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Farmers' Climate Change Understanding and Mitigation Strategies in Kebbi State, Nigeria

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ABSTRACT

The challenges of climate change are increasingly becoming major issues of concern to many regions in the world. Despite reduction in agricultural outputs, rapid diseases outbreak, shortage of rainfall and desert encroachment are serious negative consequences associated with climate change. In local communities in Nigeria, farmers adapt certain fundamental strategies as an approach toward enhancing farm production despite the menace. The research therefore surveyed the understanding of climate change, its causes and consequences among 500 farmers in Kebbi state located in north-western Nigeria. The results of this study found that many farmers are not aware of the tragedy but experienced its negative impacts. However, among farmers with good understanding of the problems, fundamental steps were been applied to ensure land protection and boost agricultural outputs. The study further explained the measures required to elevate situation awareness among respondents as a key to addressing climate change.

Keywords: Global warning; environmental issues; farming; productivity; analysis.

1.0 INTRODUCTION

Climate change is currently viewed as a major tragedy that must be addressed to ensure human productivity and sustenance in the decades to come. It is particularly associated with change in global temperature and the resulting consequences due to anthropogenic pollution. Despite the reduction in agricultural outputs, rapid diseases outbreak, shortage of rainfall and desert encroachment are serious negative consequences associated with climate change (Fasona et al., 2013; Ohunakin et al., 2015; Shiru et al., 2019).

Certainly, the climate is a consequence of global warming associated with greenhouse gases emissions. Literally, a greenhouse gas (sometimes abbreviated GHG) is a gas that absorbs and emits radiant energy within the thermal infrared range. Greenhouse gases cause the greenhouse effect. The primary greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide and ozone. The emission of these gases had been specifically attributed to fossil fuels. Although fossil fuels will continue to play a vital role as sources of fuels and petrochemicals in the next five decades, their non-renewable and environmental inconsistencies triggered the search for better alternatives. There are a number of challenging factors militating against the sustainability of these fuels. They are associated

with serious environmental pollution. Emission of greenhouse gases like CO₂ and CH₄ causes global warming due to associated rise in global temperature, with a net consequence on the rise in sea levels, flooding and other associated hazards (Adler et al., 2015; Burniaux and Chateau, 2014; Hohmeyer and Bohm; Reijnders and Huijbregts, 2007; Sathre, 2014). Other emission gases such as SO₂ promote acid rain formation with difficult consequences including monumental destructions and reduction in crops yield (Nicoletti et al., 2014; Prihatin et al., 2015; Qiao et al., 2015; Sudalma et al., 2015; Williams, 2002). Destruction to ozone layer following fuels combustion permits the release of harmful ultra-violet radiations into the earth surface. These rays have been identified as causative agents for skin and pigmental cancers (Gao et al., 2014; Kawase et al., 2015; Tang and Epstein Jr, 2011). Clearly, the dangers of fossil fuels exploration, production and utilization are of great concerns. This factor has undoubtedly necessitated the governmental and other nongovernmental agencies (NGOs) to raise alarms and shift campaign towards addressing climate change. Focusing about the climate change issues in Nigeria, researchers can state that the main reason for climate change is anthropogenic. Dangerous human activities served as the catalyst to the emergence of the current situation. Regarding natural reasons, it is evident that it is the

fundamental source of our problems. Certainly, it is man who should be considered responsible for triggering the problem and without proper concerns for its dangerous consequences. Forests are destroyed, the Sahara makes slow steps towards advancement, inadequate irrigation of lands, unqualified husbandry, etc. (Ayanlade et al., 2017; Danladi et al., 2017; Ifeanyi-Obi et al., 2017; Matthew and Ohunakin, 2017). All these parameters are gradually changing the climate and making the life of every citizen very hard and unbearable. Therefore, research efforts for the purpose of situation awareness and problems handling is an important aspect for consideration today.

1.1 Research Objectives

The north-western region of Nigeria is globally known for its agricultural potentials historically. In fact, in this area agriculture is highly dependent on rainy season because post-rainy season cultivation of crops became difficult by virtue of low irrigation standard. The experienced variation in the level and sustainability of rainfall coupled with uncertainty in its pattern has seriously affected the agricultural productivity in recent times. In Kebbi state in particular, there is almost complete absence of primary forests. Uncontrolled logging, agricultural activities, acid rain, urbanization and mining activities contribute to loss of vegetation. These harming factors have undoubtedly contributed to climate change, the impacts of which are already being felt in the states with food insecurity, increasing risk of disease and the rising costs of extreme weather damage. Addressing climate change according to Food and Agricultural Organization (FAO) and the Inter-governmental Panel on Climate Change (IPCC) of USA is a collective responsibility of all citizens. In line with this perspective, the paper presents results on the exploration of farmers' climate change understanding and mitigation strategies considered in Kebbi State, Nigeria. Data collection by

administering pre-evaluated questionnaires and post-collection analysis were adopted for the study.

