Sources of Farm Risk and Management Strategies among Cowpea (*Vigna unguiculata* SSP) Producers in North East Nigeria

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Abstract: The study identified sources of farm risks and management strategies used among cowpea producers in North East, Nigeria. Data were collected using structured questionnaires from 595 cowpea producers. Multi-stage sampling procedure was used to select cowpea producers for the study. In the first stage purposive sampling was used to select three (3) states from the six (6) states in the region and these states include Adamawa, Bauchi and Gombe States. From these selected states two (2) local governments each were selected based on *apriory* information on cowpea production from the state Agricultural Development Programs (ADPs) and analysed using descriptive statistics, Likert scale and multiple regression model. The result revealed that, pest and diseases emerged as the common source of production risk at 74%. Also, uncertainty from product price 66% was a major source of marketing risk. Furthermore, inadequate credit was an important financial risk at 54% and lack of cooperative 51% were major sources of both financial and institutional risks. The valid management strategies used in mitigating/coping among cowpea producers were livestock production to complement income, sales of produce, engagement in other jobs/activities, access to ADP's extension agent among others. Therefore, cowpea production is affected by production/environmental risk, marketing risk, financial risk, institutional risk and human/personnel risk and exhibited risk aversion attitude. The study recommends strategy of developing early varieties, disease resistant crops and products that are resistant to pest both in the farm and storage to raise the productivity of cowpea. Also, cowpea producers' cooperatives should be strengthened with priority given enlightened/educating members, create strong bargaining power for farm products as well as accessing credit facilities. Similarly, inputs such as fertilizers and certified improved high-quality seeds are available and accessible to cowpea producers to increase production and reduce risks.

Key words: Sources, farm, risks, management, bauchi, Nigeria.

1. Introduction

Cowpea is a major food and cash crop in northern Nigeria, providing nutritious grain and a less expensive source of protein for both the rural poor and urban consumers [1]. Increasing demand for cowpea consumption without increase in its supply could lead to increase in its market prices which could go beyond the purchasing powers of low-income earners that constitute the majority of the populace [2]. Cowpea production is largely subsistent, characterized by inefficiency, high risk, low productivity and very little diversification [3]. The sources of risk and level of its

severity can vary according to farming systems, geographic location, weather conditions, supporting government policies and farm types. Risk is a major concern in developing countries where farmers have imperfect information to forecast things such as farm input prices, product prices, and weather conditions, that might impact the farms in the future [4]. The agricultural environment in most of low-income countries is characterized by crop diseases, flooding, illness of household member and crime [5, 6].

Smallholder farmers often have limited capacity to manage risks or cope with resulting losses when shocks

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occur [7]. According to Kahan, [8] the common sources of risk in farming can be divided into five areas: production, marketing, financial, institutional and human risks. Production risk occurs because agriculture is affected by many uncontrollable events that are often related to weather, including excessive or insufficient rainfall, extreme temperatures, hail, insects, and diseases [9]. Also, marketing risk is related to the variations in commodity prices and quantities that can be marketed [10]. It reflects risks associated with changes in the price of output or of inputs that may occur after the commitment to production has begun [7]. In addition, institutional risks relate to institutional changes such as changes in government intervention in agriculture, weak institutional capacity to implement regulatory mandates, changes in food safety requirements, increasing environmental regulations, and macro-economic settings such as interest and exchange rate policies [11]. According to World Bank [12], policy changes pose a risk when they are made quickly and erratically, giving farmers little time to adjust. In Nigeria, access to credit and high interest rate, were the important sources of financial risk [6, 13]. Similarly, human resource risk may be associated with the labour and management functions of farmer [14]. Disruptive changes may result from such events as death, divorce, injury, or the poor health of the principal operator of the farm [10]. In many countries' labour migration away from rural areas is a common occurrence. Migration can cause labour shortages for the farm. Political and social unrest can also limit labour availability [8].

World Bank [12] risk management measures can be classified into the following three categories:

• Risk mitigation (ex ante). Actions designed to reduce the likelihood of risk or to reduce the potential impact of an adverse event, or the severity of losses (for example, water harvesting and irrigation infrastructure, crop diversification, extension).

