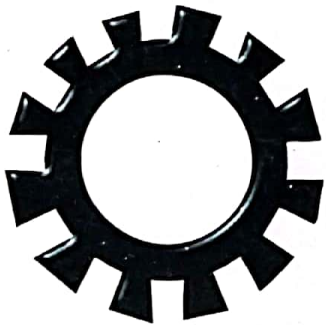


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Factors affecting the choice of cropping systems in Kebbi State, Nigeria.

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Abstract

The study examined the factors that influence choice of cropping systems in Kebbi State Nigeria. The technique applied in the study was Logit regression. Data to conduct the research was obtained mainly from primary sources through a questionnaire survey of 256 farmers, comprising 98 monocroppers and 158 intercroppers. Four variables (farming experience, asset value, risk aversion and land degradation) out of the five variables considered in this study were significant in influencing the probability of farmers practicing intercropping (reference group). It is evident that asset value, land degradation, risk are among factors which will influence farmers in the choice of mono or intercropping system.

Key words: Cropping systems, monocropping, intercropping, Logit regression

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Introduction.

Two main cropping systems practised in Nigeria are mono and intercropping systems. Intercropping involves the growing of rain-fed crops in mixtures, using available resources which permit farmers to maintain low, but often adequate and relatively steady production. Monocropping generates vast amounts of corporate wealth, gives higher yields, and is more efficient than intercropping by providing jobs and gives higher economic returns (Nelson, 2006; Mmom, 2009). Farmers in northern Nigeria practice both monocropping and intercropping. Intercropping is practiced as a means of diversification to safeguard against risk associated with agricultural production.

This study was designed to determine whether farmers' attitude towards risk and their characteristics influence the choice of cropping system, and make recommendations on the programmes that will improve monocropping or intercropping.

Materials and methods.

Study area

Kebbi State is located in the north-western part of Nigeria, and is situated between latitudes 11° 15' N - 11° 35' N, and longitudes 44° 7' E- 5° 25' E. The State is bordered by Sokoto and Zamfara States to the East, Niger State to the South, Benin Republic to the West and Niger Republic to the North. The population of the State is projected to be 2,209,003,386 and occupies an area of about 36,229 square kilometres.

Available crops grown

Millet, sorghum, maize, rice, groundnuts and cowpeas are the dominant rain fed crops in the State. Other crops grown under rain fed conditions include wheat and soya beans. Onions and peppers, which have some ecological limitations, are the dominant irrigated crops. Several crop mixtures are practiced by the farmers. These include, sorghum/cowpeas, millet/sorghum, sorghum/groundnuts, millet/cowpeas, sorghum/cowpeas/rice(KARDA, 2009).

Data collection

Primary data gathered through a questionnaire survey of the sampled farmers in the study area was employed. A formal survey was conducted through personal interviews by the researcher and trained enumerators. The questionnaire was administered using a single visit approach. Some of the questions asked in the questionnaire included: personal characteristics of the respondents, land degradation, land fragmentation and related factors. The questions were designed to answer the objectives of the study. The questionnaire was developed in English and interpreted to the sampled farmers in Hausa (the common local language in Kebbi State) by the researcher and trained enumerators.

A pilot study was conducted to test the validity of the questionnaire. For this, ten farmers were randomly selected from each of the four agricultural zones in Kebbi and the questionnaire was administered to them. The responses from the respondents were checked to see if the replies were as required in the questions. The questions that seemed not to be clear to the farmers were reconstructed.

Sampling technique.

A multi-stage sampling technique was used to select 256 farmers comprising 98 monocrop and 158 intercrop farmers. This was done because there were more intercrop farmers than monocrop in the State. In the first stage, the four agricultural zones were deliberately selected so that a good representation of all the agro-ecological zones in the State would be represented. The second stage involved a random selection of two Local Government Areas (LGAs) from each of the four agricultural zones. In the third stage, four villages were randomly selected from each of the two LGAs. The fourth stage involved the random selection of the 98 monocrop farmers and the 158 intercrop farmers. Since the population of the LGAs is not homogeneous, the number of farmers selected from each of the selected LGAs was calculated using the formula:

$$P = \frac{S}{N} \times n$$

Where P = Proportion, S = Desired sample size, N = Total population, n = Population of LGA in question.

