OECONOMICUS Journal of Economics
Vol. 9, No. 1, December 2024
pISSN: 2548-6004; eISSN: 2715-4882
DOI: https://doi.org/10.15642/oje.2024.9.1.48-55

THE ECONOMIC IMPACT OF CLIMATE CHANGE ON RURAL CHILDREN'S EDUCATIONAL ENROLLMENT IN DAMBATTA KANO STATE

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Article Info

Article history:

Recieved: Oct 18, 2024
Accepted: Nov 8, 2024
Published: Dec 31, 2024

Page: 48 – 55

Keyword:
Economic Impact, Climate Change, Rural Children Educational Enrolment, Agriculture

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Abstract

This study explores the interrelationships between climate change, agricultural productivity, household income, and student enrollment in rural areas of Dambatta Local Government Area, Kano State. Utilizing a linear regression model, the research reveals a moderate but significant negative impact of climate change on agricultural productivity, indicating that climate change accounts for 53.5% of the variability in agricultural productivity. Additionally, a strong positive correlation (r = 0.642) and a sample size of 108. The p-value of 0.000, which is significantly less than 0.05, confirms the statistical significance of this correlation, indicating that increases in agricultural productivity are closely associated with increases in household income in the studied region. The findings were found between agricultural productivity and household income, suggesting that decreases in agricultural output directly reduce household income. Furthermore, the study shows that household income significantly predicts student enrollment in schools, revealing that nearly 60% of the variability in student enrollment can be explained by changes in household income. These findings underscore the broader socio-economic implications of climate change in rural areas, emphasizing the need for targeted policies to mitigate climate impacts, support rural livelihoods, and ensure educational access. The study contributes to a deeper understanding of the cascading effects of climate change on rural communities, providing a foundation for future research and policy interventions

Introduction

Topic Description and Background

The paper examines the complex interrelationships between climate change, agricultural productivity, household income, and student enrollment in rural areas, with a focus on Dambatta Local Government Area in Kano State, Nigeria. It investigates how climate change impacts agricultural productivity, how changes in agricultural output affect household income, and how these economic shifts influence student enrollment in schools.

Background

Climate change poses multifaceted challenges to rural communities worldwide, impacting various sectors crucial for human development, including agriculture and education. In Nigeria, Kano State stands as a microcosm where these effects are particularly pronounced, given its heavy reliance on rain-fed agriculture and the vulnerability of its rural population to climatic variability (United Nations Development Programme, 2019). The adverse impacts of climate change, such as erratic rainfall patterns and prolonged droughts, threaten agricultural productivity, thereby jeopardizing rural livelihoods and economic stability because 90% of activities in rural settlements are climate-sensitive (Kurukulasuriya et al., 2006; Kurukulasuriya et al., 2022). Thus, for agriculture, erratic weather patterns and extreme conditions, such as droughts or floods, disrupt crop yields, threatening food security and income. Livestock production is equally affected by heat stress, water scarcity, and reduced pasture quality, leading to lower productivity and higher mortality rates. Petty trading, reliant on these sectors, also faces instability as reduced agricultural and livestock outputs diminish market goods, affecting traders' livelihoods. Thus, climate change poses a profound risk to the economic stability and sustainability of the rural communities (Savo et al., 2016; Zhai et al., 2021).

On the other hand, education is widely recognized as a fundamental driver of socio-economic progress. Education equips children with the knowledge, skills, and competencies necessary to secure better employment opportunities, thereby improving their long-term economic prospects (Psacharopoulos & Patrinos, 2018). Studies have shown that education significantly enhances labor market outcomes, with each additional year of schooling associated with an increase in earnings (United Nations Educational, Scientific and Cultural Organization, 2020). Thus, for rural children, who often face limited economic opportunities, education provides a pathway to upward mobility and financial independence (Glewwe, Maïga, & Zheng, 2014). However, despite the promising prospect that access to education provides, the educational outcomes of rural children in Kano State are intricately linked to climatic shifts, as agriculture serves as both a livelihood source and a determinant of household income and expenditure. Consequently, variations in climate change that disrupt agricultural yield and livestock productivity invariably lowers household income which necessitate families to prioritize survival over education, leading to decreased school enrolment and higher dropout rates among children.(Baez et al., 2017; Flabbi & Gatti, 2018). This argument is grounded in the premise that agriculture is the backbone of rural economies, providing the primary source of income for households (Food and Agriculture Organization, 2017). Consequently, when agricultural yields decline due to factors such as climate change, soil degradation, or poor farming techniques,

