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Indigenous Knowledge System and Local Adaptation Strategies to Flooding in Coastal Rural Communities of Nigeria

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Key Words

Indigenous knowledge • coastal communities • climate change • flooding

Abstract

The paper examines the nature and types of traditional and Indigenous knowledge systems used in the management of ocean (cold) and river (warm) flooding in some selected coastal rural communities in Nigeria. The study further identifies certain traditional and local engineering approaches to manage flood disasters at the community and household levels. Focus group discussion, participant observation methods, and anecdotal sources were used to collect data from the selected rural coastal communities in Nigeria. The data collected were context analyzed to provide information for the discussion. It was observed that the communities have undocumented knowledge of local meteorologies which are based on observation and traditional practices and belief systems. The Ilajes, Itshekiris and Ijaws who live in the study area have specific local meteorology that enable them to predict flooding in real time, and on a seasonal and long term basis. The lifestyle, tradition and religious belief systems of the rural coastal dwellers revolve around excess water management from the distributaries of river Niger and the Atlantic Ocean. The paper posited that a sustainable adaptation mechanism should take into considerations the local adaptation strategies with the view to modernizing them in the rural coastal communities in Nigeria and other areas.

INTRODUCTION

Climatic variability has far reaching environmental, health and socio-economic impacts in many developing countries (Boko et al., 2007; Newsham & Thomas, 2011; Nyong, Adesina, & Elasha, 2007). The magnitude of these impacts has attracted the



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attention of local and international research communities especially on the need for adaptation and mitigation of the local population to the effects of climate change including flood disaster. Several methods and approaches have been used all over the world to mitigate and respond to coastal flooding and areas prone to flood disasters. These approaches and methods have been grouped into three categories including engineering, scientific and traditional approaches. The engineering and the scientific approaches are elitist and highly technical which are often beyond the capacities of local communities. The local communities therefore depend on the central governments, state agencies or development partners for these approaches in response to flooding in their communities. The sustainable approach is the traditional method in which the local populations build on their experiences and strength to develop climate change resilience and appropriate responses. The traditional method is based on Indigenous knowledge and local technologies developed over time (Green & Raygorodetsky, 2010; Newsham & Thomas, 2011). It identifies past and current coping strategies developed by traditional communities to adapt to and mitigate environmental change based on their specific cultural background. Though the value of Indigenous knowledge is considered in the design and implementation of sustainable development projects, little has been done to incorporate this into formal climate change mitigation and adaptation strategies (Nyong et al., 2007).

There are different views and concepts of Indigenous knowledge especially on how it relates to sustainable strategies to appropriately respond to climate variability. Indigenous knowledge relates to what Indigenous people know and do, and what they have known and done for generations – practices that evolved through trial and error and proved flexible enough to cope with change (Melchias, 2001). This approach to understanding Indigenous knowledge suggests that Indigenous people are local, crude and uncivilised, and are far from the technological developments of western economies. This view has a vestige of racism and colonialism and suggests that Indigenous knowledge has survived through trial and error without any form of experimentation that characterises western knowledge. It is noteworthy; however that Indigenous knowledge developed over centuries, shows how Indigenous mechanisms have coped with real life challenges and difficult situations.

There is a large body of knowledge on the coping strategies of communities to climatic variability and extreme weather events (FAO, 2008). However, some natural resource management policies such as forest resources protection policies, fishing policies and coastal management policies are still based on a top-down approach where local populations are not involved. These local knowledge and practices have been forgotten, hidden or simply ignored despite their valuable contribution for mitigation and adaptation research efforts towards sustainable ecological developments.

In Africa, traditional or local knowledge is strongly linked to local culture and past experiences. Over long periods of time the communities have acquired knowledge about their experiences with nature, through their daily interaction and perceptions of their immediate surroundings or environment. The communities have intimate knowledge of their environment, including physical, sociological and spiritual contents. Adaptive strategies to climate variability must take into consideration the Indigenous approaches that the communities are familiar with and which they can readily apply themselves.

In an attempt to portray the significance of traditional or Indigenous knowledge in the management of climate variability, Easton (2004) has identified three different ways of understanding the concept of Indigenous knowledge. The first approach considers it as an inheritance from the past. The second approach describes it as a representation of an alternative way of thinking, typical of African cultures. The third definition considers Indigenous knowledge as a means to express what people know and create new knowledge from the intersection of their capacities and development challenges. Indigenous knowledge is conserved orally, transmitted from one generation to another and communicated through proverbs, deities' beliefs, songs, and spiritual practices, which encompass rules with *dos and don'ts*. Traditional knowledge is conveyed with speech from generation to generation through songs or tales and also through actions and observations (Grenier, 1998; McGregor, 2004). Indigenous knowledge is also conserved through the visual and performing arts such as masquerades, festivals, building design and pattern which are hinged on the understanding of the communities to the behaviors of the sea with a vestige of spirits and belief in water spirit interactions in human and community affairs.

