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The effects of climate change on the livelihood of rural women: a case study of Ilorin South, Nigeria

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Abstract

Background: Globally, the increasing impacts of climate change continue to be seen in rising sea temperature, flooding, and fluctuation in weather patterns. Recently, the phenomenon has become a reality for poor communities whose livelihoods are being washed away by floods and children whose education is being truncated by the economic impacts of climate change. Therefore, this research aims to determine the effects of climate change on the livelihood of rural women who are said to be more vulnerable to the culminating effects of anthropogenically induced climate change disasters. To achieve the aim and objectives of this study, the research was conducted phenomenologically using questionnaires, interviews, and focus group discussions to access the assets required for improving the livelihood of rural women affected by climate change.

Results: The interpreted results of the data gathered using questionnaires showed that rural women in Ilorin South Local Government Area (LGA) of Kwara State, Nigeria, are impacted by the perils of anthropogenically induced climate change disasters that have impacts on their livelihood. These implications can be seen in the resilience of the methods used by these rural women to combat the continuing impact of climate change on their livelihood. The findings of the research also indicate that there are other factors making them vulnerable to the impacts of climate change such as lack of basic infrastructures, low capital base, and the use of crude farming methods.

Conclusion: From the suggestions in this study, we can conclude that climate change is already affecting the livelihood of rural women. However, a collective effort is required to implement the proactive measures required to improve rural women's resilience to the impact of climate change on their livelihood.

Keywords: Climate change, Livelihood, Women

Background

The challenge of climate change has long been documented in studies within the African literary circle. Climate changes impact on subsistent agriculture and sustenance has long featured in folklores and indigenous stories with local adaptations to climate change impacts, one of such records is found in Chinua Achebe's 'Things fall apart'. In the book, Achebe recounted the impacts of

climate change on livelihood. Achebe (1958) noted that rainfall which determines the livelihood of the farmers did not come when it was supposed to, the sun was blazing hot roasting all the crops in the field, and when the rains finally came, it rained for several days. The rain destroyed all the crops in the field, flooding the entire village. Similarly, Alexander Graham Bell (1917) predicted that "the unchecked burning of fossil fuels would have a sort of greenhouse effect" on the planet; he, therefore, suggested the use of alternative energy sources such as solar energy.

Climate change is a global challenge that has affected many lives and livelihoods; however, women and

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children are arguably the most affected (UN Women 2014). Research conducted by Oxfam (2015) posits that women constitute a very vulnerable population group, particularly those in less economically developed countries who suffer from delayed economic development and generally live-in poverty. These women begin to earn a meagre livelihood after marriage, the bulk of which is spent on food, medicine, and the schooling of their immediate and extended family members (Oxfam 2015). In contrast, women in more economically developed countries begin earning a living before marriage, making them more likely to have fewer children. They also seem to enjoy greater autonomy within their households and communities; because they do not only receive, but they also add to their community's economy (UN Women 2014; Oxfam 2015).

In recent times, it appears the livelihood of women in rural areas of developing countries has become more vulnerable to the effects of climate change than their male counterparts primarily because women constitute a larger proportion of the poor, and they are more dependent on the available natural resources for their livelihood (Armah et al., 2010; Patterson et al. 2015). Furthermore, rural women are charged with the responsibility to secure water, food, and fuel for cooking which is being marred by unequal access to natural resources (Chigbu 2013), this has limited their mobility and made them more affected by the perils of climate change (Ifabiyi and Adedeji 2014).

As noted by Ahmed (2001) rural women in Nigeria are socially oppressed, legally ignored, politically exploited, technologically deprived, and subordinated to the production unit of bearing and rearing children. Further to this, the African Development Bank (2008) noted that Nigerian women are poor because they lack entitlement to the absolute minimum necessities for a living (food, education, clothing, housing, and healthcare). Correspondingly, the United States Agency for International Development (USAID 2010) suggests that the level of entitlement a Nigerian woman has to basic household necessities depends on her employment, income opportunities, control over assets, current income level and the endowment of her household. Additionally, the United Nations Development Program (UNDP 2012) ranked Nigeria 152nd of 187 countries globally, the report equally classified Nigerian women as underprivileged and less economically developed. Furthermore, the World Bank (2014) report suggests that 54% of Nigeria's population is concentrated in rural areas, with women comprising 50% of its inhabitants.

The form of livelihood engaged in by Nigerian women is different from that of the men. Women are more dependent on the natural environment for their

livelihood and are therefore more affected by the perils of climate change (UNEP 2004). A greater percentage of women in developing countries most, especially in Africa, have agriculture and trade as their major source of income (UNDP 2012). Agriculture is vulnerable to climate change such that a slight drop in temperature can make or mar the growth of crops, this implies that during the dry season, women have to travel long distances in search of water for irrigation, this is usually done on foot (Agaja 2013). The long distances they travel in search of water eventually reduce their daily farm input and their total yield (Koolwal and van de Walle 2013).

The results from a field survey carried out by the students of Geography and Environmental Management, in Patigi, Kwara state showed that during the rainy season, farmers (Women and Men) often experience flooding which erodes the soils surface, washing away the nutrients required for crop growth (Olanrewaju 2014). In cases where fertilizer has been applied to the soil, floodwater washes it away to surrounding water bodies, which endangers the species of organisms living therein (Olaniran 2002). This will, in turn, reduce the fisherman's yield, and thus decrease the quantity of fish the rural woman buys or sells, a decline in the quantity of fish available will escalate its selling price and reduce the buyers purchasing power (Ojogho and Equare, 2015; NGS 2020). The problem identified thereto is that climate change plays a role in the way rural women earn their daily living. Therefore, the purpose of this research is to examine the effects of climate change on the livelihood of rural women, in Ilorin South Local Government Area, Kwara State, Nigeria.

Study area

Ilorin South LGA is one of sixteen local governments in Kwara state, it comprises 50 communities, it is situated between latitudes $8^{\circ} 26' - 8^{\circ} 32' N$ and longitude $4^{\circ} 28' - 4^{\circ} 40' E$ (Fig. 1), it was created in 1996, with its headquarters located in the town of Fufu (Muhammad-Lawal and Omotesho 2013). Ilorin South LGA has a projected population of 245,000 people in a 174 km^2 area, and an average population density of about 1200 inhabitants per square kilometre (Emeilu 2004; Daramola et al. 2015). Ilorin South LGA has an agro-based economy with agriculture accounting for over 70% of the adult labour force, the inhabitants of the area are predominantly Farmers, Craftsmen, Drivers, Petty-traders, and Muslim scholars (Olaniran 2002). The migrants in the area are Traders, Artisans, Civil Servants, Bankers and Teachers a small proportion of women in the area are involved in market gardening and commercial agriculture, especially the production of sheer butter, locust bean, yam, cassava, maize, coffee, and kola-nuts (Curry n.d.; Rubenstein

