

Socio-economic drivers for single-factor productivity index of food crops among farmers in Kaduna State, North Central, Nigeria

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ABSTRACT

This study looked at the socio-economic drivers for single-factor productivity index of food crops among farmers in Kaduna state, north central, Nigeria, owing to the global focus on improving agricultural productivity in meeting increasing food demand. Data were obtained from 244 farmers with the aid of questionnaire using multi-stage sampling technique. The data were analyzed using descriptive statistics and regression analysis. The average single factor productivity index obtained is abysmally low at 1,098.8kg/ha, while major socio-economic drivers were found to be the gender of the household head (0.246), household size (0.019), farm size (-0.141), membership of association (0.007), access to market (0.163) and total income (1.122E-06). In line with the interplay of these variables, it is recommended that policy framework with regards to implementation of pro-poor, gender-sensitive, and environmentally sustainable agricultural development ought to be pursued. Land use and accessibility reforms should be looked into by making land available without gender bias. In addition, agricultural groups should be strengthened through support services like supply of inputs (such as fertilizer, agrochemicals and improved varieties of planting materials) at a subsidized rate. Policy interventions should include also measures for sound economic programs geared towards addressing economic empowerment for the farmers.

Keywords: Socio-economic drivers, Single factor productivity, Food crops, North Central, Nigeria.

INTRODUCTION

Agricultural productivity is measured as the ratio of agricultural outputs to agricultural inputs, as an increase in agricultural productivity is often linked with questions about sustainability and sustainable development gaining devoted acclaim currently in the world. Moreover, global demand and consumption of agricultural crops for food, feed, and fuel is increasing at a rapid pace. To satisfy the growing, worldwide demand for grain, Edgerton (2009), suggested two broad options are said to be applicable: (1) The area under production can be expanded or (2) productivity can be improved on existing farmlands. It has been muted that these two options are not

mutually exclusive as both should be employed to produce, for instance, the additional over 200 million tonnes/year of corn (*Zea mays*) and wheat (*Triticum aestivum*) estimated to be needed by 2018.

Modern agricultural development, however, largely prefers and focuses on raising the productivity of small-scale farmers. Mission statements of organizations and budgets reflect this focus: the Food and Agriculture Organization of the United Nations' (FAO) mission is to "raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy" (FAO, 2017), while the Bill &

Melinda Gates Foundation's (BMGF) Agricultural Development Program states its core goal as "to reduce hunger and poverty for millions of farming families in Sub-Saharan Africa and South Asia by increasing agricultural productivity in a sustainable way" (BMGF, undated). The United States Agency for International Development (USAID) identifies increased productivity as a key to "inclusive agriculture-led growth" (USAID, 2013). Over the past several decades, governments, non-profits, and others have, therefore, invested billions of dollars to raise crop yields in the pursuit of productivity related goals (Conway, 2012).

Global maize yields, for instance, average 4.9 tonnes/ha and have been noted to be increasing steadily for many years (Edgerton, 2009), and at 5.7 tonnes/ha by 2016 (foastat, 2017). This is said to be encouraging, but yields in major grain-producing countries are nearly double the global average, suggesting that there is room for significant improvements in global yields. Average maize yield in the United States and Canadian are 10.96 tonnes/ha and 9.6 tonnes/ha respectively, with this crop of tropical origin. In sharp contrast, maize yield averages 2.9 tonnes/ha in the 10 largest lower-yielding maize-producing countries (faostat, 2017); far below the global average. This productivity level begs for attention particularly if the world hunger eradication drive is to be achieved.

Various measures including land productivity, labour productivity, and total factor productivity are used to measure agricultural progress (Fuglie, 2008; Alston *et al.*, 2010). Meanwhile, the Nigerian agricultural productivity position has nonetheless been further depicted by the Doreo Partners (Undated) in their assertion that Nigeria's yield per hectare is 20% to 50% of that obtained in similar developing countries like Brazil, Indonesia, Thailand, and Malaysia. Doreo Partners noted that in

1961, Indonesia's yields were lower than that of Nigeria. In 20 years Indonesia increased its yield 3 times. Agricultural productivity as measured in yield per hectare is the driver of agricultural competitiveness. As at present, there exists a new global trend in the demand for food. Nigeria ought to take advantage of this trend in food demand. For Nigeria to effectively increase its share in Africa's agricultural space and harness the market opportunities, however, the necessity to re-focus the country's agricultural development policy to develop its agricultural productivity and production to meet the food market product demands, has become imperative.

