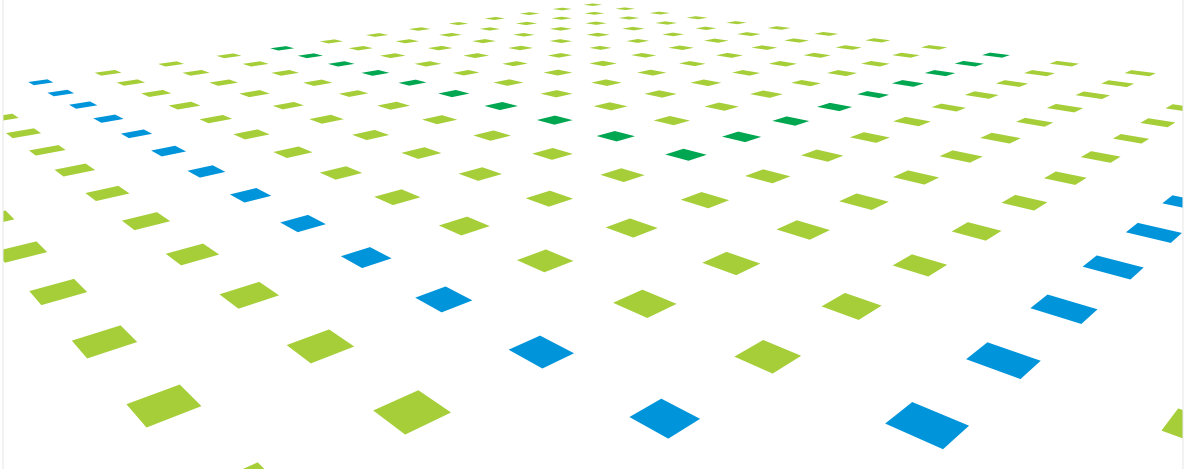


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The of the journal is to advanced understanding of the concept of environment planning in relation to sustainable development and also to serve as a bridge between academic and practitioner community and guide police and management practice to achieve environment sustainability. Environmental planning is the process of facilitating decision making to carry out land development with the consideration given to the natural environment, social, political, economic and governance factors and provides a holistic framework to achieve sustainable outcome. Sustainability is the capacity to endure social-ecological process characterize by the pursuit of a common ideal economic development, social development and environmental protection. Environmental sustainability is the rate of renewable resource harvest, pollution creation, and non-renewable resource depletion that can be continued indefinitely. If they cannot be continued indefinitely than they are not sustainable. The scope of the journal includes, but are not limited to, the following field namely: environmental policy and legislation sustainable development, environmental planning, urban planning, relational planning, town planning, rural planning, conversational management, disaster management natural resource planning and management, environmental and strategic impact assessment, environmental management, environmental economic, valuation and natural resource accounting, regulatory and market-based instrument for environmental management, sustainable agriculture, waste management, global climate change studies and application of remote sensing GIS,

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Vulnerability of Subsistence Farmers to Climate Change in Niger State, North Central Nigeria

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Abstract - Agricultural production in Sub-Saharan Africa has been predicted to be highly vulnerable to climate change and variability. The vulnerability of the subsistence farmers is against the backdrop of several multiple stresses ranging from their location in the marginal tropical areas to the numerous socioeconomic, demographic, and policy tendencies which often limit their capacity to adapt to change. This study examined the perceived climate and environmental changes by subsistence farmers in Niger State and the impact of the changes on their agricultural productivity and livelihood. Focused Group Discussion (FGD) was conducted in 18 selected farming communities, across the three agricultural zones in the state. The result indicates that all surveyed communities are unanimous in the perception that over time, they have persistently witnessed decrease in rainfall amount, stronger winds, late onset and early cessation of rains. 83.3% of the population agree to progressive temperature increase. It also shows that eight perceived impacts namely: decreased crop yield, decreased soil fertility, increased plants and animal diseases, widespread presence of *Striga hamontica*, reduction in vegetation, reduction in pasture lands, reduced domestic water supply, and prevalence in human diseases are peculiar to all 18 communities. 83.3%, 94.4% and 83.3% witnessed faster weed growth, increased presence of insects and nematodes, and emergence of new evasive weed species respectively. It is therefore recommended adoption of viable, sustainable proactive measures such as provision of logistic support, training, sensitization and education, to boost farmers' capacities to adapt or cope with the changing climate.