Survey and data collected.

The survey was carried out in January to February, 2012 and data were collected on production practices for the 2011 cropping season. The household heads were interviewed by the researcher and the trained enumerators. Data were collected on farmers' characteristics, including the age of the farmer, educational level of household head, years of farming experience, household size, extension contacts, access to credit, land fragmentation, land degradation, risk preference of the farmer. The experimental gambling approach was used to determine the risk aversion coefficients of the farmers following Binswanger 1980, Kaumè, 2010 and Miyata, 2003. The data collected on the socio-economic characteristics was used to describe the characteristics of the respondents in the study area.

Determining the factors that influence the choice of cropping system.

The Logit model was used to ascertain the influence of household characteristics on the choice of the cropping system practised. The Logit model arises from assuming a logistic distribution. Greene (2000) has stated that under the standard assumptions about the error term, there is no *a priori* reason to prefer Probit to Logit estimation. In most applications, it seems not to make much difference. Logit model is

estimated by maximum likelihood. Consequently, goodness of fit and inferential statistics is based on the log likelihood and Chi-square test statistics. The general form of the Logistic regression model is given by:

$$L_i = Ln = \beta_0 + \beta_i X_i + e_i$$

L_i is referred to as the logit, hence the term "logit model", and ϕ_i is the probability of a farmer practicing intercropping. X_i represents the set of explanatory variables that influence the farmer practicing intercropping. β_i is the parameter to be estimated and e_i represents the error term.

In general, the formulation of the model can be written as:

$$CHO_{im} = \beta_0 + \beta_1 EXP + \beta_2 ASV + \beta_3 RA + \beta_4 FS + \beta_5 LD + e_i$$

Where CHO is the choice of cropping system (intercropping or monocropping). EXP = Years of farming experience, ASV = Asset value, RA = Risk aversion coefficients, FS = Size of farm land, LD = Land degradation.

Variables that influence the choice of cropping system and expected signs

The variables that influence the choice of cropping system and the expected signs are presented in Table 1.

Table 1: Variables that influence the choice of cropping system and the expected signs

Variables	Variable description	Expected sign
Farming experience (EXP)	Farming experience of household head in years	-
Asset value (ASV)	The amount of assets (e.g house, oxen, bicycle, etc) valued in naira	-
Risk aversion: (RA)	Risk aversion coefficients	+
Size of farm land(FS)	Farm size (ha)	+
Land degradation (LD)	Dummy: 1 if the farmer perceives his soil fertility is low and eroded; 0 if otherwise	+

Farming experience.

Farming experience reduces the probability of farmers' practicing intercropping. The farmers with only few years of farming experience are likely to be more risk averse and may tend to practise intercropping as a means of diversification, so that they can harvest at least one crop in a bad year.

Asset value.

Asset value is expected to reduce the probability of farmers' practicing intercropping. For good yields, farm inputs such as fertilizer, agrochemicals and seed must be applied at the right time and at recommended rates. Only farmers with high asset value can afford inputs at the right time and at recommended rates.

Risk aversion.

Risk aversion enhances the probability of farmers' practicing intercropping. The risk

averse farmers are more likely to practise intercropping as a means of diversification so as to avoid total crop and market failure in a bad year.

Size of farm land.

Farm size is hypothesised to decrease the probability of farmers' practicing intercropping. Farmers with larger farm sizes are likely to practise monocropping because of its advantage of giving higher yields and more economic returns (Nelson, 2006; Mmom, 2009).

Land degradation.

Land degradation is expected to enhance the probability of farmers' practicing intercropping. One of the advantages of intercropping is that it serves as a means of replenishing the soil nutrients, and farmers whose farm lands are degraded are likely to practise intercropping as a means of combating the menace.

Results and discussion.

Characteristics of the farmers in the study area.

Beside the socio-economic characteristics of the farmers, other explanatory variables that are thought to affect crop production, as well as farm specific characteristics, are presented next.

Farming experience of the respondents.

