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Assessment of Indigenous Knowledge and Practices for Flood Risk Reduction in Adamawa State, Nigeria

Ibrahim A. Adamu & John A. Godwin
Department of Disaster Management
School of Environmental Sciences
Adamawa State Polytechnic Yola, Nigeria

Abdulrasheed Mohammed
Department of Geography
Adamawa State College of Education Hong
Adamawa State, Nigeria

Correspondence: ibrahimabubakaradamu247@gmail.com

Abstract

Adamawa state hosts a remarkable ethnic and cultural diversity with over 80 ethnic languages. The state is exposed to a variety of natural hazards. The occurrence and intensity of many of the hazards are exacerbated by environmental degradation processes such as deforestation, soil erosion, and loss of biodiversity. These events result in disaster when they meet with highly vulnerable population and environment. Flooding is becoming a serious challenge in Adamawa state and the situation is indeed alarming. In respect to that, this paper aimed at investigating the indigenous knowledge and practices for flood risk reduction in Adamawa state. Primary data were collected through administration of a structured questionnaire among randomly selected respondents. A total of 600 respondents were selected via purposive sampling technique. Data collected was analysed through the use of descriptive statistical analysis. The study revealed that the vast majority of respondents (72%) perceived the flood as a natural hazard/disaster, an act of the creator of earth and universe (GOD) or a means of punishment for the wrongdoings perpetrated by man on the surface of the earth; that the communities apply indigenous knowledge and skills in predicting weather patterns and interpretations to facilitate coping mechanisms (97%); that the local people apply various local and indigenous strategies in flood risk reduction. The study emphases the need for creating mechanisms that can promote and popularize indigenous knowledge and practices through public awareness-raising materials and educational activities to recognize and appreciate the value of their local knowledge in reducing flood risk. Mainstream indigenous knowledge can effectively be integrated in flood forecasting and monitoring, early warning systems and flood disaster response and recovery mechanisms.

Keywords: Celestial indicators, Early warning system, Ecological indicators, Flood, Flood Risk Reduction, Indigenous knowledge, Meteorological indicators

Introduction

Floods accounted for 47 percent of all weather-related disasters from 1995 to 2015, and affected more people than any other disaster during that period. Between 1995 and 2015, floods affected 2.3 billion people and killed 157,000 (UNISDR/CRED 2015). During this period, average annual global losses due to floods amounted to almost US$20 billion. Between 2005 and 2014, the number of floods per year also rose to an average of 171, up from an annual average of 127 in the previous decade. The number of people living in flood-prone areas is estimated to be 1.3 billion by 2050, or 15 percent of the global population. This number represents an increase of 0.3 billion over the present and takes into account both river and coastal flooding (Ligtvoet et al., 2014). Looking at river flooding specifically, the World Resources Institute (2015) has demonstrated that this hazard affects 21 million people around the world every year. In 2030, that number could rise to 54 million per year, with ongoing urbanization and climate change driving the increase and putting more people in harm's way. Indeed, the hazard of flooding is an annual phenomenon that has displaced millions every year worldwide and claimed lives and properties.

The threat to lives and property by flood is now becoming an annual event in many urban and rural areas in Nigeria (Olanrewaju and Fadiro, 2003). According to Bariweni et al., (2012) and Etuonovbe, (2011), Nigeria experiences floods every year, especially flash floods and dam related floods during the raining season. However, each disaster seems to get worse, leaving a larger impact than the previous. In 2012, the intensity with which the floods came left the affected areas in a tragic state. The flood displaced over 2.1 million Nigerians, leaving them homeless. Hundreds of lives were lost and properties including hundreds of thousands of hectares of farm lands washed away (NEMA, 2012). The northern regions of the country were affected the most, especially states which the major rivers pass through and communities by the riparian were completely submerged.

The majorities of floods are harmful to humans (Etuonovbe, 2011); however, floods can provide benefits without creating disaster and are necessary to maintain most river ecosystems. Floods replenish soil fertility, provide water for crop irrigation and fisheries, and contribute seasonal water supplies to support life in arid lands. Flooding is basically a natural phenomenon, which can be caused or even intensified in most cases by human activities.

UNDP (2012) asserts that flood risk reduction as a concept denotes the practice of reducing flood disaster risks through systematic efforts to analyze and manage the causal factors of flooding, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. It is well known that the success of flood risk reduction depends to a large extent on knowledge-based decision, robust institutional framework and flood risk communication. But these factors are missing in Nigeria and where they exist, they are poorly addressed (Ologunorisa & Adeyemo, 2005).

