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Environmental Risks Management Practices among Rice Farmers in Rice Producing Areas of Imo State, Nigeria

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Abstract

The study estimated environmental risks management practices among rice farmers in rice producing areas of Imo State, Nigeria. Multistage, purposive and random sampling techniques were used to sample 120 rice farmers across four LGAs of Imo State. Using well structured close-ended questionnaire, data were collected from 120 rice farmers. Out of the 120 questionnaires administered, 133 were properly responded to and considered suitable for analysis. Data were analysed using frequency, percentage, means and Ordinary Least Square (OLS) multiple regression analysis. The results show that pests and diseases outbreak, occasional flooding, destruction by birds, soil fertility depletion and injury during field operation are some of environmental risks facing the rice farmers. Some environmental risk management measures practiced by rice farmers include: wearing of boots in rice farms, construction of Birds scaring objects and planting of pest and disease resistant variety of rice. The result of the Ordinary Least Squares regression analysis shows that the semi-log functional form had the best fit with R^2 value of 0.9438, F-value of 158.38 and Prob>F value of 0.0000. Out of the 11 explanatory variables specified in the model, eight variables which include: education, gender, household size, cooperative, access to credit, extension contact, farm size and income statistically and significantly influenced rice farmers' practices of environmental risk measures at 1% and 5% level of significance. Based on the findings, the study recommended proactive government's intervention policies and programmes to rice farming in order to cushion the effects of environmental risks facing rice farmers among others.

Keywords: Rice, environmental risks, Imo State, Nigeria

Introduction

Rice, *Oryza sativa* belongs to the grass family *Gramineae* and an important staple in Nigeria and world over. Rice production is vital to Nigerian agriculture and forms fundamental factor in government's effort to promote food security and discourage food importation in attempt to feed its teeming population. Cultivation of rice is a principal agro-economic activity and major source of income for millions of farm households around the globe. In Nigeria for instance, rice production is predominant across almost all the agro-ecological zones and over 18 out of the 36 states in the country. Imo State is one of the notable rice producing states in southern Nigeria (see Kadiri, *et al*, 2014 and Onyeneke, 2017).

Table 1: Rice Production System across Major Producing States in Nigeria

Rice production system	Major producing states in Nigeria
Rain-fed Upland	Ogun, Ondo, Abia, Imo, Osun, Ekiti, Oyo, Edo, Delta, Niger, Kwara, Kogi, Sokoto, Kebbi, Kaduna, FCT and Benue States.
Rain-fed Lowland	Adamawa, Ondo, Ebonyi, Ekiti, Delta, Edo, Rivers, Bayelsa, Cross River, Akwa Ibom, Lagos, all Major river valleys, e.g shallow swamps, of Niger basin, Kaduna basin, and inland of Abakaliki and Ogoja areas
Irrigated	Adamawa, Niger, Sokoto, Kebbi, Borno, Benue, Kogi, Enugu, Ebonyi, Cross River, Kano, Lagos, Kwara, Akwa Ibom and Ogun States
Mangrove swamp	Ondo, Delta, Edo, Rivers, Bayelsa, Cross River, Akwa Ibom and Lagos States

Source: Federal Ministry of Agriculture and Rural Development (2011).

Nigeria is the largest rice producing country in the West African region as rice is one of the leading staple crops. The report of WARDA (2012) substantiated that Nigeria accounted for nearly 44% of the total rice output and about 57% of the total rice producing area in West Africa. According to the National Bureau of Statistics (2017), the annual household expenditure on rice accounted for

10% of household food spending and 6.6% of total household spending in 2011. Rice is consumed by over 50% of the world's population, providing about 19% of global human per capita energy, 13% of per capita protein; hence, buttressing the fact that rice production is crucial to Nigeria and global food security.

