

The Use of Indigenous Knowledge in Drought Disaster Forecasting in Northern Katsina State

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ABSTRACT

Indigenous knowledge is sum of facts that are known or learned from experience or acquired through observation and study and passed down from generation to generation. Indigenous knowledge of drought forecasting is among the local knowledge gained by the present generation from the past generation. This work attempts to investigate the indigenous knowledge used by the communities of semi-arid areas of Katsina state in forecasting/predicting the risk of drought disaster. Data were collected through semi-structured interview with purposefully selected respondents and Focus Group Discussion. It was found that indigenous knowledge of disaster monitoring, prediction and early warning is based on the observation of behaviors of animals, birds, insects, shrubs, trees, wind, temperature, and cloud among others. Even though, the communities of northern Katsina state face many natural hazards challenges, drought is among the major disaster experience over the years by the communities, hence, they have evolved indigenous ways that helped them not only in predicting these natural disasters but also in devising techniques and mechanism of dealing with them. Documentation of disaster risk reduction information and development of disaster risk reduction policy were recommended to deal with the situation.

Keywords: Indigenous knowledge, Drought, Disaster, forecasting, Semi-arid

INTRODUCTION

Drought is a period with a deficient precipitation in a certain geographical region over some period of time. It is also described as a naturally occurring phenomenon that exists when precipitation is significantly below normal level, causing serious hydrological imbalances that adversely affect land resources production system. (Ekpule *et al.*, 2013; Masinde, 2018) The drought is often describe as a creeping phenomenon because of its gradual nature and slowly accumulated effect over long period of time (Chisadza, 2015).

The effect of drought can be quantified based on frequency, duration and intensity in the affected region. African countries where rainfall accounted for over 70% of food production have the highest incidence of droughts (Masinde, 2011; 2018). Masinde (2018) reported that out of 235 drought disaster recorded all over the world between 2006 -2015, 118 occurred in Africa and is responsible for the death of 20,078 in Africa countries out of 20,257 recorded deaths due to the impact of drought. In other words, only 173 people died from 50% of drought disasters that occurred in other parts of the world and 20,078 people died from the other 50% drought that were experienced in Africa countries.

In 1970s and 1980s different types of indices and computational models were developed with a view of providing timely, relevant and comprehensive information on impending drought to mitigate and minimize its impact (Masinde, 2018). But drought early warning system depends on weather forecast and most African countries weather forecast is bedeviled with many problems including inadequate coverage of weather station, very poor facilities and the content of the forecast reports and channels used in dissemination of the reports do not take cognizance of the farmers needs and is largely irrelevant at the local level. Hence farmers in different parts of the Africa rely on their indigenous knowledge to forecast weather to make decision in each step of farming process. Because in most African countries data gathered from weather forecast are not widely accessible, lacked the

desired scalability, characterized by instrumental discrepancies and unlocalized or inapplicable to local situation. (Masinde, 2018). In other words, apart from the problem of reliability shortcomings, scientific forecast have spatial and temporal limitation for use at village level. Also increase in rainfall variability in West Africa has increased uncertainty in seasonal rainfall prediction, thereby posing a greater challenge to scientists in their effort to improve forecast accuracy and reliability (Tedesse *et al.*, 2008). It is increasingly acknowledge that scientific data alone cannot give precise information on local climatic variation to effectively address the problems posed by drought challenges. Indigenous knowledge of flood and drought disasters need to be investigated and integrated with scientific perspectives and come up with acceptable proposal of ameliorating the drought challenges (Okoya *et al.*, 2017).

It is widely documented that small holder farmers in most African countries relied on indigenous knowledge of weather to make critical farming decision and to improve weather and climate disasters preparedness. The frequent reoccurrence of disasters, low literacy and technical knowledge, lack of access and ineffectiveness of formal disaster management agencies have compel many communities to rely heavily on traditional and local coping strategies to mitigate disaster risk (Ngwese *et al.*, 2018). Intergovernmental Panel on Climate Change (IPCC) (2010) acknowledges that "indigenous and traditional knowledge may prove useful for understanding the potential for certain adaptation strategies that are cost-effective, participatory and sustainable". Such knowledge system and practice is being used to minimize the effect of drought disaster risk. Even though the importance of I K has been widely recognize, it relevance in disaster risk reduction is yet to get the desired attention. This study attempt to document information related to the role and the use of IK in drought disaster forecasting in northern Katsina State, an area described as ecologically fragile where more than 56% of the farming communities could not produce adequate food for a year consumption (Abdulrashid, 2012).