household incomes are adversely affected (International Fund for Agricultural Development, 2019) thereby making families struggle in covering the costs associated with education, leading to lower enrollment rates (World Bank, 2020). This view is supported by empirical evidence showing a positive correlation between household income from agriculture and children's school attendance in rural areas (United Nations Children's Fund, 2018).

However, despite the vital role of education on the overall development of the child, a large disparity exists in school enrolment and attendance between rural and urban communities due to a host of factors. It is argued that low agricultural productivity can increase child labor, as families may require additional hands to work on farms to compensate for reduced yields (International Labour Organization, 2017). This situation often forces children to drop out of school or attend irregularly, further exacerbating educational disparities (Bhalotra & Heady, 2016). The opportunity cost of schooling in such contexts becomes too high for families reliant on subsistence farming, leading to a preference for labor over education (Beegle, Dehejia, & Gatti, 2006). To this end, Ingutia et al, (2020) asserted that Africa's disadvantaged children are often rural, malnourished, out of school, child brides or child laborers.

Conversely, while there are series of campaigns on the need to address the immediate educational challenges in Nigeria, the growing urgency of climate change and its far-reaching effects on rural children's school enrollment has not received the necessary attention. This has made studies on the intersection of climate change, education, and rural livelihoods in Nigeria underexplored. It is argued that understanding the economic impact of climate change on school enrollment is crucial for formulating effective educational and social policies in Nigeria. This is because climate change has already begun to alter weather patterns, disrupt agricultural cycles, and exacerbate food insecurity, particularly in rural areas where agriculture is the primary source of income making them less able to adapt adequately to the consequences of climate change (Bank, 2011; Intergovernmental Panel on Climate Change, 2021). These disruptions have a direct bearing on household income, which, in turn, affects families' ability to afford educational costs such as school fees, uniforms, and supplies (Nwafor, 2017). A decline in agricultural productivity due to climate change could lead to lower school enrollment rates as families prioritize immediate survival over long-term educational investments (Ahmed, 2020). This called for studies that investigate this relationship to quantify the extent to which climate-induced economic stressors influence educational outcomes. Existing research in other contexts suggests a strong correlation between household income fluctuations and children's educational attainment (UNESCO, 2020). However, there is a lack of localized studies in Nigeria that analyze how specific climate change factors such as droughts, floods, and changes in growing seasons impact rural economies and, subsequently, school enrollment (Adger et al., 2015). Such research would provide empirical evidence needed to inform targeted interventions that could mitigate the adverse effects of climate change on education in rural Nigeria.

Against this backdrop, this study aims to explore the mediating role of agriculture in the economic impact of climate change on rural children's educational enrollment in rural

areas of Danbatta in Kano, Nigeria. By examining how climatic stressors affect agricultural outcomes and subsequently influence household income and investment in education.

Why This Topic is Interesting

This topic is particularly compelling because it highlights the cascading effects of climate change on rural communities, extending beyond immediate environmental impacts to influence economic stability and educational access. The study provides a nuanced understanding of how interconnected these factors are in rural settings, where a single shock—such as a drop in agricultural productivity—can have ripple effects on household income and educational opportunities.

Research Methods

The study adopted correlational research design. The population of the study consists of rural farmers who are residents of Danbatta Local Government Area of Kano. A sample of 230 subsistent farmers participated in the study. The sample selection was achieved using random sampling techniques. A researcher made questionnaire was used as data collection instrument. The questionnaire solicits for information that assess temperature pattern, agricultural and how they impacted on the farmers' children educational enrolment. Items in the questionnaire were on five-point Likert scale. Cronbach's Alpha reliability test was used in determining the internal consistency of the instruments. Collected data was analyzed using descriptive and inferential statistics. Descriptive statistics was used in summarizing the data while Pearson Correlation and Multiple Regression analysis were used in testing the null hypothesis at 0.05 level of significance. The analysis was conducted using Statistical Package for Social Science (SPSS) version 19.