Table 2 shows that 44 % of the monocroppers have farming experience between 11 and 20 years. 35 % of intercrop farmers have experience of between 6 and 10 years. On the average, both groups have between 15 and 12 years of farming experience. The distribution shows that both monocroppers and intercroppers have less than 16 years of farming experience, on average. This implies that the farmers in the study area have relatively little experience in farming.

Table 2: Distribution of respondents according to farming experience, Kebbi State, January 2012

Farming experience	Monocroppers (n=98)		Intercroppers (n=158)	
	Number of respondents	(%)	Number of respondents	(%)
1-5	11	(11)	39	(25)
6-10	23	(24)	56	(35)
11-15	20	(20)	15	(9)
16-20	23	(24)	23	(15)
21-25	9	(9)	3	(2)
26-30	2	(2)	11	(7)
31-35	5	(5)	4	(3)
36-40	5	(5)	7	(4)
Average farming experience (years)	15		12	
Minimum farming experience (years)	4		1	
Maximum farming experience	39		40	
Standard deviation	8.88		9.58	

Asset value of the farmers.

The distribution of the respondents, according to asset value, in Figure 3 reveals that 25 % of the monocrop farmers have assets valued between ₦90 000 and ₦130 000, and that almost 70 % have assets valued more than ₦130 000. About 33 % of the intercrop farmers have assets valued between ₦50 000 and ₦90 000 and 32 % have assets valued between ₦90 000 and ₦130 000, with only about 28 % holding assets valued at more than ₦130 000.

Farmers' asset value can have an effect on purchasing power and hence productivity. Farmers with high asset values are likely to purchase more farm inputs and afford more labour than farmers with less asset value.

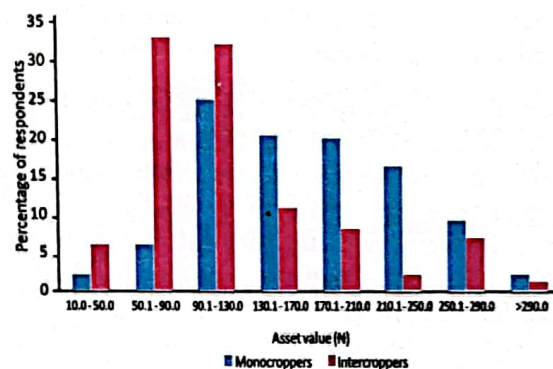


Figure 1: Distribution of respondents according to asset value (₦), Kebbi State, January, 2012

Note: The asset value figures are in thousands (1 US\$ = ₦162).

Land fragmentation and degradation.

Land fragmentation refers to distinct land parcels that are owned and tilled as a sole enterprise (Kakwagh, Aderonmu and Ikwuba, 2011). Land degradation results in loss of land productivity, and is evident through wind erosion, sand dune accumulation, depletion of soil nutrients and gully erosion owing to unreliable or torrential rainfall patterns.

Table 3 reveals that land fragmentation has been experienced by 40 % and 69 % of monocrop and intercrop respondents, respectively. Land fragmentation is a result of the nature of the land tenure system, which is predominantly by inheritance (Kakwagh *et. al.*, 2011).

Fragmentation of land is associated with increased cost of production owing to inefficient allocation of resources (Shuhao, 2005). Land fragmentation also has a negative impact on agricultural mechanization and farm productivity.

Table 3: Land fragmentation and degradation distribution of the respondents, Kebbi State, January 2012

	Monocroppers (%)	Intercroppers (%)	Average (%)
Land fragmentation			
Yes	40	69	58
No	60	31	42
Land degradation			
Yes	62	73	69
No	38	27	31

Table 3 indicates that 62% and 73% of the monocrop and intercrop respondents have experienced land degradation. The land degradation menace is connected with the desertification and desert encroachment experienced in the study area (Danjuma, 2012). The consequent effect of land degradation on arable land is that it reduces soil fertility and agricultural productivity.

Factors influencing the choice of cropping systems by mono and intercrop farmers.

Farming is associated with risk, such as production/yield risk, price risk, institutional risk, financial risk and personal risk (Drollette, 2009; Schaffnit-Chatterjee, 2010). A relatively greater percentage of farmers in Kebbi State practice intercropping, thus utilizing diversification (KARDA, 2009). The factors that are thought to influence the choice of cropping systems in the study area are: farming experience, asset value, risk aversion, size of farm land and land degradation.

