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ASSESSING THE IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES, AGRICULTURAL ACTIVITIES AND FOOD SECURITY IN ZARIA LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA

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Abstract

Agricultural activities depend greatly on climate. Therefore, any change in climate can enhance or limit the capacity of agriculture to play its major role as supplier of food and industrial raw materials. The study, therefore, assessed the impacts of climate change on water resources, agricultural activities and food security in Zaria LGA, Kaduna State. The study used both primary and secondary data. Structured questionnaire was used to collect primary data from 384 respondents who were purposively sampled. Rainfall and temperature data were collected from Institute for Agricultural Research, Zaria. Data were analyzed using descriptive statistics such as mean, percentages and presented in Tables. Results showed that mean annual evapo-transpiration (2230mm) exceeds mean annual rainfall (1053mm) indicating likelihood of surface and groundwater deficiency in the area. Result also showed that climate change has posed significant impacts on crop production and food security especially as it led to the reduction in food availability and access as perceived by 80% of the respondents. The study, therefore, recommended the need for effective water harvesting and introduction of high yielding, early maturing, and climate change resistant varieties of crops in the study area.

Keywords: Agricultural activities, Assess, climate change, Food security, Water Resources

1. Introduction

Generally, climate, water resources, biophysical and socio-economic systems (including agriculture and food systems) are mutually interconnected in such a way that slight change in one, leads to changes in the others (Abdullahi and Adeogun, 2014). Climate change has seriously disrupted the entire ecological system of the earth. It has already impacted areas such as ecology, health, agriculture, water resources and so on. These impacts are felt by both the developed and developing countries. Unfortunately, the developing countries suffer more due to their poor economic, social and political capacity to adequately cope. Climate change is defined as the long-term variations in weather patterns which poses severe repercussions for man and the environment (Parganiha, Toorray, & Qureshi, 2022) Climate change has been predicted to worsen the incidence of drought and desertification. This may lead to severe water stress for agriculture and serious impacts on food security particularly in the rural areas where farmers mostly depend on rain-fed agriculture for survival (Ayinde, Muchie and Olatunji, 2011).

Climate change has posed a significant impact on water resources potentials of many areas particularly in Northern Nigeria. It is gradually altering the hydro-climatic

characteristics of different ecological regions. This has led to severe negative consequences on the availability of water resources in both rural and urban areas. Studies (Hassan, 2013; Vaughan & Lenton, 2011; Odjugo, 2010) have shown that an increase in solar radiation and temperature leads to potential increase in the amount of evapo-transpiration thereby causing the decrease in the amount of surface and underground water resources. This is particularly more pronounced during the dry season in Northern Nigeria when the whole environment looks dry and dusty (Abdullahi and Adeogun, 2014).

Today, many parts of Northern Nigeria (Zaria inclusive), are experiencing multiple climate change impacts on water resources. These areas face severe climate change and induce extreme weather events such as devastating flood, drought, drying up of rivers, poor water quality and ground water availability, distortion of precipitation patterns, among others. The compounding effects of climate change on water resources in these areas therefore have devastating impacts on ecosystems, communities (including economic and social) and severe effects on agricultural activities from planting to harvesting, and food security which have seriously threatened the peaceful co-existence of the region (Adishi, and Oluka, 2018).

In simple terms, food security means access to basic nutritious food. It refers to the availability of food and ability of one to access it. It means 'all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their food preferences and dietary needs for active and healthy life' (Kelechi & Vincent, 2022). A household becomes food-secure when the occupants do not live in hunger (Mazenda & Mushayanyama, 2021). Unfortunately, climate change affect food production as well as food availability of Northern Nigeria which is mostly climate dependent. Climate change has the potential of impacting on food safety especially on the incidence and prevalence of food borne diseases (Ikpe**,** Sawa, Ariko, Abdulhamid & Akpu (2022). It is also evidenced that climate change leads to potential changes in the nutritional quality of some foods like cereals and cassava. The concentration of proteins, vitamins and minerals in these crops is significantly reduced due to elevated carbon dioxide in the atmosphere (Imasu & Tanabe, 2018). Climate change also poses a significant impact on the quality of drinking water which is a key element in the absorption of nutrients. It is also evidenced that, increased climate variability as well as increased frequency and intensity of extreme events will continue to affect crop production, stability of food supply, availability, access and utilization (Ayo, Amoshi and Suleiman, 2014).

