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Determinant of Risk-Smart Options among Farming Households in Agricultural Risk Management in Imo State, Nigeria: A Multinomial Logit Model Approach

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Abstract
Globally, farmers deal with a significant magnitude of uncertainty all day long. From not knowing what the vagaries of weather will be like now, to wondering if market prices will increase or decrease the next moment and even not been definite if Fulani herdsmen cow, pests and diseases will attack his promising various crops and livestock enterprises tomorrow. Therefore farmers are compelled to make decisions based on imperfect information and knowledge. Particularly, in Imo State Nigeria, farmers are heavily exposed to risk. Regrettably, the resultant effect is low agricultural output in the State all year round. The article soughed to bring incisive clarity to this discourse by estimating the determinant of Risk-Smart options among farming households in the area. Multistage random sampling technique was used in selection of One hundred and Twenty (120) household heads from the area. Well structured questionnaire was the main tool for data collection. Descriptive statistics, Smart-Art, and Multinomial Logit Model were used for data analysis. Mean age was 45.03years. Majority (65.83%) were males. Farmers cultivated on an average farm size of 1.21Ha. Average quarterly farm income was ₦84,8430.00 ($426.34). The study confirmed the evidence of various agricultural risks in the area. Greater proportion (85.00%) identified Fulani herdsmen cow attack on their crops as a source of risk. Thus, farmers have started becoming Risk-Smart through the adoption of several Risk-Smart options to thwart the negative impacts of the risk in the area. The major Risk-Smart options farmers used were diversification of livelihood (100.00%). Unfortunately, farmers Risk-Smart options are just insufficient to prevent them from devastation. However, if farmers Risk-Smart capacity are not strongly built, agricultural production in the area may be unfavourable with time. Estimated multinomial logit model showed that socio-economic characteristics of the farmers have a significant influence on their Risk-Smart options in the area. Farmers complained of inadequate Risk-Smart adoption funds and indiscriminate grazing of arable farmland by Fulani herdsmen cow. It was therefore recommended that farmers should be encouraged to form agricultural production and marketing cooperative on their own to enhance their risk-smart capacity in the area. Farmers on their own should also construct an improvised heavy wire mesh around their farms to check the indiscriminate grazing of their arable farmland by the Fulani herdsmen cow in the area. Effective agricultural policies and programmes should focus on granting farmers improved access to farm credit at zero percent interest rate. Ultimately, government at all levels should identify genuine farmers and insure their farms against risks as well as check seriously activities of these Fulani herdsmen the in the area.
Keywords: Risk, Risk-Smart Options, Risk management, Socio-economic variables, Multinomial Logit Model, Barriers, Fulani Herdsmen, Imo State, Nigeria

INTRODUCTION

Globally, farmers deal with a significant amount of uncertainty all day long. From not knowing what the vagaries of weather will be like now, to wondering if market prices will increase or decrease the next moment and even to not knowing if pests and diseases will attack his promising various crops and livestock enterprise tomorrow. Therefore farmers are forced to make decisions based on imperfect information and knowledge. Born out of this uncertainty is the possibility of agricultural injury or loss. The term "Risk" is used to describe a combination of the probability of an event and its consequences (Hatz, 2016). Risk therefore refers, to an uncertain event or condition that, if it occurs, would have a negative or positive effect on one or more project objectives (World Bank, 2013). Moreover, "Risk" and "Uncertainty" are two basic terms to any decision making framework. The studies of Olila *et al.,* (2014), opined that risk refers to imperfect knowledge where the probabilities of the possible outcomes are known, and uncertainty exists when these probabilities are not known. Uncertainty refers to imperfect knowledge of outcome agricultural production (Organisation for Economic Co-operation and Development (OECD) 2013). Risk and uncertainty are ubiquitous in agriculture and have numerous sources: the vagaries of weather, the unpredictable nature of biological processes, the pronounced seasonality of production and market cycles, the geographical separation of producers and end users of agricultural products, and the unique and uncertain political economy of food and agriculture within and among nations (Soham and Vikas, 2013). In the same vein, Risk-Smart refers to (RS) is an approach for transforming, building and re-orienting agricultural systems and farmers capacity to support food security under the uncertain realities of agricultural production. Widespread changes in rainfall, temperature patterns, market prices, technologies, health conditions (sickness and

even death) threaten agricultural production and increase the vulnerability of people's dependent on agriculture for their livelihoods, which includes most of the world's poor. Building farmers risk-smart capacity seen to be the only way out of devastation. Risk management is seen as choosing among alternatives for reducing the effects of risk on the farm which in turn affects the farms welfare position. Managing agricultural risk is particularly important for farmers, who are usually already vulnerable to poverty and lack the resources to absorb shocks since agriculture is characterised by a high variability of returns such that farmers cannot adequately predict with certainty the amount of output they will produce. A sizeable number of researchers (Székely and Pálinkás, 2009; Nto *et al.,* 2011; Fakayode *et al.,* 2012; Teweldemedhin and YKapimbim 2012; Salimonu and Falusi, 2012; OECD, 2013; Soham and Vikas, 2013; World Bank, 2013; Nto *et al.,* 2014; Jean-Paul and Guanming, 2015 and Hatz, 2016) have made a significant progress in understanding the concept of risk and risk management strategies at various farmers household level. However, particularly Imo State, none of these studies attempt to explore the risk-smart options of farming households in risk management in farming communities in Imo State, Nigeria. In the same vein, none of these studies attempted to rigorously model the risk-smart options of farming households using Multinomial Logit Model in the area. Thus, this have created a gap in knowledge, empirical evidence is largely scanty, isolated and devoid of the in-depth analysis of risk-smart options in agricultural risk management in the farming communities of Imo State, Nigeria. It is against this background that the study was undertaken to determine the socio-economic characteristics of farmers in the area; identify the major type of agricultural risk faced by farmers; describe the various risk-smart options adopted by farmers and identify barriers to farmers risk-smart options in the area.

