

Chapter

Current Issues in Early Warning and Development Initiatives Towards Enhanced Flood-Related Resilience in Nigeria

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Abstract

More than 4 years since the UNISDR Sendai framework replaced its predecessor, Hyogo, communities' resilience to flooding is still a major issue for especially the developing countries (DCs) such as Nigeria where there are unresolved limitations with early warning systems. The recent increase in human and economic damages caused by floods and the inability of communities to recover from the effects, despite years after the disaster, indicate that the global concept of resilience has not been fully grasped. Nigeria, which is the subject of this chapter, typifies this situation. Evidently, the historic flooding of 2012 and its predecessors affected many communities and individual victims most of whom are still struggling with disaster recovery and reconstruction. This raises important research questions. What is not understood in the present context is that government institutions have made a lot of politicizing various interventions and local initiative, but the present reality is a "pathetic travesty of disaster recovery." This chapter elucidates on these issues through theoretical discussions on community participation, risk-informed investment, and rural adaptation, all of which can be advocated to facilitate community resilience and coping capacity to all variants of flood hazards in Nigeria.

Keywords: flooding, resilience, Nigeria, climate change, disaster management, early warning, community participation, sustainable development

1. Introduction

Flooding has caused, and is still responsible for, most of the world's biggest humanitarian crises. It affects a large number of people through displacement from their homes, physical drowning, psychological trauma, and, in extreme cases, death. It is responsible for some of the largest economic and environmental losses in different places around the world. Recent data from the United Nations Office for Disaster Risk Reduction show that, on average, 250 million people globally are affected by flooding each year. Disaster modeling team at Aon Benfield estimates the global economic cost of flooding at over USD 90 billion and predicts an increase that will exceed USD 500 billion by 2030. Although flooding is a global phenomenon, the experience in the developing countries (DCs) is an important research issue, which reflects particularly the need to bolster action toward mitigating the human and environmental impacts.

The attribution of flooding largely reflects a variety of factors, which includes at least, rapid urban growth, the development of coastal cities, sea level rises, and poor planning ideology to accommodate fast-paced urban development. Climate change is also high on the chain of attribution of flood risk. Extant research (e.g., [1–3]) reveals that climate change is escalating the frequency of low- to high-duration high intensity rainfall events, which is the main trigger of pluvial urban flooding in recent times. Within a global context, the poorest and least-prepared communities are subject to large-scale impacts of these events, which also undermine their potential to develop economically while they aim to mitigate the loss of human lives and development efforts. In case of sea level rises, climate change has over time forced a cumulative rise in the global sea level that now compromises the usual structural defenses up to 1 in 1000-year flooding.

Simple techniques based on appropriate flood risk management concepts can save lives and reduce losses. This includes the use of modern technology, which utilizes geospatial infrastructure to identify and map areas prone to flooding and to inform appropriate action toward disaster preparedness, rescue, and recovery. This is more of a United Nations International strategy on Disaster reduction (UNISDR) concept of living with floods rather than fighting them. The principles underlying this concept are the importance of building communities' resilience to recurrent flooding events. Evidence from best practices in flood risk and disaster management reveals that building communities' resilience to flooding reflects two main factors: the establishment of timely warning systems and adequate investment in key infrastructure, with sustainable development initiatives [4–6].

Early warning systems, through communication of flood risk assessment and uncertainties, are important to improve the communities' preparedness and to help them make better decisions for their safety [7, 8]. This is a good step toward reducing human and economic impacts of flooding. However, the studies of Fakhruddin et al. [9] and Smith et al. [10], which both focused on community-based flood of early warning systems in Asia, suggest that the implementation early warning systems and communication of flood assessment in the DCs raise vital research discussions. This is now more crucial than ever with the increasing human development on the coastal areas of these DCs, along with the rate of investments in risk management and public infrastructure, which does not resonate well with a formidable sustainable development initiatives. Of course, sustainable development can build-up the emergency response and rescue currency and assist in meeting the challenges that occur much later, such as epidemics, loss of infrastructure and displacement of people from their homes. It is obvious that real development of urban centers makes significant and dominant contributions toward building communities' resilience to flooding. However, Cohen [11] underlined a major issue that is often overlooked in this regard, which relates particularly to how to give communities in the DCs the needed capacities to thrive amidst the formidable sustainable development challenges.

