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Does Rice Farmers Respond to Changing Climate: Empirical Evidence from Ebonyi State, Nigeria

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Abstract:
The study examined does rice farmers respond to changing climate; empirical evidence from Ebonyi State, Nigeria. Multi-stage sampling was used to select 70 rice farmers who were administered with a questionnaire. The study made use of primary data and were analyzed using descriptive statistics. Results showed that the rice farmers were in their productive age, 52 years, more of females, 67.1%, married 58.8%, relatively educated 11.4% and have household size of 7 persons and 16 years of farming experience. Majority of the rice farmers 70%, had high perception and awareness of climate change relative to 17.1% and 12.9% who had low and moderate perceptions. In response to climate change, rice farmers engaged the following; planting improved rice varieties 100%, Insurance 9%, planting of multiple/different crops 80%, livelihood diversification 44.3%, soil and water conservation techniques 84.3% and adjusting planting and harvesting dates 94.3%. Rice farmers also encountered challenges such as pests and disease attacks 85.7%, high cost of inputs materials 100%, unfavorable price fluctuations 64.3% and unavailability of improved rice varieties 80%. Farmers should be encouraged to seek early climate change information and practice more of climate smart practices to mitigate negative destructive effects of climate change on rice production.

Keywords: Rice Cultivation, Farmers, Responses, Changing Climate, Constraints, Ebonyi State

INTRODUCTION

Climate change has become a global phenomenon and of much concern to crop producers all over the world. The Intergovernmental Panel on Climate Change (IPCC, 2020) opined climate change as a fluctuation between normally experienced climate conditions (rainfall, temperature, wind, etc) and a different but recurrent set of climate conditions over a given region of the world. It is brought about by the increase in emission of greenhouse gases (GHGs) in the atmosphere that destabilize the ozone layer, leading to global warming (IPCC, 2018). It is further characterized in the concentration of the greenhouse gases (GHGs) trapped in the atmosphere as a result of human induced activities such as fossil fuel combustion, deforestation, and industrial processing, etc (IPCC, 2018). Other contributors include agricultural activities such as overgrazing of farmlands, continuous cropping, burning of forests and use of organic fertilizers which triggers GHG concentration (IPCC, 2020). Thus, a slight change in the climate will consequentially affect the status of agricultural production of an area (Adeagbo et al., 2021). Climate change is reported to have influenced agricultural production globally with rising food deficits, high food imports, low crop yield, poor income and heightened poverty levels amongst food crop farmers across the

world (Agovino et al., 2019). Thus, higher temperatures affect production of crops such as rice, maize, millet alongside encouraging weed and pest proliferation. Studies by the International Food Policy Research Institute (IFPRI, 2020), shows that increased floods and droughts increase the likelihood of short-run crop failures and long-run production declines in both crops and animals. Howbeit, the predominance of rain-fed agriculture, the scarcity of capital for climate adaptation measures, the warmer baseline climates and heightened exposure to extreme weather events in Africa makes agriculture more vulnerable to climate change. Food crop is particularly sensitive to climate change because crop yield depends largely on prevailing climate conditions specifically temperature and rainfall patterns (Ahsan et al., 2020).

Rice production is both a victim and a contributor to climate change. Rice cultivation is responsible for about 10 percent of global greenhouse gas emissions from agriculture (FAO, 2022). Rice one of the most abundant crops grown and consumed globally, makes up 12% of global methane emissions – and a staggering 1.5% of total greenhouse gas emissions (FAO, 2019). Rice is the nutritious staple crop for more than half of the world's people, but growing rice produces methane, a greenhouse gas more than 30 times as potent as carbon dioxide (FAO, 2020). Rice is a principal food crop grown in Nigeria despite facing a lot of climate change effects. It engages many producers, processors, and marketers at various stages but not without some climate related challenges (Kumar et al., 2021). It is a staple food which constitutes a major part of the diet of many countries in the world (FAO, 2021). It is widely produced in South-East Asia, the United States of America and other European countries. In Ebonyi State, the importance of rice over other crops, in terms of its production and the number of consumers that depend solely on it as their daily staple food is changing due to incidence of climate change. Rice production in the State is heavily affected by extreme weather and climate factors such as increased rainfall, relative humidity, wind variation, flood and extreme temperatures and is expected to get worse with further intensification of climate change as documented by Onyeneke et al. (2021). These climatic variables affect the bio-physical quality of the soil, and the speed of soil depletion on apparently well nurished soil causing low yield, and reduction in rice production in the state, this has equally affected the income and earnings of the rice producers increasing their poverty level and reducing their economic livelihood. The above incidences have created a wide gap in knowledge which this study seeks to fill in by examining the response strategies of rice farmers to changing climate in the state.

