

Risk aversion measures by Nigerian Co-operative Agricultural Producers

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The funding provided from the Obafemi Awolowo Mini Research Grant is gratefully acknowledged.

Abstract

This paper examines the various types of risk small-holder face, analyses the farmers' attitudes to these risks and the measures taken to contain them.

A total of 100 farmers were interviewed in ten local government areas of Ondo and Oyo States and certain of their socio-economic characteristics are analyzed to categorize the respondents into various risk-averse levels. Analyses indicate that high-risk averse farmers are generally younger in age, have smallest family size, lowest annual income, smallest land holdings, least education and least number in solidarity groups compared with the other risk-aversion categories.

Results of OLS regression analyses based on linear and Cobb-Douglas models show that age is a poor indicator to categorize low and medium risk-averse farmers. On the other hand family size, size of farms, secondary occupation and level of education are good indicators of risk aversion tendencies for all categories of risk-averse respondents.

A correlation analysis reveals that many of the explanatory variables correlate inversely one with another — but these are consistent with their coefficients in the regression analyses (earlier on).

Introduction

Nigeria's agriculture is largely in the hands of small-holders; as this is nature-based, it is susceptible to quite an array of hazards resulting in low productivity and output instability. Human and economic factors added to the situation make agriculture a high risk understanding. In order to cope with this circumstance, Nigeria's small holder low income farmers exhibit a remarkable sophistication in risk-aversion measures they adopt.

Attitudes toward risk are major determinants of the rate of diffusion of new technologies among small producers and of the outcome of rural development programmes. If they are going to be effective, new technologies and rural development programmes need be tailored to the attitudes toward risk of particular categories of small holders. According to Adeyemo, (1985), fish farmer cooperatives who face almost the same dimensions of risks as the crop farmers have tried to protect members against the uncertainties of this trade by helping them to obtain safer vessels and equipment, better navigating instruments and methodological information and releasing them from dependence on middlemen.

Studies of risk aversion measures in small holder agriculture is of recent vintage. Among cooperative producers, it has been observed Knight (1921) that operators who are risk averse might produce subsistence crops in order to avoid the consequences of entering the market to purchase processed farm products. Also farmers

are interested in multi-cropping to avert risk by producing a mutual fund of crops if they can obtain the same range of expected returns at lower levels of risk as they would, if they grow only one crop at not much higher risk. However, Anderson and Dillon (1972) held that the attitudes of farmers to risk varies from person to person and from one enterprise to another and even within the same enterprise depending on time and the prevailing climatic, ecological and economic conditions. Hiebert (1974) stated that a quantitative knowledge of farmers reactions to changing risk is of considerable importance in respect of programmes and policies directed towards stabilization of prices and income. Wolgin (1975) said that absolute and relative risk aversions decline with increased income. Weins (1976) held that low income risk averting farmers are generally in support of full diversification of their crops. Edgardo and Janvry (1977) listed three classes of variables with respect to production which can be used to define the socio-economic characteristics of the small-holder: the nature of his household, its income generating opportunities and its access to public institutions. Binswanger (1980) defined a risk averter as one who, starting from a position of certainty is unwilling to take a bet which is actually fair. Adesimi (1982) viewed the determinants of risk as age, level of education, family size and membership of solidarity groups. In addition, he asserted that, because the small holder farmers rely on the use of their family labour and such other inputs as land, building, and land improvement, which are fixed capital, farmers in the period of low prices are compelled to maintain full production for subsistence and to generate income for paying operating costs. These result in high fixed costs in production and introduce complexity into farm management decision making. Since it is the government policy to use producer cooperative centres as a vehicle for social and economic development we then decided to focus this research on cooperative producers.

The objectives of this study are to:

- i) examine various types of risk cooperative farmers face.
- ii) analyse their attitude to these risks and
- iii) determine relevant characteristics in explaining the risk bearing capacity of the producers.

