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INDIGENOUS KNOWLEDGE EARLY WARNING SIGNS FOR FLOOD DISASTER RISK REDUCTION IN KADUNA TOWN, NIGERIA

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ABSTRACT

This paper unveils how indigenous knowledge is employed in the prediction of flood disaster prevalence in Kaduna Town, Nigeria. The study adopts a qualitative phenomenological case study approach as it relates to the floodplain resident's experiences. The data for the study was collected through semi-structured interviews (n=30) conducted with the residents of the floodplain of Kaduna Town. The generated data was imported into Nvivo 11 qualitative data analysis software for the purpose of coding. After the coding was undertaken the results was then transferred to Microsoft Excel 2016 in order to produce the chart for the discussion of this study. Based on the analysis of the data, it was inferred that indigenous knowledge flood early warning signs are perceived in three distinctive ways in the study area via nature, water observation, and the weather. Hence, this indeed concretized that indigenous knowledge depends on the peculiarity of a given locality. However, the study concluded by recommending that indigenous knowledge flood early warning signs in Kaduna Town should be integrated with other conventional approaches of flood prediction such as the scientific technologies in order to make flood prediction robust and more effective.

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INTRODUCTION

The impacts of flood disaster amidst other forms of natural disasters has unquantified effects in the developed and the developing nations, more particularly in its destruction of lives and properties around the world which is becoming alarming on a yearly basis. This environmental hazard has increasingly become a global affair associated with climate change Van Aalst (2006) such as sea level rise Rodolfo and Siringan (2006) or where the interaction of global world pressure with local dynamics contributes to increased vulnerability to such environmental hazard Pelling and Uitto (2001).

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Thus, generally among the causes of flood disaster, climate change is known to champion all. Basically, observance of climate vulnerability in most developing countries and Kaduna Town particularly has increased the need for the use of indigenous knowledge flood early warning signs by restless marginal floodplain residents, in perceiving possible flood disaster outbreak. This is very significant as it assists in making an indigenous prediction in relation to flood disaster prevalence which in turn helps in lessening the impacts that may arise from any impending flood disaster as one of the climate change events Tadesse et al (2008), Maskey (2011). Hence, In the regions of West Africa in which Kaduna Town is also found, Tall et al (2008), Braman et al (2013), demonstrated how seasonal rain prediction was utilized to mitigate the impacts of flood disaster more especially in relation to the destruction of lives and properties as well as the contraction of water-borne diseases which has serious health implication.

