

GLOBAL JOURNAL OF ADVANCED ENGINEERING TECHNOLOGIES AND SCIENCES**NON-STRUCTURAL FLOOD PROTECTION MEASURES AND FLOOD RISK REDUCTION IN NIGERIA****Anthony Peter* & Sanmi Adeoti**

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DOI: 10.5281/zenodo.1170656**ABSTRACT**

Worldwide, flooding is without much doubt the highest cause of losses from natural events. No region in the world is safe from being flooded. Nigeria is not an exception. Modern flood mitigation is increasingly non-structural. As flood safety cannot be reached in most vulnerable areas with the help of structural means alone, a combination of structural and non-structural measures seems to be a proper solution. This study reflects on critical issue relating to flooding in Nigeria such as measures, flood risk, hazard and risk reduction. Non-structural measures are in better agreement with the spirit of sustainable development, being more reversible, commonly acceptable, and environment-friendly. Among such measures are source control (watershed/landscape structure management), laws and regulations (including zoning), flood proofing, an efficient flood forecast-warning system, flood insurance, awareness raising, and flood risk mapping. These appear today as indispensable complements to structural engineering solutions.

KEYWORDS: Flood risk, Hazard, Non- structural measures, risk reduction, vulnerability.**INTRODUCTION**

In many parts of the world, flooding is the leading cause of losses from natural phenomena and is responsible for a greater number of damaging events than any other type of natural hazard. The vulnerability of societies grows as they become wealthier and more exposed – technology helps populate more “difficult” areas. Vulnerability to floods can be regarded as a function of exposure and adaptive capacity (IPCC, 2001a) These natural events are not a problem. They present a hazard and may cause a disaster only after humans construct a built environment on flood-prone lands (NRC, 1989; Parker, 2000; Kumar et al., 2001). No populated area in the world is safe from being flooded. However, the range of vulnerability to the flood hazard is very wide, in fact wider than for most other hazards. Some societies (communities, state, regions) have learned to live with floods. They are prepared. Others are sometimes completely taken by surprise when a river surge (or the sea) rises to a level neighboring resident have never experienced before in their lives(Wolfgang,2005). During the last few decades, many floodplains have been occupied by residential areas and industrial parks. These areas are usually flat and not necessarily good for agricultural use. The nearby rivers have been tamed and confined in narrow strips by dikes, and cheap and attractive land has been reclaimed. Towns and villages have declared these areas residential areas and, therefore, many potential buyers of property counted on there being no flood hazard to be feared. (Wolfgang,2005). The dramatic increase in the world’s population, in certain regions in particular, creates the necessity to settle in areas that are dangerous (Kron, 1999).

In Africa, the study shows that Nigeria ranks topmost, overtaking Mozambique and Algeria in terms of economic loss. This reality highlights the need for more proactive efforts towards tackling flooding in the country(FME,2012). Nigeria been part of the globe is not left out in this ugly menace of flood. There have been several cases of floods in Nigeria mostly resulting from heavy downpour and excess releases from dams whose operational capacities could not cope with excessive inflows into their reservoir areas. In most cases these releases are made mainly to safe the dams whose failure could be more catastrophic than the consequences of the releases. Cases of these floods affects urban centers and rural settlements along the floodplain (Etiosa, 2006; NWRI, 2008), and in all cases houses, property, farm produce and animals were destroyed running into billions of dollars each year (Vanguard, 2005 and 2007). The National Emergency Management Agency (2012) reported that the 2012 flood in Nigeria was declared a national disaster as it affected over 2.3 million people and killed over 363 people. Some Nigerian cities were swept off by the flood and affected 34 out of 36 states of the federation. See fig. 2.

It is well known that the success of flood risk reduction depends to a large extent on knowledge-based decision, robust institutional framework and flood risk communication [Raaijmakers et al, 2008; Ologunorisa et al,2005) but these factors are missing in Nigeria and where they exist they are poorly addressed. Knowledge-based decision uses available information relating to flooding to draw conclusions on possible strategies to be adopted for tackling flooding. Flood risk communication aims at creating awareness of flooding and its impacts in stake holders and the general public. Institutional framework that tackles flooding in Nigeria refers to government

response procedures which include policies, regulations, guidelines and agencies engaged in planning and managing flood emergency conditions or in helping victims to cope with and recover speedily from extreme flooding events (Obeta 2014).

