Adaptive mitigation to Farmland Flooding as a Resilience builder in Selected Communities in Etche Local Government Area of Rivers State

Abstract

In recent times the consequences of flooding on farmlands have been majorly attributed to climate change which has contributed to the distortions in the social and economic activities in Rivers State, Nigeria. This study aims to identify adaptive mitigative measures to manage the social and economic impact of farmlands flooding in selected communities in Etche Local Government Area in Rivers State. The objectives include the identification of the significant causes of farmland flooding in the study area, determining the social and economic impacts of farmland flooding in the study area, and identify mitigation measures put in place to combat farmland flooding in the study area. The study adopted the Mixed Methods Research approach using a concurrent triangulation research design. The data sources include questionnaire administration (using a 5-scale Likert Scale), key informant in-depth interviews, personal observation, photographs, and published materials from institutions. A total of 146 questionnaires were administered across these selected communities, including Nihi, Isu and Umuechem. A purposive sampling technique was deployed, and a total of 96 questionnaires were retrieved and validated for analysis. Some of the leading causes of farmland flooding include the blockage of storm-water channels, overgrazing and bush burning, overpopulation due to increased development (structures), heavy rainfall and drainage failure. The study further revealed that the social and economic impacts on farmland, communities and inhabitants are depression, stress, anger, and social vices. Other effects include loss of farmland and produce, increase in goods and services, loss of livelihood system, loss of income and damage to properties. The anticipated mitigative measures by respondents are a collaboration of stakeholders (farmers, communities, and government agencies), warning signals, reconstruction of failed drainages, quick responses, and adequate relief materials. In addition, the study recommended proper education and enlightenment of the vulnerable population on how to avoid the negative consequences of flood disasters. vulnerable people should prepare for any eventuality, real-time data on flood vulnerability mapping of the study area to enable the government, government agencies like the (NIMET) and the vulnerable population to know the extent of flooding and duration of every flooding episode. Furthermore, effective Spatial planning of those vulnerable communities to reduce the negative consequences of flood disaster and afforestation should be encouraged to mitigate adverse impacts of the flood.

Keywords: Adaptive, Climate Change, Farmland Flooding, Resilience, Rural Communities

Introduction

Climate change and its attendant challenges have continuously evolved rapidly from the assumptions of being a disaster elusion to a frightening reality. Climate change represents a long-time global change in weather conditions and atmospheric temperature. However, in the last twenty to thirty years, the impacts of climate change have been felt by everybody through global warming drastically. They posed a significant concern and engendered the urgent need to seek sustainable approaches to tackle the World Health Organization (WHO, 2012). Whenever and wherever it occurs, flooding worsens the situation, leaving behind a trail of a more significant impact than the affecting humanity at different levels, resulting in the depletion of natural resources, causing drought and flooding (Harding *et al.*, 2016). Consequently, climate change is felt in both developed and developing countries, but the impact is deemed the most in developing countries due to the lack of adequate infrastructures to respond to it (Intergovernmental Panel on Climate Change (IPPC), 2017).

Frequently, flooding results when a dry area is overflowed with water that the land cannot absorb into the ground. This hazard of flooding has become an annual phenomenon that has displaced millions of vulnerable populations every year globally and has claimed lives and properties (Bronstert, 2013).

In Nigeria, floods occur annually in different magnitudes and scales, from flash floods to dam overflows with phenomenal episodes with tragic extremes such as homelessness, massive farmland flooding, crop yields, job losses and starvation (Etuonovbe 2011; Bariweni *et al.*, 2012). Flooding has always resulted in life-threatening depletion of natural resources, social, political, and economic instability, increased rural and urban poverty, and severe risk to sources of livelihood (Schwartz & Randall, 2013). Floods cause a wide range of complex issues. Some of the immediate consequences of flooding included the displacement of people, the destruction of infrastructures such as houses and

roads, damage to farms and crops and loss of cattle and livestock. The destruction of roads and infrastructure delays delayed ongoing development initiatives and political processes (Theron, 2017).

Aim of the study

This paper aims to identify the mitigation measures to manage the social and economic impact of farmland flooding in the study area (Nihi, Isu and Umuechem communities), Etche Local Government Area, Rivers State.

i. Identify the significant causes of farmland flooding in the study area.
ii. Determine the social and economic impacts of farmland flooding in the study area.
iii. Identify mitigative measures to combat farmland flooding in the study area.
iv. Identify the resilience paradigms adopted by the people in the study area.

There has been a dearth of information regarding the underlying causes of continuous farmland flooding, mitigation measures and resilience paradigms in the study area. As such, outputs will be vital in designing sustainable mitigation measures to minimise the impact of farmland flooding and the associated risks.

The Study Area

Etche Local Government Area is situated in the North-Eastern part of Rivers State, Nigeria. It lies within latitude 4045'N – 5017'N, and longitude 6055'E – 7017'E (Figure 1), covering about 641.28km2 with some communities including Okehi, Ulakwo, Obite, Obibi, Igbo, Odagwa, Umuechem, Ndashi, Igbodo, Ozuzu, Mba and Afara. It is bounded on the north by Imo State, bounded on the east by the Imo River and Omuma Local Government Area. At the same time, Obio/Akpor and Oyigbo in the south and Ikwerre Local Government Areas in the west. Etche is one of the host communities of the government-owned multi-billion-naira palm oil production company RISONPALM and Delta Rubber Production Company. In addition, real estate development has recently grown in the area with rapid expansion going on in Igboh-Agwuruasa, Ulakwo-Umuselem and Okehi Clans. Umuechem, as one of the selected communities in the Etche Local Government Area chosen for this study, is the second place in Nigeria oil was discovered since the beginning of exploration in the area in 1958 and endowed with agricultural farmlands. The Otamiri River is one of the major rivers in Imo State, Nigeria. The river runs south from Egbu past Owerri and through Nekede, Ihiagwa, Eziobodo, Olokwu Umuisi, Mgirichi and Umuagwo to Nihi Isu and Umuechem communities in Etche, Rivers State, from where it meets or flow to the Atlantic Ocean (Ibe & Uzoukwu, 2001).

From its source to its confluence at Emeabiam with Oramiriukwa River, the river's length is 30km. The watershed covers about 10,000km2 with an annual rainfall of about 2250-2750mm. The watershed mainly has thick underbrushes, deep green vegetation, creeping vines, and depleted rainforest resulting from foliage and heavy decay of plant droppings. The mean temperature is about 25 degrees Celsius and about 75-85% relative humidity within the region. The study area is in the rainforest belt region, having peak rainfall during June, July and September, and low rains in December and January (Ibe & Uzoukwu, 2001).