The experience of flooding in Nigeria provides some interesting insights into these challenges, the limitations in early warning systems, and how communities' lack of capacities to thrive amidst formidable sustainable development affects their resilience to flooding. Sadly, more than 4 years since the Sendai framework replaced its predecessor, Hyogo, the resilience of many communities in Nigeria to flooding is still a major issue. Of course, there are success stories here and there; however, the increase in human and economic damages caused by floods and the inability of communities to recover from the effects of floods, despite years after the disaster, indicate some asymmetries in the concept of resilience. This chapter aims to address these issues which offer significant insights into the current debates in flood disaster management. It outlined a number of specific challenges to building communities'

resilience to flood disasters in Nigeria. The experiences of communities in Lokoja, Kogi state, which were affected during the 2012 flood in Nigeria, are explored to provide useful insights into the shortcomings in early warning systems and development processes in Nigeria and how they affect communities' resilience to flooding. The chapter raised issues related to community participation, risk-based investment, and rural adaptation programs, all of which can be advocated to facilitate community resilience and coping capacity to all variants of flood hazards in Nigeria.

2. The global concept of resilience in flood disaster management

The idea of flood-related resilience was initially the core argument of De Bruijn [12], who proposed a system approach as a new perspective whose prospect was to evolve a flood risk management that fits well with the socioeconomic context in which the management of flood disasters occurs. Within the system approach, the author contrasted resistance strategies—which aim at flood prevention—with resilience strategies, which aim at minimizing flood impacts and enhancing the recovery from those impacts. Resistance measures such as the primitive engineering structures to hold back the surges of water can be illustrated as a dredge of the old wineskin. However, the new paradigm in disaster management subject to UNISDR has introduced a fresh insight into the weakness of resistance measures and thus paves the way for resilience strategies. Although those engineering structures are still being used today, their main ideology is to build the resilience of communities to flood disaster.

Resilience thinking provides new beachheads for a comprehensive flood disaster management for both rural and urban communities. Cutter et al. [13] were of the opinion that resilience is a set of capacities that can be mediated through initiatives and policies, which help build and enhance communities' capacities to respond to and recover from disasters. Communities that employ resilience strategy, rather than resistance measures, are able to better cope with the uncertainties of flood disaster. Norris et al. [14] perceived community resilience as a process that relates a range of adaptive capacities to responses and changes after adverse events. Speaking of this capacity, core flood-related resilience research based their arguments on how to solve mostly disturbance and disasters induced by climate change (e.g., [13, 15]). However, there is a different view of flood-related resilience in which resilient houses and critical infrastructure are emphasized with different engineering parameters such as robustness and flexibility. Using pluvial flooding in the DCs as the exemplar, Jiang et al. [16] presented the China's sponge city initiative in relation to contemporary understanding of sustainable urban stormwater management. This is a novel flood-related resilience framework with an emphasis on structural design in which the efficiency of the stormwater management system is related to community's flood-related resilience. Kahan et al. [13, 17] reported more recent research on resilience from a homeland security perspective, which is aimed primarily at protecting critical infrastructure from terrorism. Resilience from the point of view of homeland's security of critical infrastructure assumes that resilience is an outcome measure with an end goal of damage and loss mitigation, as well as recovery from a distorted state.