METHODOLOGY

The study was carried out in Imo State, Nigeria. Imo State is located in the eastern zone of Nigeria. It is delineated into 27 local government areas. The State lies between latitudes 5^0 48^1N and 6^0 08^1N of the equator and longitudes 6^0 14^1E and 7^0 02^1E of the Greenwich Meridian (Chineke *et al.,* 2011 and Microsoft Corporation, 2014). It occupies the area between the lower River Niger and the upper and middle Imo River. It is bounded on the east by Abia State, on the west by the River Niger and Delta State; and on the north by Anambra State, while Rivers State lies to the south. Imo State covers an area of about 5,067.20 km^2, with a population of 3,934,899 (National Population Commission (NPC), 2006 and Nigeria Bureau of Statistics (NBS), 2007) and population density of about 725km^2 (Ministry of Lands and Survey Owerri, 2013). The State has three Agricultural zones (Orlu, Owerri, and Okigwe Zones). These divisions are for administrative and extension services and not for any agro-ecological difference. The State has an average annual temperature of 28°C, an average annual relative humidity of 80%, average annual rainfall of 1800 to 2500mm and an altitude of about 100m above sea level (Imo State Agricultural Development Programme, (Imo-ADP), 2013). Ultimately, Imo State was selected because of proximity, cost, and predominates by farmers. Multistage random sampling technique was in selection of respondent. Firstly, the three agricultural zones of the State were selected. In each agricultural zone, two Local Government Areas (LGAs) was randomly selected. In each of the selected LGA, ten communities were randomly selected. Ultimately, twelve farmers were randomly selected in each of the community to give a sample size of one hundred and twenty households (120) farmers for the study. The main tool for data collection was a set of structured questionnaire and it was supplemented with verbal interview in places where the respondents could neither read nor write. The questionnaire sought for information on socio-economic characteristics of the farmers, the major type of agricultural risk faced by farmers, the various risk-smart options adopted by farmers and the barriers of farmers to adoption of risk-smart options in the area. Descriptive statistics, Smart-Art, and multinomial logit model were used for data analysis. Multinomial logit models are used to model relationships between a polytomous response variable and a set of regressor variables (Onubuogu and Esiobu, 2014). These polytomous response models can be classified into two distinct types, depending on whether the response variable has an ordered or unordered structure (Esiobu and Onubugu, 2014).The formular of the Multinomial Logit Model (MNL) is given below;

$$\Pr(Y_i = j) = \frac{e^{\beta_j x_{ij}}}{1 + \sum_{m=0}^{6} e^{\beta m x ij}}, \quad j = 0,1,2,3,..,6 \qquad \text{.....(I)}$$

$$Pj = \Pr(Y_i = j) = \frac{e^{\beta_j x_{ij}}}{1 + \sum_{m=0}^{6} e^{\beta m x ij}}, \quad j = 0,1,2,3.6 \qquad \text{.....(II)}$$

$$\text{.....(III)}$$

Where: Pr (Y_i=j_i) is the probability of choosing either of the Risk-Smart options set aside. The reference category or based category is on Risk-Smart options as the reference or, J is the number of Risk-Smart Options in the choice set, X_i is a vector of the predictor (exogenous) socio-economic factors (variables) β_j is a vector of the estimated parameters. The probability response is stated as follows; Where:

P = Response Probability (J =0,1,2,3,---6)……(IV)

Y = Risk-Smart category; J = 1, 2 ….6; ……(V)
1= Diversification,
2= Off-farm employment,
3= Holding Financial/Credit reserves,
4= Cooperative societies production/marketing
5= Use of improved Seedling/Livestock/Poultry breeds
6= Crops/Livestock Insurance
7= No Risk-Smart option
The implicit functional form of the explanatory variables for the regression model is
$Y = f(X_1,X_2,X_3,X_4,X_5,X_6,X_7,X_8,X_9+ei)$……..(VI)
Where Y = Risk-Smart category (J =0,1,2,--6)…….(VII)
X_1= Age (years)
X_2= Gender (male=1, female=0)
X_3= Educational level (years)
X_4= Farming experience (years)
X_5= Farm size (Hectare)
X_6= Household size (number of persons)
X_7 = Quarterly Farm income (₦)
X_8= Access to credit (access=1, otherwise=0)
X_9 = Access to extension agents (access=1, otherwise=0)
e_i= Error term

RESULTS AND DISCUSSION

A. Socio-economic Characteristics of the Farmers

The result of the farmers distribution based on age is complied in table 1. It reveals that majority (46.50%) of the farmers fell within the age bracket of 41-50 years. The mean age was 48.12years. The implication of the finding is that there is a huge hope in reduction and effective management of agricultural risk as these younger farmers are more likely to adopt various improved risk-smart options faster than the older ones in the area. The finding is in line with the studies of Kwesi and de-grafts Acquah (2012) and Esiobu *et al.,* (2014) who reported that majority of farmers within the age range of 41 to 50 years are still in their active age, more receptive to innovation, more technically efficient, effective and could withstand the stress and strain involved in risk management. The result of the farmers distribution based on gender is presented in Table 1. As shown in Table 1 majority (65.83%) were males. This result indicates that both men and women are involved in agricultural production in the area but males households were more involved than female. The finding is a positive hope for effective and efficient risk management in the area as both gender are key in achieving eco-friendly environment for agricultural production to strive. The implication of males greater proportion may be that technical efficiency and productivity is expected to be higher because males have the tendency to be more labour efficient (Onubuogu *et al.,* 2014). In the same vein, the result could also be attributed to the socio-cultural factor which gives males huge access to production variables such as like farmland more than female in the area. Building both genders capacity to risk management is necessary. The findings of the farmers distribution based on educational level is displayed in Table 1. It reveals that majority (49.16%) of the farmers had secondary education. The mean educational level was 12.37 years. The result implies that approximately 87.63% of the farmers had trainings in formal educational institutions which no doubt increases their literacy levels. It is expected that the higher level of education of the farmers will contribute significantly to understanding the concept of agricultural risk and becoming risk-smart. Extension agents in the area may have less work to do in educating the farmers due to the findings, as farmers will have the ability to receive, decipher and comprehend information relevant to effective and efficient risk management in the area. The result supports the finding of Okoli *et al.,* (2014) who reported that exposure to high level of education is an added advantage in terms of achieving understanding, huge income and running efficient and sustainable agribusiness enterprise. The result of the farmers distribution based on marital status is presented in Table 1. It reveals that majority (70.83%) were married. This shows that agricultural production in the area is an enterprise of married individuals, who are seen to be responsible according to societal standards (Onubuogu *et al.,* 2013). The implication of the finding is that married farmers would be more involved in effective and efficient in risk management than their single counterpart. Since they would have easy access to production variables such as land and large family size which are traditionally owned and provided by household heads (husbands) to compliment family labour and to enhance production, reduce the cost of hired labour. The finding of the farmers distribution based on farming experience is displayed in Table 1. It indicates that majority (58.33%) had 10-19 years of farming experience. the mean farming experience was 22.91 years. Experience in agribusiness enhances output performance. The finding supports Onubuogu and Esiobu (2014) who reported that farmers with higher years of experience would be more efficient, have better knowledge of climatic conditions, better knowledge of efficient

