ANALYSIS OF THE USE OF TRACTOR IN ARABLE CROPS PRODUCTION IN ZAMFARA STATE, NIGERIA

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Abstract

The study examined the socio-economic effects of the use of tractor in arable crops production in Zamfara State, Nigeria. The primary data for the study were obtained using structured questionnaire administered to 100 randomly sampled farmers from two Local Government Areas. Descriptive statistics, gross margin, net farm income, gross ratio, operation ratio and return on capital investment as well as regression analysis were used to analyze the data. The result showed that farmers who used tractor were more profitable in arable crops production than their counterparts who did not use tractor with Net Farm Incomes of N 115,883.59/ha and N83,618.77/ha respectively Based on the results, double log (Cobb Douglass) was chosen as the the lead equation with coefficient of determination (R^2)value of 0.592. This indicated that about 59.2% of variation of arable crop farmers' outputs is explained by the variables included in the regression model The F-ratio estimated as 18.216 was significant at 1% level of probability. The result also showed that land (X_1) and farmers' access to the tractor (X_6) were significant at 1%, level of probability, while agrochemical (X_5) was significant at 5% level of probability. The hypothesis tested also showed that the mean difference between the outputs of the farmers with and without the use of tractor was statistically significant at 1% level of probability. It was, therefore, recommended that tractor-hire services should be provided to farmers for efficient use of labour and improvement in production.. Also extension services should be strengthened to create more awareness on the beneficial effect of the use of tractor and improved technologies in the production of arable crops.

Key words: Tractor use, Profitability, and Arable Crops Production.

INTRODUCTION

Labour shortages constitute a major constraint to agricultural production in Nigeria. This varies across different regions due to the unequal population distribution and cultural preferences. Moreover, the perceived economic opportunities in the urban centres have tended to fuel rural-urban migration, contributing to the problem of scarce labour on the farms. Most agricultural operations are time-bound and crop yields suffer if they are not completed within due time. Timeliness depends upon good management backed up by suitable equipment and adequate levels of manpower. Mechanized farming operation is carried out with the help of a machine. The machines used for agricultural production in Nigeria include: hand tools, animal drawn implements, two wheel and four-wheel drive tractors, motorized or mechanically driven post- harvest handling and processing machines, crop storage equipment and irrigation pumps. The machine, of whatever type, requires a power input to make it produce a specified output effect such as cultivation, seed planting, or weeding among others. Some of the problems that are associated with the use of tractor

include land tenure system that is characterized by fragmentation and invariably impedes efficient use of tractors, inadequate maintenance of facilities and spare parts for the tractors and their implement coupled with low technical know-how on the part of the tractor operators. In spite of these problems, farm mechanization is reported to be indispensable for increased productivity with a view to meeting the fast growing demands for the ever growing population.

The most obvious fact is the work potential of tractors versus manual labour and animal traction. This is most advantageous in communities where labour is scarce or expensive. The labour requirements for preparing one hectare of land for planting using draught animal power are only 12% of that required when using hand labour. When using a tractor with a plough, this falls to less than 1%, and increasing labour productivity tremendously. As labour is a constraint in many farming communities, the use of animal traction and tractors in crop production provides farmers with the opportunity to expand their acreage (Anazodo, 1996). Despite successive efforts to boost agricultural production and productivity, there has been staggering deficit in food production culminating in massive food importation in recent years. According to Akoroda and Hahn (1995), the food production in Nigeria is grossly inadequate and cannot meet the ever-increasing demand for it under present level of input use. In order to meet this level of demand and even surpass it, there is need to analyze tractor usage in arable crops production in Zamfara State, Nigeria. The specific objectives of the study were to:

(i) examine the socio-economic characteristics of the arable crop farmers;

(ii) examine the profitability of arable crop production with and without the use of tractor
and after;

(iii) determine the effect of tractor use on the output of arable crop farmers and

METHODOLOGY

The study was conducted in Zamfara State of Nigeria. The State is administratively divided into 14 Local Government Areas (LGAs). It has an estimated 254,411 farm families and a population of 3,259, 846 people (NPC, 2006). About 82% of the population live in rural areas and largely depend on agriculture for their livelihood. The average annual rainfall ranges between 500 – 800mm. The climate of Zamfara State is warm tropical with temperature rising up to 38 °C (100.4 °F) between March to May. The vegetation of the State is largely the Sudan savanna type (Wikipedia, 2011)