MATERIALS AND METHODS

The study was conducted in Ikwo Local Government Area Ebonyi State, Nigeria. Ikwo being one of the Local Government Area in Ebonyi State is located within latitude: $6^{o}3^{l}11^{l}$N and longitude: $8^{o}9^{l}$ 46^{l}E. Ikwo Local Government Area is made up of twelve autonomous communities. It has a land mass of approximately 5,000 kilometers squared and shares boundaries with Izzi in the North, Ezza in the West, Cross River State in the South and Abakaliki in the East. The rainfall pattern is bimodal with peaks in July and September and ranges to 2500mm while temperature is at 30^{oc}. They indigenes are farmers' historically and cultivate the following in large quantities; Rice (Ereshi), Yam (Nji), Cocoyam (Nkashi) Cassava (Njakpu), Potatoes (Ogogo), Groundnut (Ashimoko), Soya bean (Azaku), Guinea corn (Igeri), Bambara nut (Akpanyinko) alongside with livestock production. Multistage sampling technique was used for sample selection. The first stage involved a random selection of four autonomous communities in Ikwo Local Government Area. The second stage progressed with another random selection of four villages from the selected communities giving a total of 16 villages. In the third stage, five rice farmers were randomly selected from the 16 villages making a total of 80 respondents for the study. The list of

rice farmers was provided by the Agriculture Development Programme Coordinators in the Local Government Area. Primary data was collected using the research instrument (questionnaire) which was administered in person through personal interview and focused group discussion. Out of the 80-questionnaire distributed, only 70 of them were found useful for data analysis. However, before actual data collection, the questionnaire was pre-tested using pilot survey to determine its reliability and content validity. Data were analyzed using descriptive statistics, such as the mean, frequency and percentages.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Rice Farmers

The socio-economic characteristics of the rice farmers are presented in Table 1. The table shows that majority of the farmers were within the age bracket of 51-60 years with a mean age of 52 years. This obviously implies that the farmers were advancing in age though still physically strong to carry out their farming operations. Increase in age engenders in-depth knowledge of agricultural operations which enhances improved farm output and income (Adeagbo et al., 2021). Majority of the rice farmers were females, 67.1% relative to the males, 32.9%. This implies that rice production was dominated by the female farmers in the state. This could be due to their over-involvement in rice farming relative to the male farmers who could be in engaged in non-agricultural occupations. Again, rice farming seems to be less strenuous hence the involvement of more women than the men (Agovino et al., 2019). Majority of the farmers were married, 58.8% and the singles, 7.1%. Also, about 11.4% were divorced and 22.9% widow/widower. This implies that marriage supports more of family labour used in rice production. This also shows that the married ones are more focused, dedicated and committed to their farming enterprise than the single farmers (Ahmad et al., 2020). About 22.9% of the farmers had primary education, 11.4% tertiary education, and 14.3% non-formal education. Thus, majority of the farmers 51.4% had secondary education; this implies that the rice farmers were relatively literate to understand farm production principles and techniques which are targeted towards improved rice production (Ahsan et al., 2020). The majority of the rice farmers, 74.2% had household size between 5-8 persons with a mean household size of 7 persons. This implies that the household size regarding the rice farmers was relatively large and could support their farming strength and production activities. A sizable household provides more of family labour relative to households with lesser household's sizes (FAO, 2022). Majority of the rice farmers, 92.8% were fully involved in farming operations and/ or activities while about 7.1% of them were engaged in farming activities and other related occupations. It should be noted here that these engaged occupations serve as sources of livelihoods and income earnings for farm families (FAO, 2020). Majority of the rice farmers had farm sizes within 0.1-1.0 hectares with a mean hectare of 0.7. This implies that the rice farmers cultivated less than 1 hectare of farmlands. This could be attributed to the scarcity of land in the area as well as land fragmentation which only accommodates small area of cultivation (FAO, 2019). About 18.6% of the rice farmers had between 3-4 physical contacts with extension agents, while majority of them 81.4% had between 1-2 physical contacts. The mean extension contacts were approximately 2 contacts, which implies that the rice farmers had low extension contacts with the extension agents, this could be ascribed to sometimes, the un-seriousness of the extension agents with their job responsibilities and/ or assignment given to them. Also, poor logistics could as well contribute to these anomalies (Igberi et al., 2022). The table shows that 11.4% of the farmers had no cooperative membership while a majority 88.6% belongs to rice cooperative societies. This implies that a majority of the rice farmers had access to information, farming inputs, credit facilities and others. Belonging to a cooperative group offers one the opportunity to relate and interact with other farmers across and within their territory and to

