ASSESSMENT OF FARMERS ADAPTATION STRATEGIES TO RAINFALL VARIABILTY ON INCREASING CROP YIELD IN BENUE STATE, NIGERIA

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ABSTRACT

This study assessed the adaptation strategies and farmers' knowledge for increase crop yield of cereal (maize and rice), root and tuber (cassava and yam), and legume (groundnut, soyabeans)in Benue State. Primary data was collected through a multi stage sampling technique. A questionnaire was distributed to 720 farmers from twelve (12) of the twenty- three (23) Local Government Areas in Benue State based on the production of the cereal (maize and rice), root and tuber (cassava and yam), and legume (groundnut, soyabeans). The data was collected with the assistance of extension workers from Benue State Agricultural Development Agency (BNARDA). The data analysis was through simple techniques of random sampling to issue the questionnaire amongst the respondent. Random technique sampling was used to choose the actual sample for the study and this method decreases human interference and bias. The rationale was to choose areas that are inferred to be common with various essential issues and information about socio-economic impact of the study area. The returned questionnaires were 720 and were used to carry out the analysis. Descriptive statistics was used to analyze the data obtained from questionnaire and survey of farmers. The data was presented using frequency, tables, percentages, charts and figures. The results showed that most farmers are aware of rainfall variability and they also noted that their crop yields are increasing as a result of using choices for adaptation which includes changes of planting dates as well as improvement of crop varieties as adaptation strategies for increasing crop yield. The research concludes that 73 % of farmers have tried and adapted to rainfall variability

Keywords: Farmers, Adaptation Strategies, Rainfall Variability, Crop Yield

Introduction

Over the years, despite the technological advances to crop production around the world such as the introduction of high yield crops, application of fertilizer and provision of extension services, the yield of crops still varies. This results in hunger and starvation of people who solely depend on these crops for their socio- economic activities. Igwebuike, *et al*., (2014) noted that climate prediction and analysis of past and present trends indicate that small- scale farming households in tropical and sub- tropical areas are exposed to increased climate risk and become more and

more vulnerable to these risks which result to the decline of crop yields. Intergovernmental Panel on Climate Change, (IPCC, 2012) also noted that in different countries of Africa, yield from rain-fed agriculture could be reduced by up to 50 % by the year 2020.

Agidi, (2017) also noted the inter- annual rainfall variability and crop yields in Nasarawa State has resulted to the decline of crop yields as a result of variability of rainfall pattern. Akpenpun (2013) noted the relationship between tuber crop yield variations in Kwara State to climate variation. Emmanuel *et al*., (2013) also noted that rainfall is highly variable in Makurdi as well as yield of maize. He revealed that changes in onset and cessation are the main reason for maize yield decline in Makurdi.

Nyagba, (2013) also showed a comparative analysis of the distribution of Rainy Days in different ecological zones in Benue State. Hassan, (2013) using monthly and annual rainfall characteristics to determine precipitation periodicity index, revealed that despite the fact that rainfall has been declining in Federal Capital Territory between 1990 -2005, crop yields has not declined. This may be because of farmer's adaptation techniques which this study wants to investigate. It is against this background that this research seeks to assess the farmer's adaptation strategies.

Materials and Methods

Data Requirements and methods of collection

Twelve out of the twenty three (23) Local Government Areas have been selected based on their production of the crops under study. This is an improvement on the Akpenpuun (2013) where he conducted a research in just one Local Government Area of Benue State using maize yield as it varies with rainfall. Four LGAs each from each of the Agricultural Zone of the State where the crops under study are been produced in commercial quantity. i.e Eastern zone (Ushongo, Vandeikya, Ukum and Kwande), Northern zone (Gboko, Makurdi, Gwer-West and Tarka) and Southern zone (Ohimini, Ado, Gwer-East and Otukpo) respectively. Each LGA were further divided into six (6) extension blocks where selected crop yields under study are at maximum, which will make a total of 36 extension blocks. Four (4) farming communities were randomly selected from each extension blocks which make a total of 72 communities. For each farming community, with an assistance of BNARDA local extension workers, a compilation of lists of crop farmers were also be required and ten (10) crop farmers were randomly selected which will result to a sample size of seven hundred and twenty (720) food crop farmers. That is, 240

questionnaires were being administered from each zone and 60 from each LGA respectively. These structured questionnaires were used to generate data in the study areas and the information gathered were on the socio- economic of the respondents as well as the knowledge of annual rainfall variability and the adaptation strategies adopted. The data were collected with the assistance of extension workers from BNARDA.

The number of farmers included in the study (participants) was determined using Yamani's formula. This formula is concerned with applying a normal approximation with a confidence level of 95 % and a limit of tolerance level (error level) of 3.5 %.