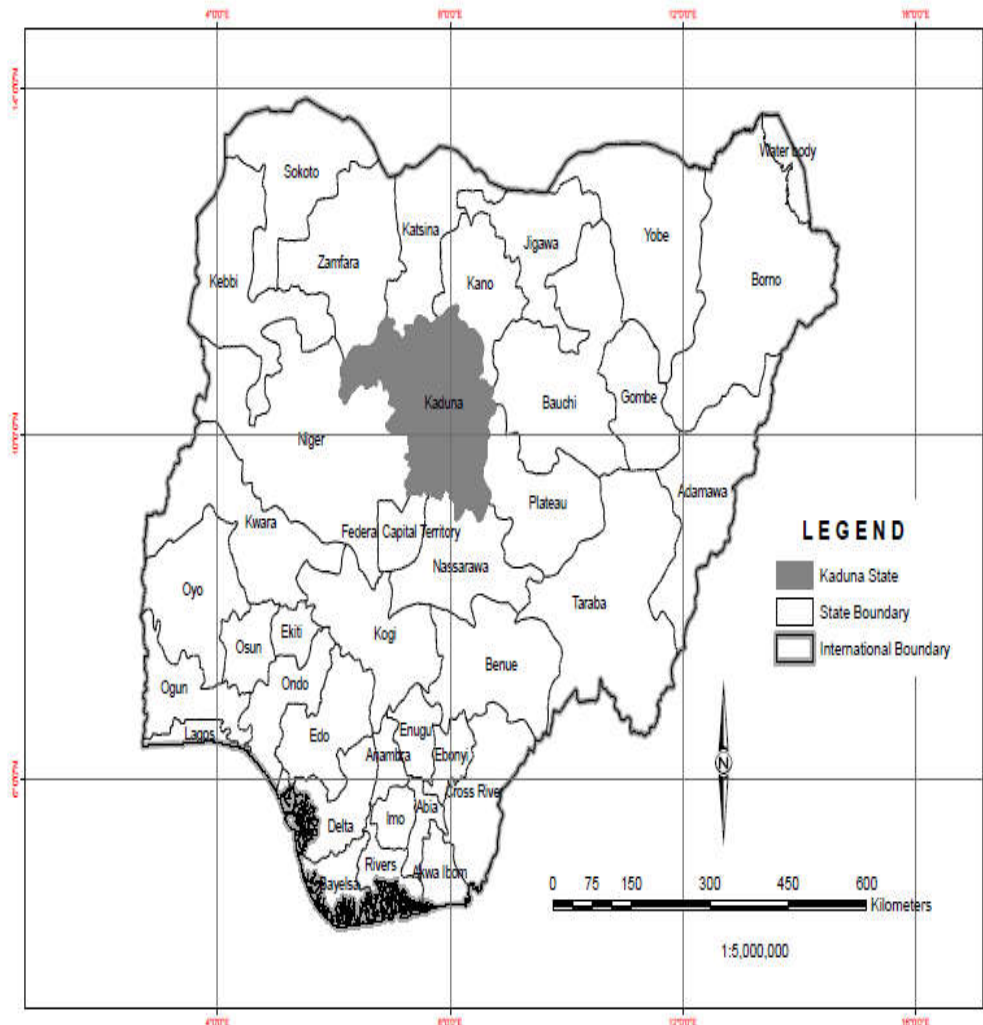


Figure 1. Location of the Study Area

By this, it cannot be disputed that the prediction of flood disaster through the use of indigenous Knowledge early warning signs are powerful resources that are domicile amidst marginal floodplain residents that warrant sustainable living with flood disaster. However, it is also worthy of note that, the use of indigenous knowledge (early warning signs) is encouraged in the sub-text of the Hyogo Framework for Action of 2005 such that emphasis was made for building the resilience of nations and communities to disaster prevalence. Not-with-standing indigenous Knowledge has been part of local disaster management system in which over centuries residents of marginal areas such as Kaduna floodplain do adjust their lives and livelihood to acclimatize to a changing context Dekens (2007). Thus, indigenous Knowledge is not apparent in varied ways Tran (2009), but still, it is employed to mitigate, prepare as well as respond and recover from disaster impacts. However, this study specifically seeks to uncover the indigenous Knowledge flood early warning signs in Kaduna that is used for the prediction of the possibility of flood disaster outbreak, considering the fact that, every region around the world has its peculiarities which may be the same or even different other localities. This if documented can serve as a reference to other place living under the same environmental context.

DESCRIPTION OF THE STUDY AREA

Kaduna Town is located between latitude 10° 28' and 10° 37' North and longitude 07° 19' and 07° 31' East.

It occupies an area of about 260km² and the distance between the eastern and western limits of the city is approximately 13.7km Fingsi, (2001). It has seasonal rainfall patterns associated with high magnitudes. The mean annual rainfall is estimated at 1,185mm Sawa, (2002). Also, the Mean annual temperature is estimated at 24.50C and a yearly evapotranspiration that almost equates the annual rainfall summation. Generally, there are two distinct seasons in the study area, which are dry and raining seasons. Furthermore, the bedrock geology of the study area is mostly metamorphic basement, characterized by gneisses and older granites. Additionally, the vegetation cover of Kaduna is characterized by savannah type of grassland with predominantly scattered trees and woody shrubs.

