**Spatial Analysis of Efficiency of Indigenous Knowledge for Flood Reduction in Flood Prone Areas of the Niger Delta, Nigeria**

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**Abstract**

The study analysed the efficiency of indigenous knowledge for flood reduction in flood prone areas of the Niger Delta Region, Nigeria. The study employed the administration of questionnaire to 400 heads of household in the study area to elicit information about the knowledge of the nature of flooding in the study area. Descriptive statistics were used to analyse the data. Findings revealed that time that water is coming to cover the land depends on the rising of the water level in Bayelsa State (22.5%) and Delta State (26%) while in Rivers State it was the volume of rainfall in the year (75.5%).The popular way to control flood was canalization and proper drainage system and creating drainage channels. Generally, the majority (>50%) of the houses were found in the low land (dried) while duration of practice for periodic environmental sanitation measures was often especially in Rivers State. More than 80% of respondents agreed that local methods and strategies can significantly enhance and sustained survival in the midst of flood occurrence. The study concluded that the residents were able to make use of indigenous knowledge to control flood in the entire study area by making use of different local approaches ranging from the volume of rainfall in the year to the noise made by frogs. The study therefore recommended among others that despite the frequent belief in the indigenous knowledge to control flood, modern technologies should be adequately provided to prevent higher destruction of lives and properties.

**Keywords:** Efficiency, Indigenous, Knowledge, Flood, Reduction, Niger Delta

**Introduction**

Flood incidence has become a global problem whereby many lives and properties have been lost. Overall local knowledge was absent from the early mainstream research into natural hazards and disasters. Then, the change from a focus on natural hazards to vulnerability and resilience was accompanied by a growing recognition of the importance of local knowledge and practices. Yet, even though research and development organizations acknowledge the existence and importance of local knowledge and practices related to disaster preparedness, in practice little documentation of its application through official channels exists. Ultimately, the growing interest in local knowledge, including in disaster management and preparedness, should be understood in the context of governance issues and the movement to participatory approaches in development and resource management. Understanding local knowledge is not enough: it is only a means to the inclusion and participation of local people in disaster management and preparedness activities. As such local knowledge can be an entry point for promoting local people’s participation with ‘higher-level’ institutions in those aspects of disaster risk prevention and management for which they have a comparative advantage (Battista & Baas 2004).

The magnitude of these impacts has attracted the 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 to easily apprehend and deploy. The local communities therefore depend on the central governments, state agencies or development partners for these approaches in response to flooding in their communities. It is more sustainable to employ approaches that can easily be built upon by the recipient population. For instance applying the traditional approach or methods will allow the local populations to build on their experiences and strength to develop climate change resilience and appropriate responses. This is because the traditional method is built on Indigenous knowledge and local technologies developed over time (Green & Raygorodetsky, 2010; Newsham & Thomas, 2011). It is noteworthy; however that Indigenous knowledge developed over centuries, shows how Indigenous mechanisms have coped with real life challenges and difficult situations.

This method 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). Despite the large body of knowledge on the coping strategies of communities to climatic variability and extreme weather events (FAO, 2008). 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 should take into consideration the Indigenous approaches that the communities are familiar with and which they can readily apply themselves.

This approach to understanding indigenous knowledge faced some setbacks as it is believed 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 characterizes western knowledge. This is one of the different views and concepts of Indigenous knowledge especially on how it relates to sustainable strategies to appropriately respond to climate variability.

Indigenous knowledge actually means and relates to what indigenous people know and do, and what they have known and done for generations. That is, practices that evolved through trial and error and proved flexible enough to cope with change (Melchias, 2001). 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 donts. Indigenous knowledge refers to understandings, skills, and philosophies developed by local communities with long histories and experiences of interaction with their natural surroundings according to the UNESCO’s programme on Local and Indigenous Knowledge Systems (LINKS) (Hiwasaki et al., 2014a). In many places of our planet, indigenous knowledge plays an important role in the disaster risks clarification, disaster preparedness, disaster mitigation, and disaster-related policies/plans implementation (Hiwasaki et al., 2014b; Nakashima, 2010). Sometimes, indigenous knowledge is found to perform even better than modern science and technology (Rasid and Paul, 1987; Zhang et al., 2010; Basak et al., 2015; Dewan, 2015). Unfortunately, due to its inherent local relevance, the direct application of indigenous knowledge to places other than its origin is questionable and risky even if it works well at low cost for a specific community under certain natural and social conditions. Reviews and typical examples of indigenous knowledge are reported in a lot of literatures such as Rasid and Paul (1987), Dekens (2007), Shaw et al. (2008), UNESCO (2009), Mercer et al. (2010), and Hiwasaki et al. (2015).