The production of rice has increased over the past few decades reaching about 3.7 million tonnes in 2017. The area under rice cultivation has equally expanded from about 2.4 million harvested hectares in 2010 to 3.2 million harvested hectares in 2017 which represents the highest in the last 5 years (Erhie, *et al*, 2018). In spite of this appreciable increase, the domestic production of rice in Nigeria has never met the demand, resulting to huge importation and smuggling of rice to complement local production in the country. Akande (2015) affirmed that there has been a substantial lag between production and demand level with imports making up the shortfall. The production of rice cut across pre and post harvest operations with wide array of activities ranging from land clearing, nursery bed preparation, preparation of rice field, transplanting or seed broadcasting, weeding, manuring/fertilizer application, scaring of birds and rodents, harvesting, threshing, parboiling, drying, winnowing, packaging and marketing. It is pertinent to state that there are series of environmental-related risks across all these identified stages of rice production and agricultural activities in general.

Igboji, Anozie and Nneji (2015) noted that Nigerian rice sub-sector is dominated by weak and inefficient producer-market linkages due to poor infrastructure including lack of improved processing facilities, low rice productivity, poor post-harvest handling and storage, expensive and poor access to high quality seed, fertilizers and crop protection, inadequate market information, lack of transparency among players, low capacity to meet quality standards, limited efficiency distribution networks; hence making rice sub-sector very risky enterprise due to high level of uncertainty including unpredictable environmental factors. Osanyinlusi and Adenegan (2016) noted that major constraint to domestic production of rice in Nigeria is connected to poor resource utilization, environmental and institutional factors. Similarly, Amusa, Okoye and Enete (2018) observed that environmental conditions, to a very large extent

determine the yield and productivity of agriculture. Kahan (2013) stated that risk affects production such as changes in the weather and the incidence of pests and diseases. In farm enterprise, risks constitute uncertain future events which could influence the achievement of farm's strategic, operational and financial objectives.

Risk and uncertainty is an inherent feature of modern agricultural production and production decision environment is characterized by risk and the absence of perfect and complete information (Iheke and Igbelina, 2016). Farming risk is associated with negative outcomes stemming from imperfectly predictable biological, climatic, and price variables. These variables include natural adversities (for example, pests and diseases), climatic factors not within the control of agricultural producers, and adverse changes in both input and output prices, in addition to biological issues, environmental hazards and processing technology present technical risks to rice sector growth (World Bank, 2015). Some of the notable environmental risks in Nigerian rice production include: pest and diseases outbreak, flooding, snake bite, birds and injury during field operations and rice processing.

Environmental risks in agriculture, as reported by Sckokai and Moro (2005) are expected to increase due to climate change, increasing volatility in agricultural markets among other factors. Briner, Huber, Elkin and Grêt-Regamey (2012) submitted that environmental risks directly affect farmers' incomes and can be a threat for the future of their farms. Amusa, Okoye and Enete (2018) noted that the full potential of the environmental endowment of Nigeria for increased agricultural productivity is undermined with notable environmental related risks and challenges. Environmental risks among other factors have grossly affected rice production activities, productivity and farmers' income in Nigeria, Imo State inclusive. Hence, sustainable environmental risk management practices in rice production have become very crucial in alleviating anticipated environmental related risks to sustain rice production. Hence, this study estimated environmental risks management practices among rice farmers in rice producing areas of Imo State, Nigeria. Specifically, the study examined environmental risks involved in rice production, environmental risks management

practices adopted by the rice farmers and determinants of environmental risks management practices by the rice farmers.

