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INFLUENCE OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTION OF FARMERS COOPERATIVE MEMBERS. A STUDY OF SELECTED AGRICULTURAL COOPERATIVE IN EHIME MBANO LOCAL GOVERNMENT AREA OF IMO STATE, NIGERIA.

[1]*Okonkwo, Chukwudi Joseph,* [2]*Okafor, Ogochukwu Esther* & [3]Ngene, Ngozi Chioma

[1]Department of Cooperative Economics & Management, Imo State Polytechnic, Omuma, Imo State. Email- jochy2kng@yahoo.com, +2348035001713

[2]Department of Cooperative Economics & Management, Nnamdi Azikiwe University, Awka, Anambra State. Email- eo.okafor@unizik.edu.ng, +2348060257508

[3]Department of Cooperative Economics & Management, Nnamdi Azikiwe University, Awka, Anambra State. Email- eo.okafor@unizik.edu.ng, +2348064217399

Abstract

This study investigates the influence of climate change on agricultural production among farmers' cooperative members in Ehime Mbano Local Government Area of Imo State, Nigeria. The research addresses a significant research gap in understanding the specific impacts of climate change on cooperative farmers' practices and productivity. The objectives of the study were to examine the effects of flooding, drought, and pests and diseases on crop output, profitability, and income of cooperative farmers in the area. Among the active and functional Farmers' cooperative in the area, 15 cooperative societies were purposively selected having a total membership strength of 2,180. A sample size of 338 respondents were determined using Taro Yamani formula. Through a comprehensive analysis of data collected from selected agricultural cooperatives, the study reveals that climate change poses substantial challenges to cooperative farmers in the study area. Results show significant challenges from climate change. Flooding reduces crop output, drought affects profitability, and pests/diseases diminish income. Recognizing vulnerabilities aids stakeholders in targeted strategies for climate change adaptation. Insights from this study benefit policymakers, agricultural extension services, and cooperative groups, aiding in designing effective adaptation plans. In conclusion, by addressing flooding, drought, and pests/diseases' specific effects, this research enhances cooperative farmers' adaptive capacity, fostering agricultural sustainability in the study area.

Corresponding author: Okafor Ogochukwu Esther - eo.okafor @unizik.edu.nd

Keywords: Climate Change, Agricultural production, Farmers Cooperatives.

Introduction

Agricultural production encompasses activities such as planting, tending, and harvesting crops, as well as raising animals and cultivating agricultural products. It is vital for providing food, raw resources, and industrial materials. Cooperatives are significant in agriculture, historically countering market dominance. They streamline processing and marketing, yielding savings. In the European Union, agriculture contributes 14.2% of total industrial output, with cooperatives generating 38.5% (Ermanno et al., 2013).

Farmers' cooperative members collaborate to enhance economies of scale, market access, and purchasing power. Climate change impacts agricultural outputs through changes in rainfall, temperature, drought, and pest and disease incidence. Human-induced factors like fossil fuel use, deforestation, and industrial processes contribute to climate change, intensifying the greenhouse effect. This phenomenon, retaining heat within the atmosphere, is exacerbated by increased greenhouse gas concentrations, leading to global warming (NASA).

Climate change profoundly affects agriculture, influencing crop yields, livestock, and food security. It can have both positive and negative effects, extending growing seasons for some crops while causing heat stress, reduced productivity, and increased pest risk for others (Lobell et al., 2011; Schlenker and Roberts, 2009). Altered precipitation patterns bring about droughts, floods, and erratic rains, disrupting planting, harvesting, and water availability, ultimately impacting yields (IPCC, 2014).

Extreme weather events intensified by climate change, such as hurricanes and heat waves, threaten crops, livestock, and agricultural infrastructure. These events lead to economic losses and disruptions in food supply (Porter et al., 2014). Climate change's multifaceted impact on agriculture necessitates comprehensive strategies to ensure food security and sustain farming communities.

Nigeria, a climate change hotspot, aims to reduce greenhouse gas emissions to counter irregular rainfall, floods, and drought. Climate change can alter pest and disease distribution and behavior, impacting crop management (Madaki et al., 2023). Shifts in agro-ecological

zones due to climate change may necessitate crop adaptation and affect water availability for irrigation-dependent agriculture (Pautasso et al., 2012; Lobell et al., 2011).

