MITIGATING CLIMATE CHANGE IMPACT WITH INDIGENUOUS TECHNOLOGY IN SOME SAHELIAN COMMUNITIES OF NORTHERN NIGERIA

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ABSTRACT

The study examined the role of indigenous technologies in coping and managing the impact of climate change among vulnerable communities in the Sahel zone of northern Nigeria .Objectives of the study included an examination of how the communities perceive the concept of climate change, their sources of information and the indigenous technology used in mitigation. It was a longitudinal survey conducted across four seasons where 120 subjects were purposively sampled from four communities and administered a ten-item semi-structured questionnaire ;(r=0.84) using Focus Group Discussion and in-depth interviews. Data was analyzed descriptively in percentages. Results revealed that; i) 60% of respondents understood the concept of climate change (CC) as it affect their livelihoods, ii) 20% perceived cc as a mystery of nature while a few viewed the phenomenon as the creation of scientists, iii) Seasonal changes determined indigenous coping strategies; iv) Institutional frameworks for educating communities on climate change were weak.. The study recommends inclusion of traditional institutions and households in the management of risks associated with CC and the establishment of CC information coordinating centres in Local Government Headquarters across the study area.

Key words: Climate Change; Indigenous Technology; Mitigation; Vulnerability

INTRODUCTION

Changes in world climates are evidenced from thawing of ice in the high latitudes, ice-capped mountain tops and the global rise in sea levels. While some areas are becoming drier, others are getting more wet. Adesina, (2009) posited that the climate change phenomenon had already manifested through increases in dust and rain storms, floods and above average daily minimum and maximum temperatures; intra- and inter annual rainfall variability in northern Nigeria. Durations and intensities of rainfall have also increased in 30 years, producing large run offs and floods. Climatic records from Institute for Agricultural research (IAR) station in Ahmadu Bello University Zaria indicated temperature increases of 0.2°C to 0.3^{o}C (1973-1998) in Northern Nigeria. Studies by Odjugo (2012) revealed that 77% of Nigerians know little about climate change (CC) concept, its underlying factors, effects, remediation measures and how to seek information on the issue. Abaje, Ati & Iguisi (2013) reported on the changing climatic scenarios and strategies for drought adaptation in the Sahel region of Northern Nigeria. They suggested the need for effective probabilistic analyses of rainfall, harvesting and preserving fodder and crop residues during normal and abnormal seasons, use of shelterbelts and wind breaks and effective information delivery on climate change phenomena for communities. Other studies (Dumoye & Abdulkarim, 1997; Abdu & Abdulkarim, 2000; Abdulkarim & Balarabe, 2004; Mamman,2009; Sawa & Adebayo, 2012) revealed how communities are adversely affected by long dry spells and receding of surface waters, occasional floods, heat waves, dust

bowls, unreliable rainfall patterns and crop failures. Other studies by Oladipo (2009) on response of National Action Programme (NAP) to combat desertification indicated a low level of institutional framework that supports vulnerable communities.

The literatures examined did not provide the link between the indigenous technologies used by vulnerable communities in the Sahel ecology in coping with the adverse effects of CC The gap prompted this study whose objectives are to: examine the perception climate change among the communities; identify the communities' sources of information on CC; examine the categories of indigenous technology used in coping and adapting to the impacts of CC, and examine the extent to which institutional framework mainstream indigenous technology in mitigating the impact of cc in the communities. It is envisaged that the outcome of this study will provide a catalogue of indigenous technology models used by communities in reducing the impact of CC on their livelihood and comfort and safety for adaption by other communities on one hand, and on the other hand by policy makers to provide the tools for best practices and for researchers to extend the frontiers of the study in focus.