To this extent the sample size were determined by $n = \frac{N}{1+Ne^2}$

Where:

n = the sample size

N = population

e = the limit of tolerance (0.035)

Therefore, $n = \frac{6600}{1+6600(0.035)^2} = \frac{6600}{1+6600(0.001225)} = \frac{6600}{1+8.085} = \frac{6600}{9.16}$

n = 720 respondent.

The study respondents were 720 and simple random sampling were used to distribute the questionnaires among the respondent. Random sampling was used to select the sample for this study and this reduces bias or human interference. The reason was to select cases that are informative and assumed to be familiar with some fundamental issues concerning socio-economic impacts of the study areas. 720 questionnaires were returned and the analysis was carried out based on these returned questionnaires. Descriptive statistics was used to analyse the data obtained from questionnaire and survey of farmers. The data was presented using frequency, tables, percentages and figures.

RESULTS AND DISCUSSION

SECTION A: Socio-Economic, Institutional and farm Specific Characteristics of farmers

Table 4.1 shows the age distribution of respondents. More than 80% of respondents are between the age of 35 years and 65 years. The result shows that most of the farmers are in their average age. This is perhaps an outcome of government action to have everyone active engaged in agriculture.

Table 4.1Distributions of respondent by Age

S/N	Variable	Frequency	Percentage
1	5-20	63	8.75 %
	21-35	104	14.44 %
	36-50	357	49.58 %
	51-65	181	25.14 %
	> 65	15	2.08 %

Source: Author field survey, 2019

Table 4.2 reveals that 69.03 % of farmers in the study areas have no any other source of income other than farming, 30.97 % engaged in other activities other than farming. The high dependence on rain fed farming by the respondents is a great risk to the economy. This is because any negative consequence of climate will render a lot jobless.

Table 4.2 Distributions of respondents by other Sources of Income

S/N	Variable	Frequency	Percentage
7	Other source of income		
	YES	223	30.97 %
	NO	497	69.03 %

Source: Author field survey, 2019

Table 4.3 shows the distribution of respondent according to their access to extension workers. 67.78 % of the respondents have access to extension workers while 32.22 % said they have no

access to extension workers. The high extension workers is a omen for great things, because extension workers are train and send to further disseminate information and demonstrate the use of seed hybrid and improve farming techniques to farmers.

Table 4.3 Distributions of respondents by Access to Extension Workers

S/N	Variable	Frequency	Percentage
8	Access to Extension Workers		
	Yes	488	67.78 %
	No	232	32.22 %

Source: Author field survey, 2019

Table 4.4 shows the distribution of the level of education of the respondents in the study areas. 39 % of the respondent has no formal education while more than 60 % of the respondents have attended at least primary, secondary and tertiary education. This reveals that most of the respondents are literate and hence will be easier to understand concepts of rainfall variability and adaptation strategies for excesses of variability of rainfall.

Table 4.4 Distributions of respondents by level of Education

S/N	Variable	Frequency	Percentage
10	Level of Education		
	Tertiary	97	13.47 %
	Secondary	189	26.25 %
	Primary	150	20.83 %
	Non	284	39.44 %

Source: Author field survey, 2019

Table 4.5 Distribution of Respondents by type of Farming

Table 4.5 shows the distribution of farmers in the study area. 87.50 % revealed they are rain fed farmers, which means they depend on rainfall for their farming activities while 12.50 % are irrigation farmers.

S/N	Variable	Frequency	Percentage
11	Type of farming		
	Rainfed	630	87.50 %
	Irrigation	90	12.50 %

Source: Author field survey, 2019

GROUP B AGRICULTURAL SYSTEM AND CROP YIELDS

Table 4.6 shows the distributions of the crops grown under study in the study areas. 37.22 % of the farmers are engaged in root and tuber crops (yam and cassava) farming. 34.58 % are into cereal crops (rice and maize) farming while 28 % are for legume (soyabeans and groundnuts) farming. Tuber crops have higher percentage because it has short growing period and suitable in all the soil across the State. While cereal has less percentage because it is usually confirm along waterlogged areas and its highly water dependent.

S/N	Variable	Frequency	Percentage
12	Crops grown		
	Yam	171	23.75 %
	Maize	116	16.11 %
	Rice	133	18.47 %
	Cassava	97	13.47 %
	Soyabeans	88	12.22 %
	Groundnut	115	15.97 %

Source: Author field survey, 2019

Table 4.7 shows the distributions of yam harvested by respondents per annum. 46.39 % of respondent harvest between 100-500 tubers of yam per annum which is the highest percentage among respondents. 11.94 % harvest between 6000 and above which is the least.

