FLOODS AND FOOD SECURITY: AN ANALYSIS OF AFFECTED CROP PRODUCE AND MITIGATION MEASURES IN KOGI STATE, NIGERIA

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ABSTRACT

This study aimed at analysing the effects of floods on food security with particular focus on crop produce as well as mitigating efforts in Kogi State, Nigeria. The two research questions and one null hypothesis that guided the study were analysed using data gathered with a research instrument from 45 farmers who were affected by floods between 2012 and 2022. Using percentage, frequency, mean, standard deviation, skewness and kurtosis for the research question, and chi-square logistic likelihood ratio inferential statistics for the null hypothesis, the analysis revealed that cereal grains, fruits, pulses (legumes), vegetables, tuber crops, spices and herbs, oil-seed and fiber crops were affected by floods. The study dropped the null hypothesis – which suggested that there is significant difference between the observed and expected values of the two categories (floods and food security). Accordingly, the study concluded that floods did extremely affect crop produce and the farmers have made mitigation efforts, but they have been considerably inadequate; hence desirable results have not been achieved. It is therefore, recommended that governments at all levels as well as non-governmental organizations should make strategic efforts in mitigating the effects of floods on food security.

Keywords: *Floods, Food Security, Crop Produce*
JEL Classification*: D62, 013, Q01, Q12, Q18*

1. Introduction

The world faces numerous environmental challenges due to human activities and natural processes – causing rising temperatures, heatwaves, wildfires, extreme weather events and floods. These challenges threaten ecosystems, biodiversity, and human well-being. Floods are among the most common and devastating natural disasters, occurring when water overflows onto normal dry land. They can result from heavy rainfall, overflowing rivers, storm surges, or dam failures. Floods have been one of the major issues of climate change that affects agricultural production (Abid,

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Schneider, & Scheffran, 2016). Floods occasioned by climate change have wide-ranging economic consequences that affect individuals, communities, businesses, and entire economies in the world; especially, in the underdeveloped one such as Nigeria. The economic impact of floods includes direct costs related to damage and destruction, as well as indirect costs that have rippled through the economy over time (Ejemeyovwi, Obindah, & Doyah, 2018). Floods have caused some direct costs such as property damage, agricultural losses, business disruption, and infrastructure damage. The indirect costs have been experienced in terms of economic slowdown, increased insurance claims and costs, loss of productivity and reduction in tourism activities in the Nigerian states, like Kogi.

Kogi State is an agricultural state in Nigeria with over two million hectares of arable land where major food crops like maize, rice, guinea corn, yam, cassava, groundnut, and vegetables are cultivated. It is a state where cash crops such as cocoa, coffee, kola-nuts, cashew nut, timber, banana and plantains are also well grown (Kogi State Ministry of Agriculture, 2020; FAO, 2021). It is bordered by nine states and the capital of the country, Abuja. The position of the state is strategic as agricultural produce harvested can easily be transported to other parts of the country for consumption. It serves as a food-belt for the transportation of agricultural produce from the Southern-to-Northern parts of the country and vice versa. As a result of climate change, the confluence of rivers, Niger and Benue States are affected by variation in the natural hydrological cycles, leading to changes in river flow patterns and increases floods cases in Lokoja, Kogi State. Floods have become a source of concern since it is a source of floods that affect agricultural production in the state.

Floods occur due to a variety of natural and human-made factors and have been one of the most common and destructive natural disasters that affect agricultural produce. Non-dredging of the two rivers and constant release of excess water from the Kainji dam in Niger or the Shiroro dam in Kaduna or the Lagdo dam in Cameroon remain the major sources of floods in Kogi State (RIWA, 2022). Ejemeyovwi, Obindah and Doyah (2018) noted that the 2012 flooding in Nigeria is considered the heaviest of all times as it greatly affected food security in the country; and Kogi state was not insulated. The floods affected rice production, maize, soybean, cassava, and cowpea causing a reduction in output by 22.4 percent, 14.6 percent, 11.2 percent, 9.3 percent and 6.3 percent respectively (RIWA, 2022). The 2012 floods in Nigeria covered over 1.9 million hectares of arable lands and swept away large number of crops (Abid, Schneider, & Scheffran, 2016).

In view of this, our focus is on the direct cost with emphasis on agricultural losses. This focus is pertinent because floods can devastate crops, livestock, and agricultural land, leading to significant losses for farmers and agricultural sector – which leads to higher food prices and food shortages. In fact, the recent report by the National Bureau of Statistics (2023) revealed that food price index was about 41% in

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the first quester of this year in Kogi State, Nigeria. This implies that the state has the highest incessant increase in general price level of foods, and this is attributed to low agricultural produce as a result of incessant floods. Accordingly, this study aims at analysing affected crop produce and the mitigation measures made by the farmers, Kogi State, Nigeria. The other four aspects of the paper (literature review, method of study, results and interpretation and concluding remarks) are presented subsequently.