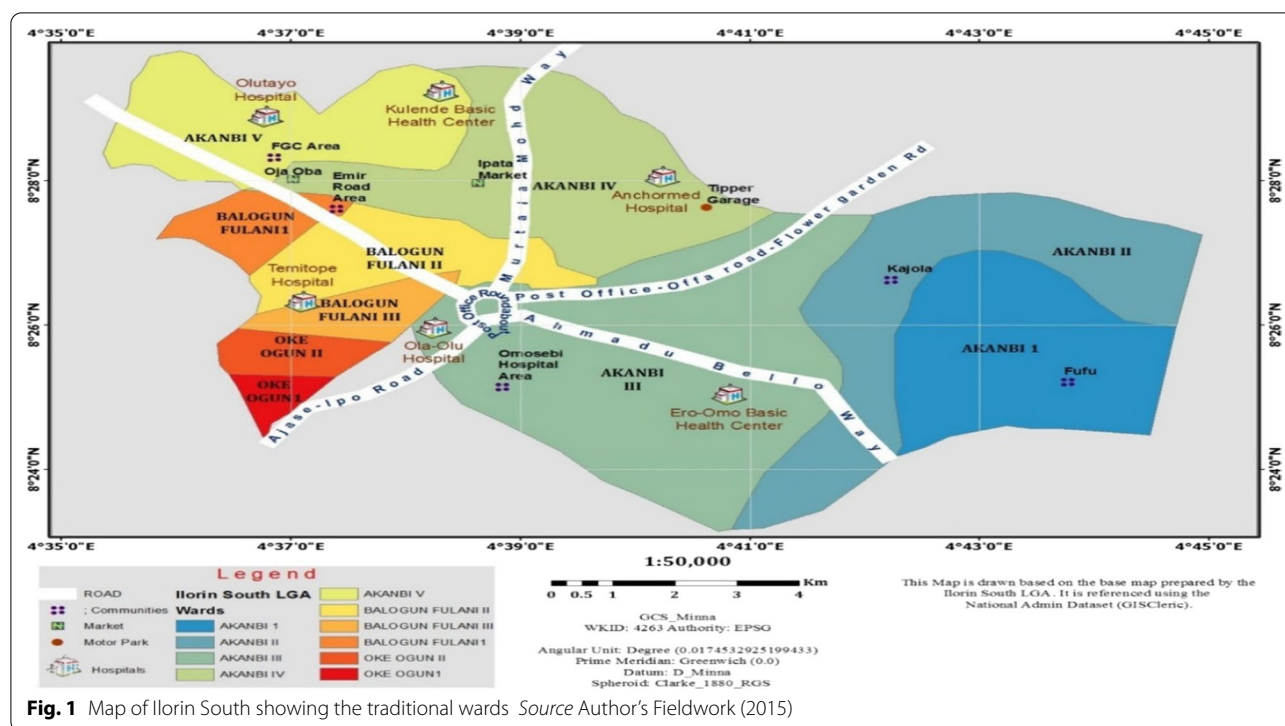


Fig. 1 Map of Ilorin South showing the traditional wards Source Author's Fieldwork (2015)

2013). The dominant religion is Islam and Christianity, the dominant tribes are the Yoruba's, there are other tribes such as the Nupes, the Fulani's, the Hausas, and a few Igbos, the languages spoken by the people in the area is English and Yoruba (Jimoh and Ifabiyi 2000).

Aim and objectives

This research aims to examine the impact of climate change on the livelihood of rural women. The objectives are to:

- Identify the livelihood of rural women in Ilorin South.
- Assess the rural women's understanding of climate change.
- Determine the impacts climate change has on their livelihood pattern.
- Identify other challenges rural women of Ilorin South face while trying to earn a living.
- Examine how rural women of Ilorin South manage the impacts climate change has on their livelihood.

To achieve the above-stated objectives, this research is designed to test the following:

H0 Women do not contribute to community development.

H1 Women contribute their quota to community development.

H0 Women are not aware of the climate change phenomenon.

H1 Women are aware of the climate change phenomenon.

H0 Climate change does not affect women's livelihood.

H1 Climate change affects women's livelihood.

This section gave a background to the study, it gave a visual and oral representation of the study area, it introduced relevant research questions, highlighted the study's aim, and objectives to justify its relevance. The subsequent section discusses methods used for the research.

Methods

This quantitative research was conducted in a phenomenological manner to deconstruct the participants' lived experiences (Englander 2012) and to understand how climate change impacts their livelihood. The research utilized questionnaire and focus group discussions to access the assets required for improving the livelihood of rural women affected by climate change.

Study design

Questionnaire administration and interviews were conducted across the study area with the intent to map out the livelihood activities engaged in by the active rural women in the population, the questionnaires included an informed consent section that highlights what the study is about, it states how the information given will be used, it noted the rights of the researcher to confidentiality and the protection of their privacy. A 10-year Climatic data and a 10-year trend of agricultural produce of the study area were incorporated into the study. The respondents that participated in the interview conducted using questionnaires, were selected using on-site recruiting, this ensured that they participated voluntarily as espoused by Lew (2011). The respondents who volunteered for the study were informally interviewed (illiterate respondents) and formally interviewed (literate respondents), using a prepared set of questions (Ahmad 2012) for a duration of ninety minutes to help with the climate change phenomenon discuss and to determine its impact on their livelihood. Questionnaires were administered in two weeks, direct observations were made, and relevant case studies as seen on the field were incorporated into the research (Montello and Sutton 2013).

Sample size estimation

To determine the proportion of respondents to be sampled for a study, Singh and Masuku (2014) suggest that the formula below should be employed.

$$Z^2 * \left(p \frac{1-p}{e^2} \right) / 1 + \left[Z^2 * \frac{p(1-p)}{e^2 N} \right]$$

where Z = confidence level [$Z=90\%$ confidence level, = 1.65].

N = population to be sampled [$N=120,000$, assuming women are 50% of Ilorin South population].

e = margin of error [$e=5\%$, = 0.05].

p = percentage probability of falsely rejecting the null hypothesis [$p=50\%$, = 0.5]

$$1.65^2 * \left(0.5 \frac{1-0.5}{0.05^2} \right) / 1 + \left[1.65^2 * \frac{0.5(1-0.5)}{0.05^2 * 120000} \right]$$

$$\text{Sample size} = \frac{269}{1000}$$

Sample size = 270.

Study population

270 questionnaires were administered in the 4 communities studied. To reach the goal of 270 respondents, the snowball sampling technique was applied. The

questionnaires were distributed based on the community's spread, 50 in Jalala, 40 in Alenuboro, 80 in Fufu and 100 in Ile-Apa, 250 respondents were female and 20 were male, this was done to ensure there was reduced bias in the response of those being studied.

Study tools

The data analysis used in this study aimed to get an accurate assessment of the effect's climate change has on the rural women of Ilorin South, to achieve this, descriptive and inferential statistics (Forbes 2015) were employed to the objectives. Descriptive statistical methods such as graphical charts, percentages, and tables were used to achieve objectives one, two, and four, while Inferential statistical methods such as cross-tabulations and chi-square were used to achieve objectives three and five, respectively. Field notes were made, SPSS was used to manage the data collected. The selection of these methods is hinged on the study's objectives, the research questions and the type of data required for the research. The adequate training required, ethical approval and consent to participate in the study were given by the University of Ilorin through the department of Geography and Environmental Management.

This section highlighted methods adopted for the research, which was discussed under, nature of data, data source, sampling procedure and data analysis method. The next section is the data analysis and a visual representation of its interpretation.