METHODOLOGY

Study Area

The study was conducted in Imo State, Nigeria. Imo State is located in southeast Nigeria. It has an estimated population of 4,609,038, occupying a land area of 5,288sq.km and annual rainfall of 2,738.0 mm (National Bureau of Statistics, 2012). Imo State is made up of twenty seven administrative Local Government Areas which are divided into three Agricultural Zones (Owerri, Okigwe and Orlu). The state lies between latitude 5°12′ and 5°56′ North of the Equator and between longitudes 6°38′ and 7°25′ east of the Greenwich Meridian. It is bordered by Abia State on the east, by the River Niger on the west, by Anambra State on the north and Rivers State on the south. Imo State is located in the rainforest zone with two major seasons: the rainy and dry seasons. The rainy season lasts from November to March like other states in the rainforest zone. Apart from Owerri as the administrative headquarters, the state is predominately rural with agriculture (farming) as the major means of livelihood. The crops grown include rice, yam, cassava, cocoyam, maize, melon, and vegetables.

Sampling Techniques

Multi stage sampling technique was used to select 80 rice farmers across the four major rice producing Local government areas in the state. Hence, the first stage involved purposive sampling of the four rice producing Local Government Areas (LGAs) in the state which are: Ideato North, Ihitte Uboma, Okigwe and Oguta LGAs. The second stage also employed purposive selection of two rice producing communities in each of the four LGAs making eight communities in all. The third stage of the sampling involved random selection of 15 rice farmers from each of the 8 selected communities making a total of 120 famers that constituted the sample for the study. The lists of the rice farmers from each of the four LGAs were obtained from ADP office Imo State.

Data Collection and Analysis

Data for this study were obtained from primary source through the use of structured and close-ended questionnaire. The data for the study were collected in 2019 cropping season by the researchers and their assistants. Out of the 120 copies of the questionnaire administered to the farmers, 113 copies were retrieved and considered good for the study. Thus, data extracted from the 113 copies of the retrieved questionnaire were used for the study. Primary data gathered included socio-economic characteristics of the rice farmers, environmental risks faced by the farmers in rice production and environmental risks management practices among the rice farmers.

Data were analysed using descriptive statistics such as frequency, percentage and means and inferential statistics such as Ordinary Least Squares (OLS) multiple regression analysis. Four functional forms: linear, semi-log, double-log and exponential were estimated using the Ordinary Least Square (OLS). This was considered necessary in order to select the functional form with the best fit. In the semi-log and double log functional forms, dummy variables with "0" values were not logged. This is because, the number 0 is undefined for log.

Descriptive (Mean)

Descriptive statistics (Mean) was used to identify environmental risks management practices. The response options to the four-point rating scale of the questionnaire were categorized and rated as:

Strongly Agree (SA) = 4
Agree (A) = 3
Disagree (D) = 2
Strongly Disagree (SD) = 1.

To calculate the mean response mode (weighted mean)

$$\text{Mean response mode } (X) = \frac{\sum fx}{N} = \frac{1+2+3+4}{4} = \frac{10}{4} = \mathbf{2.50}$$

(cut-off point)

The cut-off point of 2.50 was used as benchmark in interpreting the results. Hence, any item with mean ($\overline{X}$) value of 2.50 or above was regarded as agreed (accepted) while those with less than 2.50 were regarded as disagreed (rejected).

Multiple Regression Model (OLS)

The estimate of determinants of environmental risks management practices by rice farmers was realized using multiple regression. The dependent variable (*Y*) was defined in this study as percentage of environmental risks management practices adopted by farmer 'n' out of a given list of environmental risks management practices identified in Table 3 in the study. It was hypothesized that, the percentage of the identified environmental risks management practices that will be adopted by a given rice farmer will be determined by some socio-economic attributes of the farmer. Hence, the model is specified as follows:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11})$ ---------- (1)

Where;

Y= Percentage of environmental risks management measures in Table 4 practiced by farmers.

X_1 = Age (years)

X_2 = Education (years)

X_3 = Gender (1 if male, 0 if female)

X_4 = Farming experience (years)

X_5 = Household size (in number of persons)

X_6 = Cooperative membership (1 if member, 0 if non member)

X_7 = Access to credit (in amount of credit access in ₦)

X_8 = Extension contact (number of visits in last cropping season)

X_9 = Farm size (in hectare)

X_{10} = Income (in ₦)

X_{11} = Remittances (amount in ₦ received as remittances from family members)

e = error term.