Food production in Northern Nigeria is carried-out in both rainy and dry seasons. Crops such as maize, millet, sorghum, rice, groundnuts, tomatoes, onions, carrots, cucumber among others, are cultivated in the region. Most of agricultural production in this area is rain-fed (Ikpe**,** Sawa, Ariko, Abdulhamid & Akpu, 2022). Unfortunately, climate change-induced extreme events such as distortions in precipitation, devastating floods, prolonged dry spells, drying up of rivers and depletion of ground water sources which has severely affected water availability for food production in the area (Ayinde, Muchie and Olatunji, 2011). However, despite these prevailing challenges, there are paucity of research work on the impact of climate change on water resources, agricultural activities and food security. This reserach therefore, assesses the impacts of climate change on water resources, agricultural activities and food security in Zaria Local Government Area (LGA) of Kaduna State. To achieve this, the following questions are raised:

i. What is the nature of water balance indices in Zaria LGA
ii. What are the impacts of climate change on water resources in the study area?
iii. What are the impacts of climate change on agricultural activities and food security in the study area?

2. Materials and Methods

Zaria Local Government Area (LGA) is located between Latitudes 11º 0’ and 11º 6’ North and between Longitudes 7º 38’ and 7º 48’ East of the Greenwich meridian. The LGA has a Tropical Savanna Climate represented by Aw based on Köppen climate classification, with warm weather year-round, a wet season lasting from April to September, and a drier season from October to March. The climate in the area is divided into two: dry and rainy seasons. The dry season is usually from November to March and the temperatures recorded are within an average of 28°C towards the end of the dry season. The area is blessed with adequate rainfall and an abundance of fertile land for agriculture. Zaria has a mean rainfall of 1082m with a rainfall intensity between 25mm/hours and 125mm/hr. (Maiwada *et al.,* 2017). The predominant occupation of the area is agriculture. The LGA has a total population of 406, 990 (NPC, 2009).

Figure1: Zaria Local Government Area

The study used both primary and secondary sources of data. The primary data was collected using structured questionnaire, while secondary data (climate data) was collected from the Institute for Agricultural Research (IAR), Zaria. Krejcie and Morgan's (1970) method of determining sample size, was used to select 384 respondents which formed the sample size for the study. In this case, respondents who were directly engaged in crop production among the seven (7) agriculturally active wards and who must have reached at least 30 years of age were purposively sampled. The data collected were analysed using descriptive statistics in form of mean, percentages and tables. Out of the 384 questionnaire that were administered on the respondents in the study area, 382 questionnaires were returned and valid for analysis.

3. Results and Discussions

3.1 The Socio-economic characteristics of the respondents

The frequency of gender ratio between male and female population among respondents in the study area is 200: 182 as presented in Table 1. This implies that the majority of the respondents are male. That majority of the respondents were male might be because, male have a dominant role to play in the family as household heads in providing the households basic needs such as food. It has been generally observed that in some parts of Africa, including Nigeria, womenfolk are often deprived of property rights owing to social barriers. As a result, they tend to have lesser capabilities and resources than men (Gbegeh and Akubuilo, 2013). This result agrees with the findings of Umar, Isah, Bello and Abubakar (2015) which reported that males dominate the agricultural workforce in Sokoto State with 99.1 per cent. According to Umar *et. al* (2015), the high proportion of males to females in Sokoto State may be because religion and custom play crucial roles in the livelihoods of the people of the state. Males who are mostly the household heads have more access to land and participate more in outdoor activities than females.

