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Climate Variability and the Issues in Flood Disaster Risk Awareness in Nigerian Communities

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Abstract

Prior to human civilization, floods have been identified as one of the most lethal environmental and geophysical disasters with destructive consequences. Yet, individual/ group risk awareness levels and impact mitigations vary across distinct geographic locations and times. This study explores issues in climate-induced flood disaster risk awareness in Nigeria. The discourse analyses using qualitative and quantitative tools revealed that the causative factors and levels of flood disaster awareness in Nigerian communities varied across geographic locations and timescale. Also, the flood disaster profiles in Nigeria reflect dominant control by variations in the climatic (rainy) seasons. Hence, most of the historic flood disasters in Northern Nigeria have strong affinities with river discharge and dam failure while those in Southern Nigeria were mostly influenced by the high frequency, density, intensity of rainfall, and poor land-use planning. Also, the government, donor agencies, and the vulnerable people were basically passive in their management approaches, with emphasis on post-disaster rehabilitation, which hampered sustainable development and exacerbate the negative impacts on the realization of an ecologically smart future. The perceived flaws led to very high risk, defined by limited capacity and locational effect. The paper, therefore, recommended adequate promotion of pre-flood disaster risk mitigation options through environmental education programs to boost community awareness, increase the sense of responsibility and safety of vulnerable people.

1. Introduction

Flood disaster has long been recognized as one of the earliest and most destructive climate-induced geomorphic events in the history of an Anthropocene (Age of Humans). Yet, the levels of individual and group awareness of the risk and choice reactions for enhanced management of human-environment toward sustainability varied across geographical areas and time [1]. Hence, Nwafor [2] identifies flood as one of the most lethal to humans among the geophysical agents. It is instigated by natural factors such as rainfall, soil, topography, and accelerated by anthropogenic factors especially the nature of city planning, roads/ drainage system, urbanization, and land use.

From the regional dimension, [3] reported that Asia is the flood most affected, accounting for over 50 percent of climate and water-related global disaster in the last quarter of the 20th century.

Nigeria is not left out in the scene following the potential and actual effects of climate variability and change, accelerated by the increase in human population and the corresponding scramble for land for diverse uses. Such uses encompass settlements, agriculture, industries, and infrastructure/ social amenities in flood vulnerable areas such as coasts, shoreland, and floodplains.

Amidst the flood disaster occurrences, countries, regions, groups, households, and even individuals' reactions to mitigate or control the risks associated with them seem to vary. The variations are partly influenced by their level of awareness, exposure to the flood event, demographic attributes of the people at risk, and their socio-economic status. Climate variability and change issues are very critical within the tropics [2]. In Southern Nigeria (e.g., Lagos, Rivers, Akwa Ibom), where weather activities have become quite erratic, and the existing water bodies tend to worsen the situation for coastal and shoreland communities with their ever-growing population; thereby increasing flood and related losses.

Although irregular climate variability and change example global rainfall patterns have some positive impacts especially desert regions that were initially faced with water scarcity, with a tendency to wet the land for agriculture production. Similarly, where the extreme temperature becomes a case, the negative impacts on the production of major traditional food crops and loss of biodiversity may become eminent. Additionally, farmers remain concerned about an increasing intensity of extreme weather events that will and has continued to occur as a result of climate variability and change. Weather-induced flood and storm disasters have negative impacts on wetland agriculture, housing, rising sea level, and increased salinization.

Recent researches have indicated the past efforts to mitigate or avert the impacts of flood disaster accelerated by climate variability for the actualization of sustainable development and ecologically smart future are plagued by factors such as limited capacities and awareness across geographic locations [4, 5]. In spite of the observed issues, flood disaster risk awareness, reaction, and communication patterns in Nigeria are not given the expected attention [5]. Yet, historic flood disaster has remained a recurrent decimal with devastating consequences on governments, groups, and individuals. The preceding notions justifies the need to review some striking flood events and their possible causes with a view to identifying key options in boosting risk awareness, potential/ actual impacts communication, and mitigation options.

This study explores the thrust in climate variability and issues in flood disaster risk awareness in Southeast Nigeria with a view to providing a direction toward building ecologically smart future. To accomplish the aim, the following specific objectives were investigated.