Result and Discussion

3.1 Hypothesis 1 Testing

Ho1: Climate change has no significant effect on agricultural productivity in rural areas of Dambatta Local Government Area, Kano State.

Table 1 Regression coefficient-model of summary

Model	R	R^2	R^{2adj}	$S^{td.error}$
1	.341	.535	.573	.43096

a. Predictor: (Constant), Climate change

The table indicates the R value 0.341 that signifies a linear correlation. The value revealed the moderate correlation that shows a good level of prediction of the data. It also indicates a degree of the quality of the forecast of Agricultural productivity (dependent variable). However, R2 (often called as coefficient of determination) which is .535 tells the variation for the dependent variable. It is the proportion of variance in the dependent variable (Agricultural productivity) which can be explained by the climate change. Therefore, it can be concluding that the climate change is explaining approximately 53.5% of the variability of the dependent variable (Agricultural productivity). Adjusted R-square shows the generalization of the result, that is the variation of the sample results from the population in linear regression.

Table 2. ANOVA summary of regression analysis

Model	*df*	*F*	*p*
Regression	2	94.040	.000a
Residual	106		
Total	108		

* $p < .05$. ** $p < .01$.

The table above displays that the climate

change is statistically and significantly estimate the dependent variable (Agricultural productivity). The value is F (2, 106) = 94.040, p < .000, this means that the regression model is a good fit for the data. The result indicated that Agricultural productivity was significantly predicted by the climate change.

Table 3. Summary of regression variable predicting agricultural productivity

	Unstandardized Coefficient		Standardized Coefficient		
Variables	*B*	*std.error*	*β*	*t*	*p*
Constant	30.923	2.23-		13.864	.000
Climate change	-.262	.056	-.341	-9.697	.000

**p<.01.

The table 3 indicates how independent variable (climate change) affects dependent variable (agricultural productivity). Unstandardized coefficients point out how much the independent variable predicts the dependent variable. Moreover, significant value in the table designates to test a statistical significance of climate change. It required being smaller than .05. However, the result of the table revealed the negative effect of climate change on agricultural productivity = -.342, p = .000. This indicates that the value of agricultural productivity will decrease by the value under column labelled B of the regression model when the value of climate change changed by unit. Therefore, and based on the significant value the null hypothesis is rejected. That means climate change has negative effect on agricultural productivity.

3.2 Hypothesis 2 Testing

Ho2: There is no significant relationship between agricultural productivity and household income in rural areas of Dambatta Local Government Area, Kano State

Table 4 Pearson correlation for the variables

Variables	*r*	*p*	*n*
Agricultural productivity	.642**	·000	108
Household Income	.642**	000	108

** Correlation is significant at the 0.01 level (2-tailed).

The table above indicates a strong positive correlation between Agricultural productivity and household income in rural areas of Dambatta Local Government Area, Kano State., r = .642, n =108, p= 0.000. P <.05. However, the P =0.000 which is extremely less than .05 indicates a statistically significant correlations between the two variable. This means increase in agricultural productivity do significantly relate to increase in household income in rural areas of Dambatta Local Government Area, Kano State. The result shows how agricultural productivity relates to household income in rural area. Therefore, the analysis accepted to reject the second null hypothesis.

3.3 Hypothesis 3 Testing

Ho3: Household income has no significant effect on rural children's educational enrolment in rural areas of Dambatta Local Government Area, Kano State

Table 5 Regression coefficient-model of summary

Model	R	R^2	R^{2adj}	$S^{td.error}$
1	.721	.596	.559	.46073

a. predictor: (constant) household income

The table 1 indicates the R value 0.721 that signifies a linear correlation. The value revealed a strong correlation that shows a good level of prediction of the data. It also indicates a degree of the quality of the forecast of students' enrolment in the school

(dependent variable). However, R2 (often called as coefficient of determination) which is .596 tells the variation for the dependent variable. It is the proportion of variance in the dependent variable (students' enrolment) which can be explained by the independent variable (household income). Therefore, it can be concluding that the household income is explaining approximately 59.6% of the variability of the dependent variable (students' enrolment). Adjusted R-square shows the generalization of the result, that is the variation of the sample results from the population in linear regression.