The Otamiri watershed consists of sandy soil with little clay, loam, and silt. The area is acidic with a pH value of between 4.67-5.6 for upper and lower layers and 5.0-5.6 at the crest and valley bottom and lower at mid-slope (Njoku et al., 2011). The general slope of the Otamiri watershed is 0.016 (Simmers, 1988), and the average slope of Otamiri River at stations Chokocho and Nekede are 0.012 and 0.010, with widths of 11.07km and 8.30km, respectively (Uma & Kehinde, 1992). The soil type present

within the catchment belongs to ferralic. The soil profile is remarkably uniform, profoundly weathered and intensely leached throughout the area. The Otamiri River has a maximum average flow of 10.7 m3/s in the rainy season (September - October) and a minimum average flow of about 3.4 m3/s in the dry season (November - February). Therefore, the total annual discharge of the Otamiri is approximately 1.7 x 108 m3, and 22 per cent of this (3.74 x l07 m3) comes from direct runoff from rainwater and constitutes the safe yield of the river (Egboka & Uma, 1985). It is a micro-watershed of the greater Imo River basin. With a length of 105 kilometres, the Otamiri River is the principal tributary of the Imo River. Previous studies showed that the river has an average flow of 10.7m3/s in the rainy season (September – October) and about 3.4m3/s in the dry season (November to February) in Owerri Urban. Therefore, the total annual discharge of the Otamiri is about 1.7×108m3, with 22 per cent of this (3.4 x 107m3) coming from direct runoff from rainfall. This figure constitutes the safe yield of the river (Egboka & Uma, 1985).

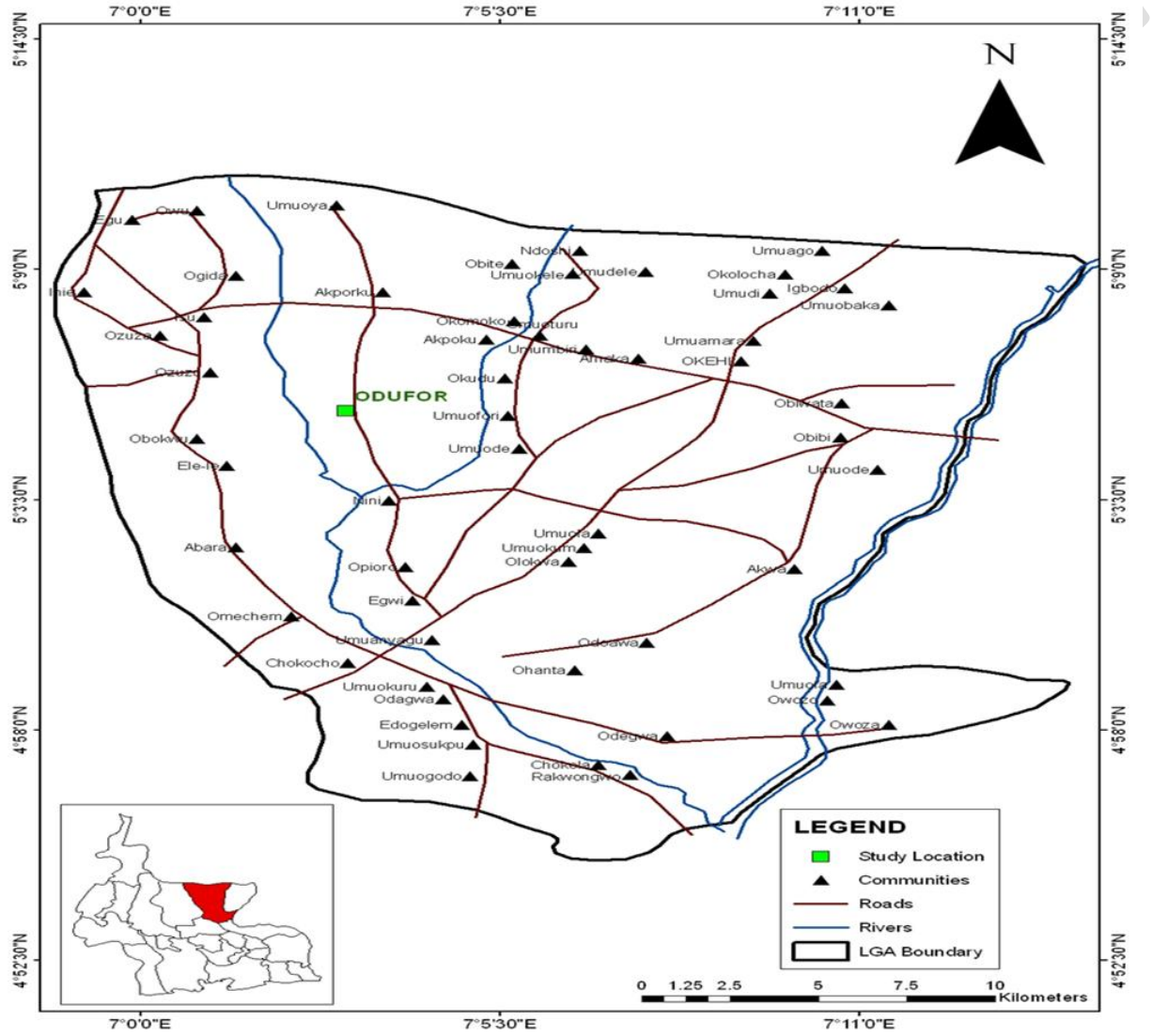

Fig. 1: Map Showing the Otamiri River and the Study Area
Source: GIS Lab, Department of Urban and Regional Planning, Rivers State University, Port Harcourt, 2022

Causes of Flooding in Nigeria

The World Health Organisation asserts that climate change represents an alteration of the climate that is attributed indirectly or directly to anthropogenic activities that alter the composition of the global atmosphere and are evident in the natural climate inconsistencies over a comparable timeframe (WHO, 2012). The 4th Intergovernmental Panel on Climate Change (IPCC) in 2007 indicated that Africa would be the net victim of climate change consequences. This status is not due to emitting the highest

carbon footprints or the highest amount of greenhouse gases. Instead, it is expected to be insufficient facilities to tackle the climate-change consequences (Medugu, 2009). Furthermore, Nigeria being a part of Africa, has already had negative impacts of climate change which has affected millions of people economically, environmentally, and socially (Medugu, 2009).

With the continuous distortion of the farm system by flood episodes, there is a 50% reduction in crop production in Africa by 2050 (Bello *et al.,* 2012). This reduction is occasioned by climate change because the agriculture system in Africa is rainfall dependent with its constantly evolving pattern (Jones & Thornton, 2013).

