# Economic Perspectives of the Diversity of Risks among Crop Farmers in the Northern Guinea Savanna of Nigeria

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***Abstract***

*In this paper, we examine the diversity of risks that affect farming in the Northern Guinea Savanna of Nigeria. We also investigate the perspectives of these risks in relation to their economic implications on the farming enterprises. We also show that through reorganization of these risks, some derived factors have the ability to present themselves whether as corresponding to existing categorization of the variables or not and also to enable us know which of the factors is more important than the other. Gross margin and factor analytical methods were used in computing the estimated results on a cross sectional sample of 348 farming households. Results show that farmers who were grouped under natural risk incurred the least mean production cost of ₦11, 115.61, while the highest mean production cost of ₦ 15,998.18 was incurred by farmers grouped under production risks. The highest mean revenue of ₦18, 998.16 was recorded by farmers under production risk which translated into a mean gross margin of ₦65, 999.85. Verifying whether some derived factors would correspond to the existing categorization of 14 risk types (from 5 sources) which the farmers faced, results from the factor analysis and the consequent F-tests from ANOVA show no marked or significant differences among the identified factors and the existing risk sources. Consequently, the individual effect or importance of the original 14 risk types that the sampled farmers considered important can be dully represented and effectively regrouped into five sources (factors) as natural, technical, social, ecosocial and biochemical.*

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## 1.0 INTRODUCTION

Risk is uncertainty that affects an individual's welfare, and is often associated with adversity and loss (Bodie and Merton, 1998). Risk is also uncertainty that "matters", and may involve the probability of losing money, possible harm to human health, repercussions that affect resources (irrigation, credit), and other types of events that affect a person's welfare. Farming is a financially risky occupation. On a daily basis, farmers are confronted with an ever-changing landscape of possible price, yield, and other outcomes that affect their financial returns and overall welfare (Harwood et. al. 1999). The consequences of decisions or events are often not known with certainty until long after those decisions or events occur, so outcomes may be better or worse than expected. Oftentimes, surveys have asked farmers about the most important types of risk that they confront in their farming operations (Harwood et. al. 1999). These types of questions are typically part of a larger survey that inquires about producers' risk management strategies, and offers respondents a list of concerns that they can score in terms of importance. Scores generally are not ranked relative to one another, meaning that producers independently analyzed each concern on the list. Sources of risk in farming include among others production or yield risk, price or market risk, institutional risk, human or personal risks and financial risks.

Production or yield 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. Technology plays a key role in production risk in farming. Price or market risk reflects risks associated with changes in the price of output that may occur after the commitment to production has begun. In agriculture, production generally is a lengthy process. Livestock production for example, typically requires ongoing investments in feed and equipment that may not produce returns for several months or years. Institutional risk results from changes in policies and regulations that affect agriculture. This type of risk is generally manifested as unanticipated production constraints or price changes for input or for output. Farmers are also subject to human and personal risks that are common to all business operators. Disruptive changes may result from such events as death, divorce, injury, or the poor health of a principal in the farm firm. In addition, the changing objectives of individuals involved in the farming enterprise may have significant effects on the longrun performance of the operation. Financial risk results from the way the firm's capital is obtained and financed. A farmer may be subject to fluctuations in interest rates on borrowed capital, or face cash flow difficulties if there are insufficient funds to repay creditors. The above risks constitute major agricultural constraints which farmers always have to contend with. In the Northern Guinea Savanna of Nigeria, risks associated with farming can be categorized into the following (Olarinde, 2005): Natural risks (drought, flood, wind and storm, disease and pest); social risk (theft of produce, bush fire, invasion of farms by cows); economic risk (producer price fluctuation, insufficient and untimely supply of fertilizer, insufficient credit and insufficient supply of seeds); technical risk (poor soil, insufficient access to chemicals, scarce labour and insufficient

processing facilities). Studying the diversity of the risks facing farmers in the Northern Guinea Savanna of Nigeria, and their economic implications particularly on crop farmers is an important milestone in the numerous efforts to provide solutions to the various agricultural constraints and challenges which resource poor farmers in sub Saharan Africa have been battling with.

After the introduction, section 2 which is on materials and methods describes the data and study area and the method of data analysis. Section 3 is on results and discussion, which interprets and discusses the estimated results. Section 4 concludes by giving a summary of findings and the implications of results.