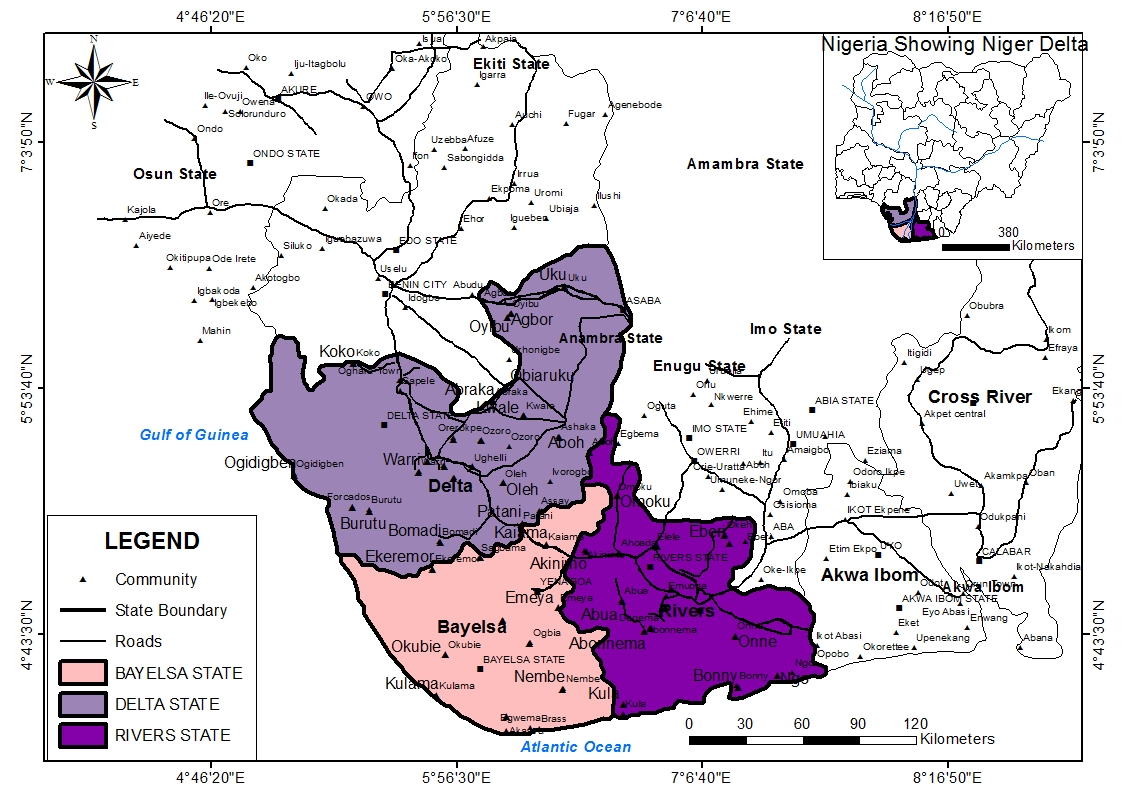
As the working mechanisms of such knowledge are mostly not well explained or validated scientifically, indigenous knowledge is generally regarded as inferior to modern science and technology. In many parts of the globe, indigenous knowledge is either under threat or the use of indigenous knowledge is considered as an alternative or temporary way for the development of poor areas where modern science and technology are not affordable. On the other hand, as indigenous knowledge is generally historied wisdoms from the nature, it is promising to provide more environment-friendly solutions compared with modern science and technology. Therefore it is important to clarify the rationales and underlying processes behind indigenous knowledge, to understand its implications, potentials, and limitations, as well as to incorporate it into latest science and technology.

Around the world, there are all kinds of indigenous knowledge in terms of both structural and nonstructural forms. The former is physically visible technical knowledge and generally presents the concrete aspect of local knowledge, while the latter is not easily recognizable such as those related to environmental, agricultural, sociocultural, and historical knowledge (Dekens, 2007). Among them, indigenous knowledge for disaster risk reduction has received increasing attention since the 1990s, and the 2004 Indian Ocean Earthquake and Tsunami has been recognized as a turning point when specialists and scientists began to show interests in such knowledge (Hiwasaki et al., 2014a). To ensure the appropriate use of such indigenous knowledge, it is crucial to understand the flow structure, sediment transport properties as well as their morphological implications (Zhang et al., 2010). Traditional knowledge is conveyed with speech from generation to generation through songs or tales and also through actions and observations (Grenier, 1998; McGregor, 2004). Many studies on flood vulnerability, capacity and risk have been investigated at various scales but the level of introducing the indigenous knowledge have been This study therefore examined the spatial analysis of indigenous knowledge for flood reduction in flood prone areas of the Niger delta, Nigeria.