Results

The results from surveyed rural women in Ilorin South can be seen in Table 1. The age distribution across the sampled locations specifies that 21.48% of the population are between 21 and 30 years old, while 27.03% of the respondents are between 31 and 40 years old, and interviewees between 41 and 50 years old constitute 25.18% of the sampled population, these age groups (21-50 years old) are referred to as the productive population. The married (72.60%) divorced (4.07%) and the widowed (11.85%) among the productive population indicate that they have the responsibility to fend for their immediate and extended families, the women seemed highly involved in a form of livelihood as 58.89% were farmers and 34.44% were traders. During the interview 32.22% of the women said they had primary schooling, 58.15% indicated that they had no schooling at all, these respondents suggested that the meagre income they earn is because they had little or no schooling. Nevertheless, an assessment of the income generated by the women indicates that 34.90% of the sampled population earn 20,000 Naira monthly, whereas most of the respondents (51.90%) earn 10,000 Naira monthly, it is difficult to conclude that their

Table 1 Demographic characteristics of the respondents

Demographic characteristics										
	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	No	%	No	%	No	%
Age distribution (years)										
21–30	12	24.00	9	22.50	17	21.25	20	20.00	58	21.48
31–40	16	32.00	10	25.00	24	30.00	23	23.00	73	27.03
41–50	15	30.00	11	27.50	16	20.00	26	26.00	68	25.18
51–60	5	10.00	6	15.00	15	18.75	21	21.00	47	17.41
Above 61	2	4.00	4	10.00	8	10.00	10	10.00	24	8.90
Total	50	100	40	100	80	100	100	100	270	100
Marital status										
Single	7	14.00	5	12.50	9	11.25	10	10.00	31	11.48
Married	36	72.00	29	72.50	58	72.50	73	73.00	196	72.60
Divorced	2	4.00	2	5.00	3	3.75	4	4.00	11	4.07
Widowed	5	10.00	4	10.00	10	12.50	13	13.00	32	11.85
Total	50	100	40	100	80	100	100	100	270	100
Level of education										
Primary	12	24.00	15	37.50	32	40.00	28	28.00	87	32.22
Secondary	2	4.00	3	7.50	5	6.25	10	10.00	20	7.41
Tertiary	1	2.00	1	2.50	2	2.50	2	2.00	6	2.22
None	35	70.00	21	52.5	41	51.25	60	60.00	157	58.15
Total	50	100	40	100	80	100	100	100	270	100
Monthly income (naira)										
10,000	27	54.00	21	52.50	41	51.25	51	51.00	140	51.90
20,000	23	46.00	17	42.50	27	33.75	26	26.00	93	34.40
30,000	–	–	2	5.00	10	12.50	14	14.00	26	9.63
40,000	–	–	–	–	2	2.50	6	6.00	8	2.96
50,000 or more	–	–	–	–	–	–	3	3.00	3	1.11
Total	50	100	40	100	80	100	100	100	270	100
Ethnic composition										
Yoruba	40	80.00	29	72.50	64	80.00	68	68.00	201	74.44
Hausa	4	8.00	7	17.50	7	8.75	17	17.00	35	12.96
Fulani	6	12.00	4	10.00	9	11.25	12	12.00	31	11.49
Igbo	–	–	–	–	–	–	3	3.00	3	1.11
Total	50	100	40	100	80	100	100	100	270	100
Occupation										
Agriculture	26	52.00	23	57.50	50	62.50	60	60.00	159	58.89
Trade	19	38.00	13	32.50	26	32.50	35	35.00	93	34.44
Others	5	10.00	4	10.00	4	5.00	5	5.00	18	6.67
Total	50	100	40	100	80	100	100	100	270	100

education has affected their ability to earn a livelihood however, their assertions are valid.

Rural women's perception of climate change

To determine the rural women's perception of climate change, certain factors have to be considered and they include their access to information, their information source, their level of understanding of the concept of

climate change and the causes of the occurrence. Table 2 shows the various sources from which rural women obtain information about climate change; this is vital to determining how they perceive the phenomenon. The interviewed respondents said their information sources are radio, television, friends, and newspaper. The result of their suggestions shows that across the four locations, the radio is the major source of information in Jalala (54%)

and Alenuboro (46.25%) while Newspaper ranked highest in Fufu (30%) and Ile-Apa (39%).

In judging perception, understanding plays a vital role and this can be seen in Table 3, 30.74% of the respondents say they understand climate change to mean a decrease in the amount of rainfall, 28.89% believe it is an increase in temperature, 20.37% claim climate change is a decrease in temperature and 20% suggest that it is attributed to increased rainfall.

This implies that rural women understand what is driving changing climate, with respect to changing weather patterns, especially rainfall and temperature. The women's understanding of climate change is seen in how they combat the effects of the occurrence on their livelihood, this will be explored in the preceding section (Techniques rural women use to combat climate change impacts), next is their understanding of the phenomenon.

Another major factor that drives perception is an understanding of the causes of climate change, Table 4

shows major causes of climate change as attested by the women in the study area. The respondents said that deforestation (34%) and bush burning (32.6%) is the major cause of climate change, they also suggested that urbanization contributes to the phenomenon by 13% and extensive agriculture accounts for 20.40%.

It is imperative therefore to note that the rural women interviewed during this research seem to be highly aware of climate change, although their perception of the occurrence differs with respect to their level of understanding, their source of information and what they attribute to being the cause of the phenomenon. However, management practices and measures must be introduced to the women to enable them to sustain their livelihood in the face of their changing climate, nonetheless, the challenges faced by the respondents when obtaining their livelihood is discussed subsequently.

Table 2 Rural women's source of information on climate change

Source	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	No	%	No	%	No	%
Radio	27	54.00	10	25.00	37	46.25	27	27.00	101	37.41
Television	3	6.00	11	27.50	5	6.25	14	14.00	33	12.22
Friends	15	30.00	7	17.50	29	36.25	20	20.00	71	26.30
Newspaper	5	10.00	12	30.00	9	11.25	39	39.00	65	24.07
Total	50	100	40	100	80	100	100	100	270	100

Table 3 Rural women's understanding of climate change

Understanding	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	No	%	No	%	No	%
Increase in temperature	14	28.00	12	30.00	27	33.75	25	25.00	78	28.89
Decrease in temperature	13	26.00	8	20.00	22	27.50	12	12.00	55	20.37
Increase in rainfall amount	7	14.00	11	27.50	13	16.25	23	23.00	54	20.00
A decrease in rainfall amount	16	32.00	9	22.50	18	22.50	40	40.00	83	30.74
Total	50	100	40	100	80	100	100	100	270	100

Table 4 Rural women's awareness as regards the causes of climate change

Causes	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	No	%	No	%	No	%
Bush burning	17	34.00	12	30.00	30	37.50	29	29.00	88	32.60
Urbanization	7	14.00	4	10.00	9	11.25	15	15.00	35	13.00
Deforestation	15	30.00	15	37.50	27	33.75	35	35.00	92	34.00
Extensive agriculture	11	22.00	9	22.50	14	17.50	21	21.00	55	20.40
TOTAL	50	100	40	100	80	100	100	100	270	100

Challenges rural women face when accessing their livelihood

Most rural women find it difficult to obtain a livelihood because the type of work available is usually labour-intensive with marginal wages. Table 5 examines the regularity with which rural women obtain a livelihood, the interviewees' response indicates that 35.9% of them earn a daily income, while 36.3% have a seasonal income, whereas 7.4% of them have a weekly income, and 20.4% claim to have a livelihood that yields monthly returns.

This implies that the majority of the respondents engage in farming and the petty trade of their farm produce, this explains the claims of those who say that they earn a seasonal livelihood as the harvest season is the period in which they earn returns from the sale of their surplus farm produce. Table 6 examines the challenges rural women face while obtaining a livelihood. The response of the interviewees shows that 20.74% of them have a low capital base, while 18.14% Lack basic the infrastructure required to improve their earnings, 22.60% claim that they use crude implements and methods in their livelihood process and 17.78% said they have little or no access to the raw materials they require to earn a living. Additionally, 20.74% suggest that their inaccessibility to loans is another challenge bedevilling their livelihood.

The response of the women indicates that there are several challenges to their livelihood, nonetheless, this research is interested in determining the impact of

climate change on livelihood. Therefore, it is pertinent to analyse the impact of climate change on the livelihood of the rural women, as this is required to achieve the research's aim, this is examined next.

Impacts of climate change on the livelihood of rural women

Crosstabulation analysis was conducted to determine how changes in climate affect the productivity of women and by implication affects their livelihood. The results show that women believed an increase in temperature had an 84.60% contribution to reduced productivity, while unfavourable weather had a 15.40% effect on their livelihood. A decrease in temperature is believed to cause an increase in diseases by 12.70% and unfavourable weather by 87.30%, while increased rainfall was said to be more active as a causal factor for an increase in disease vectors by 63%. Climate change is said to cause unfavourable weather conditions by 24.10% and is suggested to be responsible for the loss of properties during floods (13%) decrease in rainfall, on the other hand, is adjudged to be more influential in damaging properties and propagating diseases. The assertions of the respondents are shown in Table 7.