The study examined the nature of Indigenous knowledge systems and adaptation mechanisms for coastal flood management in selected coastal communities in Nigeria. The following research questions were advanced in the course of the study:

1. What are the main effects of flood disasters on the rural coastal communities?
2. What are the major traditional and Indigenous knowledge among countries about flood management?
3. What are the local adaptation strategies and technologies for flood management in the communities?

The following section presents the nature of flooding disasters in the Nigerian coastal communities, the methodology used in the study and the major findings. These are followed by the conclusion and policy recommendations.

FLOODING IN NIGERIAN COASTAL RURAL COMMUNITIES

The entire 853 kilometers of the Nigerian coastline is prone to coastal flooding both from ocean surges and when the network of river systems and creeks overflow their banks on their southward journey to the Atlantic Ocean. Most of the coastal settlements in Nigeria are rural except for a few such as Lagos, Bonny and Twon Brass. Other major communities are more than five kilometers from the coastline. Most of the rural coastal communities depend largely on local technologies and approaches to deal with the warm and cold flooding that regularly occur in the coastal communities.

Two types of flooding have been identified in Nigerian rural coastal communities, which are locally referred to as river (warm) flooding and ocean (cold) flooding (Etuonovbe, 2011). The global sea level rise encourages incessant ocean surges into the coastal communities, while the flood-laden rivers inundate the communities when they flow into the sea through the meandering creeks in the coastal region. Several anthropogenic activities also contribute to the subsidence of the coastline including dredging of canals for boat transport and oil exploration.

The communities are engaged in fishing both within the creeks and around the continental shelf of the Atlantic Ocean. The need to be close to their work environment (the sea) has encouraged them to settle on the fringe of the rivers, creeks and the Atlantic Ocean. The creeks are being put to multiple uses such as bathing, domestic use, waste disposal (toilets are built directly on the water), transportation, swimming pool for training new initiates, offices for fishermen and shops for the retail business, fish market and traditional festivals. The life of the rural coastal communities' dwellers revolves around the water. Flooding is a regular experience and has been integrated effectively into everyday lives and activities. Consequently, over time most of these communities have developed different Indigenous approaches such as consultation of gods to appease water through sacrifices, construction of embankments, anticipation of flood occurrences from some local signs, etc., to mitigate the negative effects of flooding on the settlements.

Flooding has some positive effects on the rural coastal communities, one of which is the increase in the fish catch, especially during ocean flooding. The Atlantic brings large fish to the continental shelf. Some large fish can also be found in the creeks during extensive flooding.

Though flooding does not affect the fishing business in the fishing communities, sometimes cold flooding from the Atlantic brings dangerous aquatic animals into homes and schools when it is excessive. Flooding also causes major discomfort to daily activities. Some of the negative effects of both cold and warm flooding on the rural coastal communities are outlined as follows:

1. Destruction of farmlands when salt water gets in contact with the crops.
2. When flooding occurs at night, communities record human casualties especially children and old people and often times domestic animals.
3. Flooding progressively sacks villages and as a result communities are forced to relocate further inland as the sea level rise inundates the communities.
4. Dangerous aquatic animals like crocodiles, hippopotamuses and poisonous snakes are often carried by floodwater into residences, especially at night.
5. Many house fires are reported in the rural coastal communities during flooding when women have had to move outdoor fireplaces into the house because of floodwater around the houses. The buildings are wooden and vulnerable to inside cooking fires.
6. Women and children are often constrained indoors during flooding thus limiting access to schools, medical care and economic activities.
7. Water borne diseases such as diarrhea, malaria, skin diseases, typhoid etc., are common during flooding due to water trapped in residences and restricted access to medical care.

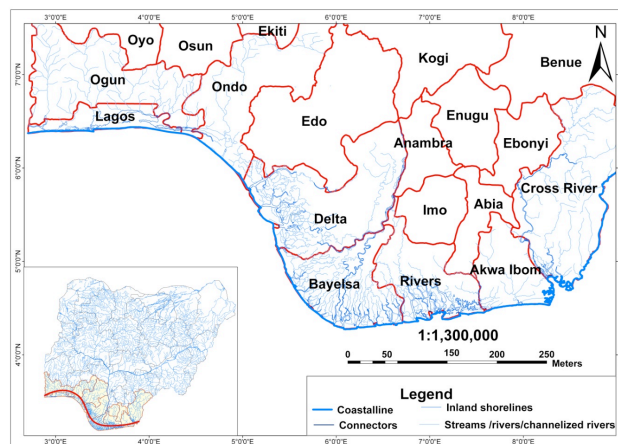
The structure of the soil in different segments of the coastline also determines the inundating effects of the flooding. The Nigerian coastline has been categorized into five major ecosystem structures by Fabiyi (2008) as follows:

1. The Lagos end of the beach is made up of coarse sand, which is easily drained and excess flood water easily percolates into the coarse substrate flow back into the sea after a few days.
2. Immediately after Epe, the coastal bend is characterized by a transgressive mud beach, which is comprised of mud a flat, marsh and vegetated bluff. This part of the beach is highly vulnerable to coastal flooding and flood water often gets trapped in the mud creeks and can remain there for days, paralyzing activities of the coastal communities. This type of beach extends to Delta state and parts of Bayelsa state.
3. Further on, the coastline is characterized by mangroves and some form of fine beach sand in a river state. The mangroves and the pockets of fine sand make the effects of flooding more disturbing to the coastal communities and boats easily run aground when flood waters veil the true depth of the coastline/banks.
4. In the Akwa Ibom end of the coastline is Barrier Island which is elevated above the other coastline and the vegetation is mainly the rain-fed deltaic. Coastal flooding has little effect on the upland area but the communities suffer from warm flooding from the distributaries of the River Niger which flows into the sea through a networks of channels that cross through the region.

5. The eastern flange of the coastline is the Nypa Palm Beach where Nypa Palms' roots hold the fragile beach. The effects of flooding on this beach are very minimal because the vegetation serves as a barrier to ocean flooding. The river channels that enter the sea at the Calabar Estuary are very limited.

Despite the absence of major settlements along the coastline of Nigeria, there are more than 3,000 minor settlements and fishing camps within one kilometer of the coastline. The coastline is dissected by several networks of river systems, which specifically make the coastal areas unfavorable for the development of road infrastructure that could serve as an engine for economic developments in the area. Figure 1 shows the hydrology of coastal Nigeria. Many camps in the coastal area lack access to the hinterland except through hand paddled canoes and some motorized boats. Some of these camps are directly on the Atlantic especially where the tidal wave is relatively gentle.

FIGURE 1: THE COASTAL STATES AND HYDROLOGY IN NIGERIA



THE STUDY AREA

The area of study falls within the transgressive mud beach zone of the Nigerian coastline. It consists of four local government areas namely: Ilaje LGA (Ondo state), Burutu, Warri and Warri South West local government areas in Delta. It is bounded by Edo state in the north, Lagos in the west, Bayelsa in the east and the Atlantic Ocean in the south (Figure 1). The area is composed of lowlands and rugged hills with granitic outcrops in several places. In general, the land rises from the coastal part (less than 15 meters) of Ilaje/Ese-Odo and Burutu (Delta) in the south, to the rugged

hills of the north-eastern portion in Akoko area, rising to above 200 meters. These areas are characterized by several ecological zones including coastal barrier islands, mangroves, freshwater swamp forest and lowland rainforests. The beaches of the region receive sand from the coastal rivers that is redistributed by long-shore currents.

The dominant geological regions within these regions are the sedimentary rocks and the region of Pre-Cambrian basement complex rocks in the north. In Ondo state major rivers dissect the sedimentary rock in a north-south direction draining into the Atlantic Ocean. The rivers include Owena, Oluwa, Oni, Ogbese and Ose. There is numerous proliferation of the basement complex by small river channels, which usually become dry between November and May. In Delta state, the Niger River drains the eastern flank of the state and discharges into the sea through several distributaries as the Forcados, Escravos and Warri rivers and creeks such as the Bomadi creeks.

The study area is comprised of three major ethnic groups widely distributed throughout the two states that make up the study area. These ethnic groups include the Ilajes, Ijaws, and Itshekiris. The Ilajes are the dominant ethnic group in Ondo state and the selected Ilaje communities are Ayetoro, Awoye, Orioke, Araromi, Abereke and Obefela all in Ondo state while the Ijaws and Itsekiris are the dominant ethnic groups in Delta states. The selected Ijaw and Itshekiri communities include Burutu, Gbekebor and Ogulaha.

The main livelihood for the majority of the population is fishing and farming. Fishing is supplemented by farming paddy-rice, plantains, yams, cocoyams, bananas and other vegetables as well as tropical fruits such as guava, mangoes and pineapple, and trading. Smoke-dried fish, timber, palm oil and palm kernels are processed for export.

METHODOLOGY

DATA SOURCING

Data for the study were acquired through several sources including key informant interview, focus group discussions and participant field observation.

Key informant interview. Key informant interviews were conducted in all the communities that have recently experienced major flooding to examine how the recent flood disasters have affected the community food security and livelihoods. The people selected for interviews included fisherman, farmers, market women and boat owners. The criteria used to select the key informants included those who had been living and working in the community for at least twenty years and those that had experienced at least one major flood disaster in the community.