**Materials and Methods**

The study area was the Central Niger Delta communities, which lies at latitude (5o 46′57.06″ N through 4o 29′56.37″N) and longitude (5o 2′47.10″ E through 7o 41′26.00″E) (Figure 3.1). The Niger Delta is located at the Atlantic Coast of the Southern part of Nigeria. It is the outlet of River Niger and Benue to the Ocean through rivers, creeks and estuaries. It is the second largest delta in the world with coastline spanning about 450 kilometers terminating at the Imo river entrance (Uyique, Etiosa 2007). It is described as the largest wetland in Africa and among the three largest in the world. The region spans over 20,000 square kilometers hoisting about 25% of the Nigeria population. About 2370 square kilometers of the Niger Delta consist of Rivers, creeks and estuaries while stagnant swamp covers about 8,600 square kilometers and has the largest mangrove swamp in Africa. The mangrove swamp extends about 1900 square kilometers. The region falls within the tropical rain forest zone (Joe-Alagoa, 2002). The Niger Delta formerly occupied the southern part of the defunct Eastern Region of Nigeria. Presently, they have been group under the umbrella of the south-south geopolitical zone. These areas are rich in oil and gas and account for about 95 percent of Nigerian foreign earnings. Oil was first discovered in 1958 in this area, since then oil has dominated the Nigerian economy (Okecha, 2003; Uyigue 2009). The Niger Delta environment has degraded due to oil exploration and exploitation. This slow poisoning of the waters in the area and the destruction of vegetation and agricultural lands by oil spillage has devastating effect on the land. The Niger Delta generally has an equatorial climate on its southern coast and sub-equatorial climate in the north (based on Koppen's Af classification). The monthly mean temperature ranges between 25 °C and 29 °C, while the annual precipitation ranges between 2000 mm and 4000 mm, with relative humidity being above 80%. Niger Delta has a tropical climate. In most months of the year, there is significant rainfall in the area. There is only a short dry season and it is not very effective. The average annual temperature in Abua is 26.5 °C. The area is endowed with abundant sunshine due to its geographical location near the equator. ‘The sun is vertically overhead throughout the year. Day light hours are larger because of the long duration of solar radiation.

The recent sediments transported by Niger River distributaries and other rivers, such as Andoni, Bonny and New Calabar. These materials deposited as regolith overburden of 30m thickness are clays, peat, silts, sands and gravels. The depositional sequence exhibits massive continental sand stones overlying an alternation of sandstones and clays of marginally marine origin, but eventually grading downwards into marine clays. Sands, by far, form the largest group of rock types in Rivers State, while mud constitutes all the polluted brackish waters of the riverine areas. However, peat constitutes the various vegetal and animal remains that lies in bogs and shallow pits. The gravel and pebbles form the last unit of the subsurface rock type, and are usually found at the base of the river channels. The Niger Delta underlies an area of about 256,000 km2, and was initially built over an older transgressive Paleocene prodelta. Delta construction proceeded in discrete minibasins ranging in tectonic configuration from extensional, through translational to compressional toe-thrust regions. Outcropping units of the Niger Delta include the Imo Formation and the Ameki Group consisting of the Ameki, Nanka, Nsugbe, and Ogwashi-Asaba formations. The subsurface lithostratigraphic units are the major transgressive marine Akata Shales, the petroliferous paralic Agbada Formation, and the continental Benin Sands.

Figure 1. The Geographic Niger Delta (South-South) Region

This study adopted the descriptive, analytic and cross-sectional study research design which employed a survey research method of data collection that helped to examine the knowledge of the residents about the characteristics of flood in their areas.

The study made use of both primary and secondary sources of data. The primary data sources consisted of data collect via the aid of survey instrument (Questionnaire) which was used to collect the required information regarding the respondents’ socio economic characteristics, indigenous method and approaches employed in the management of flood events across the affected communities in the Niger Delta. Secondary data sources consisted of books, both published and unpublished materials. Secondary data were obtained from the National Population Commission (NPC) hence, the population of the Local Governments under study. This studyconsidered the population census of 2006 as the baseline and then be projected to 2020. This threw more light on the population of exposed and vulnerable people. Data were also obtained from the government archives of affected States and Local Government Councils.

The target populations are communities impacted by flood within the core Niger Delta States. The total population of the entire states of the Niger Delta was put at 31,224,567 persons NPC, 2006 while the population of the impacted Local Government Areas in Bayelsa, Delta and Rivers States was put at 4,612,510 with the household population of affected Local Government was put at 768,751 was proportionately selected.

The sample size was determined by making use of the total of the population of communities using the Taro Yamane’s formula:

n = \_\_\_\_N\_\_\_\_

1+Ne2

where n = sample size

N = Population size (Population of the private developers firms)

1 = Constant

E = Error limit or margin of error or level of significance (accepted error set at 5% i.e. 0.05)

Applying the formula to the total number of firms, the sample size arrived at is 397 for Bayelsa, 382 for Delta and 399 for Rivers State which was applied proportionately to residents across flooded and flood prone communities in the study area.

**Results and Discussions**

**Socio-economic Characteristics of Respondents**

Table 1 presents the socio-economic characteristics of respondents in the study area. The analysis reveals that the age characteristics of household heads shows a dominant age between the age bracket of 31-45 years across the selected states in Niger delta with the peak at Rivers and the least at Bayelsa accounting for 163 persons (50.9%) and 125 persons (39.5%) respectively, the age bracket of household heads above 60 given the peak value at Bayelsa State accounting for 12.9% and 7.7% respectively, the age bracket of 40-60 years across the various states shows the peak at Bayelsa counting for 41.9% and the least at 33.2% in Rivers and finally the age bracket of 16-30 years with the peak at 15.9% in Rivers and the least at 5.7% at Bayelsa State.

