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DETERMINANTS OF AGGREGATE AGRICULTURAL PRODUCTIVITY AMONG HIGH EXTERNAL INPUT TECHNOLOGY FARMS IN A HARSH MACROECONOMIC ENVIRONMENT OF IMO STATE, NIGERIA

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[1]Determinants of Aggregate Agricultural Productivity among High External Input Technology Farms in a Harsh Macroeconomic Environment of Imo State, Nigeria

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ABSTRACT

The main purpose of this study was to isolate and discuss the determinants of aggregate agricultural productivity in an environment where policy on subsidy of fertilizer is inconsistent. The study examined determinants of aggregate agricultural productivity among HEIT farmers in Imo State, in order to provide information on those variables that play significant roles in determining the aggregate agricultural productivity in an environment where HEIT inputs such as inorganic fertilizer are not subsidized. Cross - sectional data generated from 80 smallholder farmers who practiced HEIT, randomly selected from 2 out of the 3 agricultural zones in Imo State were used. Multiple regressions was used in analyzing the data. Results showed that farm sizes, capital input, number of crops planted in a mixture in the farm, labour input, expenditure on planting materials, non farm income, distance to the nearest market, level of education and farming experience are the statistically significant determinants of aggregate agricultural productivity among HEIT users in a harsh macroeconomic environment of Imo State, Nigeria. The negative sign on man days of labour and expenditure on planting materials may suggest that a reduction in the current level of use of these inputs may increase aggregate agricultural productivity in Imo state. The negative sign associated with non farm income may imply that if more time is allotted to non farm activities less time would be available for allocation to farming activities which may reduce aggregate agricultural productivity. It is, therefore, recommended that appropriate policies be put in place by the government to increase the farm sizes through re-examination of the existing land laws. Credit liberalization in favour of HEIT farmers is expected to increase their labour and capital inputs while mass literacy and increase in extension contacts will increase their level of education. Credit facilities for the smallholder farmers should be skewed in favour of farmers with more years of farming experience and levels of education. Furthermore, improved planting materials should be made available to the HEIT smallholder farmers in the country, if aggregate agricultural productivity is to be increased under the prevailing macroeconomic environment.

Key words: Determinants, Aggregate, Productivity, External, Macroeconomic

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INTRODUCTION

Low crop yields and poor resource realities of the smallholder farmers are among the problems associated with the poor agricultural performance in Nigeria. Furthermore, purchase of agricultural inputs is constrained by low farm incomes, poor access to credit and lack of market power that can be acquired through building strong farmer organizations for political advocacy and cooperative input/output market [1]. Therefore, input subsidization is a way of inducing farmers to purchase agricultural inputs such as inorganic fertilizer and other yield enhancing technologies which, ordinarily, would have been beyond their reach. However, inconsistencies have always characterized Nigeria fertilizer policy, in a bid to find solutions to the problems of availability, leakage, scarcity and arbitrage. 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). High external input technologies are 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 generally need a relatively high capital investment and a well functioning economic and physical infrastructure for effective implementation [2]. High external input technologies are often beyond the financial reach of the small – holder farmers [3].

The 1960s marked the beginning of the Green Revolution and was a time of great hope for agriculture in developing countries. This was manifested by the spread of short-strewed, fertilizer-responsive varieties of wheat and rice that led to vast increase in food supplies in many Asian countries. For a while, it looked as if the strategy of supplying appropriate varieties and complementary fertilizers, pesticides and other inputs could bring an end to rural poverty and chronic food shortages. The approach was heavily dependent upon external supply of inputs which are often subsidized, and relied upon technology packages whose practices were similar to those used in industrialized countries.

Fertilizer is an increasingly important component of agricultural development programmes. Although it offered higher yields, it sometimes caused farmers to abandon traditional techniques of soil fertility maintenance. Occasionally, agricultural expansion and mechanization were the cause of increased soil erosion and appearance of plough pans. Increased use of high external inputs raised questions about environmental sustainability, while the costs of these chemicals, irrigation and mechanization which were often subsidized, raised doubts as to the long-term sustainability of these strategies [4].

Output per unit of land or crop yield is commonly used by agricultural scientists to assess the success of new production practices. Land productivity is also used by national policy makers to assess agricultural production intended to meet national food security needs. Output per agricultural worker, on the other hand, may be a more important indicator of rural standards of living and welfare [5].