Keywords: Vulnerability, Impacts, Subsistence, Farmers, Climate Change

1. Introduction

There is a consensus that croplands, pastures and forests are progressively being threatened by increased climatic variability and change [1]; as they exert multiple stresses on the biophysical and social environments that underpin agricultural production [2]. As a consequence of climate change, agricultural production has been projected to be severely compromised in many African countries particularly Sub Saharan Africa where majority of the populace depend directly on dry and sub-humid lands which already endures high temperature and low rainfall for their daily livelihoods [3]. It has been forecasted that poor rural farmers in the region, referred to as “subsistence” or “smallholder” farmers who already suffer other constraints such as land degradation arising from inappropriate use of land; over-cultivation and overgrazing; inappropriate policies; and tenure insecurity are likely to bear the brunt of adverse impacts[4]

Niger State, categorized among the states tagged Nigeria's food basket, the largest producer of rice in the country and a major producer of yam, maize, millet, sorghum and other staple food is almost entirely an agrarian economy with great potentials. However, studies in places lying within the same ecological zone (Sub-Saharan Africa) with the state and having the same climatic conditions have shown that there are considerable impacts of climate change on agricultural practices and the general livelihoods of the subsistence farmers with far-reaching local, regional, national and sectorial policy implications [5]. This implies that the agricultural production capacity and potentials of the state at subsistence farming level will be greatly threatened in the face of a changing climate except stringent adaptation measures are imbibed. This study therefore aimed at assessing the perceptions of subsistence farmers in Niger State on climatic variability and the vulnerability of their agricultural productivity to the observed changes.

2. Study Area

Niger state is situated in the North-central Geo-political zone of Nigeria. It is located approximately between latitudes 8°20'N and 11°30'N, and longitude 3°30'E and 7°20'E (Figure 2.1).