STUDY AREA

The area in focus is confined within latitude 6^0 37′ to $13^0$40′N and longitude $3^0$40′ to 14^0 37′East (the Times atlas). The communities: Goronyo; Yardaji, Maigatari and Ngala are located in Sokoto, Katsina, Jigawa and Borno states respectively; Most parts of the study area lie within the northern limits of rain bearing winds with a high variability of rainfall in time and space. The area also extends within the semi and arid zones known as ultimate Sahel-Savannas of West Africa (Abdu & Abdulkarim, 2000). Predominant vegetation consists of grasses and forbs. Evapo-transpiration rates are high and often exceed precipitation averages. Most water points dry up due to high evaporation rates and infiltration on sandy surfaces. The low relative humidity experienced in the dry season is a product of the dry, dusty and cold harmattan air. Temperatures can drop below 10^0C (Nov- Feb) in some nights and rise to an unbearable level (>33^0C) in the day and clear skies (March- October). During wet season; summers (*Damina*) rains are adequate for the growth of cereals, shrubs and scrubs. When dry season (*Kaka*) sets in, humidity is lower and air gets cold, windy, dry and dusty; overwhelming human comfort. The onset of spring (*Rani*) marks the beginning of acute water and bio-fuel scarcity. This condition persists and intensifies at autumn (*Bazara*) (Mortimore, 1989).

About 21% of terrain in the study area is rugged and is evenly underlined by sedimentary formations and basement complexes. These complexes constitute the crests from where prominent rivers like Rima, Galma, Kano, Hadejia, Kaduna, Benue and the Niger tributaries originated. Soils in some troughs are hydromorphic (*Fadamas* or inland wetlands) and sustain dry season agriculture even at the fringes of rain-fed surfaces.

MATERIALS AND METHODS

The study was a longitudinal survey conducted in 4 randomly sampled communities in the Sahel zone of northern Nigeria. For convenience 120 male and female subjects at Goronyo (13° 37′ N, 5° 37′ E); Yardaji (13° 48′ N, 9° 27′ E); Maigatari (13° 0′1 N, 8° 38′ E) and Ngelewa (12° 33′ N, 13° 47′ E) in Sokoto, Katsina, Jigawa and Borno states respectively were sampled for the study. Eight research assistants trained by the researcher for data collection were used. A ten-item semi-structured questionnaire was developed (r = 0.84) and administered

through Focus Group Discussion (FGD) and In-Depth Interviews (IDI) to the subjects. Administration of the instrument lasted for 2 weeks in each community and within each of the four seasonal weather conditions. Items in the questionnaire included basic house hold information on sources of livelihood, perceptions on climate change and sources of information on it. Others included the respondents' roles in management of the environmental livelihoods; indigenous responses and adaptation to physical shocks of CC. Responses were transcribed, coded, summarized in frequencies and analyzed descriptively in percentages.

RESULTS AND DISCUSSION OF FINDINGS

Community Perception of Climate Change

The categories of what respondents perceived as Climate Change is presented in table 1.

Table 1: Perception of Climate Change in the Communities

Responses	Frequency	Percentage
Climate Change is an act of God on earth	23	19
Climate Change means more rain and flooding	21	18
Climate change means excess dryness and little grass for the cattle	20	16.6
Climate change means less farm productivity	14	11.6
Climate Change means moving of people to 'less' climate area	12	10
Climate Change is the creation of scientists	10	8.3
Climate Change is created in Europe to confuse people	8	6.6
Climate Change is punishment of man on earth for his sins	6	5
Climate is not changing. It is human beings that change	4	3.3
Heard of Climate Change but do not understand it	2	1.6
Total	120	100

Source: Authors

Data in table 1 indicated that, 60% of respondents understood what CC is and its effects on their sources of livelihoods (rainfall variability, flooding and land productive capacity) not as a scientific mechanism. While 12 % perceived that CC is the creation of scientists and of Europeans to confuse people, 5% of respondents perceived that CC is God's punishment for man's excesses on earth and as a decree for purifying the human spirit. Only 3% did not accept that the climate is changing while 2% admitted to have heard discussions on CC but never comprehend what the concept of CC is all about.

Data revealed land and water resources as the pillars of sustainability in all the communities with community leaders acting as the custodians of these resources on trust. Hence, farming constitutes 94% of the people's occupation; (both rain fed and irrigation), animal husbandry (69%), fishing (32%), pottery and weaving 12% and 10% respectively. About 28% operate as herbalists and hunters while 77% that are traders sell farm produce and a mixture of manufactured commodities from urban centres.