allocation of resources and market situation and are thus, expected to run a more efficient and profitable agribusiness enterprise. As years of farming experience increases, farmers tend to build strong capacity, develop methods and technical skills to handle various kind of risk the encounter. The implication of the findings is that farmers would set realistic time and cost targets, allocate, combine and utilize better risk-smart options to thwart the negative impact of agricultural risk and enhance agricultural production in the area. The result of the farmers distribution based on household size is complied in Table 1. It shows that majority (65.00%) had household size of 6-10 persons. The mean household size was 6.21 persons. This implies that farmers in the study area have large household size. Large household size ensures availability of labour and expansion of farm size. This finding supports the result of Teweldemedhin and YKapimbi (2012) who reported that large household size compliment labour to enhance production and reduce the cost of hired labour. A household comprises all persons who generally live under the same roof and eat from the same pot. Esiobu and Onubuogu (2014) also defined a household as all people who live under one roof and who make or are subject to others making for them joint financial decision. For the purpose of this study, a household comprises the head, the wife/wives, children and other dependents that live in the same house. The implication of the findings is that, since farmers have pool household size which is a proxy for labour there would be a significant involvement of farmer in risk management. It is expected that famers who have a hefty household size would adopt several risk-smart options to effectively and efficiently manage agricultural risk than their counterpart with small household size. The result of the farmers distribution based on membership of cooperative society is presented in Table 1. It depicts that greater proportions (67.50%) of the farmers are members of cooperative society.

The implication of this result is that majority of the farmers have access to credit facilities through cooperative society to which they belong, to enhance risk-smart option. Membership of cooperative society affords farmers the opportunity of sharing information on modern production techniques, purchasing inputs in bulk as well as exchanging labour (Okoli *et al.,* 2014). The result supports the findings of Esiobu *et al.,* (2014) who reported that membership of cooperative society help agribusiness entrepreneurs obtain information and project a collective demand. The result of the farmers distribution based on extension contact is presented on Table 1. It reveals that majority (69.17%) of the farmers receives 1-2 of extension visits per month. The mean visit per month was 2.0 times. This implies that the farmers in the area are poorly visited by extension agents to ascertain their farming problem and know where they need assistance in risk management. The implication of the finding is that extension contact which is a channel through which agricultural innovations and information are passed to farmers for improvement in their standard of living, production and productivity are missing. This could bring about low productivity and threaten farmers various agricultural enterprise and risk-smart options due to lack of innovative information in the area. The findings of the farmers distribution based on quarterly average farm income is presented on Table 1. It reveals that majority (58.33%) of the farmers had an average farm income of between ₦81,000 and above. The mean farm income was ₦84,8430.00 ($426.34). The implication of the findings is that farmers with the higher farm income will be adopt various risk-smart options to enhance risk management as well as achieve huge yield/output than their counterparts who have poor average farm income in the study area. The finding supports the studies of Esiobu and Onubuogu (2014) who opined that incomes (whether on-farm or off-farm income) have a positive relationship with the adoption of agricultural technologies since the latter requires sufficient financial wellbeing to be undertaken. Table 1 also reveals that majority (48.33%) had a farm size of between 1.0-1.5 hectares. The mean farm size was 1.21 hectares. This implies that farmers in the area are mainly small holder farmers operating on less than or equal to 1.50 hectares of farmland. This could be as a result of land tenure system predominant in the area or due to the increasing population. Onubuogu *et al.,* (2014) reported that large farm size increases agricultural productivity and improves farmers technical, allocative and resource use efficiency. This implication of the findings is that farmers might have several risk-smart options to practice but limited farm size would compel them to intensively farm on a small plot of land. This is no doubt a small farm size possess a serious threat to effective and efficient risk management in the area.

B. Sources of Farm Risk Faced Crop Farmers

The result of the farmers distribution based on major type of agricultural risk in the study area age is presented on Table 2. Result reveals that the major source of production risk was disease outbreak as identified by 98.33% of the farmers in the area. The result reflects the heavy epidemic disease that has inundated the farming activities in sub-Saharan Africa especially Nigeria during the last decade (FAO, 2012). About 91.67% of the farmers reported change in weather (climate change) as the major source of risk in the area. It is becoming apparent that with the current global climate changes, changes in weather condition are creating a great concern for many farmers. This is consistent with the recent studies of Onubuogu and Esiobu (2014) who opined a significant increasing trend for changes in weather condition of agricultural production while predicting future increase if the trend continues in the area. Similar findings were reported by Enete *et al.,* (2011). Approximately 85.00%, 56.67% and 15.00% of the farmers identified pest infestation, flooding and drought respectively as the other sources of agricultural production risk in the area. Pest infestation is expected as it has been the bane of low crop performance as well as poor farmers income in Nigeria. However, with elaborate outreach programme by agrochemical dealers, any

reported pest attacks may have been due to negligence or financial constraints by farmers.

Table 1: Socio-economic Characteristics of Farmers

Age (years)	Frequency	Percentage (%)
Less than 40	42	35.00
41-50	57	47.50
51-60	21	17.50
Total	120	100.00
Gender		
Male	79	65.83
Female	41	34.17
Total	120	100.00
Educational Level (Years)		
No formal education	16	13.33
Primary	32	26.67
Secondary	58	49.16
Tertiary	14	11.67
Total	120	100.00
Marital Status		
Married	85	70.83
Single	20	16.67
Widowed	15	12.50
Total	120	100.00
Farming Experience (Years)		
Less than 10	16	13.33
10-19	70	58.33
20-30	24	20.00
31 and above	10	8.33
Total	120	100.00
Household Size (Number of Persons)		
1-5	42	35.00
6-10	78	65.00
Total	120	100.00
Membership of Cooperative		
Member	81	67.50
Non member	39	32.50
Total	120	100.0
Extension Contact (Number of Visits)		
1-2	83	69.17
3 and above	38	31.67
Total	120	100.00
Average Farm Income (₦aira)		
Less than 20,000	4	3.33
21,000-40,000	24	20.00
41,000-60,000	14	11.67
61,000-80,000	10	8.33
81,000 and above	70	58.33
Total	120	100.00
Farm Size(Ha)		
Less than 1.0	70	52.50
1.0-1.5	45	48.33
1.6-2-0	5	15.83
Total	**120**	**100.00**

Average age = 45.03years; Mean Educational level= 12.37 years; Average Farming Experience = 22.91 years; Mean household size= 5.01persons; Average farm income = ₦84,8430.00 ($426.34); Mean Farm size = 1.21Ha Source: Field Survey Data, 2016