The educational qualification of the household heads revealed the respondents had acquired tertiary qualifications with the highest percentage of 73.4% recorded in Bayelsa, 51.9% in Delta and 50.9% in Rivers respectively. In Delta State, 18.3% and 29.8% had primary education and secondary education. Of the total respondents in Bayelsa State, 12.1% and 14.5% of respondents had primary and secondary education respectively. Similarly in Rivers State, 18.4% had primary education, 30.7% had secondary education while 50.9% had tertiary education. This shows that in each State considered for this study, more than 80% of respondents had minimum of secondary education and the implication of this shows that majority were able to read and write.

The responses of respondents shows a dominant occupation of the household heads across the selected states (civil servants) with the peak in Bayelsa State accounting for 86.3% followed by Rivers accounting for 50.3% and lastly at Delta accounting for 45.1% in line with the educational qualification responses by respondents indicating the civil service as the dominant occupation. The analysis further reveals that in Delta State, 11.5% were farmers, 48.1% were civil servants, 30.8% were students and 9.6% were traders. In Bayelsa State, the analysis reveals that 13.7% were traders while in Rivers State, the analysis shows that 16.6% were farmers, 50.3% were civil servants, 11% were students and 22.1% were traders. The implication of this result is that most of the population of the central Niger Delta was found in the civil servant circle. The analysis shows the income range between 50000-70000 as the most dominant. In Rivers and Bayelsa States accounting for 71.6% and 50% respectively while > 70000 was the peak in Bayelsa State accounting for 86.3%. The analysis further reveals that 9.6% of respondents in Delta state had monthly income between 10000 and 30000 naira, 18.3% had between 30000 naira and 50000 naira while 50% had monthly income between 50000 naira and 70000 naira. In Bayelsa State, it is discovered that 13.7% had between 50000 naira and 70000 naira while in Rivers State, it is observed that 5.5% had between 10000 naira and 30000 naira, 11% had between 30000 naira nad 50000 naira while 7.4% had greater than 70000 naira.

From the analysis the combined income of household as seen in table 4.5 across the selected states with the combined income between the range of 90000-140000 accounting for 55.9%, 49.0% and 25% for Rivers, Delta and Bayelsa respect and the combined income of above 140000 with its peak at 62.9% at Bayelsa State and the least at 17.3% In Delta State.

Furthermore, 15.4%, 18.3% and 17.3% of respondents in Delta State had combined income between 10000 naira and 50000 naira, 50000 naira and 90000 naira; and greater than 140000 naira only respectively whereas in Delta State, it was recorded that 12.1%, and 25% of respondents had the combined income of 50000 naira and 90000 naira and 90000 naira and 140000 naira respectively.

Table 1. Socio-economic Characteristics of Respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Age (Years) | Delta | Percentage (%) | Bayelsa | Percentage (%) | Rivers | Percentage (%) |
| 16-30 | 8 | 7.7 | 7 | 5.7 | 26 | 15.9 |
| 31-45 | 44 | 42.3 | 49 | 39.5 | 83 | 50.9 |
| 46-60 | 44 | 42.3 | 52 | 41.9 | 54 | 33.2 |
| Above 60 | 8 | 7.7 | 16 | 12.9 | 0 | 0 |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |
| Educational Status |  |  |  |  |  |  |
| Primary | 19 | 18.3 | 15 | 12.1 | 30 | 18.4 |
| Secondary | 31 | 29.8 | 18 | 14.5 | 50 | 30.7 |
| Tertiary | 54 | 51.9 | 91 | 73.4 | 83 | 50.9 |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |
| Occupational Status |  |  |  |  |  |  |
| Farming | 12 | 11.5 | 0 | 0 | 27 | 16.6 |
| Civil servant | 50 | 48.1 | 107 | 86.3 | 82 | 50.3 |
| Student | 32 | 30.8 | 0 | 0 | 18 | 11.0 |
| Trader | 10 | 9.6 | 17 | 13.7 | 36 | 22.1 |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |
| Monthly Income |  |  |  |  |  |  |
| 10,000-30,000 | 10 | 9.6 | 0 | 0 | 9 | 5.5 |
| 30,000-50,000 | 19 | 18.3 | 0 | 0 | 18 | 11.0 |
| 50,000-70,000 | 52 | 50 | 17 | 13.7 | 124 | 76.1 |
| >70,000 | 23 | 22.1 | 107 | 86.3 | 12 | 7.4 |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |

**Forms and Efficiency of Indigenous Knowledge for the Curtailment of Flood Events**

**Prediction of the time the water is coming to cover the land**

The respondents in Table 2 were able to predict when there will be flooding using the local measures ranging from the volume of rainfall in the year accounting for 75.5% in Rivers, 8.7% in Delta and 8.1% in Bayelsa, raising of water level accounting for 22.5% in Bayelsa and 26% in Delta state other method include the noise made by frogs as State by the respondents in Bayelsa and Delta state accounting for 8.9%, and 8.7% respectively.

