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Review paper

Food Security, Climate Justice and Energy Transition: A Case of Households in Imo State, Nigeria

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KEYWORDS

Food Security

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ABSTRACT

The study was conducted on food security, climate justice and energy transition: a case of households in Imo State, Nigeria. The aim is to describe the socioeconomic characteristics of the households and determine the effect of climate justice on food security status, energy consumption and socioeconomic factors. A multi-stage sampling procedure involving random and purposive sampling techniques was used to sample 360 respondents through well-structured questionnaires. Descriptive and inferential statistics were used in analyzing the data. Results found that the average age of the respondents was 43.54 years, 66.11% of the respondents were food secure, 70.83% of the respondents were married, the average household size of the respondents was around 7 people per household, the average energy consumed by the respondents was N11,898.58, and the average monthly income was N365,972.22. The results of the effect of climate justice on food security, energy consumption and socioeconomic factors showed that the coefficient of multiple determination (R^2) was 0.964, indicating that 96.4% of the variation in the impact of climate justice in the study area was explained by the variables in the model. With an F-statistic of 11.486, it is evident that the model effectively described the impact of climate justice. Variables such as food security status ($P > 0.01$), marital status ($P > 0.01$), and income ($P > 0.1$) exhibited a positive relationship with climate justice, while education ($P > 0.1$) and age ($P > 0.05$) showed a negative relationship. Energy consumption did not show and relationship on the climate justice. The study recommended continuous education should be considered appropriate for sustainable practices to mitigate climate effects on food security, Households should embrace solar systems as an alternative to fossil fuels for a cleaner environment and sustainable agriculture.

1. Introduction

Food is essential for all humans to live healthy and productive lives. In Imo State, meeting the food needs of the growing population has become a challenging task. Farmers face difficulties due to climate change and poor or environmental management. Food security, including availability, accessibility, and sustainable utilization, is

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a crucial concern for policymakers and academics. The ability of a household or an individual to easily access food is known as food access (Ogunniyi, Omotoso, Salman, Omotayo, Olagunju, and Aremu, 2021).

Agriculture is the backbone of the Nigerian economy, employing over 70% of the active population in the sector (Aboaba, Fadiji1, and Hussayn, 2020). However, climate-related issues have led to declining agricultural outputs and have not significantly contributed to food security and improved human nutrition. Food security, climate justice, and energy transition are interconnected challenges that need to be addressed simultaneously for a sustainable future in food production and utilization. With the growing global population and increasing impacts of climate change, ensuring access to affordable and nutritious food for all is becoming more challenging (Food and Agriculture Organization, FAO, 2024).

Over the years, human activities such as mining, deforestation, transportation, inadequate waste management, and the burning of fossil fuels for energy production have led to a significant increase in global greenhouse gas (GHG) emissions. These greenhouse gases, when released into the atmosphere, trap heat, resulting in climate change and its destructive impacts on the global population and food production (United Nations Development Programme (UNDP), 2017).

Climate change is already negatively affecting food production and distribution, with vulnerable populations in developing countries bearing the brunt of the consequences. Additionally, the energy sector, a major contributor to greenhouse gas emissions, plays a crucial role in influencing food security through its impact on food production, processing, and transportation (Zhuang, Abbas, Al-Sulaiti, Fahlevi, Aljuaid, and Saniuk, 2022). Climate change, along with increased unpredictability in rainfall, prolonged droughts, and unexpected heavy floods, poses significant threats to the energy transition, sustainable livelihoods, and food security for various global population segments (Sa *et al*., 2017; Zhuang *et al*., 2022).

Adopting green energy for food security is crucial. Energy transition affects traditional energy use patterns worldwide and has a significant impact on global food production in societies dependent on fossil fuels. According to Zhuang *et al*. (2022), energy transition may have indirect social consequences, leading to adverse outcomes for sustainable land use, human livelihood, and food security. Climate justice is essential to address the impact of greenhouse gas emissions on global food production. It is a guiding principle that acknowledges the disproportionate impact of climate change on those who have contributed the least to it. Climate justice calls for equitable sharing of the burden of adaptation and mitigation (FAO, 2024).

Due to heightened concerns about food security, the energy sector plays a crucial role in expanding the food supply. However, the widespread use of traditional energy has led to environmental damage, posing a significant challenge to sustainable food production. As a result, the transition to alternative and sustainable energy sources has emerged as a vital topic in discussions about the future of human and economic activities (Luciani, 2020). Factors driving this energy transition include population growth, rapid urbanization, unsustainable utilization of non-renewable resources, climate change, and shifts in food consumption patterns, such as increased calorie intake and changes in diet composition (Abd-Elmabod *et al*., 2020).