Nigeria is precariously vulnerable to climate change consequences because about 70% of Nigerians are involved in agricultural trades. About 90% of these agrarian ventures depend on rainfall for improved farm yields (Adejuwon, 2015). In Nigeria, climate change impacts are tangible in most rural communities, from the Sahel in northern Nigeria to southern Nigeria's rainforest and coastal zones. The high population further compounds this, with endemic poverty levels and rapid economic growth making phenomenal demands on the existing natural resources in Nigeria (Building Nigeria's Response to Climate Change (BNRCC), 2011).

The hazards related to flood disasters occur naturally, but the extent of losses, impact, and damage is a consequence of anthropogenic activities (Action Aid, 2006). The flood's threat to livelihood sources, physical properties, and lives has become an annual occurrence in many rural and urban areas in Nigeria (Olanrewaju & Fadiro, 2013). Floods usually occur when surface water inundates an ordinarily dry land and overflows the confinements. Some of the most common sources of floods in Nigeria that are injurious to humans are unusually high precipitation, storm surges from tropical storms, dam bursts, and burst water mains (Etuonovbe, 2011).

Flooding is a natural occurrence caused or exaggerated by anthropogenic activities and is one of the major causes of stunted development in Africa. Despite its burgeoning population of city dwellers who tend to escape rural poverty and stands in the way of the United Nations 2020 MDGs of achieving significant enhancement in the lives of urban slum dwellers (Action Aid, 2016). Several African cities lack the necessary infrastructure to withstand severe weather conditions occasioned by poor urban planning in addition to poor urban governance challenges, which engender African urban slum dwellers vulnerable to flood-related disasters (Adelekan, 2013).

Impact of Flooding

Flooding is a multi-layered spectacle that incorporates the nexus between social systems, the natural environment, and people due to the fundamental scale of destruction representing the aftermath of every flooding episode. These devastating impacts are felt more within the immediate vicinity of the flood as there are properties and lives lost when there is no prior information about the flood. There is also the distortion of the livelihood chain in these vulnerable communities as one of the significant impacts of flood disasters. Several people are displaced from their homestead leaving behind a dysfunctional society with the loss of livelihood. Purchasing and production powers also weaken because of flood disasters and their attendant consequential damages to the physical infrastructure leading to severe interruptions in sources of potable water supply, communication routes, transport, and healthcare facilities. These challenges further upsurge the vulnerability level of these affected communities, which often leads to an additional cost of providing these services, such as relocation of the affected population. In most scenarios, restoring these services usually requires considerable financial resources that impact production and purchasing power as capital is diverted from other sectors to get the system back up and running (Simonovic, 2012).

Furthermore, there is usually a massive outward migration from the vulnerable communities as members move in search of better sources of livelihood. This migratory trend is because the increased frequency of flooding episodes engenders vulnerable populations to move to other places with prospects of economic prosperity. Such a migratory trend often depopulates the vulnerable communities and often overpopulates the receiving communities. In addition, it further overstretches some of the existing fragile public utilities and services. There are also negative health impacts of flooding because most vulnerable people suffer psychosocial effects of the trauma of the loss of properties, displacement, and bereavement (Ghatak *et al.*, 2012). In some extreme situations, the impact of flooding could also clog economic development as investors move away from such areas to relatively safer locations; at the same time, political actors also deprive the vulnerable population of the needed support and resources (Dewan, 2015).

In recent times flooding has been identified as a significant cause of stunted economic development in most urban and rural communities in Africa (Adelekan, 2013). For instance, flooding often reduces the value of properties, primarily in most flood-prone and devastated areas, as it affects returns on investments in the real estate sector, leading to the reduction of economic power (Bin and Polansky 2004).

The tourism sector is often affected by flood disasters. Most tourist destinations situated in coastal cities in the global south have continually experienced inundation by episodes of flooding that have elicited prompt actions. Unfortunately, these calls have not received the required attention, and these vulnerable destinations are increasingly becoming unpopular destinations leading to gradual loss of revenue and other associated benefits (Marzeion and Levermann 2014).

Flooding has successfully inflicted along its trail some devastating consequences such as weak governance, poverty, and lack of infrastructure in most Nigerian communities because a majority of the vulnerable population cannot survive the precarious challenges occasioned by extreme weather conditions. These inadequacies make several communities in Nigeria vulnerable to the vagaries of increased flooding. They are the indicators of deliberate human free choice that has undermined cities leading to a comprehensive transformation of the environmental and ecological processes (Adelekan, 2010). One of the most menacing natural threats to sustainable development is flooding because it destroys houses, standing crops, machinery, infrastructure, and other physical structures and diminish the asset base of households, communities, and societies, as well as causes death (Ejizu, Eri, Oyedirim and Malizu, 2014).

Experiences of Flooding in Etche Local Government Area

Nigeria has progressively become vulnerable to flood-related disasters in recent years, and this situation has exposed several Nigerians to the vagaries of flooding and its consequences (Agada and Nirupama 2015). The type and frequency of flooding in Nigeria have also increased in the last four decades. It usually occurs as channel and coastal floods and urban flash floods (Tami and Moses, 2015). As a result, flooding episodes have become a constant challenge. The National Emergency Management Agency (NEMA) adjudged the 2012 flood episode as the worst in the recorded history of flooding in Nigeria before 2012. The flood-affected 30 out of the 36 states of the country, leaving behind its trail about 2.3million displaced persons with about 7 million persons indirectly affected, 597 476 housing units destroyed and 363 recorded deaths. Other noticeable losses during that flood episode were the submergence of several hectares of arable land leading to the distortion of ecosystems, livelihood chains, displacement of wildlife and the destruction of other critical infrastructure (Tami and Moses, 2015).

Etche Local Government Area and, by extension, the Niger Delta region of Nigeria have over the years been overwhelmed by several innumerable challenges occasioned by the variations in the climate that had left the region vulnerable to extreme ecological and environmental threats such as flooding (Ologunorisa and Adeyemo, 2005; Uyigue and Agho, 2007; Mmom and Aifesehi, 2013; Tawari-Fufeyin *et al.,* 2015; Tesi *et al.,* 2016). Besides climate change-related susceptibilities hounding the region, continuous exploration and exploitation of petroleum resources have further reduced the delicate ecosystem of the Niger Delta region vulnerable to the vagaries of climate variations. These variations occur as microclimate that has left the region with a different climatic condition that enables flood disaster to become a common phenomenon with limited sustainable solution (Nzeadibe *et al.,* 2012).

