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Resource use efficiency and productivity of Cocoa Farmers in Idanre LGA of Ondo State, Nigeria

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ABSTRACT

Resource allocation and productivity is an important aspect of increased agriculture production. This study therefore attempts to determine resource-use efficiency of small scale cocoa farmers in Idanre Local Government Area of Ondo state. Data were collected from 140 randomly selected cocoa farmers' using multistage sampling technique. The data were analyzed using descriptive and regression techniques. The result of the regression showed that exponential production function gives the lead equation among the functional forms. The coefficient of farm size or land input was positive and significant, indicating that cultivation of larger hectarage of land leads to increase in cocoa output whereas the coefficient for labour input was negative and significant, implying that increases in the use of labour input leads to decreases in cocoa output. The sum of the elasticity of production of the resources indicates an increasing return to scale in the area of study (0.96). This result further implies that an increase of 10% in any of the factor inputs would lead to an increase of 9.6% in cocoa output. There was disequilibrium in resource use, as the number of family members engaged in farming, land area cultivated on cocoa, cost of durable inputs, cost of non-durable inputs, amount of money spent on labour were used efficiently as against hired labour that was inefficiently used. In the nutshell, cocoa production is yet to attain an optimum level of combination of resources. Refocusing policies to enhance emphasis on efficient use of resources is recommended.

Keyword: Cocoa, farmers, Resource-use, Exponential function, Multistage sampling
Word count: 241

INTRODUCTION:

Agriculture remains a major sector for the Nigerian economy with over 70% of her population depending on farming directly or indirectly for livelihood. It provides the bulk of employment, income and food for the rapidly growing population as well as supplying raw materials for agro-based industries. In terms of agricultural exports, cocoa remains the most important in terms of foreign exchange earnings. The role of the agricultural export crop sub-sector before the oil boom of 1970's was substantial. During the early period of independence this sub-sector accounted for 47.6% of the Gross Domestic Product (GDP) in 1970 (Shittu, 1997; Fashina, 1999; Oduwole 2004; CBN 1986). However, the current instability in oil prices and the estimated low reserves of the country's petroleum, the performance of the agricultural sector especially the export sub sector and its ability to earn foreign exchange make the sector an important force to reckon with in the country's development process. Performance of Nigeria's cocoa economy has not been as good, as it was in the past (Mafimisebi et al., 2008). This was as a result of Nigerian government's decision to stress oil sector above all others sector include agriculture.

The bulk of cocoa output is derived from numerous small scale farmers who live in rural areas which are devoid of social amenities (such as electricity, pipe borne water, hospitals and schools). Evidence has however shown that the growth rate of cocoa production has been declining, which has given rise to a fall in the fortunes of the sub-sector among other reasons (Nkang et al.2006). This has led to downward trend in the nation export when it declined from 216,000 metric tons in 1976 to 150,000 metric tons in 1986, therefore reducing the country's market share to about 6% (Folayan et al. 2006). Currently, in the international cocoa market, Nigeria's cocoa export now ranks fourth after Cote d'Ivoire, Ghana and Cameroun.

In 2001 a New Agricultural Policy and the Integrated Rural Development Policy were initiated to ensure national food security, attain self-sufficiency in basic food production, enhance employment opportunities and achieve high growth rate for the economy. These

policies are being implemented by the National Economic Empowerment and Development Strategy (NEEDS) – a medium term economic reconstruction agenda aimed at value reorientation, wealth creation, poverty reduction, job creation and elimination of corruption. In order to fast track the gains of the 2001 New Agricultural Policy, there came the Presidential Initiatives in Agriculture (PIA) (2004). The PIA gave priority to four different crop-based expansions of production and utilization programmes (e.g. cassava, rice, tree crops and vegetable oil) and livestock and fisheries programme with a view to curtail the huge foreign exchange expended in their production. For the Tree Crops Initiative (TCI), Government's objective is the rapid multiplication and distribution of high yielding, disease resistant and early maturing planting seeds, seedlings and plantlets to farmers at subsidized rates. Despite the fact that programmes were formulated toward developing and improving agricultural productivity in Nigeria, yet the realization of these objectives are seriously in doubt. Table1 shows falling cocoa production output in Nigeria which has been ascribed to some constraints such as diseases and pests, low adoption of the cocoa production technologies, inefficiency in the use and allocation of resources. Also, farmers might use resources rationally but not at the economic optimal level.