The data for this study was conducted between the months of August and November 1986 by means of structured questionnaires. A total of one hundred farmers were interviewed from different local government areas of Ondo and Oyo states. These are Ero, Ijero, Idanre, Akoko North and South, Akinyele, Ibarapa, Irewole, Oluyole, and Lagelu. Farmers interviewed were of different ages and sexes to ensure fair representation of the differential attitudes toward risk among small holder farmers. The survey also included those who held farming as secondary occupations like teachers to reflect the effect of the level of education on farmers' attitudes toward risk. Random sampling technique was employed in the collection of data of this project since not every farmer could be reached and there was need for adequate representation of the farmers' attitudes by the few interviewed.

Analysis and Discussion

Social-Economic Characteristics

Following Edgardo and Janvry (1977) and Adesimi (1982) age, years of schooling, family size, annual income, land under control and membership in solidarity groups were analyzed as variables to indicate the level of risk bearing ability of the farmers

¹Figures in parentheses are standard deviation values

investigated in this study. Of the total sample of 100, twenty-four are low, 47 are intermediate while 20 are high risk averse farmers respectively (Table 1). The mean age for the total sample was 52.7 (12.69)¹ average years of schooling was 2.15 (1.26) average family size 9.85 (3.23), average annually income ₦2,320 (340), land under control averaged 0.58 ha (0.46) while 77% were members of solidarity groups —

TABLE 1: MEAN AND STANDARD DEVIATION OF SOCIO-ECONOMIC VARIABLES OF FARMERS WITH DIFFERENT ATTITUDES TOWARDS RISK

| Group | Sample Size | Age | Schooling (years) | Family Size | Annual Income (N'000) | Land under Control (ha.) | Solidarity Group (%) |
|--------------------------|-------------|-------|-------------------|-------------|-----------------------|--------------------------|----------------------|
| Total sample | 100 | 52.7 | 2.15 | 9.85 | 2.32 | 0.58 | 77 |
| Standard deviation | — | 12.69 | 1.26 | 3.23 | 0.34 | 0.46 | |
| High Risk-averse | 24 | 33.0 | 0.85 | 3.00 | 0.85 | 0.39 | 11.2 |
| Standard deviation | | 3.92 | 0.5 | 0 | 0.47 | 0.12 | |
| Intermediate risk-averse | 47 | 49.49 | 3.14 | 9.87 | 2.0 | 0.87 | 13.7 |
| Standard deviation | | 5.26 | 0.36 | 2.43 | 0 | 0.13 | |
| Low Risk-averse | 29 | 68.5 | 5.0 | 18.0 | 3.0 | 2.25 | 52.2 |
| Standard deviation | | 5.7 | 0.0 | 0.0 | 0.0 | 0.29 | |

Source: Field survey, October, 1985

their link with public institutions. High risk averse farmers are generally younger in age, (33 years) with smaller family size (5) lower annual income (₦850.00) small land holders under control (0.39 ha.) less educated (1.43 years) and with least number in solidarity groups (11.2%)¹. These are followed by intermediate risk-averse farmers while the low risk averse respondents are oldest (68.5 years) have largest family size (18) highest level of income (₦3,000) as well as land under their control (2.25 ha.). Also they have the highest number of their category in solidarity groups (52.2%) and surprisingly longest years of schooling (5 years).

The reasons for joining solidarity groups include ability to easily procure farm inputs (52%); opportunity to obtain credit (44%); quick sales of farm output (33%); and acquisition of technical advice (25%). Majority of the farmers engaged in various forms of secondary occupations to increase their risk bearing ability; prominent among these are hunting (19%), bricklaying (12%), teaching (10%) petty trading (9%), shoe-making and black-smithing (7% each). This makes sense since majority of the respondents (91% in 1982, 84% in 1983 and 83% in 1984) earn ₦4,000 and less (Table 2) as the aggregate value of their outputs in the respective years. This aggregate value is taken as a determinant of the level of risk aversion of the respondents and thus forms the dependent variable in a multiple regression model Age of farmers, family size, size of land under control, secondary occupation, solidarity group membership, other sources of income and level of education are the explanatory variables. (Wolgin 1975), Adesimi, (1982)¹.

¹ Respondents in this group are starting farmers who have not accumulated much to fall back on in case of failure of the high risk venture that agriculture is.