1. To review the major flood disaster profiles and their causative factors in Nigerian communities.
2. To examine the influence of climate-induced flood disaster awareness and timing of impacts communication on losses in the Nigerian environment.
3. To assess the dominant factors governing flood disaster risk losses in Nigerian communities.
4. To evaluate flood mitigation options for the development of a sustainable environment and ecological smart future for Nigerians.

1.2 Description of the Study Area

1.3 Location

The study area is located within the humid tropical region of West Africa. It has diverse climate, soils, vegetation, landmass, population, and allied resources. The vastness of the Nigeria necessitates the scoping of the study area to focus on the Southeast region. The Southeast Nigeria is commonly called the Igbo land. It comprises of five (Abia, Anambra, Ebonyi, Enugu, and Imo) States. From the Geographical perspective, the region lies within Latitude 5^0 14^1 to 7^0 28^1 North of Equator and between Longitudes $6^0 11^1$ to $8^0 33^1$ East of Greenwich Meridian.

1.4 Climate and Geology

The climate of Southeast Nigeria is humid tropical environment based on Köppen's classification scheme. The Af-climate is occasion found in some pocket locations of Ohafia and Abriba in Abia State due to the influence of adjoining rivers. The Am-climate is most dominant in the five States, while the Aw-climate is common in the northern part of Enugu and Ebonyi States due to the influence of Northeast wind.

The climate of the area grouped as Af (Humid Tropical) climate in the Southern part (comprising Abia, Imo, Anambra States) and Am (wet and dry climates) around Enugu and Ebonyi States based on Köppen's climatic classification scheme. Similarly, the rainfall distributions vary across geographic space and seasons. The area usually received double rainfall maxima (April to July and August to November) with a mean annual total that ranges between 1,770 mm and over 2,710 mm. The magnitude, frequency, intensity, and amount often diminish from the North to the south [6]. The geologic formations of the study area also vary across geographic space along with the pedology as presented with respect to Southeast Nigeria (Figure 2). For instances, the distributive patterns of the hydromorphic soils in the Aba and Ikwo, Nwewi, and Obolo areas of the southeast Nigeria is influenced by the Tertiary and recent Quaternary Alluvium deposits. Similarly, Ferrallitic soils in Aba area is accelerated by the Coastal Plains Sands of Tertiary Time (Holocene) deposits while the dominant of gravelly ironstone concretions in Abakaliki is associated with Cenozoic era which Orajaka cited in Umo and Enwereuzor [6] opines that the Anticlinorium had undergoes some elements of rejuvenation following the prevalence of protracted weathering, denudation, and allied geomorphological processes.

2.0 Methodology

This study is preliminary in nature with a strict emphasis on discourse and quantification as analytical tools. The researchers employed both qualitative and secondary methodologies in data generation to evaluate climate variability and issues in flood disaster risk awareness in the Nigerian environment. Data were generated through historical traditions oral interview. Other vital data were generated from the existing published and unpublished literature such as journals, textbooks, government documents, eyewitness accounts/ historical experiences by individuals.

