

Implications of Climate Change for Rural Resource Elements in Katsina States

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ABSTRACT

This study is about climate change and the implication it portends for rural resource elements in Katsina State. The research adopted a cross-sectional research design. Data for the study were generated from the administration of a questionnaire on respondents in the study area. The data obtained for the study were presented in tables and statistical diagrams. The findings include; the causes of climate change were noted to be emission of obnoxious gases such as CO₂, CO, CH₄, O₃ and CFCs (17.35%) into the atmosphere, deforestation, land clearing/burning of bush for agricultural and constructional works (19.6%) heating of homes, burning of fossil fuels as well as the smelting of iron (15.8%), gas flaring and other industrial activities (15.6%) and volcanic eruption and other natural phenomenon (14.8%). The rural resources at risk due to climate change include vegetation cover (18.6%), Grasslands (20.7%), livestock and bush meat (17.9%), arable land (18.4%), water resources (15.6%) and fisheries resources (8.9%). The use of modern varieties of farm inputs (58.5%) and soil erosion prevention measures (45.8%) are some of the adaptation measures to climate change. The implication of the threat of climate change to the locals is that their major sources of income and livelihood is threatened, effects of which could escalate migration, crime, theft, hunger, malnutrition or death. As a result of the findings, the study thus recommends diversification of the sources of income, afforestation and reforestation and intensify campaign for the complete reduction in the emissions levels of obnoxious gases.

Keywords: Rural-resources; Climate-change; Deforestation

INTRODUCTION

Climate change is any significant long-term change in the statistical properties (principally it is mean and spread) of meteorological variables of a region (or the whole Earth) over a significant period, regardless of cause. All the theories of climate change attempt to account for variations in the amount of solar energy received by the earth and the spatial and temporal distribution of the energy over time [1-5]. It has been noted also that sector-wise, the combustion of fossil fuels is the main source of carbon dioxide emission, followed by deforestation and land clearance for agriculture [2]. In the last decades, researches have shown that man can influence climate change through the following: a) alteration in the albedo of the earth surface as a result of deforestation, land clearing, for cultivation or construction and animal grazing; b) Increase in CO₂ content of the atmosphere as a result of bush burning and burning of fossil fuels through transportation such as coal, gas, oil etc.; c) Interface and interference with ozone layer by pollution deriving from human activities.

Currently, fossil fuel burning worldwide alone account for the release of about 6 million tons of carbon per year while deforestation and land clearance account for another 1 billion tones [6-13]. With respect to the contribution of individual countries to the emission of greenhouse gases, United State Environmental Protection Agency study estimated that in 1989 the United States of America which contains only 5% of the world's population contributed the highest amount of 21%, followed by the Soviet Union to the European Economic Community [14-16]. The culpable culprits in the depletion of the Ozone layer are CFCs, CH₄, N₂O, CO₂, a major cause of global warming the reduction in the global ozone layer has been noticed over the past two decades [17,18]. The contribution of chlorofluorocarbons (CFCs) to the depletion of the ozone layer and the subsequent causing of climate change is tremendous. On the other hand deforestation and the clearing of vegetated surfaces for road construction, building of houses, farming and timber logging have aided the phenomenon of climate change. Deforestation is a factor of climate change as it denies the earth's surface carbon exchange with the atmosphere,

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forest ecosystem loss; accelerates soil erosion, and reducing sink for pollutants [19].

Nevertheless, there are indicators of climate change. The indicators are provided that one could use to assess the evidence of climate change in a region [20]. These include increasing temperature, increasing evapotranspiration, decreasing rainfall amount in the continental interiors, increasing rainfall in the coastal areas, increasing disruption in climate patterns and increasing frequency and intensity of unusual or extreme weather-related events such as; thunderstorms, lightning, floods, droughts, unpredictable rainfall patterns, sea-level rise, increase desertification and land degradation, drying up of rivers and lakes and constant loss of forest cover and biodiversity.