2.0 MATERIALS AND METHODS

2.1 The Study Location

Kebbi state is one of the seven states in the north-western region of Nigeria. It shares boundary with other states such as Sokoto, Zamfara and Niger. Some areas of the state also share a boundary with Niger republic. The map of Kebbi state is presented herein as Figure 1. In addition to the long history of fishing activities, the geographical location of Kebbi state makes it an appropriate state for the production of foods such as rice, millet, maize, guinea corn, groundnut and sugarcane (Abubakar et al., 2009; Alimi and Ayanwale, 2005; Ango et al., 2011). Farmers in Kebbi state are also known for the production of vegetables such as onions, pepper, tomatoes and spinach. Recent analysis have shown that more than 90% of the local inhabitants are farmers (Abubakar and Olukosi, 2008; Akinrotimi et al., 2011; Bello and Jeb, 2014).

The fishing and food crops cultivation activities in the area are associated with equatorial position other geographical features (Garba et al., 2012; Gwimi et al., 2015; Utomo, 2013). Specifically, Kebbi state is located around 10° and 13°N of equator and on the longitudes of 3°30' and 6°E. The total land mass of this state has been estimated at around 37,700 km² out of which 36.5% is shifted towards agricultural activities. It is very important and relevant to this study to note that the phenomenon of climate change is well-experienced in the state because many areas are situated in desert prone environment (Galadima and Lawal; Haden et al., 2012; Mustapha et al., 2013; Semenza et al., 2012). This has attributed to poor agricultural yields and outbreak of heat-borne diseases in some instances. From geological perspective, the state has thick and large sequence of sedimentary deposits that underlined > 50% of the areas.

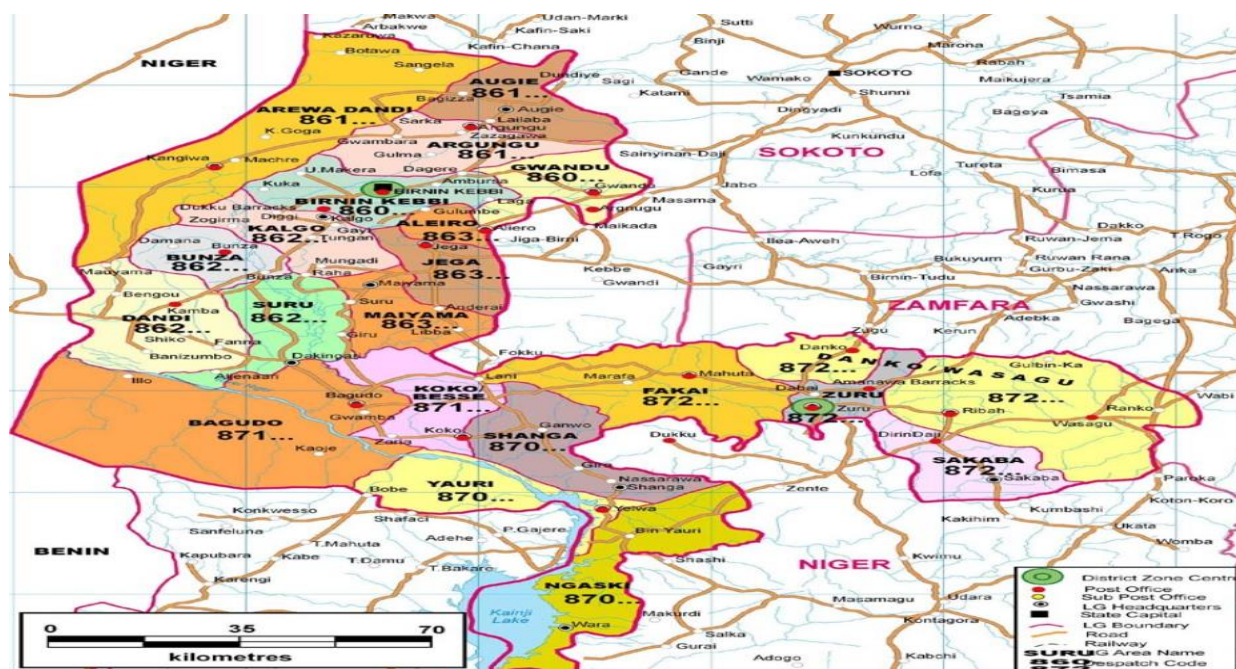


Figure 1. An illustration of the map of Kebbi state showing the study areas. Available from: <https://nigeriazipcodes.com/wp-content/uploads/2012/07/Kebbi-State-Postcode-Map.jpg>.

