DETERMINANTS OF MAIZE-BASED ARABLE CROP FARMERS PRODUCTIVITY IN NIGER STATE, NIGERIA

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ABSTRACT

The paper examined the profitability of maize-based farmers by determining the cost and returns in maize-based farming in Niger State, Nigeria. Data collection involved the use of primary data through the use of structured questionnaire. A multi-stage random sampling technique was used in selecting the respondents for the study and a total of 133 farming households engaging in maize-based crop production were used. Data were analyzed using budgetary analysis to determine the profit levels of the farmers, multiple regression analysis were used to determine the factors affecting maize yield of the farmers while elasticity of production and returns to scale were used to determine the economics of scale. The result of the costs and returns analysis revealed that the net income/Ha was ₦86,687.47and ₦178,784.65 for sole cropping and mixed cropping systems, respectively. Some of the constraints identified were inadequate extension and farm advisory services and pilfering/theft. Government should organize adult education to educate the farmers on how to effectively utilize the resources at their disposal.

Keywords: Maize Based Farming, Productivity, Budgetary Analysis, Elasticity and Returns to Scale

INTRODUCTION

Agriculture in Nigeria is dominated by small scale farmers who produce about 80% of the total food requirement (fayinka, 2004 and Mohammed, 2011). Among the crops grown by these farmers is Vitamin and mineral rich cereal of which maize belongs. Maize, an annual crop is one of the food crops commonly cultivated under sole and mixed cropping systems. Its production is popular in northern parts of Nigeria where there is abundance of cultivable land which has made the practice of sole and mixed cropping possible (Yusuf *et al.*, 2008). Sole cropping is the growing of a single crop on a piece of land. Research has shown that mixed cropping system leads to better utilization of land, labour and capital. It also ensures food security against total crop failure or with the intent to maximize yield and profit making by the use of the same labour force (Usman, 1997). Conversely, sole cropping ensures better yield as competition for nutrients by other crops is eliminated. Also it aids effective use of machineries, and application of chemicals is made easier. In Nigeria, maize is inter-planted with other crops like melon, cowpea, soybeans, sorghum and millet. Maize provides employment and generates income and foreign earnings to the farmers and Government, respectively. Therefore farmers need to know how to put to use the available resources to maximize its yield as well as knowing the optimum farm plan to adopt to attain the maximum profit level. In essence, to achieve maximum profit level, resources have to be optimally utilized to best advantage. Hence, the objectives of this paper are to determine the profitability of maize under sole or mixed cropping system and determine the factors that affect output levels of maize production.

METHODOLOGY

The study area: Niger State has twenty-five (25) local government areas. It lies between latitudes $8^0 22'$N and $11^0 30'$N and longitudes $3^0 30'$E and $7^0 20'$E. Kaduna State and F.C.T Abuja boarder the

State to the North-East and South-East, respectively; Zamfara State borders the state to the north, Kebbi State to the west, Kogi State to the south, Kwara State to the south-west, and the Republic of Benin to the North –West (National Bureau of Statistics, 2015). The State comprises of the old Nupe and Kontagora Kingdoms, Abuja (Suleja) with link to the famous kingdom of Zazzau and a host of other political entities. Niger State was excised from the defunct North-Western State and made a full-fledged state in the federation in April 1976. The State covers a total land area of 74,244km^2, or about 10% of the total land area of Nigeria and 85% of the land is arable (Niger State Ministry of Land Survey, 2014). This makes the State the largest in the country. Several ethnic groups are found in the State. The 2006 population census put the population figure of the State at 3,950,249 persons consisting of 2,032,725 males and 1,917, 524 females (NPC, 2006). The population of the state for 2015 as projected by the United Nations Population Fund (UNFPA) is 5,337,148 (UNFPA, 2015).The soil types are categorized into two: *Ku*soil and *Ya*soil. The *ku*soil has little erosion hazards, while the *Ya*soil has better water holding capacity. Niger State experiences distinct dry and wet seasons with annual rainfall varying from 1,100mm in the northern part to 1, 600mm in the southern part. Its maximum temperature is usually 37^{0}C which is recorded between March and June; while the minimum is usually 21^{0}C between December and January. The rainy season lasts for about 150 days in the southern parts to about 120 days in the northern parts of the State. The soils are fertile and the hydrology permits the cultivation of most of Nigeria's staple crops and still allows sufficient opportunities for grazing and fresh water fishing. Mineral resources such as gold, clay, silica, sand, Kyanite, Mable, Copper, Iron, Feldspars, Lead, Columbite, kaolin and tantalite are also found in the State (Niger State Ministry of Information, 2014). Most of the communities in Niger State are predominantly agrarian; the types of crops grown include sugar cane, vegetables, groundnut, soya beans, rice, mellon, cassava, sorghum, maize, millet, Shea butter, yam, cotton and cowpea. The major tree crops cultivated are mango, citrus, coconut, cashew, banana and pawpaw. The inhabitants of the State also rear livestock like cattle, sheep, goats and chicken among others.