Table 2: Time that water is coming to cover your land

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Delta | Percentage (%) | Bayelsa | Percentage (%) | Rivers | Percentage (%) |
| Rising of the water level | 26 | 26 | 28 | 22.5 | 0 | 0 |
| Locally the movement of the water at a time | 9 | 8.7 | 11 | 8.9 | 0 | 0 |
| The level of the high tide | 9 | 8.7 | 11 | 8.9 | 0 | 0 |
| Noise of the frogs as a sign | 9 | 8.7 | 11 | 8.9 | 0 | 0 |
| When the water passes a given land mark | 15 | 14.1 | 20 | 16.0 | 0 | 0 |
| The volume of rainfall in the year | 9 | 8.7 | 10 | 8.1 | 123 | 75.5 |
| When the ground become too saturated to absorbed water | 9 | 8.7 | 11 | 8.9 | 29 | 17.8 |
| From previous experience | 9 | 8.7 | 11 | 8.9 | 11 | 6.7 |
| Climate/ weather timing | 9 | 8.7 | 11 | 8.9 |  |  |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |

**Techniques used to Control Flood Water**

Table 3 evaluates the local control measures of the respondents across the study area in the case of flooding. It was discovered that the dominant control measures across the different states is creating of proper drainage system/channels accounting for 45.1%, 32.3% and 5.5% in Delta, Bayelsa and Rivers respectively while another group of respondents believed that flood water cannot be controlled which include Bayelsa and Delta state accounting for 41.2% and 40.3% respectively while others are of the opinion that flood water can be controlled by canalization and by sand filling of the flooded areas.

Tabl3 3: Control the flood water

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Delta | Percentage (%) | Bayelsa | Percentage (%) | Rivers | Percentage (%) |
| Canalization. | 10 | 9.6 | 13 | 10.5 | 89 | 54.6 |
| The flood water is uncontrollable. | 42 | 40.3 | 51 | 41.2 |  |  |
| Proper drainage system and creating drainage channels. | 47 | 45.1 | 40 | 32.3 | 9 | 5.5 |
| Avoid blocking of drainage system and other water ways. | 1 | 1.0 | 4 | 3.2 | 15 | 9.2 |
| Construction of wooden Bridges. | 1 | 1.0 | 4 | 3.2 |  |  |
| Increasing the DPC level. | 1 | 1.0 | 4 | 3.2 | 24 | 14.7 |
| By sand filling. | 1 | 1.0 | 4 | 3.2 | 17 | 10.5 |
| By embarkment | 1 | 1.0 | 4 | 3.2 | 9 | 5.5 |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |

**Variable Building Location and Types of Building**

Most buildings located within the study area are located on low dry lands as shown in Table 4 where 50.9%, .4% and 82.2% of responses affirmed that most of their building infrastructure are located in low dry land 28.9% and 31.4% of building infrastructure in Delta and Bayelsa respectively are located in low flood able lands only very few building infrastructure are located in upland of the study area this is shown by 20.2%, 24.2% and 13.5% respectively. These infrastructure irrespective of their locations are dominantly concrete made which implies more stability and therefore increased coping capacity in the event of flood

Building type also play a major role in flood resilience as observed by the respondents. From the analysis concrete bungalow houses were the major building materials used within the study area which has helped in the long way in building resilience among the people.

Table 4: Variable building location

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Categories | Delta | Percentage | Bayelsa | Percentage | Rivers | Percentage |
| Low land( dried) | 53 | 50.9 | 55 | 44.4 | 134 | 82.2 |
| Low land floatable | 30 | 28.9 | 39 | 31.4 |  |  |
| River valley |  |  |  |  | 7 | 4.3 |
| Upland area | 21 | 20.2 | 30 | 24.2 | 22 | 13.5 |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |
| **Building Types** |  |  |  |  |  |  |
| Mud house | 0 |  | 0 |  |  |  |
| Wooden house | 0 |  | 0 |  |  |  |
| Bungalow ( concrete ) | 95 | 91.3 | 115 | 92.7 | 145 | 88.9 |
| One or more storey | 9 | 8.7 | 9 | 7.3 | 18 | 11.0 |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |
|  |  |  |  |  |  |  |

**Duration of Practice for Road Reclamation Using Sandbags and Sawn Dust**

Reclamation practice using sand bags or sawdust were dominantly practiced in Bayelsa and Rivers state especially in the early phase of flood throughout the flood period though as observed in the Table 5 the practice of this technique by indigenous people of Bayelsa state cuts across the entire flood season and pre-flood season making it a daily ritual employed by the people to mitigate flood impact across the study area.

Channel cleaning as another form of practice by the people to mitigate flood impact is noticed by the people of the region as a regular means of flood season preparation aimed at preventing land inundation damage and property loss as a result of flooding. This measure employed is believed and adopted by the people aimed at eliminating flood potential and people vulnerability in the region. Cleaning blocked drainage is also perceived as a form of environmental sanitation and is believed to have the potential of diminishing or mitigating vulnerability to flooding during and after the flood period hence environmental sanitation is a daily routine across all the States in the study area.

