Resource Productivity And Issues Of Sustainability Among Low External Input Technology Farmers In Imo State. Nigeria

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Abstract: The study examined resource productivity among smallholder farmers who practiced low external input technology (LEIT) and discussed issues of sustainability of this technology in Imo State. Cross sectional data generated from 80 smallholder farmers randomly selected from 2 out of the 3 agricultural zones in Imo State were used. Production function was used in analyzing the data. Results showed that an increase of farm size by one hectare would increase gross output of LEIT farmers by N97159.13. Also an increase of one man day of labour would increase the LEIT farmers' gross income by N1876.14. Furthermore, one naira increase in capital input, planting materials and organic manure would increase the gross output of LEIT farmers by N23.54, N1.959, and N5.468 respectively. It is therefore recommended that in the face of escalating costs of fertilizer, organic manure could be used. Appropriate policies should be put in place by the government to encourage livestock rearing so as to effectively utilize their bye product-organic manure. Household refuse or bio-degradable from the cities could be channeled to farms to serve as organic manure.

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Introduction

The agricultural sector was the mainstay of the Nigerian economy before and immediately after independence until the oil boom of the 1970's. In the period before the 1970's, agriculture provided the needed food for the population as well as serving as a major foreign exchange earner for the country (CBN, 2003).

Nigerian agricultural development policy over the years has been informed by the belief that the development of agriculture is a *sine qua non* for the over all growth and development of the economy. Agriculture is the largest non oil export earner and largest employer of labour accounting for 88% of the non oil foreign exchange earnings and 70% of the active labour force of the population (FGN, 2001).

However, over the years the growth rate of agricultural production has either stagnated or failed to keep pace with the country's rapid population growth rate of about 3.2 per cent resulting in perennial food shortages, soaring food prices and massive importation of food by governments. While food production increases at the rate of 2.5 per cent, food demand increases at a rate of more than 3.5 per cent (FOS, 1996).

It is very obvious that the sustainable growth rates of the Nigerian economy cannot be achieved in the absence of increased agricultural output in the country. The main thrust of Nigeria's agricultural development efforts, therefore has been to enhance and sustain the capacity of the sector to play this assigned role, with particular emphasis on the attainment of sustainable level in the production of basic food commodities. This process of transformation from a predominantly subsistence agriculture to a highly mechanized farming to enhance agricultural production as well as ensure its sustainability has been undermined by the disincentives induced by the macroeconomic environment such as the realignment of the Naira exchange rate, which resulted in the depreciation of the Naira and the consequent increase in the prices of imported agricultural inputs such as fertilizers, agro-chemicals, tractors and vaccines among others (CBN, 2003). The potentials of these high external input technologies (HEIT) (e.g. inorganic fertilizer, agrochemicals, pesticides tractors etc.) in improving agricultural productivity in Imo state in particular and Nigeria in general is not in doubt; but what are the options open to the smallholder farmer in such a harsh macroeconomic environment under which they must operate?.

Productivity growth appears to be the main determinant of income growth and poverty reduction. Governments view increasing and sustaining agricultural productivity as a means of over all growth, poverty reduction and promotion of food security. In particular, it has been shown that agricultural productivity growth is more poverty alleviating than non agricultural productivity led growth (Nomaan, 2004).

Views on the concept of agricultural sustainability differ significantly, depending on the

perception of the authors. Pretty (2002) present's sustainable agriculture as "farming that makes the best use of natures goods and services while not damaging the environment. Sustainable farming does this by integrating natural processes, such as nutrient cycling, nitrogen fixation, soil regeneration and natural pest control within food production processes. It also minimizes the use of non renewable inputs that damage the environment or harm the health of farmers and consumers. It makes better use of farmers knowledge and skills, thereby improving their self reliance, and it makes productive use of peoples capacities to work together in order to solve common management problems. However, there appear to be a consensus on the fact that sustainability is the ability of the agricultural system to maintain a well defined level of performance or output without damaging the essential ecological integrity of the system (Anyanwu, 2006). Other scholars (Idachaba, 1987; CBN, 2003) have discussed some other aspects of sustainability, (ecological, socio-economic, and ethical).

Long term sustainability of LEIT, however, depends on the production of animal manure, and hence the availability of pasture (Graves, et al 2004). The growing of crops and rearing of livestock are integral parts of the economic activities of inhabitants of Imo State; and as such the production of organic manure may not constitute serious problems. Through careful integration of crops, livestock and trees, the long term sustainability of the system seems possible (Pantanali, 1996). In relation to its applicability to other areas, the system's economic sustainability rests on being able to grow crops all year round, which will not be feasible in areas with a pronounced dry season unless irrigation is available (Graves et al, 2004). Incidentally Imo State belongs to the humid ecological zone of Nigeria.