Table 1: Nigeria Cocoa Production Output

Year	Cocoa Production Output ('000Tonnes)	Change in Production
1970	305	-
1971	257	-48
1972	241	-16
1973	215	-26
1974	214	-1
1975	216	+2
1976	181	-35
1977	193	+12
1978	157	-35
1979	151	-6
1980	153	+2
1981	174	+21
1982	156	-18
1983	140	-16
1984	140	0
1985	160	+20
1986	148	-12
1987	100	-48
1988	253	+153
1989	256	-3
1990	244	-12
1991	268	+24
1992	292	+24
1993	306	+14
1994	323	+17
1995	203	-10
1996	323	+10
1997	325	+2
1998	345	+20
1999	165	-100
2000	170	+10
2001	171	+1
2002	172	+1
2003	185.5	+13.5
2004	202	+16.5
2005	215.4	+13.5
2006	228	+12.5

Source: Central Bank of Nigeria statistic Bulletin, 2008

This study therefore focuses on cocoa-producing households, which according to Koppelman and French (2005) is the level at which all farm decisions are made. Therefore, a research into resource-use of farmers would provide more relevant information concerning cocoa farming business and capable of change the negative trend and thereby elevating the nations' Gross Domestic Product (GDP) in the non oil sector. The ability to quantify the efficiency in the use of resource provides the policy makers with control mechanism with which to maintain the performance of the production system. Increased production and productivity are direct consequence of efficiency of inputs combination given the available technology and this will open a new dimension to policy makers on how best to improve upon the present state of cocoa production in Nigeria. This study is therefore designed to determine resource-use, the returns-to scale cocoa farmers and investigate the farming system among cocoa farmers in the study area.

The importance role agriculture has played in Nigeria's economic life has declined tremendously (Yusuf and Falusi 2000). The decline has for a long time been blamed on the neglect of the rural sector, comprising mainly of smallholdings farming families or households by successive administration in the country. Also, the age of the farmer, farm size and the farmland tenancy have had their own share of the blame (Abolagba et al. 2004). Aneani et al. (2011) analyzed the economic efficiency of resource

utilization in cocoa production of the cocoa farmers in Ghana to provide information for effective application and management of farm inputs on cocoa farms. A random sample of 300 farmers in the Eastern, Ashanti, Brong- Ahafo, Central, Volta and Western regions of Ghana were selected, using the multistage sampling approach. Cobb-Douglas regression result showed that household size, cocoa farm size, quantity of insecticides, quantity of fungicides, and quantity of fertilizer were 0.261, 0.514, 0.273, 0.090 and 0.325, respectively. The sum of elasticities of the factors included in the Cobb-Douglas production function was 1.463, which was more than one, implying that the cocoa farmers were operating in the increasing returns to scale.

Resource allocation and productivity is an important aspect of increased agriculture production which is also associated with the management of the farmers who employ these resources in production. One way of increasing production by the small farmers is to efficiently use all the resources available in the production process. Efficiency in the use of available resources is a major pivot for a profitable farm enterprise. Technical efficiency in production is the physical ratio of output to the factor input while economic efficiency, on the other hand, occurs when a firm chooses resources and enterprises in such a way that a given resource is considered efficiently utilized in production if its marginal value product is equal to its marginal factor cost (Adegeye and Dittoh, 1985).