Sampling procedure: A Multi-stage sampling technique was used. The first stage involved random selection of two local government areas (LGAs) from each zone in the state. The second stage involved random selection of two villages from each local government area while the third stage involved random selection of farmers from each village making a total of one hundred and thirty three (133) farmers in all. Farmers involved in maize-based production (sole and mixed) were used for the study. Data for the study were primary data collected with the aid of structured questionnaire.

Analytical Techniques: Profitability analysis was used to determine the costs and returns for maize production in the area. The net farm income (NFI) is the difference between gross income (GI) and the total cost (TC) of production (Olukosi and Erahbor, 1988).

NFI = GI - TC ---------- (1)

The linear, semi-log and Cobb-Douglass regression functions were used to determine the input-output level in maize-based production. The best regression fit was determined by the level of R^2, the level of significance of overall model (F- Statistics), and the level of significance of each coefficient.

The model in its general form is:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, e)$ ---------- (2)

Where:

Y = Output from production (kg)
X_1 = labour (man days)
X_2 = farm size (hectares)
X_3 = cost of fertilizer (₦)
X_4 = quantity of improved seeds (kg)
X_5 = quantity of agrochemicals (in litres)

X_6= Capital inputs (Depreciation on tools and equipments such as hoes, cutlasses, axes, machinery, rent, interest on borrowed capitals)
e = Error term
1 shows the Summary statistics of factors affecting the output of maize in Niger State. Results reveal that the mean output was 4805.82 while the minimum and maximum output was 705.00 and 19900kg respectively. The use of Labour, farm size, fertilizer, seed, agrochemical and capital inputs all have the mean score of 74.13, 1.87, 123.68, 15.09, 2.57 and 882.41 respectively, while their minimum and maximum values are 705.00,2.50,0.50,0.01,2.00,0.01,66.00 and 19900,501,10,500,54.15, 3180 respectively.

Table 1: Summary statistics of factors affecting the output of maize in Niger State.
Economics of scale: This is the measure of a farmer's success in producing maximum output from a given set of inputs. The elasticity of production (εpxi) and Returns To Scale (RTS) was computed using the formula: ∑εpxi = RTS

RESULTS AND DISCUSSION

Table 1: Summary statistics

Variables	Mean	Std. Dev.	Min	Max
Output(kg)	4805.82	3289.34	705.00	19900
Labour(manday)	74.13	67.81	2.50	501
Farm size(Ha)	1.87	1.39	0.50	10
Fertilizer (kg)	123.68	95.85	0.01	500
Seed(kg)	15.09	10.93	2.00	54
Agrochemical(litre)	2.57	2.05	0.01	15
Capital inputs(N)	882.41	719.86	66.00	3180

Source: Computed from field survey data, 2016

Estimated Cost and return analysis of maize production under sole cropping system: The estimated cost and returns analysis of maize production under sole cropping system is shown in Table 2. The Table shows that cost of fertilizer constituted about 32.43% of the total cost of production followed by labour, agrochemical and tractor hiring with 28.01, 12.24 and 10.48% respectively. A confirmation of profitability of maize production under sole cropping system is shown by the gross margin and net farm income of ₦87,403.29 and ₦86,687.47 per hectare respectively. Also, the gross ratio was 0.32.Since the ratio is less than 1, it is a proof that maize production under cropping system is a profitable venture in the study area.