Table 4.7 Distributions of respondents by total harvest of yam per Annum

S/N	Variable	Frequency	Percentage
15	Total harvest of yam in a year		
	100-500 Tubers	334	46.39 %
	600-1000 Tubers	205	28.47 %
	1000-5000 Tubers	95	13.19 %
	6000 and above Tubers	86	11.94 %

Source: Author field survey, 2019

Table 4.8 shows the distributions of total harvest Maize per annum among respondents. 55.97 % harvest between 10-20 bags of maize per annum which is the highest percentage among the respondent. While 10.28 % harvests between 110 and above bags which is the least percentage among the respondents.

Table 4.8 Distributions of respondents by total harvest of Maize per annum

S/N	Variable	Frequency	Percentage
16	Total harvest of maize in a year		
	10-20 bags	403	55.97
	30-50 bags	147	20.42
	60-100 bags	96	13.33
	110 and above bags	74	10.28

Source: Author field survey, 2019

Table 4.9 shows the distribution of cassava harvested by respondent per annum. 45.83 % of the respondents harvest is between less than 1000 tubers per annum which is the highest percentage among the respondents. 3.61 % harvest is between 15000 and above which constitute the least percentage.

Table 4.9 Distributions of respondents by total harvest of Cassava in a year

S/N	Variable	Frequency	Percentage
17	less than 1000 tubers	330	45.83 %
	1000-5000 tubers	204	28.33 %
	6000-10000 tubers	97	13.47 %
	11000- 15000 tubers	63	8.75 %
	greater than 15000 tubers	26	3.61 %

Source: Author field survey, 2019

Table 4.10 shows the distributions of the total harvest of rice among the respondents in the study area. 46.67 % harvest is between 10-20 bags of rice per annum which represents the highest percentage among the respondents. While the least is 1.53 % with the total harvest of above 110 bags per annum.

Table 4.10 Distributions of respondents by total harvest of Rice per annum

S/N	Variable	Frequency	Percentage
18	Total harvest of Rice per annum		
	less than 10 bags	126	17.50 %
	10-20 bags	336	46.67 %
	30-50 bags	146	20.28 %
	60-100 bags	101	14.03 %
	110 and above bags	11	1.53 %

Source: Author field survey, 2019

Table 4.11 shows the distributions of the total harvest of soyabeans among the respondents in the study area. 47.22 % harvest is between 10-20 bags of soyabeans per annum which represents the highest percentage among the respondents. While the least is 1.67 % with the total harvest of above 100 bags per annum.

Table 4.11 Distributions of respondents by total harvest of Soya beans per annum

S/N	Variable	Frequency	Percentage
19	Total harvest of Soyabeans per annum		
	less than 10 bags	167	23.19 %
	10-20 bags	340	47.22 %
	30-50 bags	102	14.17 %
	60-100 bags	99	13.75 %
	100 and above bags	12	1.67 %

Source: Author field survey, 2019

Table 4.12 shows the distributions of the total harvest of groundnut among the respondents in the study area. 42.64 % harvest is between 10-20 bags of groundnut per annum which represents the highest percentage among the respondents. While the least is 1.39 % with the total harvest of above 100 bags per annum.

Table 4.12 Distributions of respondents by total harvest of groundnut per annum

S/N	Variable	Frequency	Percentage
20	Total harvest of Groundnut per annum		
	less than 10 bags	199	27.64
	10-20 bags	307	42.64
	30-50 bags	126	17.50
	60-100 bags	78	10.83
	100 and above bags	10	1.39

Source: Author field survey, 2019

Table 4.13 shows the distribution of what farmers felt are responsible for changes (increase or decrease) in crop yield.30.28 % of the respondents said the change in crop yield is as a result of the use of improve crop species. This represents the highest of the percentage among the respondents. 3.75 % which is the least choice by respondents said that lack of funds are responsible for changes in crop yield.

Table 4.13 Distributions of farmers perceived causes of changes in crop yield

S/N	Variable	Frequency	Percentage
22	What is responsible for the change?		
	Increase in farm size	72	10.00 %
	Herdsmen crisis	43	5.97 %
	Early planting	76	10.56 %
	Used of fertilizer/pesticides	70	9.72 %
	Climate change	48	6.67 %
	Rain pattern	124	17.22 %
	Uses of new crop species	218	30.28 %
	Use of improve technology	42	5.83 %
	Lack of fund	27	3.75 %

Source: Author field survey, 2019

. **Group C Knowledge of farmers on Rainfall Variability**

Table 4.14 shows the distributions on their knowledge of rainfall variability.66.94 % of the respondents don't have knowledge of rainfall variability while 33.06 % have knowledge. The more number of the respondents not having knowledge on rainfall variability may not be unconnected to the fact that most of the respondents do not belong to any farming club and hence have the tendency of not having the knowledge.