These findings are comparable with those of Salimonu and Falusi (2009) who identified that between the year 2005 to 2009, 64.5% sample households in Nigeria were affected by pest infestation. The result also shared view with the finding of Nto *et al.,* (2014). Meanwhile, the result on flood seems justifiable in view of the flood disaster which occurred in most parts of Nigeria (Imo State inclusive) in year 2012. A relatively small proportion report on drought is also expected as there has not been any case of serve drought in Imo State, Nigeria. Result in table 2 also shows the distribution of price risk of the farmers in the area. Approximately 95.00%, 90.00% and 83.33% of the farmers identified change in price of inputs (seeds, pesticides, farm tools etc), fluctuation in output price (low price of food) and poor marketing condition respectively. In situations where produce prices are liberalized as it is in Nigeria, seasonal and regional fluctuations are expected (Nto *et al.,* 2011). The finding is consistent with those of Flaten *et al.,* (2005); Satit *et al.,* (2008) and Kwesi and de-Graft Acquah (2012) who argued that marketing risks associated with the variability of product and input prices were the most important sources of risk considered by the farmers in their respective study areas. About 96.67% and 93.33% of the farmers reported non-accessibility of loan and high interest rate as their financial risk in the area. Poor access to credit and high interest rate left farmers unable to cope with farm risk. This could be attributed to high collateral demand and

grantor expected of farmers before receiving loan from any credit institution. Meanwhile Ijere (1981) have opined that agricultural credit in the farmers hand will enable him to reap the economies of scale, thereby enhancing productivity growth, venturing into new fields, discovering new and cheaper products, creating demands where none exists and providing utilities to satisfy a wider market. The finding tallies with the studies of Salimonu and Falusi (2012) and Nto *et al.,* (2014) who asserted that financial risk associated with poor access to credit and high interest and collateral demand were the bane of poor coping strategies by farmers Osun and South east Nigeria of which Imo State is included respectively. About 96.67%, 91.67% and 88.33% of the farmers identified technological failure, environmental degradation and poor technical know-how respectively as their technical risk in the area. Good farm technologies, good environment and adequate technical know-how will energise and mobilise farmers to produce optimally as well as cope with any impending risk positively. This is in consonant with the findings of Ekeleme *et al.,* (2008), Daramola, (2005) which maintained that farmers in Nigeria still rely on traditional technology, outdated knowledge and low yielding variety of inputs. Others 78.33%, 46.67% and 85.00% of the farmers identified sickness/death, theft of production equipment and herdsmen cow attack on crops respectively as their major social risk in the area. Sickness/death could be attributed to the unpredictable nature of human body system while theft of production equipment maybe attributed to the high level of poverty that have engulfed the area as reported by (NBS, 2012). The result also shared view with the finding of Satit *et al.,* (2008); Nto *et al.,* (2011) and Salimonu and Falusi (2012) and which reported theft and sickness as the risk associated with farming activities. The activities of Fulani herdsmen have had a negative significant effect on farmers production in recent times in the area.

Table 2: Farmers Sources of Risk Faced

Risk Sources	Frequency	Percentage (%)
A. Production Risk		
Pest infestation	51	85.00
Disease outbreak	59	98.33
Change in weather (Climate Change)	55	91.67
Flooding	34	56.67
Drought	9	15.00
B. Price Risk		
Change in price of inputs (seeds, pesticides, farm tools etc)	57	95.00
Fluctuation in output price (low price of food)	54	90.00
Poor marketing condition	50	83.33
C. Financial Risk		
Non-accessibility of loan	58	96.67
High interest rate	56	93.33
D. Technical Risk		
Technological failure	58	96.67
Poor technical know-how	53	88.33
Environmental degradation	55	91.67
E. Social Risk		
Sickness/death	47	78.33
Theft of production equipment/farm produce	28	46.67
Fulani Herdsmen cow attack	51	85.00

Multiple Responses were Recorded*; *Source: Field Survey Data, 2016

Figure 3; Farmland Attacked by Fulani herdsmen Cow in Imo State, Field *Survey Data, 2016*

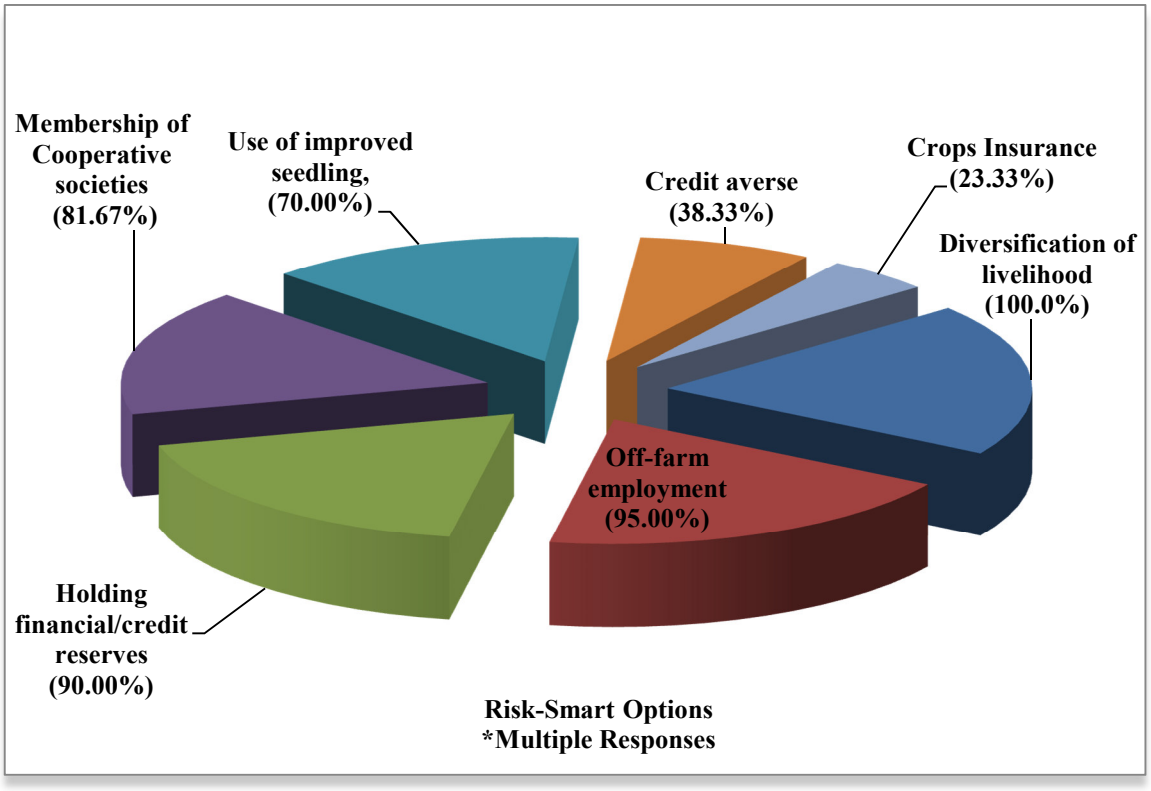
Figure 4; Fulani herdsmen Cow in Imo State, Field *Survey Data, 2016*

The picture above **(figure 3 and 4**) depicts one of the farmers sources of risk in the area. It shows the magnitude of cows these Fulani herdsmen parades around the agricultural zone of Imo State. The damage on crops is great. They posses a significant amount risk to farmers. These herdsmen are bent on turning farmer farmland into their grazing area, thereby rendering farm families homeless, without food for subsistence and commercial purposes.