Issues stemming from the exploitation of natural resources, deforestation, and other human activities contributing to climate change have led to reduced crop yields for many farmers. According to Richardson *et al*. (2020), extensive natural resource exploitation may result in land degradation and reduced soil productivity, adversely affecting the food security of the growing population. Additionally, the escalation of pests and diseases due to climate change and an increase in extreme weather events such as droughts and floods could lead to crop failure or loss, thereby impacting food security, particularly in Imo State.

The existing literature extensively analyzes the main factors affecting food supply and energy transition (Sattar *et al*., 2020; Xu and Sattar, 2020; Latief *et al*., 2021). However, these studies have not been carried out in Imo State, Nigeria, which is the reason for undertaking this study.

This study aims to contribute to future literature by prioritizing climate justice and sustainable practices in energy transition for food production, ensuring access to affordable, nutritious food, and clean energy. The study addressed the effect of climate justice on food security, socioeconomic factors, and energy transition in households in Imo State, Nigeria. The following objectives are considered to address the issues of food security, climate justice and energy transition: to describe the socioeconomic characteristics of the households and to determine the effect of climate justice on food security, energy consumption, and socioeconomic factors of the households in Imo State, Nigeria.

2. Materials and Methods

The study was conducted in Imo State, the State is divided into three Agricultural zones: Owerri, Orlu, and Okigwe. The state lies within latitude 4°45'N and 7015'N and latitude 6°50'E and 7°25'E. The state is bounded in the east by Abia state, in the west by River Niger and Delta state, in the north by Anambara state, while Rivers state lies in the south. Imo state covers an area of about 5, 100sq/km and an estimated population of

5,459,300 as of 2022 (National Population Commission, (NPC), 2023). Rainfall distribution is bimodal with peaks in July and September and a two-week break in August. The rainy season begins in March and lasts till November. The high temperature and humidity experienced in the state favour the luxuriant vegetation of tropical rainforests. This also favours honey production as there is an abundant supply of nectar from flowers for their consumption.

A multi-stage sampling procedure was used in sampling. Stage one involved a purposive selection of the three Agricultural zones. The reason is to ensure that all three zones are evenly represented in the study.
Stage two involved a random selection of two (2) Local Government Areas each from the three (3) zones, comprising 6 LGAs.

Stage three involved random selection of three (3) Communities each from the 6 selected LGAs giving (18) Communities. Four (4) villages were selected randomly from each of the (18) Communities selected in stage three above, giving 72 villages for the study.

Finally, in stage four, five (5) households were selected purposively from each of the (72) villages giving 360 respondents.

Data for the study were gathered through a well-structured questionnaire administered to primary data sources. Data collected included those on the farmers' socio-economic characteristics, food security, the effect of climate change and energy consumed by the households among others. Data were analyzed using descriptive and inferential statistics models as appropriate The Likert-type measurement scale was used extensively in this study because it has the feature of transforming a respondent's subjectivity into an objective reality.

2.1 Model Specification

Ordinary least squares regression analysis was used to determine the effect of climate justice on food security, energy justice, and socioeconomic factors of the households. The model as used by Aidoo-Mensah (2023), is specified as follows;

$$CJ = ß_0 + ß_1(FSS) + ß_2(EC) + ß_3(Edu) + ß_4(AGE) + ß_5(HHS) + ß_6(MS) + ß_7(INC) + e$$

Where;

CJ = Climate Justice (Index Score)
FSS = Food Security Status (1 = Food secured, 0 = food insecure),
EC = Amount of Energy Consumed (N), (Firewood, gas, kerosene and Fuel)
Edu = Education (Number of years spent in school),
INC = Income (N), (Aggregation of Farm income and Non-farm Income)
HHS = Household Size (Number of persons),
MS = Marital Status (Married = 1, Otherwise = 0),
AGE = Age (Number of years)
e = error term
$ß_0 - ß_7$ = parameters to be estimated

Climate justice was evaluated using an ordinal scale rating to measure the impact of climate change on economic losses, health risks, displacement, income, production, and consumption. The scale ranged from Very High Severe Effect (VHSE) scored at 5, High Severe Effect (HSE) scored at 4, Severe Effect (SE) scored at 3, Moderate Effect (ME) scored at 2, to No Effect (NE) scored at 1. The respondents' scores for each impact were added together and then divided by the number of impacts. The mean score obtained from this process was used as the climate justice score for the study.

The model was fitted into four (4) functional forms and the lead equation was selected from the following criteria

i. Model with the highest coefficient of multiple determination (R^2)
ii. Model with the best fit based on their F-statistics.
iii. Model with the highest number of significant explanatory variables.
iv. Model with the most consistent a priory expectation based on the signs of the explanatory variable.

3. Results And Discussion

3.1 Socio-economic Characteristics of the Respondents

The results of the socioeconomic characteristics of the respondents are presented in Table 1.