2. Literature Review

2.1 Theoretical Review

Ecological Systems Theory

This theory views the environment as a complex system of interacting components, including climate, soil, water, and biological organisms. Changes in one component can have cascading effects on the entire system. Flooding as a result of climate change disrupts ecological systems, affecting crop and livestock health, pest and disease dynamics, and overall ecosystem services that support agriculture. Ecological Systems theory represents a convergence of biological, psychological, and social sciences. Through the study of the ecology of human development, social scientists (Ejemeyovwi, Obindah & Doyah, 2018; Bodkin, 2019; Gershon & Mbajekwe, 2020; Eshete, Mulatu & Gatiso, 2020; Bronfenbrenner, 2023) seek to explain and understand the ways in which an individual interacts with the interrelated systems within that individual's environment.

Food Availability Theory

This theory focuses on the physical availability of food as a key component of food security. It emphasizes the importance of having sufficient food production and supply to meet the population's needs. The relevance of this theory cannot be over emphasized because of the continuous impact of climate change on food availability by altering agricultural productivity, affecting crop yields, and disrupting supply chains. Sen (2023) argued that the assumption that total food-availability decline (FAD) is the central cause of all famines is informed by incessant increase in unfavourable effect of climate change. He further posited that the more proximate cause is the so-called "entitlement failure in food supply," which occurs even at the wake of decline in aggregate food production occasioned by climate change. It therefore means that climate change is largely responsible for food unavailability which means not having enough food is physically present for the entire population.

2.2 Empirical Review

Idumah, Mangodo, Ighodaro and Owombo (2016) lent their contribution to the ongoing debate on the effect of climate change on food security in Nigeria by reporting that rainfall strongly and positively affect food production. Lone, Qayoom,

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Singh, Dar, Kumar, Dar, Fayaz, Ahmad, Lyaket, Bhat and Singh (2017) who examined real effect of climatic change on food production in India by adopting qualitative and descriptive techniques reported that flooding is inversely correlated with food production. By implication, flooding militates against food production in the study area. In a related development, Uger (2017) specifically examined the effect of flooding on yam production in Benue state of Nigeria. Using descriptive and multi-linear regression model analyses were adopted and the result stands confirms the existence of a significant relationship between the series. In essence, it implies that moderate climate change exhibits a strong favourable impact on yam production in the study area.

With the aim of examining the influence of both climate and non-climate change factors on the output performance of crops in Nigeria using ECM, Agba, Adewara, Adama, Adzer and Atoyebi (2017) reported that in the immediate period, only rainfall demonstrate a significant positive influence in promoting crop production. But in the future term, all the climate factors incorporated in the model of this study proved to exert positive and significant influence on crop output performance. Bosello, Campagnolo, Cervigni and Eboli (2018) examined the effect of climate change and agriculture output performance in Nigeria. The overall finding indicated that the cost effectiveness of the climate change depends crucially on the possibility of implementing adaptation by exploiting low-cost opportunities which show a benefit-cost ratio larger than one in all climate regimes.

In a similar study, Ejemeyovwi, Obindah and Doyah (2018) delve into empirical connection between carbon dioxide emission and crop production from 1970 to 2015 using fully modified least square method. Result indicated that the effect of carbon emission on crop yield is strong and positive. Gershon and Mbajekwe (2020) examined the empirical connection between climate change and agriculture output performance by disaggregating the sector into crop production and livestock production respectively from 1981 to 2017 by adopting the dynamic ARDL model. The finding indicates the evidence of future union between climate change and crop output performance, while long run connection failed to be established between climate change and livestock production.

Eshete, Mulatu and Gatiso (2020) investigated the influence of carbon emission on agricultural output through the adoption of the recursive Dynamic Computable General Equilibrium (DCGE) model. The finding indicated that the regressor (carbon emission) exerted a strong inverse influence on food output performance in the study area. The attempt to investigate the effect of climate change on food production, the work of Alehile, Njiforti, Duru and Jibril (2022) adopted the Non-linear Auto-regressive Distributed Lag (NARDL) model for period of 30 years and found a negative direct effect of climate change on food output in the immediate period. Tagwi (2022) examined the influence of carbon dioxide emissions (CO_2),

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renewable energy usage, and climate change on the performance of the agriculture sector in the South Africa's national economy from 1972 to 2021 by adopting the ARDL model. While the renewable energy use was found to demonstrate an intangible effect on crop yield in same period, the study also revealed that in the immediate period, climate change causes a decline in the growth rate or performance of the agricultural sector and a rise in agriculture productivity will cause a significant rise in carbon dioxide emissions.