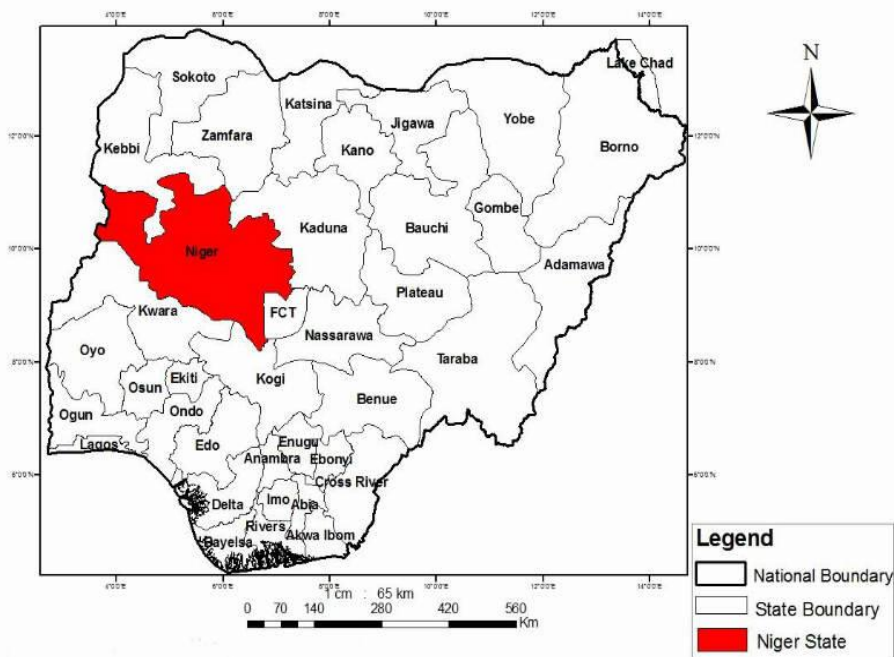


Figure 2.1 Nigeria Showing Niger State

Currently Niger State covers a total land area of about 76,363 sq. km (about 9 percent of Nigeria's total land area and the largest in size) and an estimated 80% of its land area suitable for agriculture. State experiences a distinct dry season (which lasts from October – March) and a wet season (which lasts from April – October). Annual rainfall in the state varies from an average of 1,200 mm in the northern part to about 1,600 mm in the southern part. The rainy season lasts for an average of 150 days in the Northern parts and about 210 days in the southern parts of the State. Mean maximum temperature remains high throughout the year, hovering about 32°C, particularly between March and June, while the minimum temperatures usually occur between December and January when most parts of the State come under the influence of the tropical continental air mass which blows from the North-East (Harmattan). The Guinea Savanna vegetation which is characterized by woodlands and tall grasses interspersed with tall dense species covers the entire landscape of the state.

Agriculturally, Niger State is divided into three agricultural zones; Zones 1, 2 and 3. The zones are identified by the most dominant crops grown, even though most crops are grown all over the state. Agricultural Zone 1 is called rice and tuber zone, because rice is predominantly grown in large quantities across the local

governments in the zone, and tuber zone because of the widespread cultivation of cassava in commercial quantities across the zone. Agricultural Zone 2 is called tuber zone because of the large scale cultivation of yam tubers in the zone. Agricultural Zone 3 is called cereal zone as it largely produces cereal crops especially millet, sorghum, and maize.

3. Methodology

The study primarily employed Focused Group Discussions (FGD) as its data source. The FGD data was used to elucidate information on the actual climatic changes and variations witnessed by all surveyed communities and the perceived impacts of these changes on the environment, agricultural activities and the general livelihoods of the communities. The FGDs were conducted with subsistence farmers in nine randomly selected local government areas of Niger State; three (3) from each agricultural zone, cutting across different climatic zones, tribes and cultures. The local governments are Gbako, Lapai and Mokwa for Zone 1, Gurara, Rafi and Shiroro for Zone 2; and Kontagora Magama and Wushishi for Zone 3. From each of the nine selected LGAs, two farming communities were randomly chosen. The selected communities are Muwo, Wuya Kede, Gbadafu, and Somazhiko, Duma and Takuti for Zone 1. For Zone 2, the selected communities include Shakwatu, Lashi, Gawu Babangida, Bonu, Teginu and Ungwar Batwu. Selected Communities in Zone 3 include Raba, Salka, Maito, Mailehe, Masuga and Kampanin Kiriya. Between 15 and 30 participants (drawn from the aged, middle-aged, youths and women) made up the focus group for each community.

4. Results and Discussion

4.1. Perceived Climatic Changes by Subsistence Farmers in Niger State

Figure 4.1 depicts the opinions of the subsistence farmers in the surveyed communities on their perceived changes in climate over time. All the communities surveyed are unanimously of the view that over the years, they have persistently witnessed decrease in rainfall amount, stronger winds, late rainfall onset, and early rainfall cessation. Fifteen (83.3%) of the communities asserted that there has been a progressive temperature increase over time with only 3 (16.7%) of the communities noticing decrease in temperature over. On intra-seasonal dry spells (drought), 3 communities in Zone 1 representing (16.7%) of the surveyed communities and 2 communities in Zone 2 (11.1%) noted more pronounced intra-seasonal dry spells. For Zone 3, all communities (33.3%) attested that they experienced more pronounced intra seasonal droughts.