A useful approach to the discussion of what constitutes flood-related resilience is to understand its foundations. Alexander [18] made etymological statements on the concept of resilience. The study attempted to link current perspectives of resilience to its original ideas explored by the author in the field of science, humanities, law, and politics. The study revealed that the concept of resilience benefits from a good history of meaning and application, although defining resilience from a continuum of ideas can lead to complex theories and to define a particular problem area, say flood disaster management can be slightly ambiguous. However, with the understanding

that flood risk in DC is associated with a complex range of attributions, the concept of resilience may be useful to poll a multidisciplinary interest, towards overcoming limitations in improving flood risk management strategies. It is for this reason that in order to mitigate the current problems with flooding crisis in Nigeria, research should try to understand how the history and background of resilience affect building a bespoke flood-related resilience in Nigeria. Further, from a more political point of view, it is instructive to elucidate the extent to which different actors are involved, drawing from a variety of training, career orientations, and management practices in Nigeria that can contribute to the prospect of building a flood-related resilience for Nigerians. This is an important discussion to the extent in which this chapter makes the case for investing in flood risk and community participation, which endow a somewhat statutory responsibility on both the public and private organizations in Nigeria and the need to integrate flood resilience into urban planning as proposed by Bertilsson et al. [19].

Beyond the historical underpinnings of resilience and its implications for managing flood disaster, other important areas of current discussion that are crucial for building Nigeria's flood-related resilience are (1) the metrics and standards to measure resilience that remain challenging according to Cutter et al. [13] and (2) the issue of "resourcing," which is the central theme in the discourse of resilience that it has been seen to restore life at the foundation of a community's capacity to recover from disasters [20]. These aspects of resilience are not common in many studies that have considered flood resilience and vulnerability in Nigeria, for example, Ajibade et al. [21] and Nkwunonwo [22], and these are issues that need to be addressed. In the world of resilience research, the indicators of resilience construct are often difficult to determine, and this is an important issue for Nigeria. Quasin et al. [23] and Shah et al. [24] in a flood resilience study for Pakistan selected a number of indicators of flooding from the literature search and found their proxies from preliminary data collected from a questionnaire. This gives a significant motivation as much as provides an insight into how this chapter intends to bridge the knowledge gaps in resilience studies in Nigeria.

3. Early warning systems and development initiatives in relation to flood disaster management

Early warning systems (EWSs) and a general developmental initiative are crucial in the success of disaster risk mitigation [25]. Various studies and extensive literature have shown that EWS in particular contributes to the resilience of societies to disaster and is therefore supported by various disaster management strategies [7]. Similarly, initiative toward developmental infrastructure, which includes public health facilities, microfinance institutions and insurance companies, effective communications systems and good traffic networks for easy connectivity, safe drinking water, public housing scheme, proper waste management and sanitation facilities, public recreation facilities, green spaces, community centers, geospatial data platforms, quality internet-of-things (IoT), sustainable drainage systems (SUDS), resilient houses, etc., can facilitate preparedness, emergency response, rescue, and recovery—relating to a disaster management framework—as well as enhance the resilience of communities toward disaster reduction. Speaking of floods, evidence from a growing body of scientific research indicates that the frequency of occurrence of extreme events, which possess potential for large-scale impacts, is much higher in recent times and likely to increase over the coming decades as a consequence of global climate change [3, 26, 27]. This fact cannot be more obvious; due to the inexorable nature of these disasters which suggest that risk reduction concepts

are the only possible solution therefore, modern disaster mitigation techniques must take advantage of opportunities in meteorological forecasting as well as the development and implementation of EWS that targets vulnerable regions and populations. Much improvement in technical skill and conceptual understanding of weather and climatic events including the phenomenal El Niño/Southern Oscillation, which has eased freely into advanced forecast and predictions, offers sentiments and impetus to early warning for disaster management [28]. However, a major developmental limitation still remains to be addressed in early warning for disaster prediction in developing countries such as Nigeria.

Various research opinions and empirical issues in global environmental change and science of the total environment reveal that flood risk and disaster scenarios of many urban conurbations and coastal areas have been predicted in advance, at least until 2050 [29, 30]. More than ever before in the history of man and the universe, knowledge of these predictions and their prospects to warn about future expectations is a crucial component of sustainability science. Rapid urbanization and population growth with the fast-growing coastal areas pose critical challenges, which must be addressed as part of disaster management strategy. Thus, there is a huge scientific undercurrent to the idea of resilience especially as it relates to floods that are often considered to be the worst hazard component within the human-ecological systems. Interestingly, this issue is not limited to environmental and geophysical scientists. In fact, reading through the discussions from the work of Ebi and Schmier [28], since the last 15 years, public health professionals have taken the opportunities of EWS to integrate weather- and climate-related information into local and regional risk management plans to reduce the detrimental health effects of extreme weather events, particularly tropical cyclones, floods, wildfires, and droughts. It is also worth noting that financial experts have a long-standing commitment to financial crises on the knowledge of EWS using certain *binomial discrete-dependent variable models* [31].