Kurukulasuriya, Kala and Mendelsohn (2011) investigated the effect of adaptation and climate change with focus on irrigation and farm income in Africa. Mainly examined the effect of climate change on how to choose irrigation farming given the conditional income generated by each farmer. The finding revealed that the choosing irrigation faring is responsive to both temperature and precipitation. While rainfed and irrigated farm income also are responsive to climate although. Branca, Lipper, McCarthy and Jolejole (2013) submited that any deviation from food security is always threatened by floods. For Idumah, Mangodo, Ighodaro and Owombo (2016), food security is associated with the absence of malnutrition or undernourishment, or the fear of a shortage of food – a state of affairs affected by climate change. Marie, Yirga, Haile and Tquabo (2020) argued that the agriculture sector is threatened seriously by climate change in the sub-Saharan Africa economies. Ojo and Baiyegunhi (2021) asserted that food security has become susceptible on the account of incessant flooding that has ravaged Nigerian region bordered by River Benue and Niger.

3. Method of Study

This study adopted descriptive research design with an objective to systematically and descriptively identify crop produce that have been affected by floods, as well as possible mitigation efforts made by the farmers from 2012 to 2022 in the three most affected areas (Ajaokuta, Katon-Karfe and Lokoja) of Kogi State, Nigeria. The population of the study comprised all the 45 farmers whose farming activities were affected by floods within the period of the study and were duly registered by the Kogi State Farmers Association, Lokoja branch. Out of the 45 farmers, all were selected using total proportional purposive sampling method. The study designed and used an instrument known as FFSQ – representing Floods and Food Security Questionnaire – which has three sections (demographics, checklist of some crops planted in the study areas and questionnaire statements on mitigation efforts). The instrument was validated by experts in the relevant fields, and its reliability confirmed using Cronbach Alpha test, at 0.78 (78%).

Given the nature of the research questions, percentage, frequency and descriptive statistical tools (mean, standard deviation, variance, skewness and kurtosis) were used to address them, while the null hypothesis was tested using

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Likelihood ratio and Pseudo R-squares (for logistic regression) tools. The use of mean is justified because of its ability to represent the central tendency of the farmers' responses, providing a single value that summarizes the overall trend. Measures of dispersion or spread of data around the mean as well as assesses consistency in the responses, and the degree of the spread is determined by the variance, especially for comparing variability across different groups.

4. Presentation of Results and Interpretation

Research Question One: Which crops produce were affected by floods?

Table 1: Sampled Percentage and Frequency Responses of Cereal Grains Affected by Floods

S/N	Cereal Grains	EA (4)		MA (3)		SA (2)		NA (1)		Sampled	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
1	**Wheat**	15	33.3	12	26.7	10	22.2	8	17.8	45	100
2	**Rice**	17	37.8	20	44.4	5	11.1	3	6.7	45	100
3	**Maize (Corn)**	24	53.3	14	31.1	1	2.2	6	13.3	45	100
4	**Barley**	8	17.8	25	55.6	7	15.6	5	11.1	45	100
5	**Oats**	Nil	0	2	4.4	Nil	0	Nil	0	45	100
6	**Rye**	Nil	0	2	4.4	Nil	0	Nil	0	45	100
7	**Sorghum**	1	2.2	3	6.7	Nil	0	Nil	0	45	100
8	**Millet**	23	51.1	10	22.2	7	15.6	5	11.1	45	100

Source: Field Survey, 2025.

Table 1 presents questionnaire items used to assess how floods affected cereal grains in Kogi State, Nigeria. Out of the 45 sampled farmers, 15 representing 33.3% agree that floods extremely affected (EA) their wheat crop, 12 farmers representing 26.7% responded that their wheat crop was moderately affected (MA), 10 farmers representing 22.2% agreed that theirs was slightly affected (SA) and 8 farmers representing 17.8% agreed that wheat crop was not affected (NA) by floods within the period of the study. Further, 17, 20, 5 and 3 farmers representing 37.8%, 44.4%, 11.1% and 6.7% agreed that floods extremely, moderately, slightly, and not affected their rice production respectively. 24 (53.3%) farmers were of the opinion that floods extremely affected their maize (core), 14 (31.1%) farmers agreed that floods moderately affected their maize, 1 (2.2%) farmer was of the opinion that his maize (core) was slightly affected, and 6 (13.3%) farmers said their maize was not affected by floods within the time of the field survey.