Sources of information on CC

The sources of information on climate change is shown in table 2Data in table 2 reveals that Radio, TV, social centres and town halls, places of worship, markets, grazing and watering points and direct observations as the major sources of information on CC for more than 50% of respondents.

Table 2: Sources of Information on Climate Change in the Communities.

Information Source	Frequency of Response	Percentage of Response
Radio(Local & international)	120	100
Television (TV)	22	18
Social Centers & Town Halls	67	56
Places of Worship	89	74
Motor parks	11	9.0
Schools	18	15
Health centers	16	13
Friends &Associates	66	52
Direct Observation	76	63
Markets	88	73
Grazing and Watering points	65	51

Source: Authors

Though motor parks, schools, health centres were also listed, they were not significant (< 20%) information sources in the communities. All sources are mutually exclusive because respondents' made use of multiple sources of information. House hold information revealed that 87% of respondents have lived in the communities for more than 30 years.

Even though all the respondents obtained information on CC from local and international radio stations, they reported preference of foreign radio stations like the BBC, VOA, Voice of Germany, Radio Alkhahira in (Egypt), Beijing (China) to the local FM and FRCN stations. Reasons for such preference were that Hausa programmes like '*Mutum da Duniyar Sa* (Man and his terrestrial Environment); *'Mutum da Muhallin Sa*' (Man and his Environment), 'Don Manoma'(Farmers programme), ' *Duniyar Kimiyya*'(The world of Science) provide educative and interesting discourses on CC awareness and its implications to development and livelihood. The use of TV (18%) was restrictive because of unreliable electric supply. Markets, grazing/watering points, farms and mosques, social centers and places of worship, village heads' house were common places of sharing information on CC ('Canjin Yanayi'). Communities in Yardaji and Maigatari use "town criers"; (*masu yekuwa or masu shela)* to disseminate urgent messages or call for special meeting from community leaders, District Heads, village heads; (*Sarakuna or Masu-anguwa)* or religious leaders at periods of drought, floods and heat waves, dust storms or delayed cropping. Special rain prayers are offered when rainfall is limited or periods of long dry spell and floods beyond a habitat thresholds or threats from migratory/ invasive plant and animal species.

Types of indigenous technology used in coping with Climate Change.

Table 3 shows the categories of indigenous technology used by respondents in coping with the adverse impacts of C C.

The categories of indigenous technologies listed in table 3 were reported by respondents to be in use for more than 100 years. However, communities still use them because according to 92% of them, seasonal changes have gotten extreme, intensive and unpredictable and dangerous. Major technologies identified in use by respondents are examined thus:

Table 3: Types of Indigenous Technology

Mode of Technology	Uses
Special Earth Pots and Earth beds	Storing and cooling water; Earthen beds to keep women and children warm in cold seasons
Earthen Pans	Warming rooms
Thatched Silos	Preserving grains and fodder at periods of long scarcity
Earthen Roofed Rooms (*Soro*)	Control of wind gusts and extreme temperature variations
Thatched Rooms and Fences (*Bukkoki*)	Sheds off excess rain, sunlight, intense heat, surge of cold air and dust. Are easily reconstructed at periods of floods
Tree Fodder Suspension (*Rauga/Harawa*)	Storage of dry fodder
Application of indigenous plants, animals and river basins.	For Adaptive Best Practices
Timing of socio-economic activities	To avoid weather- induced stresses
Tree Corridors	To break wind speed and slow down movement of mobile dunes

Source: Authors

(i) Special earth pots *(randuna,* beds *(gadon kasa) and* pans *(Kasko)*: Earthen pots are baked from lateritic clay for storing and cooling water in hot seasons. They were observed to be molded in different shapes to suite household needs (Figures 1& 2).The common *randuna* are deep with narrow apertures. The wider and shallower pots *'kasko'* are used to keep burning coal or wood fire for warming rooms in cold and windy seasons. These pots were observed to be among the commodities sold in local markets at Maigatari- Bubura- Yar'daji-Yekouwa (Niger Republic) routes. Women use earthen beds *Gadon 'Kasa* with hot coal beneath to keep warm when nursing infants and young children. The high temperatures stored up underneath repels germs, fungus, worms and mosquitoes from breeding in a room