• Risk transfer (ex ante). Actions that will transfer the risk to a willing third party. These mechanisms usually will trigger compensation in the case of a risk-generated loss (for example, purchasing insurance, reinsurance, financial hedging tools).

• Risk coping (ex post). Actions that will help the affected population to overcome crises, build their resilience to future shocks or to relieve the impact of the risky event once it has occurred. Such interventions usually take the form of compensation (cash or in-kind), social protection programs, and livelihood recovery programs (for example, government assistance to farmers, debt restructuring, contingent risk financing).

To better utilize scarce resources, it is important to understand which risks, or subset of risks, are causing maximum losses, and at a much greater frequency [15]. Meanwhile these risks if not well managed will result in multiplier effects in negating cowpea producers' productivity and well-being. To this end the broad objective of the study is to identify the sources of farm risks and management strategies used among cowpea producers in North East Zone of Nigeria. The specific objectives are to:

• Identify types and sources of risk among cowpea producers in the study area;

• Identify and describe the risk management strategies among the cowpea producers;

• Determine the effectiveness of the risk management strategies used by cowpea producers in the study area.

2. Methodology

2.1 The Study Area

The study was conducted in North East Zone of Nigeria. The area which constitutes North-East region of Nigeria lies between the vast arid expanse of the Sahara and the dense tropical rain forest along the Guinea Coast. Delimiting the area is Cameroon on the east, Niger and Chad republics on the north, North-Central Nigeria on the west, and South-Eastern Nigeria on the south. This geographical area constitutes the largest region in Nigeria and comprises of the present states of Adamawa, Bauchi, Borno, Gombe, Taraba and

Yobe. It has a total of 103,639 square miles, representing 29.1 per cent of the total area of Nigeria [16]. The North East has a population of 26,263,866 as of 2016 NBS [17], based on an estimated annual growth rate of 3.2%. North East, Nigeria is known for groundnut, millet, sorghum, cowpea. Cowpea is a major food and cash crop in northern Nigeria [1].

2.2 Sampling Technique and Sample Size

Multi-stage sampling procedure was used to select cowpea producers for the study. In the first stage purposive sampling was used to select three (3) states from the six (6) states in the region and these states include Adamawa, Bauchi and Gombe States, and from these selected states two (2) local governments were selected based on priori information on cowpea production in Bauchi and Gombe states from the state ADPs. While, in Bauchi state, Alkaleri and Kirfi LGAs were selected, Gombe State, Akko and Billiri were selected. However, in Adamawa state, Madagali and Maiha were ranked high in terms in cowpea production based on priori information, for security reasons Mubi and Gombi Local Governments also known for cowpea production were selected. In the second stage, from the wards made up each of the six (6) selected LGA's in the study areas communities or wards were randomly selected based on the registered farmers. In the last stage simple random sampling was used to select 595 cowpea producers for the study, using proportional allocation technique as used by Agboola [5]. Using this technique, the number of sampled farmers in each of the state and LGA's were obtained from the equation:

$$Sf \ = \frac{n*Nf}{NT} \ \ \text{........} \tag{1}$$

where,

S_f = number of cowpea producers to be selected in the state and LGA's;

n = total number of cowpea producers for the survey;

N_f = number of registered farmers in the state and LGA's;

N_T = sum of registered farmers in Adamawa, Bauchi and Gombe States.

According to FMARD [18] distribution of registered farmers in Adamawa State was 201,555 registered farmers, Bauchi State had 539,660 registered farmers and Gombe State had 360,452 registered farmers.

2.3 Analytical Techniques

Descriptive statistics were employed for objective i; Similarly, attitudinal scale approach (ASA) was used for ii.

Likert Scale was used to ascertain farmers' risk attitudes, which were determined by the sum score of the self-assessment scale's statements. A 5-point Likert scale was used to measure an individual's attitude as established by Bhattacharya [19]. The responses measured on a 5-point specified as: Strong disagreement (score of 1) implies the risk aversion attitudes of the cowpea producer. On the other hand, strong agreement (score of 5) indicates a risk-taking attitude. In between the two extremes, disagreement (score of 2), undecided/neutral (Score of 3) and agreement (score of 4) were included as alternative responses.