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MATERIALS AND METHODS

Geographic Setting of the Study

The study area is located between latitude 12°52'N and 13°19'N and longitude 7°16'E and 7°43'E. Six villages were selected Birni Kuka, Sawani, Bumbum, Magama, Dankama and Yakubawa). In other words, one village were selected from each one of the six local governments (Jibia, Kaita, Mashi, Maiadua, Zango and Baure) of Katsina State that share border with Niger republic. The landscape is underlain by sedimentary rock, dominantly flat with an average height of 300 meters above sea level (Abdulrashid, 2012). Local vegetation adapt to climatic

rhythm of long dry season and short wet season. The dominant trees in the area developed long tap roots thick barks which allow them to withstand the long dry season and bush fire. The rainfall is received between May-September; annual average is below 700mm. Temperature are high in most part of the year with the mean daily between 27°C to 40°C between March and May and 18°C to 25°C in November-February (Tomlinson, 2010). The soils are sandy ferruginous type of latosols, highly weathered and markedly laterized and slightly acidic due to low organic matter content and phosphorous (Abubakar, 2006). Subsistence rainfed farming is the major economic activity.

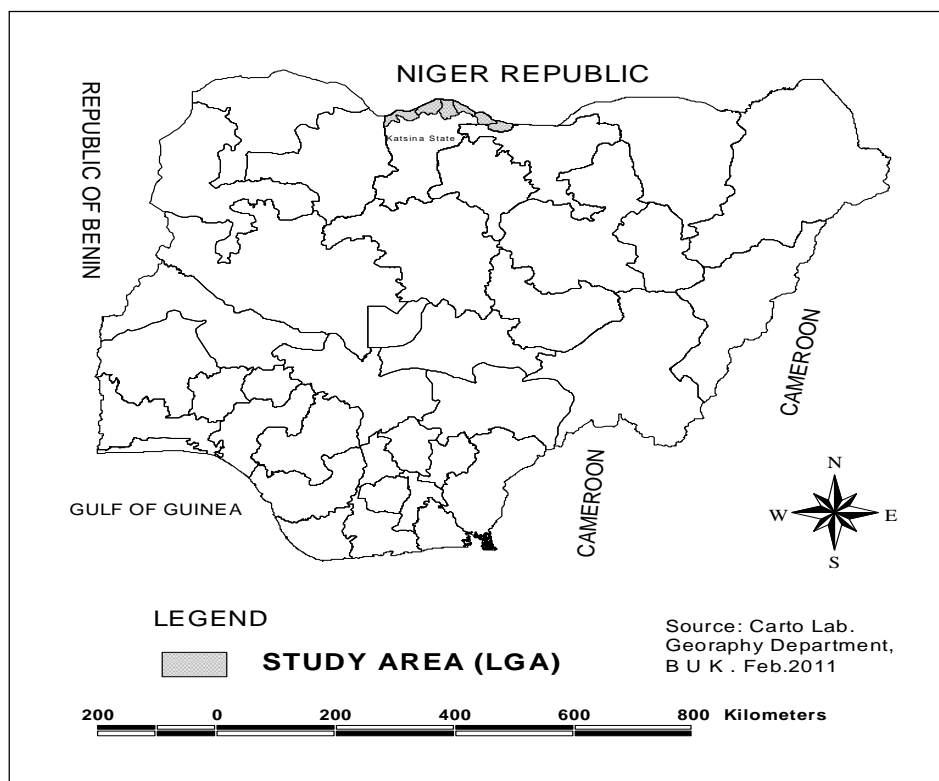


Figure 1: Location of Study Sites within Katsina State and Nigeria

Reconnaissance and Pilot Surveys:

The data was collected between 15th July – 10th August 2019. Reconnaissance survey was conducted to increase familiarity with the study area and the purposes of the research were explained to the local traditional rulers to get their permission and maximum cooperation from their subjects.

The villages were systematically selected and the numbers of respondents chosen in each village take into consideration its population size. A pilot survey was conducted to test the reliability and viability of the research tools and techniques. All the research assistants that help in questionnaire administration are tertiary institution students and are well familiar with the terrain of the villages and fluent in the local language (Hausa) spoken by the majority of the population.