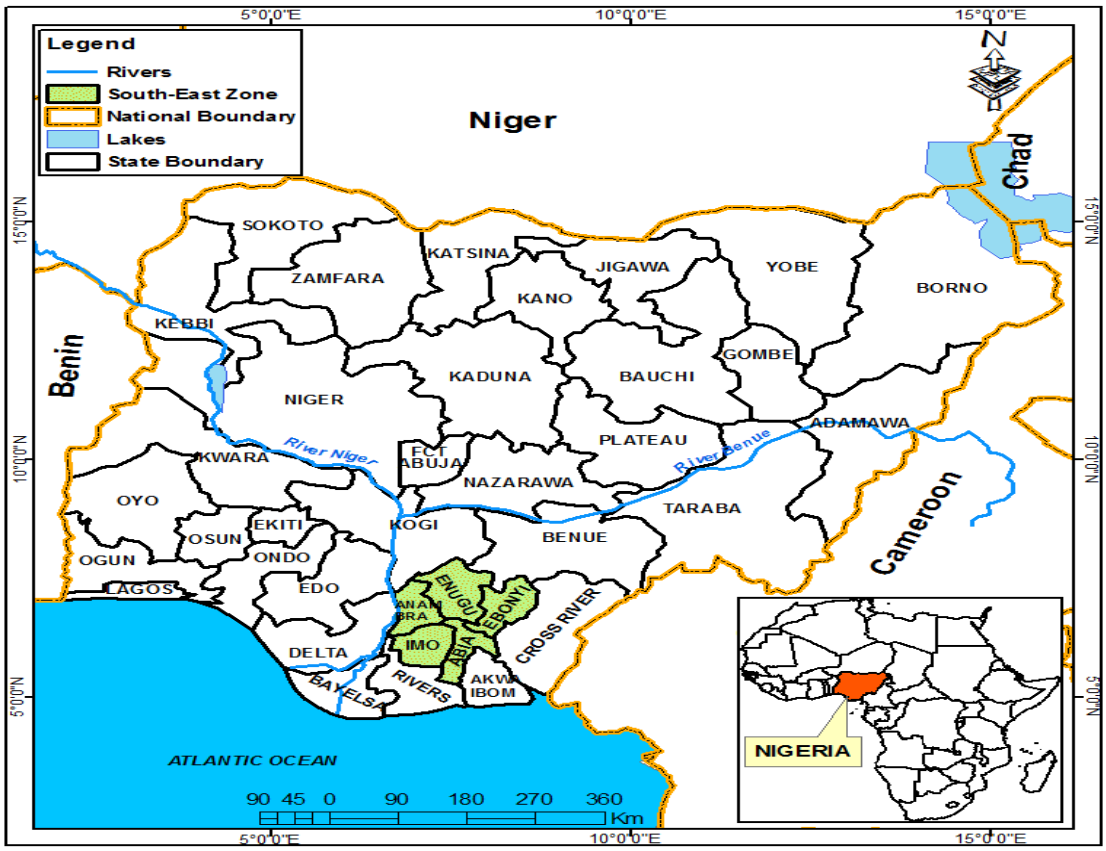

Figure 1: Nigeria showing Southeast Nigeria.