Focus group discussion. Focus group discussion (FGD) was also conducted in each of the communities to collect information about the local perceptions on flood disaster and adaptation strategies. FGD technique was adopted because of the

homogeneity observed in the previously designed household questionnaire during the pilot test. Various social groups and categories participated in these FGD. There were opinion leaders, traditional rulers, religion leaders (pastors and priest), youth leaders, men leaders, and women leaders. The FGD covered issues such as the perceptions of the communities on flood disasters, the occurrence and duration of the coastal flood, the trend and the economic activities affected, and the infrastructures affected. Also the knowledge of flood preceding signs, ecological indicators and the Indigenous technologies for mitigating floods.

Participant field observation. The team of researchers visited the communities and participated in the fishing activities, shopped on board paddleboats and attended local festivals on the water. The participation afforded the researchers an opportunity to observe first hand all the negative effects of flooding in the communities and how these communities developed local strategies to resolving flooding challenges in the communities.

SYNTHESIS AND ANALYSIS OF DATA

The data collected through the three principal sources and other anecdotal sources were later synthesized and analyzed to generate discussions in the following sections.

1.0. MAJOR FINDINGS OF THE STUDY INDIGENOUS KNOWLEDGE, BELIEF, CULTURE AND PRACTICES ON COASTAL FLOODING

Indigenous knowledge and practices of the local population are entrenched in religious beliefs, culture and past experiences of the people. The knowledge and practices held by communities in regard to flooding in the study area, varies among communities.

Religion, cultural believes and practices associated with flooding in the coastal communities. Though most of the local population in the study area including the Ijaws, Ilajes and Itshekiri are now primarily Christians (95% profess to be), with Catholicism and Anglicanism being the varieties of Christianity most prevalent among them, yet each community has elaborate traditional religious practices and beliefs which include veneration of ancestors and respect for water spirits especially the Olokun (The god of the Atlantic). Veneration of ancestors plays a central role in Ijaw traditional religion, while water spirits, known as *Owuamapu* figure prominently in the Ijaw pantheon. The Ilajes also reference and worship a water goddess often referred to as *Oluweri* or *Ajuwaleri*.

Ijaw religious beliefs specifically hold that water spirits are like humans in having personal strengths and shortcomings, and that humans dwell among the water spirits before being born. The role of prayer in the traditional Ijaw system of belief is to maintain the living in the good graces of the water spirits among

whom they dwelt before being born into this world, and each year the Ijaw hold celebrations in honor of the spirits lasting for several days. The Atlantic god will fight through ocean flooding if the worship is delayed or the tokens used in sacrifice are defective. The sin (violation of sacred cultural rules and instructions) of individuals or communities may incur the wrath of the water spirit. Central to the festivities is the role of masquerades, in which men wearing elaborate outfits and carved masks dance to the beat of drums and manifest the influence of the water spirits through the quality and intensity of their dancing. Particularly spectacular masqueraders are taken to actually be in the possession of the particular spirits on whose behalf they are dancing.

The Ilajes believe the water spirits can be angered and if they are angry, they show their anger through inundating flooding of the coastal communities. The water goddess can be appeased through chicken or goats. The blood of these tokens for sacrifices is poured onto the shrine of the river goddess at a designated spot on the water while the priest and other initiates in the community will cook and eat the flesh of the token. An individual can also offend the water spirits and the spirits will take it out on the entire community. They hold the belief that what individuals do in their houses are known to the water spirit who is watching over them in their daily activities.

It is sacrilege for any member of the community to curse at night even in their bedroom as this will anger the water spirit and flood may inundate the entire community the following morning. When there is a major incursion of ocean water into the rural coastal community in Ilajes around Igbo kingdom it is believed that someone has incurred the wrath of the spirits.

It was observed that even in predominantly Christian communities the water spirits are still revered and are believed to be involved in day-to-day activities of the communities. In some communities, they hold the belief that the water spirit is responsible for a good fish catch and if the spirits are annoyed the fishes may not enter the nets and will result in poor catch for fishermen.

CULTURAL PRACTICES AND TABOOS ON FLOODING

The cultural practices of the people in the rural coastal communities are water based and depend on the variability of ocean currents and river flow. The Ilajes begin their annual monthly calendar with the onset of the rainy season. *Ini odun* which is the first month of the year in the Ilaje calendar falls in March of the conventional Roman calendar. This period coincides with the beginning of the rainy season in the region which signifies the Ilajes once thriving fishing activities. Their twelve calendar month year begins in March as shown in Table 1.