Table 2: Cost and return analysis of maize-based sole cropping in the study area

Cost items	Maize (₦)	% of total cost
Variable Cost		
Labour	11,695.32	28.01
Fertilizer	13,540.92	32.43
Seed	1,266.29	3.03
Agrochemical	5,109.62	12.24
Tractor hiring	4,374.68	10.48
Transportation	3,230.57	7.74
Processing	1,018.53	2.44
Storage	806.48	1.93
A. Total Variable Cost	**41,042.41**	**98.29**
Fixed Cost		
Depreciation	715.82	1.71
B. Total Fixed Cost	**715.82**	**1.71**
C. Total Cost	**41,758.23**	**100.00**
D. Total Revenue	128,445.70	
E. Gross Margin (D-A)	87,403.29	
F. Net Farm Income (D-C)	86,687.47	
G. Gross Ratio (C/D)	0.32	

Source: Data Analysis, 2016.

Estimated Cost and return analysis of maize production under mixed cropping system: The estimated cost and returns analysis of maize production under mixed cropping system per hectare is shown in Table 3 and 4. The Table shows that the total variable cost per hectare for maize/rice enterprise was ₦83,934.40 which accounts for 97.15% of its total cost of production followed by maize/millet and maize/sorghum enterprise with ₦65,102.43 and ₦63,543.54 respectively. The results also reveals that maize/rice enterprise earns the highest net income of ₦178,784.65 while the maize/sorghum enterprise earns the lowest net income of ₦120,109.16. The result also indicates that the maize/soybeans enterprise recorded the least gross ratio of 0.25 which means that the total cost per naira of gross sales is 25k. This implies that only 25% of the total revenue was required to cover the total cost of production in the study area. On the other hand, maize/sorghum enterprise recorded the highest gross ratio of 0.34 and hence the financially least efficient maize mixed crop production enterprise in the study area. This is also in agreement with the assertion of Olukosi and Erahbor, (2008) that a less than one gross ratio is desirable for any farm business, the lower the ratio, the higher the return per naira invested.

Table 3: Cost and return analysis of maize based mixed cropping in the study area

Cost items	Maize/Rice (₦)	Maize/Sorghum (₦)	Maize/Millet (₦)	Maize/Soybeans (₦)
Variable Cost				
Labour	25,439.28	13,842.39	12,328.74	15,475.87
	(29.44)	(21.38)	(18.54)	(26.53)
Fertilizer	27,279.87	21,758.73	20,792.05	10,253.18
	(28.10)	(33.61)	(31.27)	(17.58)
Seed	6,730.18	2,330.25	2,953.18	3,817.51
	(7.79)	(3.60)	(4.44)	(6.54)
Manure	0.00	178.65	565.37	0
	(0.00)	(0.28)	(0.85)	(0)
Agrochemical	6,450.67	6,023.82	5,947.15	4,628.35
	(7.47)	(9.30)	(8.94)	(7.93)
Tractor hiring	0.00	11,550.50	12,526.50	13,200.30
	(0.00)	(17.84)	(18.84)	(22.63)
Transportation	7,725.00	5,035.67	5,730.51	4,500.05
	(8.94)	(7.78)	(8.62)	(7.71)
Processing	10,564.16	1,873.26	2,764.16	3,773.64
	(12.23)	(2.89)	(4.16)	(6.47)
Storage	2,475.24	950.27	1,494.77	654.05
	(3.18)	(1.47)	(2.25)	(1.12)
Total Variable Cost	**83,934.40**	**63,543.54**	**65,102.43**	**56,302.95**
	(97.15)	**(98.15)**	**(97.91)**	**(96.53)**
Fixed Cost				
Depreciation	1,540.71	670.15	885.07	980.71
	(1.78)	(1.04)	(1.33)	(1.68)
Interest on credit	925.38	530.12	503.33	1,045.20
	(1.07)	(0.82)	(0.76)	(1.79)
Total Fixed Cost	**2,466.09**	**1,200.27**	**1,388.40**	**2,025.91**
	(2.85)	**(1.85)**	**(2.09)**	**(3.47)**
Total Cost	**86,400.49**	**64,743.81**	**66,490.83**	**58,328.86**
	(100.00)	**(100.00)**	**(100.00)**	**(100.00)**
Total Revenue	265,185.14	184,852.97	190,623.53	227,460.00
Gross Margin	181,250.74	121,309.43	125,521.10	171,157.05
Net Income	178,784.65	120,109.16	124,132.70	169,131.14
Gross Ratio	0.32	0.35	0.34	0.25