Chi-square analysis was equally carried out to determine if climate change has an impact on the livelihood of rural women and results show that Chi-square = 434.495 $df=9$ $p<0.001$, therefore, implying that climate change has a significant impact on women's livelihood.

Table 5 Regularity of source of livelihood

Regularity	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	NO	%	No	%	No	%
Daily	16	32.00	16	40.00	29	36.25	36	36.00	97	35.93
Weekly	4	8.00	2	5.00	4	5.00	10	10.00	20	7.40
Monthly	12	24.00	7	17.50	15	18.75	21	21.00	55	20.37
Seasonally	18	36.00	15	37.50	32	40.00	33	33.00	98	36.30
Total	50	100	40	100	80	100	100	100	270	100

Table 6 Challenges to livelihood

Challenges	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	No	%	No	%	NO	%
Low capital base	15	30.00	8	20.00	10	12.50	23	23.00	56	20.74
Poor access to raw materials	6	12.00	9	22.50	13	16.25	20	20.00	48	17.78
Lack of basic infrastructure	9	18.00	6	15.00	21	26.25	13	13.00	49	18.14
Use of crude methods	7	14.00	5	12.50	19	23.75	30	30.00	61	22.60
Inaccessibility to loans	13	26.00	12	30.00	17	21.25	14	14.00	56	20.74
Total	50	100	40	100	80	100	100	100	270	100

Table 7 Cross-tabulation analysis showing perception of climate change versus challenges to livelihood

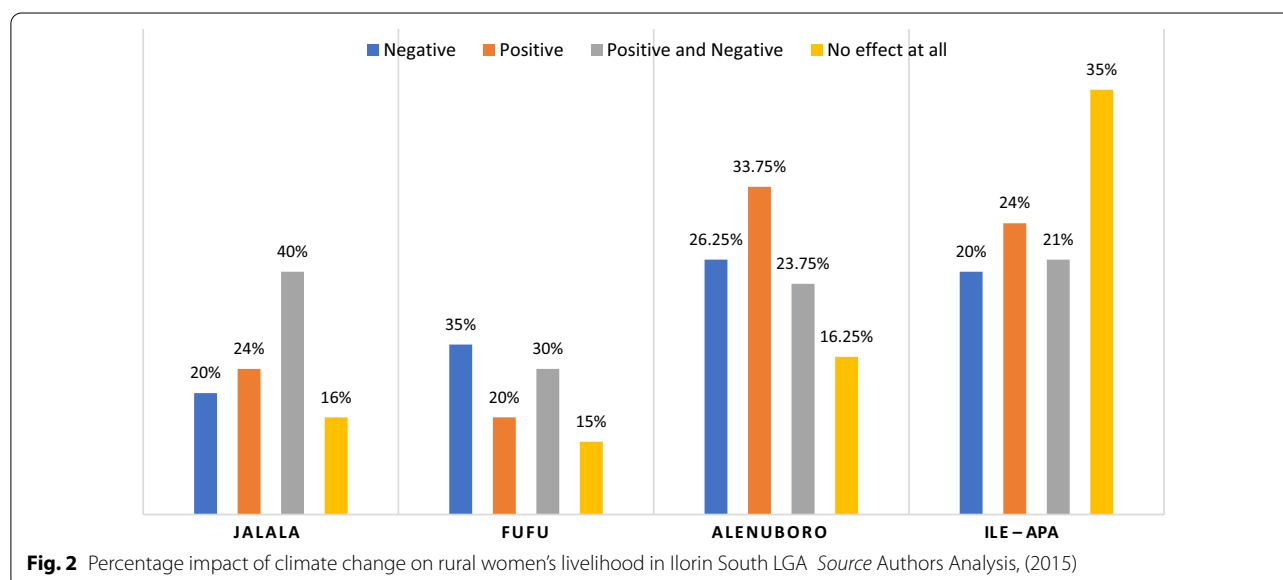
	Increase in diseases	%	Loss of properties	%	Reduced productivity	%	Unfavourable weather	%
A decrease in rainfall amount	21	25.30	62	74.70	0	0.00	0	0.00
Decrease in temperature	7	12.73	0	0.00	0	0.00	48	87.27
Increase in rainfall amount	34	62.96	7	12.96	0	0.00	13	24.07
Increase in temperature	0	0.00	0	0.00	66	84.62	12	15.38
Grand Total	62	22.96	69	25.56	66	24.44	73	27.04

The questionnaire survey also corroborated the chi-square analysis as a majority of the women agree that climate change has impacted their livelihood. In Jalala, 24% of the women noted that climate change has impacted their livelihood, 40% claimed it has had both positive and negative impact. In Fufu, 35% of women said climate change has negative impacts, 20% suggested positive outcomes while 30% stated it has positive and negative impacts while 15% noted that it has no effect at all, whereas in Alenuboro 33.75% alleged positive impacts, 26.25% said it had negative results, 23.75% claimed both and 16.25% noted no effect. In ile-apa, 35% suggested that climate change has no effect, 20% alleged negative impacts, 24% supposed there were positive outcomes and 21% maintained that it has had negative and positive results, as shown in Fig. 2. The subsequent section discusses how rural women mitigate the effects of climate change.

Techniques rural women use to combat climate change impacts

Climate change is a global issue, nevertheless, this research has profoundly made it seem that it is an apparent occurrence in local communities. An assessment of the mitigation and adaptation techniques used by rural women is discussed in Fig. 3. The perceived mitigation measures women take against climate change; and their said results suggest that the rural women have reduced bush burning (Jalala 10, Fufu 8, Alenuboro 31 and ile-apa 27), they equally recommend adopting better waste disposal methods (Jalala 10, Fufu 10, Alenuboro 14 and ile-apa 23). The women went further to advocate for a reduction in the use of pesticide (Jalala 17, Fufu 9, Alenuboro 13 and ile-apa 21) and the need to adequately prepare for floods (Jalala 13, Fufu 13, Alenuboro 22 and ile-apa 29).

While the respondents noted the migration techniques, they use to combat the effect of climate change, an assessment of how effective their strategies are was discussed with them. Table 8 shows divided opinions



with 37.80% claiming it has not been effective and 31.10% alleged effectiveness.

Questions were posed on what could be done to curb the effect of climate change on their livelihood and Table 9 shows that the majority of the respondents (36.30%) believe that the government should do more to help combat the effects of climate change, the respondents also proposed measures as public awareness (27.80%) and alternative energy use (35.90%) to help mitigate the effects of climate change on their livelihood.

Over time, the responsibility of tackling climate change has been passed back and forth between governments and the international community, this question was posed to the respondents and Table 10 shows their responses. 27.04% supposed the responsibility lies with the federal government, 24.81% believes it lies on the state government, 23.70% suggest the local government while 12.60% think the responsibility is on the international community and 11.85% claims it lies on individuals.