C. Risk –Smart Options of Farmers

The result of the farmers distribution based on Risk –Smart Options of Farmers in the study area is complied in Figure 1. The Risk –Smart Options for this study were based on asking farmers about their perception of agricultural risk and the actions they had taken to thwart any impending risk. The Risk –Smart Options the farmers reported may be profit driven, rather than effective agricultural risk management driven. Regardless of this dearth in knowledge, the researcher assumed that farmers actions were farm risk rather than profit driven, as identified by farmers themselves. The result reveals that all the farmers (100.00%) of the practiced diversification of livelihood while 95.00% adopted off-farm employment to mange and copes with any impending farm risk in the

area. This is in consonant with the findings of and Taiwo and Ayanwale (2005) and Nto *et al.,* (2014) who noted that crops diversification is the major risk management strategies of farmers, while studies of Korir (2011) asserted that off-farm investment (investment outside agriculture) is the key risk management strategies farmers usually adopt in the face of impending agricultural risk. Also in the case of non-farm business and diversification of livelihood the farmers could be engaged in other income yielding non-farm activities like teaching, politics, artisan, extension services, motorcycle or tricycle transportation business among others. In the same vein Nto *et al.,* (2010) reported that diversification involves investment in more than one portfolio (Some of the agribusiness operators also engaged in non agribusiness activities. Engagement in and earning of non-agribusiness income lowered the variants of incomes from agribusiness operation. Some of the agribusiness investors engaged in diversification of products produced, that is, they are involved in the production of two or more agribusiness products or output simultaneously. A sizeable number of researchers (Pandey, 2004; Van Horne, 2004; Alimi and Ayanwale, 2005 and Akinsulire, 2006) have noted that diversification served the best by spreading risk across a number of enterprises. Diversification acts as a strategy to stabilize firms incomes. A reasonable proportion (90.00%, 81.67%, 70.00% and 38.33%) of the farmers identified holding financial/credit reserves, membership of cooperative societies, use of improved seedlings, and credit averse respectively as their risk management strategies in the face of any impending farm risk in the area. However, most of these farmers do not even understand how contract sales and hedging work. Perhaps, necessary organizations like cooperative society and individuals to deal with are not available in the study area. Membership of cooperative grant farmers ease access to financial/credit reserves, credit, marketing, information as well as improved seedlings The finding is similar with the studies of Nto *et al.,* (2014) who have argued that membership of cooperative society affords farmers the opportunity of sharing information on modern production techniques, new innovation, purchasing inputs in bulk as well as exchanging labour. The findings also share view with the studies of Esiobu *et al.,* (2014) who opined that membership of cooperative help agribusiness entrepreneur to access information and project a collective demand. While a smaller proportion (20.00%) of the farmers reported crop insurance as their risk management strategies in the face of any impending risk. Insurance involves payment of premium to an insurance company which indemnifies the insured investor against losses recorded in the business. However, the finding tallies with the studies of Nto *et al.,* (2011) but is not in consonance with Alimi and Ayanwale (2005) who reported that investors never used insurance as a means of reducing risk because of their unavailability. Furthermore, the low usage of insurance services could be attributed to the fact that majority of the farmers in the study area are poorly away of any crop insurance agencies in the area. However, greater proportion of the farmers explained that they did not know of any crop insurance package from any source, which they could patronized to assist them in farm risk situation. The confidence which farmers could have gained to invest in production through insurance policy to cushion their financial position in case farm risk situation might be lacking in the area. Others 12% of the farmers have no risk management strategies in the face of any impending risk. This could be attributes to dearth in research and information about risk management strategies in the area.



Distributions of risk-smart options of Farmers; *Multiple Responses were Recorded*; *Source: Field Survey Data, 2016

D. Farmers Agricultural Enterprise Type

The result of the farmers distribution based on agricultural enterprise type is presented in Figure 2. It shows that the farmers are involved on one form of agricultural enterprise or the other. This implies that farmers are noticing the risk situation of agriculture and have started becoming Risk-Smart through the adoption of several Risk-Smart options to thwart the negative impacts of the risk in the area among which is diversification of livelihood. Farmers in the area have several enterprise-types to hold-on in effective risk management. Diversification of livelihood is one of the risk-smart options farmers used in risk management as earlier found out in the study. The study is in line with the findings of Onubuogu and Esiobu (2014) and Nto *et al.,* (2014) who observed that diversification of livelihood is the major option farmers used in the means of uncertainty of agricultural production. Also A sizeable number of researchers (Alimi and Ayanwale, 2005; Akinsulire, 2006 and Esiobu and Onubuogu, 2014) has noted that diversification served the best by spreading risk across a number of enterprises. Diversification acts as a strategy to stabilize firms incomes. In the same vein, livelihood diversification includes both on and off-farm activities which are undertaken to generate additional income from the major agricultural activities, via the production of subsidiary agricultural and non-agricultural goods and services, the sale of wage labor, or self-employment in small and medium enterprises firms, and other strategies undertaken to minimize risk. These include activity or environment diversification in agriculture