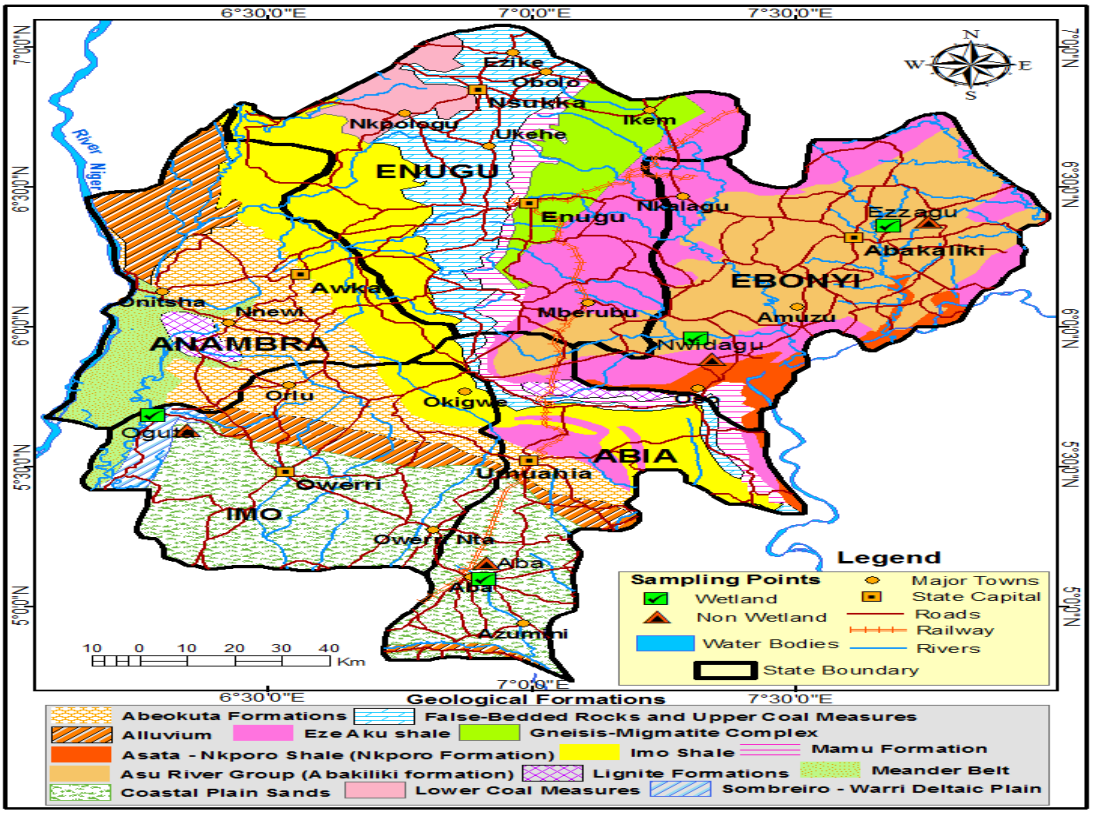

Figure 2: Southeast Nigeria showing Geologic Formations

3.0 Results and Discussion

3.1 Flood Disaster Profiles and Major Causative Factors in Nigeria

Flood is a geophysical concept that depicts a situation where a large volume of water submerges a wide landscape (area) that was initially a dry land for a reasonable period of time. The severity and intensity of its occurrence vary from one location to another based on the type propel by prevailing natural and anthropogenic factors in an area. In most cases, the variability in flood events is classed based on their types. For instance, Akpofure [7] Emeriiole [8], Umo and Enwereuzor [9], identified four distinct flood types (flash; urban; coastal; and river) that are prevalent in Nigerian environment and Southeast in particular. A flood disaster is a situation where the flood event causes widespread destruction of life and property to such a magnitude that is beyond the coping capacity of the affected people using their available resources. That means once the capacity of the flood-affected people are overwhelmed, and they resorted to external (national or international) assistance, then disaster has occurred. Capacity is, therefore, measure in terms of the physical, economic, social, environmental, and other resources within the affected region which enable people to cope effectively with the flood disaster. The identified resources are what enable the vulnerable people to prepare for, prevent, mitigate, or quickly recovered from the effect of the disaster over a period of time.

Table 1: Trends in major Flood Events and Causative Variables

S/N	Some Historic Flood Events	Major Possible Causes
1	Ogunpa flood in Ibadan, 1981, 1984	Blocking of river channels with solid wastes and illogical activities along the river channel.
2	Bagauda flood in Kano, 1988.	Excessive storage leading to Dam failure due to protracted and heavy rainfall.
3	Bauchi flood in 1991.	Overflowing of Yuli River due to excess rainfall.
4	Benin City flood, 1984, 2008	Heavy rainfall & blocking of drainage channels.
5	Angwan Rogo (1992) and Lamingo flood (2012) in Jos.	Heavy rainfall, unregulated urbanization along floodplain and drainage lines.
6	Ikot Ekpene flood in Akwa Ibom, 1998.	Deforestation and urbanization.
7	Port Harcourt City flood, 1984, 2006.	Heavy rainfall and building structures along natural water ways.
8	Benue River/ Niger Delta flood 2008, 2012, 2020	Excessive and unprecedented rainfall coupled with the release water storage from Dam.
9	Oguta Flood in Imo State, 2012, 2014	Excessive and unprecedented rainfall coupled with flooding of Niger River

Source: Modified from Akpofure [7] and Emeribeole [8]

From Table 1, there are clear indicators that flood disaster is majorly a natural occurrence but its severity and impacts over geographic location and time vary due to the level of anthropogenic interferences (activities). Outstanding among the natural forces that cause flood events in the humid Tropics and Nigeria in particular, are weather and climate (heavy and prolong rainfall), underlying soil structure and texture, nature of the underlying topography, proximity to water bodies (such as river, ocean, dam, or waterlogged, and nature of vegetation cover as observed in Umo and Enwereuzor [6].

Similarly, major anthropogenic variables that instigate flood disaster in a settlement/ industries/ farms and others, in the flood-prone areas, are: poor monitoring and gauging of water projects/ bodies, blockages of river channels, and drainages with solid wastes, poor sanitation, urbanization,

and poor town planning, poor legal framework that guide human occupation in government reserve areas (such as parks, green land, open space, bye pass, gulf, and game resort).