Out of the 42 farmers sampled, 8 (17.8%) said their barley was extremely affected by floods, 25 of them (55.6%) held an opinion that their barley was moderately affected by floods, while 7 farmers representing 15.6% accepted that their barley was slightly affected by floods, as 5 farmers with 11.1% representation agreed that floods did not affect their barley. With respect to "Oats and Rye", no farmer accepted that floods extremely or slightly affected it, but only 2 farmers (4.4%) agreed that their oats and rye were moderately affected. It was also revealed in the table that while 1 farmer agreed that sorghum was extremely affected, 3 farmers were of the opinion that it was moderately affected by floods. 23 farmers representing 51.1% were of the opinion that their millet grain was extremely affected by floods, 10 (22.2%) farmers maintained that their millet was moderately affected by floods, 7 (15.6%) of the total farmers said that their millet was slightly affected by floods and 5 (11.1%) agreed that there was no effect of floods on their millet.

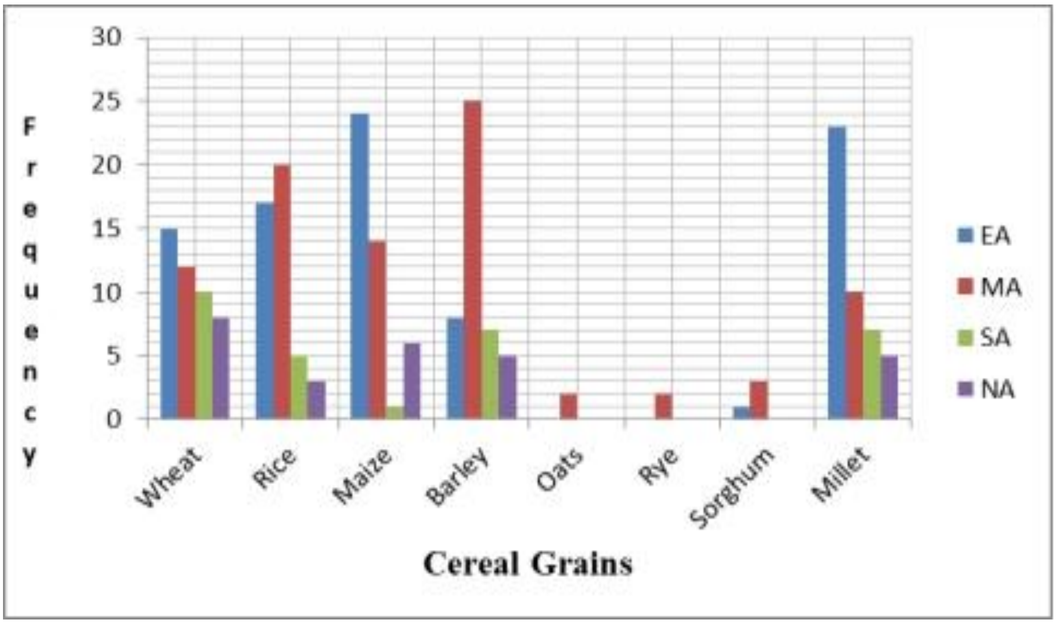

Figure 1: Graphical Representation of Data Distribution on Cereal Grains
Source: Field Survey, 2025.

It is evident from the graphically illustration that most farmers responded that wheat was extremely affected. Farmers whose rice was moderately affected by floods had the greatest number. Farmers who accepted that their maize was extremely affected by floods had the highest number. Farmers whose barley was moderately affected by floods maintained the greatest number. Only two farmers responded that floods moderately affected their oat and rye. Floods moderately affected greater number of farmers, followed by those who accepted it was extremely affected. The number of farmers whom were extremely affected by floods was the greatest in number followed by those who accepted it was moderately affected and slightly affected.

Table 2: Result of Descriptive Statistical Test on Cereal Grains Affected by Floods

Cereal Grains	N	Sum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Wheat	45	124.00	2.7556	1.11101	1.234	-.321	.354	-1.245	.695
Rice	45	141.00	3.1333	.86865	.755	-.921	.354	.444	.695
Maize	45	147.00	3.2667	.98627	.973	-1.316	.354	.752	.695
Barley	45	126.00	2.8000	.86865	.755	-.679	.354	.078	.695
Oats	45	6.00	.1333	.62523	.391	4.575	.354	19.811	.695
Rye	45	6.00	.1333	.62523	.391	4.575	.354	19.811	.695
Sorghum	45	13.00	.2889	.94441	.892	3.103	.354	8.312	.695
Millet	45	141.00	3.1333	1.05744	1.118	-.881	.354	-.547	.695
Valid N (listwise)	45								

Source: An Extract from SPSS Result Output, 2025.