Semi structure questionnaire with open-ended and close-ended questions were used to get information on the available indicators used to predict occurrence of drought in each village (Ngwese *et al.*, 2018). Focus group discussion (FGD) was held in each of the six villages. The FGD is aimed at weighing and balancing the information derived from questionnaire administration with a view of getting a consensus and develops generalization on the use of IK in forecasting drought in each village. Selection of the FGD members take into consideration of age, gender, literacy (Western or Arabic/Islamic knowledge's) and social status of the participants. As Mogotisi *et al.* (2011) point out these factors affect variation in traditional knowledge in communities. Local plant names mentioned by the respondents and verified during the FGD, were later matched with scientific ones used by Von May dell (1990) and Blench (2007).

Table 1: Sample Sizes and Some Characteristics of the Study Area

Local Govt.	Villages	Location (Coordinate)	Estimated Population	Sample taken	Dominant tribe
Baure	Sawani	12°52'N, 8°49'E	1,300	13	Hausa/Fulani
Maiadua	Bumbum	13°16'N, 8°07'E	1,700	17	Hausa
Mashi	Birnin Kuka	13°19'N, 07°59'E	3,200	32	Hausa/Fulani
Jibia	Magama	13°06'N, 07°16'E	3,600	36	Hausa
Kaita	Dankama	13°18'N, 07°47'E	4,500	45	Hausa/Fulani
Zango	Yakubawa	13°04'N, 08°29'E	1,800	18	Hausa/Fulani
Estimated Population and Samples sizes respectively			16,100	161	

Sources: Field Work (2019)

RESULTS AND DISCUSSION

A total of 161 questionnaires were administered to men (77%) and women (23%). Only 34% of the respondents have formal education but all have attended Quranic Schools. Farming is the primary occupation of 96% of the respondents. Different type of domestic animals were kept by the villagers, goats, being the most common (81%) owned by the household. Other animals include sheep (52%), cattle (22%), donkeys (13%), and camel (7%). Four types of domestic birds were kept chickens (61%) ducks (5%) Pigeon (3%), Guinea fowl (22%). Most of the respondents (54%) kept domestic animals for their cash value, not for their food potentials. Money obtained from the sale of animals were used to purchase food to fill in the harvest deficit, cloth and finance other expenses particularly wedding ceremony.

Majority of the respondents practice rainfed cultivation but Fadama cultivation was practice by 37% of the respondents most of them from Jibia, Kaita and Maiadua local governments. Most planting of Fadama occurred late spring before the arrival of first rain. The most prominent cultivars grown in the Fadama include tomato, Onion, chill pepper, sweet potato, lettuce, Okara cabbage, carrot, water melon and others. Also grown in the Fadama together with the domesticated crops were numerous so called "edible weed" of agriculture define as volunteer species and recognized as food resource (Cooper *et al.*, 2018).

Type of Disasters Experienced in Northern Katsina State

Frequent droughts cases is common disaster related to climate affecting Northern Katsina State. Farmers can recall severe drought that occurred in the 1940s, 1950s, 1970s, 1980s, 1990s and 2000s and floods that occur almost every year. The communities acknowledge that they could not stop the disasters once they occurred, but could mitigate it in the form of preventive or remediative measures. The approach or measure taken depends on the prediction/forecasting of disaster and its possible severity and consequences.

The communities largely depend on indigenous knowledge to forecast or anticipate most of the disaster that affect them particularly weather and climate related disasters.

The major disaster hazards mentioned and prioritized by the respondents are presented in Table 2. Base on the potential risk they posed on farming and pastoral communities source of livelihood. The highest proportion of the respondents (82%) believed that drought was the most devastating disaster in the area. This could be attributed to the impact of drought experienced and documented in the past years such as decrease in water and pasture availability, crop failure, increase food, in security and malnutrition, increase susceptibility in human and livestock diseases, migration and increase in school drop-out due to community migration in search of pasture and water, farmers and herders conflict.