TABLE 2: DISTRIBUTION OF VALUE OF OUTPUTS FOR THE LAST THREE YEARS¹

| Amount (N) | Response | | |
|----------------|----------|------|------|
| | 1982 | 1983 | 1984 |
| 1 — 1000 | 16 | 20 | 15 |
| 1001 — 2000 | 47 | 26 | 23 |
| 2001 — 3000 | 21 | 26 | 28 |
| 3001 — 4000 | 7 | 12 | 17 |
| 4001 — 5000 | 2 | 5 | 6 |
| 5001 — 6000 | 3 | 2 | 3 |
| 6001 — 7000 | 1 | 2 | 1 |
| 7001 — 8000 | 1 | 3 | 3 |
| 8001 — 9000 | — | — | 1 |
| 9001 and above | - | - | 2 |

Source: Field survey, October, 1985.

Regression Analysis

Linear and Cobb-Douglas production functions² were specified while Ordinary Least Squares technique was used to derive coefficients for each of the explanatory variables in stepwise fashion (Table 3).

The estimated linear production function is:

$$a_1 = a_0 + a_1x_2 + a_2x_3 + a_3x_4 + a_4x_5 + a_5x_6 + a_6x_7 + a_7x_8 + e$$

where x_1 = value of aggregate output
 x_2 = age of farmer (in years)
 x_3 = family size
 x_4 = size of land under control (in ha.)
 x_5 = secondary occupation
 x_6 = solidarity group membership
 x_7 = other sources of income
 x_8 = level of education
 and e = error term

while the Cobb-Douglas form was

$$x_1 = a_0x_2^{a_1} x_3^{a_2} x_4^{a_3} x_5^{a_4} x_6^{a_5} x_7^{a_6} x_8^{a_7}$$

¹ Respondents were asked series of questions on the physical outputs of their various trades and farm crops as well as the average price of each of these for each of the years in question. Some of the questions are cross-references to ensure that fairly accurate and consistent answers are obtained.

which linearized by logarithm is

$$\log x_1 = a_1 \log x_2 + a_2 \log x_3 + a_3 \log x_4 + a_4 \log x_5 + a_5 \log x_6 + a_6 \log x_7 + a_7 \log x_8 + e$$

where the variables are defined as before.

Tests of significance of the coefficients of the variables are based on t-statistic. Again, the basis for the analysis is to find out the strength of each variable as a determinant of the level of risk aversion tendency of the respondents in this study.

A priori signs on the coefficients of the variables would be

| <i>coefficient</i> | <i>expected sign</i> | <i>Rationale</i> |
|--------------------|----------------------|---|
| a ₁ | positive | as one advances in age security dominates one's actions hence increase in risk aversion tendencies |
| a ₂ | positive | large family size discourages risk taking tendencies |
| a ₃ | negative | increased land holding reduces level of risk aversion |
| a ₄ | „ | secondary occupation constitutes a form of security thereby reducing level of risk aversion |
| a ₅ | „ | as above |
| a ₆ | „ | as above |
| a ₇ | „ | education sharpens one's instincts and provides greater access to information thereby reducing one's aversion to risk |

The results are as follow:

For the high risk averse farmers, the linear equation shows x_4 (size of land under control) as the most important variable, it accounts for 61.6% of the total variation of 73.3% in the total equation (Table 3a). This is followed by x_2 (age in years) and x_5 (secondary occupation) — and these three are the only significant variables in this equation. A similar result is obtained for the Cobb-Douglas equation for this class of farmers — the same variables x_4 , x_2 , and x_5 are the only ones significant (Table 3b).

For the intermediate risk-averse farmers x_4 is the lead variable as it accounts for 42.2% of the total variation of 49.96% in the whole equation in the linear form. This is however followed by x_8 (level of education) and x_2 and these are the significant variables among the five that enter in this equation. Similarly in the Cobb-Douglas form x_4 is the lead variable accounting for 46.2% of the total variation of 54.95%; variables x_8 and x_2 follow in order, but of the six variables in this equation only x_4 and x_8 are significant.

¹Risk bearing ability is just the obverse of risk-averse tendency

²Cobb-Douglas production function is specified to provide "diagnostic bench marks" (Heady (1956) for the linear function.