Basically, Kaduna Town is made up of four (4) administrative local area council that falls in the floodplain these include; Kaduna North, Chikun, Kaduna South, and Igabi. In addition, Kaduna River is the major tributary of river Niger found in central Nigeria. It begins from Jos Plateau 18 miles (29) south-western part of Jos town near Vom and it runs in a north-western direction at 22 miles (35 kilometers) north-east of Kaduna town. It then takes a south-westerly and southerly direction before ending its 340 miles (550-kilometer) movement to the Niger at Muregi (opposite Pategi). A greater number of its courses go through the open savanna woodland; though its lower part cuts many gorges (This includes the 2-mile (3-kilometer) granite ravine at Shiroro) which is higher than its entrance to the wide Niger floodplains.

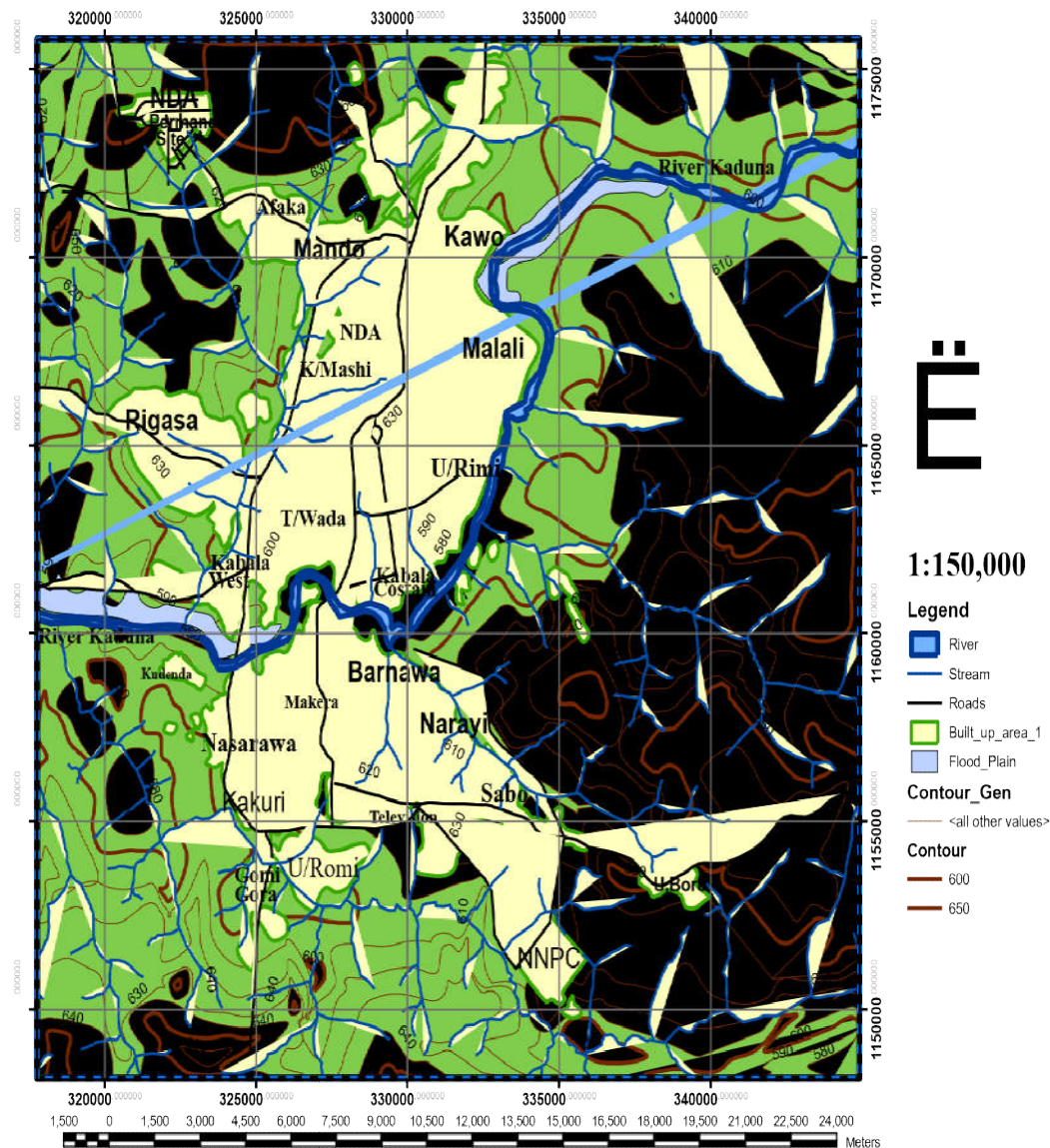


Figure 2. River Kaduna

River Kaduna is characterized by great seasonal variations or fluctuations and it is navigable below Zungeru as from July to October for minor craft. It is also used for fishing activities as well as, transportation of local produce. The inhabitants of the floodplain of Kaduna for a considerable time have been into the cultivation of rice and in the southern part of the floodplain, the Nupe tribal territory cultivates both rice and sugarcane as the major economic activities or sources of livelihood. River Kaduna passes through the town dividing it into two parts. Other rivers in Kaduna such as river Romi, Mashi, and Barnawa stands as natural drainages that drain runoff emanating from rain and sludge water from the town down to the river. See Figure 2.

MATERIALS AND METHODS