Source: Data Analysis, 2016.
Figures in parentheses are the respective percentages

Table 4: Cost and return analysis of maize-ased mixed cropping in the study area

Cost items	Maize/Groundnut (₦)	Maize/Bambaranut (₦)	Maize/Cowpea (₦)
Variable Cost			
Labour	15,475.87 (25.64)	16,439.28 (27.11)	14,375.33 (24.70)
Fertilizer	11,253.18 (18.64)	13,279.87 (21.90)	10,553.88 (3.3)
Seed	4,087.35 (6.77)	2,358.30 (3.89)	4,381.60 (18.13)
Manure	0 (0)	153.07 (0.25)	0 (0)
Agrochemical	5,865.03 (9.72)	5,444.19 (8.98)	6,028.35 (10.36)
Tractor hiring	10,570.55 (17.51)	12,502.95 (20.62)	12,850.30 (22.08)
Transportation	5,207.67 (8.63)	4,773.05 (7.87)	3,920.64 (6.74)
Processing	4,153.71 (6.88)	3.672.75 (6.06)	3,780.75 (6.50)
Storage	1,547.45 (2.56)	945.44 (1.56)	1,023.82 (1.76)
Total Variable Cost	**58,160.81 (96.36)**	**59,568.90 (98.24)**	**56,914.67 (97.79)**
Fixed Cost			
Depreciation	1,390.01 (2.30)	945 (1.57)	1,185.13 (2.04)
Interest on credit	804.2 (1.33)	120.33 (0.53)	98.5 (0.17)
Total Fixed Cost	**2,194.21 (3.64)**	**10,065.33 (1.76)**	**1,283.63 (2.21)**
Total Cost	**60,355.02 (100.00)**	**60,634.23 (100.00)**	**58,198.30 (100.00)**
Total Revenue	209,178.60	213,352.53	216,123.33
Gross Margin	151,017.79	153,783.63	159,208.66
Net Income	148,823.58	152,718.30	157,925.03
Gross Ratio	0.28	0.28	0.26

Source: Data Analysis, 2016.

Regression analysis: The Wheat Grain Equivalent table as shown in Table 5 was used to aggregate the maize-based crop output(Y). The various combinations of the maize based crop outputs were Maize/Rice, Maize/Sorghum, Maize/Millet, Maize/Soybeans, Maize/Groundnut, Maize/Bambaranut and Maize/Cowpea. The output of each crop was multiplied by its unit in the grain equivalent table and then summed up to give the output. Table 6 shows the regression analysis indicating the input-output levels in maize production. The F-Ratio shows that the whole model is significant at 1% while the value of the value of coefficient of determination (R^2) indicated that about 59% of the variation in output is explained by the input included in the regression model while the remaining 41% is as a result of non-inclusion of some explanatory variables as well as other factors outside the control of the farmers. The regression coefficients of farm size and capital inputs were positively significant at 1%. This means that increase in the farm size and capital inputs of maize-based farmers results in an increase in the maize output which ultimately results into increased income.