RESULTS AND DISCUSSION

Table 2: Summarized Statistics of the Variables Used in the Analysis (n = 113)

Variables	Nature of Data	Min.	Max.	Mean	Std. Dev.
Age of Farmers	Continuous	31.00	74.00	48.30	11.97
Years of Education	Continuous	0.00	24.00	9.60	3.28
Gender	Dummy	0.00	1.00	0.64	0.53
Farm Experience	Continuous	8.00	55.00	34.10	9.34
Household Size	Continuous	4.00	11.00	6.00	2.30
Coop Membership	Dummy	0.00	1.00	0.59	0.42
Access to Credit	Continuous	0.00	240,000	79,540	3937.20
Extension Contacts	Continuous	0.00	8.00	3.90	0.45
Farm Size	Continuous	0.60	5.70	3.44	0.59
Remittances	Continuous	0.00	205,000	101,350	5649.10
Income	Continuous	80,000	1,200,000	485,628	8939.40

Source: **Field Survey, 2019**

Equations 1 was estimated by trying the four functional forms of linear, semi-log, double-log and exponential in other to make choice for the lead model. The choice of the lead equation was determined by the magnitude of coefficient of multiple determination (R^2), number of significant variables and level of significance and the sign of the significant variables as they conforms to the *apriori* theoretical expectations.

The result in Table 2 shows that the minimum and maximum ages of the rice farmers are 31 and 74 years respectively while their mean (average) age was 48 years. This implies that the rice farmers are still relatively young and active though tending towards their declining productive stage. This result conformed with that of Kadiri, et al, (2014) who investigated technical efficiency in paddy rice production in Niger Delta Region of Nigeria, Imo State inclusive and found mean age of rice farmers to be 49 years. Ibitoye, Orebiyi and Shaibu (2012) in a study found that the mean age of rice farmers in Kogi State 45 years. The mean of years of education of the rice farmers in this study was about 10 years. As regards gender of the rice farmers (1 if male, 0 if

female), the mean of 0.64 indicates that majority of the rice farmers are males. Osanyinlusi and Adenegan (2016) on determinants of rice farmers' productivity in Ekiti State found that 73.1% of farmers were males. Chekene and Chancellor (2015) also found that the majority of rice farmers in Nigeria were males.

The minimum year of farming experience among the rice farmers was 8 years while the maximum recorded was 55 years with mean (average) of 34 years of experience in rice farming. This shows that most of the farmers are well endowed with many years of experience in rice production activities. This corroborated the result of Igboji, Anozie and Nneji (2015) on analysis of socio-economic factors and profitability of rice production among small scale farmers in Ebonyi State where the authors found that most (45%) of the rice farmers had reasonable years of experience ranging between 16 and above. This study also found that the mean (average) household size of the rice farmers was 6 persons per farm household. Kadiri, et al, (2014) in a study established 17 years of experience in rice farming, with mean farm size of 2.32 (ha) and mean household size of 6 persons. In respect to membership of cooperative by rice farmers (1 if member, 0 if non member), the mean of 0.59 indicates that some of the rice farmers belong to cooperative societies.

The mean (average) amount of credit access by the rice farmers was ₦79,540.00.

On number of extension contacts of visits in the last cropping season, the mean was about 4 times. The minimum farm size among the rice farmers was 0.6ha while the maximum recorded was 5.7ha with mean (average) of 3.4ha of rice farms. The finding of this study is consistent with that of Osanyinlusi and Adenegan (2016) who studied determinants of rice farmers' productivity in Ekiti State and found that average size of rice farms was 3.5 hectares. As presented in table 2, the mean (average) amount of remittances received by the rice farm household was ₦101,350.00. The result of this study also shows that the minimum income of rice farmers was ₦80,000.00 while the maximum income recorded was ₦1,200,000.00 per annum with mean (average) of ₦485,628.00. This shows that rice production is profitable in the area depending on the scale of production. Igboji, Anozie and Nneji (2015) in a study carried out in Ebonyi State found that the total revenue and profit of

rice farmers were ₦375,560.00 and ₦241,250.00 respectively and that rice business outfit is profitable enough to keep the farmers in further production.