2.2 Farmer's Interaction Methodology and Results Analysis

Five hundred (i.e.500) farmers across five (5) local government areas of the study state (i.e. Kebbi state) were targeted and interacted with for the purpose of this investigation by administering pre-designed and eco-evaluated questionnaires. The selection of interviewees was done using a multistage random sampling technique. Rapid Rural Appraisal involving transect-walks, identification and inspection of farmlands was used to encourage the respondents to describe their relationships with their natural resources, particularly the indigenous adaptive measures.

The interview schedule was divided into five (5) sections (A-E). Sections B-E, however, had more relevance to the main aim of the research. Section B determined rural households' climate change awareness. Respondents were asked to indicate the extent to which variables such as high/low rainfall, floods, food insecurity and hunger, extinction of animal and planting species, desertification etc. represented their level of climate change awareness. Section E looked at the effective indigenous, emerging technologies and innovations adopted by the farmers to mitigate the negative effects of climate change in their neighbourhoods. The methodology was generally in line with our earlier adopted strategy (Galadima and Lawal).

3.0 RESULTS AND DISCUSSION

Table 1: Level of understanding of the climate change impacts and challenges among the targeted farmers.

	Birnin Kebbi	Bunza	Aleiro	Bagudo	Jega
Excellent:	05	-	10	10	-
Very Good:	15	10	-	12	04
Good:	05	13	09	15	15
Fair:	17	12	17	23	15
Poor:	48	65	64	40	66
Total (%)	100	100	100	100	100

3.1 Situation Awareness and Impacts Knowledge

The results presented in Table 1 has clearly indicated that the level of climate change awareness among the local farmers in Kebbi state is generally

very low. By implication, the farmers with poor knowledge of climate change and its devastating effects range between 40 and 66% which very high. In Birnin Kebbi area which represents the capital city and the most-educationally expected region, 48% of the inhabitants claimed poor understanding of climate change and its impacts. Clearly, the results followed a closer pattern in the other areas explored. It can be seen from Table 1 that farmers in Bagudo and Aleiro had better understanding of the problem with an equivalent of 10% each. The geographical location of these areas and dedication to agricultural activities could be the main driving factor. Certainly, poor knowledge of climate change awareness is a clear indication that there is either a lack of coherent policy plan or its proper implementation by the appropriate authorities responsible (do Nascimento Nadruz et al., 2018; Thorpe and Figge, 2018). Earlier investigations in other parts of the world have shown that well-planned and implemented climate awareness and mitigation policies had successfully helped in addressing many of its associated challenges (Gonda, 2019; Hewawasam and Matsui, 2019; O'Donnell, 2019).

3.2 The Information Sources and Coverage

Source of climate change information is a very important parameter for predicting the strategies to be adopted by relevant agencies for the purpose of policy design and implementation (Di Falco and Sharma-Khushal, 2019; Martínez-Cruz et al., 2017; Vano et al., 2018). As shown in Table 2 below, agricultural extension, radio, politicians, friends and allied sources were considered in this study based on the responses received from the farmers targeted. Among these farmers, especially in Bunza and Jega (having up to 85 and 80% respectively),

listening to radio and watching television programmes provided the targeted respondents with the most valuable information about climate change. Birnin Kebbi, Aleiro and Bagudo local governments with only 52 to 60% of their farmers obtaining most of their information about climate change from radio/television stations is still interesting. It could be clearly established from the analysis that the people in this area have good listening habits to both local and international media. This practice is key to policy design and situation awareness campaign by relevant authorities.

The menace of climate change is undoubtedly associated with human activities. Therefore, having clear information on its dangers from reliable sources is necessary for future mitigation purposes. As a global and international problem, global solutions are inevitably desirable. Many countries around the world have designed certain policies and regulations that relate to the environmental monitoring and protection (Reusser et al., 2011; Rickard et al., 2014). A part from the international campaign through media platforms and internet, there are some local commitments in selected regions of the northern Nigeria. Based on the results presented in Table 2, conversations between among local farmers are very likely whereas politician commitment could not be established. Accordingly, there are necessary steps that are still required to ensure full situation awareness and mitigation options. These include but are not limited to community management, clearly defined regulatory frameworks, market based incentives and sustainable dissemination and follow-up strategies (Becken, 2007; Lim et al., 2005; Matisoff, 2008)

Table 2: Showed the sources of information (in percentage) about climate change and its effects.