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The upward trend in fertilizer consumption in the early 1980's in Nigeria continued into the 1990 and peaked in 1993 with total consumption reaching 1590 thousand metric tones. Thereafter fertilizer consumption declined consistently from 1010 thousand tones in 1994 to the lowest level of 357.8 thousand tones in Nigeria in 2001. The sharp increase in fertilizer utilization in the early 1990's was sustained by subsidy which was sometimes as high as 75% of the total cost per bag. However, the level of fertilizer subsidy gradually fell to between 50 and 25% as reflected in the sharp decline in fertilizer use from 80kg/ha to 23kg/ha in 1996 and 2000, respectively, compared with the minimum of 200kg/ha internationally recommended standard [6].

In Nigeria, some of the major constraints to optimum output growths in 2001 were inadequate supply of fertilizer and other inputs as well as tardiness in supply and distribution of some of these inputs [7]. On the other hand, given the worsening valuation of the Nigerian currency, acquisition of farm inputs has become almost impossible by the smallholder farmers who constitute the bulk of the producers [8]. Previous works did not indicate the determinants of aggregate agricultural productivity among HEIT farmers in Imo State [9, 10, 11, 12, 13, 14]. It has also been reported that low external input technology (LEIT) farmers achieved higher levels of aggregate agricultural productivity, relative to their High external input technology (HEIT) counterparts [15]. Furthermore, the determinants of aggregate agricultural productivity among LEIT farmers in Imo State, has been outlined and discussed by Anyanwu [16], indicating a vacuum in knowledge among HEIT farmers in the State. It becomes compelling therefore, to isolate those factors that determine aggregate agricultural productivity among HEIT farmers in such a harsh macroeconomic environment of Nigeria for a closer examination, to redirect agricultural policy and to try and improve the productivity of this group of farmers in the country.

The aim of this work was, therefore, to determine factors influencing aggregate agricultural productivity of HEIT farmers in Imo State, Nigeria.

METHODOLOGY

The study was carried out in Imo state of Nigeria. Imo State is located in the South Eastern part of Nigeria and lies 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. According to the National Population Commission [17], Imo state has a population of 3,934,899 people with an annual growth rate of 3.2 per cent. Low external input agricultural technologies, especially intercropping, animal manuring, and alley cropping were predominant, while high external input agricultural technologies such as inorganic fertilizer application, irrigation facilities, and use of herbicides were not, due to their scarcity and high prices.

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

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the resource characteristics of the farmers at different stages and to ensure a good spread of the data. 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 was the usage of organic manure, including poultry droppings and inorganic fertilizer. 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 high external input technology (HEIT) in the communities was compiled with the assistance of the extension agents. This list formed the sampling frame. From this sampling frame, 10 farmers were randomly selected from each of the 8 communities, making a sample size of 80 HEIT users.

Data used for the study were collected using a structured questionnaire and an interview schedule. Practical field measurements of plots were taken using global positioning system (GPS). Data were collected on socio- economic characteristics of the farmers, such as age, years of farming experience, level of education, farm size, input prices, expenditures on fertilizer and organic manure, expenditures on herbicides/insecticides/pesticides, 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, value of farm output and price per unit of output, value of produce (in Naira, the local currency) consumed, stored and sold.

Data Analysis

Aggregate agricultural productivity in this study is measured by the index of the ratio of the total value of farm output (measured in naira values), to the value of total inputs (expressed in naira) used in farm production. This approach is consistent with the reports of other scholars [18, 19]. In its implicit form, the function estimated in this study is specified as: $Q_H = f(X_1, X_{2,}\ldots, X_{12}, e)$…… eqn. (1)

$Q = \sum Yp / \sum Xr$ = Aggregate Agricultural productivity … eqn. (2)
$\sum Yp$ = total value of output
$\sum Xr$ = total value of input

Where
Q, = aggregate agricultural productivity (ratio of total value of farm output to total value of farm input), and Q_H = high external input technology.
X_1 = farm size (ha)
X_2 = Labour input (man-days)
X_3 = Expenditure on planting materials (₦)
X_4 = Non farm income (₦)
X_5 = Capital input (depreciation and interest charges) (₦)

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X_6 = Expenditure on fertilizer (HEIT) (₦)
X_7 = number of crops in a mixture (number)
X_8 = Distance to the nearest market (km)
X_9 = Years in schooling of the farmer (years)
X_{10} = Age of the farmer (years)
X_{11} = Household size (persons)
X_{12} = Years of farming experience (years)
e = random error

RESULTS

Results of the estimated model are as follows:

Linear: Q = -1.458 + 1.10X1 – 0.003X2 – 0.0000069X3 – 0.0000024X4 + 0.000139X5 +
(6.39)*** (-4.19)*** (-5.72)*** (-3.23)*** (5.63)***

0.0000004X6 + 0.47X7 + 0.19X8 + 0.063X9 – 0.029X10 – 0.012X11 + 4.46X12
(0.28) (3.34)*** (3.38)*** (2.19)** (-1.31) (-0.33) (2.03)**
(Figures in parenthesis are t-ratios)