Table 2: Severity Ranking of Types of Disasters Mentioned By Respondents

No.	Major Hazards	Severity Rank	% of the Respondent
1	Droughts	1	82
2.	Desertification	2	66
3.	Floods	3	62
4.	Bush fires	4	52
5.	Farmers/herders Conflicts	5	50

Source: Field work (2019)

Indigenous Techniques of Droughts Forecasting For Disaster Risk Reduction

Communities of Northern Katsina State used different strategies to forecast drought hazards by assessing and

interpretation of locally observe variable such as biological/indicators (plants, animals and in seeds) meteorological, astronomical and historical events as outlined in Table 3.

Table 3: Biological Indicators of Droughts and Floods Prediction/Forecasting

Indicator.	Signs or Symbols	Prediction
Biological indicators	<ul style="list-style-type: none"> Late flowering of <i>Acacia nilotica</i> Dropping of wild fruit before maturity 	Drought is expected Drought is expected
Plant phenology	<ul style="list-style-type: none"> An abundance of <i>Adansonia digitata</i> tree fruits Early appearance of <i>Alysicapus vaginalis</i> in the farms (locally called gadagi) it grow normally at the end of rainy season Early appearance of <i>Corchorus olitorious</i> in the farm (lalo) Abundant <i>Cucumis melo</i> (Gurji) Abundance of <i>Cenchrus ciliaris</i> (Karagiya) Early grow of leaves <i>Faidherbia albida</i> (Gawo) Growth of dense leaves of <i>Ficus polita</i> (Durumi) Abundance of fruit of <i>Lannea acida</i> (faru) 	Drought is expected Drought is expected Drought is expected Drought is expected Drought is expected Drought is expected Drought is expected
Livestock behaviour	<ul style="list-style-type: none"> Decrease in small ruminants mating Cattle standing for long time near river after drinking water Frequent breaking of barn by cattle for grazing. 	Drought is expected Drought is expected Drought is expected
Presence of reptiles in residential areas	presence of snakes or other reptiles around homes in search of water and food	Drought is expected
Increase in rats population	When rat are plenty in the villages	Drought is expected
Colony of ants carrying eggs	Ants transfer their eggs to moist environments. The further away from their present dwelling the longer the drought	Drought is expected
Appearance of certain grasshopper	<ul style="list-style-type: none"> Early appearance of certain grasshoppers in the raining reason is an indication of cessation of rain 	Drought is expected
Migration of birds	<ul style="list-style-type: none"> Early migration of certain birds in rainy season from North to South indicate cessation of rain 	Drought is expected
Increase in food competition by certain birds	<ul style="list-style-type: none"> When birds became greedy not satisfying regardless of how much they feed. 	Drought is expected

Source: Field work (2019)

Communities during FGD have mentioned how they cope and survive from natural disasters, by monitoring the environmental condition around their areas and make meaningful predictions and take appropriate actions to mitigate the disasters and associated hazards. Also the communities have demonstrated that a well-conserved environment helps to prevent or minimize the occurrence of natural disasters and also enable communities to mitigate and cope with natural disasters when they occur. The communities have repertoires of early warning indicators for coming disaster as show in Table 3. The *Adansonia digitata* is one of the important plant used as indigenous early warning indicator for rainfall or drought in all the villages visited.

The tree shed all leaves at the end of the long rainfall season and remains leafless during the long dry season. The communities also use the fruiting pattern of the trees to forecast the likely performance of the season; especially rainfall failure and drought. Also, the communities used the height of the nest of quela bird locally called gado to predict floods. When floods are likely to occur, the nesting of the quela bird is very high up the trees close to the river and when floods are unlikely, the nest are low down. 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.

Table 4: Metrological Indicators of Drought

Indicators	Prediction/Forecast
Meteorological	
Dark Cloud	Excessive rainfall is expected
Excessive Cold	Drought is expected
Excessive wind and dark cloud	Excessive rainfall is expected
Frequent appearance of rainbow	Drought is expected
High temperature & dark cloud	Excessive rainfall is expected.

Source: Field work (2019)

Meteorological indicators such as temperature, humidity, clouds and wind direction before or during the raining season are used by the communities to forecast the timing, intensity and duration of rain. In other words, drought or excessive rainfall forecasting signs are observed through the specific behavior of locally available plants and animals behavior, monitoring weather and climatic elements changes, and by observing the nature and the behavior of celestial bodies (Ifoka, 2016). The indicators are locally-bound and case specific, they stem from the communities close relationship with the surrounding environment. The use of meteorological indicators in predicting drought is common phenomenon as indicates in different studies (e.g. Nwese *et al.* (2018) in Ghana; Masinde *et al.* (2018) in South Africa, Iticha and Husen (2018) in Ethiopia).