(ii) Earthen and thatched rooms and fences; Construction materials in 61% of households were observed to constitute 75% earth (clay), 15% animal manure and 10% dry turfs and grass. Narrow windows were placed close to roof tops to regulate extreme temperature fluctuations; very low temperatures, dusty and windy harmattan air and the surge of hot air in hot and very dry conditions. Inner walls of rooms are painted white and the exterior are left brown to conform to the micro environment of the locality. Thatched houses (*bukkoki)* were observed to be common among 80% of migrant community. They were constructed with corn stalks, grass and interwoven with leaves from surrounding shrubs to shed off rain drops, repel harmful insects, direct sunlight and intense heat. *Bukkoki* have no windows and but very short doors to regulate surge of dust and cold air. In some households, (55%); clay and thatched roofs were combined in a room with palm-mat (*Asabari)* or stalk-mat *(Zana)* serving as door curtains.

(iii) Fodder Stores *(Rauga/ Harawa):* Tree tops were used as suspended storage sites to keep hay or fodder long enough for animal needs. This method preserves nutrients level of the fodder and prevents being trampled upon by animals and destruction by termites, rodents and wild fires. The technology also ensures the supply of fodder to animals throughout periods of scarcity when prolong aridity makes animal feeds scarce. Communities store grains in silos made of thatched stalks or earthen-clay (Figure 3).

Best Practice Initiatives

Initiatives identified in the communities were among the adaptive measures employed as coping strategies with the adverse effect of CC in the study area. These are achieved in the communities through the following modes of activities:

i. Irrigation along streams and wetlands *(fadamas)*: Irrigation was observed being practiced on flood plains, river banks and adjacent terraces. About 94% of households claimed that irrigation sustains their food and fodder needs in dry season even when aridity gets prolonged. In the advent of floods communities widen the rivulets to drain excess discharge and sediment yield from inundating farmlands. Vegetables were extensively grown in most of wet lands of the study communities

ii. Change in diet: While more of dried and preserve fodder are used for animals, dry edible leaves and nuts are used by humans (*Moringa Oleifera,* baobab and tamarind leaves etc). In most instances, the communities consume lot of cheese from goat, cow and camel milk in addition to mixing the liquid milk with dough made of millet as *fura and nono.* Berries from baobab are mixed with milk to enrich the nutritional status of the menu. Baobab trees were identified among the most common edible species of plant in the study area. Because of its high adaptability extreme drought conditions and its nutritional value they are wide spread in compounds and farms.

iii. Animal-Driven Transportation (Figure 6 & 7): About 87% of community members use camel, bulls, donkeys and horses for long distant journeys characterized by hot, sandy and difficult terrain. This practice dates several centuries according to respondents. These animals are able to withstand dust storms, dryness and hot sandy paths. They are occasionally used for river crossings (Figure 7).

iv. Seasonal and temporal migration *(Ci-Rani* or *Tashi)*: Communities and herds move in search of pasture when rain ceases and low environmental thresholds get prolonged. '*Ci-Rani*' was identified as a practice engaged by young male members of the communities to urban centers in the communities as the seasons change. Community leaders posited that *Ci-Rani* has become more frequent and prolonged. This situation was attributed to CC. In the area. Hunting was also a common preoccupation in the same period. *Tashi* is the movement of herdsmen-household to a richer and safer habitat. Data revealed this practice among 98% herdsmen. In most cases, 10% of both categories of migrants never returned.