Nevertheless, it seems logical to assume that the responsibility of tackling climate change lies on all the

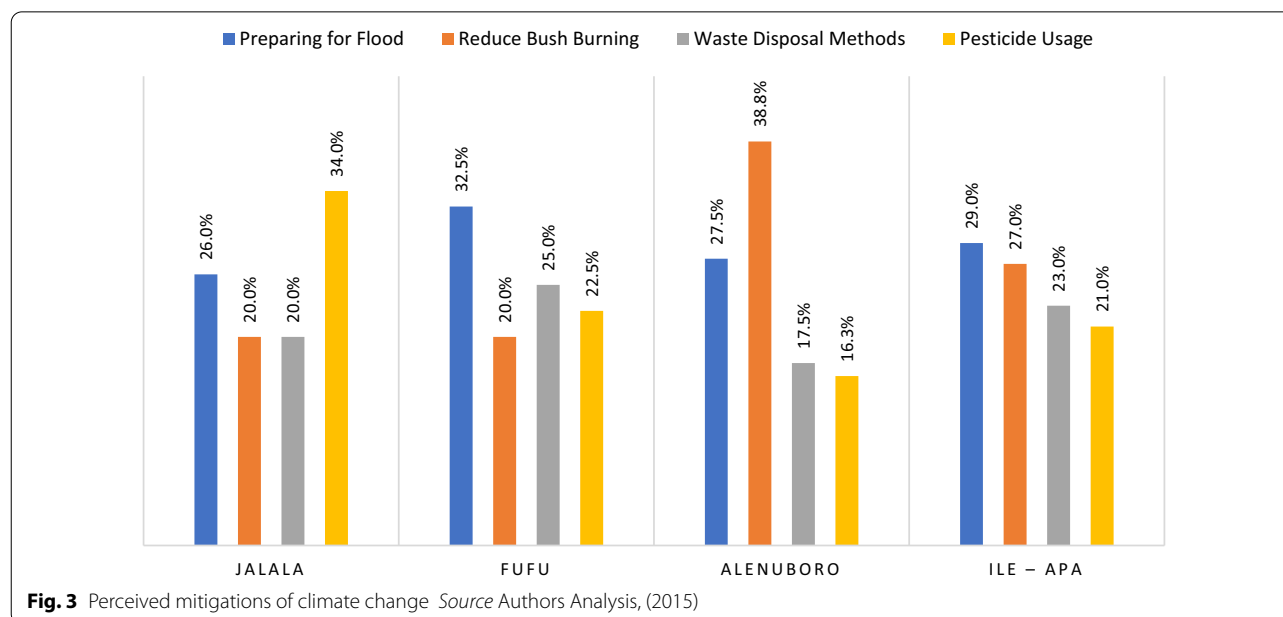


Table 8 The effects of mitigation on climate change

Effects	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	No	%	No	%	No	%
Highly effective	14	28.00	13	32.50	22	27.50	35	35.00	84	31.10
Effective	19	38.00	10	25.00	35	43.75	20	20.00	84	31.10
Not effective	17	34.00	17	42.50	23	28.75	45	45.00	102	37.80
Total	50	100	40	100	80	100	100	100	270	100

Table 9 What can be done to curb climate change?

Solutions	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	No	%	No	%	No	%
Government intervention	15	30.00	18	45.00	25	31.25	40	40.00	98	36.30
Public awareness	20	40.00	10	25.00	20	25.00	25	25.00	75	27.80
Alternative energy use	15	30.00	12	30.00	35	43.75	35	35.00	97	35.90
Total	50	100	40	100	80	100	100	100	270	100

Table 10 Who has the responsibility of tackling climate change?

Organization	Jalala		Fufu		Alenuboro		ILE-APA		Total	Total
	No	%	No	%	No	%	No	%	No	%
International organizations	7	14.00	6	15.00	7	8.75	14	14.00	34	12.60
Federal government	15	30.00	8	20.00	19	23.75	31	31.00	73	27.04
State government	13	26.00	12	30.00	21	26.25	21	21.00	67	24.81
Local government	12	24.00	9	22.25	24	30.00	19	19.00	64	23.70
Individuals	3	6.00	5	12.50	9	11.25	15	15.00	32	11.85
Total	50	100	40	100	80	100	100	100	270	100

aforementioned organizations, it is required to begin at the local level with the individual, then it should correspondingly be tackled headlong at all cadres of the government and the international community.

This chapter discussed findings from the field survey, an analysis of the generated data highlights the women's livelihood, the frequency of their activities, their understanding of climate change, its impact on their livelihood and their management techniques. The following section discusses concepts, theories, frameworks, and literature that are pertinent to this research.

Discussion

This section will review existing literature on the impacts of climate change on livelihood (Agriculture and Trade), it will discuss relevant case studies and introduce the sustainable livelihood framework that suggests how to improve the livelihood of rural women.

Agriculture and climate change

Agriculture depends on specific climatic conditions, while an increase in temperature and CO₂ can be beneficial for some crops, it hinders the survival of other crops (Talmage and Gobler 2011; Nwajiuba 2013). Climatic fluctuations can harm crops and reduce yields by encouraging the growth of weeds and, pests, encouraging farmers to use harmful chemicals to salvage their yield (Wilson and Tisdell 2001; EPA 2009; IFRPI 2009). Tables 11 and 12 show the temperature and rainfall requirement for certain crops.

A deviation in the temperature and rainfall requirements of crops indicates impacts such as crop failure, livestock deaths, economic losses, higher food prices, and reduced food security; these influences will eventually increase the world's demand for food (Wamlawa 2011; Savary et al. 2012).

The statistical evidence that shows the impact of climate change on trade, is considered next.

Table 11 Temperature requirement for some selected crops
Source Oshodi (1996)

Crop		Effective growth energy (EGE)
1	Swamp rice	Greater than 350°F
2	Oil palm	250–350°F
3	Rubber, cocoa, coconut	250–300 °F
4	Rice, maize, benniseed	200–250 °F
5	Sorghum	100–250 °F
6	Cotton, groundnut	100–200 °F
7	Millet	75–150 °F

Table 12 Rainfall requirement for some selected crops Source Ayoade (2004)

Crops		Mean annual rainfall
1	Yam	At least 1250 mm
2	Kolanut	At least 1250 mm
3	Groundnut	500–1000 mm
4	Beniseed & soya beans	1250–1500 mm
5	Oil palm	1500–3000 mm
6	Cocoa	1250–2000 mm
7	Rubber	2000–2500 mm
8	Cotton	652–1250 mm

Trade and climate change

Statistical studies have indicated that trade will likely lead to increased CO₂ emissions (Tamiotti 2011; Saboori 2012; IPCC 2014), nonetheless, research indicates that an increase in CO₂ emissions will have different outcomes for developed and developing countries, with environmental improvement being observed in more economically developed countries and environmental deterioration detected in developing countries (Strømman et al. 2008; Cristea et al. 2013). Additionally, the transportation aspect of trade has made contributions to the world's CO₂ emission (SEI 2013), with shipping

accounting for 11.8%, aviation contributing 11.2%, rail transport constitutes 2% and road transport adding 72.6% of the total CO₂ emissions (WTO-UNEP Report 2008). Therefore, the most carbon-emission efficient modes of transportation should be considered when determining the best modes of transport for national and international trade, this will help mitigate the impacts of climate change.

A case study discoursing the impacts of climate change on women's livelihood is highlighted next.

Women and climate change

In 2015, Sheheli and Khan's research conducted in Bangladesh to determine what was required to improve the livelihood situation of the poor women farmers affected by climate change in the study area indicated that the availability of credit facilities (interest-free or low interest) was most important to improving their livelihood situation, they also noted that job opportunities, health service, shelter, and education are required to improve their current livelihood status (Heijman et al. 2007; Sheheli and Khan 2015). The poor women in the study area of Bangladesh went further to demand the attention of the government to alleviate their poverty by promoting suitable income-generating opportunities throughout the year so that they can correspondingly resolve food security problems in the locality. Sheheli and Khan's (2015) literature makes it evident that climate has an impact on the livelihood of poor women in Bangladesh and this is similar to the situation in Nigeria. Research conducted by Nzeh et al. (2012) on the impacts of climate change on agriculture in Nigeria affirms that climate change has

destroyed several farmlands, led to crop failure, crop diseases, threatened food security, and reduced farmers income. The research further suggests the provision of information, resources, incentives, and mitigating the unintended consequences of climate change to help improve yield. Nevertheless, to improve the livelihood situation of women in Ilorin South, the Sustainable Livelihood framework would seem relevant because it understands the causes of poverty to proffer solutions, this is discussed next.