TABLE 3: STEP-WISE REGRESSION ANALYSIS: TERMINAL EQUATIONS

(a) LINEAR FUNCTION

| SAMPLE | ENTERING VARIABLE | CONSTANT | | | | | R ² | R ² | F-RATIO |
|-----------------------------|--------------------|-----------------------|---|---|---|--|----------------|----------------|---------|
| High risk averse | X ₈ | 5697.5613 | 1222.6428X ₄ - 46.6871X ₂ | -1051.0541X ₅ + 661.5711X ₆ | +910.9861X ₇ + 70.6578X ₃ | -323.3390X ₈ | 0.7328 | 0.5437 | 2.2891 |
| | | | (481.0124) (31.0246) | (722.8355) (555.7464) | (1062.2518) (92.1363) | (584.8517) | | | |
| Intermediate risk averse | X ₅ | 1685.0049 | 618.9889X ₄ + 327.1548X ₈ | +3.6112X ₂ + 10.6949X ₃ | +50.9186X ₅ | | 0.4997 | 0.4021 | 2.0455 |
| | | | (286.7029) (166.8815) | (1.9186) (14.8748) | (73.6519) | | | | |
| Low risk averse | X ₈ | 213.7274 ₆ | 299.6484X ₆ - 9.5549X ₂ | -292.0284X ₄ + 42.0464X ₃ | +399.6707X ₇ | +104.6724X ₅ -36.9122X ₈ | 0.6961 | 0.4319 | 1.4992 |
| | | | (127.8384) (5.35182) | (232.5290) (35.3223) | (324.9718) | (178.3007) (161.1969) | | | |
| (b) COBB-DOUGLAS FUNCTION | | | | | | | | | |
| High risk averse | log X ₈ | 4.2277 | 0.3442 log X ₄ + 0.2608 log X ₂ | + 0.1013 log X ₅ + 0.1127 log X ₃ | +0.1987 log X ₆ | + 0.1983 log X ₇ -0.0392 log X ₈ | 0.7224 | 0.5298 | 2.1934 |
| | | | (0.2172) (0.1706) | (0.0926) (0.1290) | (0.2589) | (0.2527) (0.1369) | | | |
| Intermediate risk averse | log X ₅ | 3.3158 | 0.1813 log X ₄ + 0.1793 log X ₈ | + 0.1034 log X ₂ + 0.0575 log X ₃ | +0.0273 log X ₇ | +0.0208 log X ₅ | 0.5495 | 0.4370 | 2.2166 |
| | | | (0.0711) (0.0868) | (0.1518) (0.0903) | (0.1070) | (0.0910) | | | |
| Low risk averse | log X ₈ | 2.9786 | 0.2882 log X ₄ + 0.5041 log X ₃ | -0.3808 log X ₂ + 0.2053 log X ₅ | +0.4822 log X ₇ | -0.0676 log X ₄ + 0.430 log X ₈ | 0.6942 | 0.4292 | 1.48 |
| | | | (0.1648) (0.2825) | (0.2393) (0.2161) | (0.4249) | (0.1193) (0.2092) | | | |

Source. Field Survey data 1986

Note: * indicates significance at 1% and 5% levels respectively
() figures in parenthesis are standard errors.

For the low risk-averse respondents, x_6 (solidarity group membership) is the first variable in the linear equation, it accounts for 41.6% of the total variation of 69.6% and is followed by x_2 and x_4 respectively. Only variables x_6 and x_2 are significant in the seven-variable whole equation. In the Cobb-Douglas form, x_6 similarly enters first but the followers are x_3 (family size) and x_2 respectively. x_6 accounts for 42.4% of the total variation of 69.4% in the whole equation while the first three entries are the only significant variables.

Not all the variables enter in all the equations; in the linear forms variables x_6 and x_7 do not appear in the equation for the intermediate risk averters while x_6 does not enter in the Cobb-Douglas form of the equations.

In the same vein, not all the variables possess positive coefficients, some have negative coefficients — implying that these explanatory variables exert negative influence on the dependent variable. However more coefficients (whether positive or negative) are consistent with a priori expectations than those which are not.