Major Sources of Environmental Risks in Rice Farming

The different sources or types of environmental risks inherent in rice farming activities as encountered by rice farmers in the study area are presented in table 3.

Table 3: Frequency and percentage responses of rice farmers by common environmental risks encounter in rice production. (n = 113)

SN	Environmental risks	Frequency	Percentage (%)
1	Pests and diseases outbreak	92*	81.4
2	Occasional flooding	88*	77.9
3	Erosion	57*	50.4
4	Drought	41*	36.3
5	Destruction by birds	113*	100.0
6	Fire outbreak	34*	30.1
7	Excessive heat	10*	8.8
8	Soil fertility depletion/degradation	78*	69.0
9	Wind	11*	9.7
10	Injury during field operation	89*	78.8
11	Snake bite or animal attack	36*	31.9
12	Burns	23*	20.4
13	Injury during processing	12*	10.6
14	Land slide in farmlands	14*	12.4
15	Oil spillage	4*	3.5
16	Theft of farm produce (rice)	8*	7.0
17	Unfavourable government policy environment	12*	10.6

Source: Field Survey Data, 2019

Note: * = Indicates multiple responses

The result on environmental risks encountered in rice farming by farmers is presented in Table 2. From the result, the major environmental risks encountered by the rice farmers were: destruction by birds (100.0%), pests and diseases outbreak (81.4%), injury during field

operation (78.8%), occasional flooding (77.9%), soil fertility depletion/degradation (69.0%) and erosion (50.4%). Other less serious environmental-related risks include: drought (36.3%), fire outbreak (30.1%), snake bite or animal attack (31.9%), burns (20.4%), wind (9.7%), injury during processing (10.6%), land slide in farmlands (12.4%), excessive heat (8.8%), oil spillage (3.5%), theft of farm produce (rice) (7.0%) and unfavourable government policy environment (10.6%). Briner and Finger (2012) reported that environmental risks directly affect farmers' incomes and can be a threat for the future of their farms. Howden, *et al.,* (2007) submitted that risks in agricultural production are expected to increase due to climate change and increasing volatility in agricultural markets.

Environmental Risks Management Practices adopted by the Rice Farmers The result of this study on environmental risks management measures practiced by the rice farmers was presented in Table 4. The result showed that 13 out of the identified environmental risk management practices had their mean values greater than the cut-off point value of 2.50 on 4-point rating scale. The identified 13 environmental risks management measures practiced by the farmers with their respective mean values include: wearing of boots in rice farms (3.92), managing multiple farm enterprises (3.78), construction of birds scaring objects in rice farms (3.75), seeking assistance from rice farm association (3.72), planting of pest and disease resistant variety of rice (3.63), engaging in rice farming using different locations (3.49), diversification into off-farm enterprises (3.46), constant replenishment of soil fertility (3.37), planting early maturing rice variety (3.30), creating drainage system in case of rice farm flooding (3.30), staying in the farms from morning to evening to fright away birds during rice fruiting (3.28), selling farm assets to reduce effect of environmental shock (3.08), farm and storage security against theft (2.99) and construction of contour bonds to reduce run off (2.58). The findings of this study supported that of Usman, Jirgi, Ojo and Tiamiyu (2017) who reported that farmers have adopted prevention, mitigation and coping with risk as management strategies. Jirgi (2013) also reported that in environmental risk management, farmers use prevention, diversification, mitigation, and various risk managements practices to avert risks in farming.

Table 4: Mean ratings of environmental risks management practices adopted by the rice farmers in the study area (n = 113).