For the purpose of this study, a qualitative phenomenological case study approach was adopted. The reason for employing this approach is because it assists in transforming lived experiences into textual data, such that the text is often a reflexive re-living and the reflection of the appropriation of something that portrays meaning, that is, such that a reader is strongly animated in his or her own lived experiences

AfoaKwah (2016). Furthermore, in order to collect data, the semi-structured interview method was adopted. The choice for this technique was prompted because it is flexible, accessible, intelligible and, more importantly, capable of disclosing important and hidden facets of human and organizational behavior. Indisputably, it is the most effective and convenient means of gathering information. Hence, the projected population of Kaduna Town from 2006 National Population Census (NPC) was estimated at 1,992,500 out of which the floodplain population makes 396,331 households. The selection of participants in this study was based on age and residency, in which residents of age 60yrs and above as well as living in Kaduna floodplain were the target participants of this study. The reason for the selection of this age limit is because of the experience they acquired living with floods for a considerable period of time. In all, 3% makes the population of the age 60 years and above NPC (2006), out of the 396,331 households of the floodplain, which gives 11,889 of the population of age 60 years and above. At this point, a purposive homogenous sampling method was employed to arrive at thirty-eight (30) number of participants for this study, (Bernard, 2002; Etikan, 2016) asserted that purposive sampling is a nonrandom technique that does not need underlying theories or a set number of participants, rather the sample units are chosen because they have particular features

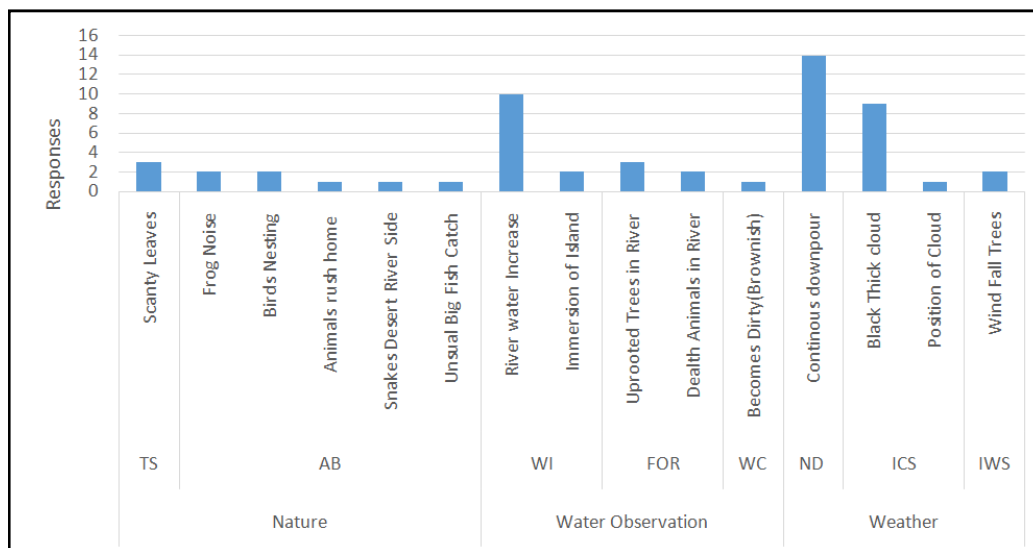


Figure 3. IK Flood Early Warning Signs in Kaduna Floodplain



(Source: Researcher, 2017)