Table 1: Gender Status of Respondents at Zaria

Gender	Frequency	Percentages (%)
Male	200	53
Female	182	47
TOTAL	**382**	**100**

Source: Field work 2022

Table 2 present the ages of the respondents. A larger percentage of respondents (42%) fall within the ages of 30 — 40 years; 23% between 41 – 50 years; 18% between 51 – 60 years and 18% are above 61 years of age. It is interesting to observe that every age group ranging from the young totalling were all represented which is imperative in this study.

Table 2: Age Structure of Respondents at Zaria

Ages (In Years)	Frequency	Percentage (%)
30 – 40	162	42
41 – 50	86	22
51 – 60	67	18
61 and above	67	18
TOTAL	**382**	**100**

Source: Field work 2022

Respondents who were above 30 years of age were purposively selected for the study which agrees with the study of Deressa, Hassan, Alemu, Yesuf and Ringler (2008), who argued that the age of the respondents represent experience on climate change and household related issues. The older the respondent, the more experienced he was in knowledge of climate change and the more exposed to past and present climatic conditions over a longer horizon of his lifespan. These results imply that the sampled grain farmers in the study area were above the dependent age.

The marital status of respondents in Zaria is presented in Table 3

Table 3: Marital Status of Respondents

Gender	Frequency	Percentage
Married	194	51
Single	172	45
Divorced	16	4
TOTAL	**382**	**100**

Source: Field work 2022

As shown in Table 3, 51% of the respondents are married; 45% are single, while only 4% of the respondents are divorced as at the time of conducting this research work. That 51% of the respondents are married implies that more household heads are in the best position to discuss the effects and impacts of climate change not just on themselves but on their families and livelihood.

Figure 2 represented the educational qualification of respondents in the area. A total of 267 of the respondents have higher degrees from the tertiary institutions, distantly followed by those with secondary school certificate (10 respondents). This indicates that most of the respondents received various forms of education in the study area. This might have probably helped them in their agricultural and other household activities. According to Enete, Madu, Mojekwu, Onyekuru, Onwubuya and Eze (2011), education has a positive and highly significant relationship between the farmers' level of education with the level of

investment in indigenous and emerging climate change adaptation practices. This is to be expected as educated farmers may better understand and process information provided by different sources regarding new farm technologies, thereby increasing their allocation and technical efficiency.

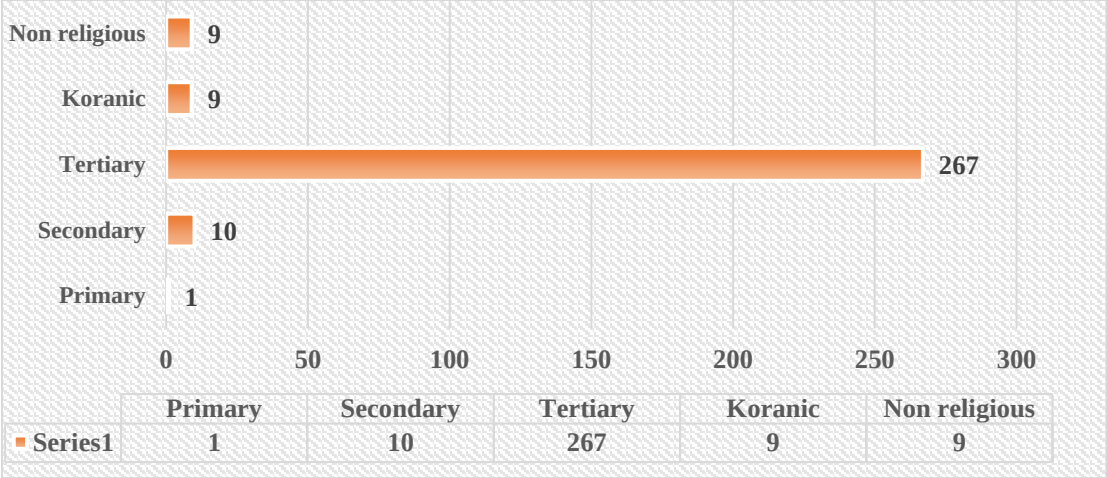

Figure 2: Educational Qualification of Respondents at Study Area
Source: Field work 2022