SN	Environmental risks management practices:	Mean ($\bar{x}$)	SD	Remarks
1	Planting of pest and disease resistant variety of rice	3.63	0.60	**Agreed**
2	Adoption of use of farm machines in rice production and processing	2.44	0.50	**Disagreed**
3	Wearing of boots in rice farms	3.92	0.45	**Agreed**
4	Diversification into off-farm enterprises	3.46	0.52	**Agreed**
5	Managing multiple farm enterprises	3.78	0.48	**Agreed**
6	Engaging in rice farming using different locations	3.49	0.52	**Agreed**
7	Obtaining loans and credits in terms of crop failure	2.42	0.49	**Disagreed**
8	Selling farm assets to reduce effect of environmental shock	3.08	0.50	**Agreed**
9	Seeking assistance from rice farm association	3.72	0.44	**Agreed**
10	Creating drainage system in case of rice farm flooding	3.30	0.47	**Agreed**
11	Stopping rice farming in lowland areas or waterways	2.36	0.51	**Disagreed**
12	Planting early maturing rice variety	3.30	0.55	**Agreed**
13	Insuring the rice farm enterprise	1.33	0.48	**Disagreed**
14	Construction of contour bonds to reduce run off	2.58	0.48	**Agreed**
15	Construction of birds scaring objects in rice farms	3.75	0.47	**Agreed**
16	The use of irrigation system in times of drought	2.34	0.47	**Disagreed**
17	Construction of fence round the farm to disallow entrance of rodents and snakes	2.38	0.55	**Disagreed**
18	Constant replenishment of soil fertility	3.37	0.50	**Agreed**
19	Staying in the farms from morning to evening to fright away birds during rice fruiting.	3.28	0.46	**Agreed**
20	Avoiding risk prone zones in rice farming	2.40	0.45	**Disagreed**
21	Farm and storage security against theft	2.99	0.68	**Agreed**
	Grand mean	**3.02**	**0.49**	**Agreed**

Note: Benchmark = 2.50
Field Survey, 2019

Though, the remaining seven identified environmental risks management practices, specifically: adoption of use of farm machines in rice production and processing (2.44), obtaining loans and credits in terms of crop failure (2.42), stopping rice farming in lowland areas or waterways (2.36), construction of fence round the farm to disallow entrance of rodents and snakes (2.38), avoiding risk prone zones in rice farming (2.40) and insuring the rice farm enterprise (1.33) all have their mean values less than the benchmark of 2.50 on 4-point rating scale. This implied that the remaining seven environmental risk management practices are used by rice farmers in Imo State.

Factors Influencing Rice Farmers' Environmental Risks Management

The estimates of the factors influencing rice farmers environmental risks management practices in the study area are presented in Table 5. Out of the four functional forms (linear, semi-log, double-log and exponential) that were estimated, semi-log functional form had the best fit, based on the values of R^2 (0.9438), number of significant variables, their levels of significance and signs. The R^2 value of 0.9438 for instance implies that the significant variables are responsible for about 94% variation in percentages of environmental risks management practices adopted by the rice farmers. The F-value of (158.38) and Prob>F value of 0.0000 statistically imply that the overall equation was highly significant at ($p<0.01$) 1 percent. Out of the 11 explanatory variables specified in the model, eight were statistically significant which include: education, gender, household size, cooperative, access to credit, extension contact, farm size and income at 1% and 5% level of significance.