## 2.0 MATERIALS AND METHODS

### 2.1 Data and Study Area

The data used for this study are from a cross-sectional sample of smallholder crop farmers in the Northern Guinea savanna agro ecological belt of Nigeria. The data were obtained in respect of the 2004/05 agricultural year in a survey (see Olarinde, 2005). The sample comprised 348 households selected from the 23 local government areas (LGAs) and from the four Agricultural Development Programme (ADP) zones of Kaduna State. Structured questionnaire and checklists were used to obtain the data through personal interviews and focus group discussions. Detailed information on various aspects of the farm–household under various farming risk conditions and for different crop activities was collected. This included the household's demographic characteristics, farm size, cropping patterns, crop output in actual and value terms, labour and non–labour inputs in actual and value terms. The risk sources and types which affected the majority of the sampled farmers were identified as (i) natural risks, e.g. drought, flood, wind and storm, diseases and pests: (ii) social risks, e.g. theft of produce, bush fire, invasion of farm by cows; (iii) economic risks, e.g. producer price fluctuation, insufficient supply of seeds, (iv) production risks, e.g. poor soil, lack of spraying equipment, lack of chemical, (v) technical risks, e.g. scarce labor, insufficient credit facilities. Technical risks are those that are related to production. It is worth mentioning that identification of the risk sources and types and their nomenclature is necessarily the outcome of a focus group discussion between the researchers and the village extension practitioners who live and are conversant with the farming activities and needs of the sampled households.

### 2.2 methods of data analysis

The results of the focus group discussion were employed to classify the sampled farmers based mainly on the characteristic features of the risks they faced during the agricultural year of survey. This was done for each of the four ADP zones and made to coincide with the major cropping patterns in the study area. The cropping pattern is typically a multiple crop system which consists of maize plus one or

two of other cereals or grain legumes in the northern, drier axis and maize plus one or two grain legumes and root crops in the southern humid axis (Tables 1 and 2).

Table 1: Lay-out of Sample and Survey Design by Risk Type and by ADP Zone

| | Risk Types | | | | | |
|---|---|---|---|---|---|---|
| | Natural ($n_n$) | Social ($n_s$) | Economic ($n_e$) | Production ($n_p$) | Technical ($n_t$) | Total ($n_z$) |
| **ADP Zones** | | | | | | |
| Birmin Gwari | 21 | 16 | 24 | 10 | 09 | 80 |
| Lere | 13 | 11 | 16 | 06 | 06 | 52 |
| Maigana | 31 | 25 | 36 | 15 | 13 | 120 |
| Samaru | 25 | 20 | 29 | 12 | 10 | 96 |
| **Total** | **90** | **72** | **105** | **43** | **36** | **348** |

Source: Survey Data
n= sample size: $n_n$= natural risk; $n_s$ = social risk; $n_e$ = economic risk; $n_p$ = production risk; $n_t$ = technical risk; $n_z$ = zonal total

Table 2: Cropping Patterns of Respondents by Risk Type and by ADP Zone

| | Natural | Social | Economic | Production | Technical |
|---|---|---|---|---|---|
| **ADP Zones** | | | | | |
| Birmin Gwari | mz/gc/rc | mz/mil/sb | mz/cp/gn | mz/gc/mit | mz/mlt/gn |
| Lere | mz/gc/sb | mz/gc/cp | mz/rc/sb | mz/gc/gn | mz/mlt/sb |
| Maigana | mz/gc/mlt | mz/gc/gn | mz/gc/sb | mz/gc/rc | mz/cp/gn |
| Samaru | mz/gn/ym | mz/gc/cs | mz/cp/cy | mz/rc/pt | mz/gc/cs |

Source: Survey Data
mz = maize; gc = guinea corn; cp = cowpea; rc = rice; mlt = millet;gn = groundnut;
sb = soybean; cy = cocoyam; ym = yam; pt = potatoes; cs = cassava

Descriptive statistical tools which include scattered diagrams were used to compare the means and standard deviations of the farmers' characteristics, which included the age, years of formal schooling, cropped area, household size and farming experience. Bar charts were used to depict and compare the gross margin components of the farmers' cropping activities, e.g. cost, revenues and gross margins. Analysis of variance (ANOVA) was used to compare the cost, revenues and gross margins for the four ADP zones and under the five identified risk situations. At a given probability level (usually 0.05), ANOVA was selected for this purpose because it enables us to conclude on the differences among the risks and zonal mean values. A Factor Analysis was finally carried out on a list of 14 responses (risk types from 5 sources) which were included in the questionnaire prepared for the sampled farmers. Factor analysis includes both component analysis and common factor analysis. Factor analysis (FA) and principal component analysis (PCA) are statistical techniques applied to a single set of variables when a researcher is interested in discovering which variables in the set form coherent subsets that are relatively independent of one another. Variables that are correlated with one another but largely independent of