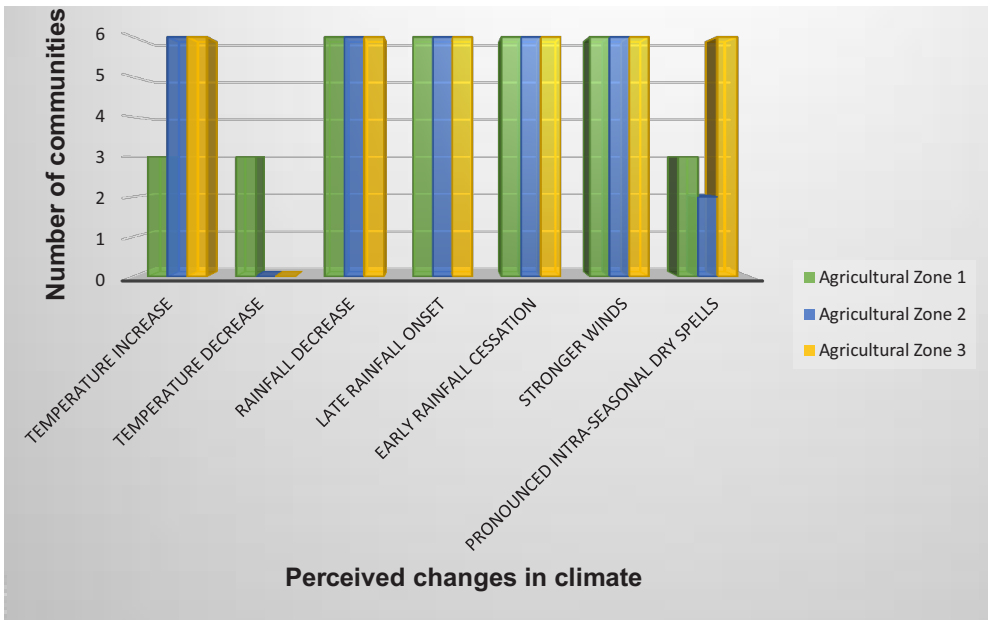


Figure 4.1: Perceived changes in climate

The claim of decreasing rainfall may be supported [6] who observed downward trends in precipitation in the deep tropics from 10°N to 10°S, especially after 1976/1977. The work of [7] did not only reveal downward trends in rainfall in most of the weather stations distributed over Northern Nigeria where Niger State is located, but also demonstrated that rainfall over the region is characterized by irregular variations in both time and space. The observed rising temperature by the communities is in agreement with [7] who found out that beginning from the 1970s there has been a general temperature shift in Northern Nigeria, with temperatures showing an increase everywhere in northern Nigeria.

Variations in rainfall characteristics such as false onset of the rains, late onset of the rains, pronounced breaks during the rainy season, and early cessation of the rains as witnessed by all the communities surveyed are known to impact negatively on agriculture ([8] [9] [5]). Specifically, [9] has noted that most crop failures are associated with late arrival of the growing season or premature cessation of the rainy season, while low yield of crops are associated with prolonged dry spells within the growing season.

The three communities that have witnessed slight temperature decrease (Gbadafu, Wuya Kede and Somazhiko) over the last 20 years or there about are very close to River Kaduna. This seeming relative temperature drop in those communities may be attributed to the climate-modifying effect of the river, since one of the communities (Wuya Kede) noted that the river has particularly witnessed

increased volume of water during the dry season with the construction of Shiroro Hydro-Electric Dam upstream.

The pronounced intra-seasonal drought witnessed by the communities may be explained by the assertion by [6] that higher temperatures increase the water-holding capacity of the atmosphere and increases evaporation, thus favouring increased climate variability, with more intense precipitation and more droughts. The resultant effects of drought are exacerbated by human activities such as deforestation, overgrazing and poor cropping methods [10]. The interaction with the communities reveals widespread activities such as fuel-wood harvesting, shrubs harvesting for yam stakes, lumbering, and clear-cutting for crop cultivation as the major causes of deforestation. These activities may largely be responsible for the stronger winds and higher temperatures being experienced by the communities.

However, all the communities exhibited ignorance on the actual cause(s) of the observed changes; particularly decreasing rainfall amount, rainfall onset and cessation, frequent intra-seasonal drought and strong winds. The communities believe the observed changes were brought by God as punishment on the communities for evils perpetuated by man such as witchcraft, wickedness and disobedience. Others are of the view that evil men sometimes use diabolical powers to influence climatic elements, especially wind (e.g. in Gbadafu and Wuya Kede). The implication of this is the dire need to adequately educate and sensitize farmers and farming communities to keep them well informed and aware of how their actions and inactions can contribute to global trends being witnessed in the world's climate.