In the linear form of the equations, the coefficients of x_2 are negative from stem 2 to step 7 for both the low risk and high risk averse respondents — this is inconsistent with a priori expectations. The coefficients of x_8 are also negative in step 7 for the same categories of risk-averse respondents. Similar results are obtained for the coefficients of x_5 for high risk averters and for x_4 in respect of low-risk averse respondents in step 3 to step 7 — these latter results are however consistent with expectations.

In the Cobb-Douglas form, x_2 possesses negative coefficients in steps 2, 4, 5 and 6 for high risk-averse respondents and at step 3 through step 7 for low-risk averters. Again these results are at variance with a priori expectations. Negative coefficients are obtained for x_5 in steps 4 and 5 as well as at step 7 for x_8 for high risk averse respondents — both results are in line with a priori postulations. Finally, negative coefficient appear in respect of x_4 at steps 6 and 7 for low risk averters and at step 5 for x_3 in respect of intermediate risk-averse respondents, again these results agree with expectations.

From the foregoing, it would appear that in both the linear and Cobb-Douglas models variable x_2 is poor at explaining risk aversion status of both the low and high risk-averse respondents. On the other hand variables x_3 , x_4 , x_5 and x_8 are good indicators of risk-aversion tendencies for all categories of risk-averse respondents. Over-all the Cobb-Douglas model is superior in explaining the variation in the dependent variable for the intermediate risk-averse respondents relative to the linear form (i.e. 59.52% compared to 49.97%).

A zero-order correlation matrix of variables (Tables 4a, b, c) was constructed to examine for possible multicollinearity among the variables in the models. There is no evident of very high correlation whether positive or negative among these variables. Only X_2 and X_3 as well as X_1 and X_4 have significant correlations among themselves. The level of correlation between X_2 and X_3 is 0.6052 and that between X_1 and X_4 is 0.5681. The relationships among all the others are less than 0.5000. Quite a number of the variables indicate negative correlations among themselves: X_1 correlates negatively with X_3 and X_5 ; X_2 with X_5 , X_6 , X_8 ; X_3 with X_6 and X_3 , X_4 with X_5 ; also X_7 , X_5 with X_8 ; X_6 with X_7 and X_8 respectively for the high risk-averse farmers.

TABLE 4: SIMPLE CORRELATION MATRIX

(a) High Risk-Averse Sample

| | X_1 | X_2 | X_3 | X_4 | X_5 | X_6 | X_7 | X_8 |
|-------|---------|---------|---------|---------|---------|---------|---------|--------|
| X_1 | 1.0000 | | | | | | | |
| X_2 | 0.1599 | 1.0000 | | | | | | |
| X_3 | -0.0574 | 0.6052 | 1.0000 | | | | | |
| X_4 | 0.5681 | 0.0388 | 0.0515 | 1.0000 | | | | |
| X_5 | -0.2316 | -0.1693 | 0.1968 | -0.2082 | 1.0000 | | | |
| X_6 | 0.3359 | -0.1193 | -0.1641 | 0.3443 | 0.0531 | 1.0000 | | |
| X_7 | 0.0920 | 0.1412 | 0.0808 | -0.2651 | 0.1969 | -0.2459 | 1.0000 | |
| X_8 | 0.1256 | -0.4415 | -0.3532 | 0.2314 | -0.1527 | 0.1005 | -0.2329 | 1.0000 |

(b) Intermediate Risk-Averse Sample

| | X_1 | X_2 | X_3 | X_4 | X_5 | X_6 | X_7 | X_8 |
|-------|--------|--------|--------|---------|---------|--------|---------|--------|
| X_1 | 1.0000 | | | | | | | |
| X_2 | 0.1509 | 1.0000 | | | | | | |
| X_3 | 0.1567 | 0.4925 | 1.0000 | | | | | |
| X_4 | 0.3492 | 0.2984 | 0.4294 | 1.0000 | | | | |
| X_5 | 0.0248 | 0.1986 | 0.0371 | -0.0170 | 1.0000 | | | |
| X_6 | 0.0234 | 0.1053 | 0.1590 | -0.0931 | -0.0699 | 1.0000 | | |
| X_7 | 0.1345 | 0.0939 | 0.1087 | -0.3348 | -0.0598 | 0.2272 | 1.0000 | |
| X_8 | 0.2853 | 0.0268 | 0.1020 | 0.0476 | -0.1723 | 0.0645 | -0.0626 | 1.0000 |