other subsets of variables are combined into factors[1]. Factors are thought to reflect underlying processes that have created the correlations among variables. Respondents were asked to indicate which of the risk types affect their farming activities. Because of scale of measurement, the responses were converted to percentages using the local government areas as bases. The percentage scores were thereafter used as proxies for the variables in the factor analysis. The importance of factor analysis in this paper is seen in its ability to present the derived factors whether as corresponding to existing categorization of the variables or not and also to enable the researchers know which of the factors is more important than the other. The techniques in factor analysis are frequently utilized in multivariate data analysis and are described in details by Tabachnick and Fideli (2000). In this paper, results from the factor analysis are employed to complement the findings on the attributes of the risk sources and types which the sampled farmers are facing.

## 3.0 RESULTS

### 3.1. Characteristics (means and standard deviation) of sampled farmers

Figures 1, 2, 3, and 4 present the overview of the characteristics of the sampled farmers. The data revealed that for farmers in Birmin Gwari zone, the mean age stand at about 45yrs with a standard deviation of about 5. In the same zone (Birmin Gwari), means of years of schooling, cropped area, household size and years of farming experience are about 7, 5, 6 and 22 with standard deviation of about 3, 4, 3 and 18 respectively. Considering all the four zones however, farmers in Samaru zone appear to be most advanced in age, with mean age of about 46. Though the risk bearing ability of the sampled farmers was not and cannot be tied to the farmers' age, it is reasonable to infer that the incidence of the various farming risk faced by the farmers in the study area is a burden to mainly the middle–aged farmers (the average age of the sampled farmers in the four zones was not less than 44). The average years of the schooling of the sampled farmers range between 5 and 9 years, with farmers in Samaru zone attaining the highest average school level of about 9 years. In the study area, cropped farms area range between 5 and about 7 hectares, with the largest being cropped by the farmers in Lere zones (6.58 hectares). The average household size per sampled farmers stand at 5 in each of the zones of Lere and Maigana, while in Birmin Gwari and Samaru, they are about 6 and 7 respectively. Years of farming experience vary between 15 and 22, with farmers in Birmin Gwari having the highest years of experience which span 22 years.

[1] PCA produces components while FA produces factors, but it less confusing in this study to call the results of both analyses factors.

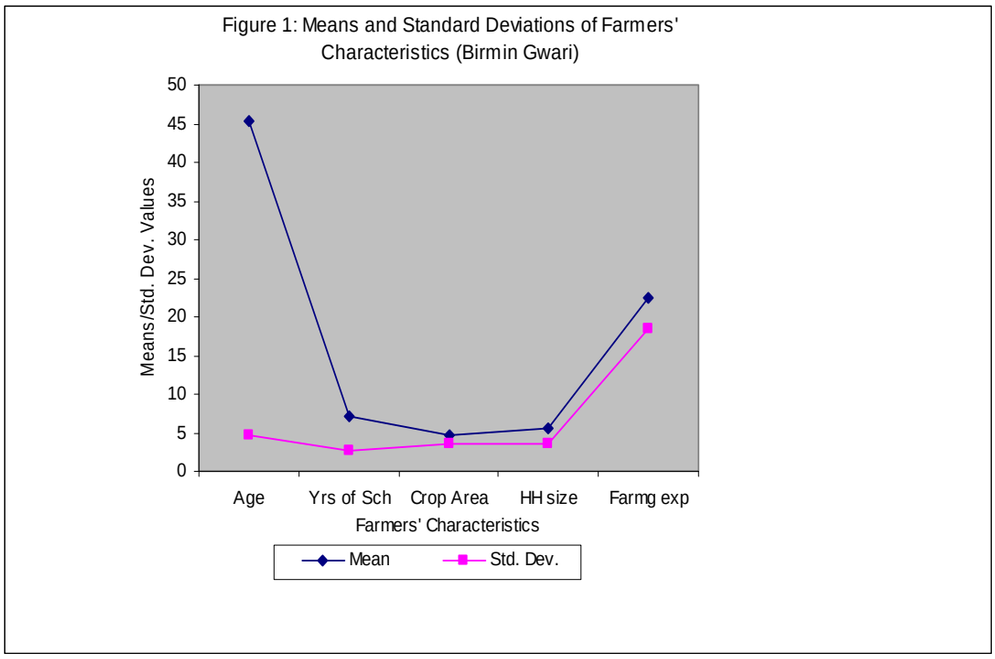


Figure 1: Means and Standard Deviations of Farmers' Characteristics (Birmin Gwari)
Means/Std. Dev. Values
50
45
40
35
30
25
20
15
10
5
0
Age
Yrs of Sch
Crop Area
HH size
Farmg exp
Farmers' Characteristics
Mean
Std. Dev.