obtain certain useful information and agricultural inputs that would have been difficult to access individually (FAO, 2020). Majority of the rice farmers 77.1% participated in workshop/training between 3-4 times per cropping season. About 21.4% participated between 1-2 times. The mean participation value was 3.0 shows that on average the rice farmers participated at least 3 times per cropping year. Participation in these trainings and workshops instill new farming skills, knowledge acquisitions and adequate understanding of crop production principles which enhances better yield performances (Ikuemonisan et al., 2020). Majority of the rice farmers, 72.9% had farming experience between 11-20 years, with a mean farming experience of 16 years, implying that the rice farmers were well experienced in their farming operations and rice cultivation. Farming experience exposes the farmers to deeper knowledge and understanding of farm operations and production activities. This increases farm production and better farm performances in both the short and long run basis (Kogo et al., 2020). About 5.7% accessed their capital from banks, 18.6% from friends/relatives, 48.6% from personal savings, while 21.4% accessed their capital from co-operatives societies. The implication is that the rice farmers accessed their farm capital mostly via personal saving considering the fact that other sources may not be easily accessible as expected (FAO, 2019). About 4.3% got their land via pledge, 10.0%, got through purchase, 2.9%, got through gifts, 8.6% got through lease/rent and 74.3% via inheritance. This implies that the land acquisition in the area is majorly via inheritance as this source of land sometimes characterized the rural land ownerships (Kumar et al., 2021). Majority of the farmers, 71.4% utilized family labour, 17.1% made use of hired labourers while the remaining 11.4% used both family and hired labourers. This implies in general that the labour used in the area was mainly family labour relative to the hired labour, this could be probably due to the higher fares charged by hired labourers (Ahsan et al., 2020).

Socio-economic characteristics of the rice farmers

Age	**Frequency**	**Percentage**
20-30	09	12.9
31-40	16	22.9
41-50	10	14.3
51-60	35	50.0
Mean	**52**	
Sex		
Male	23	32.9
Female	47	67.1
Marital status		
Single	05	7.1
Married	41	58.8
Divorced	08	11.4
Level of education		
Primary	16	22.9
Secondary	36	51.4
Tertiary	08	11.4
Non formal	10	14.3
Household size		
1-4	15	21.4
5-8	52	74.2
9-12	03	4.3
13-16	-	
Mean	**7**	

Occupation		
Farming only	65	92.8
Farming and others	05	7.1
Farm Size		
0.1-1.0	54	77.1
1.1-2.0	12	17.1
2.1-3.0	2	2.9
3.1 & above	2	-
Mean	**0.7**	
Extension contacts		
1-2	57	81.4
3-4	13	18.6
5-6	-	-
7& above	-	-
Mean	**1.6**	
Cooperative membership		
Yes	62	88.6
No	08	11.4
Participation in workshop/training		
1-2	15	21.4
3-4	54	77.1
5-6	01	1.4
7 & above	-	-
Mean	**03**	
Farming Experience		
1-10	17	24.3
11-20	51	72.9
21-30	2	2.9
31-40	-	-
Mean	**16**	
Source of Capital		
Banks	04	5.7
Friends/relatives	13	18.6
personal savings	34	48.6
Co-operatives society	15	21.4
Other	04	5.7
Source of land		
Inheritance	52	74.3
Lease/rent	06	8.6
Gift	02	2.9
Purchase	07	10.0
Pledge	03	4.3
Source of labour used		
Family	50	71.4
Hired	12	17.1
Both	08	11.4

Source: Field survey data, 2023.

Perception of Rice Farmers to Climate Change

The perception of the rice farmers to climate change is presented in Table 2. The table shows that about 12.9% of the rice farmers had moderate perception of climate change; this implies that the rice farmers had reasonable knowledge about climate change probably via the radio, television, internets, and seminars/trainings (FAO, 2020). About 17.1% of the rice farmers had a low perception of climate change, this could be probably due to lack of information concerning climate change around these rice farmers in the area. This could also result from lack of interest on the part of the farmers on climate change related activities. Furthermore, the majority of the rice farmers, 70% had higher perception of climate change, this implies that these groups of farmers accessed climate change information and were more sensitive enough to the influence of climate change around their neighborhood and farm environments. This gives credence to the high perception and awareness of climate change perceived by the farmers Kumar et al. (2021).