Generally, it is anticipated that climate variability and change in Nigeria will have an overwhelming impact on agriculture and land use, ecosystem and biodiversity, human settlements, diseases, livelihood, hydrology and water resources. It is also pointed out that, with respect to agriculture and land use, climate change will likely elicit a significant change in agricultural production both in terms of the quantum of products as well as the location or area of production [21,22]. Identification of a shift from the production of long duration guinea corn to millet, which requires a shorter duration of rainfall [19]. He further revealed in Borno, Yobe, Sokoto and Zamfara state the percentage production of Guinea corn and Millet was 70% and 30% respectively in 1980, as in the year 2000, it has changed to 40% and 60% respectively. This clearly shows that rainfall duration and amount is fluctuating in northern Nigeria.

Climate change has also been found to either dry up rivers or reduce their depth. This was also revealed that for the past 52 years (1950-2001) drastic ecological changes have occurred in the semi-arid region of Nigeria [14,23]. While temperature has been on the increase, rainfall has been declining. This climatic change and the pressure on the land from farming, overgrazing, deforestation, and indiscriminate bush burning have led to desert encroachment and its associated ecological degradation, such as loss of vegetal cover, crop failure, and water scarcity. For instance, Lake Chad, which had a mean depth of 3 m in the early 1960s, is less than 2 m as at 2000. The surface area of the lake which was 23,500 km² in 1963 has shrunk to between 2,300 km² and 2,500 km².

Nigerian urban centres have been feeling the impacts of climate change with incessant annual flooding that affect large areas and a large number of people. For example, in 2010, flood in Northern Nigeria affected 2 million people in Jigawa State and another 40,000 people were displaced in Sokoto State where Usmanu Dan Fodio University was forced to close down for weeks as a result of bridge collapse associated with the flood. Similar floods were reported in Lagos where 689 people were to be relocated in Ajegunle as a result of the flood [1,20,24].

Available evidence also shows that climate change in Nigeria has impacted on crop production and livelihood. It has been pointed out that, there is an increase in rainfall amount in the coastal areas since the 1970s, and a constant decline in rainfall amount and duration in the continental interior of the semi-arid region of Nigeria [14]. The increasing temperature and decreasing rainfall in the semi-arid region of Northern Nigeria- Sokoto, Katsina, Kano, Nguru and Maiduguri may have resulted in the increasing evapotranspiration, drought and desertification in the region.

Furthermore, between 1901 and 2005 temperature increase of 1.1°C was observed in Nigeria for the 105 years while the rainfall amount dropped by 81 mm. whereas the rainfall amount is generally decreasing in Nigeria, the coastal region of the country has been experiencing slightly increasing rainfall since the early 1970s. The short-dry-season popularly known as August break is currently being experienced more in the month of July as against August. Sea-level rise is observed to have inundated 3400 km² of Nigeria coastal region while desert encroachment is reducing arable lands from the northern part of the country by 1-10 km a year [21,22]. A shift in crops cultivated by farmers from long to short duration is also noticed. Looking at these established facts, it is therefore feared that the impact of climate change is impacting natural resources and by extension the income of the people. This study thus investigated the climate change problems and the implication for rural resource elements in Katsina State.

MATERIAL AND METHODS

Katsina state is located approximately between latitude 12°15'00" and 12°25'00" N and longitude 7°30'00" and 7°500'00" E of the Greenwich meridian (Figure 1) (National Geo-Spatial Intelligence Agency, 2015).

The area enjoys a hot semi-arid climate according to the Koppen climate classification system. The temperature of Katsina is usually high all year round with the highest values from the months of January to May being within 43°C to 56°C and the lowest values from the months of June to September about 12°C and again rises from the months of November and December being 63°C to 125°C (Climate Datasheet for Katsina state, 2012).

The vegetation of Katsina state is the Sudan Semi-Arid enriched with varieties of Grasslands, Shrubs, trees and the spare drought-resistant trees [21]. Many of the trees are also resistant to fire as they are involved in Nitrogen fixation and also provide shades and nesting sites for animals. The predominant animals of the Sudan Savanna vegetation belt of Katsina are the Grazers, Kangaroos, Antelope, Rodents, birds, insects and reptiles. There is usually about 50-150 cm of rain per year which is not distributed evenly throughout the year [20].