Floods in the study area (Nihi, Isu and Umuechem) in Etche Local Government Area of Rivers State are an annual phenomenon that is most severe in July and August with devastating consequences. It usually causes regular river floods, which affects about 20%, increasing up to 68% in extreme years. This kind of flood is particularly catastrophic, resulting in large-scale destruction and loss of agriculture-related land use because of the environment and effect of the annual floods, such as riverbank erosion. The water source is from the Otamiri River in Imo State, Nigeria; when flow discharge is relatively high, it overflows the natural and artificial banks within reach of a river into low planes. It originates in the highlands around Egbu and runs southward past Owerri, draining through Nekede, Ihiagwa, Eziobodo, Olokwu Umuisi, Mgbirichi and Umuagwo to Nihi, Isu and Umuechem in Etche, Rivers State. from where it flows into the Imo River at Umuebulu Rivers State (Obed, Abam, & Sabastine, 2016).

Resilience

Resilience as a concept emanated from ecology before gaining importance in numerous fields such as sociology and psychology. Resilience has been the significant driver prominently applied in several social sciences discourses such as economic geography, environmental planning, disaster studies and psychology (Davoudi et al., 2012). Its application across various research fields has unclear its definition (Manyena 2006; Cote and Nightingale 2012). Resilience does not entirely characterise its emphasis on the need to reduce damage in the eventuality of any anthropogenic or unexpected natural distortions in the physical environment (Park *et al.,* 2013)

Ungar (2008, p225) defined resilience as:

> *the context of exposure to significant adversity, whether psychological, environmental, or both, resilience is both the capacity of individuals to navigate their way to health-sustaining resources, including opportunities to experience feelings of well-being, and a condition of the individual family, community and culture to provide these health resources and experiences in culturally meaningful ways.*

Resilience reinforces the capability of the vulnerable population to recuperate to a near-normal state of existence after any natural and anthropogenic disturbances. The social environment that incorporates personal characteristics, family, and culture contribute meaningfully to building resilience (Ungar, 2008). Several researchers have over the years established a nexus in the creation of resilience capacities in any disaster situation that involves the organisation of resources and having adaptive human structures that reflect the ability to survive and recover from any disaster scenario (Chaskin 2008; Coleman and Hagell 2007).

Progressively, researchers have enabled the concept of resilience to gain global currency because it involves the collection of both material and human resources and, in some situations, presents adaptive strategies to survive internal and external stressors in the environment. These stressors often distort socio-ecological systems to test the capacity to absorb anticipated and recurring disturbances (Adger *et al.,* 2005).

Community resilience

Community resilience in a disaster scenario originates from the individuals within the community. Since resilience comes from the individual within the community, collective actions among the individuals impulsively engender community resilience (Cairns 2002; Mallak 1998; Jacelon 1997). Community resilience has some underpinning layers of individual activities, resulting from collective individual resilience capacities within the community (Doron 2005; Mallak 1998). Such underpinning layers revolve around the combination of potential and natural resources possession of durable networks and relationships, which Bourdieu (1986) refers to as social capital. It has the potential of enhancing the resilience level of vulnerable communities at risk of any disaster. Community resilience is an indication of the ability of the community not only to bounce back instead, the vulnerable bounce forward after any disaster. It is such that bounce back indicates the power of the vulnerable to return to a pre-disaster condition that is unachievable. Besides, it fails to come to terms with the present scenario of devastation engendered by the disaster. At the same time, bounce forward summarises community stability in the distorted realities engendered by the disaster scenario (Manyena, 2009).

The concept of community resilience exhibits a complex and dynamic concept that depends on various indicators that revolve around knowledge and education of a phenomenon. Implicitly, there is a need for community members to have the requisite expertise to educate others about any disaster response and risk reduction approaches within the community. Thus, the capability of individuals in the community underpins a community's resilience to enable them to develop their coping strategies by deploying available local resources (Rahman *et al.*, 2017).

Characteristics of Resilient community

Community resilience is not a stand-alone concept as the social and physical components reinforce it. The social features encompass considering the sensitivities of individuals and the community as a whole. On the other hand, it also involves the ability of community members to have an adequate knowledge of the nature, chronology and magnitude of preceding disasters scenario the community had experienced in addition to the existing available social networks, norms, and forms of capital (Cohen *et al.,* 2013). Some of the characteristics exhibited in vulnerable communities in any disaster scenario have some embedded components of resilience because of the dynamics of the economic and social circumstances of the community. These characteristics facilitate sustainable lifestyles within the community that enable collective strength during and after any disaster (Poortinga, 2012).

Masten and Obradovic (2008) have, over the years, compiled relevant literature regarding key indicators that engender community resilience in vulnerable communities. Some of these community resilience indicators exhibited in any disaster scenario include social capital (Castleden *et al.,* 2011; Chandra *et al.,* 2010; Bourdieu 1993), collective efficacy (Sampson *et al.,* 1997), social trust (Poortinga 2012; Cacioppo *et al.,* 2011), social support (Norris *et al.,* 2008), leadership (Longstaff and Yang, 2008; Baker and Refsgaard 2007) and emergency preparedness (Mishra et al., 2010; Norris *et al.,* 2008).

Community resilience is underpinned by social capital, which entails the networks of relationships and the relationships influenced by an individual to highlight the relative strength inherent in families and communities. In context, having relationships and belonging to a network of relationships engenders the individual to access resources and further confers a distinct benefit to accumulate more capital. These relationships and the network of relationships are evident practically fuelled by symbolic and material exchanges that bind the members within the network. These networks of relationships are sometimes socially constructed and assured based on the application of a collective connotation in the form of family, club, school, social class, tribe, profession and occupation. At the same time, they are also guided by a set of foundational actions which enables them to form a bond that underpins the relationship to establish objective relationships of proximity in the physical, social and economic space (Bourdieu, 1986).

Method

This study adopted a mixed-method approach by deploying qualitative and quantitative methods to increase the findings' reliability level and ensure that every group in the study area is heard (O'Cathain and Thomas, 2006). The primary sources of data in the study include personal observations, in-depth interviews with key gatekeepers, photographs, and questionnaire administration. The secondary sources include published and unpublished institutional documents, internet sources, and related documents.

The sample size was drawn purposively and pro-rated based on the population of the communities. A total of 146 questionnaires were distributed in the study area, with Nihi having 44 questionnaires, Isu having 49 questionnaires, and Umuechem having 53 questionnaires, respectively. However, 96 questionnaires were successfully retrieved, with Nihi having 28 questionnaires, Isu having 32 questionnaires and Umuechem 36 questionnaires. Data were analysed using the SPSS version 22 and a 5-scale Likert Scale for the questionnaires and represented frequencies and percentages. Key informant interviews were transcribed and analysed with content analysis.

Results

After the analysis of the questionnaires, the study results were presented based on the study's objectives.

Objective 1: What causes farmland flooding in the study area?