Table 6. ANOVA summary of regression analysis

Model	*df*	*F*	*p*
Regression	1	84.042	.000a
Residual	106		
Total	107		

* p < .05. ** p < .01.

The table above displays that the climate change is statistically and significantly estimate the dependent variable (students' enrolment in the school). The value is F (1, 107) = 84.042, p < .000, this means that the regression model is a good fit for the data. The result indicated that students' enrolment in the school was significantly predicted by the household income.

Table 7. Summary of regression variable predicting agricultural productivity

	Unstandardized Coefficient		Standardized Coefficient		
Variables	*B*	*std.error*	*β*	*t*	*p*
Constant	50.853	3.12		3.969	.000
Household income	.623	.041	.721	3.952	.000

**p<.01.

The table 3 indicates how independent variable (household income) affects dependent variable (students' enrolment in the school). Unstandardized coefficients point out how much the independent variable predicts the dependent variable. Moreover, significant value in the table designates to test a statistical significance of household income. It required being smaller than .05. However, the result of the table revealed the strong positive effect of household income on students' enrolment in the school = .721, p = .000. This indicates that the value of students' enrolment in the school will increase by the value under column labelled B of the regression model when the value of household income changed by unit. Therefore, and based on the significant value, the null hypothesis is rejected. That means household income has strong positive effect on students' enrolment in the school.

Discussion

The findings from this study provide significant insights into the relationships between climate change, agricultural productivity, household income, and student enrollment in rural areas, specifically in Dambatta Local Government Area, Kano State.

Firstly, the study revealed a moderate yet statistically significant negative impact of climate change on agricultural productivity. With an R value of 0.341, the correlation between climate change and agricultural productivity is moderate, indicating a somewhat reliable prediction model. The R^2 value of 0.535 further supports this, showing that approximately 53.5% of the variability in agricultural productivity can be explained by changes in climate. This suggests that while other factors may influence agricultural productivity, climate change plays a substantial role in this context. The negative coefficient of -.342 underscores the detrimental impact of climate change on agricultural productivity, which aligns with

existing literature highlighting how adverse climate conditions can reduce crop yields, disrupt farming schedules, and ultimately decrease agricultural output.

Moreover, the strong positive correlation (r = 0.642) between agricultural productivity and household income illustrates that increased agricultural output directly contributes to higher household income in these rural areas. This is critical as it shows the economic vulnerability of rural households to changes in agricultural productivity, which is heavily influenced by climate change. As agricultural productivity declines, household income is likely to decrease, potentially exacerbating poverty and food insecurity.

Furthermore, the study underscores the significant positive effect of household income on student enrollment in schools, with a strong correlation (R = 0.721) and an R^2 value of 0.596. This indicates that nearly 60% of the variability in student enrollment can be attributed to changes in household income. The strong positive coefficient (.721) suggests that as household income increases, so does student enrollment, underscoring the importance of economic stability for educational access in rural areas. This relationship highlights the indirect impact of climate change on education through its effect on agricultural productivity and, consequently, household income.

Conclusion

The study concludes that climate change significantly affects agricultural productivity in Dambatta Local Government Area, Kano State, which in turn impacts household income and student enrollment in schools. The moderate correlation between climate change and agricultural productivity indicates that while other factors are also at play, climate change is a significant predictor of agricultural outcomes. The strong positive relationship between agricultural productivity and household income underscores the economic dependence of rural households on farming activities, making them particularly vulnerable to the adverse effects of climate change. Additionally, the strong positive effect of household income on student enrollment highlights the broader social implications of economic changes driven by agricultural productivity.

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