Sampling Techniques*:* Two Local Government Areas (LGAs), namely Gusau and Tsafe LGAs were purposively selected because of prevalence of the arable crops such as rice, maize and sorghum among others in the area using multistage sampling technique. The second stage involved a simple random selection of 50 farmers (25 farmers that cultivated with the use of tractor and 25 farmers that cultivated without the use of tractor) from each of the two LGAs, to give a sample size of 100 respondents. The data were collected with the use of structured questionnaire designed in line with objectives of the study.

Method of data collection

Data mainly from primary sources were collected through questionnaire. Data collected include total output produced per annum in kg, while the inputs include the size of farm land in hectare, quantity of seeds in kg; quantity of fertilizer used in kg; quantity of herbicides used in litres and total labour in man-days which include family and hired labour utilized for pre and post planting operations and harvesting; price of 1kg of each arable crop in naira; total production cost per year; average wage rate per man days of labour, price per kg of seed, average price of 1litre of agrochemicals, average price of fertilizer and average price of farm tools and tractor hiring cost. Data collected also include the farmer's socio-economic variables such as farmer's age, years of schooling, household size, farming experience and means of land acquisition.

Method of data analysis

Generally, descriptive Statistics such as mean, frequency distribution and percentage were used to group and summarize the data obtained from the field.

Gross margin: This is the difference between the Gross Farm Income (GFI) and the Total Variable Cost (TVC). It is a useful planning tool in situations where fixed capital is negligible portion of the farming enterprises in the case of small scale subsistence agriculture (Olukosi and Erhabor, 1988).

GM = GFI – TVC (1)

Where GM = Gross Margin, GFI = Gross Farm Income, TVC = Total Variable Cost.

Gross margin analysis is one method of calculating profitability of small scale cropping enterprises (Olukosi *etal,* 2006).

Net Farm Income *(NFI)* = Gross Margin (GM) – Total Fixed Cost (TFC)

Gross ratio: This is a profitability ratio that measures the overall success of the farm. The lower the ratio, the higher the return per naira.

$$GR = \frac{TFE}{GI} \quad (2)$$

Where GR = Gross Ratio, TFE = Total Farm Expenses and GI = Gross Income.

Operating Ratio: The operating ratio is directly related to the farm variable input usage. The lower the ratio, the higher the profitability of the farm business.

$$OR = \frac{TOC}{GI} \quad (3)$$

Where OR = Operating Ratio, TOC = Total Operating Cost and GI = Gross Income.

Return on Capital Invested: This is defined as gross margin divided by total variable cost.

$$RI = \frac{GM}{TVC} \quad (4)$$

Where RI = Return on Capital Invested, GM = Gross Margin and TVC = Total Variable Cost

Production Function Analysis

Regression model was used to examine input-output relationship and the implicit form of the model is given by:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, U_i) \quad (5)$$

Where Y = Output of arable crops production (kg). The outputs of diifferent cereal crops planted by the sampled farmers were aggregated using grain equivalent values.

X_1 = Farm size (ha)

X_2 = Quantity of seeds (kg)

X_3 = Quantity of fertilizer (kg)

X_4 = Labour input (manday)

X_5 = Agrochemical (litres)

X_6 = Access to Tractor (Dummy variable i.e.1= farmer used tractor; 0 otherwise)

U_i = Error term.

The explicit form of this function takes the following forms:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + U_i\,(linear) \quad (6)$$

$$Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + U_i\,(semi\log) \quad (7)$$

$$\ln Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + U_i\,(double\log) \quad (8)$$

$$\ln Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + U_i\,(\exp onential) \quad (9)$$

RESULTS AND DISCUSSION

Socio-economic characteristics of respondent

Selected socio-economic variables considered in this study include sex, marital status, age, education, household size, years of farming experience and means of land acquisition.

Table1: Socio-economic characteristics of sampled farmers.