Production function analysis for estimation of efficiency of resource use in crop production systems and determination of the optimal resource allocation for adjustment in resource allocation has been employed in some studies (Iheanacho et al,, 2000; Rahman and Lawal,2003). They reported that there was inefficiency in the use of resources. Hence, adjustments in resource allocation for economic optimum might be required to meet the needed percentage change based on the equality of marginal value products and marginal factor costs of inputs.The production function analysis gives the physical or technical relationship between inputs and output in any production scheme or process (Farrel, 1957; Olayide and Heady, 1982; Olukosi and Ogungbile, 1989). Mathematically, this function is differentiable. Its differentiability enables the calculation of the rate of return. It is assumed that the technical relationship between variable factors of production and output can be represented by a production function, which is mathematically expressed as;

$$Y = f(X_i \ldots X_n) \quad \ldots\ldots (1)$$

Y is the quantity of output and X_i, $\ldots X_n$ are factors of production.

It is presumed that there are n factors, one or all may be varied and any of which may be considered fixed. Since output is measured in physical terms, Y is referred to as total physical product. Important physical concepts are the average and marginal physical products. The average physical product APP, measures the average rate at which an input is transformed into a product, while the marginal physical product MPP is the change resulting from a unit increment or unit change in variable input. It measures the amount that total output increases or decreases as input increases. The APP and MPP are differentiable and allows us to vary one factor while the others are held constant and it gives an insight into the efficiency of resource use. There is need to develop a sound knowledge of the current situation as regard cocoa producers in Nigeria, and most especially as regards to the utilization of the available resources to them. This study is therefore designed to determine the efficiency of resource-use, the returns-to scale and to investigate the farming system among cocoa farmers in the study area.

MATERIALS AND METHODS

The study area: The study was carried out in Ondo State; Ondo State is in the Southwest of Nigeria. Southwestern Nigeria produces, 95 percent of total cocoa produced in the country (Alabi, 2003). Ondo State has 17 Local Government Areas (LGAS) with State Capital in Akure. It has about 3,441,024 people (NPC, 2006, who are mostly small-scale farmers. Ondo State Agricultural Development Project (ODSADEP) has grouped the state into 3 zones on ecological basis. The three zones are (1) Ile-Oluji/Ondo zone, (2) Akure/Owo zone and (3) Owena/Idanre zone. The study concentrates on Owena/Idanre zone where cocoa farming is popular. The annual average rainfall is between 1100 mm, relative humidity is between 80–85%. Rainy period is between 240–260 days/year, dry period is 96–125 days/year. The rain has a bimodal distribution, with peaks in June and in September and a period of lower precipitation in August. December to February constitute a major dry season. The main vegetation types are mostly Evergreen forest in the south and derived Savannah of Saki zone where there is mixed semi deciduous forest and dry deciduous forest. The soils are mainly Alfisols and Entisols

Agriculture is the principal occupation of men; women frequently farm independently of their husbands and, in general, are engaged in gainful activities such as food processing and petty trading in addition to their domestic responsibilities.

Sampling procedure and sample size: Data collection was done through the use of structured questionnaire. The target population for this study was cocoa farmers in Ondo State. A multistage sampling was employed. Owena/Idanre Zone was purposively selected for this study because it has the highest concentration of cocoa farmers in the state. Idanre Local government area (LGA) was randomly selected from LGAs that make up Owena/Idanre Zone. Eight villages were also randomly chosen from the list of the villages in the LGA obtained from Ondo state Agricultural Development Project (ODSADEP) in Ibadan. They are: Ita-Olorun, Teju, Agbajo, Gberiwojo ,Ipoba, Ilanarowa, Gbalegi, Ipoba/Balogun, Onikokojiya andIleru-moba. 14 farmers were further selected from each village that subsequently gave 140 farmers that constituted the sample size for the study. Only 135 of the returned questionnaires were found useful. The relevant information in the returned questionnaires was coded and analysed using descriptive statistics and production regression model.