Education of the rice farmers was significant at 5% and positively influences percentage of environmental risks management practices by the farmers. This indicated that education is an important factor that sensitizes farmers' adoption of environmental risk management practices among the rice farmers. This agreed with the findings of Enete, *et al* (2011) that farmer's number of years of formal education was also positive

and highly significantly related with the level of investment in indigenous technologies and practices in climate change adaptation. Knight, Weir, Woldehanna (2003) found that education encourages farmers to adopt innovations. The coefficient of gender (1 if male, 0 if female) was also a significant factor which positively influenced farmers' environmental risk management practices at 5% level of significance. The implication of this finding is that male rice farmers tend to practice more environmental risk management techniques than their female counterparts in the study area. Asfaw and Admassie (2004) reported that male-headed households are often considered to be more likely to get information about new technologies for adoption and take risky businesses than female-headed households. Although, the findings of this study disagreed with that of Kakooza, Kabasimba, Ssemakula and Musisi (2005) while assessing gender variation in agricultural technology in Uganda and found out that women have greater preference and use of indigenous agricultural technologies than men. Household size of rice farmers in Imo State was significant but negatively related to environmental risk management practices by the farmers. This showed that increase in household size results in farmers' ability to practice more environmental risk management techniques in their rice farming. Hence, increase in household's size may at times result in increased off-farm expenditure which may worsen farmers' inability to adopt various environmental risks management techniques in farm operation.

Table 5: Estimated Coefficients of determinants of environmental risks management practices adopted by rice farmers in the study area

Variables	Linear	{a}Semi-Log	Exponential	Double-Log
Age	-0.0006139	0.0040601	-0.0029082	0.1662289
	(0.0011733)	(0.0036274)	(0.002172)	(0.1453628)
Education	0.004632	0.0249616	0.0067937	0.2204893
	(0.0038306)	(0.0118426)**	(0.0070912)	(0.0489407)***
Gender	0.0533033	0.2343368	0.0093792	0.0890477
	(0.0351987)	(0.1088196)**	(0.0651596)	(0.0995866)
Farming Experience	0.0008056	0.016175	0.0010093	0.0479764
	(0.0010082)	(0.0031169)	(0.0018663)	(0.0597318)
Household Size	-0.0110202	-0.0457278	-0.0121006	0.2738023
	(0.0060685)*	(0.0187612)**	(0.011234)	(0.0955863)***
Cooperative	0.1002854	0.1974178	0.2117986	0.3022906
	(0.026544)***	(0.0520631)***	(0.0491382)***	(0.0700219)***
Access to credit	1.290600	9.584071	3.674209	0.0410363
	(0.2006328)***	(3.114698)***	(0.956320)***	(0.0300016)
Extension contact	0.0610337	0.1192911	0.1151123	0.0924614
	(0.0058179)***	(0.0179866)***	(0.0107701)***	(0.0153671)***
Farm Size	0.0848823	0.2717344	0.1378404	0.7847627
	(0.0229362)***	(0.0709092)***	(0.0424594)***	(0.1010978)***
Income	3.508032	1.413707	4.128357	0.0498603
	(0.9832093)***	(0.320487)***	(1.088342)***	(0.0425393)
Remittances	0.0000811	0.0003429	0.0000925	0.0161179
	(0.0001507)	(0.0004660)	(0.0002790)	(0.0418593)
(CONSTANT)	0.1906794	1.847943	1.23697	1.635586
	(0.0267991)***	(0.2374309)***	(0.1421702)***	(0.2848484)***
R^2	0.9042	0.9438	0.8952	0.8738
Adjusted R^2	0.8959	0.9295	0.8862	0.8629
F - Value	104.79	158.38	99.39	98.54
Prob>F	0.0000	0.0000	0.0000	0.0000
Observation	113	113	113	113

Note: Figures in parentheses are standard errors.
*** denotes 1%; ** denote 5% while * denotes 10%
{a} is the lead equation based on fitness.
Source: Field Survey, 2019

Cooperative is an important factor in this study which was highly significant at 1% and positively related to environmental risk management practices by the farmers. This result implies that rice farmers who are members of cooperative societies are more at advantage for increased adoption and practices of various environmental risks management practices in rice farming in the study area. The coefficient of access to credit was significant at 1% and positively related to environmental risk management practices by the farmers. This conforms with *a priori* expectation as access to credit increases financial capacity of farmers to adopt new farming techniques and practices to alleviate environmental risks. Access to farm credit as found out by Nhemachena and Hassan (2008) increases financial resources of farmers and their ability to meet transaction costs associated with various adaptation options they might want to take.