Table 1: Causes of Farmland Flooding in the study area

S/N	QUESTIONS	FREQUENCY/ LIKERT SCALE					MEAN $\bar{X}$
1.		SA 5	A 4	D 3	SD 2	U 1	
	Damaged community pipe-borne water supply.	10 (50) 10.42%	16 (64) 16.67%	8 (24) 8.33%	29 (58) 30.21%	33 (33) 34.38%	2.39
2.	Heavy rainfall and Drainage failure.	59 (295) 51.95%	25 (100) 26.04%	1 (3) 1.04%	6 (12) 6.25%	4 (4) 4.17%	4.31
3.	Overpopulation caused due to increase in development.	3 (3) 3.13%	29 (116) 30.21%	5 (15) 5.21%	7 (14) 7.29%	52 (260) 54.17%	4.25
4.	Blockage of storm-water channels through the erection of structures.	57 (285) 59.37%	27 (108) 28.13%	5 (15) 5.21%	3 (6) 3.13%	4 (4) 4.17%	4.35
5.	Overgrazing, Bush burning and other agricultural activities.	-	28 (112) 29.17%	58 (290) 60.42%	7 (14) 7.29%	3 (3) 3.13%	4.41
	GRAND MEAN $\bar{X}$						**3.94**

Source: Authors' Fieldwork, 2022 ******Criterion Mean =2.5**

Table 1 indicates the responses from the respondents regarding the causes of flooding in their respective communities, answered as follows; they disagreed that damaged community pipe-borne water supply with (mean score of 2.39), they further agreed that heavy rainfall and drainage failure (mean value 4.31). Furthermore, they disagreed that overpopulation causes flooding due to increased development (mean value 4.25). Also, the respondents agreed that blockage of stormwater channels through the erection of structures with (4.35 mean value). Finally, they rejected the opinion that overgrazing, bush burning, and other agricultural activities lead to flooding in their communities with (4.41 mean value). Therefore, with a grand mean value of 3.94, the result is accepted well above the criterion mean of 2.5.

Objective 2: Identifying the Social Impacts of Farmland Flooding in your Community

Table 2: Social impacts of farmland flooding in the study area

S/N	QUESTIONS	FREQUENCY/ LIKERT SCALE					MEAN $\bar{X}$
		SA 5	A 4	D 3	SD 2	U 1	
1.	Loss of communal spaces	96 (480) 100%	-	-	-		5
2.	Increase in social vices such as destruction of social infrastructures	96 (480) 100%	-	-	-		5
3.	Impairment of communication	96 (480) 100%	-	-	-		5
4.	Depression, stress, anger, frustration arise after the flood incident	20 (100) 20.83%	20 (80) 20.83%	20 (60) 20.83%	36 (72) 37.50%	-	3.25
5.	Loss of privacy	20 20.83%	20 20.83%	20 20.83%	36 37.50%	-	3.25
	GRAND MEAN $\bar{X}$						**4.30**

Source: Authors' Fieldwork, 2022

Table 2 indicates the social impact of flooding in the study area. Respondents agreed that a loss of communal spaces is a social impact caused by flooding; it causes an increase in social vices such as destruction of social infrastructures and makes for impairment of communication (all with mean value 5 respectively). Also, the respondents disagreed that flooding causes depression, stress, anger, frustration, and loss of privacy, both having (mean value 3.25 respectively).

Objective 3: Identifying the Economic Impacts of Farmland Flooding in the study area.

Table 3: Economic impacts of farmland flooding in the study area

S/N	QUESTIONS	FREQUENCY/ LIKERT SCALE					MEAN $\bar{X}$
		SA 5	A 4	D 3	SD 2	U 1	
1.	Loss of farmland and farm produce	69 (345) 71.88%	20 (80) 20.83%	-	4 (8) 4.17%	3 (3) 3.13%	4.54
2.	Loss of income	59 (295) 51.95%	25 (100) 26.04%	1 (3) 1.04%	6 (12) 6.25%	4 (4) 4.17%	4.31
3.	Increase in the prices of goods and services	69 (345) 71.88%	20 (80) 20.83%	-	4 (8) 4.17%	3 (3) 3.13%	4.54
4.	Loss of sources of livelihood	59 (295) 51.95%	25 (100) 26.04%	1 (3) 1.04%	6 (12) 6.25%	4 (4) 4.17%	4.31
5.	Increased cost of building damaged properties.	59 (295) 51.95%	25 (100) 26.04%	1 (3) 1.04%	6 (12) 6.25%	4 (4) 4.17%	4.31
	GRAND MEAN $\bar{X}$						**4.40**

Source: Authors' Fieldwork, 2022

Table 3 represents the identified economic impact of farmland flooding in their respective communities as generated through respondents' responses. There is a loss of farmland and farm produce. Which gave a mean value of (4.54), loss of income caused a mean value of (4.31), increase in the prices of goods and services generated a mean value of (4.54), loss of sources of livelihood gave a mean value of (4.31). Increased cost of building damaged properties generated a mean value of (4.31).

Objective 4: Identifying the flood mitigation measure put in place in the study area

Table 4. Anticipated Flood Mitigation Measures in the study area

S/N	QUESTIONS	FREQUENCY/ LIKERT SCALE					MEAN
		SA	A	D	SD	U	$\bar{X}$
1.	Collaboration with the affected communities to improve on the flood management process.	52 (260) 54.17%	29 (116) 30.21%	5 (15) 5.21%	7 (14) 7.29%	3 (3) 3.13%	4.25
2.	Synergy among State government, National Emergency Management Agency (NEMA), and the local government council.	57 (285) 59.37%	27 (108) 28.13%	5 (15) 5.21%	3 (6) 3.13%	4 (4) 4.17%	4.35
3.	Renovation/reconstruction of failed drainages in the communities.	58 (290) 60.42%	28 (112) 29.17%	-	7 (14) 7.29%	3 (3) 3.13%	4.41
4.	Early warning of indigenes on the consequences of future flooding and evacuation before it happens.	57 (285) 59.37%	27 (108) 28.13%	5 (15) 5.21%	3 (6) 3.13%	4 (4) 4.17%	4.35
5.	Provide quick and adequate relief materials to the affected communities whenever it floods.	58 (290) 60.42%	28 (112) 29.17%	-	7 (14) 7.29%	3 (3) 3.13%	4.41
	GRAND MEAN $\bar{X}$						**4.35**

Source: Authors' Fieldwork, 2022

Table 4 indicates that most respondents agreed that they anticipated those mitigative measures against the menace of farmland flooding in the study area. Respondents also accepted that effective collaboration with those affected communities could improve the flood management process (with a mean value of 4.25). They also anticipated that meaningful synergy among the State government, the National Emergency Management Agency (NEMA), and the local government council would mitigate the impact of flooding with a mean value (4.35).