(c) Low Risk-Averse Sample

| | X_1 | X_2 | X_3 | X_4 | X_5 | X_6 | X_7 | X_8 |
|-------|--------|--------|---------|---------|---------|---------|---------|--------|
| X_1 | 1.0000 | | | | | | | |
| X_2 | 0.2140 | 1.0000 | | | | | | |
| X_3 | 0.1515 | 0.2854 | 1.0000 | | | | | |
| X_4 | 0.1508 | 0.2075 | 0.4240 | 1.0000 | | | | |
| X_5 | 0.1704 | 0.3340 | 0.3371 | -0.2788 | 1.0000 | | | |
| X_6 | 0.3413 | 0.0644 | 0.0342 | 0.2027 | 0.0917 | 1.0000 | | |
| X_7 | 0.2182 | 0.2500 | 0.1162 | 0.1264 | -0.1338 | 0.2085 | 1.0000 | |
| X_8 | 0.1580 | 0.2182 | -0.4828 | 0.2399 | 0.0155 | -0.1690 | -0.1762 | 1.0000 |

Source: Field Survey data 1986.

For the intermediate risk averters, X_4 correlates negatively with X_5 , X_6 and X_7 ; X_5 and X_6 , X_7 and X_8 respectively. In similar manner, X_3 correlates negatively with X_8 ; X_4 with X_5 , X_5 and X_6 with X_7 and X_7 with X_8 respectively for the low risk-averse respondents.

All these are largely consistent with their role (that is, the sign of their coefficients) in the regression analyses. Also, the values of these correlation coefficients (whether positive or negative) indicate absence of high level multicollinearity among the variables hence the robustness of the regression coefficients obtained earlier on.

The regression analyses show that the equations give reasonable fits of the two models considered, the error term accounting for between 27% and 50% of the unexpected variations in the linear model and between 28% and 40% in the Cobb-Douglas model. The best fits are obtained for the high risk averse farmers ($R^2 > .7000$) followed by the low risk category ($R^2 > .6960$) and the intermediate group ($R^2 > .5000$) in both models.

Policy Inferences

On basis of foregoing analyses a mix of policies is called for to improve the risk bearing ability of Nigerian cooperative producers. Since X_2 possesses negative but significant coefficients in both models for low and high risk averse farmers respectively one would support policies that provide adequate rural infrastructures which will encourage young people to take to farming as the relatively old people in the sample indicate low risk aversion tendency in their business. When rural infrastructures are adequate enough young entrants with no family ties will be more prone to experiment with risks that could increase their revenue intake. Variable X_3 has significant negative coefficient only once and this is for intermediate risk averse respondents in the Cobb-Douglas production function model. A solution for the problem is reduction in family size or an increase in cooperant factors to allow a more rational use of family labour (for example increased capital input to enhance family labour productivity). Size of land under each farmer's control is significant in four equations but with negative coefficients — an indication of non-rational use of this fixed resource (for high risk averse farmers in both production models and for low risk averters in the linear case). For this one would advise greater input of complementary variable resources to return land use to the rational stage of production. Secondary occupation (x_5) has significant but negative coefficients for the high risk averters in both production models, thus respondents in this category need be encouraged to concentrate more on their primary source of income by provision of inputs, social infrastructures and technical aid to make the concentration worthwhile. Solidarity group membership possesses significant and positive coefficients in the two production models for the low risk averters. This is quite consistent as such groups are sources of credit, farm inputs and technical aid for members. Social education to attract most farmers to such organizations is called for; group farming may even grow out of such associations. Level of education (X_8) shows significant but negative coefficients for the low and high risk averters in the linear production model. This is surprising given the low level of education reported by respondents: increased opportunities for formal and informal education for our farmers is incontestable as education increases one's flexibility to adapt to changes, learn more about technological improvements and enhance one's management ability.

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