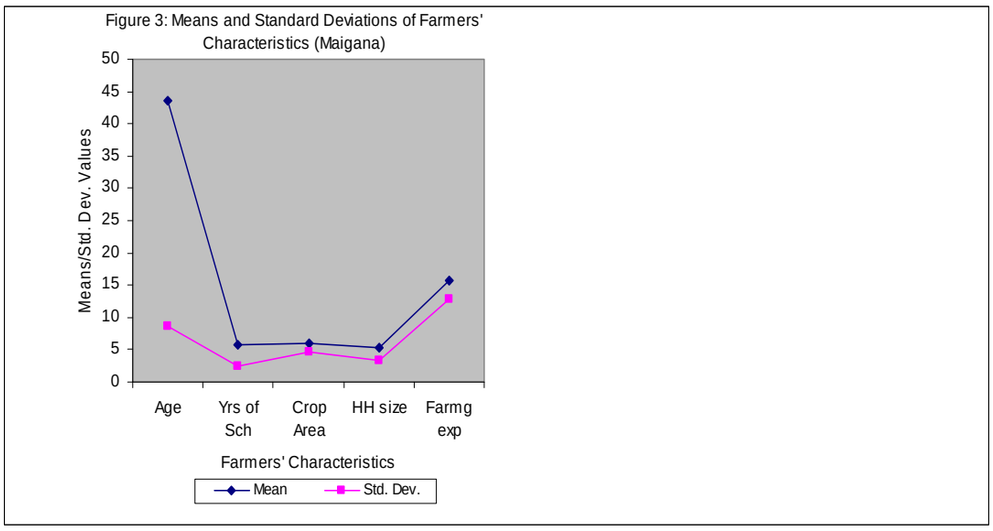
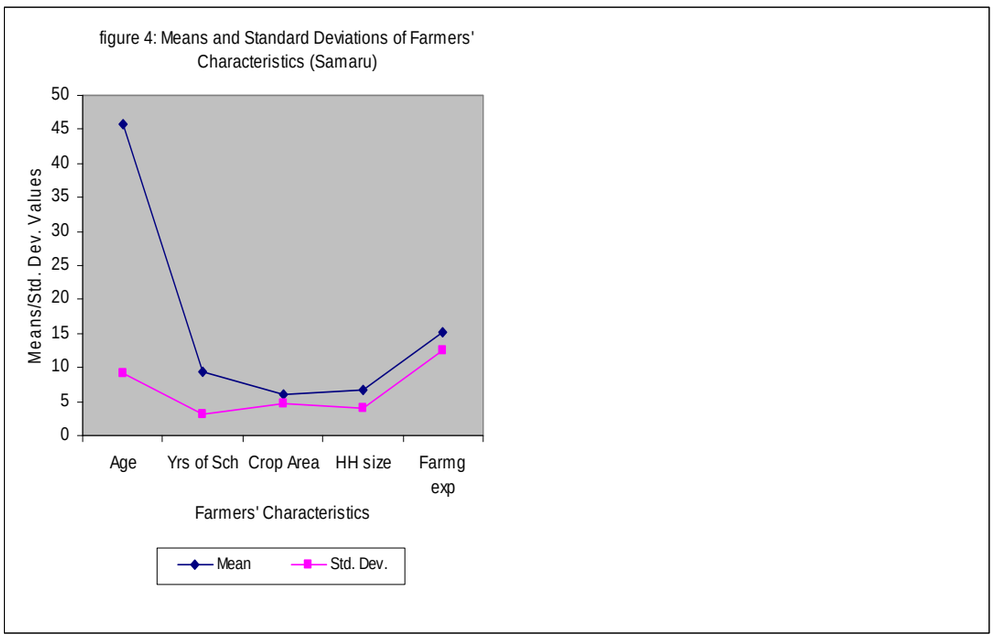