Plate 1. Island in Kaduna River

or characteristics which will enable detailed exploration and understanding of the central themes and puzzles which the researcher wishes to study. These may be socio-demographic characteristics or may relate to specific life experiences, behaviors, roles, etc. Also, in the analysis of data, this research employs a Computer-Assisted Qualitative Data Analysis Software (CAQDA) package. Categorically Nvivo 11 was utilized when analyzing the data on IK flood early warning signs in Kaduna Town. Nvivo 11 is well suited for the analysis of the semi-structured interviews in this study because it provides the functionalities required. Additionally, prior studies recommended the use of Nvivo software in case study researches for instance (Bandara, 2006, Beekuzen et al, 2010). Also, after the coding of data in Nvivo 11 in order to generate the charts that depict flood early warning signs in Kaduna, the coding result was transferred to MicrosoftExcel2016 and the chart used for the discussions of this study was generated.

RESULTS AND DISCUSSIONS

IK Flood Early Warning Signs in Kaduna Floodplain.

The semi-structured interviews conducted indicated varied IK flood early warning signs that are inbuilt in Kaduna floodplain.

These indigenous flood signs evolved as a result of the habitation of the floodplain residents for a considerable number of years experiencing flood disaster. Hence, these Indigenous flood signs are grouped into three via nature, water observation as well as those signs related to the weather (Figure 3). Undeniably, over the years these flood early warning signs assisted the floodplain residents in order to get much prepared for any impending flood disaster occurrence in the floodplain, which in turn assisted enormously in reducing the impacts of flooddisasters because adequate preparatory measures are always put in place even before they manifest. Further discussions are made below:

Legend

TS=Trees Shading
 WI=Water Increase
 AB=Animal Behavior
 FOR=Floating Object in River
 WC=Water Color
 ND=Nature of Downpour
 ICS=Indigenous Cloud Study
 IWS=Indigenous Wind Study

Early Warning Signs by Nature

Within the context of this research, flood early warning signs by nature can simply be described as signs that manifest or are detected without any human connection or interference but rather tends to manifest naturally as a result of some attributes probably through animals or plants etc. Basically, in the floodplain of Kaduna, indigenous flood early warning signs are observed naturally by trees shading as well as animals' behavior (Figure 3). Thus, few responses indicated that trees shading is one of the natural means of detecting the possibility of an impending flood disaster in the floodplain of Kaduna. Indeed, based on past experiences whenever there is the likelihood of flood disaster taking place, trees are observed to shade their leaves, more especially at the beginning of the raining season. Usually, this happens in such a way that the trees look as if they are trimmed; such that you only see leaves at the top of the trees. This shading of leaves by the trees is normally as a result of water percolation in the soil in such a way that the roots of the trees get affected in which consequently, in extreme cases, some trees even fall down. All these attributes are utilized indigenously by the residents of Kaduna floodplain for the prediction of flood disaster prevalence. This is supported below:

"Another sign is noticed through trees because some of the trees shade their leaves and others even fall down because already water has affected their roots underground."

(Interviewee 15, RQ1)

Furthermore, animal behaviors are also among the natural ways of envisaging the possibility of flood disaster occurrence in Kaduna floodplain. Usually, animals such as frogs which are locally called "*kwadi*" do make unpleasant noise (croaks). These noises do sound like "*kwooooo.... kwoooooo.... kwooooo*" in a consistent manner. Normally, once this sound is heard by the residents of the floodplain, this usually gives them a signal of an impending flood disaster because they hardly make such noises, except if flood is about to occur. In turn, this gives room for preparation, in order not to be taken unaware as well as adopts some measures of mitigating the impacts of the impending flood disaster. Succinctly, this sound made by frogs over the years has been observed to be accurate in the floodplain of Kaduna, which makes the residents' earmark it as one of the indigenous flood early warning signs whenever it is to take place. This is confirmed below:

"Sometimes if you hear frogs making an unnecessary sound, it is a sign that water has started entering their places that is why they make such sounds."