4. The 2012 flooding experience in Lokoja, Nigeria: implications for early warning systems, community participation, risk-based investment, and rural adaptation toward flood-related resilience in Nigeria

Nigeria's 2012 flooding event has been the most devastating in over 40 years. The floods affected more than a third of the states of the federation and account for mass casualty and hundreds of thousands of internally displaced people (IDP). Its economic impact amounts to millions of US dollars in economic products and farmlands, which were either destroyed or rendered without any commercial values. There were epidemics of water-borne diseases in many states leading to declaration of "state of emergency" by the presidency. Since the event, with the exception of news reports and tabloid coverage, numerous local and international research groups have focused on the attribution, impacts, and implications of the flooding event as well as related disaster risk reduction and national development [32–34]. **Figure 1** is a graphical representation of the experience and impacts of 2012 flooding events in Kogi.

Although the flood disaster affected the whole of Nigeria, Kogi state is the most affected. The geography and the natural landscape of the state, which include the spectacular Niger-Benue confluence and the abundance of inland waterways and contiguous land-water boundaries, make the area prone to flooding. A geospatial-assessment carried out by Aderoju et al. [35] revealed that the 2012 flood disaster in Kogi led to the displacement of about 300,000 people within 37 communities in



Figure 1.
Images of the 2012 flooding in Kogi state, Nigeria. Source: Google images of Nigeria's Kogi 2102 flooding.

seven local government areas (LGAs). Many farmlands were washed away. Urban and rural settlements were devastated leaving dozens and dozens of residents in immediate needs of rehousing or resettlement. Despite the large-scale impacts of the event, evidence from especially Richard et al. [36], who examined the characteristic pattern of the response of major stakeholders during the Kogi flood disaster, Danjibo Nathaniel et al. [37], who identified the issues with rehabilitation and post-disaster housing reconstruction, and Adaji et al. [38], who illustrated the fall out of the flooding event in Kogi, revealed that the majority of the victims are still in serious crises, and that there are significant issues of uncertainty regarding the overall recovery process from flood damage in Nigeria. There is no doubt that the very nature of this unfortunate situation raises a number of real and unambiguous questions and opinions about the state of disaster management in Nigeria. It stimulates critical dialog on flood disaster resilience, which broadens into adaptation and coping capacity and overtly implicates early warning systems and the unique policies in Nigeria pertaining to disaster preparedness and recovery.

Speaking of preparedness in respect of Kogi's experience of the 2012 flooding, Idowu and Zhou [39] argued that the devastating effects of the 2012 flooding for the whole of Nigeria have been due to limitations in flood monitoring and a lack of an effective early flood warning system in the country. Indeed, Nigeria has yet to evolve efficient flood monitoring and early warning techniques given that the current available data on rainfall are mostly "hourly amounts," which underestimate the intensity-duration-frequency (IDF) parameter needed in flood monitoring [40]. This data sparse situation, which according to Nkwunonwo et al. [33] constrains the application of more scientific approaches to flood risk management such as flood modeling and vulnerability assessment, is a major technical barrier to establish efficient early warning system in Nigeria. Two other important technical barriers are the lack of accurate flood assessment models to communicate the risk of flooding to a general population and epistemic uncertainties surrounding the warning issued by flood management agencies in Nigeria. Through its mainstay hydrological and meteorological institutions, for example, the NIMET (Nigeria Meteorological Agency) and NIHSA (Nigeria Hydrological Services Agency), Nigeria has monitoring and early warning systems in place, but their effectiveness

and robustness, as well as the uncertainty surrounding warnings given prior to extreme weather events, are vital issues. Early warning systems are often used to alert communities of an imminent flooding event or any other hazard as the case may be, but also served as positive and proactive instruments that foster the reduction of the impacts of flooding on a community through knowledge and awareness of the causes and impacts of flooding [38]. Arguably, how these objectives relate to Nigeria's situations is still under investigation.