Conversely, it was discovered that fertilizer and quantity of improved seeds used were positively significant at 5% and 10% respectively. The implication of this is that if any of these variables increases, maize yield will also increase. On the other hand, if any of these variables decreases, maize yield will also decrease. This agrees with the findings of previous studies by Awoniyi and Omonona (2007), Izekor and Olumese (2010) and Shehu *et al.* (2010) in Ekiti, Edo and Benue States respectively.

Table 5: System of weights

Grains	**Grain Equivalent Unit**
Wheat	1.00
Wheat-flour	1.43
Rice, rough	1.80
Rice, clean	1.19
Barley	0.65
Oats	0.65
Maize	0.75
Millet	0.68
Sorghum	0.60
Buckwheat	0.65
Other grains (as maize)	0.75
Starchy roots	
Potatoes	0.65
Sweet potatoes	0.30
Cassava	0.23
Vegetable oil and oilseeds	
Coconut, shelled	2.52
Groundnuts, shelled	1.83
Groundnuts, unshelled	1.10
Linseed	1.45
Soybeans	1.30

Table 6: Regression estimate of factors affecting the output of maize in Niger State.

Variables	Linear(Lead equation)	Semi-Log	Double-Log	Exponential
(Constant)	283.10	-2134.81	7.71	7.49
	(0.62)	(-1.13)	(17.94)***	(63.60)***
Labour(manday)	2.83	342.82	0.18	0.00
	(0.88)	(1.23)	(0.29)	(0.42)
Farm size(Ha)	1200.37	3360.39	0.84	0.25
	(7.02)***	(7.66)***	(8.44)***	(5.76)***
Fertilizer (kg)	5.62	115.85	0.21	0.00
	(2.50) **	(1.85)*	(1.52)	(1.83)*
Seed(kg)	34.64	262.39	0.16	0.03
	(1.96)*	(1.03)	(2.79)***	(0.69)
Agrochemical(litre)	-99.43	-338.67	-0.05	-0.04
	(-0.97)	(-2.40)**	(-1.83)*	(-1.79)*
Capital inputs(₦)	1.24	696.59	0.06	0.00
	(4.31)***	(2.52)**	(1.05)	(2.91)***
R^2	0.59	0.55	0.51	0.42
R^2-adjusted	0.57	0.53	0.49	0.40
F-ratio	30.51***	26.31***	22.26***	15.83***

Source: Computed from field survey data, 2016
Note: *** Significant at 1% ** Significant at 5% *Significant at 10%

Elasticity of production and return to scale: The elasticity of the various production inputs mix which is explained in terms of return to scale is presented in Table 7. The return to scale value of 0.923 showed a decreasing return to scale for maize-based crop producers in the state. In other words, a 1% increase in any of the inputs will lead to a corresponding increment of the maize output by 0.923%. The result is not in agreement the findings of Nwaru and Iheke (2010) who reported higher RTS of 4.16 which was higher than that obtained in this study.

Table 7: Estimated elasticity of factor input and return to scale

Variables	Elasticity of production
Labour(manday)	0.044
Farm size(Ha)	0.453
Fertilizer (kg)	0.148
Seed(kg)	0.117
Agrochemical(litre)	-0.060
Capital inputs(₦)	0.221
Return to scale	**0.923**

Source: Data Analysis, 2016.

CONCLUSION AND RECOMMENDATION

The profitability analysis revealed that both the sole and mixed cropping system is profitable. Also the regression analysis revealed that farm size, capital inputs, fertilizer, quantity of improved seeds are the main factors affecting the output level of maize production in the study area. In addition, most of the production inputs were not at optimal usage and the farmers were operating at decreasing return to scale. Based on these findings, effort should be directed into educating farmers on both sole and mixed cropping system through field demonstrations, workshops and seminars.

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