(Interviewee 4, RQ1)

Still, on animals' behavior, birds nesting is another natural way of predicting the possibility of flood disaster occurrence based on past experiences by the residents of Kaduna floodplain. Thus, whenever flood is to take place the floodplain resident does observe the nesting of a bird locally called "*chilokowa*". This bird's nesting is done either very low or high on a branch of a tree. Therefore, at any time it is noticed that the bird (*chilokowa*) makes its nest very high, that is an indication flood disaster may not be experienced but rather there is going to be drought, inversely, whenever it is

noticed *chilokowa* makes its nest very low at a tree branch, that doessignify that there will be an impending flood disaster in the floodplain. This bird's (*chilokowa*) behavior is more often observed at the beginning of the raining season. Also, over the years this has been observed to be accurate, which as a result makes the floodplain resident to often get prepared for an impending flood disaster. Additionally, if flood is set to occur, snakes leave the riverside and tend to take over the floodplain. Here, snakes a seen moving within the residential areas. In view of this, the floodplain residents begin to suspect the possibility of impending flood disaster prevalence. This is because snakes moving haphazardly are unusual, thus this also makes the floodplain residents put all measures in place to anticipate flood outbreak as well as be prepared. Again, another natural signal as an IK flood warning sign in relation to animal behavior as opined by the respondents is the catch of unusual big fishes in river Kaduna. Indeed, over the years if flood disaster will occur unusual big fishes are caught by fishermen in river Kaduna been the dominant surface water body in the study area. As a matter of fact, the fishes in river Kaduna are known to be of moderate sizes but based on past experiences, the moment unusual big fishes are caught or seen in the river, this often serves as an indication of the water of another distant river which has probably already been flooded must have taken over that of the floodplain, that is why those fishes are caught or seen. Considering this, the floodplain residents start to prepare for an impending flood disaster outbreak through strengthening mitigation measures. Hence, this also over the years have been observed to be correct in the floodplain of Kaduna based on previous flood prevalence. Lastly, based on the interviews, still, on animal behavior, the rushing back home by some domestic animals is another natural IK flood early warning sign in Kaduna floodplain. Usually, animals are allowed to graze without any restriction, based on that, it has been observed over time, if flood disaster is to take place animals more especially goats and sheep do rush back home, based on past experiences, if where they came from is traced particularly during raining season, indisputably it will be found that flood disaster must have started there. Also, this too has been observed to be consistent over time.

Early Warning Signs by Water Observation

These are the varied IK flood early warning signs that are detected through river water observation. This is also evolved, due to the experience of living in the floodplain for numerous years, by the floodplain residents of Kaduna, which as a result assisted them in figuring out some of these common early warning signs through water observation. This is considering the fact, that the river itself warns before the prevalence of any flood outbreak in the study area. Therefore, the major IK flood early warning sign by water observation in Kaduna floodplain is river water increment. By this, the river water in the floodplain keeps increasing in level within a particular time interval. As a result of this, the floodplain residents based on past experiences keep watch of this increment by employing indigenous means of measuring it, in order not be taken unaware by its overflow to outlying areas of the floodplain. Usually, a long local stick called "*sanda*" is used by way of submerging it into the river in order to keep track of the river increase by taking measurements indigenously at specific time intervals. At this point, it is worthy to note that, sometimes this water increase in river Kaduna may not be due rainfall in the floodplain, but rather it could be as a result of a close by settlement that has been flooded, such that its flood water

moved to the river (Kaduna) of the study area, Succinctly, if this trend continues, suspicion is always made of the likelihood of an impending flood disaster occurrence. As a matter of fact, in the time past, up to this present time, river water increment is indigenously employed as one of major IK flood early warning signs in the floodplain of Kaduna and this is confirmed by an interviewee below:

“The sign we use to know if flood disaster will take place among other signs is continued increase in the water level of the river.... more especially if it is noticed water begins to overflow its banks, then we begin to suspect the possible manifestation of flood disaster.....”