The people of Katsina state are mainly agricultural and fishing society. They cultivate rice, yam, millet, Guinea corn, onions, tomatoes, sorghum, maize [25]. Due to the availability of vast landmass, the people practiced large scale cultivation of crops and commercial agriculture [6]. The people also engage in artisan fishing as there is the presence of several rivers and water bodies in the state. Also, trading, craft making such as the building of cane chairs, hats boat making, etc. to earn a living. These activities are tremendously important as they provide huge economic potential to the people of the area. A huge amount of revenue is generated and the people in the rural areas depend on the revenues from them. The people also engaged in wanting wildlife, lumbering and local craft production. The people also engaged in a local cottage industry in which they produced goods that are sold to the outside world. They produced groundnut, groundnut oil and sugar. These activities the Katsina people engage in are activities that can easily be affected by climate change.

This research adopted a cross-sectional research design. The data for this study were generated from the administration of a questionnaire on respondents in the study area. As for the

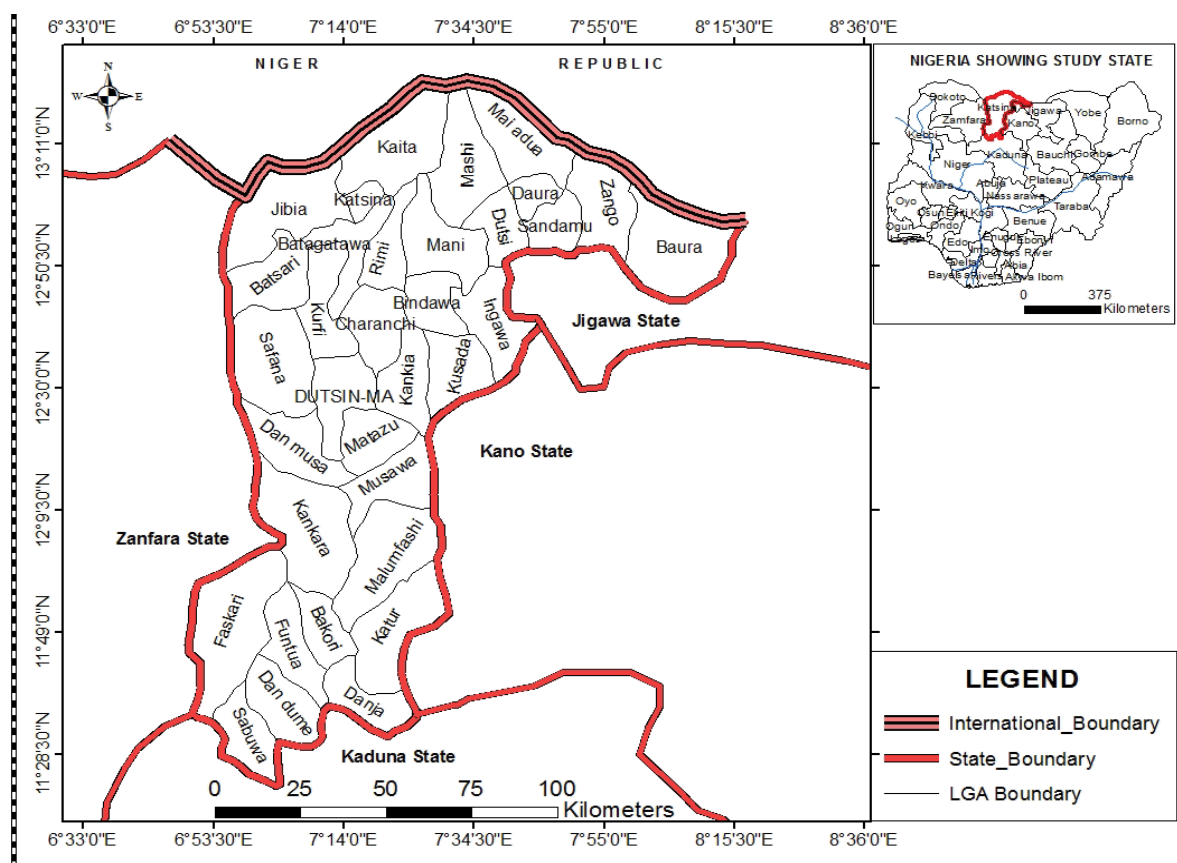


Figure 1: Katsina state showing LGAs.

population, the study area comprised of all the thirty-four (34) Local Government Areas of Katsina State with a total population of 5,801,584 persons as at the Nigerian population census of 2006 (NPC, 2006); when this population is projected using a growth rate of 3% the population of the state becomes 8,030,749 million persons as of 2017. Thus, to ascertain the sample size for this study, the total number of households in the 34 Local Government areas was determined to be 1146159 and to further determine the total number of the household to a sizeable sample in the LGAs, the Taro Yamane formula was used (Equation 1). Thus 400 households are the sample size for this study.