Variables	Frequency	Percentage (%)
Sex		
Male	95	95.0
Female	5	5.0
Marital status		
Married	73	73.0
single	18	18.0
divorced	7	7.0
Widow(er)	2	2.0
Age		
21-30yrs	20	20.0
31-40yrs	25	25.0
41-50yrs	31	31.0
51-60yrs	17	17.0
Greater than61	7	7.0
Mean age = 40.5years		
Education		
Primary	55	55.0
Secondary	30	30.0
Tertiary	13	13.0
Non-formal	2	2.0
Household size		
1-5	14	14.0
6-10	61	61.0
11-15	21	21.0
16-20	4	4.0
Mean household size = 10.5		
Farming Experience		
1-5yrs	16	16
6-10yrs	31	31
11-15yrs	17	17
16-20yrs	17	17
Greater than20 years	19	19
Mean years of farming experience = 10.70		
Methods of land acquisitions		
Inherited	68	68
Gift	7	7
Purchased	25	25

Source: field survey 2009

Table1 shows that majority of the respondents were males (95%) while only 5% of respondents were female. This is a manifestation of gross inequality in gender distribution

and calls for concerted effort in empowering the women to contribute their own quota to production in the study area. It is also shown in the table that 56% of the sampled farmers were between the ages of 31 and 50 years. Thus, majority of the sampled farmers were middle aged, which could result in a positive effect on production. The modal class of educational level of respondents was primary education (55%) followed by secondary (30%) and tertiary (13%) education while that of non-formal education (2%). Findings also show that 75% of the farmers had less than 10 family members while 25% had 11 to 20 members. Generally, in agrarian settlements, a large family size could be a source of free and cheap labour. Moreover, It is shown that 68% of the farmers inherited the land in which they are using for farming and 7% of the farmers got it as a gift or compensation while 25% purchased the land for farming.

Gross Margin Analysis of arable crop production

The estimated cost and return analysis for arable crop farmers is shown in Table2. The table showed that cost of hired labour constituted 28.97% for farmers who used tractor and 56.24 percent for farmers who did not. This implies that farmers who did not use tractor spent more on hired labour than those who used tractor because most of the land cultivation activities on the farm were done with tractor.

Table 2: Estimated Cost and Return Analysis for arable crop production in the study area

	Farmers with tractor		**Farmers without tractor**	
Cost items and revenue	**Cost (₦/Ha)**	**% of Total Cost**	**Cost (₦/Ha)**	**% of Total Cost**
Variable Cost				
Seed cost	138.00	0.66	152.00	1.33
Fertilizer cost	517.14	2.49	302.67	2.66
Hired labour cost	6,027.25	28.97	6,405.79	56.24
Agrochemical cost	399.00	1.92	465.20	4.08
Total Variable Cost	**7,081.39**	**34.04**	**7,325.66**	**64.31**
Fixed Cost				
Hired tractor cost	4,716.92	22.67	-	-
Rent on land	3,621.00	17.41	2,762.00	24.25
Farm tools (Depreciation)	5,384.61	25.88	1,302.98	11.44
Total Fixed Cost	**13,722.53**	**65.96**	**4,064.98**	**35.69**
Total Cost	**20,803.92**	**100.00**	**11,390.64**	**100.00**
Returns				
Gross Income	**136,687.51**		**95,009.41**	
Gross Margin	129,606.12		87683.75	
Net Farm Income	115,883.59		83,618.77	
Gross Ratio	0.15		0.11	
Operating Ratio	0.005		0.077	
Return on Capital Invested	18.30		11.97	

Source: Field Survey, 2009

It is also shown in the table2 that average cost of hiring tractor constituted 22.7percent of the total cost for farmers that used tractor on their farms.

The evidence of profitability of arable crops for both farmers with and without tractor is shown by the net farm income of ₦ 115,883.59/ha and ₦ 83,618.77/ha respectively. Also, the return on a Naira invested is ₦ 18.30 for farmers that used tractor and ₦ 11.97 for farmers who did not use tractor. This shows that use of tractor was more profitable in arable crops production.The profitability ratio for farmers who used tractor was less than those who did not use which implies that the use of tractor in arable crops production is more profitable in the study area.