3.2. Categorization of Flood Disaster Risks and Determinants of Losses

Flood risk depicts the qualitative and/ or quantitative measures of the probability and severity of losses in events of flood disaster. Very often, flood risks are rated based on one's exposure and vulnerability to the impact of the hazard in an area over a period of time. Therefore, since each flood event has a frequency (magnitude) and the corresponding consequences, the risk can be defined based on whether the potential risk (impact) is very high, high, moderate, low, or very low as depicted in Table 2.

Flood disaster risk signifies the possibility of adverse effects of flood in the future. It derives from the interactions of social and environmental processes, as well as the combinations of physical hazards and the vulnerabilities of elements. A flood event is not the sole driver of risk. There is increasing confidence that the levels of adverse effects are in part determined by the vulnerability and exposure of societies and socio-ecological systems [10, 11, 12, 13].

Table 2: Flood Risk Rating and Possible Effect Definition.

Exposure Rating	Flood Disaster Impact Definition
A = Very Low	Exposures to the flood risks are often negligible with almost zero loss.
B = Low	Risks are controlled and may likely remain same in accordance with the assessment criteria used by the assessors.
C = Moderate	Risks are currently under control to meet assessment, but such control is often difficult to measure.
D = High	Risks are not adequately controlled to meet assessor's criteria.
E = Very High	Exposures to flood disaster risks are enormously high and will certainly lead to huge losses of life and property.

Source: Modified from Iwuchukwu [14].

Deducing from Table 2, it is clear that flood disaster risk is not fixed over time and place, but a continuum in constant evolution, yet individual and/ or group level of awareness, responses, and management can influence how severe or minute the impact is felt. This is more evident because what one may perceive as potential often comes into manifestation, if adequate measures are not introduced to avert or mitigate its occurrence.

Disaster risk is associated with differing levels and types of adverse effects on the elements. The effects may assume catastrophic level or levels commensurate with small disasters. Some have limited financial costs, but very high human costs in terms of loss of life and numbers of people affected as the case of Rivers Niger and Benue flood (of October 6) instigated by the forceful release of water from a dam in Cameroun; others have very high financial costs but, relatively limited human costs as the case of Oguta Lake flood.

Modern space observers such as geographers, engineers, environmentalists, and allied scientists believe that the cumulative effects of what may be considered as small disaster can affect the capacities of communities, societies, or social-ecological systems to deal with future events at sub-national or local levels [15, 16]. To promote sustainable development and create ecological smart future with limited or zero flood disaster risk demands developing, working, and sustaining pre-

disaster plans blueprint, whose principles, methods, and applications in Nigerian environment need be people-society friendly.

3.3 Flood Disaster Losses, Risk Awareness, and Communication

It is commonly recognized that once a disaster occurs and no life and/ or property is affected, or the affected peoples' capacities are not overwhelmed the hazard; then it is not classed as a disaster. Similarly, the intensity or magnitude of flood events are usually determined partly by environmental degradation, level of human preparedness and intervention, the severity of natural and anthropogenic elements, local geomorphology and geology in a given geographical location.

Contextually, individuals' losses to flood disaster over time may depend squarely on one or more of the following factors: the magnitude of the flood disaster, population density in the flood risk zone, structure, and composition of the vulnerable people in the flood risk zones, the socio-economic structure of the elements in the risk zones, level of awareness, timing of information/ responses, geologic foundation of the flood risk zone, and the institutional framework of the area.

Viewing from Cardonna et al. [16] perspective, individual, or group exposure to flood events involves taking inventory (such as pictorial, mapping, and recording) of elements in an area in which hazard events may occur. Such documentaries often serve as guides for future responses and evacuations. However, if the population and economic resources of the vulnerable groups are not located in or exposed to potentially dangerous settings, the problem of flood disaster risk may be either not exist or negligible.