Information Source	Birnin Kebbi	Bunza	Aleiro	Bagudo	Jega
Extension workers:	15	02	20	08	10
Friends:	-	-	-	-	-
Cooperatives:	20	08	10	25	10
Radio/TV:	60	85	58	52	80
Internet:	05	05	12	15	00
Politicians:	-	-	-	-	-
Total (%)	100	100	100	100	100

3.3 The Strategies for Adaptation in Practice

Climate change adaptation can be considered as the effective or cumulative response to the experienced global warming challenges through the adjustment

of regular practices already in place. The adaptation strategies are usually dependent on the region, situation awareness and the farming practices under consideration (Lobell et al., 2008; Moser and

Ekstrom, 2010). There is an indication that the adaptive capacity of a region can be closely linked to its socio-economic as well as scientific development. When good strategies are employed, the possibility to help farmers and organizations as well as natural systems to handle devastating consequences of climate change could be certain (Field et al., 2012; Lim et al., 2005; Thomas and Twyman, 2005). Therefore, adaptive measures must include practical options considered to the manage risks of climate change, community protection and elevating food production. For exploring the strategies adopted by farmers in Kebbi state, we targeted factors such as cover crops

planting, mixed farming practice, employment of well-acclimatized seeds and other strategies that are commonly used (Table 3). The results demonstrated that utilization of crops that are well-acclimatized is the main practice in the region (i.e. up to 53% in Jega local government as the highest). On the other hand, planting cover crops and those that require short harvesting periods are increasingly getting attention for all the local governments (i.e. up to 20% for now). Other strategies are only partly explored and therefore government campaign and interventions are still necessary.

Table 3: Fundamental strategies utilized as adaptive measures by the farmers in study areas.

Adaptation Strategy	Birnin Kebbi	Bunza	Aleiro	Bagudo	Jega
Planting Cover Crops	20	10	22	10	20
Planting Pest Resistance Crops	15	05	16	05	12
Mixed Farming Practice	05	25	15	13	06
Use of crop Varieties that are well acclimatized:	55	31	30	42	53
Use of Crops that are harvested in short period:	05	29	17	20	09
Total (%)	100	100	100	100	100

3.4 Strategic Factors for Mitigation

Climate change mitigation measures are the practices and implementation actions utilized to reduce or eliminate the release of harmful climate change causing chemicals such as greenhouse gases or other local attitudes considerable by the farmers (Jones and Leibowicz, 2019; Lucena et al., 2018; Mi et al., 2019; Yu et al., 2019; Zheng et al., 2019). In order to mitigate climate change effects, the targeted farmers/respondents in the local governments employed basically three practices; reforestation/afforestation, use of contour bounds around farmlands and draining of wetlands for crops production. Therefore, any measure that has the potential to greatly slow the process of climate change can be considered as positively mitigating parameter. Although the issue is difficult among

local farmers due to its poor knowledge, focus is still underway. In Kebbi state, farmers emphasized on the process of reforestation/afforestation (i.e. 52-70% across the local governments; see Table 4). The closeness of the area to Sahara desert acquainted most farmers with the knowledge of tree planting as a climate change mitigation practice. There are other practices still under consideration. Contour provisions around the farmlands is currently an average practice but will likely escalate in the near future (currently, 40% as the highest in Bunza local government). The draining of wetlands for crops production is also currently considered but is the least practice especially in Aleiro local government (only 2%). Therefore, further government efforts that will assist the local farmers are necessary.

Table 4: Strategies considered suitable for mitigation by the targeted farmers in Kebbi state.

Mitigation Strategy	Birnin Kebbi	Bunza	Aleiro	Bagudo	Jega
Reforestation/Afforestation:	60	52	65	70	59
Making Contour bounds around farmlands:	15	40	31	24	23

Draining of wetlands for crops production:	25	08	02	06	18
Total (%)	100	100	100	100	100

4.0 CONCLUSION

Kebbi state of northern Nigeria is one of those states in the area with good consideration for farming activities. However, climate change menace experienced by global regions is also affecting the area. Results from this research established that the targeted farmers are indeed aware of climate change and are familiar with its effects. The factor therefore instigated them to employ several mitigation and adaptation strategies to ensure agricultural land conservation and the escalation of farm outputs. Most of the adaptation strategies employ the use of acclimatized seedlings; cover cropping, mixed farming and using crops with short harvesting period. For mitigation, the respondents utilize reforestation/afforestation and use of contour bounds. Generally, while there is significant awareness, the perception of the targeted farmers on the associated dangers of climate change is still poor. Accordingly, the government efforts in this direction are only partly implemented or completely neglected. It is the view of these researchers that tremendous commitment involving extension services, door-to-door campaign and subsidize acclimatized seedlings provision are intensified for an efficient solution to be attained.

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