Analytical Techniques:

Model specification: This study considers only three major groups of explanatory variables in modeling the production function for cocoa production. Based on a prior knowledge, the three inputs considered to be important in explaining variation in output of cocoa in the study area are quality and quantity of non-durable inputs (fertilizer, agrochemical and labour) and quality and quantity of durable inputs (cutlass, harvesting pole, sprayer, basket, other tools) and land (size and condition of the soil). Descriptive statistics such as frequency distribution, mean, range and percentages were used for socio-economic variables while Regression model was used to examine input-output relationship and the implicit form of the model is given by:

$Y=f\ (X_1, X_2, X_3, X_4, X_5; e)$…… (2)

Linear, quadratic, exponential, semi-log and double-log forms of the production function were fitted to the data. The exponential function gave the best fit and was chosen as the lead equation on the basis of the number of significant variables, magnitude of the R^2, F-statistic, standard error and the signs of coefficients. The explicit form of the lead equation is given as:

$\ln Y = b_o + b_1X_1 + b_2X_2 + b_3X_3 - b_4\ln X_4 + b_5X_5 + b_6X_6 + e$…….. (3)

Where,
Y= Total income from cocoa (Naira)
X_1= number of family members engaged in farming
X_2= Farm size in hectares
X_3= cost of non-durable capital input (Cutlass, Go-to-hell, basket etc) (Naira)
X_4 =Value of durable input used (agrochemicals eg fertilizer, insecticides, pesticides) (Naira)
X_5 = Amount spent on labour (Naira)
X_6 = Percentage of labour hired (%)
$b_i \ldots b_n$= coefficients of regression
e = error term
All the explanatory variables are expected to be positively related to the value of output.
Efficiency of resource use was determined by the ratio of marginal value product (MVP) to marginal factor cost (MFC) of inputs based on the estimated regression coefficients. Following

Rahman and Lawal (2003) and Iheanacho *et al* (2000) efficiency of resource, r, is given as:

The value of output was estimated as specified in equation 1 as exponential function.

The marginal value product (MVP) of resource provides a framework for policy decision on resource adjustment. When the MVP value is positive, it is an indication that output could be increased by using more of the given factor input. However, the magnitude of the MVP has to be compared with acquisition price which is the marginal factor cost (MFC) of the input in order to determine how useful it is to increase the level of the factor used. The divergence between the acquisition price of the input and its MVP indicates the scope of resource adjustment necessary to attain economic optimum. A given resource is optimally allocated when there is no divergence between its MVP and the MFC of the resource input. That is:

$MPPxi = b_iY = MVPx_i$ (exponential function)

$MV\ Px_1 = Px_1$

Where $MVPx_1$= Marginal Value Product of input x_1

Px_1= Price of input x_1= MFC

A t-statistic is used to determine if there is divergence between MVP and MFC.

The acquisition price or MFC for all resources used is

the average market price prevailing in the area. However, where resources are measured in value terms, efficiency in the use of resources must be evaluated by equating their MVP to one Naira plus some interest rate.

The elasticity of production indicates the changes in output relative to a unit change in input of other levels that are held constant. Mathematically, the elasticity of production is expressed:

$$E_p = \frac{\delta y}{\delta x} \cdot \frac{x}{y} \quad \text{..... (4)}$$

y = aggregate value of output

x= resource input

And $\frac{\delta y}{\delta x}$ = derivatives of y with respect to x

Elasticity of production = $EYx_i = b_i x_i$ (exponential function)

According to theory, when the ratio is greater than one, this means that the increase in output outpaces the increase in input and production is elastic. When it is less than one, this indicates that the percentage increase in output is less than the percentage increase in input and the production is said to be inelastic. When the ratio is equal to one, then output increases by the same rate as input and elasticity is said to be unitary.