Exposure is necessary, but not sufficient determinant of risk. It is possible to be exposed but not vulnerable, for example by living in a floodplain but having sufficient capacities to manipulate (building structures, proper timing of information and response and behaviour to mitigate) potential loss. However, to be vulnerable to the extreme flood event, it is necessary to also be exposed, but ones' knowledge of the event and ability to control the situation is very vital in this post-modern age of climate change and variability to boost sustainable development and ecologically smart future in Nigeria.

Risk awareness and communication are vital tools that influence people's perception and response to flood disasters in any region. Risk communication represents complex multidisciplinary actions that involve reaching different audiences to make risk comprehensible, understanding and respecting audience values, predicting the audience's response to the communication, and improving awareness, collective and individual decision-making as emphasized in [16]. Failures in flood risk awareness and communication have been revealed in past disasters, such as Hurricane Katrina in 2005 or Pakistan floods in 2010 [17]. Particularly, the loss of trust in official institutions responsible for early warning and disaster management were the key factors that contributed to the increasing disaster risk.

Effective and people-oriented flood risk communication is, therefore, a key to improving vulnerability and risk reduction in the context of extreme events like floods, particularly in the context of people-centered early warning [17]. Weak and insufficient risk communication as well as the loss of trust in government institutions in the context of early warning or mitigation can be seen as a core component of institutional and individual vulnerability.

The effectiveness or failure of people-centered flood risk communication can contribute to increasing people vulnerability and disaster losses. Peoples' awareness (knowledge) of factors that

determine how people perceive and respond to a specific flood risk often enhances the management and mitigation of losses [12].

Effective risk awareness and communication can be built on risk assessment and tailored to a specific audience. The channels may range from decision-makers at various levels of government, to the private sector and the public at large, including local communities and specific social groups [16]. Impediments to information flows and limited awareness are risk amplifiers. Beliefs, values, and norms influence risk perceptions, risk awareness, and choice of action.

In most cases, poor people often suffer worse during flood disasters due to low level of awareness, cultural ties, poor information sources, and low income which together limits their capacity. To some extent, most of the blame should be shifted to the Government and allied authorities because they owe their people the duties of organizing periodic seminars, workshops, orientation, and awareness programs regarding the causes and effects of flood disaster in their domains and how to respond timely for their safety. Indeed, the flood disasters that occur around September to October 2012 along the Lower Niger River and Coastal belt of southern Nigeria attests to this.

Recent efforts by the Federal and State Governments through their agencies especially Federal Emergency Management Agency and State Emergency Management Agency are highly recommendable but seem to be grossly inadequate because of information gaps between the Federal, State, and Local level of the agencies and above all funding of research and advocacy programs on flood and allied weather/climate-related disaster in the 21st century. Appropriate and timely risk communication is critical for effective flood disaster risk awareness and impact mitigation.

3.4. Flood Disaster Risk Management and Impact Mitigation

Flood disaster risk management include all the activities, programs, measures which can be taken before, during and after a given flood event for the purpose of averting its occurrence, reducing its impacts and/or recovering from the losses over time and scale. It is obvious that the levels of individuals, groups, and government awareness and response to flood disaster risk is a key determinant of how effective the given management strategies are appropriately adopted. Timing of each flood disaster scenario is crucial in each management perspective (Figure 3).

There are ranges of vital action plans involved at each stage of management and/or mitigation as shown in Srinivas Hari [18]; Warfield [19]; United Nations Development Programme [20]; NEMA [21]. For instance, pre-flood disaster risk management encompasses all appropriate actions are taken to reduce or avert losses before a given flood event. The actions include the creation of awareness through public education and enlightenment programs, early warning signal, proper monitoring, and enhanced information sources regarding a flood event, timely evacuation/ relocation plans, strengthening existing structures (buildings, infrastructures, amenities, and drainages), building capacity and mobilization of manpower at government/volunteer group/household levels.