2.3.1 Reliability Testing

Also, objective ii (identifies the risk management strategies among the cowpea producers in mitigating/coping with risk) was determined using Reliability Testing of Likert Scale. It measures consistency, precision, repeatability, and trustworthiness of a research [20]. The purpose of reliability testing is to optimize the number of statements, by including such statements in the final refined scale which really contributes to explaining and measuring the risk attitude of the cowpea producers. A measurement that is frequently used to evaluate the reliability is Cronbach's coefficient alpha (α) [21-23]. Coefficient alpha measures the proportion of communal variation due to true differences in cowpea producer attitudes toward the risk. It is measured as:

$$\alpha \ = \ k/k-1 \left\{ 1 - (\Sigma \text{з} 2i / \text{з} 2y) \right\} \ \dots \tag{2}$$

where:

α = Cronbach's coefficient (alpha);

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k = number of statement items in the ASA Model;

$s2i$ = variance of ith statement item;

$s2y$ = total variance of the k-statement item scale.

The coefficient alpha ranges between 0 and 1. The minimally acceptable coefficient alpha is subjective and varies based on the developer's objectives [21]. DeVellis [24] suggested the range of aggregated coefficient alpha between 0.65 and 0.7 is minimally acceptable, while 0.7 and above is the minimum acceptable value by Taber [25]. The objective is to have α as high as possible. The implication of a very high α is that the statement (Copping/Mitigating management strategies) included in the ASA model accounted for a total variation of the risk attitudes of the respondent.

The reliability test objective is to generate α as high as possible. Scale optimization can be established by the statement refinement procedure. To optimize the ASA model and increase value of α, statement item (K) with negative or low corrected item score correlation (CISC) was deleted. The more correlated the individual statement's response to the remaining statements' responses, the more desirable is the item as part of the scale. Also, deleting the items increases α for the remaining statements, thereby improving the statistical quality of the ASA model. The CISC is measured as follows:

$$ri(y - i) = (ryi_{s}y - s_i)/\sqrt{(s2i + s2y + 2s_i.ryi_{s}y)} \quad ... \quad (3)$$

where;

$ri(y - i)$ = correlation of statement item i with sum of scores of all statement items, excluding statement i [21, 22];

ryi = correlation of statement item i with total score y;

sy = standard deviation of the total score y;

si = standard deviation of statement item i.

The aggregated score of the refined statement for each cowpea producer in Northeast, Nigeria refers to the identified management strategy used.

2.3.2 Regression Analysis

Multiple Regression Analysis was employed for objective 3. Multiple regression analysis using SPSS V20-32 bit Enter method was used to explain the conventional approaches.

The general form of the multiple regression model is given below:

$$Y = f(X1, X2, X3, X4, X5, X6, X7, Ei.) \quad ... \quad (3)$$

where:

Y = aggregate score of risk attitude for North East, Nigeria cowpea producers.

From the 5-point Likert Scale model, the cowpea producers' response rating of the statement items from 1-5 was summed up to yield an aggregate score (Y) which was a quantitative measure of his risk attitude.

The identified risk management strategies among the cowpea producers due to risk aversion in Adamawa state, Bauchi state, Gombe state and pool data for North East zone of Nigeria were regressed against their aggregate score risk attitude of cowpea producers (Y) to determine the effectiveness of management strategies used.

3. Results and Discussion

3.1 Sources and Types of Risk among Cowpea Producers

3.1.1 Production and Environmental Risk

Production and environmental risk as shown in Table 1, revealed that the incidences of pests and diseases constituted (74%) and emerged as the most common source of risk, then inadequate improved varieties (52%) and inadequate soil nutrients (52%). Also, inadequate inputs (51%) and high cost of inputs (50%) were other very important sources of production risk. It implies that, the identified threats create uncertainty and that production risk is worrying among cowpea producers in the region. These findings are consistent with Ndem and Osondu [26]; Nmadu and Dankyang [6]; World Bank [7]; Salimonu and Falusi [15]; Ayinde *et al.* [27], that state inadequate inputs (e.g., fertilizer, herbicides, and pesticides), plant pest and diseases, high cost of inputs, inadequate soil nutrients and inadequate supply of improved varieties

were the important production threats. It is also confirmed by Capitanio [28] the environment in most of low-income countries is characterized by crop diseases, flooding. All these create uncertainty [29].