The Taro Yamane formula is given as $n = \frac{N}{1 + N(e)^2}$ (Sule, 2005).....
Eq. 1

Where n=The same size sought

N=The finite population

e=Level of significance (5%)

I=Unity

$$\text{Thus, } n = \frac{N}{1 + N(e)^2}$$

$$= \frac{1146159}{1 + 1146159(0.5)^2}$$

$$= \frac{1,146,159}{286,549.75} = 3.9998 \times 100 = 399.98 = 400$$

The sampling procedure adopted in this study is the multi-stage

sampling technique. This method became relevant because, it helped the researcher to break the whole study area into sample units with which the study was conducted, using the vegetation belts. Secondly, the stratification was necessitated, due to the fact that the researcher wanted to show the spatial variations in the phenomena of inquiry since there is a slight difference in the vegetal cover as one moves from the south to north of the state, there should also be a corresponding difference in the rates of effects of climate change on resources. The first stage of the multistage sampling was therefore achieved when the area (Katsina State) was calibrated into three districts. The second stage was achieved when the purposive sampling technique, was used to select four communities from each of the inherent local government areas of the zones. The purposive sampling technique was used because the researcher had a fair knowledge of the rural settlements most hit by the climate change phenomenon. The third stage of the multistage sampling technique was achieved when one in every 5th household was selected as points of inquiry in the selected communities using the systematic sampling technique, thereafter the copies of questionnaires were administered to the selected heads of households in the sample communities. The research instrument was subjected to face and content validation by experts in the field of climate change. This was necessitated by the need for the items on the instrument to measure what they are supposed to measure and do so consistently. Furthermore, the instrument's reliability was achieved using the Pearson's correlation coefficient to compute the scores of selected respondents (20 household heads) who completed the instrument twice (with a two weeks interval) reliability significance was $r=0.89$, at $p<0.005$. The data obtained for the study were presented in tables and statistical diagrams.

RESULTS

The data as presented in (Figure 2), shows that different factors are predisposing conditions for climate change. As shown, 17.35% of the sample respondents noted that climate change is caused by the emission of obnoxious gases such as CO₂, CO, CH₄, N₂O and CFCs into the atmosphere. Again, 19.6% of the respondents noted that deforestation, land clearing/burning of bush for agricultural and constructional works is another cause of climate change. Also, heating of homes, burning of fossil fuels, as well as the smelting of iron, is another cause of climate change. Incomplete combustion of a fossil through transportation activities is also a cause of climate change as 15.8% of the respondents have noted. 15.6% also noted that gas flaring and other industrial activities is another cause of climate change while others such as natural factors such as volcanic eruption and other natural phenomenon have induced climate change (14.8%).

(Figure 3) revealed the respondent's perception of climate change. In the figure, 54.6% of the total sample population of the study noted that they are aware and have heard of the climate change phenomenon. 8.2% said they not at all heard of climate change. While 18.1% said they have somehow heard of it, 19.1% said, somewhat, they have heard of the phenomenon of climate change.

The analysis of data is shown in (Figure 4) is about the rural resources at risk due to climate change. From the analysis, the results show that various rural resources are affected and they include vegetation cover (trees and shrubs) as 18.6% of the total sample respondents affirmed thus, Grasslands (open grassland for grazing) 20.7%, livestock's and bush meat (17.9%), Arable land for farming 18.4%, while water resources such as stream and rivers accounted for 15.6% and fisheries resources from communal rivers and streams accounted for the remaining 8.9% of the sample respondents.

Given the above, the study went further to examine the rural resources that are mostly affected by the impact of climate change in the study area. Thus, the respondents identified and ranked the rural resources according to their level of vulnerability and susceptibility to climate change.

However, the study investigates whether do the rural resources in the area provide any income to the rural people or not. The result is presented in (Figure 5).