In Nigeria and Imo State in particular, so many research studies have been done on climate change, however no known research study has been done on the influence of climate change on agricultural production of farmers' cooperative members. Hence the need to carry out this study to close the gap.

Therefore, the specific objective of this research work is to examine the effect of flooding, drought, pest and diseases on the Cooperative farmer's crop output in the area.

Conceptual Review

Climate Change

Climate change can lead to shifts in agro ecological zones, impacting crop suitability due to changing temperature and precipitation patterns. While some areas may become less suitable for conventional crops, others may become more beneficial, influencing agricultural practices like crop selection and adaptation methods (Lobell et al., 2011). This shift, exacerbated by changes in rainfall patterns, melting glaciers, and reduced snowpack, can limit irrigation water supply, decreasing crop yields and productivity (Tsojon, 2017).

The impact of climate change on food production has been particularly severe in underdeveloped regions, including Sub-Saharan Africa, where agriculture is a crucial livelihood. Rising temperatures, driven by climate change, can lead to heat stress in various crops, exacerbating food security concerns (Gray, 2021; Tajudeen et al., 2022). The causes of climate change encompass both natural factors like solar activity, cloud formation, and human activities such as greenhouse gas emissions and land use changes (Bast, 2010).

Climate change poses a significant threat to rural farmers and communities, impacting necessities such as water, energy, housing, and food, and has been linked to increased extinction risk for species and heightened hunger vulnerability (Musa and Omokore, 2011). In the agricultural sector, climate change affects animal performance, feed quality, and livestock health, ultimately influencing agricultural productivity (Tsojon, 2017). These effects are observed globally, and Nigeria, despite its agricultural significance, is not immune to the

impact of climate change, affecting the productivity of Nigerian farmers (Tsojon, 2017).

Drought

Drought, characterized by substantial rainfall deficit and hydrological imbalances, impacts land systems and agricultural productivity in various climatic zones (Um et al., 2017). It poses threats to agriculture, ecosystems, and societies, gradually developing with lasting and pervasive effects (Yue et al., 2018). Historical instances of drought-induced famines in Northern Nigeria, exacerbated by factors like overgrazing and poverty, highlight its detrimental impact (Shiru et al., 2018; Abaje et al., 2013; Eze, 2017).

Drought's influence on agriculture stems from reduced soil moisture, affecting crop yields, water availability, and subsequent economic and social repercussions (Dalezios et al., 2017). Managing drought's impact requires understanding its spatial and temporal variability, crucial for mitigating its adverse effects on agriculture (Zipper et al., 2016). Severe drought may prompt farmers to shift from expansion to drought mitigation strategies, and famine drought, an extreme form, can severely undermine food security (Dalezios et al., 2017). The complex relationship between drought and famine underscores the need for comprehensive approaches to address these intertwined challenges.

Flood

Floods, natural phenomena arising from heterogeneous rainfall patterns, significantly damage various sectors, with agriculture particularly vulnerable due to its climatic dependence (Sîli et al., 2020). In Nigeria, floods manifest through coastal, river, urban, and dam-related events, adversely affecting farmers, causing loss of agricultural produce, hindering transportation, and leading to economic hardships (Joy and Edet, 2018; Sohel et al., 2015). These floods also facilitate the spread of pathogens, contributing to crop degradation and impacting peasant farmers (Khan, 2018).

Globally, floods occurred around 149 times annually from 2009 to 2018, inflicting substantial damages, totaling nearly $400 billion across industries, with agriculture bearing a significant share (CRED 2020). In developing countries, floods ranked second to droughts in agricultural catastrophes, resulting in $21 billion of crop and

animal losses from 2008 to 2018 (FAO 2021).

Pests and Diseases

Pests encompass various organisms damaging crops or livestock, including weeds, animals, and pathogens, leading to reduced food quantity and quality (Waterfield and Zilberman, 2012). Insect pests significantly contribute to global crop output losses, threaten food security, and diminish farmer income, with examples from Nigeria showing substantial production reductions and yield losses (Zakari et al., 2014). Despite available pest management approaches, Nigerian farmers often lack active control over pests in their field crops (Waterfield and Zilberman, 2012).