Ottah's [41] study—with the main purpose being to identify the impact of early warning on the people of Ibaji—illustrates one of the crucial lessons from Kogi's experience of flooding that will highlight the limitations of Nigeria's EWS. Ottah [41] examined the warnings issued by Kogi radio before, during, and after the flood, which aims to raise awareness about floods and to urge residents of the River Niger bank to evacuate. Using a quantitative approach that sampled randomly 622 respondents from the population (127,572), the study found that almost all (100%) the residents listened to Kogi radio. However, while the majority (86.7%) heard of flood warnings on Radio Kogi, about 60% of the residents did not take warnings in preparation for the flood. Some of the respondents (44.7%) stated that the impact of the message was only average, while a few others (25.7%) said that the message failed to inspire any instincts or flight. Few respondents (45.6%) felt that Kogi radio should follow a communication strategy that would change the residents' behavior and attitude. In fact, the results of this study raise the question of why the 2012 floods have had a major impact on residents, despite the fact that everyone has access to a source of warning information (namely the Kogi radio). So, what is the overall impact of EWS in the context of Nigeria's flood-related resilience? How can EWS be developed to reflect on the cultural, social, and demographic profile of Nigerian communities? These are very important issues now being considered in the literature to improve on EWS for flood-related issues [42].

Adaji et al. [38] attributed the failure of flood early warnings in Nigeria to a number of social and technical barriers. First, the study argued that the failure was largely due to the fact that many of the flood disaster victims were unaware of floods. This is in addition to the general limitations in the adopted method of disaster response, rescue, and relief operations in Nigeria. This sheds light not only on the particular issues of social and demographic profile of residents and how it affects the effectiveness of early warning in Nigeria in terms of building communities' resilience to floods, but also on the technical aspects of warning system needed to establish accuracy, reliability, and trust. Alfa et al. [43] conducted a study to identify socioeconomic factors that may influence the effectiveness of early warning systems by using their relationships with knowledge about the causes of flooding in rural areas of Kogi State, Nigeria. Cross-sectional study was conducted in 325 households in Oforachi using quantitative data collection methods. The *Pearson's Chi Square* Consortium of the Association and Student's *t* test were used to assess the respective associations of the social factors with the 95% confidence level of knowledge. Results showed that 8.00% of respondents had fair knowledge, 80.92% had good knowledge, while 11.08% had excellent knowledge of the causes of floods. Factors that affected participants' knowledge of flooding in decreasing order of associations were age, education, employment, previous flood experience, and marital status. The knowledge of these interrelated components will help to overcome the social barriers to establishing early warning systems and to enhance the development of effective warning system that will be useful to building the communities' resilience to flooding.

The success of early warning and preparedness in disaster management depends largely on the effectiveness of risk communication, and this is an area of concern with regard to Kogi's experience of 2012 flooding but also explains the level of

Nigeria's risk communication profile. Sjoraida and Anwar [44] and Ogie et al. [45] raised two important issues that can elucidate the risk communication prospects and challenges in Nigeria. In particular, Sjoraida and Anwar [44] underlined the importance of integrating various communication methods to make risk communication more effective. Based on the study, effective risk communication must include traditional, modern, and digital communication systems. Similarly, Ogie et al. [45] identified the problem of risk communication in culturally and linguistically diverse communities. This is an issue that may explain the level of impact of the 2012 floods in many Kogi communities. In the context of these studies, one has to take a critical view of Nigeria's risk communication, and, particularly in the light of the findings of Ottah [41], why residents respond with a *laissez-faire* attitude toward the key object of the early warning? Of course, traditional approaches to risk communication are prevalent in Nigeria, but today's everyday life is often sought after by mostly social media and popular culture, both of which are now largely driven by digital technology. Nkwunonwo et al. [46] constructed the idea that social media (including Facebook, WhatsApp, Instagram, etc.) and popular culture can be used in much the same way as research output. The study looked at a Nollywood film and was able to make sense of its linkages with the key areas of a scientific investigation. Arguably, effective warning can be achieved for Nigeria if risk communication is accomplished using social media and popular culture. This will equally address the problem of cultural and lingual diversity, which is also part of the social barriers to risk communication in Nigeria.