RESULTS AND DISCUSSION

Table 2 shows the socioeconomic characteristics of cocoa farmers in the area of study. Majority (about 81.5 %) of cocoa farmers in the area are above 40years.The mean age was 59years. This implies that cocoa farming in the area is dominated by old people. The reason is that the young people in the rural area now see farming as poor people job and therefore prefer to go to cities in search of white collar. This result confirms Adetunji et al (2007) and Gray (2001) that cocoa farmers in West African countries in general have an average age of 50 years and above. About 79.3% of the farmers had no formal education. This has implication in their ability to adopt technology that can improve their efficiency and resource use. However, farmers have the tendency to bear as many children as possible in the belief that the more the household number, the greater the opportunity to use them as source of family labour. The family size was high in the area with an average of about 6 persons per cocoa household. Land was mainly acquired through inheritance (65.2%). 40.7% of cocoa farmers have farm size less than one hectare. Hired labour is prominent among the farmers most especially during peak period of weeding and harvesting. Labourers are paid in cash at pre-arranged daily rate usually ranging from ₦500-₦1200 depending on operation to be performed.

Table 2: **Socioeconomic characteristics of cocoa farmers**

Variable	Frequency	Percentage
Age(years)		
21- 40	13	9.6
41-50	12	8.9
51-60	59	43.7
61-70	37	27.4
>70	14	10.3
Total	135	100.0
Mean	59.0	
SD	10.0	
Education level		
No formal	107	79.3
Primary school completed	18	13.3
Secondary school completed	7	5.2
Tertiary education	3	2.2
	135	100.0
Family size		
1-5	22	16.3
6-10	83	61.5
11-15	20	14.8
16-20	10	7.4
Total	135	100.0
Mean	6.0	
SD	1.3	

Source of Labour		
Family labour	13	9.6
Hired labour	61	45.2
Family/Hired labour	61	45.2
Total	135	100.0
Farm size (Ha)		
< than 1	55	40.7
1.0-2.0	34	25.2
> than 2.0	46	34.1
Total	135	100.0
Mean	1.2	
SD	0.3	
Source of land		
Inheritance	88	65.2
Gift	40	29.6
Purchase/rent	7	5.2
Total	135	100

Source: Field survey 2009

The results of the regression are shown in Table 3. The exponential production function was chosen as lead equation based on the number of significant variables, magnitude of the R^2, F-statistic, standard error and the signs of coefficients. This equation shows that the number of family members engaged in farming and land area cultivated on cocoa are positive significant at 1% level while amount spent on labour and percentage spent on hired labour are highly significant at 5% level. The coefficient of determination (R^2) indicates that 71.4% of the variation in income from cocoa is explained by variation in the level of use of each of the specified inputs. The F-value attested to the joint significance of the explanatory variables on revenue from cocoa output. The coefficient of farm size or land input was positive and significant, indicating that cultivation of larger hectarage of land leads to increase in cocoa output whereas the coefficient for labour input was negative and significant, implying that increases in the use of labour input leads to decreases in cocoa output. The reason might be because the marginal rate of returns has reached the maximum point and any further increase will not add to output. The result in Table 4 shows that marginal value productivity (MVP) from land was significant in the lead equation with its acquisition cost given, farmer could increase output by bringing more land into planting. This indicates that the input is used efficiently. However, the marginal value productivity for percentage of hired labour used by cocoa farmer was also significant. The significant difference between MVP and MFC of percentage of hired labour employed as depicted by the calculated t-value reveal that hired labour are not used efficiently. The result of production elasticities for the resources used showed that the number of family members engaged in farming, land area cultivated on cocoa, cost of durable inputs, cost of non-durable inputs, amount of money spent on labour and percentage of hired labour have values 0.06, 0.69, 0.07, 0.11,0.20 and -0.17 respectively. The use of hired labour was found to have a negative efficiency coefficient. This indicates an extreme use of hired labour by the farmers which in turn leads to reduction in profit obtained. On the other hand, number of family members engaged in farming, land area cultivated on cocoa, cost of durable inputs, cost of non-durable inputs and amount of money spent on labour were the inputs being over utilized as their efficiency coefficient is less than one. The sum of the elasticity of production of the resources indicates an increasing return to scale in the area of study (0.96). This result further implies that an increase of 10% in any of the factor inputs would lead to an increase of 9.6% in cocoa output in the study area. The result of increasing return to scale is in line with the findings of Ajibefun (2002) but contrast with the finding of Obasi (2007). This indicates that the percentage increase in output is less than the percentage increase in input and the production is said to be inelastic. This means that cocoa producers are already attained an optimum size of the combination of the resources and can only increase output by increasing areas of their farm holdings.