Table 2: Perception of rice farmers to climate change

Climate Change Perception	Frequency	Percentage
High Perception	49	70.0
Low Perception	12	17.1
Moderate Perception	09	12.9
Total	**70**	**100**

Source: Field survey data, 2023.

Response of Rice Farmers to Climate Change

The response of the rice farmers to climate change is presented in Table 3. The table reveals that all the rice farmers, 100% responded to climate change by adopting planting improved rice varieties and erosion control measures. Improved rice varieties have shown to be effective in terms of yields, quality, and resistant to rice pests and diseases which attack rice crops both in the field and stored produce (Loum and Fogarassy, 2015). Opening up farm drainages, and creating path-ways for erosion and running water during and after rainfalls helps to check gully and soil erosion around farmlands. This measure prevents the farms from being flooded and from being washed away by rain-water. About 8.6% of the rice farmers responded through insurance. Insurance is overtly an important adaptation strategy engaged by modern day farmers to withstand the adverse effects of climate change and mitigate it accordingly (Mama et al., 2021). An insured farm averts certain farm risks and uncertainties inherent in agricultural production and at the same time instills peace of mind in the heart of the insurer. About 80.0% of the farmers responded via planting of multiple/different crops, 44.3% responded via livelihood diversification, 84.3% thorough soil and water conservation techniques, 94.3% via adjusting planting and harvesting dates and 60% via irrigation. Planting of different crop helps to mitigate and overcome negative influences of climate change (Onyeneke, 2021). The planting of multiple crops protects both the farmer and his/her farm lands from total crop failure occasioned by adverse climatic condition (Onyeneke et al., 2019). Livelihood diversification is noted to uplift the living standard of the poor rural farmers and provide maximum supports both for their families and farming enterprises in times of need and also during total crop failures. Thus, the farmers engage in other viable occupations outside farming. Soil and water conservation techniques secure the fertility of the farmland making them fertile at all times irrespective of the adverse climatic changes. This form of adaptation techniques is known to improve the soil structures, soil aeration, texture and moisture contents of the farmland leading to increased rice yield and output (Onyeneke, 2017). As climate change occurs frequently, rice farmers are forced to adjust their planting and harvesting dates to suit the prevailing climate conditions (Osuji et al., 2019). Adjusting planting

and harvesting dates ensures that farmers tailor their production to tally with the changing climate, this is necessary to negate the adverse consequences of climate change. Irrigation guards against shortage of water (low rainfall), prolonging dry season, unpredictable rainfall, late onset of rain, and early rain cessations (Onyeneke et al., 2019). The practice of irrigation averts total crop failures especially during prolonging dry seasons, ensuring that planted crops are well catered for even in the face of changing climate. Furthermore, 57.1% of the rice farmers responded via reliance on climate information and forecasts, 54.3% via collaboration with extension workers/agents, 95.7% via appropriate application of fertilizers, 72.9% via efficient and effective use of pesticide, and 32.9% via increased land access. Reliance on climate information and forecasts equip the farmers on how to go about their rice farming without encountering losses (Osuji et al., 2021). Collaboration with extension workers/agents helps the farmers in learning practical ways and methods in responding to climate change. Fertilizer applications increase the fertility of the soils especially on eroded and marginal farmland thus leading to improved rice yield. Adoption of pesticides use and application is seen as an integral response strategy used by most rice farmers to mitigate climate change effects. Increased land access enhances large scale cultivation and averts possible climatic destructions.

Table 3: Response of rice farmers to climate change

Response of Rice Farmers to Climate Change	*Frequency	Percentage
Planting improved rice varieties	70	100.0
Insurance	06	8.6
Planting of multiple/different crops	56	80.0
Livelihood diversification	31	44.3
Soil and water conservation techniques	59	84.3
Adjusting planting and harvesting dates	66	94.3
Irrigation	42	60.0
Reliance on climate information and forecasts	40	57.1
Collaboration with extension workers/agents	38	54.3
Appropriate application of fertilizer	67	95.7
Efficient and effective use of pesticide	51	72.9
Increased land access	23	32.9
Erosion control measures	70	100.0