Empirical Review

Yamauchi (2014) examines climate change effects on agricultural productivity in the Lower Mekong Basin, attributing decreased agricultural productivity to weather unpredictability and shifting seasons.

Oluwatayo and Ojo (2016) illustrate climate change's impact on Nigerian yam production, emphasizing the vulnerability of rain-fed agriculture and the importance of adaptive practices.

Jifin (2017) investigates climate change's influence on agricultural productivity in Nigeria's Taraba State, revealing farmers' limited awareness and proposing the need for education and workshops to address climate change adaptation.

Theoretical Framework – System Theory

This study is anchored on the System theory. System theory says that a change in one component of a system may affect other components or the whole system. It may be possible to predict these changes in patterns of behavior. This is relevant to the work because once there is a change in climate it will adversely affect agricultural production which will bring about low productivity and yields.

Methodology

Research Design

The research design adopted for this study is the survey research design. Data for this study was collected from the conventional sources; primary and secondary data. Data were gathered from the primary source through questionnaire that was self-administered while secondary source of information

were journals, textbooks and other records that are relevant to the study.

The area of the study is Ehime Mbano local government area of Imo state. Ehime Mbano is a Local Government Area of Imo State, Nigeria. Its headquarters are in the town of Umuezeala Owerre. It has an area of 169 square km and a population of 130,931 at the 2006 census.

Among the active and functional Farmers' cooperative in the area, 15 cooperative societies were purposively selected having a total membership strength of 2,180.

The sample size was determined using Taro- Yamani (1964:250) formula as this;

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

Where n = Signifies sample size

N = Signifies the population under study

1 = Constant

e = The degree of error expected

N = 2180

e = 0.05

Therefore,

$$n = \frac{2180}{1 + 2180(0.05)^2}$$

$$n = \frac{2180}{1 + 2180x0.0025}$$

$$n = \frac{2180}{6.45}$$

n = 337.9

n = 338 (approximately)

Method and Tools for Data Analysis

Descriptive statistics such as frequency distribution, means and percentages was used to analyze the data obtained to address the objectives of the study. Also inferential statistics, such as one sample t-test and regression was employed to address the research questions and to test the promulgated hypotheses.

Effects of Flooding	SA	A	U	D	SD	Mean	Remark
During the flooding season, yields significantly decrease.	56	226	0	0	46	3.75	Accept
Flooding leads to a decrease in the quality of my crops.	67	238	0	0	23	3.99	Accept
Flooding has a negative impact on productivity of crops.	67	238	0	0	23	3.99	Accept
Difficulties managing my crops effectively during the flood season.	46	259	23	0	0	4.07	Accept
Occurrence of floods hampers my ability to harvest my crops on time.	23	236	23	23	23	3.65	Accept
Flooding reduces the market value of my crops.	23	250	23	32	0	3.80	Accept

DATA PRESENTATION AND ANALYSIS

Of 338 questionnaires distributed 328 were returned.

Table 1: Effect of Flooding on the Cooperative Member's Farm Output

Source: Field survey 2023

Table 1 above analyzed the effect of flooding on the cooperative member's farm output. Out of the six (6) variables used for the effect of flooding was significant on all. They include; decreased yield, negative overall productivity, difficult crop management, hindered harvests, reduced market value.

effect of drought was significant in five (5). They include; Reduced Profitability, Decreased yield, Negative financial return, Personal fin losses, Reduce demand & price. The only variable that was not significant was; drought causing increase expenses on irrigation and water. Since five (5) of the six (6) variables were significant, the researcher concludes that drought changes affects cooperative members' farm output.