Production Function Analysis:

The production function that was used to determine the effect of the use of tractor in arable crops production is shown in Table 3. double-log production function was chosen as the lead equation. The value of coefficient of determination (R^2) indicated that about 59.2% of variation in output is explained by the inputs included in the regression model (Table 3), while the remaining 40.8 % is as a result of non-inclusion of some explanatory variables as well as other factors outside the control of the farmers.

Table 3: Estimated production functions (double log as lead equation)

Variables	Linear	Double-log	Exponential	Semi-log
Constant	1575.973	8.124	7.676	3760.423
	(2.222)**	(14.053)***	(52.170)***	$(1.234)^{NS}$
Farm Size(X_1)	301.666	0.273	0.0562	1302.527
	(5.062)***	(4.092)***	(4.544)***	(3.705)***
Seed (X_2)	-32.096	0.0124	-0.0035	68.926
	$(-0.225)^{NS}$	$(0.161)^{NS}$	$(-0.136)^{NS}$	$(0.170)^{NS}$
Fertilizer (X_3)	-2.059	0.0024	-0.0003	128.701
	$(0.767)^{NS}$	$(0.022)^{NS}$	$(-0.325)^{NS}$	$(0.222)^{NS}$
Labour (X_4)	-0.767	-0.0554	-0.00004	-380.923
	$(-1.286)^{NS}$	$(-0.800)^{NS}$	$(-1.359)^{NS}$	(-1.042)
Agrochemical (X_5)	-130.718	0.156	-0.0366	-586.838
	(-1.007)	(2.334)**	$(-1.359)^{NS}$	$(-1.292)^{NS}$
Access to tractor (X_6)	1456.335	0.424	0.267	2569.101
	(3.866)***	(3.390)***	(3.413)***	(3.894)***
R^2	0.519	0.592	0.478	0.438
R^2 Adjusted	0.488	0.520	0.445	$(0.399)^{NS}$
F-Statistics	16.738***	18.216***	14.204***	11.286***

***-- *Significant at 1% level of probability,* **-- *significant at 5% level of probability.*

NS-- Not significant

Source: field survey 2009

Table 3 also showed that farm size (X_1), access to tractor (X_6) were significant at 1% level of probability while agrochemical (X_5) is significant at 5 % level of probability. This result implies that the use of tractor has positive and significant effect on the output of arable crops in the study area. The F-ratio 18.216 is significant $p<0.01$, implying that the variables significantly explained variations in the gross output.

Hypothesis of the study

The result of the hypothesis tested using t-test is showing in table 4 below. The result shows that there is difference between the outputs of the farmers that used tractor and those that did not use tractor with mean outputs of 5198.00kg and 2576.00kg respectively. The result also shows that the difference is significant at 1% level of probability. This implies that use of tractor by the arable farmers in the study area led to increase in their outputs

Table 4: Difference between the outputs of farmers with and without tractor use.

Variables	Mean	t-value	Decision
Output of the farmers with tractor	5198.00	5.166***	Hypothesis rejected
Versus			
Output of the farmers without tractor	2576.00		

*** = Significant @ 1% level of probability
Source: Field Survey, 2009

CONCLUSION AND RECOMMENDATIONS

This empirical study is on analysis of socio-economic effect of tractor use in arable crops production in Zamfara State, Nigeria. The results from the study showed that farmers who used tractor were more profitable and successful in arable crops production than their counterparts who did not use tractor with net farm incomes of ₦ 115,883.59/ha and ₦ 83,618.77/ha respectively. Also the return on a Naira invested was ₦ 18.30 for farmers that used tractor and ₦ 11.97 for farmers who did not use tractor. Estimates of the production function indicated that farm size, access to tractor and agrochemicals were the significant factors in arable crops production in the study area. The t-test result also showed that there was difference between the mean outputs of the farmers with and without the use of tractor and this difference was statistically significant at 1% level of probability.

The policy implication of this study is that food sufficiency target should include raising farm production from subsistence and small-scale levels coupled with efficient use of available resources. Therefore, tractor-hire services should be made available to farmers for better use of labour and management in production. Moreso, farm inputs, should be supplied to farmers at the right time and at cost that is within their reach. Finally, extension agents should be

provided to create more awareness on the beneficial effect of the use of tractor and modern technology by arable crop farmers in the study area.

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