Sustainable livelihood framework

Figure 4 discusses the Sustainable livelihood framework (SLF) it is the core of the Sustainable Livelihoods Approach (SLA) the framework can be understood as a tool for comprehending poverty as the poor perceive it (DFID 2010) the framework sets out to conceptualize:

- How people operate within a vulnerability context that is shaped by factors such as seasonal constraints, economic shocks, and long-term trends
- How to draw on different types of livelihood assets or capitals in different combinations which are influenced by vulnerability contexts, a range of institutions policies and processes and how they use their asset base to develop a range of livelihood strategies.

The DFID (2010) framework above can be used to depict women as operating in a context of vulnerability (fluctuation and seasonality) within which they have access to certain natural resources. When the natural resources at their reach are combined with education,

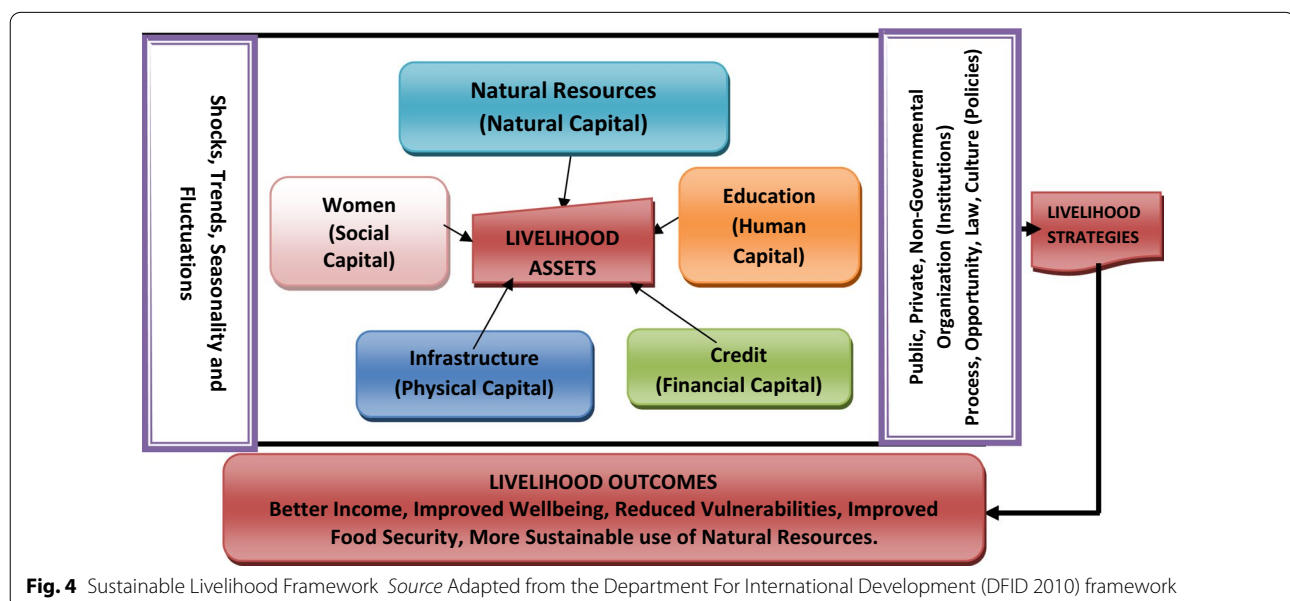


Fig. 4 Sustainable Livelihood Framework Source Adapted from the Department For International Development (DFID 2010) framework

input and credit, their assets begin to gain weight and value (Livelihood Assets) through prevailing institutions and policies (Livelihood Strategies). The outcome of effectively combining assets and strategies is better income, improved wellbeing, reduced vulnerabilities, food security and sustainable use of natural resources (IFRC n.d.). The SLF decisively shapes the livelihood strategies open to people in pursuit of their self-defined beneficial livelihood outcomes (Kollmair et al. 2002; Robert et al. 2009).

This section highlighted theories, concept, framework, literature, and relevant case studies pertinent. The next chapter gives a summary of the research's findings, gives recommendations for improving rural women's livelihood and highlights the research's limitations.

Conclusions

From this research, it can be acceded that rural women participate in primary (agriculture) and secondary (trade) income-generating activities; however, their labour often goes unrecognized even though their income enhances their community's livelihood outcome. This research made it evident that asides the influence of climate, a low capital base affects rural women's livelihood by 20.74%, lack of basic infrastructure influences their livelihood by 18.14% while the use of crude methods affects their livelihood by 22.60%. Poor access to raw materials influences their livelihoods productivity by 17.78% and the inability to get loans for their businesses affects their livelihood by 20.74%.

The studied rural communities suggest that the rural women earn little from their income-generating activities, 9.63% earn #30,000 monthly, 34.90% earn #20,000 monthly, and 51.90% earn #10,000 monthly. The women seemed highly aware of climate change although their perceptions differ. This research made it evident that 90.37% of the rural women had little or no access to formal education, the rural women recommended that perhaps if their capability (education) is enhanced their livelihood outcome will be improved; therefore, further research to determine the impact formal education has on women's resilience or ability to sustain their livelihood should be conducted. The research aim of examining the impact of climate change on the livelihood of rural women was explored and the following recommendations were made.

Recommendations

The women mentioned that soft loans from Governmental Organization (GOs) and well-meaning people (Non-Governmental Organizations) will improve their living situation. They revealed that they have a trade union; therefore, relevant GOs and NGOs can use these

associations to create working opportunities, introduce climate change mitigation measures, management practices, create gender awareness programs and other community initiatives targeted towards improving the women's livelihood outcomes. Additionally, they advocated for the availability of interest-free credit, and health services, to improve their wellbeing.

There are scholarly concepts on improving the livelihood of rural women that supports the findings of this research such as Chambers and Conway (1992) which advises that enhancing capability, improving equity, and increasing social sustainability are required to improve rural women livelihood (Scoones 1998). Additionally, Sheheli (2015) suggests that an educated woman will have increased income as the outcomes of their livelihood process is linked with various resources such as association with NGOs, credit sources, education, farm size, improved housing, better healthcare, quality water, and freedom of choice. Further to this, the Department For International Development (DFID 2010) asserts that rural women's livelihood is vulnerable to the effects of climate change, still, their livelihood can be made to thrive through prevailing policies, institutions, and processes.

Nzeh et al. (2012) affirm that in Nigeria, climate change has destroyed rural women's farmlands, led to crop failure, crop diseases, threatened food security, and reduced income. The research further suggests that provision of information, resources, incentives, might mitigate the unintended consequences of climate change and help improve yield. Additionally, research conducted by the United Nations Framework Convention on Climate Change (UNFCCC 2021) revealed that 32,500 women farmers in the South-East Nigeria are impacted by climate change which has led to loss of livelihoods. To ameliorate their situation, and raise climate change awareness, tree-planting, cover cropping, contour tillage, and cut-off drainage were introduced to the rural women which have improved their livelihood situation. Similarly, to raise climate change awareness and mitigation measure in Ilorin South LGA, the use of radio as a mass media campaign is worth exploring as 37.41% of the respondents get their information from this channel.

The suggested recommendations might help enhance livelihood and improve rural development, thereby assisting policymakers and researchers on how to introduce methods to reduce poverty among rural women by introducing income-generating activities. However, the successful implementation of these suggestions will depend on the cooperation of identified stakeholders. To ensure the research was conducted meaningfully and manageably using available resources, data collection was limited to four communities, this ensured the research represents what goes on in the studied areas. The

sampled population of 250 women and 20 men helped achieve the study's aim by giving a broader understanding of the women's situation. While agriculture and trade do not fully represent all livelihoods in the study area, they keep the study's focus.