Kogi's experience of the 2012 flooding also explains, in addition to the lack of early warning systems, the particular scenarios of investment in risk reduction, community participations, and rural adaptation toward flood-related resilience in Nigeria. There are a number of studies (e.g., [33, 47, 48]) that are more specific on these issues. Evidence from these studies suggests that these issues in their present state are a consistent syndrome, which collectively interferes with the overall success of Nigeria's flood disaster management. Drawing from the UN disaster risk reduction program that is often responsive to community involvement and sustainable risk investment, one can quickly realize the need to rewrite and redefine Nigeria's disaster management policy. The present top-bottom ideology should be replaced with a system that allows communities to speak on any aspect of flood risk management. The economic aspects of flood risk management should be part of the annual budget. In the Netherlands, floods and water management schemes are a statutory Dutch policy, which is one of the factors that makes flood risk management in the Netherlands one of the most elaborate and in the world. While this may not be sustainable in Nigeria, entrepreneurs—small and medium—and many multinational companies should be encouraged to see the importance of investing in solving the flood problems in Nigeria. In fact, while the issues of urban sprawl and rural-urban drift are being addressed as both political and economic agenda, often at the expense of sustainable human development and environmental management, the problem of risk-based investment and community participation which are the core of the contemporary approaches of disaster management should not be ignored.

5. Conclusion: mediating the challenges and spotlighting research issues for Nigeria's experience of early warning systems for flood-related resilience

Flooding in Nigeria has been an important issue. Viewed from a global perspective, Nigeria is in the top 20 countries with current and future flood risk scenarios (including climate change and socioeconomic exposure and vulnerability to

mostly coastal flooding) that are issues of grave concern. Besides the flooding of 2012 that is the central focus of discussions in this chapter, there has been series of flooding events in Nigeria that have severely impacted human lives and economic development. Historically, flooding in Nigeria dates back to the early 1950s and has affected mostly the coastal regions and places characterized as highly urbanized. Nkwunonwo [49] reviewed flood risk in Nigeria and found that within the period of 1985–2014, flooding has affected more than 11 million lives with a total of 1100 deaths and property damage exceeding US\$17 billion. The study also found that Lagos state has experienced most of the floods, while more frequent floods are recorded in Niger, Kaduna, Cross River, Adamawa, Oyo, Kebbi, Kano, and Jigawa, hypothesized to be influenced by the rivers Niger, Benue, Ogun, and Hadejia [33, 50, 51]. These findings are validated by a 50-year flood hotspot analysis and mapping that identifies areas that seem more prone to flooding in Nigeria (see Figure 2).

Fluvial, coastal and flash, and pluvial flooding events are major part of Nigeria's flood history, and they have been a major cause of concern for rural areas and cities within the country [52, 53]. Fluvial flooding is being influenced by seasonal interruption of major rivers and the overflow of water, which overtops their natural and artificial defenses and overflows into areas not typically submerged. Adebayo and Oruonye [54] and Obeta [55] argued that fluvial flooding in Nigeria accounts for the majority of the hazard threats experienced in locations along the plains adjoining the major rivers in the country. The worst episode of fluvial flooding in Nigeria reported by Jeb and Aggrawal [56] was the Kaduna flood disaster of 2006, which resulted from heavy rainfall and dam collapse and flooded a whole community affecting more than 1000 families and 500 homes. The economic impact of the event was up to 3 billion naira (\$35.45 million). As well as fluvial floods, coastal and flash floods in Nigeria affect the low-lying areas in the southern part of the country (e.g., Lagos, Oyo, Ondo, Akwa Ibom, and Bayelsa states). The social and economic impacts of these floods in Nigeria have been severe due to the number of human populations exposed as well as the economic growth within especially the coastal areas, which in recent times has increasingly become a source of attraction