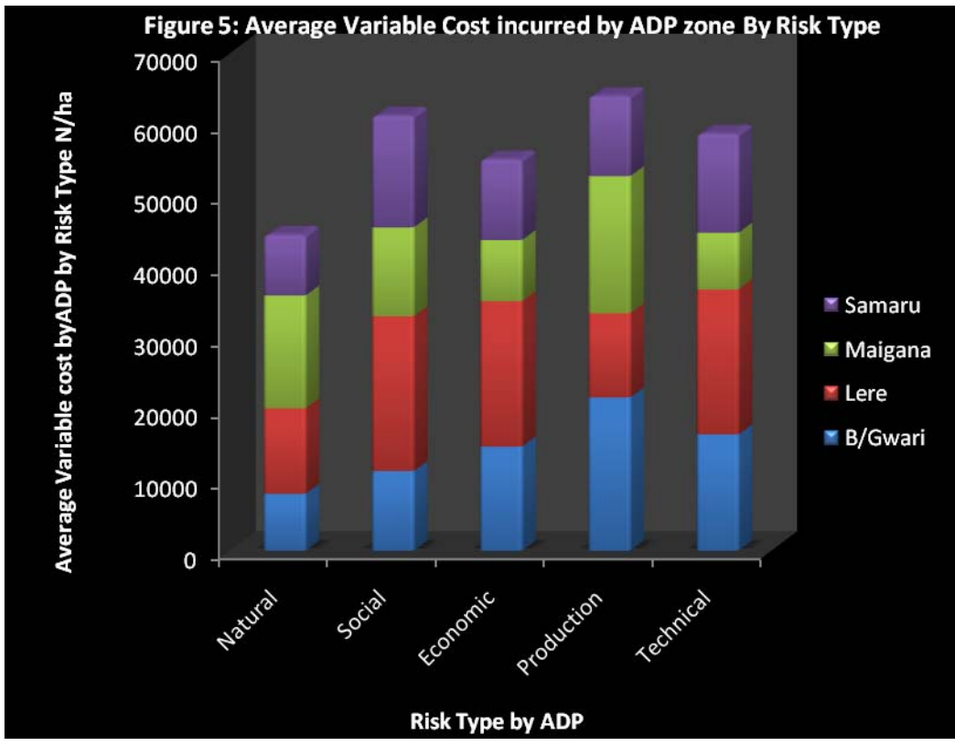
Figure 3: Means and Standard Deviations of Farmers' Characteristics (Maigana)
Means/Std. Dev. Values
50
45
40
35
30
25
20
15
10
5
0
Age
Yrs of Sch
Crop Area
HH size
Farmg exp
Farmers' Characteristics
Mean
Std. Dev.