The choice of reconstruction and renovation of failed sections of the drainages in those communities gave a mean score of (4.41). At the same time, early warning of residents regarding the consequences of flooding and possible evacuation strategies should be put in place before it floods gave a mean value of (4.35). Most respondents agreed that adequate relief materials should be sent to affected communities whenever it floods. That would mitigate the adverse impact of flooding with a mean score (of 4.41).

Discussion of Findings

Some of the study findings indicate that the significant cause of farmland flooding is heavy rainfall and drainage failure/ blockage of stormwater channels. This result is congruent with the research findings of (Agbonkhese *et al.,* 2014) regarding the causes of flood episodes in Nigeria. They further assert that it has become a norm and a re-occurring phenomenon with devastating consequences on livelihood sources and infrastructural development. Also, Cigler (2017) claims that 'flash flooding' occurs in rivers and streams due to heavy rains and disrupts many systems, with risks to life and property. Runoff from rain over land surfaces causes flooding. For instance, driveways, parking lots, roads, and other impervious surfaces prevent water from sinking into the ground. This significantly increases runoff during intense precipitation, especially in poorly planned communities or overdeveloped areas. Stormwater fills the premises and damages public infrastructures and landscaping.

Besides, there is a lack of proper environmental planning, rapid in-migration, poor governance, poor drainage facilities and decaying infrastructures, and improper dumping of household wastes inside drainages that inhibits the uncontrolled flow of stormwater during and after rains (see Plate 1).

Plate 1: Debris filled drainage in Umuechem Community causing flooding on the adjoining Farmlands
Source: Authors' Fieldwork, 2022

Data regarding the social impacts of farmland flooding in the study area was obtained from responses. Some of the adverse social effects identified include a spike in social vices such as youth restiveness among the community members. There is also a reduction of communal spaces that further limits social interaction that impedes collective activities. In addition, there are incidences of communication facilities being destroyed by floodwaters, which disrupts effective communication whenever it occurs.

Responses on the economic impact of farmland flooding in the study area was obtained from the respondents. Available data indicates a general decline and disruptions in economic activities whenever the farmlands are flooded. It is such that income and livelihood sources are massively distorted as farmlands and crops are lost, leading to an increase in the cost of farm produce, commercial and industrial areas are submerged, as economic activities are at a minimal level. This finding supports the research outcome of (Ejizu, Eri, Oyedirim and Malizu, 2014).

Respondents highlighted some of the flood mitigation measures in the study area. From available data, it was evident that most of the respondents want an effective synergy among the State government, the National Emergency Management Agency (NEMA), the local government council, and members of those affected communities to improve on the flood management process. Some respondents also suggested that a complete renovation and, in some cases, reconstruction of failed portions of drainages in those communities should be put in place. This action would forestall further devastating consequences of flooding in those vulnerable communities. Besides, there should be effective dissemination of relevant information regarding the products of flooding.

Furthermore, an adaptive early warning system for the indigenes should be implemented, especially on the consequences of flooding and possible evacuation before it happens. These are perfect measures for alleviating the plight of flood-affected areas in Nihi, Isu and Umuechem communities in Etche Local Government Area of Rivers State. These suggestions agree with the findings of Elahi (2010) on risk management. Similarly, Chiadikobi and Oyebanji (2011) assert that intense rainfall is one of the significant determinants of flood disaster depending on the duration of rain, which can be controlled by effective monitoring of the weather condition and reporting same to the relevant authority and vulnerable communities.

Conclusion

It is evident from the study that flood has devastating consequences that have adversely affected most of the vulnerable populations in several parts of Etche Local Government Area. The study further revealed that the government and other relevant agencies such as the Nigeria Meteorological Agency (NIMET) cannot take proactive steps with an early warning system of the looming disaster occasioned by intense rainfall. Farmlands are being destroyed, leading to an untold economic hardship on the lives of the vulnerable population and those from neighbouring Bayelsa State who rely on these communities for food items. The quality of life of the vulnerable people was seriously affected because of the flood. As farmlands are being flooded, it carries along faecal debris that contaminates drinking water sources. This contaminant poses serious health risks to all the vulnerable populations, which adds pressure on existing health facilities with reduced income due to the disruption of livelihood sources occasioned by the flood. Those challenges occasioned by the flooding episodes negatively impact the social and economic domains of the vulnerable population. These devastating consequences need prompt and urgent attention to safeguard the vulnerable population's environmental, social, economic, and health.

Recommendations

Based on the conclusion generated for the study, this study recommends that:

i. There should be proper education and enlightenment of the vulnerable population on avoiding the negative consequences of flood disaster and how they should prepare for any eventuality.

ii. There should be real-time data on flood vulnerability mapping of the study area to enable the government, government agencies like the (NIMET) and the vulnerable population to know the extent of flooding and duration of every flooding episode.

iii. Proper spatial planning of those vulnerable communities should be undertaken to reduce the negative consequences of flood disasters.

iv. Afforestation should be encouraged to mitigate some of the adverse consequences of the flood episode in the entire vulnerable population.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

References

ActionAid (2006). *Climate change, urban flooding and the rights of the urban poor in Africa: Key findings from six African cities.* A report by ActionAid

Adejuwon, J.O. (2015). An assessment of the changing pattern in the choice of vegetable varieties in Sokoto-Rima River Basin, Nigeria: Pepper. *International Journal of Ecology and Environmental Sciences, 3(2).* 7-15.

Adelekan, I. (2013). *Private sector investment decisions in building and construction: Increasing, managing and transferring risks: Case study of Lagos, Nigeria.* Background paper prepared for the global assessment report on disaster risk reduction

Adelekan, I.O. 2010, "Vulnerability of poor urban coastal communities to flooding in Lagos, Nigeria", *Environment and Urbanization,* vol. 22, no. 2, pp. 433-450.

Adger, W.N., Hughes, T.P., Folke, C., Carpenter, S.R. & Rockstrom, J. 2005, "Social-ecological resilience to coastal disasters", *Science (New York, N.Y.),* vol. 309, no. 5737, pp. 1036-1039.

Agada, S. & Nirupama, N. 2015, "A serious flooding event in Nigeria in 2012 with specific focus on Benue State: a brief review", *Natural Hazards,* vol. 77, no. 2, pp. 1405-1414.

Agbonkhese, O., Agbonkhese, E.G., Aka, E.O., Joe-Abaya, J., Ocholi, M., & Adekunle, A. (2014). Flood Menace in Nigeria: Impacts, Remedial and Management Strategies. *Civil and Environmental Research, Vol. 6(4).* ISSN 2225-0514 (Online)

Baker, D. & Refsgaard, K. 2007, "Institutional development and scale matching in disaster response management", *Ecological Economics,* vol. 63, no. 2-3, pp. 331-343.