Table 1 Socioeconomic characteristics of the respondents

Socio-Economic Characteristics	Frequency	Percent	Cumulative Percent	Mean
Age (Year)				
20 – 35	38	10.56	10.56	
36 – 51	287	79.72	90.28	
52 – 67	31	8.61	98.89	
68 – 83	4	1.11	100	
Total	**360**			**43.54 years**
Food Security Status (Index Score)				
Food Secure	238	66.11	66.11	
Not Secure	122	33.89	100	
Total	**360**			
Marital Status				
Married	255	70.83	70.83	
Single	89	24.72	177.72	
Widowed	16	4.45	100	
Total	**360**			
Household Size (No Person)				
1 – 5	61	16.94	16.94	
6 – 10	282	78.33	95.27	
11 – 15	17	4.73	100	
Total	**360**			**7.4 persons**
Energy Consumption (N)	**Mean Amount**			
Liquefied gas	9, 862.3			
Premium Motor Spirit	17, 208.12			
Firewood	3, 315.78			
Kerosene	17, 208.12			**N11,898.58**
Income (N)				
100,000 – 350,000	211	58.61	58.61	
350,000 – 600,000	112	31.11	89.72	
600,000 – 850,000	24	6.67	96.39	
850,000 – 1,100,000	9	2.5	98.89	
1,100,000 – 1,350,000	4	1.11	100	
Total	**360**			**N365,972.22**

Source: *Field Survey Data, 2024*

Table 1 indicates that the average age of the respondents was 43.54 years. This suggests that the respondents are relatively young and capable of generating income to support their basic needs. Individuals in this age group often hold significant positions in the workforce and may be responsible for making family nutrition and food choices. Their economic stability and access to resources directly impact household food security. Additionally, they play a role in food production and distribution systems and can influence policies that address the disproportionate effects of climate change on vulnerable populations, especially in Imo State. Moreover, they are in a position, based on their ages, to make decisions regarding energy use in their households and workplaces.

This finding aligns with Akin (2024), who reported that farmers in this category consider agriculture a full-time business. They engage in year-round farming during both dry and wet seasons to meet food security needs. However, this contrasts with the findings of Osuji et al. (2017), which reported a mean respondent age of 67 years, indicating that farmers are ageing, which may significantly impact their output and food security.

In Table 1, 66.11% of the respondents were food secure, while 33.89% were food insecure. Additionally, 70.83% of the respondents were married, 24.72% were single, and 4.45% were widowed. This indicates that the majority of the respondents were married. Married households are better positioned to manage resources and adopt sustainable practices in energy consumption and environmental maintenance. These findings are consistent with Kanu and Onyekwere (2023), who reported that the majority of the respondents being married implies greater family support systems.

Table 1 indicates that the average household size of the respondents was around 7 people per household. This suggests that the respondents have an adequate number of individuals to provide food and energy for a comfortable life. However, there may be concerns about food security if climate change negatively impacts their agricultural productivity (Kanu and Onyekwere, 2023). The results also reveal that the average energy consumed by the respondents was N11,898.58, and the average monthly income was N365,972.22. This income is used to cover the food security and energy consumption needs of the households, with the respondents spending around 11.7% of their monthly income on energy consumption. This indicates that the

respondents have a relatively high income, which enables them to purchase essential items to meet food security and energy requirements and to mitigate the effects of climate change. The amount spent on energy consumption is of a great concern to the environment and food production. According to Osuji et al. (2017), low-income households struggle to afford essential farm inputs and implements due to financial constraints.

3.2 Determinants Effect of Climate Justice on Food Security Status, Energy Consumption and Socio-economic Factors

The results of the effect of climate justice on food security status, energy consumption and socioeconomic factors of the household are presented in Table 2.

Table 2 Climate Justice, Food Security Status, Energy Consumption, and Socioeconomic Factors of Household

Explanatory Variable	Linear Function	+Exponential Function	Double-Log Function	Semi-Log Function
Constant	1.938 (11.509) ***	-0.172 (-11.128) ***	0.290 (0.816)	1.591 (1.676) *
Food Security Status	-0.072 (-0.908)	0.025 (4.132) ***	0.026 (0.791)	-0.029 (-0.576)
Energy consumption	-8.960E-007 (-0.001)	-1.971E-008 (-0.471)	-0.017 (-0.913)	-0.048 (-0.549)
Education	0.001 (0.027)	-0.001 (-1.738) *	-0.049 (-1.577) *	-0.032 (-0.388)
Age	0.008 (3.184) ***	-0.001 (-2.423**)	0.216 (4.607) ***	0.352 (2.852) ***
Household Size	-0.011 (-0.978)	2.087E-005 (0.025)	-0.086 (-3.176) ***	-0.065 (-0.919
Marital Status	-0.008 (-0.156)	0.017 (4.362) ***	0.009 (0.377)	-0.027 (-0.441)
Income	-5.129E-008 (-0.551)	1.224E-008 (1.749) *	0.005 (0.280)	-0.019 (-0.397)
R^2	0.423	0.964	0.880	0.329
Adj R^2	0.23	0.963	0.694	0.133
F – Value	2.222**	11.486***	4.730***	1.678*