Table 2 reports the result of descriptive statistical test on floods effects on cereal grains such as wheat, rice, maize, barley, oats, rye, sorghum and millet. The test was conducted on the threshold of 2.5 mean score and above as the acceptable point. Findings revealed that wheat, rice, maize, barley and millet have a mean score of 2.76, 3.13, 3.27, 2.80, and 3.13 respectively. This result is further supported by their corresponding negative skewness values which suggest that most extreme responses are found further to the left. This implies that most of the farmers agreed that floods affected crop produce. Furthermore, oats, rye, and sorghum are not affected by the floods. This could be attributed to the fact that very low number of farmers are in the business of cultivating the three cereal grains. This is supported by the fact that the three cereal grains have positive skewedness, in addition to the low values of their means.

Table 3: Result of Percentage and Frequency Responses on Tuber Crops Affected by Floods

S/N	Tuber Crops	EA (4)		MA (3)		SA (2)		NA (1)		Sampled	
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
9.	**Irish Potatoes**	4	8.9	1	2.2	Nil	0	Nil	0	0	100
10.	**Sweet Potatoes**	14	31.1	5	11.1	Nil	0	Nil	0	45	100
11.	**Yams**	10	22.2	7	15.6	Nil	0	1	2.2	45	100
12.	**Cassava**	14	31.1	12	26.7	2	4.4	2	4.4	45	100
13.	**Taro**	Nil	0	1	2.2	Nil	0	Nil	0	45	100
14.	**Beets**	Nil	0	1	2.2	Nil	0	Nil	0	45	100
15.	**Carrots**	Nil	0	3	6.7	Nil	0	Nil	0	45	100
16.	**Turnips**	Nil	0	3	6.7	Nil	0	Nil	0	45	100

Source: Field Survey, 2025.

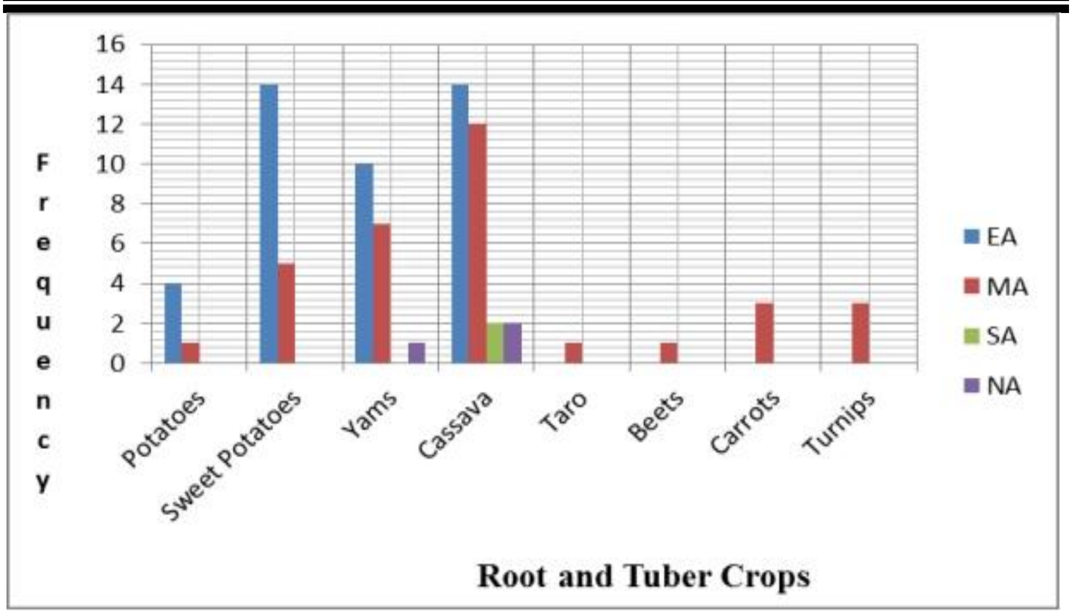

Figure 2: Graphical Representation of Data Distribution on Tuber Crops
Source: Field Survey, 2025.

Table 3 and Figure 2 of the study present the frequency and percentage of responses of 45 farmers on the effect of floods on tuber crops, though not all the sampled farmers cultivated the listed tuber crops. However, the table represents the opinions of those framers who cultivated Irish potatoes, sweet potatoes, yams, cassava, taro, beets, carrots and turnips as listed in items 9 to 16. Out of the 45 sampled farmers, only 5 cultivated Irish potatoes – out of which 4 admitted that floods had extreme effect on their potatoes while 1 accepted that it had moderate effect on it. With respect to sweet potatoes, 14 farmers said floods affected it extremely while 5 farmers acknowledged that floods affected it moderately. Out of the 45 sampled farmers, only 17 cultivated yam – out of which 10 of them accepted that floods extremely affected their crop while 7 maintained that floods affected it moderately.