3.1.2 Marketing Risk

Also, Table 1 revealed uncertainty of product price as the most common source of marketing risk at 66%, then inadequate market at 38%. This could be attributed to unstable government policies, high cost of inputs, inefficient marketing system. This is confirmed by Aditto [4] who stated that uncertainty of input prices and product prices has become increasingly worrisome among smallholder farmers.

Table 1   Distribution of cowpea producers according to sources of risk.

Risk sources	Adamawa		Bauchi		Gombe		North East	
Production/environmental	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Pest & disease	89	85	213	75	116	62	418	74
Drought	43	41	48	17	78	42	169	33
Erratic rain	24	23	108	38	39	21	171	27
Flood	18	17	44	16	84	45	146	26
Inadequate improved varieties	69	66	133	47	80	43	282	52
Desert encroachment	6	6	33	12	48	26	87	14
Inadequate soil nutrients	70	67	145	51	68	37	283	52
Inadequate inputs	61	58	158	56	73	39	292	51
Bush fire	30	29	8	3	8	4	46	12
Dangerous weed	12	11	82	29	123	66	217	36
Destruction of crops by animals	38	36	132	47	51	27	220	37
High cost of inputs	74	71	154	54	50	27	278	50
Marketing								
Inadequate market	43	41	75	27	88	47	206	38
Uncertainty of product price	57	54	192	68	129	70	378	66
Financial								
Inadequate credit	62	59	180	64	72	39	314	54
High interest rate	19	18	87	31	56	30	162	26
Inadequate insurance	25	24	111	39	142	76	278	46
Institutional								
Lack of functional cooperatives	43	41	203	72	73	39	319	51
Govt. policies	7	7	93	33	74	40	174	27
Human/personnel								
Ill health of farmer	73	70	120	42	64	34	257	49
Inadequate labour	36	35	96	34	76	41	208	36
Inadequate farming land	14	14	35	12	25	13	74	13
Theft	23	22	62	22	21	11	106	18
Adulteration of farm inputs	48	46	60	21	46	25	154	31
Lack of technical know how	25	24	98	35	67	36	190	32
Insurgency	24	23	6	2	8	4	38	10
Conflict within community	7	7	3	1	11	6	21	5
Conflict with herdsmen	8	7	4	1	9	5	21	5

Source: Field Survey, 2017.

3.1.3 Financial risk

Consequently, 54%, 44% and 26% accounted for inadequate credit, inadequate insurance and high interest rate as important source of financial risk respectively. It implies that majority of the cowpea producers do not use formal credit sources to finance

cowpea production. Also, high interest rates can affect profitability. Similarly, inadequate insurance could be attributed to the costs associated with acquiring agricultural insurance coverage and probably lack adequate enlightenment. But, having crop insurance plays an important role in mitigating risk in small farms (Dankyang, 2014) [30]. This is in line with Ndem and Osundu [26]; Agboola [5]; Nmadu and Dankyang [6] that identified high interest rates, lack of functional Microfinance Banks, lack of adequate insurance as major sources of financial risk.

3.1.4 Institutional Risk

Furthermore, lack of functional cooperatives accounted for 51% changes in Government policies 27%. The institution of cooperative among cowpea producers is very weak in terms of access to credits, farm inputs, labour and so on. Cooperatives/associations manage risk directly or indirectly in agricultural activities helping farmers increase their production and obtain higher standard of living [31].

3.1.5 Human/Personnel Risk

Similarly, the incidence ill health, inadequate labour, low technical know-how and adulteration of farm inputs 49%, 36%, 32% and 31% respectively accounted for the most important sources of human/personnel risk. This is consistent with the findings of Ndem and Osundu [26] that revealed that cowpea producers experienced inadequate family labor, ill health, lack of technical knowhow, adulteration of input and communal conflict, respectively. According to Ugwu [32] the risk of ill health implies that the productivity of the farmers will be affected. Inadequate labor could be credited to rural-urban migration of young people in search of white-collar jobs. Also, majority of the cowpea producers lack the technical skills to carry out modern farm operations. Modern farming skills such as agrochemical use and planting specifications for improved cultivars require additional training to be carried out [12].