4.2. Perceived Climatic Change Impacts Subsistence Farmers in Niger State

The impacts of climate change on the environment, farming activities, well-being and livelihoods of farmers as noted by the communities are highlighted in figure 4.2.

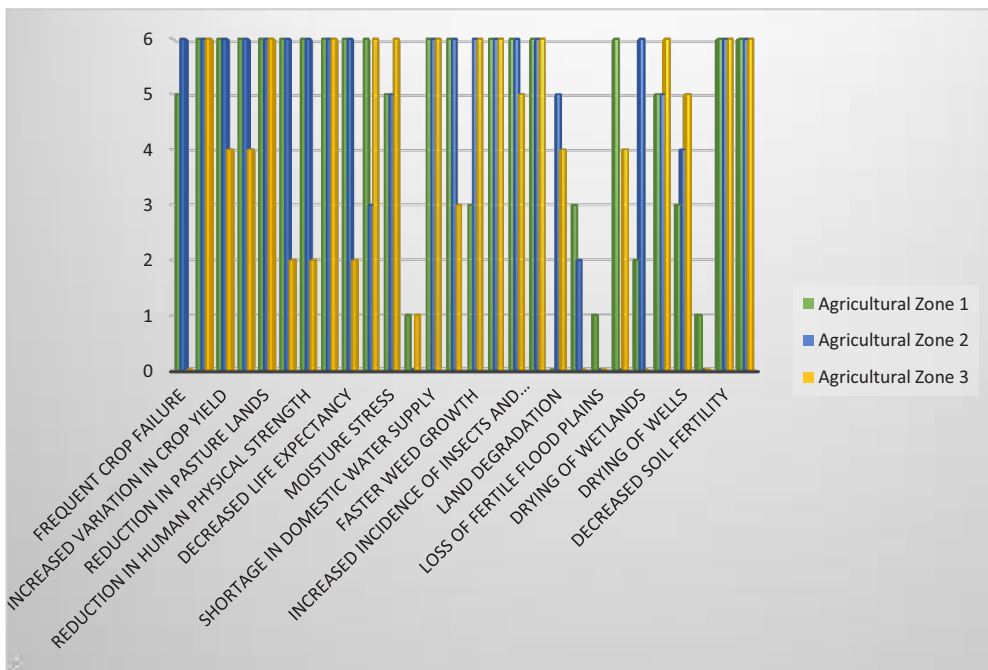


Figure 4.2: Perceived climate related Impacts

All 18 identified eight (8) perceived impacts of the observed changes namely: decreased crop yield, decreased soil fertility, increased plants and animal diseases, widespread *Striga hamontica*, reduction in vegetation, reduction in pasture lands, reduced domestic water supply, and prevalence in human diseases generally. Other impacts were identified by the communities. Fifteen (15) communities (83.3%), 17 communities (94.4%) and 15 communities (83.3%) have witnessed faster weed growth, increased insects and nematodes, and emergence of new evasive weed species respectively. 16 communities (88.9%) observed drying of erstwhile perennial streams and increased moisture stress, while 83.3% of the communities witnessed increased variation in crop yield and decay/withering of cultivated seeds and seedlings.

Furthermore, 16.7% of the communities identified decreased physical strength, increased heat related diseases and reduced life expectancy in humans as impacts of climate change. Human health impacts of climate change like malaria risk affect availability of labour for agriculture and other non-farm rural economic activities [11]. When good health and nutrition which are important preconditions for the capacity to work and generate income are compromised, the vulnerability of the farmers' increases and their capacity to adapt to climate change reduces ([12] [8]). The communities also highlighted drying of wetlands, land degradation, reduced

income from farm and associated activities, frequent destruction of crops and buildings by strong winds among others.

The observed deterioration in soil fertility in all communities, believed to be occasioned by climate change may be explained by the fact that warmer conditions are likely to speed the natural decomposition of organic matter and to increase the rates of other soil processes that affect fertility [13]. In the same vein, the increased incidences of infestation of crops and animals by diseases, insects and nematodes as noted by the communities may also be attributed to temperature changes. This is because higher temperatures increase rate of development, survival and population of insects [14], while altered wind patterns change the spread of both wind-borne pests and of the bacteria and fungi that are the agents of crop diseases[13].