In the linear model, nine explanatory variables were statistically significant at 5 and 1 percent levels of probability and the coefficient of multiple determination (R^2) was 0.772. In the semi-log model seven explanatory variables were statistically significant at ($p<0.05$) and $p<0.01$) percent level of probability, the coefficient of multiple determination is 0.610. In the double log and exponential models on the other hand, five and six explanatory variables, respectively were statistically significant at ($p<0.05$) and $p<0.01$). Their coefficients of multiple determinations were 0.479 and 0.560, respectively. Therefore, based on the size and signs of the parameter estimates and the magnitude of the coefficient of multiple determinations, the linear model was chosen as the lead equation, and used in discussing the results.

DISCUSSION

The results show that farm size, capital input, number of crops planted in a mixture in the farm, labour input, expenditure on planting materials, non farm income, distances to the nearest market, level of education and farming experience are statistically significant at ($p<0.05$) and $p<0.01$). This implies that these variables play significant roles in determining aggregate agricultural productivity in HEIT farms in Imo state, Nigeria. Farm size, capital input, number of crops planted in a mixture in the farm, distance to the nearest market, level of education and farming experience are positively related to aggregate agricultural productivity. This implies that an increase in farm size, capital inputs, number of crops planted in a mixture, level of education, distance to the nearest market, and farming experience will lead to an increase in aggregate agricultural productivity in Imo state, all other factors being held constant.

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The positive relationship between level of education and aggregate agricultural productivity in this study agrees with the findings of Feder *et al.* [20] who found that farmers with higher education tend to be early adopters of new technology. Similar results have been found in Ghana, where the adoption of modern maize varieties and row planting is significantly related to the farmers' level of education [21]. The positive relationship between farming experience and aggregate agricultural productivity is in tandem with the findings of another study in Kenya, Honduras and Sri Lanka where it was observed that the capacity to take advantage of an innovation is related to experience in farming. However, the positive relationship between distance to the nearest market and aggregate agricultural productivity is at variance with a priori expectation. This is because, increase in the distance between the nearest markets would increase the transportation costs of the farmers both in the purchase of inputs such as inorganic fertilizer and sale of their outputs. This result also disagrees with the findings of a study in eastern Kenya [22], and in the Philippines [23] where the experiences of several soil conservation efforts were compared and results showed that adoption was highest in an area where proximity to markets gives farmers an incentive to conserve their soil due to the extra cash received.

The result could be explained by the fact that the more distant the farm is from the input source, the more farmers rely on alternative sources of soil fertility management.

In the United States of America, smaller farms derive a high proportion of their household income from non – farm activities, and this division of attention may make them less likely to take interest in resource – conserving, but management – intensive techniques such as precision farming or integrated pest management [24]. In Madagascar, farmers who tried the Systems for Rice Intensification (SRI) techniques and then abandoned them were more likely to be those with higher dependence on off – farm income [25]. In Indonesia, rice farmers living near the main road and had other income sources were much less interested in learning the techniques of Integrated Pest Management (IPM). The coefficient of multiple determination (R2 =0.772) indicates that about 77.2 percent of the variations in the aggregate agricultural productivity of HEIT farmers in Imo state, Nigeria was accounted for by the explanatory variables. The remaining 22.8% may be accounted for by other variables not explicitly stated in the model such as topography and soil type. Furthermore expenditure on fertilizer, age and household size were statistically non significant at 1 and 5 percent levels. However, expenditure on fertilizer was found to be positively related to aggregate agricultural productivity but statistically non significant. The non significance of inorganic fertilizer is understandable, being a product of the harsh macroeconomic environment.

CONCLUSION AND RECOMMENDATION

The main factors responsible for the observed level of aggregate agricultural productivity among HEIT farmers in Nigeria identified in this study included farm size, capital input, number of crops planted in a mixture in the farm, labour input,

expenditure on planting materials, non farm income, distance to the nearest market, level of education and farming experience. It is, therefore, recommended that:

- Policies geared towards increasing farm sizes such as re-examination of existing land laws should be put in place by the government.
- Credit liberalization policies should be implemented. This is hoped to ease access to capital inputs.
- Credit facilities should be skewed in favour of farmers with more years of farming experience and level of education.
- Mass literacy programme and increased extension contact should be vigorously pursued by the government to increase the level of education of these farmers.

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REFERENCES

1 **Valerie A K** Factors affecting demand for Fertilizer in Sub-Saharan Africa, **A**griculture and Rural Development Discussion Paper 23, The World Bank http://siteresources.worldbank.org/INTARD/Resources/ARD DP23 FINAL.pdf Accessed July 2009.