These hazards were generally linked to poor urban planning and climate change especially in increased frequency and intensity of rainfall (Action aid,2006; Adelojo et al,2011; Cline,2007). The impacts of floods in Nigeria include mortality, physical injuries, widespread infection and vector-borne diseases, social disorders, homelessness, food insecurity, economic losses (mainly through destruction of farmlands, social and urban infrastructure) and economic disruption (most notably in oil exploration in the Niger delta, traffic congestion in many cities in Nigeria, disruption in telecommunication and power supply (Ogunbode and Sunmola,2014;Ologunlorisa and Adeyemo,2005;Fadairo and Ganiyu,2010). The impacts of such floods have been severe due to the number of human populations exposed following the attractions of coastal areas for economic and social reasons (Adelekan,2010). Nigeria is globally ranked with the top 20 countries whose present population and future scenarios in the 2070s (including climate change and socio-economic factors) are exposed to coastal flooding. (Nicholls et al,2008). However, various levels of government, the community and other stake holders have been active with measures to tackle flooding in Nigeria (Olorunfemi,2011). These measures have been criticized as ad-hoc, nongeneralizable and not well established (Obeta,2014). In the light of 'best practices' in flood risk reduction and 'lessons learned' from other countries' experiences of flooding, it can be argued that such stake holders' efforts are at best limited most probably due to lack of quality data, which among other things are needed to systematically tackle flooding, poor perception of flooding among the general public, lack of funds and improved technology as well as poor political will power. Best practices in flood risk reduction ideally is based on "living with floods and not fighting them" idea, which dominates key environmental risk research themes (for examples: Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA)) and integrates structural and nonstructural measures to reduce the impacts of flooding on social systems and to achieve key requirements in risk management which are prevention/ mitigation, preparedness, emergency response, recovery and lessons learned (Balbi et al,2012;Dibadasarre et al,2012;DEFRA,2013;EC,2004;Zhu et al,2011).

Method and Data

A search process to identify the body of literature relevant to flooding and measures towards addressing it in Nigeria was undertaken. The study adopted the secondary source of data collection by exploring previous works on the subject matter using internet, journals and books.

Description of the study area

Nigeria is situated on the west coast of Africa, lies on latitudes 4° north of the Equator and latitudes 3° and 14° on the east of the Greenwich Meridian. Shares boundaries with The Republics of Benin and Niger in the west, Cameroon in the East, Niger and Chad in the north and the Gulf of Guinea in the South. It has an area of 923,768.64sq. Kilometers. Abuja is the capital city. Made up of: A Federal Government, Federal Capital Territory,36 states and 774 Local Governments. See fig. 1.

It maintains a large expanse of coastline, over 853 km in magnitude, with hydrological features which includes the rivers Niger and Benue, both of which confluence at Lokoja, and flows further southwards passing through the Niger Delta to empty into the Atlantic ocean .The 2006 census confirmed over 140 million people in Nigeria ,but this population has grown steadily, and is presently estimated at more than 180 million people, making the country the seventh most populous country in the world (Obeta,2014;NPC,2007). According to United Nations projections, Nigeria is one of the eight countries expected to account collectively for half of the total population increase in the world from 2005-2050, and will by 2100, record a population amounting between 505 million and 1.03 billion people (UN,2004)

MEASURES

Awareness/Education

Enhancing knowledge about floods is of enormous importance for awareness raising and enhancing the consultative procedure, which leads to a flood protection measure. Only informed stakeholders can make rational decisions about choice of strategies of flood protection, in cost-benefit framework; with the account of sustainability issues. Yet, misconceptions and myths about floods and flood protection are deeply rooted in the society – the general public, politicians and decision-makers alike. It is of utmost importance to dispel and to rectify misconceptions such as those inherited from forefathers. Apart from misconceptions there are counter-productive “principles,” valid throughout political and social systems, such as Klemes’ rule of hydro-illogical cycle. Flood occurrence triggers high expenditures on flood protection. Yet, memory fades and after some time without flood, the willingness to pay drastically decreases. How can this truth be communicated to the electorate and decision-makers whose term of office is short? The role of media in awareness raising and information spreading is worthy of interest. The freedom of press does not always match responsibility. A particularly bad example is embedding flood mitigation into a political campaign (Kundzewicz *et al.*, 1999). Apart from collecting data and building flood-related databases, information can be generated by modeling. Mathematical models do not only serve forecast systems. They are indispensable for improving general understanding – simulation of events, analyzing efficiency of policies and measures (Zbigniew, 2002)