Problem Statement

Graves et al., (2004) observed that the significant reduction in the total number of the undernourished in the world in the past was as a result of the use of high external input agricultural technologies (HEIT) i.e. high yielding cereal varieties, together with high levels of inputs such as water from irrigation system, fertilizer to provide the nutrients needed by the varieties and pesticides to control any associated weeds, pests and diseases. In order to increase farm level productivity, some scholars (Pretty, 1995, Snapp et al., 1998) propose labour intensive low external input technology (LEIT). Proponents of LEIT often claim that the reliance on local sources of inputs is more sustainable, but the analysis of De Jager et – al., (2001) suggests there is little difference between HEIT and LEIT in this respect. However, the disincentives induced by the macroeconomic environment on HEIT utilization such as removal of subsidy on fertilizer and re-alignment of the Naira exchange rate and consequent increase in the prices of imported agricultural inputs (such as fertilizer, agro-chemicals , tractor etc) have narrowed down its use. In the rural areas where resources of land and labour are in abundance, it has been reported that in the LEIT farm type, these resources as well as planting materials and organic manure are highly productive (Anyanwu and Adesope 2010). In the face of the apparent scarcity and expensiveness of the high external input agricultural technologies, it becomes compelling to re-examine the low external input agricultural technologies, (e.g. organic manure, compost, animal manure, etc.) with a view to determining the resource productivity of this farm type. Although, Anyanwu (2010) has shown that both LEIT and HET are equally economically efficient there is the need to re-examine such equilibrium vis-à-vis issues of sustainability.

Methodology

The study was carried out in Imo state of Nigeria. Imo State is located in the south eastern part of Nigeria. The State lies between longitude 6° 4' East of the Greenwich Meridian and latitude 4° 4' and 8° 15' North and is located in the tropical rain forest belt of Nigeria. Low external input agricultural technologies especially intercropping, animal manuring, alley cropping are predominant while high external input agricultural technologies such as inorganic fertilizer application, irrigation facilities, use of herbicides are not predominant due to their scarcity and high prices.

Sample Selection

Two agricultural zones (Owerri and Okigwe) were randomly selected from Owerri, Okigwe and Orlu that make up the state. From these two agricultural zones, two local government areas (LGA) were purposively selected from the list of LGAs in each zone making a total of 4 LGAs. These 4 LGAs are Ohaji- Egbema, Ahiazu-Mbaise, Ihitte-Uboma, and Isiala-Mbano. The basis for the purposive selection of these LGAs is where the usage of organic manure, poultry droppings and inorganic fertilizer are more predominant. From each of these LGAs two communities were randomly selected from the list of communities in the LGAs collected from the LGA headquarters. The communities selected include Umuokanne, Mgbuishii, Obohia, Amuzi, Amainyi-Ukwu, Umuezegwu, Umuelemai and Isiama. The lists of farmers that use low external input technology (LEIT) in the communities were compiled with the assistance of the extension agents. This list formed the sampling frame. From this sampling frame, 10 farmers that used LEIT were randomly selected from each of

the 8 communities making a sample size of 80 LEIT users.

Data used for the study were collected using structured questionnaire and interview schedule. Practical field measurement of plots was undertaken using global positioning system (GPS). Data were collected on socio- economic characteristics of the farmers farm size, input prices, expenditures on fertilizer and organic manure, expenditures on agro-chemicals, seeds, labour input, wage rate, capital inputs used, farm output and output prices, value of produce (in Naira) consumed, stored and sold. The production function model employed in its implicit form is stated as follows:

$Q_L = f(X_1, X_2, X_3, X_4, X_5, e)$……eqn. (1)

Where;

Q_L = Value of total output in LEIT farms (₦)

X_1 = Farm size (Ha)

X_2 = Man-days of labour (man days)

X_3 = Value of planting materials (₦)

X_4 = Value of capital inputs (₦)

X_5 = Expenditure on organic or inorganic manure (₦)

e = error term.

Four functional forms were fitted to the data. These are the linear, semi- log, double log and the exponential functions. The function that gave the best fit was selected based on the magnitude of the coefficient of the multiple determination (R^2) and the size and signs of the estimated coefficients and the statistical significance of the parameter estimates.

Productivity of Resources

The marginal value product (MVP) of each resource was computed in order to determine the productivity of resources in the two farm types. The MVP is the marginal physical product (MPP) multiplied by the product price. The MPP of a variable factor input is the partial derivative of the production function with respect to that factor. It may also be defined as the slope of the total product curve. The MPP may be positive, zero, or negative.

Results and Discussion

The results of the estimated production function for the LEIT farmers are presented in Tables 1.

The double log model where all the explanatory variables are statistically significant appears to be a better fit for the data. More so the coefficient of multiple determinations in the double log model (0.803) is relatively high. The double log function produced F-values of 60.385 for the LEIT farms which is statistically significant at 1percent level, implying that the double- log function gave a good fit to the data. The result of the double-log function is therefore used for discussion and further analysis. The coefficient of multiple determinations of 0.803 shows that 80.3 percent of the variations in the gross income of LEIT farmers are accounted for by the variations in the explanatory variables.

Table 1 Estimated Production Functions for Low External Input Technology Farms in Imo State.