Indigenous knowledge refers to the methods and practices developed by a group of people from an advanced understanding of the local environment, which has formed over numerous generations of habitation in a certain location (Iloka, 2016). This knowledge differs from other types of knowledge as it originates within the community, which is also transferred through informal means of dissemination, it is collectively owned and developed over several generations and subject to adaptation, and it is embedded in a community's way of life as a means of survival and well-being. Matsika (2012, 209-210) defines indigenous knowledge as: "The traditional and local knowledge that exists and is developed through the experiences of the local community in the process of managing the conditions or context that challenge the people's everyday life". Indigenous knowledge is therefore a body of knowledge existing within or acquired by local people over a period of time through accumulation of experiences, society–nature relationships and community practices and institutions and passed down through generations (Sillitoe, 2000; Mercer et al., 2009).

It is natural for every community to take measures to prevent and mitigate losses they might face when hazards strike. Most of the at-risk communities have a long history of observing changes in the environment and have amassed a wealth of knowledge and practices closely related to these changes. Their knowledge systems include elements of disaster prevention, risk awareness and preparedness. Communities also employ complex strategies to respond to, cope with and recover from the impacts of hazards. This type of traditions and practices has influenced the way local communities anticipate, and adapt to, extreme weather events and other hazards.

Iloka (2016) discussed the role of indigenous knowledge in Disaster Risk Reduction (DRR) from the African perspective, and the paper argues that mere application of scientific knowledge in Africa did not yield satisfactory results due to exclusion of local perspectives and dynamics. The study recommended integration of indigenous knowledge as a starting point in

DRR programming and local policy development. One of the most comprehensive studies in Africa is the United Nations Environment Programme (2008) study on the application of indigenous knowledge in disaster management in Kenya, Swaziland, South Africa and Tanzania. The results indicated that indigenous knowledge served as a valuable tool that enabled communities to develop their own forecasting and early warning systems, and based on these, to develop various coping mechanisms and food management techniques. The examples include observations of the behavior of different animal species (e.g., birds, insects), plants and tree species, meteorological indicators and observation of celestial bodies.

Adamawa state hosts a remarkable ethnic and cultural diversity, with over 80 ethnic languages (Adebayo and Zemba, 2020). There are quite numerous different tribes in the State, speaking different local languages. However, Hausa language is the most widely spoken and, of course is also the language used for business aside the English language in most of the urban areas. This north-eastern state boasts of a rich mix of languages, religions, and ways of life than most of the 36 states of Nigeria. The people of the state are noted for their rich cultural heritage, which reflects in its history and her cordial relationships. The state is exposed to a variety of natural hazards. The occurrence and intensity of many of the hazards are exacerbated by environmental degradation processes such as deforestations, desertification, soil erosion, pollution, and loss of biodiversity. These events result in disaster when they meet with highly vulnerable population and environment.

Flooding is becoming a serious challenge in Adamawa state and the situation is indeed alarming (Gangunen, 2018). Adamawa state therefore is considered a flood prone area and has suffered losses of lives and properties annually. Particularly, the local governments that are situated along River Benue; specifically, Yola North, Yola South, Girei, Fufore, Song, Numan, Demsa, Lamurde among others.

Despite huge budget on modern structural flood risk reduction strategies and massive investments in public awareness raising on flooding and its effects on humans and their assets; loss of lives, property destruction, loss of crops and livestock have persisted. Against this backdrop, this paper aimed at assessing the indigenous knowledge and practices for flood risk reduction in the state. To construct explanations to the problem statement, the study sought to achieve the following objectives:

i. To assess the indigenous perception of flood in the study area;
ii. To identify the indigenous practices for flood prediction; and
iii. To identify the various indigenous flood risk reduction strategies in the study area.

Material and Methods

Study Area

The study region covers Adamawa State, located in the Northeastern part of Nigeria. Geographically, it is situated between Latitude 11°0' 0" to 7º 24' 0" N and Longitude 13° 48 0" to 11° 30' 0" E covering a total landmass of approximately 38,700 km² (Figure 1). The state comprised of 21 1ocal government areas. The topography of the area is typically of steep hills, undulating slopes and gentle escarpments. The landform is the consequence of geological and geomorphological processes. The area is characterized by high relief ranging from 2,000 m above sea level in the western part to 3,900 m above sea level in the southern part of the area (Lazarus et al., 2020). Major Rivers that traverse the study region include the River Benue, Gongola River, River Yedzeram, and River Yinagu.