From (Figure 5) 8.2% of the respondents strongly disagreed that

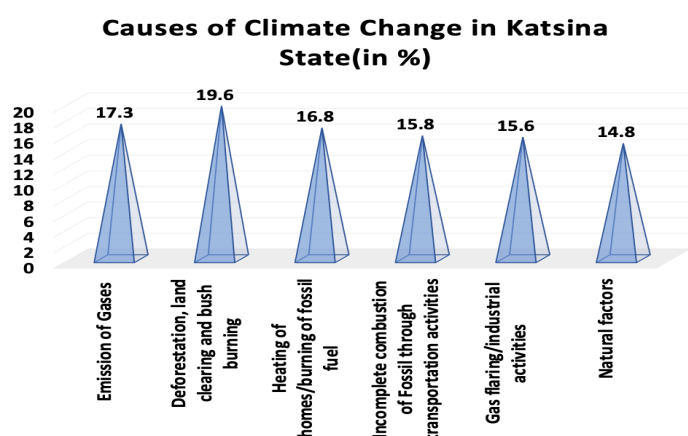


Figure 2: Causes of climate change in Katsina state.

rural resources provide any income to the rural people. This is an infinitesimal fraction of the sample population of the respondents. However, 25.0% disagreed that rural resources provide income to the rural people, 28.1% agreed they were very sure that rural resources are the source of income generation to the rural people of Katsina state and 38.7% strongly agreed that they were certain that rural resources were the main source of income generation and source of livelihood to the local people in the study area.

Having seen from the analysis above, the study went further to rank the resources in their order of importance in terms of income generation. The result of the analysis is shown in (Figure 6).

From (Figure 6) the rural resources in terms of importance in their contribution to income generation was analysed. The data analysis revealed that arable land for farming activities generated the highest income to the rural people in the area (20.9%). The second rural

Awareness of Climate Change among people of Katsina state (%)

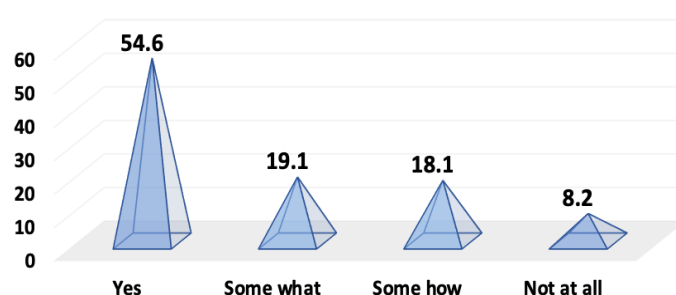


Figure 3: Awareness of climate change.

Rural Resource at Risk Due to The Impact Climate Change in Katsina State (%)

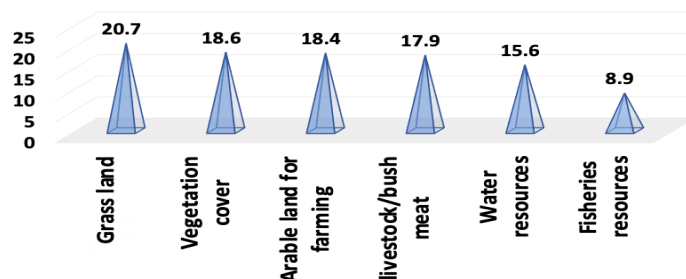


Figure 4: Resources mostly affected by climate change.

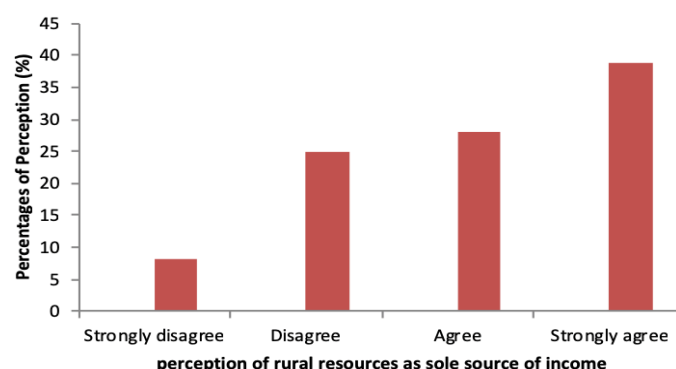


Figure 5: Distribution of responses on rural resource as source of income.

resources in terms of income generation are Grassland for open grazing cattle and livestock as livestock provide the second higher income to the people (20.2%). Again, the third-highest income generation rural resource is natural vegetation that provides timber, fuelwood, electric poles, etc. (18/4%). Again, other rural resources in terms of importance in income generation are Bush meat (15.3%), water resources (12.8) and fisheries resources (12.5%).