Zoning, building codes and Relocation

Zoning measure is used to limit the type and extent of development in the floodplain. A saying goes that if people build in a floodplain, there is no solution. Certainly, precautionary measures, such as zoning and regulation of floodplain development, are advantageous. Building codes can be designed to ensure that new structures built in flood-prone areas are resistant to damage. However, if endangered locations have already been developed, a remedy is that humans and infrastructure move out of harm’s way. Nigeria Has well established system of zoning where lands apportioned to specific function are shown on maps, these maps guide the public especially on flood prone zones. The authorities saddled with the implementations of such maps should execute it appropriately.

Flood Insurance

Existence of appropriate schemes of insurance, or distribution of risks and losses over a large number of people and long time, and disaster aid, or capacity to compensate losses not covered by insurance, are important components of flood preparedness. These mechanisms are needed in order to help flood victims recover after losses.

Flood Forecasting and Warning

Flood forecasting and warning is a very important non-structural flood protection measure. Detection and warning systems provide sufficient time for individuals and communities to limit their losses in a flood. Forecasting, based on mathematical modeling, allows experts to convert the information on the past-to present rainfall, status of moisture, and snow cover into a river flow forecast (discharge, stage, and inundated area for a future time horizon). For small catchments and flash floods, a time lag between an intense precipitation and the flood peak is very short. Therefore, deployment of radar and quantitative precipitation forecast is necessary. Propagation of a flood wave in a large river may take several weeks, allowing for ample time for response to flood forecast. There are many attempts to improve the forecast accuracy and to extend the time horizon for a meaningful forecast. One challenging avenue is to make use of atmospheric-oceanic-hydrological links. Accurate forecasts should be translated into reliable warnings, broadly and effectively disseminated to the communities at risk so they can take adequate loss-reducing actions (Zbigniew, 2002)

Flood risk mapping

Conveys valuable spatial messages. Yet, in a number of cases, such maps, solicited by authorities, have not been disseminated – the consequences would be unbearable for the ruling powers. The components are: flood hazard maps and flood risk maps. Flood hazards maps covers the geographical areas which could be flooded according to different scenarios; shows areas which could be flooded according to three probabilities (low, medium and high) complemented with: type of flood, the flood extent, water depths or water level while the flood risk maps shows the potential adverse consequences associated with floods under those scenarios. Areas at risk of flooding can be dynamic in nature. With a changing level of development, the nature and degree of risk also changes. Flood risk increases mainly because of an increase level of exposure of the elements under threat. Flood risk maps represents a spatial integration of the hazard, exposure and the level of vulnerability. They effectively combine vulnerability maps with flood hazard maps to give an overall view of the risk (Jha *et al.*, 2012).

Continuous updating and monitoring of risk maps is, therefore, most important for proper flood risk management: Decision makers needs up-to-date information in order to effectively allocate resources.

Watershed Management

Source control modifies the formation of floodwater. This concept belongs to a broader category of watershed management including land use and soil conservation to minimize surface runoff, erosion, and sediment transport by terracing and contour ploughing, vegetation cover management and afforestation. The idea of “catching water where it falls” is implemented by such measures as enhancing infiltration, reducing impermeable area, and enhancing storage by ponds or artificial storages (Kundzewicz and Takeuchi, 1999). Enhancing retention counteracts such adverse effects of urbanization as decrease in storage potential, growth of flood peak, and decrease in time-to peak of a hydrograph. Watershed management should also include increase of storage in the river system (floodplains, polders, wash lands) .

Flood proofing

It includes building retrofitting in the form of sealing gates or small floodwalls. Other flood proofing options include relocation of vulnerable contents to higher floors in a building. This measure reduces losses especially of properties.

Risk Defined

The term risk is understood in different ways by different people. While this plurality in usage may often be of no consequence, risk should be defined, for scientific discussions, in an unambiguous and consistent way. In the scientific community, it is widely agreed that risk is the product of a hazard and its consequences. Where there are no people or values that can be affected by a natural phenomenon, there is no risk. In a similar way, a disaster can only occur when people are harmed and/or their belongings damaged. A devastating flood in an uninhabited region without human property cannot result in disaster. Similarly, a flood in a well-prepared region will not be catastrophic. In a poorly prepared region, however, even a moderate flood may cause a devastating catastrophe. The flood hazard is clearly highest in the first case, while the flood risk is highest in the third case.