The 14 farmers who cultivated cassava admitted that floods affected it extremely, the response option of moderate effect of floods on cassava was chosen by 12 farmers, 2 farmers said floods slightly affected cassava production and 2 acknowledged that floods did not affect cassava cultivation. This result points to the fact that more farmers admitted that floods had extreme effect on cassava production. Of the 45 sampled farmer, only 1 farmer planted taro and beets. They admitted that floods had moderate effect on their crops. Carrot and Turnips were planted by 3 farmers out of the 45 sampled farmers. They acknowledged that their crops were moderately affected by floods.

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Table 4: Result of Descriptive Statistical Test of Tuber Crops Affected by Floods

Tuber Crops	N	Range	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Irish Potatoes	45	4.00	.4222	1.21522	1.477	2.615	.354	5.155	.695
Sweet Potatoes	45	4.00	1.5778	1.88883	3.568	.393	.354	-1.858	.695
Yams	45	4.00	1.8222	1.70945	2.922	.033	.354	-1.818	.695
Cassava	45	4.00	2.1778	1.70945	2.922	-.318	.354	-1.687	.695
Taro	45	3.00	.0667	.44721	.200	6.708	.354	45.000	.695
Beets	45	3.00	.0667	.44721	.200	6.708	.354	45.000	.695
Carrots	45	3.00	.2000	.75679	.573	3.595	.354	11.433	.695
Turnips	45	3.00	.2000	.75679	.573	3.595	.354	11.433	.695
Valid N (listwise)	45								

Source: Extracted from the SPSS Results Outputs, 2025.

Using measures of central tendency as descriptive analytical tools, Table 4 presents the result of the test of the effect of floods on tuber crops in the three selected areas of Kogi State, Nigeria. The mean scores of Irish potatoes, sweet potatoes, yams, cassava, taro, beets, carrots and turnips are 1.22, 1.89, 1.71, 1.71, 0.44, 0.44, 0.76 and 0.76 respectively. From this point of view, it is evident that none of the tuber crop received a mean score greater than the criterion mean of 2.5; hence adjudged accepted in relation to the opinions of the 45 sampled farmers as well as the research question. Of statistical interest are the positive values of skewness and kurtosis which indicate that the responses of the sampled farmers were positive in relation to the number of farmers who cultivated respective tuber crops.

Research Question Two: What are the Mitigation Measures Against Floods?

Table 5 presents ten (10) questionnaire items used to identify mitigation measures adopted by farmers against floods in Kogi State, Nigeria. From the responses, it is evident that questionnaire item A has 28, 7, 5 and 5 responses for SA, A, D and SD respectively. This gives rise to total 45 responses and 148 response-sum, with the mean value of 3.29, standard deviation of 1.06 and 1.12 variance. By the mean value, it is instructive to point out that the item is accepted in favour of the research question. The low values of standard deviation (1.06) and variance (1.12) support this claim by revealing that the data point of responses of the 45 sampled farmers do not differ.

Table 5: Transformed Data and Result of Descriptive Statistical Test for Research Question Two