3.2 Risk Management Strategies Used by Cowpea Producers in Coping/Mitigating Risk

3.2.1 Management Strategies among Cowpea Producers Used in North East Nigeria Mitigating/Coping with Risk

The reliability and optimizing test show that Cronbach coefficient Alpha (α) for the entire 32 statement-items (Table 2) was 0.649 indicating that 64.9% of the total variation in the management strategies of the cowpea producers was explained by the included statements which were in line with DeVellis [24]; Lagerkvist [22]. The percentage was increased to 73.6% when those with low and negative CISC were deleted leading to identified management strategies. More importantly, the optimized attitudinal scale revealed that these 11 statement items as shown in Table 3 were valid risk management strategies used among cowpea producers with risk aversion attitude and were included in the remaining 15 statement-items (Table 2). For each operation and manager, circumstances factoring into any decision-making process are different [33]. Resource availability will often determine what is possible [34]. Therefore, cowpea farmers need more enlightenment on correct solution to whatever might be their threats. The findings are in line with Bard and Berry [21] and Lagerkvist [22] that reported a minimum acceptable alpha value of 69% and 83% respectively. It is also confirmed by Agboola [5]; Nmadu and Dankyang [6] 2015; Timothy [35] who identified management strategies such as livestock production to complement household income, sales of farm produce, engagement in off-farm jobs/activities and so on. It implies that community level decision making for agricultural risk management, will reduce the response time losses and prevent the spread of risk [34].

Table 2   Reliability of the management strategies for North East, Nigeria cowpea producers.

Statements of strategy	CISC	Cronbach's coefficient (α) if item deleted
I never insure farm (1)	0.303	0.727
I don't have formal live insurance (4)	0.353	0.721
I used tractor for my farming activities (8)	0.303	0.726
I never rear animal to sell for complementing my income (9)	0.550	0.699
I never sell my farm produce at the market (11)	0.449	0.713
I do not have any other job apart from farming (13)	0.325	0.724
I do not access ADP extension agent (17)	0.321	0.724
I rely heavily on market information in making marketing decision (18)	0.301	0.726
There is nobody else in the household who has interest in farming business (19)	0.268	0.729
I never apply fertilizer in my farm (21)	0.476	0.708
I save greater share of my income in bank (22)	0.287	0.727
I never had storage facilities to store my farm produce (23)	0.315	0.725
I never used improved seed in my farm (25)	0.239	0.731
I never used organic manure in my farm (27)	0.182	0.736
Weather is never favourable for my farming in the previous seasons (29)	0.186	0.735
I have ready-made market for my farm produce (31)	0.409	0.716
Coefficient alpha (α) for the entire 32 Statements		0.649
Coefficient alpha (α) for the entire 15 Statements		0.736

Table 3   Management strategies used by cowpea producers in North East, Nigeria.

Statements of strategy	CISC	Cronbach's coefficient (α) if item deleted
I never rear animal to sell for complementing my income (9)	0.550	0.699
I never sell my farm produce at the market (11)	0.449	0.713
I do not have any other job apart from farming (13)	0.325	0.724
I do not access ADP extension agent (17)	0.321	0.724
There is nobody else in the household who has interest in farming business (19)	0.268	0.729
I never apply fertilizer in my farm (21)	0.476	0.708
I save greater share of my income in bank (22)	0.287	0.727
I never had storage facilities to store my farm produce (23)	0.315	0.725
I never used improved seed in my farm (25)	0.239	0.731
I never used organic manure in my farm (27)	0.182	0.736
Weather is never favourable for my farming in the previous seasons (29)	0.186	0.735
Coefficient alpha (α) for the entire 32 Statements		0.649
Coefficient alpha (α) for the entire 15 Statements		0.736

