Low External Input Technology Agriculture and Rural Development in Nigeria

Anyanwu, S.O[1*] and Adesope, O.M[2]

1. Department of Agricultural Economics and Extension, Rivers State University of Education, Port Harcourt
2. Department of Agricultural Economics and Extension, University of Port Harcourt, Nigeria.
sixtusanyanwu@yahoo.com; omadesope@yahoo.co.uk

Abstract: The study examined resource productivity among low external input technology smallholder farmers in Imo State and their implications for rural development in Nigeria. Cross- sectional data generated from 80 LEIT smallholder farmers randomly selected from 2 out of the 3 agricultural zones in Imo State were used. Production function analysis was used in analyzing the data. Results showed that farm size, labour input, capital input, planting materials and organic manure are the main determinants of the gross income of LEIT farmers. The relative abundance of a significant proportion of these resources in the rural areas therefore makes their increased use, a veritable instrument for sustainable rural development. Formation of cooperative societies among farmers whose lands are contiguous and utilization of extension agents as channels for credit delivery to farmers were also recommended. [New York Science Journal 2010;3(11):65-70]. (ISSN: 1554-0200).

Key words: Low External Input Technology, Agriculture, Rural Development, Nigeria

1. Introduction

Continuing rural poverty, the high cost of purchased inputs and environmental problems, all support the view that farmers should rely as much as possible on local inputs to enhance the productivity of their soils. This partly explains why low external input technology agriculture has attracted so much interest in discussions about the future of smallholder farming in developing countries. Thus technologies using low levels of external inputs readily available either on-farm or from nearby off-farm sources are seen by some experts as more appropriate and sustainable (Pretty, 1995). This approach often referred to as low external input technology (LEIT) agriculture, emphasizes the use of techniques that integrate natural processes such as nutrient cycling, biological nitrogen fixation, soil regeneration and natural enemies of pests into food production process (Pieri, 1995, Snapp et al 1998). Efforts are also made to minimize losses from the system, such as by leaching or removal of crop residues. The use of non renewable inputs such as pesticides and fertilizers that can damage the environment or harm the health of farmers and consumers is also minimized, and more emphasis is placed on the use of such techniques as , for example intercropping, agro forestry, cover-crops, or animal manure. Usually but not always, such technologies are more labour intensive than the HEIT approach (Deugd, et al 1998). In many cases LEIT technologies are not new but are variations of those practiced by farmers for generation, who have sought to make use of resources such as vegetation or animal manure that have always been ready to hand (Graves et al, 2004).

On the other hand, 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. These technologies according to him generally need a relatively high capital investment and a well functioning economic and physical infrastructure for effective implementation. Not only did increased use of HEIT raise questions about environmental sustainability, but the costs of the chemicals, irrigation and mechanization were often subsidized raising further concerns about the capacity to support these strategies in the long term (Tripp, 2006). There is therefore the need to examine other cost effective agricultural technologies that are not only readily available but possesses the capacity of making the process of rural development more sustainable.

Rural development is synonymous with improving the living standards of the mass of the low-income population residing in rural areas, and making the process of their development self-sustaining (Lele, 1975). Williams (1979) made Lele's definition of rural development more explicit. According to him rural development involves the generation of new employment, more equitable access to arable land, equitable distribution of incomes, widespread improvement in health, nutrition, and housing, maintenance of law and order, creation of incentives and opportunities for savings, credits and investments. Rural development is a process aimed at bringing about positive changes with regard to initiating or actualizing improvement and increase in scope and intensity of the social, economic and political life of rural people. Okafor (1986) argued that rural development involves the provision and maintenance of social services such as education, health, good water supply, housing and roads. It also involves accessibility to land, introduction of modern agricultural equipment and the provision of better market facilities for the products of especially, the agricultural sector. In other words, rural development is the creation of wider opportunities for individuals to realize their full potentials through education and participation in decision-making and actions that affect their daily lives.