S/N	AC	Questionnaire Items	SA (%)	A (%)	D (%)	SD (%)	N	Sum	Mean	SD	Variance
1	A	Practices such as reduced tillage, crop rotation, and cover cropping help reduce the effect of climate change.	28 (62.2)	7 (15.6)	5 (11.1)	5 (11.1)	45 (100)	148	3.29	1.06	1.12
2	B	Integrating trees and shrubs into agricultural landscapes help to reduce climate change.	16 (35.6)	19 (42.2)	6 (11.1)	4 (11.1)	45 (100)	136	3.02	.97	.93
3	C	Organic farming reduces reliance on synthetic inputs and reduces effect of climate income.	14 (31.1)	20 (44.4)	4 (8.9)	7 (15.6)	45 (100)	131	2.91	1.02	1.04
4	D	Planting trees on agricultural land or converting degraded land into forests can sequester significant amounts of carbon and reduce climate change.	15 (33.3)	19 (42.2)	3 (6.7)	8 (17.8)	45 (100)	131	2.91	1.06	1.13
5	E	Adding compost, biochar, or green manures sequesters carbon in the soil reduces overall atmospheric CO2 levels.	10 (22.2)	24 (53.3)	4 (8.9)	7 (15.6)	45 (100)	127	2.82	.96	.92
6	F	Using energy-efficient machinery and adopting renewable energy sources on farms reduces fossil fuel consumption.	15 (33.3)	19 (42.2)	6 (11.1)	5 (13.3)	45 (100)	133	2.96	1.00	1.00
7	G	Recycling agricultural by-products and waste reduce waste and the need for synthetic inputs, lowering emissions.	9 (20.0)	25 (55.6)	5 (11.1)	6 (13.3)	45 (100)	127	2.82	.91	.83
8	H	Diversifying crops and livestock can spread risk and improve resilience to climate impacts.	22 (48.9)	15 (33.3)	4 (8.9)	4 (8.9)	45 (100)	145	3.22	.95	.90
9	I	Combining crops, livestock, and forestry within a single farming system enhances resource use efficiency.	20 (44.4)	13 (28.9)	6 (13.3)	6 (13.3)	45 (100)	137	3.04	1.07	1.13
10	J	Providing farmers with knowledge and training on climate-smart agricultural practices can empower them to adopt more sustainable practices that mitigate climate change.	32 (71.1)	4 (8.9)	4 (8.9)	5 (11.1)	45 (100)	151	3.36	1.11	1.23
		Average Mean Values	18.1	20.8	4.7	5.7	45	136.6	2.70	1.01	1.02

AC = Analytical Codes. SD = Standard Deviation. SA = Strongly Agree, A = Agree, D = Disagree, SD = Strongly Disagree.

Source: Extract from Result Output, 2025.

Responses on the second questionnaire item with analytical code of B show that out of the 45 responses from the sampled farmers, SA, A, D, SD have 16, 19, 6 and 4 responses respectively. The item has a mean score of 3.02, standard deviation and variance values of 0.97 and 0.93 respectively. From the analysis, it is obvious that the item is accepted in favour of the research question. This acceptance is supported by the low values of standard deviation and variance. Responses to item C of the questionnaire has 14, 20, 4 and 7 for SA, A, D and SD respectively. With a response-sum of 131, the mean score is 2.91, standard deviation is 1.02 and variance stands at 1.04. This shows that the item is accepted in favour of the research question. With respect to item D, the responses of the 45 sampled farmers are 15, 19, 3 and 8 for SA, A, D and SD respectively. This gives rise to 131 response-sum, mean value of 2.91, standard deviation value of 1.06 and 1.13 for variance.

For questionnaire item E, the responses are 10 for SA, 24 for A, 4 for D and 7 for SD, a response-sum of 127, and the values of mean, standard deviation and variance stand at 2.82, 0.96 and 0.92 respectively. By the mean value the questionnaire item is accepted in relation to the research question. Questionnaire item F has respective responses to SA, A, D, and SD as 15, 19, 6 and 5, giving rise to 133 response-sum, 2.96, 1.00 and 1.00 values for mean, standard deviation and variance respectively. Also, this signifies acceptance of the item in favour of the research question. Questionnaire item G of the study has 9 responses for SA, 25 for A, D has 5 and SD gets 6. These responses from 45 sampled farmers give rise to 127 response-sum, 2.82 mean score, standard deviation of 0.91 and 0.83 variance score.

Questionnaire item H has 22, 15, 4 and 4 responses to SA, A, D and SD respectively; with 145 response-sum, 3.22 mean score, 0.95 standard deviation and 0.90 variance scores. All of these point to the fact the questionnaire item is accept accepted in favour of the research question. Questionnaire option responses, SA, A, D and SD, to questionnaire item 'I' have 20, 13, 6 and 6 scores respectively; with response-sum of 137, mean value of 3.04, 1.09 for standard deviation and 1.13 for variance. With the value of the mean, the questionnaire item is accepted in favour of the research question. The responses of the 45 farmers to questionnaire item J are in the distribution of 32, 4, 4 and 5 for SA, A, D and SD respectively. The response-sum stands at 151, mean value is 3.36, standard deviation of 1.11 and variance of 1.23.

It is obvious that all the questionnaire items have mean scores above the criterion mean of 2.50; hence they are all accepted in favour of the research question under consideration. This implies that mitigation measures adopted by farmers against floods in Kogi State, Nigeria, include reduced tillage, crop rotation, cover cropping, integration of trees and shrubs into agricultural landscapes, and organic farming which reduces reliance on synthetic inputs and mitigate the effects of climate change. The result also revealed that planting trees on agricultural land, conversion of degraded land into forests, addition of compost, biochar, or green manures sequesters carbon in the soil reduced overall atmospheric CO2 levels. Using energy-efficient machinery and adopting renewable energy sources on farms reduces fossil fuel consumption and sequester significant amounts of carbon and reduce the effect of floods. Other mitigation effect of floods is recycling agricultural by-products and waste. Diversifying crops and livestock can spread risk and improve resilience to floods effects. In a similar manner, combining crops, livestock, and forestry within a single farming system enhanced resource use efficiency and providing farmers with knowledge and training on floods-smart agricultural practices can empower them to adopt more sustainable practices that mitigate floods.