The major economic activity of the inhabitants is agriculture (farming, fishing and cattle rearing). Some agricultural crops of importance are cereals, roots, and legumes supplemented by few planted trees. The main food crops grown are maize, sorghum, millet, rice, cowpea, groundnut, sweet potato, yam and cassava. Non-farm economic activities include trading, blacksmithing, fishing and animal husbandry among others (Maurice et al., 2015). The State fails within the guinea Savannah zone and has hot (April to October) and cool (November to March) seasons. The mean minimum and maximum temperatures vary from 16.7;C to 34.5;C. The state receives an average annual rainfall of 981.24 mm (Zemba et al., 2020).

Methodology

Both primary and secondary data were utilized. Data from primary sources were obtained from questionnaire administration, One-on-one interviews and Focus Group Discussion (FGD) with community elders. Questionnaires were designed to facilitate easy acquisition of primary data for the research and its analysis. Each questionnaire consisted of several questions that were geared towards addressing the aim of the research. The designed questions were in two categories, the first is the personal information, which included: sex, age, marital status, family size, and duration of stay in the area, occupation, level of education and income level. While the second category covers the objectives of the study. A total of 600 copies of questionnaires were administered to a sample population of 600 respondents which were purposively selected from the 6 local governments on the bases of 100 questionnaires per local government. One-on-one interviews and Focus Group Discussion (FGD) with community elders were conducted. In which structured questions were asked, to provide the respondents with the opportunity to express their

views and also to provide their own suggestions. Secondary sources of data were obtained from published and unpublished works, such as Journals, Magazines, Newspapers, the internet and edited textbooks.

Six local government areas (Yola North, Girei, Lamurde, Numan, Demsa and Song) were purposively selected from the 21 local governments of the state. Thus, the study areas were selected for several reasons. The selected areas were considered a priority because of their location and experiences of flood occurrences. They all experience annual floods leading to severe losses of lives and properties, annual displacement, and were the worst hit in the 2012 and 2022 floods events and importantly, they play a vital role in the economic growth of the state and food production. The sites selected also vary as some are proper urban communities while others are rural communities. The research data were presented in form of tables and analyzed descriptively.

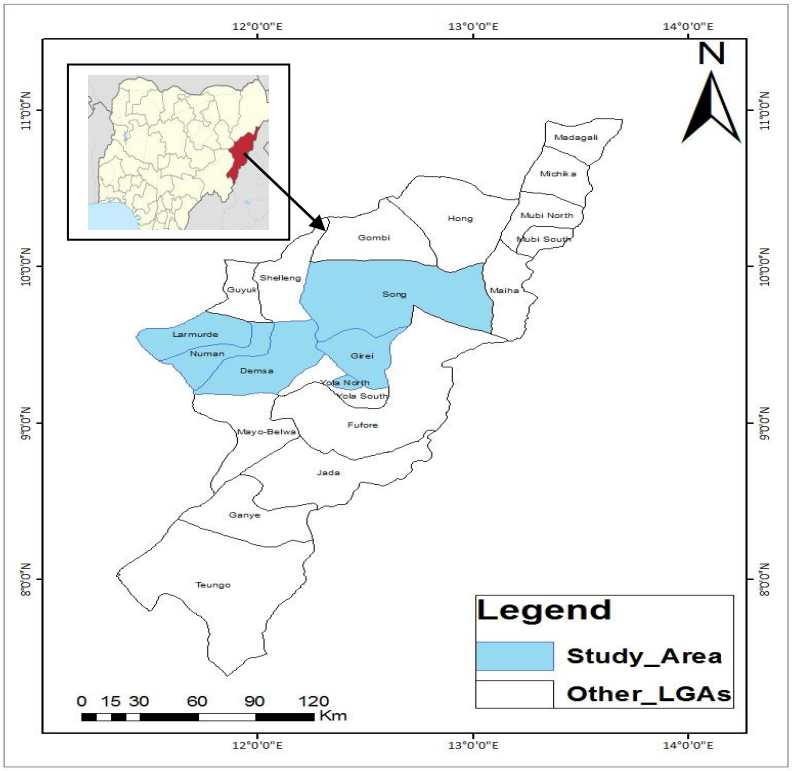

Figure 1: Map of Adamawa State Showing the Selected Sampled Study Areas.

Results and Discussion

Data in Table 1 shows the socio-economic characteristics of the sampled respondents. Investigation into the sex of respondents reveals that the majority (71%) are male, while 29% are female. Regarding to marital status, 89% are married, followed by 9% singles.