Table 5: Duration of practice for road reclamation using sandbags and sawn dust

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Duration of practice for road reclamation using sandbags and sawn dust | Delta | Percentage | Bayelsa | Percentage | Rivers | Percentage |
| Early face of flood | 0 |  | 9 | 12.5 | 99 | 55 |
| 2 months | 0 |  | 9 | 12.5 |  |  |
| 3 months | 0 |  | 18 | 25 |  |  |
| Often | 0 |  | 9 | 12.5 |  |  |
| Period of the flood | 0 |  | 9 | 12.5 | 81 | 45 |
| Yearly | 0 |  | 9 | 12.5 |  |  |
| Annual | 0 |  | 9 | 12.5 |  |  |
| Total | 0 |  | 72 | 100 | 90 | 100 |
| Duration of practice for cleaning blocked drainages channels |  |  |  |  |  |  |
| Very often | 35 | 33.7 | 32 | 25.8 | 65 | 39.9 |
| Monthly | 35 | 33.7 | 40 | 32.3 | 98 | 60.1 |
| Yearly | 34 | 32.6 | 52 | 41.9 |  |  |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |
|  |  |  |  |  |  |  |
| Duration of practice for periodic environmental sanitation measures |  |  |  |  |  |  |
| Always | 29 | 28.0 | 21 | 16.9 |  |  |
| Monthly | 24 | 23.1 | 40 | 32.4 | 9 | 5.5 |
| Often | 17 | 16.3 | 21 | 16.9 | 127 | 77.9 |
| 3 months | 17 | 16.3 | 21 | 16.9 | 27 | 16.6 |
| Every months | 17 | 16.3 | 21 | 16.9 |  |  |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |

**Measures put in place locally aimed at controlling flood**

Table 6 presents the local measures put in place for controlling of flood. The use of sand bags, creating/cleaning of drainage system and opening of channel to divert flood water these methods have been in use since the ancient times across the different study area.74.2% of respondents in Rivers strongly agreed that the measures put in place locally to control flood occurrence has helped tremendously followed by 38.4% and 25.6% in Delta and Bayelsa agreed to this perceived improvements. The weighted averages 3.5, 2.8 and 4.2 obtained from the responses of respondents in Delta, Bayelsa and Rivers State Respectively indicate indicates respondents in Delta state do not fully agree while respondents in Bayelsa do not fully disagree that these local control measures has reduced the negative impact of flooding in their area. But respondents from Rivers totally affirmed that that local flood control measures put in place has reduced the damages caused by flood in their region. Government engineering projects and efforts in flood mitigation as revealed by the people were felt in Delta and Bayelsa state. Given a weighted average of 2.0 each, the state is relieved to have the potential of mitigating flood using engineering approaches. While respondents in Rivers state do not share to the fact that government engineering projects has played any role in flood mitigation.

Despite the employment of indigenous technology by communities in the Niger Delta; it is believed that approaches employed have not in any form or way reduced flood occurrence given a weighted average of 2.4, 2.6 and 2.7 for Delta state, Bayelsa State and Rivers State respectively the respondents do not agree that neighbours who applied local control measures have in any form enjoy flood free environment. Hence local approaches employed do not reduce flood occurrence though these approaches has in one way or the other helped the residents of the community coped with the incidence of flood as affirmed by the respondents in Delta state and Bayelsa state given a weighted average of 3.75 and 3.72 respectively while respondents from Rivers state do not agree or disagree that local approaches employed has mitigated flood occurrence and improved their coping capacity this is affirmed by giving a weighted average of 2.72.

The role of local method in flood mitigation in enhancing survival is believed to be high across all the States. It is believed that this local method employed has played significant role in sustaining the survival of the people in the mist of frequent flood though this does not necessarily imply that the individual who apply local method of flood mitigation are free from flood occurrence this is shown giving a weighted average of 2.5, 2.6 and 2.8 for Delta state, Bayelsa state and Rivers state respectively which implies that flood occurrence is not a factor or is not mitigated by the local method applied.

The role of local method in flood mitigation in enhancing survival is believed to be high across all the States. It is believed that this local method employed has played significant role in sustaining the survival of the people in the mist of frequent flood though this does not necessarily imply that the individual who apply local method of flood mitigation are free from flood occurrence this is shown giving a weighted average of 2.5, 2.6 and 2.8 for Delta State, Bayelsa state and Rivers state respectively which implies that flood occurrence is not a factor or is not mitigated by the local method applied.

