especially Lagos, Niger delta and rain forest region of Nigeria.

iii. Land use control, landscape maintenance, weather stations, proper enforcement of construction works consistent with plan should be strategically put in situ for effective monitoring and alleviation of flood and erosion in Nigeria.

iv. Watershed protection methods and improved dams and dykes are often constructed in strategic places.

v. Flood hazard mapping framework should be strictly enforced for sustainability and for mitigation of environmental impacts as presented in Figure 5.

Figure 5. Flood hazard mapping framework [30, 32]

Figure 6 indicates risk assessment of Hydro-meteorological and nature-based solution management while figure 7 indicates management cycle for flood risks. Figure 8 indicates Lagos Coastal Areas Monthly Frequency of Ocean Surge. Figure 8: Damage of Pavements as a result of Incessant Flood in Coastal Area of Lagos.

Figure 6: Risk Assessment of Hydro-Meteorological and Nature-Based Solution Management [35]
Figure 7: Management Cycle for Flood Risks [37]

Figure 8: Lagos Coastal Areas Monthly Frequency of Ocean Surge

Figure 9: Damaged Pavement Infrastructures due to Incessant Flooding in Lagos
5. Conclusions
Disaster management, flood abatement and erosion control require adequate priority for prevention of hazards, sustainable development, rapid urban growth and infrastructural development, national security, protection of life and property. Every strategy which will curtail flood and erosion must be implemented to avert natural hazard and to make sure that development efforts do not aggravate vulnerability to those hazards in view of incessant and destructive effects of flood and erosion tragedy globally. Hazard assessment and provision of mitigation measures should be done before the occurrence. Efficient drainage and irrigation systems are crucial for alleviating flood and erosion in developing countries. Prevention measures include quality control and monitoring of civil engineering projects especially on roads and drainages; quality research output by experts, physical barriers reinforced structures, restrictions, implementation of strategies, establishment of frameworks, enforcement of government policies and regulations. The ultimate tool is integrated and collaborative Flood Management Act. Stakeholders, researchers, hydrologists and engineers should partner with government agencies in the planning, construction, management and maintenance of rural and urban drainages for adequate funding and sustainable construction.

6. Recommendations
The following recommendations are essential for handling flood and erosion.
 i. Governments need to perpetually check on flood-prone and vulnerable areas.
 ii. A lot of study and fund need to be dedicated to flood and erosion connected matters.
 iii. Mitigation measures like sensible drain systems, seminars, public awareness and training, environmental and land-use controls need to be organized.
 iv. Research related to hazard assessment and implementation strategies to avert flood should be supported and funded by government and non-governmental organizations.
 vi. Periodic removal of solid wastes and unwanted materials from the drainages is very crucial in rural and urban centers.
 vii. Coastal protection should be done in areas prone to flooding.
 viii. Policies, engineering standards and laws should be put in place to check populace on activities that can results into flooding and overtopping waves in vulnerable places and coastal areas.
 ix. Due to uncertain nature of flood, preventive measures and urgent action are necessary especially in coastal areas.

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