TABLE 1: ILAJE LOCAL COASTAL CALENDAR AND FLOOD OCCURRENCE

Months in Western Calendar	Indigenous Calendar in Ilaje area	Month
March	Ini	1st
April	Eeji	2nd
May	Eeta	3rd
June	Eerin	4th
July	Aarun	5th
August	Eefa	6th
September	Eeje	7th
October	Eejo	8th
November	Eesan	9th
December	Eewa	10th
January	Oriro	11th
February	Orika	12th

Source: Authors' fieldwork, 2012

Indigenous meteorology signals and signs of approaching flood. The study also observed that the local communities accumulated knowledge acquired from generation to generation about the patterns of weather, the behavior of the ocean currents and the timing and magnitude of river and ocean flooding. Some of the Indigenous signs of approaching flood disaster include the following:

Lunar observation. An approaching full moon signifies approaching ocean flooding in the communities. Though the moon sighting and observation cannot be used to estimate the level of flooding, it is believed that the tidal level rises with the approaching new moon. The communities prepare for flood as soon as they sight the new moon.

Indigenous cloud study. Thick dark clouds signify approaching heavy rain and the likelihood that the villages will be inundated by the rain fed river channels waterways. Knowledge of the local methodology is still enshrined in mystery and some members of the community appear to be more gifted in reading and interpreting cloud patterns. However, it was observed during the field study that some of the predictions of cloud watchers often miss and can be very misleading.

Behavior of aquatic animals. The coastal rural communities also study certain aquatic species to understand the behavior of the floodwater. In Ilaje communities for instance the migration pattern of a crab species often called in the local language as *lagbaja* or *Sabutu* signify approaching floodwater. When these crabs migrate en

mass towards the Atlantic, it signifies approaching freshwater flooding (warm flood). On the other hand, if the same crab species move en mass towards the fresh water through the creeks, it signifies the approaching flood from the Atlantic (cold flood). The movement pattern was confirmed to be accurate and the community noted that the speed at which these crabs migrate, indicates the magnitude and the ravaging nature of the approaching flood.

Water colour observation. The color of water in the creeks changes to dark brown, brownish or yellowish colour depending on the period of the year and the activities in the upstream. However when there is sudden change in the color of the water as opposed to the eight hourly tidal movement of the Atlantic ocean in the creeks, it signifies impending flooding. When the water suddenly changes to a very dark color, it indicates that there is an approaching sea flood (cold flood), and when the water in the creeks suddenly change to a brownish or yellowish color, that signifies an approaching river flood (warm flood). When the water color changes are understood by all the community members and they take action quickly, some may be trapped in neighboring communities because of the ocean floods and schools are closed.

Leaves and particles observation. The creeks in the selected communities have water weeds (water hyacinth), which an approaching river flood often carry and move rapidly towards the sea. When the water weeds move rapidly toward the fresh water it indicates an approaching sea flood (cold flood). Other floating particles and floating leaves are linked to flooding in all the selected communities. Some of the local signs and perceptions are presented in Table 2.

These signs are complemented with some Indigenous knowledge and past experiences, which have their roots in the spiritual beliefs and ancestral practices in the area. The famous beliefs in Ilaje communities are the influence of *Ojuoluweri* god in Araromi community and the *Ajuwaleri* god in *Abereke*. In the Ijaw or Itshekiri communities, Olokun is the famous god often worshiped and linked to coastal flood disaster. Any offence against these gods will cause flooding in the communities and an offence against the gods requires sacrifices of chicken, goats and local gin or brandy depending on the gravity of the offence. Some examples of offences are the use of cutlass in the night in *Abereke*, the crossing of a particular river by a woman menstruating in Araromi, etc. The sacrifices to appease the gods would be conducted by the chief priest on behalf of the communities.

TABLE 2: LOCAL SIGNS AND ECOLOGICAL INDICATORS OF FLOODING OCCURRENCE IN THE SELECTED COMMUNITIES

Communities	Local Perceptions/ Signs of Flood	Ecological Indicators	Indigenous Knowledge Applications
<i>Abereke</i>	Heavy rainfall of more than two hours signifies potential flooding. 2 hours after a particular wind or storm	Loss of some vegetation species: <i>opepe</i> (<i>Sarcocephalus latifolius</i>), <i>abura</i> (<i>Mitragyna ciliate</i>)	Efforts are made to bring the domestic animals and other valuables into safe place. The floodwater often come at night.
<i>Ori Oke</i>	Approaching full moon shows flood is likely from the sea		Fishermen are cautioned
<i>Araromi</i>	Consultation of Ojuoluweri river god, to know how strong and disastrous the flood will be in advance There is yearly prediction of flooding by the priest of the water god When oriro, orika and ini months approach		Preparations are made in advance in response to predictions of water priests. Flood holidays for school children and markets are closed. In extreme cases the community can disperse the clouds and rain may be minimised or dispersed.
<i>Obefela</i>	Thick clouds signify heavy rain and flooding when the moon is getting fuller.		The domestic cooking fireplaces are raised on a platform.
<i>Awoye</i>	Calculation of months predict the high tide period (November, December, January – February) Fullness of the moon	Loss of some vegetation species: raffia palm, <i>opepe</i> , <i>abura</i>	High tides are known by all and preparations are made to avert losses.
<i>Ayetoro</i>	Full moon Rainy season, when it rains more than two times a week between 11 and 15 of January.		Preparations are made to reduce damages from flood disasters. They have relocated the king's palace twice due to flooding and subsidence.