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

3 **Reardon T V, Kelly E, Crawford T, Savadogo K and D Clay** 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. 1997; 1-42.

4 **Tripp R** Self Sufficient Agriculture, Labour and Knowledge in Small Scale Farming. Earthscan Sterling V.A. UK and USA. 2006.

5 **Block S A** The Recovery of Agricultural Productivity in Sub – Saharan Africa. *Food Policy.*1995**; 20(5):** 385 – 405.

6 **Central Bank of Nigeria.** Contemporary Economic Policy Issues in Nigeria. Nnanna, O.J., Alade, S.O and Odoko, F. O. (Eds). Kas Arts Services, Nigeria, 2003.

7 **Central Bank of Nigeria.** (2002) *Annual Report and Statement of Accounts* for the Year ended 31st December. CBN, Nigeria, 2002.

8 **Imahe O J and R A Alibi** The Determinants of Agricultural Productivity in Nigeria. *J. of Food Agric. and Environment.* **3.**

9 **Anyanwu S O** Gender and Relative Technical Efficiency among Low External Input Technology Farms in Food Crop Production in Imo State. *Acta Agronomica Nigeriana*, 2009; **9(1&2):** 41-48.

10 **Anyanwu S O and U C Ibekwe** Farm Labour and its Productivity in Low and High External Input Technology Agriculture in Nigeria. *J. for Applied Res.2010;* **19(1):**22- 27.

11 **Anyanwu S O and O M Adesope** Low External Input Technology Agriculture and Rural Development in Nigeria *New York Sc. J.* 2010a**; 3 (11):** 65-70**.**

12 **Anyanwu S O and O M Adesope** Indigenous Knowledge and Modern Intensive Agriculture in a Harsh Macroeconomic Environment of Imo State" Paper presented at the 5th Annual Conference and General Meeting of the Nigerian Society for Indigenous Knowledge and Development (NSIKAD) held at Ayaro Hall, Ididie Hotel, Yenagoa, Bayelsa State, November. 3rd-6th, 2010b.

13 **Anyanwu S O and P C Obasi** Comparative Analysis of Land Productivities in Low and High External Input Technology Agriculture in Imo State, Nigeria *Acta Agronomica Nigeriana. 2010*a**; 10(1):** 15-20.

14 **Ohajianya D O and D O Onu** Economics of Fertilizer Use in Vegetable Production in Nigeria. *Trop. Agric. (Trinidad) 2004;* **81(4):** 253-258**.**

15 **Anyanwu S O and P C Obasi** Comparative Analysis of Aggregate Agricultural Productivity between Low and High External Input Technology Farms in Nigeria" *Afric Journal of Bio-technology (Kenya),* 2010b**; 9 (34):** 5530-5534.

16 **Anyanwu S O** Comparative Analysis of Productivity and Efficiency in Low and High External Input Technology Agriculture in Imo State Unpublished PhD Thesis Federal University of Technology, Owerri, Nigeria.2010.

17 **National Population Commission.** Population Census of Nigeria. Government Press Abuja, Nigeria, 2006.

18 **Obasi P C** The Determinants of Food Consumption and Agricultural Productivity in Imo State, Nigeria. Unpublished Ph.D Thesis Federal University of Technology Owerri, Nigeria.2000.

19 **Olayide S O and E O Heady** Introduction to Agricultural Production Economics. Ibadan University Press, Ibadan Nigeria, 1982; 9-247.

20 **Feder G, Just RE and T Zilberman** Adoption of Agricultural Innovations in Developing Countries: A Survey. *Economic Development and Cultural Chang.* 1985*;* **33:** 255 – 298.

21 **Morris M I, Tripp R and A A Dankyi** Adoption and Impacts of Improved Maize Technology: A Case of the Ghana Grains Development Project. Economics Programs Paper 99-01 Mexico, DE CIMMYT, 1999.

22 **Zaal F and R H Oostendorp** Explaining a Miracle: Intensification and the Transition towards Sustainable Small-Scale Agriculture in Dry Land Machakos and Kitui, Kenya. *World Development.* 2002; **30**: 1271- 1287.

23 **Cramb R A, Garcia JNM, Gerrits RV and G C Sarguiguit** Conservation Farming Projects in the Philippines Upland: Rhetoric and Reality .*World Development*. 2000; **28:** 911-927.

24 **Smith K R** Does Off- Farm Work Hinder "Smart" Farming? *Agric.Outlook*. 2002; 28-30.

25 **Moser C and C Barrett** (2003) The Disappointing Adoption Dynamics of a Yield Increasing, Low External Input Technology: The Case of SRI in Madagascar. *Agric. Systems*. 2003; **76**: 1085-1100**.**