Table 3: Estimated regression coefficients of resources used by cocoa farmers

Forms of Equation	*Dependent variable*	*Independent variables*										
		Constant	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**R2**	**R2Adj**	**SD**	**F-Ratio**
Linear	Y	-0.2541 (0.303)	0.1316 (0.125)	0.4536 (0.071)	0.0579 (0.061)	0.4385 (0.193)	0.2264 (0.121)	-0.5943 (0.061)	0.693	0.673	0.688	34.93
Power	logY	-0.0045 (0.094)	0.17200 (0.099)	0.4940 (0.083)	0.0899 (0.067)	0.2407 (0.130)	0.2384 (0.106)	-0.065 (0.067)	0.683	0.663	0.315	33.45
Quadratic	Y	1.0697 (0.1631)	0.0008 (0.0281)	0.0827 (0.010)	0.0098 (0.009)	0.1058 (0.051)	0.0309 (0.023)	-0.0203 (0.009)	0.709	0.690	0.669	37.86
Semi-log	Y	0.7934 (0.220)	0.4870 (0.233)	0.8794 (0.194)	0.2388 (0.157)	0.9450 (0.305)	0.4803 (0.248)	-0.0400 (0.159)	0.659	0627	0.709	28.71
Square root	Y	-3.1255 (0.644)	0.5495 (0.351)	1.3218 (0.246)	0.2388 (0.204)	1.3070 (0.492)	0.6941 (0.357)	-0.1121 (0.204)	0.673	0.652	0.709	31.93
Exponential	LogY	-0.3220 (0.132)	0.0499 (0.055)	0.2254 (0.031)	0.0328 (0.027)	0.0873 (0.084)	0.1126 (0.052)	-0.0565 (0.026)	0.714	0.695	0.299	38.68

Source: Field survey 2009

Table 4: Marginal productivity of all the resources used by cocoa farmers

Forms of Equation	$MVPx_1$	$MVPx_2$	$MVPx_3$	$MVPx_4$	$MVPx_5$	$MVPx_6$
Linear	0.1316	0.4537	0.0579	0.4385	0.2265	-0.0594
Power	0.6317	0.3251	0.1121	0.9985	0.3114	-0.0424
Quadratic	-	-	-	-	-	-
Semi-log	0.2224	0.4011	0.1091	0.4315	0.2193	-0.0183
Square root	0.2477	0.3915	0.0875	0.5968	0.2657	-0.0333
Exponential	0.0346	0.1562	0.0228	0.0605	0.1780	-0.0392

Source: Field survey 2009

Conclusion and policy recommendation: This study has revealed some salient issues that can be drawn as regards cocoa production in Nigeria. The average size of plot cocoa producers was 0.55 hectare. Cocoa producers in the areas are already attained an optimum level of combination of resources as any additional input led to decrease in production output. Hence, the farmer increases elasticity of production of the resources indicates a decreasing return to scale. The need arises for adjustment in the level of resource use most especially with regards to expanding the size of plots used for production.

These observations underscore the need for special programmes that empower and recognize the need of cocoa farmers, especially through education, finance and information. To increase the production output of cocoa in Nigeria will not be too difficult proposition to achieve it government and stakeholders in the sector have focused attention on ability of small scales cocoa farmers in the country to manage and use their resources efficiently. To achieve this much desired productivity, there is need to extend the universal Basic Education programme of government (UBE) to accommodate illiterate farmers, through adult education classes by extension agents planned for farmers within the confines of findings that would make them improve their resource management skills.

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