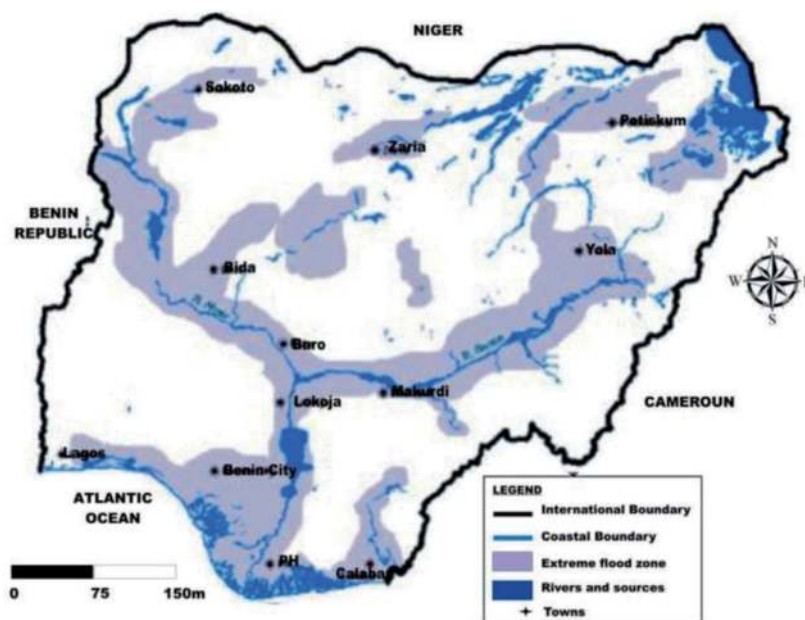


Figure 2.
Hotspots of flooding in Nigeria. Source: Nkwunonwo et al. [49].

for urban development [49]. What seem to complicate discussion of flooding in Nigeria in recent times are the pluvial floods, which are the most prevalent types of floods in recent times and affect mainly the urban areas. These floods are influenced by heavy rainfall, which overwhelms the capacity of local drainage systems and soil infiltration potentials. Kogi state demonstrates the uniqueness of flooding typology in Nigeria as communities within the area have been subject to all known types of flooding in Nigeria. This is a situation that might explain why flooding impacts have been severe, and why it is important to consider the means to raise efficient early warning systems toward building the resilience of communities within the area.

The long history of flooding in Nigeria with its spatial and temporal variability offers a ground to interrogate any possible changes in the meteorological context of the country. Within climate and ecology research, there is compelling evidence to show that Nigeria has experienced long-term changes in meteorological conditions, which is a strong foundation for the increasing exposure and vulnerability to flooding and other health hazards within the country. One of the important studies, which examined meteorological changes in Nigeria, was carried out by Tarhule and Woo [57]. This study examined crucial changes in several rainfall characteristics (such as annual total rainfall and number of rainy days, the dates of onset, termination and duration of the rainy season, as well as monthly rainfall, monthly number of rainy days, and various categories of rainfall above certain intensities) in the northern Nigeria. Using rainfall records at 25 locations, which were analyzed for the occurrence of abrupt changes and trends on the basis the Pettitt and the Mann-Kendall tests, result showed, inter alia, the abrupt change in the time series of annual rainfall, number of rainy days, and affected areas north of latitude 11° N. Abdussalam et al. [58] revealed that certain variations in climatic variables such as daily maximum temperature, relative humidity, and sunshine are the most important explanatory influence on monthly meningitis incidence in the Northwest Nigeria. Other studies, which examined this variability, are Ogolo and Adeyemi [59], Obioha [60], and Shiru et al. [61]. The general importance of the evidence in these studies is the reality of long-term meteorological variations and how it influences more recent hazard events particularly flooding in Nigeria. Knowledge of these variations from more global models, such as Hirabayashi et al. [2] and Winsemius et al. [3], shows that the effects of meteorological variations on global flood risk scenarios are likely going to worsen in the future. Thus, current research should give priority toward enhancing the resilience of communities to flooding, especially by kindling interests for more effective warning systems.