3.3 Effectiveness of the Risk Management Strategies Used among Cowpea Producers in North East, Nigeria

The multiple linear regression analyses of the aggregate score measuring risk attitude of cowpea producers and the optimized identified used management strategies showed statistically significant (1%, 5% and 10%) positive relationship between the statements: 11, 13,19, 22, 23, 25, 29, a negative relationship for statements 21 and the risk attitudes of the cowpea producers as shown in Table 4 were the effective management strategies used by the farmers who had risk aversion attitude in the study area. According to Sulewski *et al.* [36] decisions regarding the choice of risk management methods and the scale of activities to an extent depend on the degree of the risk aversion. Farmers with a greater aversion to risk more often choose diversified activities [37]. This result is confirmed by Agboola [5], Nto *et al.* [13], Ayinde *et al.* [27] who reported that farmers adopted diversification strategy as a way of reducing risks.

Table 4   Relationship between cowpea producers risk attitudes and management strategies in North East, Nigeria.

Management strategies	North east coefficients	*t*-value	Sig.
Constants	51.933	28.661	0.000***
Livestock production to complement my income (9)	0.027	0.715	0.475[NS]
Sales of produce (11)	0.060	1.667	0.096*
Engagement in other jobs/activities (13)	0.201	5.899	0.000***
Access to ADP's extension agent (17)	0.004	0.104	0.918[NS]
Household members interested in farming (19)	0.202	5.335	0.000***
Application of fertilizer (21)	-0.105	-2.562	0.011*
Saving greater share of my income (22)	0.423	11.775	0.000***
Storing of farm produce (23)	0.218	6.232	0.000***
Use of improved seeds (25)	0.257	6.625	0.000***
Use of organic manure (27)	-0.030	-0.873	0.383[NS]
Relying on weather conditions for production decisions (29)	0.225	6.735	0.000***
R^2		0.473	
Adj. R^2		0.463	
F ratio		45.924	0.000

Significant level: * 10%, ** 5%, &*** 1%. NS- Not significant

The goodness-of-fit of the multiple regression models represented by adjusted R squared (R_{adj}^2) was 47%. These values for R_{adj}^2 indicate the percentage of risk attitude variance that can be explained by optimized identified management strategies used. This implies that farmers are engaged in multiple management activities in mitigating/coping strategies when faced with the risk, in agreement with Agboola [5] and Hardakar *et al*. [38] who reported an R^2 value was 42%, meaning that 42% of the risk attitudes (risk aversion attitude) of the farmers were explained by the use of the optimized identified management strategies. However, the management strategies are not directly related to the threats earlier mentioned. It therefore means that the farmers need more enlightenment on correct solution to whatever there might be threats [6].

4. Conclusion

The study on the sources of farm risks and management strategies used among cowpea producers in North East Zone of Nigeria revealed that pests and diseases emerged as the most common source of production risk, while uncertainty of product price incidence emerged for marketing risk. Also, for financial risk, inadequate credit was the most common source and incidence ill health for human/personnel

risk. Furthermore, management strategies due to risk aversion for the region include livestock production to complement my income, sales of produce, engagement in other jobs/activities, access to ADP's extension agent among others.

Similarly, the management strategies regressed against aggregate risk attitude for the region had positive relationship for sales of farm produce, engagement in other jobs/activities, household members interested in farming, saving greater share of my income, storing of farm produce, use of improved seeds, relying on weather conditions for production decisions and were significant at 1%, 5% and 10%. The R^2 value 47.30% of the risk attitudes (risk aversion attitude) of the cowpea producers was explained by the valid identified management strategies due to risk aversion.

5. Recommendation

• Strategy should focus on tackling the production constraints by developing early varieties, disease resistant crops and products that are resistant to pest both in the farm and storage to raise the productivity of cowpea.
• The study revealed that high cost, inadequate and adulterated agricultural inputs such as

herbicide/pesticides, fertilizer and seedlings were very important sources of risk. Therefore, government at all levels should ensure the availability, affordability and accessibility from certified dealers at subsidized rate before production commences to cowpea producers.

• Effort should be geared towards training cowpea producers on the appropriate management strategies with emphasis on the need for farmers to adopt innovation that will enhance improved farm practices.

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