Table 4.14 Distributions of respondents on their knowledge of Rainfall Variability

S/N	Variable	Frequency	Percentage
24	Are you aware of rainfall variability?		
	YES	238	33.06 %
	NO	482	66.94 %

Source: Author field survey, 2019

Table 4.15 shows the distributions of the respondents on their sources of information on rainfall variability. 45.28 % of respondents relied on extension workers for their source of information and knowledge on rainfall variability, while 12.08 % got their information in school. This shows the importance of extension in better informing farmers on new techniques of farming and impending dangers. With a paltry 87 % of respondents getting to know about rainfall variability in schools goes to show that our education is not living up to the reality of the society. Such need to be taught in schools which will help in turning the fortunes of agriculture in the State.

Table 4.15 Distributions of respondents on what is their source of Information on Rainfall Variability

S/N	Variable	Frequency	Percentage
25	Source of information		
	School	87	12.08 %
	Television	109	15.14 %
	Extension workers	326	45.28 %
	None	198	27.50 %

Source: Author field survey, 2019

Table 4.16 shows the distribution of respondents on how rainfall variability manifest. 47.36 % indicated that rainfall manifest as decreased in rainfall while 19.03 % noted that it is manifested

through increase in rainfall. This concurs with the fact that climate change does not give uniform consequence, some places will have drought while others will have flood. The least percentage of manifestation goes to short growing season which has 7.92 %.

Table 4.16 Distributions of respondents by how Rainfall Variability Manifest

S/N	Variable	Frequency	Percentage
26	How does rainfall variability manifest in your area		
	Increased rainfall	137	19.03 %
	Decreased rainfall	341	47.36 %
	Changes in onset/cessation dates	106	14.72 %
	Low rainfall frequency	79	10.97 %
	Short growing season	57	7.92 %

Source: Author field survey, 2019

GROUP D: Knowledge of farmers on rainfall variability adaptation

Table 4.17 shows that 73.89 % of the respondents have tried adaptation strategies to counter the consequences of rainfall variability while 26.11 % have never tried adapting. Adaptation is an inherent process for farmers; the years put into farming activities give the farmer edge in adaptation. As noted by (Govina, 2013) that indigenous traditional knowledge has over the time immemorial played significant role in solving problems that are related to climate change and variability.

Table 4.17 Distributions of respondents on whether they have tried adapting to rainfall variability

S/N	Variable	Frequency	Percentage
28	Have you try adapting to rainfall variability?		
	Yes	532	73.89 %
	No	188	26.11 %

Source: Author field survey, 2019

Table 4.18 shows the distributions of different adaptation methods used by respondents. 55.83 % relied on changing the planting dates as adaptation strategies others, others about 33.33 % used improved crop variety as strategy for adaptation. The least strategy used is insurance which account 0.56 %.

Table 4.18 Distributions of methods of adaptation used by respondents

S/N	What is the adaptation strategies used?	Frequency	Percentage
29			
	Changes in planting date	402	55.83 %
	Used of improved crop varieties	240	33.33 %
	Switch from crop to livestock farming	7	0.97 %
	Insurance	4	0.56 %
	Move to new farm site	12	1.67 %
	Increased water management	7	0.97 %
	Increased in farm size	40	5.56 %
	Used of fertilizer and insecticide	8	1.11 %

Source: Author field survey, 2019

SUMMARY AND CONCLUSION

The computation of responses from the respondents indicates that majority of farmers in the State are male and married. The educational status of most farmers in the State shows that they have attended formal education while about 39 % have no formal education. With 61 % of them having one form of education or the other, it makes it easier to understand rainfall variability and ways to adapt a strategy to manage its effect.

Little number of the respondents has other sources of income while a large number of the respondents depend mainly on farming. This is not too good because of the excessive climatic variability which may turn a lot into unemployed in case of any eventuality.

The respondents were also enquired on their knowledge of rainfall variability, it was observed that 33 % of the respondents are aware and about 73 % of them have attempted adapting in one way or the other. This to a larger extent accounted for the positive trends most of the crops considered (cassava, yam, maize, soyabeans and groundnut).

45 % of the respondents got their information about rainfall variability from extension workers. This shows that there is a positive influence of the extension officers among farmers in Benue State.

47 % of the respondents perceived rainfall variability as in decreased in rainfall amount while 19 % felt the opposite which is increased in rainfall. These supports a lot of assertions that consequences of rainfall variability are not uniform everywhere, some places experiences flood while other experiences drought.

49 % of the respondents perceived changes in the onset dates and cessation dates as the major factor affecting crop yields. About 55 % of the respondents resulted to changes in planting dates as adaptation strategies while 33 % used improved seeds variety as an adaptation strategy against

negative effect of rainfall variability. Most of the respondents agreed that limited awareness is the greatest constraints to adaptation and 49 % of the respondents recommended that more advocacies on adaptation and effects of rainfall variability should be adopted as a strategy to improve crop yield. The perception result shows that most farmers are aware of rainfall variability and they also noted that their crop yields are increasing as a result of using choices for adaptation.

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