Table 6. Measures put in place locally aimed at controlling flood occurrence has helped tremendously

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Measures put in place locally aimed at controlling flood occurrence has helped tremendously | | | | | | |
| **Response** | **Delta** | **Percentage** | **Bayelsa** | **Percentage** | **Rivers** | **Percentage** |
| SA | 20 | 19.2 | 22 | 13.7 | 121 | 74.2 |
| A | 40 | 38.4 | 41 | 25.6 | 13 | 8.0 |
| D | 20 | 19.3 | 26 | 16.3 | 5 | 3.1 |
| SD | 24 | 23.1 | 36 | 22.5 | 0 | 0 |
| UD | 0 | 0 | 35 | 21.9 | 24 | 14.7 |
| **Total** | **104** | **100** | **160** | **100** | **163** | **100** |
| Neighboring communities that apply local flood control methods enjoys flood free communities | | | | | | |
| SA | 0 | 0 | 0 | 0 | 15 | 9.2 |
| A | 0 | 0 | 0 | 0 | 5 | 3.1 |
| D | 65 | 62.5 | 80 | 64.5 | 68 | 41.7 |
| SD | 39 | 37.5 | 44 | 35.5 | 75 | 46.0 |
| UD | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 104 | 100 | 124 | 100 | 163 | 100 |
| Local methods and strategies has helped you significantly cope with flood occurrence | | | | | | |
| SA | 10 | 9.6 | 18 | 14.5 | 10 | 6.1 |
| A | 62 | 59.6 | 63 | 50.8 | 9 | 5.5 |
| D | 28 | 26.9 | 34 | 27.4 | 70 | 43.0 |
| SD | 4 | 3.9 | 9 | 7.3 | 74 | 45.4 |
| UD | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **104** | **100** | **124** | **100** | **163** | **100** |
| Local methods and strategies can significantly enhance and sustained survival in the midst of flood occurrence | | | | | | |
| SA | 7 | 6.7 | 9 | 7.3 | 46 | 28.2 |
| A | 80 | 77.0 | 88 | 70.9 | 41 | 25.2 |
| D | 12 | 11.5 | 18 | 14.5 | 43 | 26.4 |
| SD | 5 | 4.8 | 9 | 7.3 | 33 | 20.2 |
| UD | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **104** | **100** | **124** | **100** | **163** | **100** |
| The individuals that apply local method in flood control are not affected by flood water | | | | | | |
| SA | 2 | 2.0 | 6 | 4.8 | 12 | 7.3 |
| A | 2 | 2.0 | 6 | 4.8 | 6 | 3.7 |
| D | 46 | 44.2 | 51 | 41.2 | 87 | 53.4 |
| SD | 54 | 51.8 | 61 | 49.2 | 58 | 35.6 |
| UD | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **104** | **100** | **124** | **100** | **163** | **100** |

**Discussion of findings**

The respondents were able to predict when there will be flooding using the local measures ranging from the volume of rainfall in the year to the noise made by frogs etc. It was discovered that the dominant control measures across the different states is the creating of proper drainage system/channels. Other respondents were of the opinion that flood water can be controlled by canalization and by sand filling of the flooded areas. 74.2% of respondents in Rivers state strongly agreed that measures put in place locally to control flood occurrence has helped tremendously followed by 38.4% and 25.6% in Delta and Bayelsa States. The use of sand bags, creating/cleaning of drainage system and opening of channel to divert flood water are methods used and have been in use since the ancient times across the different study areas. Environmental sanitation is a daily routine across all the States in the study area. The role of local method in flood mitigation in enhancing survival is believed to be high across all the States. It is believed that this local method employed has played significant role in sustaining the survival of the people in the mist of frequent flood while respondents from Rivers state do not agree or disagree that local approaches employed has mitigated flood occurrence and improved their coping capacity. Thus, the analysis in Obi et al (2021) revealed that the existence of eight categories of indigenous flood control and management knowledge practices in the coastal communities is significant in flood disaster risk reduction. This implies that the indigenous flood control and management knowledge system was effective in risk reduction of flood disaster in Nigeria's coastal communities. Furthermore, integrating indigenous knowledge and scientific methods for flood risk analyses, responses and adaptation in rural coastal communities in Nigeria, engaged flood-affected communities, local government and civil society organizations and advanced a platform for integrating indigenous knowledge, participatory GIS and basic weather data monitoring, to develop a community-based participatory approach to coastal flood management. Field surveys were conducted in twenty villages to identify flood related indigenous knowledge. Weather stations and flood gauges were also installed in ten of the communities and GIS-based flood risk maps were introduced to the flood trained monitors who were deployed to integrate approaches of indigenous knowledge and science based techniques to coastal flood management. The analysis is therefore related to the finding of the present study as because each of the communities have certain signs and techniques to forecast different types and magnitudes of floods. It was also observed that the rural communities are well aware of potential effects of sea level rise on their communities and willing to participate in the adaptation process.

Respondents in Rivers State, Delta state and Bayelsa State believe that local measures to reduce flood water intrusion have reduced the level of flooding in their communities though not significantly. While in Delta state, the efforts has not tremendously reduced the occurrence and help mitigate the impact of flooding. hence the people has left the situation in the hands of God as indicated by the weighted average of 4.0 while respondents in Bayelsa and Rivers states also seem to have little or no hope in controlling the rate of flood water  injection. Community survival and continuous habitation of the region is believed to have been sustained by the approaches employed by the people in flood mitigation this is as shown by the responses of the people giving a weighted average of 3.7 and 3.6 for Delta state and Bayelsa state respectively while respondents in Rivers state do not believe that local knowledge has played any significant role to enhance their habitation. Hence there is a mixed reaction on the effectiveness of the application of local knowledge to flood situation across the states.