Hence, three components determine the risk:

1. the hazard: the threatening natural event including its probability of occurrence;
2. the values or values at risk: the buildings/items/humans that are present at the location involved;
3. the vulnerability: the lack of resistance to damaging/destructive forces.

WHY FLOOD RISK IS INCREASING

The fact that flood catastrophes are becoming more and more frequent and severe – and the flood risk is, therefore, higher – although protection and preparedness measures have been improving, is addressed in the following by highlighting some aspects of each of the three components that determine the risk

Increasing Hazard

Over the past decades there have been a number of developments that have certainly caused changes in the flood hazard, i.e. in the occurrence frequency and magnitude of high flows. Practically all of these developments must be attributed to human activities, even the ongoing shift in the hydrologic regime due to climate change.

Emergence of new settlement areas directly leads to a reduction in the storage volumes of natural retention areas. Flood plains are occupied by new settlements or otherwise heavily used. This often requires river training in the form of channel straightening and dikes that sometimes even prevent agricultural areas from being flooded. In this way flood peaks and their propagation velocities become higher and increase the flood hazard downstream. In a similar way, the increase in anthropogenic ground sealing by parts of the catchment being covered by impermeable or at least less permeable surfaces such as houses, roads and parking lots, causes a further increase in the runoff and – in some cases – in the peak flows in the rivers. However, one should be wary of blaming the above changes for the increase in the flood hazard everywhere. While they may have dramatic consequences in some areas (particularly in small catchments), their influence usually becomes smaller and finally almost negligible as the size of the catchment and river network increases. A flood along a large river is not created by impermeable urban areas; it needs quasi-impermeable rural areas as well. This “natural impermeability” is caused by antecedent rainfall that soaks the soil and uses up its storage capacity.

Lumped assumptions that link higher flood peaks to higher flow velocities are not always valid either. In a river system, the crucial point is how the hydrographs from the various branches act together, i.e. how they are superimposed on each other. Hence, a faster propagating flood wave from a major tributary may even be advantageous if it enters the main river before the peak from the upstream drainage area has arrived there, and,

therefore, alleviates the situation. A sure consequence of faster flowing water is increased erosion of the channel and its bed. This may

increase the threat to bridge piers and abutments, dikes, and embankments, and reduce the storage capacity of reservoirs where the sediments settle. But as far as the higher flood hazard is concerned, erosion processes in the catchment are a more important factor. In many places, a change in the use of land (agricultural areas instead of pastures and forests) is a major reason for a dramatic increase in the sediment transport rates of rivers and deposition rates in downstream reaches. This deposition not only causes the bed levels to rise, but also leads to the retention areas along the rivers being filled with sediment, and, hence, more and more inactivated.

The implications of a changing climate should not be forgotten. In many places the hydrologic impact of climate change on floods is not primarily due to the increased annual rainfall depth but to the shift in the seasonal rainfall pattern. A strong tendency towards a higher variability in weather parameters (e.g., rainfall intensity) is expected, leading to more pronounced extremes, in terms of both flood and drought. On the global scale, the expected temperature increase of 1.4 to 5.8°C by the end of this century (IPCC, 2001b) will lead to higher rainfall amounts and to higher probabilities of extremes.

Increase in Values

The dramatic increase in Nigerian's population and in particular in certain regions certainly constitutes the main reason why losses from flood disasters have been almost exploding in recent decades. The increase in losses from natural events is a direct function of the number of people who must or wish to settle in flood-prone areas, and a function of the increasing values they possess and their greater susceptibility to water. Floodplains (and coastal plains) are, if one neglects the flood hazard, well suited for development. They are flat, provide easy access to process and cooling water, allow transport of raw materials and products by boat and are easy to develop with roads, water and power networks, and other lifelines. The river is usually thought to be "tamed" by a dike, and residents and property owners feel safe, especially if no major event happens in the first few years after they have occupied the land. In such a situation, huge values are built up in the form of buildings, equipment, and stocks. Additionally, many jobs are dependent on the industries and businesses located on floodplains, which becomes a problem as soon as production or business is interrupted by inundation and people cannot work or even go to work. Generally, people today own more things than ever before and things with higher values as well. For instance, electronic and electrical installations such as computer centers, air-conditioning control centers, and elevator machinery are the typical and highly vulnerable contents of basements. Underground parking garages for employees and customers are component parts of most new office buildings. Although cars are relatively easy to remove, they still represent a very high loss potential which could be realized in the event of a flash flood when there is no lead time for warning.