Extension contact or visits to farmers was also highly significant at % and positively influenced farmers' practices of environmental risk management techniques in the study area. This is equally expected as extension agents sensitises the farmers through training on techniques and farm practices for improved production and risk management in farming. Therefore, the more number of extension visits a rice farmer received, the more the tendency and capacity of the farmers to take up more environmental risk management practices in rice farming. This finding is in agreement with that of Bekele and Drake (2003) whose findings showed that extension education was an important factor motivating increased intensity of use of specific soil and water conservation practices. Birungi and Hassan (2010) that found positive relationship between agricultural extension and adoption of inorganic fertilizer as land management technology in Uganda; also Hassan and Nhemachena (2008) found out that extension contact had positive influence on adoption of multiple crops under irrigation, mono crop-livestock under dry land, mono crop-livestock under irrigation, multiple crop-livestock under irrigation and multiple crop-livestock under dryland as adaptation strategies employed by African farmers.

The coefficient of farm size is positive and significantly related to environmental risks management practices by rice farmers. The implication of the

significant and positive relationship of farm size and environmental risk management is that as the farm size of the rice farmers' increase in hectare, there is tendency for increased practices to manage environmental risks in rice farming. Ayanwuyi, *et al* (2010) who found out that farm size had positive and significant relationship with the perception and adaptation strategies adopted by farmers. Income of the rice farmers was highly significant at 1% and positively related to environmental risk management practices by the farmers. This also conforms with *a priori* expectation as income is expected to increases financial capacity of farmers to practice new farming techniques that will result to effective risk management. Effiong, *et al* (2014) reported that increased income will assist farmers in tackling additional risk on the farm without being risk averse. This in essence will lead to an increase in output of the farmers and will also help farmers to generate income needed to manage other additional farm risks.

Conclusion

The trend of environmental risks associated with agricultural production is on the increase as occasioned by worsening climatic conditions, increased pressure on the environment and poor response capacity of farmers among others. Therefore, sustainable environmental risk management practices in rice production have become very crucial in alleviating anticipated environmental related risks to sustain rice production. This study estimated environmental risks management practices among rice farmers in rice producing areas of Imo State, Nigeria. The study identified pests and diseases outbreak, occasional flooding, destruction by birds, soil fertility depletion/degradation and injury during field operation as some of the environmental risks facing rice farmers in the area. Some environmental risk management measures practiced by rice farmers include: wearing of boots in rice farms, managing multiple farm enterprises, construction of birds scaring objects in rice farms, seeking assistance from rice farm association and planting of pest and disease resistant variety of rice. The result of the Ordinary Least Square regression analysis shows that the semi-log functional form had the best fit with R^2 value of

0.9438, F-value of 158.38 and Prob>F value of 0.0000. Out of the 11 explanatory variables specified in the model, eight variables which include: education, gender, household size, cooperative, access to credit, extension contact, farm size and income statistically influence rice farmers' practices of environmental risk measures at 1% and 5% level of significance. Based on the findings of this study, the following recommendations are made:

1. There should be government intervention programmes and policies to rice farming in order to cushion the effects of environmental risks facing rice farmers.
2. Extension agents should be amply equipped to provide rice farmers needed training assistance in predicting environmental risk and deploy appropriate measure to manage eventual occurrence of environmental risks.
3. Rice farmers should be adequately supported with relevant farm technologies and management strategies to enhance their productivity and minimize the effect of environmental risks in rice production.
4. Policies by the government and non-governmental agencies should be geared towards encouraging farmer's education on risk management practices so that they would be able to adopt appropriate risk management strategies more efficiently for optimum yield.
5. Encouraging and empowering rice farmers to form cooperative societies so that they can pull resources together and thereby averting or alleviating effects of eventual environmental risks

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