Appendix

Questionnaire

Good day, our names are (Jemima, Joseph, and Racheal). This questionnaire is research work from the Department of Geography and Environmental Management, University of Ilorin, Kwara state Nigeria, it aims to examine how climate change affects the way rural women obtain their livelihood.

If you are interested in participating in the study, please be informed that your privacy will be protected, and your responses will be used for academic purposes only.

Please answer the questions carefully and honestly as all responses will be used strictly for academic purpose and will be treated with confidentiality.

Thank you.

Instruction

Please, carefully tick appropriate answers.

Please fill in the blanks where necessary

General question

Age of respondent: less than 20 yrs. ☐ 30–40 yrs. ☐ 41–50 yrs. ☐ 51–60yrs ☐ above 60 ☐

Marital Status: Married ☐ Single ☐ Divorced ☐ Widowed ☐

Educational Qualification: Primary ☐ Secondary ☐ Tertiary ☐ No formal education ☐

Tribe: Yoruba ☐ Hausa ☐ Fulani ☐ Igbo ☐ Other specify

Monthly income: Less than N10,000 ☐ N10,000–N30,000 ☐ N31,000–N50,000 ☐ N51,000–N100,000 ☐ Above N100,000 ☐

Primary occupation: Farming ☐ Hunting ☐ Forestry ☐ Fishing ☐ Others specify

Secondary occupation: Bead making ☐ Textile production ☐ Feed Production ☐ Others specify

Tertiary occupation: Trading ☐ Transportation ☐ Hair dressing ☐ Seamstress ☐ Others specify

How often do you engage in your form of livelihood? Daily ☐ Weekly ☐ Monthly ☐ Seasonally ☐ Others specify

What challenges do you face when carrying out your livelihood? Insufficient funds ☐ Inadequate basic infrastructures ☐ Use of crude methods ☐ Inaccessibility to loans ☐ Others specify

Global environmental issues

What do you understand about climate change? An increase in temperature ☐ A decrease in temperature ☐ an increase in rainfall ☐ A decrease in rainfall ☐ Others specify

Where did you first hear about it? Radio ☐ Television ☐ Newspaper ☐ Friends ☐ Other's specify

What are the causes of climate change?

What impacts if any do you think climate change has on you?

What kind of impact does climate change have on your livelihood? Positive ☐ Negative ☐ Positive and Negative ☐ No effect at all ☐ Others specify

What have you been doing to curb the effects of climate change on your livelihood: Preparing for flood ☐ Reducing the frequency of bush burning carried out on the farm ☐ Avoid dumping of refuse in water bodies ☐ Reducing the use of pesticides ☐

☐ other's specify

How effective are the measures you have put in place to curb the effects of climate change on your livelihood? Very effective ☐ Effective ☐ Not effective ☐

Who do you think has the responsibility of tackling climate change? International organization ☐ The Federal government ☐ The State government ☐ The local government ☐ Individuals ☐ Community ☐

What do you think can be done to handle the problem of climate change?

Have you ever benefited from the relief aids being given to the victims of climate change? Yes ☐ No ☐

If your answer for question 20 is yes, what type of relief aid was it? Food ☐ Shelter ☐ Drugs ☐ Money ☐ others specify

Is there anything else you will like me to know about climate change or what is responsible for the occurrence and how it has impacted you?

Abbreviations

DFID: Department for international development; GDI: Global development index; GO: Governmental organizations; LGA: Local government area; NGO: Non-governmental agency; SLA: Sustainable livelihood approach; SLF: Sustainable livelihood framework; UND: United Nations development program.

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Author contributions

JD was responsible for writing the Abstract, interpreting the gathered data in the Discussion section, drawing a Conclusion from the interpreted data, and compiling the References. JA was responsible for discussing the study's Background and designing the Methods used to conduct the data analysis. REO was responsible for bringing relevant works of Literature together. All authors read and approved the manuscript.

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Availability of data and materials

The datasets generated for the study are not publicly available because the respondents did not give the authors their consent to publicly share the raw data. However, the respondents gave consent to use the analysed data for this published article.

Declarations

Ethics approval and consent to participate

A written ethics approval and consent to participate were given by the University of Ilorin through the department of Geography and Environmental Management. The statement reads thus:

The research submitted by Duru, Jemima Nneamaka with Matriculation Number 11/66ME038 has been read, certified, and approved as meeting the ethical requirements for the award of a Bachelor of Science (BSc) degree in Geography and Environmental Management at the Department of Geography and Environmental Management, Faculty of Business and Social Science, University of Ilorin, Kwara State, Nigeria.

A written consent to participate was discussed with and obtained from the study participants upon their acceptance to participate in the study. The written consent to participate form is embedded in the questionnaire located in the appendix section of this research.

Consent for publication

Not applicable.

Competing interests

Not applicable.