(Interviewee 24, RQ1)

In addition, the immersion of some islands in the floodplain caused by water increase is another IK flood early warning sign by water observation as opined by some of the respondents' in Kaduna floodplain. Hence, once it is observed that the islands in river Kaduna are taken over by water, the residents of the floodplain begin to draw a conclusion of the likelihood of flood disaster prevailing. This is because these islands are not usually taken over water, but if such an anomaly is observed, then indeed, suspicion begins to rise of the possibility of an impending flood outbreak. However, these islands though, not very extensive, are always carefully monitored by the floodplain residents, more particularly during raining season, although in the dry season they are sometimes not surrounded with water due to draught (Plate 4.8), hence, they remain one of the features used in flood disaster prediction in the floodplain. Quite frankly, this too over years has been observed to be accurate indigenously. Thus, similarly to other indigenously flood early warning signs, this also assists the floodplain residents to have an insight about the possibility of an impending flood disaster outbreak as well as help them to put adequate measures in place for reducing the associated impacts that may follow.

Still, on water observation, floating objects in river Kaduna also serves as an IK flood DRR early warning sign to the residents of the floodplain. Indeed, whenever flood will occur sometime uprooted trees or branches of trees are seen floating in the river. These uprooted trees are normally planted by the side of the riverside, which probably must have been washed by flood water in distant or close by settlements where probably, flood disaster must have taken place, whose water is brought to the floodplain of Kaduna. Thus, as an indigenous flood disaster early warning sign, the residents of the floodplain use to be alerted in anticipation of an impending flood disaster prevalence, when already what is needed to mitigate its impact are been put in place.

Also, apart from uprooted trees, it was also found that dead animals like the carcasses of goats' chickens, snakes and in extreme cases even death cows are seen floating in the river by water observation, which also serves as flood disaster early warning signs in Kaduna floodplain. Indeed, just like the case of uprooted trees that is seen floating in the river, immediately these carcasses are observed, also suspicion begins to rise of the likelihood of flood outbreak. Succinctly, all these indications of the possibility of flood disaster prevalence often demand adequate measures to be put in place to cushion its impact. This is supported below:

“If flood disaster will take place sometimes overnight we do notice the river becoming full of wastes like log of trees, grasses, and even dead animals sometimes floating in the river..... on noticing those things, we do get tensed up because that is a clear sign it might have occurred in a close settlement which more often if that happens it does follow suit in this floodplain..... what do float in the river is a warning sign to us.”

(Interviewee 29, RQ1)

Lastly, change in water color is another IK flood disaster early warning sign by water observation. Nonetheless, the river water in the floodplain of Kaduna does change to dirty or brownish color from the normal color of been somehow transparent, if an impending flood disaster will take place. This change in watercolor takes a considerable time persisting and it is usually caused as a result of polluted or contaminated flood water from nearby or far settlements that have been flooded, in which the flooded water from such settlements gradually moves down to the river in the floodplain, in which after some time it is always accompanied by intense flood outbreak. Therefore, if this change in water color is understood or noted in time by the residents of the floodplain, this often serves as an early warning sign to them in which appropriate actions are taken indigenously of curtailing the impacts of the impending flood disaster manifestation. In short, it gives room for adequate preparation.

Early Warning Signs by Weather

These are the indigenous flood early warning signs that are observed through the weather or climatic conditions in Kaduna floodplain, which does assist in predicting the possibility of flood disaster outbreak indigenously. Hence, these signs are also acquired based on the experience of residing in the floodplain due to considerable years of habitation witnessing flood disaster prevalence by the residents of the floodplain, which in turn makes them be able to detect some of these signs even before flood disaster occurs through the weather.