Figure 3 shows the number of years the respondents have been living in the study area. More respondents (209 respondents) have lived within the period of 20 — 30 years, while 114 respondents have lived in the area below 10 years. It is quite appreciating to note that out of the 382 sampled respondents, a total of 228 respondents have lived above 20 years in the study area, thus, they have background knowledge of the area. That majority (209) of the respondents had lived in the study area for the period of between 20 and 30 years agrees with the study of Nhemachena and Hassan (2008) in Tanzania which reported that the longer a farmer lives and farms in an environment, the more experienced and knowledgeable he will be about the environment of the study area.

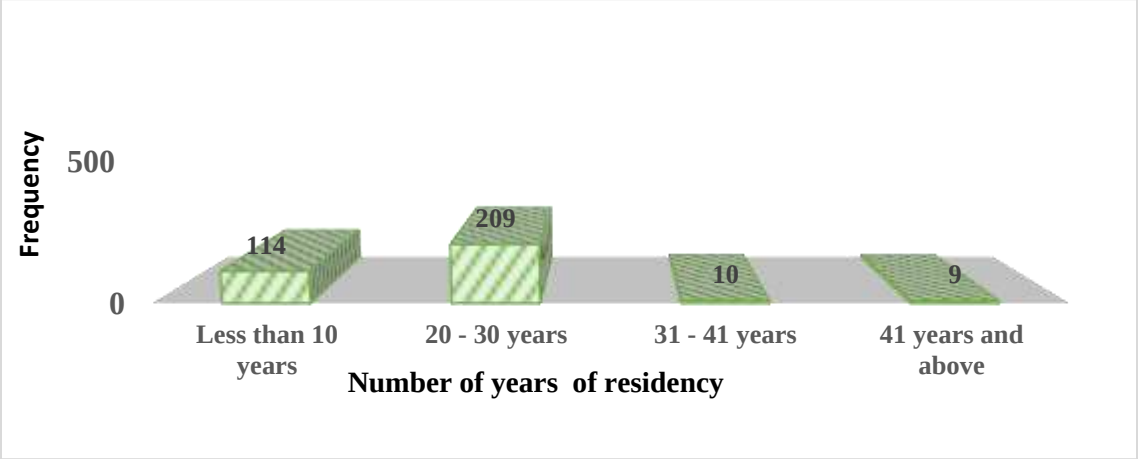

Figure 3: Number of years of living in the Study area
Source: Field work 2022

The water balance indices of the study area are presented in Table 1.

Table 4: Water Balance Indices

Decadal mean	Rain (mm)	Evapotranspiration (mm)	Differences (mm)
1992 – 2001	1009.3	1999.68	990.38
2002 – 2011	1086.02	2199.96	1113.94
2012 – 2021	1063.95	2493.22	1429.27
Mean annual Total	**1053**	**2230.95**	**1177.95**

Source: IAR, Zaria

Table 4 show that the mean annual rainfall for the study period (1992 - 2021) was 1053 mm while the mean annual evapotranspiration data for the same period was 2230.95 mm. This indicates that the rate of evapotranspiration exceeds precipitation (rainfall). This is an indication of deficit in both surface and groundwater which might be exacerbated by the impact of climate change

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Table 5: Perception of the Impacts of Climate Change on Water Resources

Impacts of Climate change on Water	SD (%)	D (%)	U (%)	A (%)	SA (%)
Decrease in quantity/quality of water	17	12	5	32	34
Shrinking/drying up of surface water	14	8	2	24	52
Water related diseases	18	15	7	31	29
Increased frequency of drought/dry spell	31	22	3	20	24
Burden on women/children in search of water	12	11	5	34	38
Farmer/herder conflicts over scarce water	11	13	10	24	42
Wilting of crops due to water stress	11	14	5	34	36