v. Large-scale sales of animals: At periods of prolong dry spells with limited farm produce and shrubs, herdsmen and women in the sedentary households sell off animals and engage in other forms of trading

vi. Water, fuelwood and animal feed rationing**:** Some households reported skipping meals to stretch the use of wood fuel. Alternatives fuel used ranged from dry twigs, cornstalks, discarded plastics (*roba*), dried berries (*Kyangyaran*) shells from peas, rice and peanuts

vii. Timing of social activities: Communities reduce their day light activities to avoid heat stroke and dehydration when temperature is high for human survival. For example day time temperatures have risen to 47^0C in the city of Goronyo in April, 2011. Also, 83% of families sleep in the open during *Bazara* and cluster in windowless rooms during *kaka/hunturu.* All the communities, in most cases come to life at night time.

viii. Planting of tree corridors along city entrance (Figure 8)**:** This is a communal effort assisted by the local government authorities and supervised by a head of forestry

(Malamin Gandun Daji). The corridors were observed to be along farmlands and village entrances.

ix. Water and food storage: As high as 98% of households buy plastic cans to store water fetched from boreholes constructed by their local governments and philanthropic organizations. Children and men queue up to fetch water as early as 5.45am (after morning prayers); the water-laden cans were observed to be transported on cows and camels when households are located far from the sources of water. Vegetables and grains are sun-dried and stored for use at *Rani and Bazara* when food is critical and the weather is excessively hot and dry. Watering points were dug and preserved for animals

x. Change in dressing: Respondents change their mode of dressing as the season dictates. Dominant colour shades for men ranged from white to other bright/ light colours, women use multiple colours with preference to red yellow and black. Both genders sew their clothes in free- flowing designs.

xi. Acceptance of humanitarian assistance: Aids informs of food and drugs are collected in periods of extreme poor harvest from government, non government and voluntary organizations.

xii. Divine Intervention: Communities resort to rain prayer during dry spells and rain 'constriction' at periods of prolonged rainfall. Other calamities associated with the weather were bush fires, floods and locust invasion. They refer to this as 'spiritual technology' because their weather 'has become very unreliable'

Missing links in institutional frameworks for adapting indigenous technology to CC

Data revealed that formal institutions have no specific plans in mainstreaming the traditional technologies being used to reduce the severe impact of CC for decades in the study area. About 98% of households, for instance reported that: (1) Empty and wasteful campaigns on CC have been embarked upon instead of putting intervention measures in place; (2) Uncoordinated dam construction and the inundation of *fadama* from a complex range of channel responses without considering the long- and short-term impacts of CC on their localities have generated mistrust for government projects; (3) Indifference to the implication of temporal migrations (*Ci-rani)* and constant change of human habitats (*tashi*); (4) Another missing gap is the use, by government agencies, of climate change as a conduit pipe for siphoning funds and imprudent neglect of the negative consequences of CC on the most vulnerable people; (5) Poverty from abuse of multilateral funds for CC has limited the capacity of households to improve their indigenous technologies at mitigating and adapting to CC.

Figure1: Earthen Pots from Yekouwa to Yar'daji

Figure 2: Earthen Pan (Kasko)at Goronyo

Figure 3: Thatched Silos at Yardaji

Figure 4:An Earthen roofed house of Village Head

Figure 5: Baobab Tree amidst Sea of Sand(Yardaji)

Figure 6: River Crossing at Goronyo

Figure 7: An ox-driven transportation.(Maigatari)

Figure 8: Corridor of Wind Break (Yardaji)

RECOMMENDATIONS AND CONCLUSION

The perception of CC by majority of communities in the study area was a mix of reality and ambivalence. Indigenous technologies were in operation even before they were made aware through radio programmes that their climate is changing. Indigenous technology and best practices was found to be an extension of strategies employed to cope with intense weather fluctuations triggered by global climate change affecting the ecological zone. Local Governments and State Ministries of Environments have not effectively mainstreamed environmental governance in the study area. In view of the study findings, the following are recommended**.**

Developing framework for strengthening the use of indigenous technology among households and communities by the state Ministries of Environment (SME) in the study areas to enhance easy adaptation to climate change impacts should be a policy priority. Also SME should establish Climate Change Centres at Local Government headquarters in the study area to bridge the gap between people's perception and action on CC on one hand, and weak environment frameworks from government on the other. Finally, SME should mainstream CC issues in all aspects of communities' sustainable strategies originating from vulnerabilities associated with global climate change.

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