At this juncture, it is pertinent to ask the question; how can the process of improvement in the standard of living of the rural population be made self sustaining? 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). Agriculture is the major occupation of the rural dwellers, and as such a holistic approach to agricultural development appears to hold the key to the quest for rural development. This include improvement in the technology or skills and knowledge base of the farmers through increased extension contact, policies geared towards ensuring steady supply of labour by stemming the tide of out migration of youth through the provision of basic infrastructural facilities and social amenities, provision of improved and high yielding planting materials, enactment and enforcement of laws to ensure easy access to land and credit facilities by genuine farmers. Besides, there is a positive correlation between the national Gross Domestic Product (GDP) which is an index of the standard of living of the inhabitants and the agriculture share of the GDP (Anyanwu, 2009d), which implies that development of the agricultural sector will inexorably translate to rural development in Nigeria. Development in Africa means essentially improvement of agricultural, physical and social development of the rural areas which contain not only the overwhelming majority of the people, but the most ill-fed, ill-housed and ill-clothed sector of the continent's population. Rural development implies the improvement of the agricultural potentials of a nation as well as other resources, human and physical, in order to enhance the people's capacity to produce and consume (Obibuaku, 1983).Therefore efforts geared towards developing the rural areas, directly or indirectly are beneficial to agricultural development. If health centres, educational institutions, pipe borne water, or electricity, or road networks are established, in the rural areas; it is because of the rural dwellers who incidentally are mainly smallholder farmers. Among the two approaches -HEIT and LEIT, the later appears more sustainable. Besides, it has been shown elsewhere (Anyanwu, 2010) that LEIT had a higher aggregate agricultural productivity than their HEIT counterpart.

Unfortunately, little data appear to have yet been collected to measure the impact of the system in terms of production, gross income and net returns to labour, either compared to traditional cropping methods, or to recommended modern improved technology practices based on monocropping, mechanical power, chemical fertilizers and pesticides (Pantanali, 1996). This study examines the productivity of resources among LEIT farmers in order to bridge the gap in knowledge on "the impact of the system in terms of production". It is further believed that, since rural development is synonymous with improving the living standard of the mass of the low-income population residing in rural areas, and making the process of their development self-sustaining, it is hoped that LEIT be further examined given its reliance on local sources of inputs, the heavy reliance of HEIT on subsidy and imports, in a world that is fast embracing the benefits from economies driven by market forces.

2. Methodology

The study was carried out in Imo state of Nigeria which is located in the south eastern part of Nigeria. According to the National Population Commission (NPC, 2006), Imo state has a population of 3,934,899 people with an annual growth rate of 3.2 per cent. 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. Farming is the predominant occupation of the people. Almost all the families farm either as primary or secondary occupation. It was estimated that 84% of the total land area is potentially productive with 48% being devoted to the production of annual crops under the traditional bush fallow systems, while the rest 36% is under the tree crops (ISMANR, 1986). 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.

2.1 Sample Selection

The multi-stage random sampling technique was used in selecting the sample. This technique was used in order to enable the researcher capture a significant portion of the resource characteristics of the farmers at different stages and to ensure a good spread of the data. Two agricultural zones were randomly selected from the three that make up the state. These agricultural zones are Owerri, Orlu and Okigwe. 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 list of farmers that used 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 the 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 such as age, years of farming experience, years spent in school, farm size, input prices, expenditures on fertilizer and organic manure, expenditures on agro- chemicals, seeds, labour input (including contract sum in case of farm operations contracted out) wage rate, income sources, number of crop species (in a mixture) planted per plot per year, household size, 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 either organic or inorganic fertilizer and agro-chemicals for LEIT (₦)

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.

2.2 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.

3. Results and Discussion

The results of the production functions estimated for LEIT farmers in Imo State are presented in Table 1.