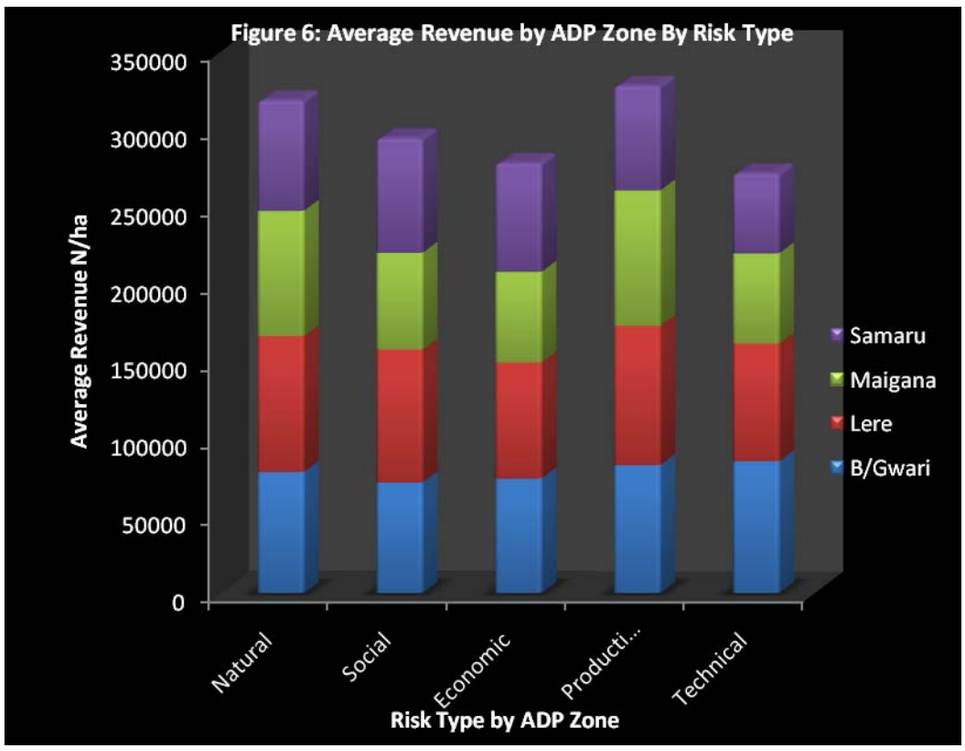


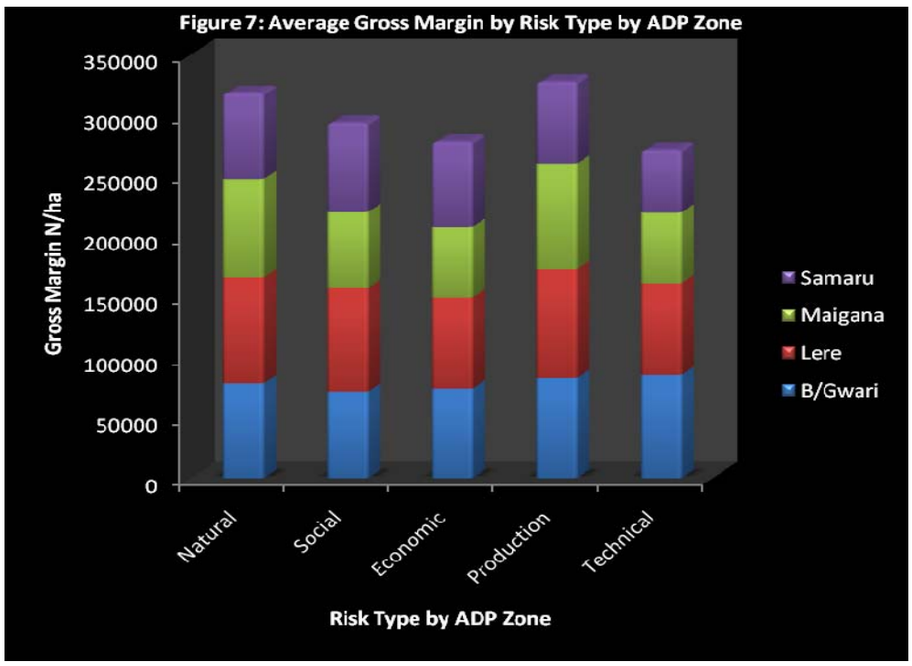

### 3.2 Gross margin analysis

This section uses data from farmers' plots planted with maize and with guinea corn and rice, millet and soybean, cowpea and groundnut, guinea corn and millet, millet and groundnut, guinea corn and soybean, guinea corn and cowpea, rice and soybean, guinea corn and groundnut, groundnut and yam, guinea corn and cassava, cowpea and cocoyam, guinea corn and cassava, cowpea and cocoyam, rice and potato, groundnut and cassava. All the plots of the sampled farmers were planted with maize as the major crop in the agricultural year. In the northern axis of the study area, farmers make use of other portions of their plots to plant other cereal crops (guinea corn and millet) and grain legumes (groundnut, cowpea and soybean). In the southern axis, the sampled farmers, besides maize and few pockets of other cereal crops, plant root crops like yam, cassava, cocoyam and potato on other portions of their plots. The result of the components of gross margin analysis show that farmers who were grouped under natural risk incurred the least mean production cost of ₦11, 115.61, while the highest mean production cost of ₦ 15,998.18 was incurred by farmers grouped under production risks. The highest mean revenue of ₦18, 998.16 was recorded by farmers under production risk which translated into a mean gross margin of ₦65, 999.85. In spite of the highest revenue recorded by farmers under production risk and the gross margin thereof, farmers under natural risk situation recorded the overall highest mean gross margin. On zonal basis, the sampled farmers in Samaru zone incurred the least mean production cost. However, farmers in Lere zone recorded the overall highest mean values of the production cost, revenue and the resultant gross margin. For ease of compassion and because most sampled farmers worked on either traditional or inherited land, the opportunity cost of land was computed for the study area and the benchmark value used as a variable

cost which was included in the production costs incurred by each sampled farmers during the agricultural year. Figures 5,6 and 7 depict the patterns of the average cost, revenue and gross margin.