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References

- Achebe C (1958) Things fall apart, 1st edn. Solih, Beirut, London, pp 21–22
- African Development Bank (ADB), (2008). *National women development policy*. ADB. Ashirwadani, J., n.d. Communication Research Methods; Methods of Data Analysis. *Academia*
- Agaja O (2013) Causes of climate change. University of Ilorin, Ilorin
- Ahmad S (2012) Questionnaire and Types. *Research gate*
- Ahmed A (2001) Improving the livelihood of rural women through income generating activities. p.2
- Armah F, Yawson D, Yengoh G, Odoi J, Afrifa E (2010) Impact of Floods on Livelihoods and Vulnerability of Natural Resource Dependent Communities in Northern Ghana. *Research gate*, [online] 2(2), Available at: https://www.researchgate.net/publication/43336432_Impact_of_Floods_on_Livelihoods_and_Vulnerability_of_Natural_Resource_Dependent_Communities_in_Northern_Ghana Accessed 2 July 2015
- Ayoade, (2004) Application of geographic information system to the effects of climatic variability on sustainable agricultural production in kwara state
- Chambers R, Conway G (1992) Sustainable rural livelihoods: practical concepts for the 21st Century. *IDS Bull* 22(4):5–11
- Chigbu U (2013) Rurality as a choice: towards ruralising rural areas in sub-Saharan African countries. *Dev South Afr* 30(6):812–825
- Cristea A, Hummels D, Puzzello L, Avetisyan M (2013) Trade and the greenhouse gas emissions from international freight transport. *J Environ Econ Manag* 65(1):153–173
- Curry T (2015) n.d. *Culture of Nigeria - history, people, clothing, traditions, women, beliefs, food, customs, family*. [online] Everyculture.com. Available at: <https://www.everyculture.com/Ma-Ni/Nigeria.html> Accessed 2 July 2015
- Daramola L, Aro J, Daramola J (2015) An assessment of the impact of deforestation on climate change: case study of ilorin, kwara state. *Academia*, pp 6–14
- Department For International Development (DFID), 2010. Sustainable livelihood approaches and its framework. *GLOPP*, pp 3–5
- Emeiliu, (2004) Secondary School Geography. 2nd ed. Nigeria: Lantern, pp.100–106
- Englander M (2012) The interview: data collection in descriptive phenomenological human scientific research. *J Phenomenol Psychol* 43(1):13–35
- Environmental Protection Agency (EPA), (2009) Climate change impacts and adaptation to change. [online] [Adaptationclearinghouse.org](https://www.adaptationclearinghouse.org/resources/epa-s-climate-change-impacts-and-adaptation-to-change-website.html). Available at: <https://www.adaptationclearinghouse.org/resources/epa-s-climate-change-impacts-and-adaptation-to-change-website.html> Accessed 8 July 2015
- Forbes J (2015) Descriptive and Inferential Statistics. *Int J Res Methodol Soci Sci* 1(1):20–32
- Grahambell A (1917). Letter from Alexander Graham Bell to Helen Keller, [Manuscript/Mixed Material] Retrieved from the Library of Congress, <https://www.loc.gov/item/magbell.12400317/>
- Heijman W, Hagelaar G, Heide C (2007) Rural resilience as a new development concept. *Research gate*, [online] pp.383–394. Available at: https://www.researchgate.net/publication/40105962_Rural_resilience_as_a_new_development_concept Accessed 2 July 2020
- Ifabiye I, Adedeji A (2014) Analysis of water poverty for irepodun local government area (Kwara state, Nigeria). *Geogr Environ Sustain* 7(4):81–94
- Intergovernmental Panel for Climate change (IPCC), (2014) *Climate Change Synthesis Report Summary For Policymakers*. Fifth Assessment Report. IPCC
- International Federation of Red Cross and Red Crescent Societies (IFRC), n.d. What Is A Livelihood?. [online] ifrc.org. Available at: <https://www.ifrc.org/en/what-we-do/disaster-management/from-crisis-to-recovery/what-is-a-livelihood/> Accessed 2 July 2015
- International Food Policy Research Institute (IFPRI), (2009) Climate change impact on agriculture and costs of adaptation. Food policy report. [online] Washington, DC: IFPRI, pp.1–17. Available at: http://www.fao.org/fileadmin/user_upload/rome2007/docs/Impact_on_Agriculture_and_Costs_of_Adaptation.pdf Accessed 2 July 2015
- Jimoh H, Ifabiye I (2000) Contemporary issues in environmental studies. Haytee Press and Publishing Co., Ltd, Ilorin
- Kollmair M, St G (2002) The sustainable livelihood approach. Input paper for the integrated training course of NCCR North-South. University of Zurich, Development Study Group, Zurich
- Koolwal G, van de Walle D (2013) Access to water, women's work, and child outcomes. *Econ Dev Cult Change* 61(2):369–405
- Lew A (2011) Research methods in geography. *Int Plan Stud* 16(2):194–196
- Montello D, Sutton P (2013) An introduction to scientific research methods in geography & environmental studies, 2nd edn. Sage, London
- Muhammad-Lawal A, Omotesho OA (2013) Analysis of food demand among rural households in Kwara State, North central Nigeria. *Niger J Technol Res*. <https://doi.org/10.4314/njtr.v8i1.88868>
- National Geographic Society (NGS), (2020) *Rural Areas*. [online] nationalgeographic.com. Available at: <https://es.education.nationalgeographic.org/encyclopedia/geography/> Accessed 8 July 2020
- Nwajiuba C (2013) Nigeria's Agriculture and Food Security Challenges. *Agriculture and food security*, pp.45–53.
- Nzeh E, Eboh R, Nweze N, Orebiyi J, Lemeche J (2012) Climate change adaptation in nigeria and its challenges in agricultural sector. *Agro-Science*, 7(1)
- Ojogho O, Ekwere R (2015) Price generating process and volatility in the Nigerian agricultural commodities market. *Int J Food Agric Econ* 3(4):55–64
- Olaniran OJ (2002) Rainfall Anomalies in Ilorin South LGA: the Contemporary Understanding. 55th Inaugural Lecture Series. University of Ilorin, Ilorin
- Olanrewaju (2014) Climate change causes and impacts. University of Ilorin Department of Geography and Environmental Management, Ilorin
- Oshodi A (1996) Amino acid and fatty acid compositions of *Adenopus brevis* flours/benth seed. *Int J Food Sci Nutr* 47(4):295–298
- Oxfam, 2015. Why The Majority Of The World'S Poor Are Women Oxfam International. [online] Oxfam International. Available at: <https://www.oxfam.org/en/why-majority-worlds-poor-are-women> Accessed 2 July 2015
- Patterson K, Bremner J, Lamere C, Yavinsky R, (2015) The impact of population, health, and environment projects: a synthesis of the evidence. *Research gate*, [online] pp.14–19. Available at: https://www.researchgate.net/publication/304527514_The_Impact_of_Population_Health_and_Environment_Projects_A_Synthesis_of_the_Evidence Accessed 2 July 2015
- Robert C, Maureen H, Stephen Posner P, John T (2009) Beyond GDP: the need for new measures of progress. *Soc Indic Res* 109(3):355–376
- Rubenstein J, (2013) *The cultural landscape: an introduction to human geography*. 11th ed. Pearson.
- Saboori B, Sulaiman J, Mohd S (2012) Economic growth and CO2 emissions in Malaysia: a cointegration analysis of the environmental Kuznets curve. *Energy Policy* 51:184–191

- Savary S, Ficke A, Aubertot J, Hollier C (2012) Crop losses due to diseases and their implications for global food production losses and food security. *Food Security* 4(4):519–537
- Scoones (1998) Sustainable rural livelihoods: a framework for analysis. *Inst Develop Stud IDS Bull* 22(4):5–11
- Sheheli S, Khan M (2015) Coping strategies of women in flood-prone areas of Bangladesh. *Progress Agric* 26(2):155–167
- Singh A, Masuku M (2014) Sampling techniques & determination of sample size in applied statistics research: an overview. *Int J Econ Commer Manag* 2(11):12–17
- Stockholm Environmental Institute (SEI), 2013. *International Trade And Global Greenhouse Gas Emissions: Could Shifting The Location Of Production Bring GHG Benefits?*. Project Report. [online] Sweden: SEI, pp.1–22. Available at: <https://mediamanager.sei.org/documents/Publications/Climate/sei-3c-2013-pr-trade-ghg-lr.pdf> Accessed 3 July 2015
- Strømman A, Hertwich E, Duchin F (2008) shifting trade patterns as a means of reducing global carbon dioxide emissions. *J Ind Ecol* 13(1):38–57
- Talmage S, Gobler C (2011) Effects of elevated temperature and carbon dioxide on the growth and survival of larvae and juveniles of three species of northwest atlantic bivalves. *PLoS ONE* 6(10):e26941
- Tamiotti L (2011) The legal interface between carbon border measures and trade rules. *Climate Policy* 11(5):1202–1211
- United Nations Development Programme (UNDP), (2012) *Gender And Climate Change Africa*. Gender, climate change and food security. [online] New York: UNDP, pp.1–6. Available at: <http://www.undp.org/gender> Accessed 2 July 2015
- United Nations Environmental Programme (UNEP), (2004) *Women And The Environment*. Ecosystem and Biodiversity. Nairobi: UNEP
- United Nations Framework Convention On Climate Change (2021) available from <https://unfccc.int/news/climate-change-is-an-increasing-threat-to-africa> Accessed 9 December 2021
- United Nations, (2014) *Women And Poverty*. [online] UN Women. Available at: <https://www.unwomen.org/en/news/in-focus/end-violence-against-women/2014/poverty> Accessed 2 July 2015
- United States Agency for International Development (USAID), 2010. *Gender Assessment*. [online] Bangladesh: USAID. Available at: https://pdf.usaid.gov/pdf_docs/Pnads882.pdf Accessed 25 May 2021
- Wamlawa J (2011) The consequence of emerging cash crops on small-scale rural farmers livelihood: a case study of the energy crop jatropha curcas l in kenya. Massey University, Master of Philosophy, New Zealand
- Wilson C, Tisdell C (2001) Why farmers continue to use pesticides despite environmental, health and sustainability costs. *Ecol Econ* 39(3):449–462
- World Bank, 2014. *Nigeria Economic Report*. Economic Updates. [online] Washington, DC: The World Bank. Available at: <https://openknowledge.worldbank.org/handle/10986/19980> License: CC BY 3.0 IGO Accessed 25 May 2021
- WTO-UNEP, (2008) *Trade And Climate Change*. [online] Wto.org. Available at: https://www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf Accessed 8 July 2015

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