Table 6: Result of Test of Hypothesis on Model Fitting Information

Effect	Model Fitting Criteria	Likelihood Ratio Tests Likelihood Ratio Test			Pseudo R-Square	
	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig		
Intercept	2.766[a]	.000	0	.	Cox and Snell	.842
J	2.766[b]	.000	3	1.000	Nagelkerke	.954
I	4.464[b]	1.698	3	.637	McFadden	.861
B	5.539[b]	2.773	9	.973		
C	2.766[b]	.000	3	1.000	Model	Model Fitting Criteria
D	2.766[a]	.000	0	.		-2 Log Likelihood
E	2.766[b]	.000	3	1.000	Intercept	85.87
F	2.766[a]	.000	0	.		
G	2.766[b]	.	3	.	Final	2.77
H	4.582[b]	1.816	6	.936		
Summary of Likelihood Ratio Tests		83.10	45	0.000		

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0. (a). This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom. (b). Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.

Source: An Extract from Result Output Analyses With SPSS, 2025.

Table 6 presents the likelihood ratio result of test of hypothesis on whether or not mitigating measures adopted by farmers have significantly reduced the effect of floods on farming activities in Kogi State, Nigeria. The test was done using model fitting criteria of -2 log likelihood of reduced model. The opinions of the sampled

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45 farmers on the ten questionnaire items ranging from A to J were used in the analysis. It is observed that the values of the items are considered high because they are greater than 2. Following this result, it becomes instructive to point out that the questionnaire items raised to address the research questions have no reasonable goodness-of-fit and suitable in identifying the mitigating measures adopted by farmers against floods in Kogi State, Nigeria.

In furtherance of the test of hypothesis, the pseudo regression square test was conducted. The result of the test revealed that Cox and Snell value is R^2 = 0.842; the Nagelkerke test value is R^2 is 0.954; and the McFadden test produces a value of R^2 = 0.861. These results suggest that the model explains about 84%, 95%; and 86% of the variance in the mitigation measures, which is considered a very good fit, however not significant in reducing the effect of flood on crop produce within the period of the study. The table further revealed a likelihood test ratio with a chi-square value of 83.10 – which was used to determine whether there is a significant difference between expected and observed frequencies in categorical data with a degree of freedom (df) of 45. From the result, the p-value of 0.000 suggests that the null hypothesis of no association between the two categorical variables is dropped, and the alternative retained. This implies that the mitigations measures taken by the farmers do not associate with reduction effect of flood on crop produce in Kogi State, Nigeria.

5. Discussion of Results

The results of the analysis revealed that cereal grains (in terms of wheat, rice, maize, barley and millet), fruits, pulses (legumes) and tuber crops (Irish potatoes, sweet potatoes, yams, cassava, taro, beets, carrots and turnips) were affected by floods. From the analysis, it is evident that farmers have adopted certain measures to mitigate the effect of floods on crop produce in Kogi State, Nigeria. The null hypothesis of no significant difference between the observed and expected values of the two categories (floods and food security) is dropped.

The findings of this study are in corroboration with a study by Abbah, Udeh, Mancha and Musa (2023) who argued that floods occasioned by climate change have wide-ranging economic consequences that affect individuals, communities, businesses, and entire economies in Lokoja, Kogi State. Floods have caused some direct costs such as **p**roperty damage, agricultural losses, business disruption, and infrastructure damage (Erekpokeme, 2015), it affected economic activities especially farming by communities bordering these rivers (Abid, Schneider, & Scheffran, 2016; RIWA, 2022).

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6. Conclusion and Recommendation

6.1 Concluding Remarks

This study investigated the impact of flood on crop production, and the mitigation measures taken by farmers in Kogi State, Nigeria. The analysis revealed that floods pose significant threats to human lives, the economy, and the environment. Based on the results, the study conclude that crop produces were extremely affected by floods between 2012 and 2022; although, the farmers have adopted some mitigation measures against floods – which have not yielded desirable results.

6.2 Recommendation

It is therefore, recommended that government at both local and state level should effectively manage it through structural and non-structural measures so as to reduce their impact. Governments, farmers, communities, and individuals must work together to enhance flood preparedness, improve land use policies, and adopt sustainable environmental practices to protect the environment.

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