Effects of Pests and Diseases	SA	A	U	D	SD	Mean	Rmk
Pests/ diseases have a detrimental effect on my crop's health and yield.	76	252	0	0	0	4.23	Accept
Pests/diseases increases farming expenses for pest control measures.	23	238	21	0	46	3.59	Accept
Financial losses due to damage caused by pests & diseases on my crops.	67	238	0	0	23	3.99	Accept
Managing & controlling pests/diseases significantly impact my income.	46	238	0	23	21	3.81	Accept
Occurrence of pests and diseases lowers the market value of my crops.	90	238	0	0	0	4.27	Accept
Challenges in effectively managing pests/diseases in farming practices.	90	215	0	0	23	4.06	Accept

Table 2: Effect of Drought on the Cooperative Member's Farm Output

Effects of Drought	SA	A	U	D	SD	Mean	Rmk
Drought significantly reduces my farm's profitability.	90	229	9	0	0	4.25	Accept
Lack of water during drought periods leads to a decrease in crop yield.	46	282	0	0	0	4.14	Accept
Drought negatively affects financial returns from my farming activities.	69	238	21	0	0	4.15	Accept
Financial losses due to adverse impact of drought on my farm.	44	215	23	23	23	3.71	Accept
Drought causes increased expenses for irrigation & water mgt, reducing profits.	0	164	42	53	69	2.92	Reject
Occurrence of drought reduces the market demand/ prices for my crops.	92	206	0	30	0	4.10	Accept

Source: Field survey 2023

Table 2 above analyzed the effect of drought on the cooperative member's farm output. Out of the six (6) variables used,

Table 3: Effect of Pests and Disease on the Cooperative Member's Farm Output

Source: Field survey 2023

Table 3 above analyzed the effect of pest and diseases on the cooperative member's

farm output. Out of the six (6) variables used for the effect of pest and diseases was significant on all. They include; Detrimental effect on crop's health & yield, increased expenses, financial losses, Management & Controlling impact income, Lowered market value, Challenging farm practices.

Table 4: Regression Estimates showing the effect of Flooding on the Cooperative Member's Farm Output

Model	B	Std Error	Beta	T	Sig
Constant	-2.152	.463		-4.653	.000
Decreased yield	.464	.037	-.639	-12.442	.000
Negative overall productivity	1.548	.054	1.664	28.813	.000
Difficult Crop mgt	1.101	.082	.587	13.483	.000
Hindered harvests	-.507	.055	-.574	-9.277	.000
Reduced market value	-.782	.072	-.645	-10.894	.000
R	.866[a]				
R^2	.750				
Adj. R^2	.746				
F-statistics	193.223				

a. Predictors: (Constant), Decreased yield, Negative overall productivity, Difficult crop management, Hindered harvests, Reduced Market Value.

The implication of the above estimation is that about 75% of the variation in the dependent variable (Cooperative member's farm output) was explained by the independent variables (Decreased yield, Negative overall productivity, difficult crop management, Hindered harvests, Reduced Market Value).

This can be interpreted as a very strong positive relationship between the dependent and independent variables. The adjusted R^2 means that our model has accounted for 75% of the variance in the dependent variable, the remaining 25% of the variation in Cooperative member's farm output is explained by stochastic factors. The F-statistics with value of 193.223, explains that the independent variables jointly explained the variation that occurred in the dependent variables and thus reveals the model to have a good fit for prediction.

Hypothesis One

Ho_1: There is no significant influence of flooding on the Cooperative member's farm output in the study area.

Decision: Since the calculated t-value is higher than the table t-value and p-value is significant, the null hypothesis is rejected. Therefore, we conclude that

flooding influences Cooperative member's farm output in the study area.

Table 5: Regression Estimates showing the effect of Drought on the Cooperative Member's Farm Output

Model	B	Std Error	Beta	T	Sig
Constant	4.371	.726		6.022	.000
Reduced Profitability	.057	.095	.033	.598	.550
Decreased yield	.489	.250	.200	1.954	.052
Negative financial return	-.433	.144	-.256	-3.017	.003
Personal fin losses	-.223	.071	-.267	-3.162	.002
Increase expenses on irrigation, water	-.476	.057	-.686	-8.356	.000
Reduce demand & price	-.165	.083	-.154	-1.975	.049
R	.775[a]				
R^2	.601				
Adj. R^2	.593				
F-statistics	80.467				

a. Predictors: (Constant), Reduced Profitability, Decreased yield, Negative financial return, Personal fin losses, Increase expenses on irrigation, water, Reduce demand & price.