The ANOVA result shows that the mean differences in the cost along the risk types and across the ADP zones were not statistically significant. This indicates that during the agricultural year, the cost incurred by the sampled farmers for crop production was not related to the differences in the risks faced by the farmers neither was it related to the spatial differences in the farmers' plots of cultivated lands. The mean differences in the revenue generated by farmers across the zones show a statistical significance ($p < 0.05$), indicating zonal variation in the revenues generated by the sampled farmers. A further check (*LSD tests*) on the mean differences on the zonal revenues shows that the existence of the differences is between Birmin Gwari and Samaru zones; Lere and Maigana zones and between Lere and Samaru zones. There was no difference in the mean revenue between each of the zones and the grand (benchmark) mean for the study area. The difference in the revenue between Birmin Gwari and Samaru could be as a result of the sharp differences in the types of crops grown in the two areas besides maize. For example, in Birmin Gwari, cereals and grain legumes are the crops grown while in Samaru, root crops dominate the cropping activities. The same reason could be adduced for the differences in mean revenue recorded by the farmers in Lere and Samaru. The extent of maize growing in Lere accounts for the mean revenue differences between it and Maigana zone. In the study area, bulk of the maize produced come from Lere zone. The

ANOVA results on the gross margin show a statistical significance ($p<0.05$) in the mean differences among the sampled farmers along the risk situations. For example, there were mean farmers' gross margin differences between the pairs of natural and economic risks; natural and technical risks and production and technical risks situation. No statistical difference was observed in the mean gross margins between any of the risk situations and the grand (benchmark) mean for the overall risk situation. The difference in the gross margins among the identified pairs of risk situation could be as a result of the effect of the individual types or elements within each risk source or situation. These have enormous consequences and implication on the production requirements (resources and inputs), the output and ultimately the marketing components of the crops which also affect the revenue generated from the crop and the gross margin thereof.

**3.3 Results of Factor analysis**

Table 3 presents the factor loadings obtained after a varimax rotation of responses from the 14 questions that measured the sources from 5 risk types, e.g. natural, social, economic, production and technical risks. As can be seen (Table 3), five factors (from the factor loadings) were identified as the actual risk sources that are of utmost importance to the sampled farmers. The following are the factors and the constituents of each of them: factor one retained the risk types which are purely natural; these are drought, flood and poor soil. Factor two is formed mainly from the two components of technical/production risks, e.g. scarce labor, insufficient credit facilities and inadequate supply of chemicals. It also has wind/storm (from natural risk) and producer price fluctuation (from economic risk). Other factors and their constituents are: factor three (theft of produce and invasion of farms by cows) which are mainly social risk types; factor four (bush fire and insufficient supply of maize seeds); factor five (disease/pest and inadequate spraying equipments). The results from ANOVA for the factor loadings of each of the original risk sources and for those of the five identified clusters are presented in Table 4. The F- tests from the ANOVA analysis indicate that there are no significant inter-source differences for every risk source. The F- tests also show no significant inter-factor differences for every identified factor.

In the following discussion, the only variables presented on Table 3 are the very important ones based on their factor loadings. As a rule of thumb (Tabacknick and Fideli, 2000), only variables with loadings of 0.32 and above are interpreted. The greater the loading, the more the variable is a pure measure of the factor. Suggestions based on Comrey and Lee (1992) are that loadings in excess of 0.71 950% (overlapping variance) are considered excellent, 0.63 (40% overlapping variance) very good, 0.55 (30% overlapping variance) good, 0.45(20% overlapping variance) fair, and 0.32 (10% overlapping variance) poor. On the strength of the foregoing, the individual effect or importance of the original 14 risk types that the sampled farmers considered important can be dully represented as shown on Table 5. These risk types are effectively regrouped into five sources (factors) as natural, technical, social, ecosocial and

biochemical. Assigning a nomenclature to each of the otherwise identified risk sources is evidenced from the elements of the identified new risk sources (factors) which have clearly been re-allocated.

Table 3: Results of the Factor Analysis of Risk Sources: Factor Loadings

| | Factor1 | Factor2 | Factor3 | Factor4 | Factor5 |
|---|---|---|---|---|---|
| Natural Risk | | | | | |
| *Drought* | *0.671* | | | | |
| *Flood* | *0.513* | | | | |
| *Wind/storm* | | *0.508* | | | |
| *Disease/pest* | | | | | *0.966* |
| | | | | | |
| Social Risk | | | | | |
| *Theft of produce* | | | *0.852* | | |
| *Bush Fire* | | | | *0.982* | |
| *Invasion of farms by cows* | | | *0.365* | | |
| | | | | | |
| Economic Risk | | | | | |
| *Producer price fluctuation* | | *0.621* | | | |
| *Insufficient supply of maize seeds* | | | | *0.435* | |
| | | | | | |
| Production Risk | | | | | |
| *Poor soil* | *0.746* | | | | |
| *Lack of spraying equipment* | | *0.536* | | | |
| *Lack of chemical* | | | | | |
| | | | | | |
| Technical risk | | | | | |
| *Scarce labour* | | *0.849* | | | |
| *Insufficient credit facilities* | | *0.359* | | | |