To cope with consequent crop failures and animal losses, farmers in all communities as a matter of necessity have been compelled to step up time and effort in cultivating larger farm sizes where available, and incur increasing expenses in procuring agro-chemicals (insecticides and herbicides) for more frequent application. Dwindling crop yield coupled with increase in production costs directly reduces farmers' livelihood and incomes from farming activities [15] and has direct consequences on rural poverty [16]. By and large all 18 surveyed communities unanimously submitted that their livelihoods or income from both farm and non-farm income activities are often affected by climate variability and change.

On animal rearing, farmers in all communities affirmed that livestock and poultry production is often compromised by reduced availability of pastures due to encroachment on pasture lands, and widespread livestock and poultry epidemics which sometimes defy available veterinary solutions. In addition to these vulnerabilities, animal production in Niger State may face other hostile conditions. For instance a number of studies in Africa and Mongolia already show a strong negative relationship between drought and animal death and have established that thermal stress reduces productivity, conception rates and is potentially life-threatening to livestock[11].

Striga hamontica, widespread in all the communities surveyed is a major threat to crop production, especially to guinea corn and maize that are largely grown across the state. Traditionally found only in soils devoid of nutrients and known for competing favourably with only maize and guinea corn, *Striga hamontica* known as “the witch weed of the Savanna” now grows even on fallow lands. It competes favourably with other crops like millet, yam and legumes and is currently a big threat to cereals crop production. The weed is believed by farmers in some surveyed communities to thrive better with increasing drought conditions.

Dwindling domestic water supply in the communities have far reaching implications. One community (Ungwar Batwu) lamented that the drying up of streams increased the stress and burden of women. They are not only compelled to wake up very early and trek long distances before accessing potable water, but also spend longer hours at the streams. The implications of these changes on water supply in the communities both in terms of quality and quantity as revealed by existing literature are obvious ([8][17]). Additionally, heightened water scarcity may result in subsequent potential increase of water conflicts [18], has the potential to aggravate adverse health outcomes [19] and may impede the development of the state if it becomes drier [20]. Lack of access to safe water has therefore been identified as a key vulnerability in many parts of Africa[21].

The observed vegetation depletion in all surveyed communities and their surrounding environments may have been caused by the changing patterns in precipitation. This is because in arid and semi-arid lands, drought is believed to increase tree mortality and results in degradation and reduced distribution of entire forest ecosystems [22]. The effects of vegetation loss as highlighted by the communities include destruction of crops, trees and buildings by strong winds, scarcity of wood for fuel and scarcity of shrubs for making yam stakes.

Additionally, vegetation loss increases the farmers' vulnerability to climate change because it stimulates changes in micro-climates, induce drought and desertification, and results in pasture depletion, soil erosion, degradation and nutrient depletion [23]. Other likely causes and effects of the observed vegetation depletion have been well documented ([19][23] [22]). Due to the importance attached to yam stakes, farmers in some communities (Lashi, Shakwatu, Gawu Babangida and Bonu) revealed that they often travel far in search of stakes; thereby incurring additional costs on transportation.

Further vulnerability of subsistence farmers in Niger state is against the backdrop that none of the communities have any communal efforts aimed at adapting to environmental changes at the community level, neither are there any logistic support(s) in cash or in kind from the governments, NGOs and donor agencies to help the communities tackle the prevailing problems. Moreover, access to credit facilities by farmers to finance adaptation measures is hampered by other constraints such as bottlenecks involved in accessing the funds, the meagre amount being loaned to them and the untimeliness of the funds if available.

5. Conclusion and Recommendations

The result of this study reveals the implications of climate change and

variability on the livelihoods of the rural farming communities and the attendant increase in their vulnerability. It is therefore highly expedient to adopt viable, sustainable proactive measures to boost their capacities to adapt or cope with the changing climate and in the long run improve food production and reduce their vulnerability to climate change. There is also a need to sensitize, educate and create awareness campaigns in rural farming communities to keep the farmers well informed on climate change issues.

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