From the data presented in the (Table 1), it is revealed that the use of modern varieties of farm inputs and soil erosion prevention measures are some of the adaptation measures to climate change as 58.5% and 45.8% of the respondents agreed to it respectively while the remaining 41.6% and 56.2% of the respondent respectively either disagreed or strongly disagreed to that. Also, on the issues of crop diversification and income diversification to non-farm income, 52.6% and 57.2% of the respondents agreed to the statements while those that disagreed accounted for the remaining 47.4% and 42.9% of the respondents respectively.

On other measures such as harvesting rainwater and the use of irrigation water as adaptation measures to climate change, the data analysed revealed that 37.2% and 41.4% of the respondents agreed to the statements while the remaining 64.7% and 58.7% disagreed. This goes to show that these measures have not yielded positive

results to the measures for adaptation to climate change. Again, change of field location in farming and mix crop and livestock production as measures of adaptation to climate change shows 60.8% and 46.7% respectively agreeing to it while 39.8% and 53.3% disagreeing over these measures. The data further show that 49.2% and 48.7% respectively of the sample respondents agreeing to migration and seek off-farm employment and setting up food storage facilities as measures to adapting to climate change while 50.8% and 51.3% to the respondents disagreeing of these measures.

Further, 51.5% and 49.5% of the respondents equally agreed that planting of drought-resistant and tolerant crops and the planting of flood-resistant/tolerant crops or varieties are adaptation strategies to climate change impact while the remaining 48.5% and 52.85 of the respondents have disagreed to these measures. Also, on the issue of planting of disease-resistant tolerant crops or varieties and a decrease in the use of chemical fertilizer as adaptation strategies to climate change, 57.2% and 65.3% of the respondent agreed to the measures while the remaining 42.8% and 43.6% of the respondents do not. Lastly, while 52% of the respondents agreed that an increase in the use of organic manure has served as a measure of adaptation to the impact of climate change, the remaining 48% do not.

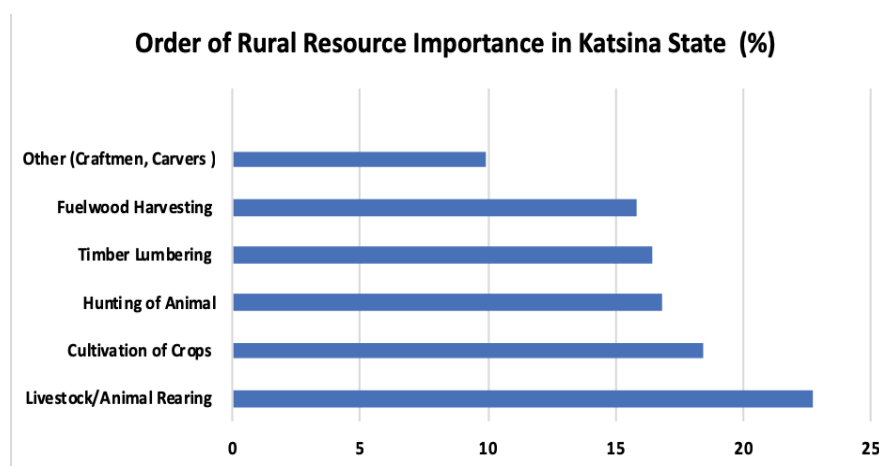


Figure 6: Order of rural resource importance.

Table 1: Distribution of extent to which the respondent disagreed to the adaptation measure to the climate change.