Source: Authors' fieldwork, 2012

TABLE 3: INDIGENOUS KNOWLEDGE AND EXPERIENCE ON CLIMATE CHANGE AND FLOOD DISASTER IN THE COASTAL COMMUNITIES OF NIGERIA

Communities	Indigenous Taboos, Belief System
<i>Abereke</i>	In 1960 and 1970, our fathers used to appeal to water. Proverb: <i>Igi ganganran ma gun mi l'aju, a t'oke ni ati woo</i> : showing that they prepare themselves before flood. In Abereke, there is a god called Ajuwaleri. In the communities, it is a taboo to curse a person in the night or use a cutlass. If this is trespassed, the <i>Ajuwaleri</i> will get offended and cause flooding in the communities. The chief priest investigates the report of the trespass. A sheep, chicken or goat is sacrificed to appease the god.
<i>Ori Oke</i>	This is a small community which participates in the worship of the river goddess of the Ugbonla kingdom. They also have taboos and proverbs that describe what to do during a flood.
<i>Araromi</i>	Worshipping of <i>Ojuoluweri</i> canal to appeal to the god for the protection of the village. <i>Taboo</i> : If a woman is menstruating, she should not pass through <i>Ojuoluweri</i> canal, otherwise she will not stop menstruating. And if the woman walks towards the ocean, it will rise and cause flooding in the communities. A sacrifice must be made after a consultation with the high priest of the communities.
<i>Obefela</i>	During <i>Ajodun Ibile</i> festival, the water spirit is appeased against flooding the following year.
<i>Awoye</i>	An annual sacrifice of a cow to the water goddess with the participation of the Oba (King) of Benin Kingdom who usually donates the cow during <i>Ode-Ugbo</i> kingdom festival, every year in June (<i>eerin</i>) or July (<i>aarun</i>).
<i>Ayetoro</i>	This is a Christian community, which doesn't believe in other gods except Almighty God to whom prayers are addressed. They have anecdotal records of the yearly inundation of their villages by the ocean flood for more than 35 years. Schools and the Oba's palace have been submerged by the sea water and mud.
<i>Ogulaha</i>	This is a Christian community but they also have a large number of community members who participate in the worship of Olokun through a carnival on the Atlantic. They worship the sea once a year during their festival specifically to ward off floods.
<i>Burutu</i>	This is a Christian community, which doesn't believe in other gods except Almighty God to whom prayers are addressed. However, the Indigenous people participate in the worship of Olokun (the god of the Atlantic Ocean).
<i>Gbekebor</i>	This is a Christian community, which doesn't believe in other gods except Almighty God to whom prayers are addressed. Modernisation has taken over and only the aged are left to worship the water spirit in the community.

Source: Authors' fieldwork, 2012

In Abereke, for instance, the spokesman of the chief, Prince Ayedatiwa explained that it was taboo to curse someone at night in his villages, and that any contravention would bring ocean floods the following morning which could be very devastating to the entire community. When the offender confessed, his fine would be to provide a fowl which would be killed and its blood poured into the river at the shrine as the initiates eat the fowl on behalf of the gods. When this was done, the flood would recede and the culprit would be pardoned. He said that it was considered dangerous to deny an accusation by the gods, because the entire village could be wiped out. This knowledge has long helped the fishermen decide when to fish and when to prepare for devastating floods.

Despite the realities and the confirmed efficiency of Indigenous knowledge, some issues have yet to be addressed. These are: scientific efficiency and the transferability of Indigenous knowledge from generation to generation. Since these knowledge systems have not been documented they can easily be forgotten. In the past, Indigenous knowledge was transferred to younger generations through folklores, communal festivals and age grade initiations. However, all these oral traditions are considered to be local and outdated by the younger generations today, which means that this knowledge will never be learned by the youth in the communities. Proven Indigenous knowledge should be documented for the coming generations as new generations are oblivious to most of the Indigenous knowledge especially the weather prediction, cloud reading and local cloud seeding (through which impending rain is dispersed).

It is evident that some predictions based on Indigenous knowledge are inaccurate or misleading which means that Indigenous knowledge needs to be enhanced through the systematic and careful integration of scientific knowledge and modern technologies, in order to meet the modern day challenges facing the rural coastal communities.