In the linear model four of the explanatory variables are statistically significant at 1 percent and 5 percent levels in the LEIT farms. The coefficients of multiple determination ($R^2 = 0.848$) is also relatively high. In the exponential function, four of the explanatory variables are statistically significant at 1 percent and 5 percent levels of probability. Also, three of the explanatory variables are statistically significant at 1 percent and 5 percent levels in the LEIT farms in the semi log model. In the double log model on the other hand, all the explanatory variables are statistically significant at 1 and 5 percent levels and possess the appropriate positive signs. The coefficients of multiple determination in the linear, semi log, double log and exponential functions are 0.848, 0.490, 0.803, 0.668. The double log model where all the explanatory variables are statistically significant appears to be a better fit for the data in LEIT farms. More so the coefficient of multiple determination in the double log model (0.803) is relatively high. The double log function produced F-values of 60.385, 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 in the LEIT farms. 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. The remaining 19.7 percent are accounted for by variables such as topography, soil quality and other unquantifiable variables which are not included in the model.

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 of farmers agrees with the findings of Anyanwu, 2009 in Rivers State Nigeria, Onyenweaku et-al, (2005), and Obasi, et-al (1995) in Imo State of Nigeria and Olomola, (1988) in Ondo State of Nigeria. In addition the coefficient of multiple determination (R^2 = 0.803) shows that about 80.3 percent of the variations in the gross income of LEIT farmers are accounted for by the explanatory variables included in the model. Organic inputs and conservation investment practices add organic matter to the soil, conserve soil nutrient (prevent erosion) and help water retention (e.g. bunds and tied ridges, terraces) and increase productivity by increasing soil moisture (Reardon et al., 1997).

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	0.00000292
	(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)***
Expenditure on manure (X_5)	11.86	274664.3	0.131	0.00000148
	(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.

Table 2 shows that an increase of farm size by one hectare would increase gross output of LEIT farmers by N97159.13. Similarly an increase of one man day of labour would increase the gross income of this group of farmers by N1876.14. Furthermore an increase of one Naira expenditure on planting materials, and organic manure would increase the gross income of LEIT farmers by as much as N1.96 and N5.47. An increase of one Naira capital input would all things being equal increase the gross output of these farmers by ₦23.40.

Table 2 : Marginal Value Product of Resources

Farm type	Farm size (X_1)	Labour input(X_2)	Expenditure on planting materials(X_3)	Capital input(X_4)	Expenditure on organic manure (X_5)
LEIT	97159.1	1876.14	1.959	23.40	5.468

Source: Survey data, 2008

3.1 Implications for Sustainable Rural Development

With the exception of capital inputs, resources such as land, labour, planting materials and organic manure are not in short supply in the rural areas. The positive correlation between these inputs and the gross income of these smallholder farmers implies that increase in farm size, labour input, planting materials, organic manure use, and capital input will increase the gross income of these farmers and positively impacting on their standard of living. In addition, the fact that a significant proportion of these resources are readily available locally and within the reach of the smallholder farmers makes this approach a veritable means of sustaining the process of rural development especially in developing countries like Nigeria. More so, it has been shown that both low and high external inputs technology farmers are equally economically efficient in the use of resource inputs (Anyanwu, 2010). Appropriate policies could be put in place by the government to increase smallholder farmers' access to capital inputs.

4. Conclusion and Recommendations

Resources such as land, labour, planting materials and organic manure are abundant in the rural areas. Increases in these resources will lead to increase in the living standards of the rural dwellers. Furthermore, the replacement of inorganic fertilizer with organic manure as a means of replenishing soil fertility in the rural areas appears more sustainable.

The formation of cooperative societies, among smallholder farmers' especially those whose farmlands are contiguous in the rural areas may encourage them to pool their land resources together and thereby overcome the problems of land fragmentation. What Nigeria needs now is not the floating of more financial institutions, but the devising of appropriate means of reaching the smallholder farmers with the requisite credit and making the loan recovery process more sustainable. In this regard, extension agents could be used both as co-guarantors and a means of channeling credit to the appropriate farmers in the rural areas and holding these extension agents accountable in event of default.

References

[1] Pretty, J. (1995) Regenerating Agriculture Polices and Practices for Sustainability and Self-Reliance. P. 336. Earthscan London.