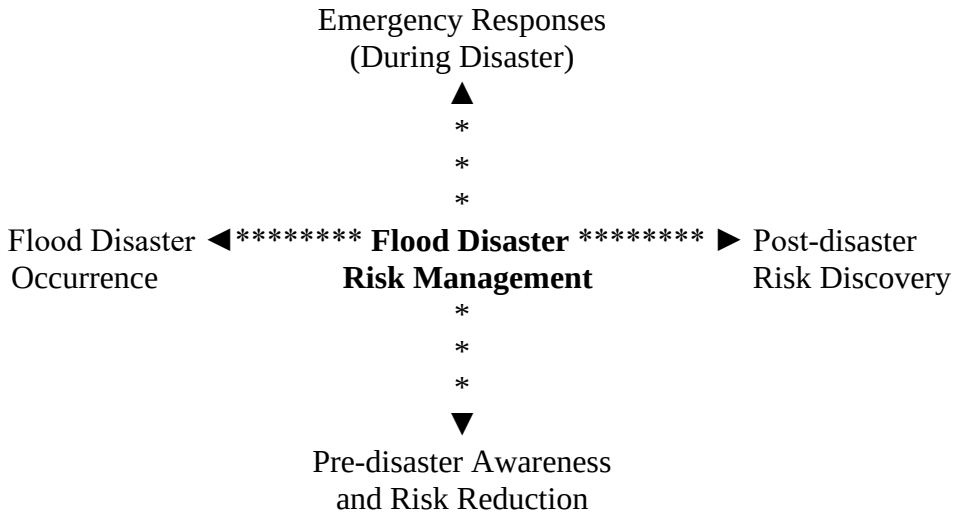

Figure 3: The diverse Perspectives to Flood Disaster Risk Management.

On the other hand, emergency response actions are those actions taken during a flood disaster to mitigate or avert the impacts on people over a period of time. Such actions embrace emergency aid/supplies (food, drugs, clothes, water, money, and etcetera), search and rescue mission for the weaker people, evacuation and rehabilitation, hospitalization and others. Hence, most of the services at this stage are very essential, risky, and highly specialized.

The third phase is post-disaster actions. It encompasses all the actions taken for the purpose of reassuring the flood victims of their early recovery from the psychological, health, socio-economic and physical effects imposed on them as a result of the event. Some major plans at this stage include reconstruction, rehabilitation, medication, counselling, reintegration, quarantine/ immunization, training, and retraining programs which usually take a longer period of time and heavy capacities investments.

3.5 Mitigation Options for Environmental Sustainability and Ecologically Smart Future

Contemporary researchers have suggested that flood disaster risk cannot be completely control whether with engineering or non-structural measures, but its impacts on people and property can be mitigated through coordinated plans and actions as envisaged in Umo [1], Ojinma et al. [5], Adedeji et al. [13], Pollner et al. [22], Ologunorisa [23], and Umo et al (2018). Moreover, since the past efforts have failed to yield the expected results at present, we are confident that promoting sustainable development and working towards ecologically smart future necessitate the adoption of proactive, sensitive, and vital options that are people-oriented, as identified and chronologically elucidate in the discussions that follow.

I. Promotion and Implementation of existing Legal and Institutional Frameworks

Although there are diverse viable legislative and institutional frameworks put in place to guiding and regulate human activities at both urban and rural areas of Nigeria, some exploitative actions such as building on green/ shelter belts, drainage lines, power lines, right of way, colonization of waterways/ parks/ reserve area, and indiscriminate wastes dumping have serious adverse influence on flood disaster.

The outlined actions and structures are considered illegal, yet the regulatory bodies like Town Planning Authorities, City Development Authorities, environmental Protection Agencies, and allied institutions' levels or efforts against such unwarranted activities are abysmally low, thereby de-accelerating the promotion of environmental sustainability and impairing actions towards creating an ecologically smart future.

This is necessary because previous laws that were supposed to regulate unplanned and illegal activities in the floodplain region are either neglected or not carefully implemented as exemplified in areas close to the lower Niger Bridge. Generally, the regulatory and institutional framework re-establishes national responsibilities for risk mitigation by providing authority to respective government agencies and individuals to discharge certain responsibilities relating to agreed government measures.

II. Introduction and Promotion of Flood Disaster Risk Assessment

The development of natural hazard risk assessments for selected areas and hazards, based on the analysis of historical events at these locations, can feed into probability distributions and predictions of likely future occurrences. To undertake a risk assessment, data on climate and land use change should be collected and analyzed on the assets and populations exposed in a given location. Probable damage scenarios, vulnerability models, and loss scenarios analyses are useful tools, which constitute key foundations for the development of preparedness actions and investments, as well as for risk financing options.