Source: Field Survey data, 2023. *Multiple Responses

Constraints Encountered by Rice Farmers in Rice Production

The constraints encountered by rice farmers in rice production are presented in Table 4. The table shows that 100% of the rice farmer's indicated technical application of some adaptation (response) strategies, high cost of inputs materials and inadequate capital/severe poverty. No doubt some of the response strategies require technical applications which the farmers may not be conversant or in tune with it thus causing a little or no response to climate change effects (Woods et al., 2017). High cost of inputs materials has always been a serious problem in the input market as most rice farmers cannot afford to as much inputs as they need due to high cost. Inadequate capital/severe poverty also poses serious constraints in rice farming as majority of the rural farmers are poor and cannot procure enough capital to support their rice production (World Bank, 2020). About 95.7% of the rice farmers observed high cost of transportation, 72.9%, high cost and low availability of labor supply, 88.6%, inadequate farming lands, 80%, poor extension access and services and 84.3%, land fragmentation. High cost of transportation prevents most rice farmers from visiting their choice and desired markets to sell their rice produce making them

to result in farm-gate outright sales (Zamasiya et al., 2017). High cost and low availability of labor supply impede rice cultivation in that the available and limited man-labour inflates their labour fares making it extreme difficult for the poor farmers to cope, as they cannot afford the high labour charges per time. Inadequate farming lands distort large scale rice cultivation in that the issue of land scarcity prevents the farmers from both extensive and intensive farm cultivation (Zbigniew et al., 2017). Poor extension access and services causes low output of the farmers as the farmers are unable to access extension services which are targeted at improving the performance of the farmers per cropping season. In most cases, the extension agent fails to visit their places of primary assignments which are at the detriment of the rural rice farmers. Land fragmentation issues exist in most areas where there is scarcity of lands; the available ones are divided or shared in piecemeal to accommodate as much farmers as possible thus impeding land productivity of farmers. However, other perceived constraints encountered by rice farmers includes; problem of storage and processing facility, 91.4%, inadequate information concerning climate change, 92.9%, pests and disease attacks, 85.7%, Unfavorable price fluctuations, 64.3%, Unavailability of improved rice varieties 80%, weather and climate change issues, 70.3% and Infrastructural deficits which accounted for 61.4%. Problem of storage and processing facility encourages spoilage of stored rice and its value chain processes (Adeagbo et al., 2021). Inadequate information concerning climate change distorts or alters rice farmers farming calendar and exposes them to adverse climatic changes. Pests and disease attacks cripple planted rice seedlings causing serious havoc in rice cultivation and growth processes. Unfavorable price fluctuations negatively influence the income and revenue of rice farmers in general. Unavailability of improved rice varieties impedes rice cultivation as farmers' sticks to local rice seedlings which are easily susceptible to pests and diseases (Agovino et al., 2019). Weather and climate change issues poses lasting constraints in farm production as the era of changing climate is now being felt all over the world. High temperature impairs rice growth and production. Infrastructural deficits such as electricity, good pipe-borne water, hospitals and other basic amenities causes able bodied farmers to migrate to urban cities in search of white-collar jobs thereby leaving farming in the hands aged households and available youths who charges outrageous fares for labour supply (Osuji et al., 2019).

Table 4: Constraints encountered by rice farmers in rice production

Constraints Encountered by Rice Farmers	*Frequency	Percentage
High cost of transportation	67	95.7
High cost and low availability of labor supply	51	72.9
Technical application of some adaptation (response) strategies	70	100.0
Inadequate farming lands	62	88.6
Poor extension access and services	56	80.0
Land fragmentation	59	84.3
Problem of storage and processing facility	64	91.4
Inadequate capital/ Severe poverty	70	100.0
Inadequate information concerning climate change	65	92.9
Pests and disease attacks	60	85.7
High cost of inputs materials	70	100.0
Unfavorable price fluctuations	45	64.3
Unavailability of improved rice varieties	56	80.0
Weather and climate change issues	52	74.3
Infrastructural deficits	43	61.4

Source: Field Survey data, 2023. *Multiple Responses

CONCLUSION AND RECOMMENDATION

The findings of the study shows that the rice farmers were more of females, married, relatively educated and had household sizes of 7 persons and farming experience of 16 years. About 17.1% of the rice farmers had a low perception of climate change, while 70% and 13% had high and moderate perception of climate change. The study reveals that the rice farmers responded to climate change differently using various methods such as planting improved rice varieties, insurance, planting of multiple/different crops, livelihood diversification, soil and water conservation techniques, adjusting planting and harvesting dates and irrigation systems. Constraints faced by rice farmers includes; high cost of transportation, high cost and low availability of labor supply, technical application of some adaptation (response) strategies, inadequate farming lands, poor extension access and services, land fragmentation, problem of storage and processing facility, and inadequate capital/ severe poverty. Farmers should be encouraged to seek early climate change information and practice more of climate smart practices to mitigate negative destructive effects of climate change on rice production.

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