Increasing Vulnerability

In olden days, most belongings were hardly susceptible to damage by water. The ones that were could be carried to a safe place and even if they were lost, the damage was relatively minor. Today's contents often suffer total damage when they get in contact with water. Especially electric and electronic machines, appliances, and other devices are highly vulnerable to humidity and dirt and other pollution particles, which are always found in flood waters. The change from stove heating to central heating is maybe the most important difference. Not only the central heaters are installed in the basement and cannot be removed, but there are also oil tanks that can lead to severe pollution when they are flooded. This means much more effort has to be put into the flood protection of low-lying parts of residential buildings.

People ignore the fact that they live in areas endangered by floods and often "forget" their exposure in a surprisingly short time after a flood they have actually experienced, and after a period of raised awareness they return to ignorance.

RISK REDUCTION

General actions including physical intervention, legislation and policy formulation, creation of awareness of flooding, urban renewal and development, engineering structures such as dams, bridges and drainage systems, relocation of human populations during flooding and assisting flood victims with basic humanitarian needs (Olorunfemi and Odunuga, 2008). These measures are grouped into organized approach, local communities and the general public approach, humanitarian agencies approach and research/ media approach.

Institutional Framework Approach

Institutional approach towards addressing the threats of flooding in Nigeria dates back to the early 1960's with the establishment of federal and state ministries of works (Ibitoye, 2007). However, the increasing frequency and

severity of floods across the country prompted the establishing of the Federal Environmental Protection Agency (FEPA) as a unit in the Federal Ministry of Works and Housing in 1988 (Obeta,2009) and the Federal Ministry of Environment (FME) in 1999 (FME,2012). Among other things, the key roles of FME towards flooding risk reduction in Nigeria is to assess the flooding potentials as well as design, determine, develop and/or authorize the development of appropriate flood reduction measures for the country (FME,2012).With the FME comes various ministries and agencies for tackling flooding in Nigeria which include: Federal Emergency Management Agency (FEMA), National Emergency Management Agency (NEMA),State Emergency Management Agency (SEMA), Local Emergency Management Agency (LEMA), National Orientation Agency (NOA),National Commission for Refugees (NCR), National Environmental Standards and Regulations Enforcement Agency (NESREA) which by 2009 Nigerian Acts supersedes the FEPA, Nigerian Meteorological Agency (NIMET), Nigeria Hydrological Services Agency (NIHSA),NEST (Nigeria Environmental Study/Action Team) and Building Nigeria's Response to Climate Change (BNRCC).

NEMA is basically a coordinating body for disaster management in Nigeria. Actions towards addressing the threats of flooding which the agency coordinates include but not limited to policy formulation, leasing with and assessing the state of preparedness of all other relevant agencies, data collation from relevant agencies, education of the general public on flooding and interaction with SEMA towards the distribution of relief materials to disaster victims within states and local government areas. Recently, a memorandum of understanding was signed with NESREA and NOA to intensify efforts towards flood risk management in Nigeria (NEMA,2013).The protection and development of the environment, a measure that helps keep check flooding, is the key role of NESREA, the agency which enforces all environmental laws, guidelines, policies, standards and regulations in Nigeria, as well as enforcing compliance with provisions of international agreements, protocols, conventions and treaties on the environment to which Nigeria is a signatory.

Whilst the provision of humanitarian needs such as shelter, clothing and floods for internally displaced persons is anchored by NCR, the importance of local communities being aware of flooding and actively participating in discussions and decisions which might increase their resilience and adaptability to the hazard highlights in the roles of NOA, which re-orientates and keeps Nigerians informed about ways of taking part in issue that affects them. The poor perception of flooding in the country should be the concern of this agency. NIHSA provides reliable and high quality hydrological and hydrogeological data on a continuous basis for the for the purposes of assessing the status and trends of the nation's water resources including its location in time and space, extent, dependability, quality and the possibilities of its utilization and control. Since 2013, the agency has been creating awareness of flooding through the "flood outlook" initiative. Other activities of NIHSA include; provision professional advice to various levels of government in Nigeria on all aspects of hydrology, collaborates with NIMET to issue flood forecast and contributes towards creating awareness of flooding among local communities. NIMET furnishes the country with weather report, and other meteorological information, issues alerts and early warning and forecast on impending flood disasters within the country.