III. Curriculum Reviews and Promotion of Environmental Education

There is an urgent need for the review and inclusion of disaster risk mitigation in the curriculum as aspect of environmental education at the primary and secondary schools' levels. Such inclusion will serve as catalyst to the public for enhanced people's level of awareness and response for safety. Also, the use of mass media (e.g., television, radio, schools), social media (e.g., Facebook, Twitter, WhatsApp, and e-mails), and community outreach programs can disseminate information on flood and allied disasters in various domains. Public awareness of various flood-risks also helps monitor developments on the ground and keeps authorities accountable for their actions in hazard risk management/ mitigation.

IV. Control, Approval, and Implementation of Building Plans

Land use planning, flood-resistant designs and construction, building regulations and permitting systems, and enforcement of urban plans and building codes address the safety of future structures. These measures are particularly important in fast-growing and often unregulated developmental areas (urbanization). Spatial development plans and regulations for natural hazards, as well as enforcement of the existing or newly formulated building codes and regulations, are of key importance for mitigation against all hazards.

V. Reinforcement of Catchment Management Plans and Existing Dam Projects

The sustainability of any flood management plan depends of the feasibility, utility, and adaptability of people to the standard engineering structures and rules. Investments toward enhancing flood prevention projects such as erecting seawalls, building safe houses, and constructing levees along the river bank especially in the South; improvement of reservoirs and dykes; retrofitting of existing dams for safety with larger spillways and gates especially in the North; enlarging flood ways; building levees, flood walls, seawalls/ bulkheads; dam monitoring, reviews and revisions of operating rules for dams in Nigeria.

Contextually, frantic efforts can be focus on periodic reinforcement of existing engineering, infrastructure, and environmental structure to protect and mitigate the impacts of flood and allied disasters associated with a specific catchment. Proper feasibility and follow-up studies that incorporate economic, environmental, and social assessments should precede decisions on flood protection investments, accounting not only for historical frequency and loss data projections, but require a modified technical approach.

VI. Building Capacities for Flood Specific-Hazard Risks

There is a need to build valid guidelines for flood disaster risks based on their distinct types and causative variables. The enhancement of capacities through flood hazard-specific capital investment can strengthen tools and equipment procurements for flood-risk communities. For example, the level of risk associated with a flash flood in the urbanized areas of World Bank/ Amakohia/ Akwakuma/ Uratta in Owerri axes of Imo State or Nnewi/ Awka/ Ekworobia/ Ihiala axes in Anambra State are not the same as the historic Ogunpa River or Oguta Lake flood. More so, promotion of insurance policies for flood risks and educating people on flood preparedness and response actions are effective and relatively low-cost measures, which Federal, State, and Local governments can pursue.

4.0 Conclusion and Recommendations

The preceding discourses on climate-induced flood disaster risk awareness in Nigeria indicated that the causative variables have a strong affinity with the changing patterns of weather and climate. Yet, the contemporary increase in negative impacts on the vulnerable elements is accelerated by the anthropocentric parasitism on the human environment. There is an urgent need for human activities in ecosystem to focus more on caring, protecting, loving, harmonizing, sustaining, and symbiotic for posterity; instead of the destructive and parasitic. The perceived past neglect and/ or poor enforcement of valid environmental Laws and Regulations in Nigeria tend to promote human insensitivity to environmental protection thereby hampering the sustainability of sound future ecological systems. To eradicate the lapses, functional legislations need to be carefully enforced in distinct geographic regions and States in Nigeria. The areas of urgent attention are those pertaining to land use ordinances, building codes, and colonization of prohibited spaces such as green belt, drainage channels, and grass verge for illegal structures. The flood disaster vulnerability mapping is not given the expected attention that is commensurate with the prevailing issues of climate variability and change. Such exercises can be sponsored by the government through its ministries, agencies, and donor organizations to facilitate the assessment of risks and identify actual/ potential mitigation measures, and viable action plans to guide future actions. Also, investments need to be prioritized, implement, administer, and sustain to promote appropriate ecological smart future and sustainable development.

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