Kogi's experience of the 2012 floods, especially the recovery part for the victims, provides an important lesson that is still a major topic in political and academic affairs. Within the academics, a number of studies have developed in the risk and disaster literature to improve the current knowledge of flood risk and management in Nigeria. The scarcity of geospatial data that are an integral part of limitations in Nigeria's flood disaster management is now being addressed through international research collaborations and accessed to burgeoning open source geospatial data infrastructure. Evidence from current Lagos state flood risk management which Adelekan [62] outlined in a systematic review of policies, countermeasures and principles towards mediating the catastrophic effects of flooding in Nigeria. Some of the policies outlined are initiatives which focused on long- and short-term objectives, which include health reform, infrastructure development, water and land resource management, capacity development, strengthening of institutions, and various disaster management agencies across the country, collaborating with international partners such as OCHA (United Nations Office for the Coordination of Humanitarian Services), International Federation of Red Cross and Red crescent communities (IFRC) for aids, emergency relief assistance, and formulating ways

to meet the urgent needs of people internally displaced by flooding. Meanwhile, according to various reports by IFRC, there is a number of ongoing long- and short-term courses of action to address the endogenous humanitarian crises brought about by flooding in Kogi floods and elsewhere in Nigeria. Literally, these efforts, which are being motivated by the Kogi's flooding experience, promote collaborative flood disaster management. However, Adekola and Lamond [63] found that collaborative flood disaster management in Nigeria, which is essential to build community resilience to floods, must engage the governments, communities, businesses, multilateral, and nongovernmental organizations.

Debates on flood-related resilience are important and have long attracted interest in research, business, and political negotiations. Globally, these discussions are a call to action to alleviate the growing socioeconomic risks of flooding. Despite the great nature of these discussions, developing countries (DCs), for example, Nigeria, may still be ill-equipped to meet the minimum objectives of flood risk management especially as it pertains to building the resilience of communities, which the now defunct Hyogo framework for action capitalized on. Although Hyogo has been successfully replaced by SENDAI, the need to build community resilience as of now has not been redacted from disaster management. This less attention to community resilience has been demonstrated in Nigeria in relation to flood experiences. Undoubtedly, floods are virulent, cause massive loss, damage to natural resources, and affect the global economy, and these are the causes of concern in global disaster management. However, for Nigeria, uncertainty about how to mitigate flooding implies the need for extensive research to address the problem of increasing human vulnerability and highlights the potential for exploration if the aim of building a flood-related community resilience will ever be achieved. This chapter has opened a window into these discussions and in the main focus of building resilience to flood-related disasters in Nigeria, it outlines research strategies from a global perspective and important components of the SENDAI program for disaster reduction:

1. The substantial reduction of all forms of flood risk including direct losses in lives, livelihoods, and health and in the economic, physical, social, cultural, and environmental assets of persons, businesses, and communities; damage to critical infrastructure and disruption of basic services within Nigeria is the primary role of Nigeria and Nigerians alone. To make it more effective, this responsibility should be shared among the various tiers of government, the private and public sectors, donor agencies, international partners, local communities, and concerned citizens.
2. Reduction of these losses should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics, and the environment. Such knowledge can be used in the development of resilience and to widen the number of communities with adequate and sustainable support to complement their local actions for implementation of flood disaster risk reduction strategies.
3. Improving on the current method of flood risk assessment and governance at the national, state, and community levels should be imperative. This should reinforce the general flood disaster management framework in Nigeria, which includes preparedness, mitigation, response, and recovery.
4. There is urgent need to prioritize the development of, increase the availability of, and access to sustainable flood hazard early warning systems and flood disaster risk information and assessments to the general population.

In order to “build back better and quicker” from flood disasters, the Nigerian government must contemplate integrating flood disaster risk reduction measures into development plans.

5. Building the economic, social, health, and cultural resilience of the general population and local communities should prompt public and private investment in flood disaster risk prevention and reduction through structural and nonstructural measures.

Conflict of interest


The author declares no conflict of interest.

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