Source: Field Survey, 2022

Table 5 show that 32% and 34% (66%) of the respondents had agreed and strongly agreed respectively that there was decrease in the quantity and quality of water resources in the

study area; 24% and 52% (76%) agreed and strongly agreed respectively perceived the shrinking and drying up of surface water in the study area. This is particularly more pronounced during the prolonged dry season when everywhere looks dry and dusty. This scenario has serious impact on irrigation farming and other agricultural activities in the study area. Table 2 further shows that majority (60%) of the respondents opined that there was increasing water related diseases in the study area. This connotes that the area suffers from climate change exacerbated diseases such as cholera, diarrhea, dysentery and typhoid fever. More so, Table 2 further shows that majority of the respondents (72%) agreed that climate change induced water stress which has increased the burden on women and children who always roam around in search of water for domestic use. Table 2 also shows that majority (66%) of the respondents perceived increasing farmer/herder conflicts due to scarcity of water supply; while 70% indicated that climate change induced water stress has been causing partial drying of crops during the growing season. All these may have significant impacts on food security of the study area.

Table 6: Impacts of Climate Change on Crop Production and Food Security

Impacts of Climate change on Food	SD (%)	D (%)	U (%)	A (%)	SA (%)
Reduced food availability and access	16	14	4	32	48
Reduced nutritious quality of food	14	18	7	24	37
Food stability is severely hampered	13	21	6	38	22
Reduced fresh water availability	18	22	7	38	15
Prevalence of food-borne diseases	16	19	4	24	37
Frequent food spoilage after storage	21	22	4	18	35

Source: Field Survey, 2022

Table 6 indicates that 32% and 48% (80%) of the respondents agreed and strongly agreed respectively that climate change has significantly affected crop production, availability and access to food in the study area. This is exacerbated by climate change induced conflicts in wards such as Wucicciri, Dutsen Abba and Kufena. The people in these areas are forced to migrate to another area which leads to decrease in food availability and access or undernourishment. That climate change has significantly affected crop production in Zaria agree with the report of Ikpe**,** Sawa, Ariko, Abdulhamid & Akpu (2022) which reported that climate change has led to a decline in the yield of grain crops in Sokoto State thereby affecting the availability of food. Table 3 also shows that 61% of the respondents perceived that climate change has led to the reduction in the nutritious quality of food. Typical example of this, is the continuous rise in carbon dioxide level in the atmosphere which reduces plants nutrients and vitamins needed for human survival (Ikpe, 2021). Table 3 further shows that majority (60%) of the respondents agreed and strongly agreed that food stability is seriously hampered by the effects of climate change in the study area, which implies that food availability for human consumption is seriously affected by the impact of climate change.

More so, fresh water availability for domestic consumption has significantly reduced as shown in Table 3 (53%). This owes to the rapid drying up of surface water and depletion of groundwater particularly in the

dry season. Table 3 further shows that majority (61%) of the respondents, perceived high prevalence of foodborne diseases in the study area. This is obvious as the rising temperature and increased precipitation promotes many foodborne diseases like typhoid and cholera which are paramount in the area. Table 6 further shows that 53% of the respondents reported frequent food spoilage after storage. Increasing temperature and rainfall may promote pathogens proliferation and foodborne diseases outbreaks. Non-refrigerated foods are more susceptible to spoilage due to the impacts of climate change.

4. Conclusion

Based on the findings of the study, it is concluded that, mean annual evapo-transpiration exceeds mean annual rainfall, indicating likelihoods of surface and groundwater deficiencies in the study area. The study also concludes that climate change impacts had led to decrease in quantity and quality of water resources, increasing water related illnesses as well as climate change induced water stress. Climate change has also impacted on food security in that it led to reduction in food availability and access, reduction on nutritious quality of food and prevalence of foodborne diseases.

5. Recommendations

Based on the aforementioned, the study recommends the need for effective water harvesting particularly, during the rainy season to be used at the time of water deficiencies as well as the need for the introduction of high yielding, early maturing and climate change resistant varieties of crops to carter for food deficiencies in the area.