Table 4 shows the logit regression for the data. The variables were subjected to a multicollinearity test. Correlation matrix indicates that there is no correlation between the regressors. All the correlation coefficients were less than 0.3. The VIF is less than or equal to 1.09, condition number is less than 2.2 and the condition index is less than 1.50 indicating the absence of multicollinearity in the variables used for the logit regression. The predictive efficacy of the logistic model shows that 188 out of the 256 farmers (73.74%) were correctly predicted.

Four variables (farming experience, asset value, risk aversion and land degradation) out of the five variables considered in this study were significant in influencing the probability of farmers practicing intercropping (reference group). Farming experience has a negative influence and reduces the probability of farmers practicing intercropping. This is in line with the *a priori* expectation. Farmers with more farming experience are more likely to cope with

the risk associated with monocropping; on the other hand, farmers with fewer years of farming experience may not be willing to take the risk of monocropping, probably because they are not familiar with changes in climate and seasonal price variations.

Asset value has a negative influence and reduces the probability of farmers practicing intercropping. This confirms the negative sign of the hypothesis of asset value. Farmers with higher asset values are likely to manage the risk associated with monocropping better than farmers with lower asset values. Monocropping requires adequate application of fertilizers and agrochemicals (pesticides, herbicides) for good yields (Iyegha, 2000). Besides, monocropping can be associated with total crop failure in a bad year. Only farmers with high asset values can cope with or manage crop failure, adequate fertilizer and agrochemical application.

The coefficient of risk aversion is positive as hypothesized. Risk aversion enhances the practicing of intercropping. Diversification in the form of intercropping is a risk management strategy for intercrop farmers. Intercropping reduces risk from natural catastrophe and facilitates better disease control and better use of available labour (Beuerlien, 2001). Palitza (2010) has pointed out that the negative consequences of climate change can be mitigated by increasing crop diversity, which can be used to combat total crop failure.

The expected sign of the coefficient of size of farm land is hypothesized to be negative, implying that size of farm land reduces the probability of farmers practicing intercropping. Large sizes of farm lands are suitable for monocropping and this encourages mechanization and gives higher total yields (Nelson, 2006; Mmom, 2009). The result from the study reveals that size of farm land has a positive non-significant influence and enhances the probability of farmers practicing intercropping, which, however, is contrary to expectation. The probable reason for this is that farmers may prefer to practise intercropping even on large sizes of farm land as a means of diversification to guard against total crop and market failure in a bad year. Moreover, intercrop farmers can maintain low but often adequate and relatively steady production.

Land degradation has a positive influence and enhances the probability of farmers practicing intercropping, which is in conformity with the

hypothesized sign. Land degradation is the reduction of the economic productivity of arable land owing to soil erosion and desertification (Eswaran, Lal and Reich 2001; Coxhead and Øygard, 2007). Farmers whose farm lands are degraded are more likely to practise intercropping as a means of replenishing the soil nutrients through planting of leguminous crops which are often intercropped with cereal crops.

The findings reveal that farmers practice intercropping because they are risk averse; they have low farming experience, low asset value and degraded farm lands. Intercropping as a means of diversification reduces risk in farming: intercropping system is less susceptible to pests and diseases, and some of the crop combinations used, e.g. millet, are drought tolerant and can grow in soils with low fertility. Accordingly, this system is suitable for the farmers who have low asset values and cannot afford to practice monocropping because of disadvantages associated with it. Also, the intercropping system is good for degraded soil as the legumes that are used in crop combinations fix nitrogen in the soil which enhances soil fertility; hence the system requires less fertilizer when compared to the monocropping system. Based on the risk aversion of the farmers, nature of soils and low asset values of the farmers, intercropping seems to have the potential for improving crop production in the study area.

Conclusion

A logit regression was conducted to determine the factors that influence the choice of cropping systems by the monocroppers and intercroppers. The findings reveal that farming experience, asset value, risk aversion and land degradation influence the choice of cropping systems in the study area.

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