Bariweni, P. A., Tawari, C.C., & Abowei, J.F.N., (2012). Some Environmental Effects of Flooding in the Niger Delta Region of Nigeria. *International Journal of Fisheries and Aquatic Sciences 1(1),* 35-46.

Bello, B., Ganiyu, T., Adegoke, W., Azeez, M., Abdulmaliq, S. Y., Ige, S.A., Mahmood, J., Oluleye, F., & Michael, A. (2012). Yield and disease reactions of quality protein maize varieties in the Southern Guinea Savanna Agro-Ecology of Nigeria. *International Journal of Agricultural Science, 2,* 203-209.

Bin, O. & Polasky, S. 2004, "Effects of flood hazards on property values: evidence before and after Hurricane Floyd", *Land Economics,* vol. 80, no. 4, pp. 490-500.

Bourdieu, P. 1986, "The forms of capital (English version)", *Handbook of theory and research for the sociology of education,* pp. 241-258.

Bronstert, A. (2013). Floods and Climate Change: Interactions and Impacts. *Risk Analysis, 23(3),* 11-19.

Building Nigeria's Response to Climate Change (BNRCC) (2011). *Gender and Climate Change Adaptation: Tools for Community-level Action in Nigeria*. Nigerian Environmental Study/Action Team (NEST).

Cacioppo, J.T., Reis, H.T. & Zautra, A.J. 2011, "Social resilience: the value of social fitness with an application to the military". *American Psychologist,* vol. 66, no. 1, pp. 43.

Cairns, K.2002, "Attachment, trauma and resilience" British Association for Adoption & Fostering, London.

Castleden, M., McKee, M., Murray, V. & Leonardi, G. 2011, "Resilience thinking in health protection", *Journal of Public Health,* vol. 33, no. 3, pp. 369-377

Chandra, A., Acosta, J., Meredith, L.S., Sanches, K., Stern, S., Uscher-Pines, L., Williams, M. & Yeung, D. 2010, "Understanding community resilience in the context of national health security", *Santa Monica, CA:* RAND Corporation.

Chaskin, R.J. 2008, "Resilience, community, and resilient communities: Conditioning contexts and collective action", *Child Care in Practice,* vol. 14, no. 1, pp. 65-74.

Chiadikobi, K.C., & Oyebanji, O. (2011). *Flood Risk Assessment of Port Harcourt, Rivers State, Nigeria*. https://www.researchgate.net/publication/336288521

Ciglar, B.A. (2017). *U.S. Floods: The Necessity of Mitigation*. https://www.researchgate.net/publication/319989862

Cohen, O., Leykin, D., Lahad, M., Goldberg, A. & Aharonson-Daniel, L. 2013, "The conjoint community resiliency assessment measure as a baseline for profiling and predicting community resilience for emergencies", *Technological Forecasting and Social Change,* vol. 80, no. 9, pp. 1732-1741.

Coleman, J. & Hagell, A. 2007, "The nature of risk and resilience in adolescence", *Adolescence, risk and resilience: Against the odds,* vol. 3, pp. 2-16.

Cote, M. & Nightingale, A.J. 2012, "Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research", *Progress in Human Geography,* vol. 36, no. 4, pp. 475-489.

Davoudi, S., Shaw, K., Haider, L.J., Quinlan, A.E., Peterson, G.D., Wilkinson, C., Fünfgeld, H., McEvoy, D., Porter, L. & Davoudi, S. 2012, "Resilience: A Bridging Concept or a Dead End?"Reframing" Resilience: Challenges for Planning Theory and Practice Interacting Traps: Resilience Assessment of a Pasture Management System in Northern Afghanistan Urban Resilience: What Does it Mean in Planning Practice? Resilience as a Useful Concept for Climate Change Adaptation? The Politics of Resilience for Planning: A Cautionary Note: Edited by Simin Davoudi and Libby Porter", *Planning Theory & Practice,* vol. 13, no. 2, pp. 299-333.

Dewan, T.H. 2015, "Societal impacts and vulnerability to floods in Bangladesh and Nepal", *Weather and Climate Extremes,* vol. 7, pp. 36-42.

Doron, E. 2005, "Working with Lebanese refugees in a community resilience model", *Community Development Journal,* vol. 40, no. 2, pp. 182-191.

Egboka, B.E.C., & Uma, K.O. (1985). Water resources of Owerri and its environs, Imo state. *Nigeria Journal of Mining and Geology, 22,* 57-64.

Ejizu, A.N., Eri, E.E., Oyedirin, R., and Malizu, L.O. (2014). Integrated Water Resources Management for Economic Development at Watershed level. Proceedings of the 2nd International Conference on Flood and Erosion Prevention, Protection and Mitigation. Sodave Classic Publication, Port Harcourt, Nigeria. ISBN 9788068663. P. 72.

Elahi, E. (2010). *How Risk Management can turn into Competitive Advantage*. https://www.researchgate.net/publication/254695340

Etuonovbe, A.K. (2011). *The Devastating Effect of Flooding in Nigeria. Hydrography and the Environment.*http://www.fig.net/pub/fig2011/papers/ts06j/ts06j_etuonovbe_5 002.pdf

Ghatak, M., Kamal, A., Mishra, O.P., 2012. Background paper flood risk management in South Asia. In: Proceedings of the SAARC Workshop on Flood Risk Management in South Asia

Harding, R., Arnell, N., Reynard, N., Prudhomme, C., Blyth, E., & Taylor, C. (2016) Climate change and hydrology. In: Rodda, J. C., & Robinson, M. (eds.) (2017). *Progress in modern hydrology: past, present and future.* Wiley Blackwell.

Ibe, K., & Uzoukwu, S. (2001). An Appraisal of Subsurface Geology and Groundwater Resources of Owerri and Environs Based on Electrical Resistivity Survey and Borehole Data Evaluation. *Environmental Monitoring and Assessment, 70,* 303-21. 10.1023/A:1010783426570.

Intergovernmental Panel on Climate Change (IPCC) (2007). *Intergovernmental Panel on Climate Change: Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Jacelon, C.S. 1997, "The trait and process of resilience", *Journal of advanced nursing*, vol. 25, no. 1, pp. 123-129.

Jones, P.G., & Thornton, P.K. (2013). The potential impacts of climate change on maize production in Africa and Latin America in 2055. *Global Environmental Change, 13,* 51-59.

Longstaff, P.H. & Yang, S. 2008, "Communication management and trust: their role in building resilience to "surprises" such as natural disasters, pandemic flu, and terrorism", *Ecology and Society*, vol. 13, no. 1, pp. 3.