[2] Pieri, C. (1995) *Long Term Soil Management Experiments in Semi-Arid Franco Phone Africa. In "Soil Management Experimental Basis for Sustainability And Environmental* Quality. Advances In Soil Science" (R. Lal And B.A. Stewart. Eds.) Pp. 225-266. CRC. Lewis.

[3] Snapp, S..S., P.L. Matongoya, And S. Washington,(1998) "Organic Matter Technologies for the Integrated Nutrient Management in Small Holder Cropping Systems Of Southern Africa. *Agric. Ecosyst. Environ*. 71, 185-200.

[4] Deugd, M; N. Roling, and E.M.A Smaling, (1998) A New Praxeology for Integrated Nutrient Management Facilitating Innovation with and by Farmers. *Agric. Ecosyst. Environ*. 71, 269 - 283 .

[5] Graves, A., R. Matthews and K. Waldie (2004) *Low External Input Technologies for Livelihood Improvement in Subsistence Agriculture*. Institute of Water and Environment, Cranfield University Sisloe Bedfordshire United Kingdom.

[6] Tripp, R. (2006a) "Is Low External Input Technology Contributing to Sustainable Agricultural Development"? *Natural Resource perspective* 102. ODI (Oversea Development Institute), UK pp. 1-4

[7] Lele, Uma (1975) The Design of Rural Development: Lessons from Africa, Washington:Hopkins press, pp.20.

[8] Williams, S. K. T. (1979) Rural Development in Nigeria, University of Ife press.

[9] Okafor, S. O. (1986) "The 1976 Local Government Reform and Rural Development in Nigeria: A Case Study of Damboa Local Government Area in Borno State" Nigerian Journal of Policy and Strategy, National Institute for Policy and Strategic Studies, Kuru, Jos, Nigeria, pp. 101-113.

[10] Federal Government of Nigeria (2001) *New Agricultural Policy*, Ministry of Agriculture, Natural Resources and Rural Development Lagos.

[11] Anyanwu, S.O. (2010) "Comparative Analysis of Productivity and Efficiency in Low and High External Input Technology Agriculture in Imo State" Unpublished Ph.D. Thesis, Submitted to the Post Graduate School, Federal University of Technology Owerri, Nigeria.

[12] Obibuaku, L.O.(1983) *Agricultural Extension as a Strategy for Agricultural Transformation*, University of Nigeria press, Nsukka, Nigeria.

[13] Pantanali, R. (1996) Lesotho: a Note on the Machobane System. Report No. TC1 Occasional paper Series No. 7. Food and Agricultural Organization, Rome, Italy.

[14] National Population Commission (2006) Population Census of Nigeria, Government Press, Abuja, Nigeria.

[15] Anyanwu, S. O. (2009) "Gender and Resource Productivity Among Small Scale Food Crop Farmers in Rivers State, Nigeria" *Global Approach to Extension Practice* Vol. 5, No. 1. pp. 107-114.

[16] Onyenweaku, C.E., and J.C Nwaru (2005) Application of A Stochastic Frontier Production Function to the Measurement of Technical Efficiency in Food Crop production In Imo State, *Nigeria Nig, Agric J.* 36, Pp. 1-12

[17] Obasi, P.C., J.E. Njoku, and A.C. Falusi, (1995) "Resource Productivity and Returns to Scale in Food Crop Production in Owerri Area of South-Eastern Nigeria" *Modeling, Measurement and Control*, Vol. 11, No. 2, pp. 34- 48.

[18] Olomola, A.S.(1988) *Agricultural Credit and Production Efficiency*: A Case Study. Nigerian *Institute of Social and Economic Research Monograph Series No. 4 N.I.S.E.R.Ibadan.*

[19] Reardon, T. V. E. Kelly; T. Crawford, K. Savadogo And D. Clay (1997**)** "*Determinants of Farm Productivity in Africa: A Synthesis of four Case Studies. Technical Paper No. 75, SD Publication Services. Office of Sustainable Development Bureau for Africa. U.S. Agency* for International Development USAID. Pp1-42.

8/12/2010