Table 1: Socio-Economic Characteristics of Respondents

Socio-economic characteristics	Frequency (f)	Percentage (%)
Sex of Respondents		
Male	425	71
Female	175	29
Marital Status		
Single	51	9
Married	534	89
Divorce/Widow	15	2
Educational Background		
No formal education	80	13
Primary	371	62
Secondary	127	21
Tertiary	22	4
Type of Occupation		
Civil servants	50	8
Trading/business	111	19
Farming	350	58
Unemployed	85	14
Others	4	1
Duration of Stay		
< 1 year	14	2
1 – 3	50	8
4 – 10	100	17
11 – 20	135	23
21 years +	301	50
Age of Respondents		
19 – 30	52	9
31 – 40	182	30
40 – 60	254	42
Above 60	103	17
Total	**600**	**100**

Source: Questionnaire survey, 2023

Educationally, the majority of respondents (62%) acquired a primary school-leaving certificate, followed by those with SSCE (21%), 13% with no formal education, while only 4% attended tertiary institutions. Occupationally, bulks of the respondents are farmers (58%), 19% are into trading and businesses, 8% are civil servants while 14% are unemployed. It is important to state that those unemployed class are those that do not have any specific standard occupation but they go around the town each morning in search for any available activity to earn a

livelihood. Investigation into the age of the respondents reveals that the majority (42%) are within the age bracket of 40 – 60 years, this followed by those between the ages of 3 – 40 years.

As regard the respondent's length of stay in the area, Table 1 reveals that 50% of the respondents have lived in the area for over 21 years; 23% for as long as 11 – 20 years, 17% for 4 – 10 years, 8% for 1 – 3 years while 2% have lived in their residence for less than a year. This shows that the vast majorities of respondents are locals and have possessed in-depth knowledge of the study areas and also have experience of the research topic.

Table 2: Respondent's perception of flooding in the study area

Perceptions	Frequency (f)	Percentage (%)
Natural disaster	430	72
Man-made disaster	109	18
Hazard	61	10
Total	**600**	**100**

Source: Questionnaire survey, 2023

Investigation into the respondents' perception of flooding reveals that the vast majority of respondents (72%) perceived flooding as a natural disaster with no human interference. They described the type as mostly river floods; which were a result of excessive precipitation beyond the holding capacity of rivers. Interviews with some local respondents revealed their perception of the flood disaster in the areas as an act of the creator of the earth and universe (GOD) or a means of punishment for the wrongdoings perpetrated by man on the surface of the earth. 18% of respondents perceived flooding as a man-made disaster; which were a result of human negligence and interference with river channel or water bodies, while 10% perceived flooding in the study area as a hazard that has no much impact on the community.

Table 3: Frequency of flooding in the study area

Flood Frequency	Frequency (f)	Percentage (%)
Annually	510	85
Once after every 2 years	50	8
Once after every 5 years	27	5
Once every 10 or more years	13	2
Total	**600**	**100**

Source: Questionnaire survey, 2023

The Table above reveals that the occurrence of flooding in the study area is more of an annual event, as revealed by the vast majority of respondents.

Table 4: Impact of flooding in the study area

Impact	Frequency (f)	Percentage (%)

Loss of lives	53	9
Damage to properties	67	11
Destruction of farmlands	256	43
Disease outbreak	201	33
Others	23	2
Total	**600**	**100**

Source: Questionnaire survey, 2023

The Table above shows that farmlands were mostly affected followed by disease outbreak like cholera which serves as secondary threat after flooding events. It's clearly showing that there were other impacts which included loss of lives (9%), damage to properties (11), and other related impacts.

Table 5: Presence of early warning indicators

Presence of early warning indicators to flooding	Frequency (f)	Percentage (%)
Yes	583	97
No	17	3
Total	**600**	**100**

Source: Questionnaire survey, 2023

Table 5 above assess on whether there were any traditional or indigenous early warning indicators used to predict flooding, 97% of the respondents revealed that there were locally available indicators that can be used to predict a flood.

Indigenous Rain and Flood Prediction Methods

One-on-one Interviews and FGD with community elders revealed that they do predict heavy rains and flooding through ecological, meteorological, riverine and celestial indicators.