Mallak, L.A. 1998, "Measuring resilience in health care provider organisations", *Health manpower management*, vol. 24, no. 4, pp. 148-152.

Manyena, B. 2009, *Disaster resilience in development and humanitarian interventions*, (Doctoral dissertation, Northumbria University).

Manyena, S.B. 2006, "The concept of resilience revisited", *Disasters*, vol. 30, no. 4, pp. 434-450.

Marzeion, B. & Levermann, A. 2014, "Loss of cultural world heritage and currently inhabited places to sea-level rise", *Environmental Research Letters*, vol. 9, no. 3, pp. 034001.

Masten, A. & Obradović, J. 2008, "Disaster preparation and recovery: Lessons from research on resilience in human development", *Ecology and society*, vol. 13, no. 1. Pp. 9.

Medugu, N. (2009). Combating Climate Change in Nigeria. Accessed online on the 5th of January 2022 via: http://environmentalsynergy.wordpress.com/2009/08/14/comba ting-climate-change-in-nigeria/

Mishra, S., Mazumdar, S. & Suar, D. 2010, "Place attachment and flood preparedness", *Journal of Environmental Psychology*, vol. 30, no. 2, pp. 187-197.

Mmom, P.C. & Aifesehi, P.E. 2013, "Vulnerability and resilience of niger delta coastal communities to flooding", *IOSR Journal of Humanities and Social Science*, vol. 10, pp. 27-33.

National Emergency Management Agency (NEMA) (2012). *Flood: more than 25, 000 displaced in Benue as many communities remain adamant.* http://www.nema.gov.ng/emergency-zones/floods.aspx

Nigerian Meteorological Agency (NIMET) (2016). Concept Note on the Comprehensive Vulnerability and Needs Assessment for Nigeria. https://www.mdpi.com/2073-4433/11/2/190/htm

Njoku, J.D., Nnaji, A.O., & Iwuji, M.C. (2011). Spatial Analysis of Soil Fertility using Geographical Information System (G.I.S) Technology. *African Research Review.*

Norris, F.H., Stevens, S.P., Pfefferbaum, B., Wyche, K.F. & Pfefferbaum, R.L. 2008, "Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness", *American Journal of Community Psychology*, vol. 41, no. 1-2, pp. 127-150.

Nzeadibe, T.C., Egbule, C.L., Chukwuone, N.A., Agwu, A.E. & Agu, V.C. 2012, "Indigenous innovations for climate change adaptation in the Niger Delta region of Nigeria", *Environment, Development and Sustainability*, vol. 14, no. 6, pp. 901-914.

Obed, N., Abam, T., & Sabastine, N. (2016). Prospects of Otamiri River as a Source of Water Supply to Its Catchment Communities in Rivers State. *Journal of Nigerian Environmental Society, 10.*

O'Cathain, A., &Thomas, K. (2006). Combining qualitative and quantitative methods. In: Pope C, Mays N, editor. *Qualitative Research in Health Care.* Third. Oxford: Blackwell Publishing.

Olanrewaju, D., & Fadairo, G. (2003) Flooding as an Induced Environmental Problem: A Case Study of Ala River in Akure, Nigeria. *Journal of Nigerian Institute of Town Planners, 16,* 85-96.

Ologunorisa, T.E. & Adeyemo, A. 2005, "Public perception of flood hazard in the Niger Delta, Nigeria", *Environmentalist*, vol. 25, no. 1, pp. 39-45.

Park, J., Seager, T.P., Rao, P.S.C., Convertino, M. & Linkov, I. 2013, "Integrating risk and resilience approaches to catastrophe management in engineering systems", *Risk Analysis*, vol. 33, no. 3, pp. 356-367.

Poortinga, W. 2012, "Community resilience and health: The role of bonding, bridging, and linking aspects of social capital", *Health & place*, vol. 18, no. 2, pp. 286-295.

Rahman, A., Sakurai, A. & Munadi, K. 2017, "Indigenous knowledge management to enhance community resilience to tsunami risk: Lessons learned from Smong traditions in Simeulue island, Indonesia", *IOP Conference Series: Earth and Environmental Science* IOP Publishing, pp. 012018.

Sampson, R.J., Raudenbush, S.W. & Earls, F. 1997, "Neighborhoods and violent crime: a multilevel study of collective efficacy", *Science (New York, N.Y.)*, vol. 277, no. 5328, pp. 918-924.

Schwartz, P., & Randall D (2003). *An Abrupt Climate Change Scenario and its Implication for United States National Security*. In: Kwari, J.W., Paul, M.K. Shekarau, L.B. (2015). The Impacts of Flooding on Socio-Economic Development and Agriculture in Northern Nigeria: A Case Study of 2012 Flooding in Yola and Numan Areas of Adamawa State Nigeria. *International Journal of Scientific & Engineering Research, Vol. 6(7),* 1433-1442.

Simmers, I, (1988); Estimation of Natural groundwater Recharge, North Atlantic Treaty Organization, Scientific Affairs Division. PP. 18-19.

Simonović, S.P. 2012, *Floods in a changing climate: risk management*, Cambridge University Press.

Tami, A.G. & Moses, O. 2015, "Flood vulnerability assessment of Niger Delta States relative to 2012 flood disaster in Nigeria", *American Journal of Environmental Protection*, vol. 3, pp. 76-83.

Tawari-Fufeyin, P., Paul, M. & Godleads, A.O. 2015, "Some aspects of a historic flooding in Nigeria and its effects on some Niger-Delta Communities", *American Journal of Water Resources*, vol. 3, no. 1, pp. 7-16.

Tesi, G.O., Iwegbue, C., Emuh, F.N. & Nwajei, G.E. 2016, "Lagdo Dam Flood Disaster of 2012: An Assessment of the Concentrations, Sources, and Risks of PAHs in Floodplain Soils of the Lower Reaches of River Niger, Nigeria", *Journal of environmental quality*, vol. 45, no. 1, pp. 305-314.

Theron, M. (2017). *Climate Change and Increasing Floods in Africa: Implication for Africa's Development.* Silowa Printers South Africa.

Uma, K.O., & Kehinde, M.O. (1992). Quantitative Assessment of the Groundwater Potential of Small Basins in parts of Southeastern Nigeria, Hydrological- Sciences. *Journal des Sciencas 37*, 4-8.

Ungar, M. 2008, "Resilience across cultures", *The British Journal of Social Work*, vol. 38, no. 2, pp. 218-235.

Uyigue, E. & Agho, M. 2007, "Coping with climate change and environmental degradation in the Niger Delta of southern Nigeria", *Community Research and Development Centre Nigeria (CREDC)*, pp. 24-27.

World Health Organization (WHO) (2012). *Climate Change*. https://www.who.int/heli/risks/climate/climatechange/en/