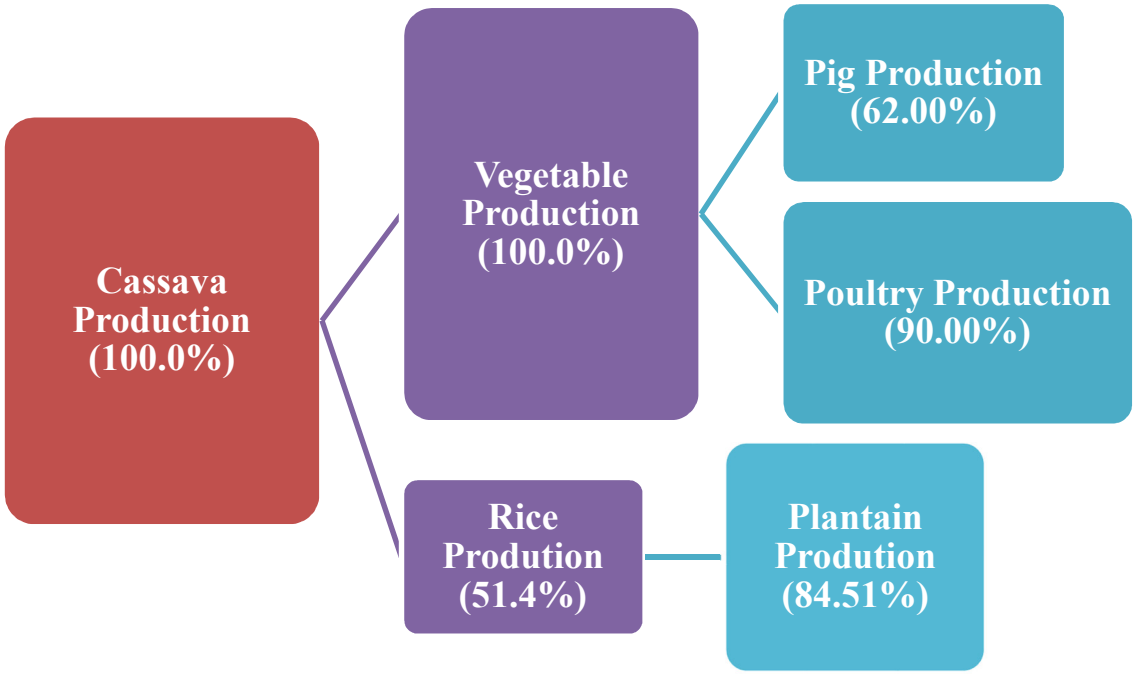


Figure 2: Smart-Art Distribution of Farmers Enterprise Type; *Multitple Reponses were recorded; Field *Survey Data, 2016*

E. Farmers Socio-economic Characteristics and Risk-Smart Options

Table 3 shows the multinomial logit model analysis of the influence of farmers socioeconomic characteristics on their various risk-smart option to risk management. The risk-smart options set in the multinomial logit model included Diversification of livelihood, Off-farm employment, Holding Financial/Credit reserves, Cooperative societies production/marketing, Use of improved Seedling/Livestock/Poultry breeds and Crops/Livestock Insurance no risk-smart options. The estimation of the multinomial logit regression model for the study was undertaken by normalizing one category, which is usually referred to as the "reference or base category". In the analysis, the last category (no risk-smart options) was the base category. The model was analyzed and tested for the reliability and validity of the independence of the irrelevant alternatives (IIA) assumption by using the Hausman test for IIA. The analysis accepted the null hypothesis (H_o) of independence of the farmers adaptation options, suggesting that the multinomial logit model is appropriate to model risk-smart options of farmers in the area, (Chi-square (X^2) ranged from 0.0001 to 5.518, with probability values ranging from 0.449 to 1.000 for the Hausman test). The total observations (sample size) were one hundred and twenty (120).The likelihood ratio statistics from multinomial logit regression model indicated that $\chi 2$ statistics (1958.215) are highly significant at 1% ($P<0.00001$), level of probability, hence suggesting that the model has a strong explanatory power. The variables of the multinomial logit model were in conformity with the signs of the *a priori* expectations. The empirical result is also consistent with the theoretical postulations of the model. The significance of the likelihood ratio statistics revealed that the farmers socio-economic characteristics have a significant influence on their various risk-smart options to effective risk management. The null hypothesis (H_0) of the study was therefore rejected; and the study therefore accepted that the farmers socio-economic characteristics have a significant influence on their risk-smart options to effective risk management in the area. Hence, the finding presents the marginal effects along with the levels of statistical significance.

Age (X_1): The age of the farmers had a significant relationship on their Risk-Smart Options in effective risk management. Farmer's age was positively related to the likelihood of choosing all the Risk-Smart Options. The finding shows that there is a positive relationship between age of the household head and the adoption of various risk-smart options. the finding also reveals that a unit increase in farmers age propels a unit increase in adoption of various risk-smart option to effective risk management. The implication of the finding is that there is a huge hope in reduction and effective management of agricultural risk as these younger farmers are more likely to adopt various improved risk-smart options faster than the older ones in the area. The finding is in line with the studies of Kwesi and de-grafts Acquah (2012) and Esiobu *et al.,* (2014) who reported that majority of farmers within the age range of 41 to 50 years are still in their active age, more receptive to innovation, more technically efficient, effective and could withstand the stress and strain involved in risk management

Gender (X_2): Gender had a positive relationship across all the farmers Risk-Smart Options in effective risk management in the area. This result indicates that both men and women are involved in agricultural production in the area but males households dominates. The finding is a positive hope for effective and efficient risk management

in the area as both gender are key in achieving eco-friendly environment for agricultural production to strive. The implication of males greater proportion may be that technical efficiency and productivity is expected to be higher because males have the tendency to be more labour efficient (Onubuogu *et al.,* 2014). In the same vein, the result could also be attributed to the socio-cultural factor which gives males huge access to production variables such as like farmland more than female in the area. Building both genders capacity to risk management is necessary.

Educational Level (X_3): Educational level had a positive and significant relationship across all risk-smart options in the area. This result is line with the *a priori* expectation of the model. A unit increase in the year of education of farmers increases the probability of choosing various risk-smart options. The probable reason for the positive relationship is due to the fact that educated farmers have more knowledge of farm risk and are already aware of various techniques and management practices that could be employed to combat the negative impact of risk and uncertainty in the area. These findings are confirmed by studies undertaken by Nto *et al.,* (2011) and Onubuogu and Esiobu (2014) have all noted that higher education was likely to enhance information access of the farmer for improved technology up take and higher farm productivity. They have also observed that education is likely to enhance the farmers' ability to receive, decipher and comprehend information relevant to making innovative decisions in their farms.

Farming Experience (X_4): Farming experience had a positive relationship across all risk-smart options in the area. The result showed that experienced farming households have an increase likelihood of choosing all the risk-smart options Experience has taught most of the farmers on the various farm management practices and techniques that could be used in the face of uncertainty in the area. The findings are similar to those arrived at by Nto *et al.,* (2014) that farming experience enhances the probability of uptake of various risk management options as experienced farmers have better knowledge and information on risk in management practices. Since the experienced farmers have high skills in farming techniques and management, they may be able to effectively manage risk when faced with uncertainty than less experienced farmers.

Farm size(X5): Farm size had a negative significant relationship with the probability of choosing the various risk-smart options. The negative relationship between farmers adaptation measure and farm size shows that risk-smart measures is plot - specific. This means that it is not the size of the farm but the specific characteristics of the farm that dictates the need for specific risk smart options. Also increase in farm size increases the tendency of farmers' easy adoption of various risk-smart option especially diversification of livelihood.

Household Size (X_6): Farm size had a positive and significant relationship with the probability of choosing the various risk-smart options. Household size had a positive and significant coefficient with them. Large household size increases the likelihood of choosing all risk-smart options in risk management. The probable reason for this relationship is that large household size which is normally associated with a higher labour endowment would enable a household to accomplish various farm production tasks especially at the peak of the farming seasons. A farmer with pooled and large household size diversifies easily than farmers with less household size. Onubuogu *et al.,* (2014) and Onubuogu and Esiobu (2014) noted that, household size is a proxy for labour availability.