Ecological indicators

Across the case study communities, numerous ecological indicators were revealed. These indicators could be either by specific behaviour of animals or changes in plant behaviour. Communities notice some of these occurrences already from March, all the way to the flooding season. These indicators are shown in the table below:

Table 6: Ecological Indicators of Droughts and Floods Prediction/Forecasting

Indicator	Signs or Symbols	Prediction
Arrival of birds	• Arrival of a certain bird (*Shamuwa*)	Onset of rainy season
Plant phenology	• Dense Flowering of *Acacia nicolita* • Abundance of *Cucumus melo* (Gurji) • Abundance of *cencifirius bilforus* (Karangiya)	Heavy rainfall and hence flooding is expected.

	• Growth of dense leaves of *ficus polita(* Durumi*)* • Abundance of fruit of *Lannea acida* (faru)	
Livestock behaviour	• Ducks raise their wings and want to be in the waters	Flood is expected
Insect	• An increase number of insects such as mosquitoes and spiders are observed	Flood is expected
Nest of Birds	• Nesting of queal birds high on trees far away from rivers • When various types of birds were found in increased numbers, producing a specific loud sound. • Other birds make more nest near the rivers.	Flood is expected
Fish in rivers	• When fishermen observed and catch more fish than usual before the beginning of the season.	Flood is expected
Colony of ants	• When ants start appearing in increased numbers, inside and outside the houses and the communities are at unrest because they disturb their sleep. • Increased number of ants found in farms	Flood is expected
Animal behaviours	• When river animals such as tortoise come out of rivers; often seek shelter on higher ground. • Other wild animals like rabbits are seen looking for and grazing in higher ground that is normally reserved for human habitation.	Heavy rainfall and hence flooding is expected.

Source: Field work, 2023

The communities have repertoires of early warning indicators for coming flood, as shown in Table 3. These indicators were confirmed in key informant interviews with the village heads, who confirmed that taking heed of some of these seemingly unimportant indicators leads to effective flood risk reduction. These correspond with the account given by the communities as reported by Joshua *et al.,* (2017) in Malawi; Ajibade and Eche (2017) in Central Nigeria, Okonja *et al.,* (2017) in Uganda; Iticha and Husen (2015) in Ethiopia. The sound produced by livestock, bird and insects before the onset of rainfall is observed as a warning sign of imminent rainfall and potential of flood. Electromagnetic field that happens before extreme events like tornadoes or the animals may be reacting to ultrasound or micro temblors which cannot be heard by human (Alvera, 2013).

Meteorological indicators

Meteorological flood forecasting indicators in the case study communities were primarily concerned with observing the changes in temperatures, rainfall patterns and intensity and specific blowing of winds. The following indicators where revealed.

Table 7: Meteorological Indicators of flood

Indicators	**Sign and Symbols**	**Prediction**
Hot temperatures	Hot temperature is experienced starting from	Flood is expected

	February and leading up to a flooding season.	
Wind direction	Both southern and northern winds, depending on the community) were also indicated as a sign of more imminent indicator.	Flood is expected
Cumulonimbus clouds	Appearance of dark cumulonimbus clouds, especially at the east horizon and increased whirlwinds	heavy rainfall and hence flooding is expected.

Source: Field work, 2021

Meteorological indicators such as temperature, humidity, clouds, and wind direction before or during the raining season are used by the communities of the study area to forecast the timing, intensity and duration of rain which in turn used to ascertain the potential of flood with biological and astronomical indicators. The use of meteorological indicators in predicting flood and drought is a common phenomenon as indicates in different studies e.g. Ngwese *et al.,* (2018) in Ghana; Masinde *et al.,* (2018) in south Africa, Iticha and Husen (2018) in Ethiopia.

Riverine indicators

The study found that riverine indicators are the most reliable indicators for flood forecasting in the study area. For instance,

Table 8: Indigenous Riverine Indicators of flood

Indicators	Sign and Symbols	Prediction
River	• Presence of debris and waste, muddy colours, foaming of waters and unpleasant odour coming from the river • If the water in the river looks dirty and they (waters) come along with litter and timber planks and the moment these show up we know it is only a matter of hours before the river overflows. • When waters are of increased velocity and increasing in height.	Flooding is expected.

Source: Field work, 2023

Celestial indicators

In comparison with other groups of indicators, celestial indicators constituted a smaller group. These indicators include:

Table 9: Indigenous Celestial Indicators of flood

Indicators	Sign and Symbols	Prediction

Stars	• The appearance of bright stars in groups, the 'redness' of the sun are also seen as indications of a rainy season, appearing in a period from July to August.	Flood is expected
Moon	• The direction of the rising of the moon is also being interpreted as a sign of heavy rainfall in the season. • In several communities, concentric rings around the moon. • A full-moon in a period from July to August indicates rain, and respondents described that the full moon is surrounded by stars that 'fall across each other in the east-west direction.	Heavy rainfall and hence flooding is expected.