LOCAL ADAPTATION STRATEGIES AND INDIGENOUS TECHNOLOGIES

Over time the coastal communities have developed local strategies to cope with the effects of climate change and flooding, some of these strategies are local policy while some of them are physical. Some of these adaptation strategies are presented as follows: Social capital. The communities had put in place coping mechanism through mutual support, to assist in reducing the effects of losses to flood through cooperative society, religious organizations and age grade groups. The assistance rendered to flood victims include loan, or outright grant, temporary accommodation to the victims and families until flood water recedes or help scooping water out of their living room, and provision of food items in the events when flood ravages the farmland of flood victims. These processes of assistances are informally organised and spontaneous.

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Building materials used and construction style. The communities have adapted their building materials and building style to withstand the regular devastating flood disaster in the communities. It was noted that the communities take a cue from natural features in the areas to construct their buildings. The river birds and mangroves provide insight to the people in the communities for building on piles and raft foundations.

Local Public works. Community development in the coastal community is very active and dynamic. The community develops strategies to cope with coastal flooding through the construction of wooden walkways and streets. They also construct shoreline protection and jetties with the assistance of the local or provincial governments. Communities have developed and constructed some infrastructures with the assistance of oil companies, to mitigate the effects of flooding (Table 4).

TABLE 4: COPING MECHANISM AND INDIGENOUS TECHNOLOGIES

Communities	Coping Mechanism	Indigenous Technology/Local Adaptation Strategies
<i>Abereke</i>	Financial assistance from the community cooperative	Construction of wooden bridges, mud and concrete embankments
<i>Ori Oke</i>	Mutual support in the community	Pathways for water
<i>Araromi</i>	Mutual support in the community	Culverts and gutters
<i>Obefela</i>	Mutual support in the community	Building on raised platform or pile foundation
<i>Awoye</i>	Mutual support in the community	Sand filling
<i>Ayetoro</i>	Assistance from church	Mud and concrete embankment
<i>Ogulaba</i>	Assistance from oil companies like Shell	Concrete embankments
<i>Burutu</i>	Assistance from oil companies and local government area councils	Concrete embankments
<i>Gbekebor</i>	Mutual support in the community	Concrete embankments

Source: Authors' fieldwork, 2012

The Indigenous technologies have helped the construction of bridges using planks, wood, concrete embankments for the protection of villages, and rock embankments for the protection of shoreline.

TABLE 5: LOCAL PERCEPTIONS ON FLOOD RISKS IN EACH RURAL COASTAL COMMUNITY

Communities	Natural Disaster	Occurrence/ Duration	Trend	Challenges
<i>Abereke</i>	Sea rise and flood	Frequently in September (<i>eeje</i>)-October (<i>eejo</i>) 10-15 days	Before: moderate Now: high	Difficulty of harvesting, no potable water, accommodation problems
<i>Ori Oke</i>	Sea rise and flood	Every month, mostly in February (<i>orika</i> month)	Before: moderate Now: high	No big fish due to the increase in the salinity of water
<i>Araromi</i>	Sea rise/ river overflow flood	June (<i>eerin</i>) – July (<i>aarun</i>), 14 days	Before: high Now: higher	Scarcity of big fish
<i>Obefela</i>	Sea rise/ canal overflow flood	September (<i>eeje</i>)-October (<i>eejo</i>)	Before: moderate Now: high	Scarcity of fish, accommodation problems, difficult to get to schools, markets, etc.
<i>Awoye</i>	Sea rise/ canal overflow flood Storms	Every year in October (<i>eejo</i>) and November (<i>eesan</i>)	Before: high Now: higher	Devastation of farms and destruction of domestic animals due to oil spillage, no clean or potable water, blockage of fishing activities
<i>Ayetoro</i>	Sea rise/ canal overflow flood Storms	Every year in October 3-7 days	Before: moderate Now: high	Impassability of roads, blockage of farming, no potable water, damaging of houses by storms, inaccessibility to classrooms

Source: Authors' fieldwork, 2012

NATURE OF OCCURRENCE AND IMPACT OF FLOOD DISASTERS ON COASTAL COMMUNITIES

The occurrence and the duration of flooding vary from one community to another. In some communities flooding occurs in September and October (*eeje* and *eejo*), while others experience it in June and July (*eerin* and *aarun*) and others mostly in February (*orika*) according to the Indigenous calendar. Flooding can last from 3

to 15 days and will be more severe during the rainy season. Many of the communities agree that flooding is a serious problem in the coastal area. Other problems include the difficulty of harvesting, lack of potable water, accommodation problems, scarcity of big fish due to the increase in the salinity of water, lack of transportation to schools and markets, the devastation of farms and destruction of domestic animals due to oil spillage, the reduction of fishing and farming activities, impassability of roads, and damage to houses by storms. The local perceptions of the coastal communities in Nigeria for flood mitigation are compiled in Table 5.