Farm Income (X_7): Farm income had a positive and significant coefficient with the likelihood of choosing all risk-smart options.

This is because higher-income farmers are risk-smart, have more access to risk management information, a lower discount rate, a longer-term planning horizon and wealthier than less-income farmers. Risk-smart option is costly. Hence farmers with poor farm income are not risk-smart. This observation is similar to that by Esiobu and Onubuogu and Hatz (2016) who noted that farmers' incomes (whether on-farm or off-farm income) have a positive relationship with the adoption of agricultural technologies since the latter requires sufficient financial wellbeing to be undertaken. Nonetheless, off-farm income generating activities may sometimes present a constraint to adoption of agricultural technology because they compete with on-farm activities.

Access to Credit(X_8): Access to credit had a positive and significant coefficient with the likelihood of choosing all the risk smart option. Inadequate fund is one of the main constraints to risk management and diversification of livelihood.

Access to Extension services/agents(X_9): The coefficients of access to extension services had a significant and positive relationship with the likelihood of choosing all risk-smart options. This implies that farmers who have access to extension agents are more likely to be aware of risk and uncertainty nature of agriculture as well as the knowledge of various management practices that they could employ to adapt effectively, efficiently and steadily in the area. Extension services provide an important source of information on risk as well as agricultural production and management practices. Farmers who have significant extension contacts have better chances to be aware of changing risk sources and also of the various risk-smart options that they can use thwart its negative impact

Table 3: Estimated Multinomial Logit Model Analysis of Risk-Smart Options and Farmers Socio-economic Characteristics

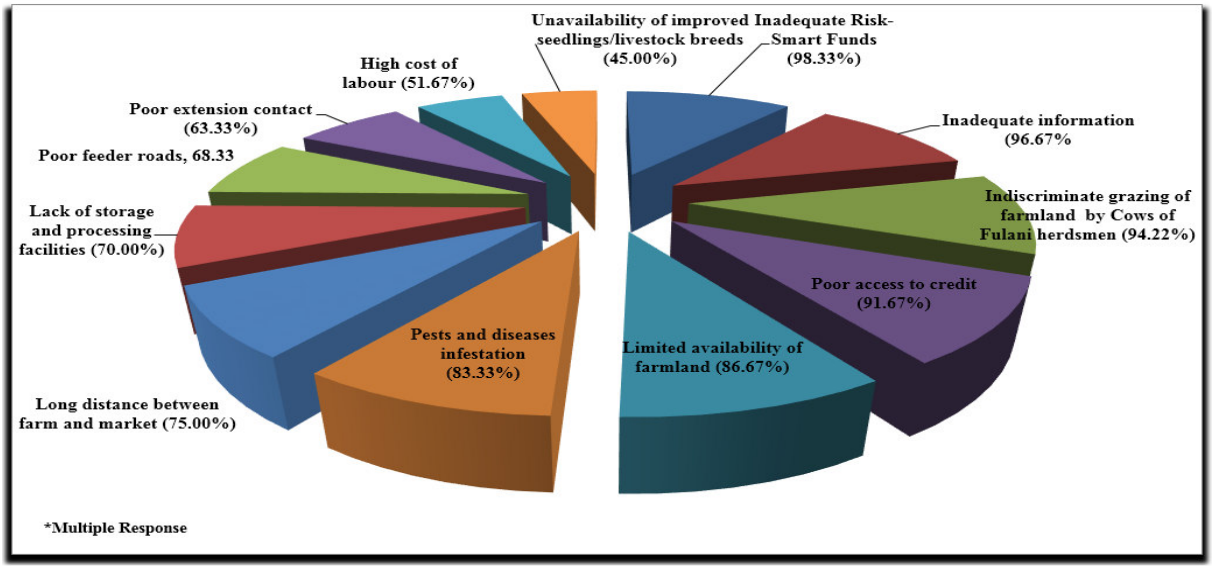
Explanatory variables	Diversification of livelihood		Off-farm employment		Holding Financial/Credit reserves		Cooperative Societies Production/Marketing		Use of improved Seedling/Livestock/Poultry breeds		Crops/Livestock Insurance	
	Coeff.	Wald	Coeff.	Wald	Coeff.	Wald	Coeff.	Wald	Coeff.	Wald	Coeff.	Wald
Age (X_1)	15.2^{xxx}	20.1	35.1^{xx}	10.3	8.7^{xxx}	20.2	13.2^{xxx}	24.9	17.6^{xxx}	19.2	30.5^{xxx}	17.3
Gender(X_2)	18.7^{xxx}	11.1	3.3^{xx}	6.2	18.5^{xxx}	14.4	15.2	9.1	15.9^{xxx}	12.1	18.0^{xxx}	15.2
Edu (X_3)	38.4	1.0	4.4	0.3	25.2	1.8	34.0^{xxx}	15.0	20.4	0.4	19.0***	12.8
FExp (X_4)	12.9	0.6	22.3	0.5	20.5	1.5	33.4	1.5	38.4	2.1	8.1***	22.4
FmS (X_5)	-13.1^{xxx}	17.2	-33.5^{xx}	8.2	-7.2^{xxx}	24.4	-10.4^{xxx}	24.0	-20.4^{xx}	10.4	-24.3^{xxx}	14.1
HHS(X_6)	16.0^{xx}	8.1	25.0^{xxx}	8.1	15.9	0.5	34.1^{xxx}	13.0	15.1	0.2	12.2	2.2
QFmI (X_7)	33.3	1.6	18.2^{xxx}	27.2	11.4	1.5	16.0	2.0	3.1	0.7	8.7	2.5
ATC (X_8)	23.1^{xxx}	5.8	20.1^{xx}	6.2	29.3^{xxx}	4.1	70.5^{xxx}	35.1	13.1^{xxx}	3.4	28.1^{xxx}	4.1
ATEAs(X_9)	17.2^{xxx}	2.1	40.3^{xx}	5.2	25.3^{xxx}	12.2	35.1^{xxx}	5.9	15.1^{xxx}	12.0	25.1^{xxx}	15.2
Intercept	50.5	0.5	5.2	0.10	23.1	1.0	35.5^{xxx}	18.0	30.2	23.1	40.5	0.5
Reference / Base Category					**No Risk-Smart Options**							
Likelihood Ratio Chi Square (χ2)					**1958.215^{xxx}**							
Pseudo R-Square (Cox and Snell; Nagelkerke; McFadden)					**(0.948; 0.904; 0.883)**							

Hausman Test				
Least Chi Square Value	**Level of Significance**	**Robust Chi Square (χ2) Value**	**Level of Significance**	**Total Observation/Sample Size**
0.0001	1.000	5.518	0.449	120