Source: Field work, 2023

Indigenous Flood Risk Reduction Practices

Across the case study communities, a number of indigenous flood risk reduction practices were revealed and assessed. FGD with the community elders revealed that upon observing indigenous flood forecasting indicators, community members have developed various practices that assisted them in reducing flood risk and taking early actions. These various practices revealed include:

- Since it was observed that farming close to river banks exposes crops to flooding waters, farmers in the study area have resorted to shifting of their farms away from the river banks to minimize the impacts of flooding.
- Some community members prefer to farm both on land and upland to serve as a diversification measure. Some findings revealed that some farmers change planting places or decide to plant earlier in the season to avoid crops being affected by floods.
- Foundations of mud-bricks houses are improved by adding an extra layer of mud around the houses as part of flood risk reduction strategies before the expected heavy rains and floods. To make roofs more resistant to blowing of heavy winds and water leakages, roofs are strengthened by the process of thatching and covering the roof with the sheets of plastics and tarpaulin. New houses are now mostly constructed with cement bricks.
- Some wealthy individuals in the community resorted to owning houses both in the lowland and in the uplands.
- Sticks are positioned on the river banks or close to the bank and monitor the speed at which waters are increasing. Upon seeing the water levels rapidly increasing, people living in the

low lands will be advised to relocate or move to the uplands (to the relatives, evacuation centres or temporary shelters). The decision on possible evacuation is made based on the local early warning systems. In most cases, women, children and livestock move to the uplands whilst some men search for a safe place in the mountains or the top of hills close to the lowlands monitoring the situation.

- It was also revealed by the community that livestock and other small animals are kept in raised platform (popularly known as *Danki*) made from local materials to ensure their safety during the flooding events, while cattle (bigger animals) might be relocated to graze in the uplands. This is part of the measures developed for minimizing the losses of livestock and cattle in the study area.
- Stockpiling of food and water is considered is an emergency preparedness measure. Study revealed that food (maize flour, millet, sorghum and beans) is stored in sacks to prevent it from getting moist. However, it was observed that food storage was rather an exception as communities hardly keep food and water due to the level of poverty in most of the selected study areas. It was revealed that building of raised platform (popularly called Rumbu) in storing food and seeds, thus preventing them to being damaged by floods, are another measure in reducing the impacts of flooding on food. Fodder for cattle and other livestock is also stored when available. Some respondents reported that the food is being stored in their upland residence to avoid any flood emergencies.

Conclusion and Recommendations

These research findings show that the inhabitants of coastal areas of Adamawa state have long been developing mechanisms to survive and to adapt to flooding for centuries. They are rich in indigenous knowledge relating to the environment and how to live in harmony with it, much of which is manifested in survival and livelihood strategies. Indigenous knowledge has allowed these communities at risk to mitigate, prepare for, respond to and recover from disasters well before the establishment of high technology-based early warning systems. The study indicates that the local and traditional knowledge of nature and natural phenomena still plays a key role for many people and communities in this modern era of technological advancement.

A blend of scientifically or technologically advanced methods and traditional knowledge opens avenues towards better disaster prevention, mitigation and preparedness. It is therefore natural for every community to take measures to prevent and/or mitigate losses they might be facing when hazards strike. At-risk communities in Adamawa have a long history of observing changes in the environment and have amassed a wealth of knowledge and practices closely

related to these changes. This type of traditions and practices has influenced the way these local communities anticipate, and adapt to extreme weather events and other hazards.

The study recommends that governments at all level, especially the local governments and its development partners such as Community-Based Organizations (CBOs) and NGOs need to recognize and adopt flood related indigenous knowledge and practices and use it to the benefit of the communities. In this regard, there is a need to quickly expedite a process of collecting and compiling the diverse range of indigenous knowledge before it disappears since it is largely embedded in institutional memory of elderly people. The study emphases the need for creating mechanisms that can promote and popularize indigenous knowledge and practices through public awareness-raising materials and educational activities to recognize and appreciate the value of their local knowledge in reducing flood risk. Mainstream indigenous knowledge can effectively be integrated in flood forecasting and monitoring, early warning systems and flood disaster response and recovery mechanisms. Lastly, there is a need to blend indigenous knowledge and modern knowledge in flood prevention, mitigation and preparedness with the goal of building community capacity in a participatory, sustainable and cost-effective manner.

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