S/N	Adaptation measures to climate change	Strongly Agreed		Agreed		Disagreed		Strongly Disagreed	
		F	%	F	%	F	%	F	%
1	Using modern varieties of farm imputes	108	27.6	121	30.9	82	20.9	84	20.7
2	Soil erosion prevention measure	84	21.4	88	24.4	130	33.2	90	23
3	Crop diversification	98	25.0	108	27.6	82	20.9	104	26.5
4	Income diversification to non-farm income	92	23.5	132	33.7	94	24	74	18.9
5	Harvesting rain water	64	16.3	82	20.9	88	24.4	158	40.3
6	Use of irrigation	78	20	84	21.4	98	25	132	33.7
7	Change field location in farming	131	33.4	105	26.8	94	24	62	15.8
8	Mix crop and livestock production	86	22	97	24.7	110	25	99	25.3
9	Migration and seek off farm employer	89	22.7	104	26.5	99	25.3	100	25.5
10	Set up food storage facilities	94	24	97	24.7	99	25.3	102	26
11	Planting of drought resistant/tolerant crops	100	25.5	102	26	99	25.3	91	23.2
12	Planting of flood resistant tolerant crops or variation	96	24.5	98	25	88	24.4	110	28.1
13	Planting of disease resistant tolerant crops or variation	96	24.5	128	32.7	97	24.7	71	18.1
14	Decrease use of chemical fertilizers	115	29.3	106	27	84	21.4	87	22.2
15	Increase in use of organic manure	95	24.7	109	27.8	92	23.5	96	24.5

Implication for rural dwellers

Generally, the findings show that there is a situation of climate change in the area. This shows that it is no longer news from the findings of this study that the climate is changing abnormally as it is felt in many parts of the world including Nigeria in general and Katsina State in particular. This finding collaborates the work of those researchers who noted that the evidence of the nature of global warming resulting to climate change was noticed in regional change antiquity through the 19th century with the spatio-climatic change in temperature and the evidence of temperature increases across the earth surface, the evidence of the first calculation of human-induced climate change in 1896 by Swante Arrhenus, the paleo-climatic changes of the industrial periods and the 20th and 21st centuries [15]. Again, the finding of this study, also collaborate the work of the researchers who noted that the global average temperature that has been risen by 0.06°C above the pre-industrial average was, even more, hotter in 1958 and even continued to rise to 2.5°C in the 21st century with perhaps a substantive increase over the landmass, particularly in the Northern high latitude and part of the arctic or Antarctica region [16]. Also, this finding is in conformity with the work, on the assessment of climate change in Taraba State, Nigeria noted that climate change may be attributed to both natural and anthropogenic causes [17]. Human-induced factors account for short-term variations in climate over the last century. Such human-induced factors include the emissions of greenhouse gases and aerosols, changes in land use and the depletion of the ozone layer through various human activities such as industrialization, urbanization, and agriculture amongst others. Furthermore, they noted that a series of events and changes in environmental conditions in Nigeria generally and Taraba State in particular, in recent years, lends credence to the existence of climate change.

It was also noted that deforestation and the clearing of vegetated surfaces for road construction, agricultural activities, the building of houses, and timber logging and fuelwood collection have aided the phenomenon of climate change [19]. Nevertheless, the data obtained from the field and analysed revealed that, vegetation cover (Shrubs, trees, etc. (18.6%), Grass land (Open grass land for grazing) (20.7%), livestock, bush meat and wild animals etc. (17.9%), Arable land for farming activities (18.4%) and water bodies such as streams, ponds, lakes, rivers (15.6%) as well as fisheries resources from communal rivers and streams (8.9%) are the rural resources that are found in Katsina State and are at risk to the impacts of climate change. This findings of the study is in tandem with the work on natural resources and livelihood assets who pointed out that, sustainable rural livelihood is an example of the “multiple capital” of natural Capital Assets such as wetland and the biodiversity of Ecosystems they support as seen in the various productive assets they provide and the benefits, services and income they provide to the households [1,2,24-26]. This helps the household with their sources of livelihood. The implication of the threat of climate change to the locals is that their major sources of income and livelihood are threatened, effects of which could escalate migration, crime, theft, hunger, malnutrition or even death.

CONCLUSION AND RECOMMENDATION

This study investigated the perception of climate and its implication

for rural resource elements in Katsina State. The study was able to establish the cause of climate change and how that, it has become a major threat to the rural resources which is the major source of income for the locals (Katsina state inhabitants). This is particularly not good for existence and sustenance in the study area since it could lead to forced migration, a rise in criminal activities, starvation and malnutrition. As a result of these findings the study recommends, diversification of the sources of income, afforestation and reforestation and intensify campaign for the complete reduction in the emissions levels of obnoxious gases. There should also be an aggressive campaign for the complete reduction in the emissions levels of obnoxious gases (Co1, Co2, Sox, Nox1 CH₄, etc.) that cause the phenomenon of climate change.

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