Table 4: Results of ANOVA from the risk sources and factors

| Risk Sources | *Mean* | *F* | *P-Value* | *F-Critical* |
|---|---|---|---|---|
| *Natural* | *1.1008* | | | |
| *Social* | *0.6856* | | | |
| *Economic* | *0.5086* | *1.6203* | *0.2082* | *2.8661* |
| *Production* | *0.8492* | | | |
| *Technical* | *0.5380* | | | |
| | | | | |
| Factors (clusters) | *Mean* | *F* | *P-Value* | *F-Critical* |
| *Natural* | *0.8892* | | | |
| *Technical* | *0.7398* | | | |
| *Social* | *0.7536* | *0.2330* | *0.9165* | *0.8661* |
| *Ecosocial* | *0.6976* | | | |
| *Biochemical* | *0.6012* | | | |

However, since the ANOVA results show no marked or significant inter-source and inter-factor differences, the overall impact of the risk elements, whether in their original sources or in the identified factors on maize production cannot be attributed to a particular risk source or factor. Instead, the enormity of the effects of the risks faced by the farmers is only described by the loadings in the five identified factors.

Table 5: Risk types reassigned to the identified new (derived) risks (factors)

| Factor1 (*Natural)* | Factor2 *(Technical)* | Factor3 *(Social)* | Factor4 *(Ecosocial)* | Factor5 *(Biochemical)* |
|---|---|---|---|---|
| *Drought* | *Wind/storm* | *theft of prod.* | *Bush fire* | *disease/pest* |
| *Flood* | *producer price fluc.* | *Invas. Of farms* | *short. Of seeds* | *short. Of spr. Equip.* |
| *Poor soil* | *shortage of chem.* | | | |
| | *Scarce labour* | | | |
| | *Insuff. Credit facil.* | | | |

## 4.0 Conclusion

This study examined the diversity of risks that affect farming in the Northern Guinea Savanna of Nigeria. It also investigated the perspectives of these risks in relation to their economic implications on the farming enterprises. The paper also showed that through reorganization of these risks, some derived factors have the ability to present themselves whether as corresponding to existing categorization of the variables or not and also to enable us know which of the factors is more important than the other. Results indicated that farmers who were grouped under natural risk incurred the least mean production cost of ₦11, 115.61, while the highest mean production cost of ₦ 15,998.18 was incurred by farmers grouped under production risks. The highest mean revenue of ₦18, 998.16 was recorded by farmers under production risk which translated into a mean gross margin of ₦65, 999.85. In spite of the highest revenue recorded by farmers under production risk and the gross margin thereof, farmers under natural risk situation recorded the overall highest mean gross margin. The ANOVA result indicates that during the agricultural year, the cost incurred by the sampled farmers for crop production was not related to the differences in the risks faced by the farmers neither was it related to the spatial differences in the farmers' plots of cultivated lands. The mean differences in the revenue generated by farmers across the zones show a statistical significance indicating zonal variation in the revenues generated by the sampled farmers. Furthermore, ANOVA results showed a statistical significance in the mean differences of farmers' gross margin between the pairs of natural and economic risks; natural and technical risks and production and technical risks situation.

As demonstrated by the factor analysis, five factors (from the factor loadings) were identified as the actual risk sources that are of utmost importance to the sampled farmers. Consequently, the individual

effect or importance of the original 14 risk types that the sampled farmers considered important can be dully represented and effectively regrouped into five sources (factors) as natural, technical, social, ecosocial and biochemical.

From the findings, the following conclusions can be drawn: (1) the difference in the gross margins among the identified pairs of risks could be as a result of the effect of the individual types or elements within each risk source or situation. These have enormous consequences and implication on the production requirements (resources and inputs), the output and ultimately the marketing components of the crops which also affect the revenue generated from the crop and the gross margin thereof; (2) the overall impact of the risk elements, whether in their original sources or in the identified factors on crop production cannot be attributed to a particular risk source or factor. Instead, the enormity of the effects of the risks faced by the farmers is only described by the loadings in the five identified factors. Generally, the aggregate effect of both the initially identified risks and the derived risks is one that influences the profitability of the resource poor farmers. This has impact on the measures of farm business performance such as the net cash flow generated by the farming activities or the net farm income earned.

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