Celestial indicators, in comparison with other group of indicators constitute a smaller group. Many communities cited concentric rings around the moon as a sign of heavy rainfall. Communities on other part of World are also using moon position to predict the occurrence of environmental hazard (e.g. in India as reported by Achyara and Poddar (2016). Also solar eclipse is also used by the communities to forecast occurrence of drought by recording moon and sun eclipse and determine the time of occurrence of drought. It is important to note that the communities apart from forecasting the occurrence of drought and flood. There was disagreement among the participants of FGD on the differences between dry spell and drought. The consensus was reached through voting, majority believed that if dry spell exceed 2 weeks it is drought base on the believe that most of the crops that are grown in that area cannot withstand 2 weeks without rainfall, even if it withstand, the harvest will be very poor. Majority of the respondents (71%) belief that drought was caused by spiritual factors others (9%) attribute the occurrence of drought to improper human action such as committing sins, refusal to giving alms, adultery etc. Two percent link it to unsustainable utilization of environmental resources such as deforestation, poor farming practice, overgrazing among others. Only one person linked drought to climate change by giving example of changes in the pattern of rain fall which were not the same compare to the past 30 – 40 years ago. In

other words, in the past the onset of rain is late March now shifted to late May.

Droughts Coping and Adaptation Strategies Used by the Communities

Communities of northern Katsina state use a variety of coping, adaptation and mitigation strategies to minimize the effects of droughts and flood hazards. The strategy of cultivation of different crops is widely used. This strategy helps to reduce total crop failure due to the varying tolerance of crops to environmental stress. Mixed cropping were used by the communities to stabilized yields, preserved soils and make possible to harvest different crops at the same time; growing drought resistant and early maturing indigenous crop varieties; gathering wild fruits and vegetables; destocking, planting of crops that require less water; dispersal and mobility of forage, flood prevention. Table 6 provides a summary of coping and adaptation strategies used by the communities of the study area.

CONCLUSION

Local communities have not always been helpless in the face of disaster hazards, before the advent of scientific knowledge; they have their own approaches using their own indigenous knowledge to forecasting the occurrence of any weather and climate related hazards. It has also shown that people interaction with their environment influence the way they relate with the environment and also enable them to understand and anticipate impact as a result of changes in the environment or changes in its resources. Change in climatic condition increases local communities understanding of environmental dynamics which always lead to development of new adaptation strategies. Bodies responsible for emergency management should incorporate indigenous knowledge in disaster risk reduction policy especially at the local level. The indigenous knowledge could provide the necessary grass root information from the historical and cultural context, which could enhances understanding how things work or operate at the local level, this will help in developing disaster risk reduction initiative applicable to local situation.

Table 5: Astronomical Indicators of Droughts

Indicator	Sign and symbols	Prediction
Astronomical indicator: Moon	<ul style="list-style-type: none"> • Moon with concentric rings is a sign of heavy rainfall • Orion star occurrence • Frequent eclipse of the moon 	Flood is expected
Star	<ul style="list-style-type: none"> • Morning star (<i>Suraiya</i>) observed 240 days without eclipse • Moring star (<i>Suraiya</i>) hide from view for more than 60 days 	Flood is expected Drought is expected Drought is expected Flood is expected.

Source:Fieldwork(2019)

Table 6: Drought Coping/Mitigation Strategies Used and Proposed by Communities of Northern Katsina state.

Hazard	Pre disaster	During disaster	Post disaster
Drought	<ul style="list-style-type: none"> • Information dissemination • Provision of food and fodder bank • Developing water points for communities and livestock • Selection of early maturing and draught tolerant crops species • Destocking • Income diversification • Information dissemination • Provision of soil and water conservation structures 	<ul style="list-style-type: none"> • Use of food and fodder bank • Mobility • Dry season farming and grazing • Emerging aid • Optimum resource utilization • Use of wild food plant • Engaging in labour works 	<ul style="list-style-type: none"> • Provision of drought resistant crops • Evacuation of the affected people • Social support for drought affected household. • Farming and herding diversification

Source: Field work (2019)

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