The implication of the above estimation is that about 60.1% of the variation in the dependent variable (Cooperative member's farm output) was explained by the independent variables (Reduced Profitability, Decreased yield, Negative financial return, Personal fin losses, Increase expenses on irrigation, water, Reduce demand & price).

This can be interpreted as a very strong positive relationship between the dependent and independent variables. The adjusted R^2 means that our model has accounted for 60.1% of the variance in the dependent variable, the remaining 39.9% of the variation in Cooperative member's farm output is explained by stochastic factors. The F-statistics with value of 80.467, explains that the independent variables jointly explained the variation that occurred in the dependent variables and thus reveals the model to have a good fit for prediction.

Hypothesis Two

Ho_2: There is no significant influence of drought on the Cooperative member's farm output in the area.

Decision: Since the calculated t-value is higher than the table t-value and p-value is significant, the null hypothesis is

rejected. Therefore, we conclude that drought influences Cooperative member's farm output in the study area.

Table 6: Regression Estimates showing the effect of Pest and Diseases on the Cooperative Member's Farm Output

Model	B	Std Error	Beta	T	Sig
Constant	-3.020	.371		-8.130	.000
Detrimental effect on crop's health & yield	1.621	.140	.805	11.586	.000
Increased expenses	-.130	.030	-.170	-4.306	.000
Financial losses	-.356	.047	-.383	-7.583	.000
Mgt & Controlling impact income	-.065	.027	-.075	-2.410	.016
Lowered market value	.571	.126	.300	4.521	.000
Challenging farm practices	-.540	.030	-.604	-17.947	.000
R	.878[a]				
R^2	.771				
Adj. R^2	.767				
F-statistics	180.429				

a. Predictors: (Constant), Detrimental effect on crop's health & yield, Increased expenses, Financial losses, Management & Controlling impact income, Lowered market value, Challenging farm practices.

The implication of the above estimation is that about 77.1% of the variation in the dependent variable (Cooperative member's farm output) was explained by the independent variables (Detrimental effect on crop's health & yield, Increased expenses, Financial losses, Management & Controlling impact income, lowered market value, Challenging farm practices).

This can be interpreted as a very strong positive relationship between the dependent and independent variables. The adjusted R^2 means that our model has accounted for 77.1% of the variance in the dependent variable, the remaining 22.9% of the variation in Cooperative member's farm output is explained by stochastic factors. The F-statistics with value of 180.429, explains that the independent variables jointly explained the variation that occurred in the dependent variables and thus reveals the model to have a good fit for prediction.

Hypothesis Three

Ho_3: There is no significant influence of pests and diseases on the Cooperative member's farm output in the area.

Decision: Since the calculated t-value is higher than the table t-value and p-value is significant, the null hypothesis is rejected. Therefore, we conclude that pests and diseases influences Cooperative member's farm output in the study area.

Discussion of Findings

The study's hypotheses are supported by significant p-values, leading to the rejection of null hypotheses. Flooding, drought, and pests have significant impacts on Cooperative member's farm output in the study area, aligning with previous research findings (Sohel et al., 2015; Dalezios et al., 2017; Waterfield and Zilberman, 2012; Zakari et al., 2014). These findings underscore the need for targeted climate change adaptation strategies, benefiting policymakers, agricultural services, and cooperative organizations in the design and implementation of effective measures to address these challenges.

Conclusion and Recommendations

Conclusion

This study highlights that farmers' cooperatives are collaborative organizations formed by agricultural producers to collectively sell goods, access resources, and provide services, but notes that climate change profoundly affects agricultural output, impacting crop yields, livestock productivity, and food security. Addressing specific challenges like flooding, drought, and pests offers crucial insights for enhancing cooperative farmers' adaptive capacity and ensuring sustainable agricultural practices in the study area, particularly evident through significant influences of flooding, drought, and pests on farm output in Ehime Mbano Local Government Area, Imo State.

Recommendations

The study's recommendations emphasize the need for novel strategies to mitigate climate change impacts on farmers' cooperatives, particularly by establishing emergency relief funds and materials to address losses caused by flooding, drought, and pest and diseases, urging a reconsideration of traditional approaches to financial aid, technology, and management to enhance resilience among cooperative members.

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