FLOODING LOCAL SIGNS, INDICATORS AND FLOOD RELATED INDIGENOUS KNOWLEDGE

The communities develop some local skills and abilities to predict flooding and prepare for it. Over the ages, through their interactions with the environment and their yearly and monthly experiences with flood, they have realized the significance of some signs that precede flooding in Nigerian coastal areas. These signs are related to their ability to read the weather conditions and to their knowledge about the peculiarity of each month in their local calendar, the state of the moon, the consultation of local gods and some ecological indicators. For example, after a particular storm, some elders in a community, based on their experience, can predict flooding. Also some admit that when the moon is full, the community should expect ocean flooding and prepare for it. Ecological indicators are the scarcity of some vegetation species like *opepe* (*Sarcocephalus latifolius*) and *abura* (*Mitragyna ciliate*). When these species are scarce in a particular season, floods are likely to occur in the area mainly in *Abereke* and *Awoye* communities (Table 3).

CONCLUSION

The analysis of flood related Indigenous knowledge in the selected coastal communities reveals that Indigenous knowledge in the Nigeria coastal communities is still holistic, oral, and dependent on observations, past experiences, unrecorded tales and rumors. It is particularly linked to spiritualities, local customs and social values.

Though most of the community groups are aware of the global effects of climate change, they still believe that spirits and taboos are relevant to the inundation of communities by floodwater. In some communities where oil exploration is ongoing, the communities believe that oil exploration defiles their communities and causes their land to sink while the creeks and the ocean takes over because the water spirits are angry.

Indigenous knowledge constitutes a basis for problem-solving strategies for local communities in the coastal area of Nigeria. But this knowledge is still undervalued because it is oral, holistic and culturally buried under taboos. Despite its importance in addressing global environmental change issues, it is still not documented and

is difficult to understand. Understanding Indigenous knowledge can increase responsiveness to flood effects by communities. Hence they can develop appropriate adaptation strategies and methods. Those strategies will enable the individual or the community to cope with or adjust to the impacts of the climate in their local areas. They include the use of technological products that enable individuals to cope with the extreme events of climate change.

The local early warning systems based on Indigenous meteorology and observations of creatures and water tone is a veritable opportunity for local participation in response strategies to climate change and the adaptation mechanism. There is a need therefore to integrate these aspects of Indigenous knowledge to climate risk reduction strategies with western climate information, in order to empower the local communities with new tools for coping with the current climate extremes and to adapt communities for future climate changes.

References

- Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Yanda, P. (2007). Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, & C. E. Hanson. (Eds.), Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, (pp. 433-467) Cambridge, UK: Cambridge University Press.
- Easton, P. B. (2004). Education and Indigenous knowledge. In R. Woytek, P. Shroff-Mehta, & P. C. Mohan (Eds.), *Indigenous Knowledge. Local Pathways to Global Development. Marking Five Years of the World Bank Indigenous Knowledge for Development Program*, (pp. 9-12). Knowledge and Learning Group Africa Region: The World Bank. Retrieved from: <http://worldbank.org/afr/ik/default.htm>
- Etuonovbe, A. K. (2011, May). The devastating effect of flooding in Nigeria. In I. Chirisa (Ed.), *Inclusive cities and housing: Analysis of stewardship instruments in Epworth, Zimbabwe*, FIG Working Week 2011 Bridging the Gap between Cultures, Marrakech, Morocco. Retrieve from: http://www.fig.net/pub/fig2011/papers/ts06j/ts06j_etuonovbe_5002.pdf
- Fabiyi, O. O. (2008, September). Mapping environmental sensitivity index of the Niger delta to oil spill: The policy, procedures and politics of oil spill response in Nigeria'. *Proceedings of MapAfrica*, Held in Oliver Tambo Conference Centre, Johannesburg, South Africa.
- FAO. (2008). Climate change adaptation and mitigation in the food and agriculture

- sector. (p. 17). Technical Background Document, Rome, Italy: FAO.
- Green, D., & Raygorodetsky, G. (2010). Indigenous knowledge of a changing climate. *Climatic Change*, 100, 239-242.
- Grenier, L. (1998). Working with Indigenous knowledge: A guide for *researchers* manual. (p. 100). IDRC, Canada.
- McGregor, D. (2004). Traditional ecological knowledge and sustainable development towards coexistence, IDRC. Retrieved from: http://www.idrc.ca/en/er-64525-201-Do_Topic.html
- Melchias, G. (2001). *Biodiversity and conservation*. Enfield: Science.
- Newsham, A. J., & Thomas, D. S. G. (2011). Knowing, farming and climate change adaptation in North-Central Namibia. *Global Environmental Change*, 21, 761-770.
- Nyong, A., Adesina, F., & Elasha, B. O. (2007). The value of Indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. Mitigation and Adaptation Strategies. *Global Change*, 12, 787-797.

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