Hence, majority of the responses pointed out that the nature of downpour gives an insight of the possibility of flood disaster outbreak. More often, a continuous downpour that takes several hours or rather one to two or even three days or more in the floodplain of Kaduna, serves as an indigenous flood disaster early warning sign, of the tendency of flood disaster striking. In most cases when this happens, mud houses in the floodplain begin to collapse and as the downpour continues coupled with blocked drainages, in no distant time flood disaster often takes over the floodplain. In essence, based on past experiences, if incessant heavy downpour ceased to quit in time, the floodplain residents become alerted by ensuring that measures of curtailing the impacts of a possible impending flood disaster outbreak are worked out as well as options are sought out for possible evacuation in case it comes with great intensity. Thus, this sign is also commonly used indigenous in flood prediction.

Still on IK flood disaster early warning signs of weather. Indigenous cloud study is also employed in predicting the likelihood of a flood disaster outbreak in Kaduna floodplain. Usually, the formation of a black thick cloud is a strong indication of the possibility of a heavy downpour, which in most cases comes with flood disaster. Thus, at any given time

it observed, the inhabitant of the floodplain does be on the alert, which also makes them take adequate necessary measures of ensuring that the impacts of the possibility of flood disaster occurring are mitigated accordingly. However, this too just like other indigenous flood early warning signs, have been proven to be accurate indigenously over the years. Additionally, the position of the cloud too is not left-out as an indication of the possibility of flood disaster prevalence in the floodplain of Kaduna. Thus, the formation of cloud in the north-western part of the floodplain do signify that that rain will definitely fall in the floodplain of Kaduna but if it is formed in a different direction, usually rain hardly falls. Therefore, if a black thick cloud is formed in the north-western part of the floodplain, without restraint there will be a heavy downpour as well as the high possibility of flood disaster taking place. This often calls for preparatory measures to be put in place in case flood disaster manifest.

Furthermore, the falling of trees by the wind is another weather IK flood early warning sign in Kaduna floodplain. Here, the wind, more particularly, at the beginning of the raining season comes with great pressure and intensity. It continues to blow consistently for a considerable period of time, which as a result, trees begin to fall or are pulled out from their roots. On seeing this, the residents of the floodplain begin to raise suspicion of the likelihood of flood disaster occurring within the season (raining season). This is because, in other raining seasons which were not accompanied by strong winds, flood hardly manifests based on experience. However, this has been observed over time to be correct. In addition, the direction at which the wind blows is also taken in to notice, more especially if it keeps blowing from west to east of the floodplain, that too does signify as well as affirm the possibility of flood prevalence. Considering this, the floodplain residents do imbibe in strengthening measures of mitigating the impacts of an anticipated flood outbreak at any given time within the season (raining season). At this point, it worthy to note that, this indigenous flood early warning sign gives a long-range warning. This is because whenever the wind begins to blow, flood doesn't really take place immediately, but for sure as it continues to blow continuously, and flood disaster indeed does take place at any given time within the raining season.

Conclusion and Recommendation

This study explored indigenous flood early warning signs in Kaduna. Basically, the study was able to discover that flood early warning signs in Kaduna are perceived based on three varied ways such as by nature e.g. Trees shading (Scanty leaves), animal behavior (AB) (frog croaking, birds nesting etc.) Also, it was unveiled by this study, that there are flood early warning signs perceived through water observation e.g. water level increase (river water increase), Floating Objects in the River (FOR) (e.g. uprooted trees) Lastly, it was uncovered that flood early warning signs are also perceived through the weather e.g. Indigenous Cloud Study (ICS) such as black thick cloud and position of the cloud. Thus, all these indigenous flood early warning signs were unveiled in the study area based on the premise that different regions around the world have their peculiar indigenous knowledge which does assist in saving lives and properties in relation to mitigating the impacts of flood disaster.

However, this study recommends the integration of the indigenous knowledge employed in flood disaster prediction that is evolved within the effected flood plain residents with conventional methods of flood prediction such as the scientific technologies, this no doubt will make flood prediction more robust an effective.

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