Issues relating to flood insurance are coordinated by FEMA, the agency which makes federally funded insurance protection policy available for property owners in Nigeria. Policies relating to assisting flood victim at state and local government levels are coordinated by SEMA and LEMA. As climate change is complicit with other factors that influence flooding in Nigeria, BNRCC's key role is to collaborate with other agencies to promote the capacities of the generality of human populations within the country to cope with all effects of climate change. NEST undertakes continuous research required for enhancing decisions and robust measures towards addressing flooding in Nigeria (Kolawole et al,2011;Akintola and Ikwuyatum,2012).

local communities and the general public approach

The peculiar attitude of Nigerians towards issues they probably have no solution to is to find a possible natural means to adapt. Although such attitude has cost many lives and properties, however, it is arguably a significant potential for Nigerians and has severally favored them in emergency situations. Families in Nigeria co-habit and this offers a comparative advantage in the event of flood disasters. In many flooding incidences in Nigerian cities, the general public has often offered assistance to victims, assisted in evacuation of those displaced and in protecting property from further damage. Many IDPs easily find shelter and other humanitarian needs from families and friends while awaiting intervention by authorities. Although anti-social behavior, such as looting and sexual harassment of some of the internally displaced victims often arise, however the civilized attitudes of the general public, which may be comparable to those in the developed world such as the US following the hurricane Katrina of 2005 (Wilson et al,2007) has been commendable.

Humanitarian agencies approach

Humanitarian response to flooding in Nigeria dates back to the early 1980s following the Ogunpa, Sokoto-Rima, Banguada flood disasters (Anih,2004). Almost in all cases of flooding in Nigeria victims have received humanitarian supports with most notably the International Federation of Red Cross (IFRC), United Nations, World Bank, Foreign countries including UK, the United States, China, Japan, France as well as religious organizations including the Catholic, Anglican and Pentecostal churches and missionary societies .The support rendered during the ugly occurrence goes a long way to show a sense of belonging to the affected communities These supports which seem to indicate solidarity for Nigeria as a whole and the people affected by flooding within the country in particular have been whole heartedly appreciated.

Research and the media approach

Arguably, much of what is known about flooding in Nigeria can be attributed to efforts by research and media. In the literature, undoubtedly, considerable attention has been given to flooding in Nigeria. Presently there are more than five hundred publications indexed in the Google scholar that relates to flooding and means of tackling it in Nigeria. In addition, the country has a number of countrywide research-based groups such as the NEST (Nigeria Environmental Study/Action Team), BNRCC (Building Nigeria's Response to Climate Change) and university-based research groups that focus on flooding within Nigeria. Similarly, the Nigerian media has been given the credit of providing qualitative information regarding the widespread flooding in Nigeria (Aderogba,2012).

CONCLUSION

The future change of flood risk may be complex. In many places flood risk is likely to grow, due to a combination of anthropogenic and climatic factors. Yet, quantification of flood statistics is difficult and subject to high uncertainty. Building flood risk consciousness among the public is of paramount importance. Since a flood protection system guaranteeing absolute safety is not possible, a change of paradigm is required. It is necessary to live with the awareness of the possibility of floods by harmonizing them, not to attempt, in fiasco, to eliminate them. Risk reduction must, therefore, not only address hazard reduction, e.g. through the erection of flood protection structures, but also aim for encompassing of each individual in this task. Non-structural measures are of utmost important in combating flood menace.

Flood risk is increasing worldwide. Risk must be considered a result of hazard, values at risk, and vulnerability, each of these parts must be taken into account and analyzed if one is looking for the reasons for this increase. It means the major factors are the almost exploding development in the values people place in flood-prone areas and the much higher vulnerability of the things they possess. Furthermore, increased – though sometimes forced – mobility brings people into areas whose natural features they are not familiar with. As a result, they do not know how to react in an extreme situation. Additionally, the hazard situation concerning hydrological events is also changing as a result of the ongoing process of climate change, which in most regions has a tendency to intensify extremes.

Efforts towards addressing the challenges of flooding in most places for example the US and Europe include these more robust operations to achieve the three-tier risk management cycle, which includes mitigation/prevention, preparedness, response and recovery. Unfortunately, the implementation of these operations in Nigeria is not sufficient to counter the ugly menace of flood.

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