References

Abdullahi S. A. and Adeogun B. K. (2014). Managing climate change and water resources in Nigeria. *International Journal of Applied Science*, 3(1), 9 - 19

Adishi, E. and Oluka, N. L. (2018). Climate change, insecurity and conflict: issues and probable roadmap for achieving sustainable development goals in Nigeria. *International Journal of Social Sciences and Management Research*, 4(8), 12 - 20.

Ayinde, O. E., Muchie, M. and Olatunji, G. B. (2011). Effect of climate change on agricultural productivity in Nigeria: a co-integration model approach. *Journal of Human Ecology*, 35(3), 189-194.

Ayo, J. A., Omosebi, M. O. and Sulieman, A. (2014). Effect of climate change on food security in Nigeria. *Journal of Environmental Science*, 3(4), 1763 - 1778.

Enete, A. A., Madu, I. I., Mojekwu, J. C., Onyekuru, A. N., Onwubuya, E. A. and Eze, F. (2011). *Indigenous Agricultural Adaptation to Climate Change: Study of Southeast Nigeria*. Published by African Technology Policy Studies Network, Nairobi, Kenya.

Gbegeh, B. and Akubuilo, C. (2013). Socioeconomic Determinants of Adoption of yam Minisett by Farmers in Rivers State, Nigeria. *Wudpecker Journal of Agricultural Research*, 2(1):033 - 038,

Hassan, I. M. (2013). Impact of Climate Change on Water Resources in the Nile Basin and Adaptation Measures in Egypt, A review article presented at the Department of Civil Engineering, University of Assuit, Cairo, Egypt.

Ikpe, E., B. A. Sawa, J. D. Ariko, A. I. Abdulhamid and B. Akpu (2022). Relationship between Rainfall and Temperature Variability and the Yields of Selected Grain Crops in Sokoto State, Nigeria, Osun (University) Geographical Review, volume 4, 63-70.

Ikpe, E. (2021). Effect of Climate Change on the Yield of Selected Grain Crops and Farmers; Adaptation Strategies in Sokoto State, Nigeria. PhD Thesis submitted to the Department of Geography and Environmental Management, Ahmadu Bello University, Zaria.

Kelechi, J. A. & Emmanuel, M. (2022). The Impact of Climate Change on Food Security and Human Security in Nigeria, International Journal of Climate Change Strategies and Management, 14(2): 148-167.

Krejcie, R. V and Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Journal of Educational and Psychological Measurement*, 3 (30), 607 - 610.

Maiwada, A. L, Laah, J. G., Garba, S. and Ahmed, M. A. (2017). Livelihood and coping strategies of female headed households in Zaria local government area of Kaduna State, Nigeria. *Zaria Geographer*, 24(1), 62 – 77

Mazenda, A., & Mushayanyama, T. (2021). Analyzing Household Dietary Diversity Amongst Urban Food Insecure Households. Journal of Hunger & Environmental Nutrition, 17(5), 630–641. https://doi.org/10.1080/19320248.2021

Nhemachena, C. and Hassan, R. (2008). Determinants of African Farmers' Strategies for Adapting to Climate Change. Multinomial Choice Analysis. *African Journal of Agriculture and Resource Economics*, 2(1):83-140.

NPC (2009). *2006 Population Census of the Federal Republic of Nigeria: Analytical Result Report at the National Level.* National Population Commission, Abuja.

Odjugo, P. A. O. (2010). General Overview of Climate Change Impacts in Nigeria, *Journal of Human Ecology*, 29(1), 47-55.

Parganiha, O. P., Toorray, N. K., & Qureshi, A. (2022). Farmers Perception about Impact of Long-Term Climate Change on Agriculture in Plain Zone of Chhattisgarh, India. International Journal of Environment and Climate Change, 3736–3744. https://doi.org/10.9734/ijecc/2022/v12i111424

Umar, I., Isah, A. D., Bello A. G. and Abubakar, B. Z. (2015). Farmers' Perception on Climate Change in Sokoto State, Nigeria, *African Journal of Agricultural Research*, 10(11), 1288-1294.

Vaughan, N. E., and Lenton, T. M. (2011). 'A Review Climate Geoengineering

Proposals' Climate Change, 109, pp
745-790.