Explanatory variables	Linear	Semi log	Double log	Exponential function
Farm size(X_1)	166096.1	231847.6	0.169	0.193
	(4.160)***	(1.99) **	(2.26)**	(3.166)***
Labour input(X_2)	219.81	41020.7	0.505	0.000657
	(1.52)	(0.269)	(5.147) ***	(2.97) ***
Planting materials (X_3)	1.74	197302.8	0.279	0.0000029
	(4.44)***	(1.67)	(3.671)***	(4.87)***
Capital input (X_4)	19.74	308762.2	0.412	0.0000363
	(3.56)***	(2.34)**	(4.87)***	(4.29)***
Manure (X_5)	11.86	274664.3	0.131	0.0000015
	(11.76)***	(2.95)***	(2.20)**	(0.963)
Constant	-87929.5	-2487681	1.233	4.599
R^2	0.848	0.490	0.803	0.668
F-ratio	82.285	14.237	60.385	29.831

** = Significant at 5% *** = Significant at 1%.

Figures in parenthesis are t – ratios

Source: Survey data, 2008.

The explanatory variables- farm size, labour, expenditure on planting materials, capital inputs (depreciation and interest charges) and expenditure on organic manure are statistically significant at 5 percent level and positively related to gross farm output. This shows that an increase in these inputs will lead to an increase in the gross income of LEIT farmers, all things being equal. These positive relationship existing between farm size, labour input, planting materials, capital input and organic manure and gross output Obasi, et-al (1995) in Imo State of Nigeria.

Productivity of Resources among LEIT Farms

The marginal value product (MVP), of each resource input shows the expected increases in gross income that is forthcoming from the use of an additional unit of the resource, the levels of other inputs being held constant. The marginal value product is the product of the marginal physical product (MPP) and the product price. However the outputs of the LEIT farms (except land and labour) were measured in Naira terms. Thus in the model MPP =MVP, for all resources except land and labour. Following Onyenweaku et al., (1991), and Ohajianya et-al., (2004) and the information in Table 2 the MVP are calculated as: MVP = bi (Qij /Xij)

Where bi = output elasticity or regression coefficient,(for Cobb-Douglas function)

Qi = Geometric mean of output,

Xi = Geometric mean of the ith input.

The MVP of each of the resources in the two farm types are presented in Table 2.

An increase of farm size by one hectare would increase gross output of LEIT farmers by ₦97159.13. Also an increase of one man day of labour would increase the LEIT farmers' gross income by ₦1876.14. Furthermore, one naira increase in capital input, planting materials and organic manure would increase the gross output of LEIT farmers by ₦23.54, N1.959, and ₦5.468 respectively. It has been shown elsewhere (Anyanwu, 2010) that expenditure on organic manure contributed more to gross farm output in the LEIT farms than expenditure on fertilizer in the HEIT farms.

The beneficial effects of animal manures on crop yields, when applied in sufficient quantities are well documented (Selvarajan and Krishnamoorthy, 1990; Ali, 1996; Drechsel and Reck, 1998).

Table 2: Indices for LEIT Farms in Imo State

Items	**Production Elasticities**	**Geometric mean of inputs and outputs**	**Marginal Value Product**	**Marginal Factor Cost**
Land (Ha)	0.169	0.6709	97159.13	2970
Labour (md)	0.505	103.82	1876.14	717.5
Capital input ₦	0.412	6790.75	23.40	1.19
Planting materials (₦)	0.279	54945.56	1.959	1
Organic manure ₦	0.131	9240	5.468	430.5/50kg
Farm output		385704.5		

Source: Survey data, 2008.

Issues of Sustainability

A fertile soil indeed contains all the necessary nutrients which are made available to the plants when needed. Soil fertility and its maintenance play a crucial role in determining the productivity of land. Studies have shown that reliance on technologies whose potency and long term sustainability have not been ascertained could be counter productive. This therefore makes the search for alternatives, a desideratum, if the needed increase in resource productivity to meet the food and fiber needs of a growing population of a country such as Nigeria will be realized.

Murwira et-al (1995) argues that if manure is to be extensively used to enhance soil fertility, it will need to be culturally acceptable to the farmers, which is most likely to occur where livestock are an integral part of the farming system already. These conditions abound in the study area - Imo state. That may explain why Graves' et-al (2004) contends that the sustainability of a technique is a function both of the agronomic performance of the system and the socio-economic context in which it is located including the knowledge and understanding of the farmers.

Available literature (Pretty, 2002, Graves et al., 2004, Pantanali, 1996, De Jager, 2001, and Anyanwu, 2006) shows that this resource productivity could be sustained if organic manure or LEIT is adopted on a larger scale.

Conclusion and Recommendations

This study examined resource productivity and issues of sustainability among LEIT farmers in Imo State. Cross-sectional data generated from 2 out of the 3 agricultural zones of Imo State were used. Results showed that resources of land, labour, capital, planting materials and organic manure were highly productive. Available literature also gives hope on the possibility of sustaining this productivity over time. It is therefore

recommended that in the face of escalating costs of fertilizer, organic manure could be used. Appropriate policies should be put in place by the government to encourage livestock rearing so as to effectively utilize their bye product-organic manure. Household refuse or bio-degradable from the cities could be channeled to farms to serve as organic manure. Further research on the economics of organic manure use and ways and means of converting the bio-degradable that litter our environments into organic manure should be intensified.

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