Source: Computer Printout of STATA (2016); *Statistically Significant at 10%; **Statistically Significant at 5%; * Statistically Significant at 1%, Edu; Education; FExp; Farming Experience, FmS; Farm Size; HHS; Household Size, QFmI; Quarterly Farm Income, ATC; Access to Credit; ATEAs; Access to Extension Agents**

A. Barriers to Risk-Smart Options

The result of the farmers distribution based on barriers to Risk-Smart Options in the area is compiled in Table 4. About 98.33%, 96.67% 94.22% and 91.67% of the farmers complained of inadequate risk smart fund, inadequate information, indiscriminate Fulani herdsmen cow grazing and poor access to credit. Poor access to credit left farmers unable to cope with farm risk due to poor risk smart fund. This could be attributed to high collateral demand and grantor expected of farmers before receiving loan from any credit institution. Esiobu *et al.,* (2015) have argued that agricultural credit in the farmers hand will enable him to reap the economies of scale, thereby enhancing productivity growth, venturing into new fields, discovering new and cheaper products, creating demands where none exists and providing utilities to satisfy a wider market. About 86.67%, 83.33% and 75.00% of the farmers also identified limited availability of farmland, pests and diseases infestation and long distance between farm and market respectively as their barrier in managing and coping with farm risk in the study area. Limited availability of farm land could be attributed to land tenure system which is prevalent in the study area as well as the increasing population. Onubuogu and Esiobu (2014) has opined that high population pressures force farmers to intensively farm over a small plot of land and make them unable adopt various sustainable agricultural development strategies for green economy initiative in the study area. Pests and diseases infestation could be attributed to poor and adulterated pesticides and plant disease control agro-chemicals available in market area. Okoli *et al.,* (2014) asserted that only agricultural projects and programmes agencies (example; CADPs and ADPs) provide the right quality of inputs to farmers. Long distance between farm and market also left the farmers at the mercy of farm gate sale which make them loss greater proportion of their produce to exploitation and dubious middlemen in the area. Approximately 70.00%, 68.33%, 51.67% and 45.00% complained of lack of storage and processing facilities, poor feeder roads, poor extension contact, high cost of labour, unavailability of improved crops/seedlings. For poor storage and processing facilities, farm produce could be only be stored for few days in which case, it must be disposed even when the price is not favourable, this accounts for the severe losses suffered by pineapple farmers as also reported by (Esiobu and Onubuogu, 2014). Poor feeder roads could be attributed to poor infrastructural development in the area. Poor extension contact could be attributed to poor mobility for extension staff in the area. Also high cost of labour is associated with farmers small household size in the area. Ultimately, there is no doubt that these barriers are the major bane for poor coping of farmers to farm risk in the area. These barriers contribute to farmers not been risk-smart in the area. Curbing these barriers will be important for farmers and agricultural production in the area.



Distributions of Barriers of risk-smart options; *Multiple Responses were Recorded*; *Source: Field Survey Data, 2016

CONCLUSION AND RECOMMENDATION

Conclusively, farmers deal with a significant amount of uncertainty all day long. From not knowing what the vagaries of weather will be like now, to wondering if market prices will increase or decrease the next moment and even not been definite if Fulani herdsmen cow, pests and diseases will attack his promising various crops and livestock enterprises tomorrow. Therefore farmers are compelled to make decisions based on imperfect information and knowledge. Particularly, in Imo State Nigeria, farmers are heavily exposed to risk. Regrettably, the resultant effect is low agricultural output in the State all year round. The article soughed to bring incisive clarity to this discourse by estimating the determinant of Risk-Smart options among farming households in the area. The study confirmed the evidence of various agricultural risks in the area. Greater proportion (85.00%) identified Fulani herdsmen cow attack on their crops as a source of risk. In recent times, the Fulani herdsmen have been threaten farmers productive capacity in the area. The magnitude of cows these Fulani herdsmen parades around the agricultural zone of Imo State is sizeable. The damage on crops is great and devastating. They posses a significant amount risk to farmers. These herdsmen are bent on turning farmer farmland into their grazing area, thereby rendering farm families homeless, without food for subsistence and commercial purposes. Thus, farmers have started becoming Risk-Smart through the adoption of several Risk-Smart options to thwart the negative impacts of the risk in the area. The major Risk-Smart options farmers used were diversification of livelihood (100.00%). Unfortunately, farmers Risk-Smart options are just insufficient to prevent them from devastation. However, if farmers Risk-Smart capacity are not strongly built, agricultural production in the area may be unfavourable with time. Estimated multinomial logit model showed that socio-economic characteristics of the farmers have a significant influence on their Risk-Smart options in the area. Farmers complained of inadequate risk-smart fund and information. Inadequate risk-smart funds could be attributed to high cost adoption of various risk-smart options in the area. Inadequate fund hinders farmers from getting the necessary resources and technologies which assist them to successfully manage farm risk effectively. Lack of information could be attributed to dearth in research on risk and risk-smart options in the country as well as well as poor information dissemination on the part of the government/private information agencies as earlier found out in the study. Poor knowledge on appropriate risk-smart options left most of the farmers unaware of better and sustainable risk-smart options to adopt and address impending farm risk effectively.

Recommendation

Increasing education and extension contact of the farmers will significantly propel a unit increase in effective risk management as education and extension contact had a positive coefficient in the multinomial model. A unit increase in access to credit of the farmers will also boast the risk-smart capacity for the farmers in the area. Farmers should be encouraged to form agricultural production and marketing cooperative to enhance their risk-smart capacity in the area. Farmers on their own should construct an improvised heavy wire mesh to check the indiscriminate grazing of their arable farmland by the Fulani herdsmen cow in the area. In the same vein, effective agricultural policies and programmes should focus on granting farmers improved access to farm credit at zero percent interest rate. Diversification into off-farm investments should be encouraged among farmers in the area as

it reduces risks by increasing resilience and offsetting the seasonal nature of agricultural income. Building farmers capacity to risk management is also necessary given the trends of farm risk in recent times. Ultimately, government at all levels should identify genuine farmers and insure their farms against risks as well as check seriously activities of these Fulani herdsmen the in the area.

Suggestion for Further Research

In spite of the logical, systematic, strength, magnitude, novelty and empirical nature the present study, there is still room for further research. Empirical research on risk and risk-smart options of farmers are still scare in the area and even beyond. Hence these article presented here provide an incisive insight and interesting ground for further research. Understanding the conditions under which farmers adopt several risk-smart options for effective risk management as well as the option they adopt in checkmating particularly the activities of these Fulani herdsmen on their crop production and the impact of these risk-smart options on farming decisions at micro-level would provide excellent avenues for future research. Logical and systematic modeling of impact of risk on crop and livestock production at farmers household level in the area is also a clear avenue for further research. Several policy incisive insights can be obtained from this present study in building further research on risk and risk-smart options.

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