The most dominant knowledge employed in managing of flood event and ensuring easy maneuvering in Delta and Bayelsa states of the study area is the construction of wooden bridges critical solution and as indicated by 42.3% and 42.8% in Delta and Bayelsa State respectively. In Rivers State cleaning of blocked drainage is classified as a major local approach available to the people in combating flood occurrence. Most of the respondents do not follow any form of metrological sequence that enables or enhances the ability to predict flood which implies that the situation comes to them unprepared hence the level of impact noticed and reported.

Various studies from different regions have demonstrated that the prevalent indigenous knowledge vary from one region to another one. There are varied studies that were carried out to show the significance of indigenous coping strategies. For instance, Mercer et al., (2013) explored the local people survival strategies and assess variation in people’s ability to cope with flood and riverbank erosion of two char land (Mid-channel Island) villages of Bangladesh. The study revealed that household’s capacity to cope with floods and river erosion is dependent on people’s socio-economic conditions such as education, income, and occupation. The study went further to highlight that although flooding and river erosion resulted in the destruction of lives and properties, people’s indigenous coping techniques significantly reduce their vulnerability without demanding outside assistance. Similarly, Mavhura et al., (2021) explored indigenous survival strategies and variations in people’s ability to cope with the flood. The study indicates that IK systems played an important role in mitigating the effects of floods in Muzarabani district. However, the extent to which IK improves resilience to floods was governed by geophysical locations, socio-economic capabilities and exposure to floods. The study emphasized that IK systems are significant components of disaster resilience. This is because IK systems can be quitted and adapted by other communities; enhances public participation and empowerment of affected communities, is usually beyond formal education in relation to environmental hazards. In contrast, Irfanullah and Motaleb (2011) summarized the endeavor of Haor residents in Bangladesh in dealing with post-flood situation by partaking in floating garden indigenous farming technique as a result of intense motivation, determination and capacity development. They state that floating gardens and winter vegetable farming were discovered to be helpful for promoting nutritional security, household income, and land use capacity of the extremely poor and landless people, particularly during the post-flood disaster period.

Turi et al (2021) also reported that conventional and ancient buildings are normally more resistant to disasters than new ones. For instance, during many disasters, churches, mosques, temples and other old vernacular buildings survived due to their robust nature of construction (Ganchi et al., 2016). The front shapes of such buildings are pointed so that the push impact of flood water can be minimized. Besides, mangroves and some other plants and trees are planted  
around houses to mitigate the flood impact and land erosion. These mangroves and other plants not only protect buildings but protect household items and livestock stuff. In some Indian, people dump their household items in a trench. Contrary to this, in some Chinese flood prone areas, community has prepared a platform at a high altitude where flood water cannot reach (Main, et al., 2015). Agro-pastoral tribes of Maasai in Africa keep on rotating, grazing and vegetation areas to conserve vegetation, fertility and water management in drought season. In some parts of India have seedbeds (Dhap or Baira) are constructed in waterlogged conditions for cattle refuge. Bamboo fencing and grass planting are used for earthen embankment to reduce flood erosion. A unique construction and style of three-meter-deep and seventy cm wide foundation trenches filled with stones, are common in Purola area of Utterkhashi district in India. The buildings are normally 2.30-meter-high above the surface of earth. This very style protects the buildings from floods (Zarmina & Zarmina, 2014). Besides, the plantation of trees like Thysonolaena is common as it gives protection from land sliding. Besides, house roofs are covered with grass to insulate them against heat and rain. Besides, the fish ponds are covered with a net to stop the fish to jump out of the pond during floods (Khan et al., 2016). They perform many unique and different rituals like dancing, singing, and conducting marriages between frogs and chickens etc to influence the natural phenomena. These are the part of their belief and culture system. Furthermore, these are the sources of entertainment as well. The festivity factor is very important to enhance the resilience of the people (Ganchi et al., 2016).

However, the floating gardening is unsuitable for open waters (Qasim et al., 2017). Likewise, in some flood-prone areas of Bangladesh and India, people have prepared platforms in the trees to provide protection and shelter to hen and some other birds during floods. Other animals like cow and buffaloes are shifted to some safer places specially built for castles. These places or  
platforms are called Tharas. The flood normally takes three to four days to let the people to resettle themselves. When the flood water is down, people start settling down again  
in their houses (Batool, 2017). Research findings indicate that social support networks,  
serving others, Hakka spirit, self-reliance, resource availability, governmental agencies, preparedness, acceptance, and spirituality have direct and positive impacts on disaster resilience (Ganchi, Shakoor, Thaver, Khan, & Janjua, 2016).

**Conclusion and Recommendations**

The study can be concluded that the residents were able to make use of indigenous knowledge to control flood in the entire study area by making use of different local approaches ranging from the volume of rainfall in the year to the noise made by frogs. People in the study area have strongly appreciated the local measures put in place locally to control flood occurrence which has helped tremendously. The study recommended among others that despite the frequent belief in the indigenous knowledge to control flood, modern technologies should be adequately provided to prevent higher destruction of lives and properties.

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