Source: *Field Survey Data, 2024 Values in parenthesis are the t ratio *** = Significant at 1%, ** = Significant at 5%, * = significant at 10% + = Lead equation*

In Table 2, it is evident that the exponential functional form yielded the primary equation, boasting the highest coefficient of multiple determination, significant variables, and F-value. The coefficient of multiple determination (R^2) equalled 0.964, indicating that 96.4% of the variation in the impact of climate justice in the study area was explained by the variables in the model. With an F-statistic of 11.486, it is evident that the model effectively explained the impact of climate justice. Variables such as food security status ($P > 0.01$), marital status ($P > 0.01$), and income ($P > 0.1$) exhibited a positive relationship with climate justice, while education ($P > 0.1$) and age ($P > 0.05$) showed a negative relationship.

The coefficient of food security status was found to be significant at one per cent and positively related to climate justice. This means that an increase in climate justice leads to an increase in the food security status of the household. It demonstrates that achieving food security involves implementing adaptation strategies that take local climate conditions into account, such as crop diversification and sustainable farm management practices to improve food security and build climate resilience. Sustainable agricultural practices, often included in climate justice initiatives, can enhance food production and availability, reducing vulnerability to climate impacts. These findings align with RUAF (2021), which stated that the climate crisis poses a serious threat to global food security and that the way we produce our food plays a role in exacerbating climate change.

The results show that the marital status coefficient is statistically significant at the one per cent level and is positively related to climate justice. This means that as the marital status of the household increases, so does climate justice. Climate change often leads to economic challenges for married households, which in turn prompts them to adopt measures aimed at ensuring food security. During crises such as droughts or floods, families face financial burdens in trying to maintain food security and energy consumption.

Similarly, the income coefficient is significant at the ten per cent level and is positively associated with climate justice, indicating that an increase in climate justice can lead to a ten per cent increase in income. This suggests that households with higher income levels are better equipped to invest in alternative energy sources, such as solar power, to mitigate the impact of climate change and reduce greenhouse gas emissions

that can affect production. Consequently, these households are more likely to have an adequate food supply to meet their dietary needs. According to Sriram (2023), higher income levels are generally associated with greater resilience to the impacts of climate change, as wealthier households are able to make investments in infrastructure, technology, and resources that help mitigate climate risks.

The education coefficient was found to be significant at ten per cent and has a negative association with climate justice. This means that a decrease in education levels leads to an increase in climate justice. Education plays a critical role in promoting climate justice by raising awareness, enhancing capabilities, and empowering households to address the inequalities related to climate change. However, insufficient education among household members hinders the development of innovative solutions to mitigate climate change, which in turn affects food security. According to Trott *et al* (2023), the latest IPCC report calls for a shift in educational systems from a commercialized, individualized, entrepreneurial model to an education that prioritizes planetary health and human well-being to accelerate awareness and action on climate change.

The coefficient of age was found to be significant at five per cent and was negatively related to climate justice. This means that as people get older, they tend to have a greater sense of climate justice because they may be less willing to adopt innovative methods to combat the effects of climate change compared to younger households. Older generations often possess valuable traditional ecological knowledge that can be used to develop strategies for adapting to climate change. By incorporating this knowledge into climate justice initiatives, we can improve community resilience and encourage collaboration between different generations.

4. Conclusion

Based on the findings of the study, the respondents are food secure and earned adequate income to meet both their food security and energy consumption. The respondents spent around 11.7% of their monthly income on energy consumption, having a relatively high income, which enables them to purchase essential items to meet food security and energy requirements and mitigate the effects of climate change.

The study also found that the education of the households has a negative relationship to climate justice. Based on these, the following recommendations were made;

1. Continuous education should be considered appropriate for sustainable practices to mitigate climate effects on food security,
2. Households should embrace solar systems as an alternative to fossil fuels for a cleaner environment and sustainable agriculture.

Conflict of Interest

There is no conflict of interest among the authors

Authors' Contribution

Anyiam, K.H., Nwosu, F.O = Conceptualization, Methodology design, Models Design, Data Analysis, Review Manuscript; Anyiam, K.H., Obinna-Nwandikom, C.O. = Data Analysis, Section writing and proofreading; Nwosu, F.O., Okoro, F.N. = Questionnaire design, data collection, section writing and grammar check; Enoch, O.C., Isaiah, I.G., Bala, M.B., Ubochi, V.N. = Data collection, Data sorting and data entering; Nnorom, E.I = Data coding, Data curation, Data Processing

Ethical consideration

There is direct contact with respondents.

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