This study therefore looks at socio-economic drivers for single factor productivity measure of food crops in Kaduna state, North-central Nigeria, among the smallholder farmers who form the bulk of food crop producers in the country with a view to understanding and garnering reliable information on food crop productivity as a pre-requisite for accurate and effective design, monitoring and promulgation of agricultural development policy. Moreover, owing to significant variation in farming practices and growing conditions across farming systems and agro-ecological zones, national-level yield estimates may differ starkly from yields realized by any given smallholder farmer, or even by smallholders as a group (Craig *et al.*, 1997). This fact may portend custom-made policy framework for increasing agricultural productivity that is regionally based.

METHODOLOGY

The study was conducted in Kaduna state in the north-central part of Nigeria. The state is located between latitude 09° 30'N and longitude 08° 30'E in Northern Guinea Savannah, with a land area of about 45,567 km². Kaduna has two seasons, the rainy (May – October) and dry (November – April) seasons. Crops such as maize,

cassava, potatoes, sorghum, cowpea, soya bean, cocoyam, and ginger are cultivated by the predominant populace who are mostly smallholder farmers.

Multi-stage sampling technique was used in selecting the study sample. In the first stage, two of the four agro-ecological zones were purposely selected namely, Samaru-Kataf and Maigana zones depicting the southern and northern fringes of the state. Four local government areas: Kachia, Zango Kataf, Giwa, and Ikara were randomly selected, two from each of the zones and thereafter, 2 farming communities were randomly selected from each local government chosen. The last stage involved the selection of 10% farming households from each farming community to make a total sample size of 244 respondents from a population of 2,439 households, for questionnaire administration, following the Creative Research Systems (2012) formulae. Primary data were collected and data collected focused on socio-economic characteristics of farmers and output—quantities of various food crop produced.

Measures of productivity can be divided into partial or total measures depending on the number of inputs under consideration. Total output as a ratio of some measure of labour quantity, usually, man-days in developing countries, is called labour productivity (LP) and provides some notion of output per worker; while output per area of land planted is land productivity (Wiebe, Soule, Narrod, and Brenneman, 2003; Zepeda, 2001). The two previously mentioned measures are examples of single-factor productivity (SFP), defined as the ratio of a measure of output quantity to the quantity of a single input used (Diewert and Nakamura, 2005). An additional measure is also the Multifactor Productivity. A multifactor productivity measure utilizes more than a single factor, for example, both labour and

capital, considering same basal units for the inputs.

The productivity of land as an input for consideration in productivity measure is a very important factor in agriculture because it is the most permanent and fixed factor among the three categories of input; land, labor, and capital (Dharmasiri, 2009). Furthermore, Diskin (1999), asserted that crop yield per area (amount of crop harvested per amount of land planted) is the most commonly used impact indicator for agricultural production activities. It is the simplest and in some respects the most useful aspect of agricultural productivity as it indicates the level of agricultural development being the end signal for the level of input packages in use; consisting improved seeds, fertilizers, agrochemicals, and labour intensive practices. However, one of the well-known techniques developed and used for the measurement of agricultural productivity is to assess agricultural production as grain equivalents (Buck, 1967). The total food crop output (production) per unit hectare is, therefore, what this paper used as a Single-Factor Productivity Index of food crops cultivated by farmers in the study area. It is given as:

$$SFPI = \frac{\text{Total Food Crop Output in Grain Equivalence(Kg)}}{\text{Total Land Area Cultivated (Ha)}}$$

Where: SFPI is Single-Factor Productivity Index of food crops cultivated. See *Appendix 1* for grain equivalence conversion index.

RESULTS

The results of the survey conducted are as presented in Tables 1, 2 and 3. Table 1 shows selected socio-economic variables of sampled farmers. Table 2 presents the distribution of single factor productivity measure (index) of sampled farmers, while Table 3 shows the regression estimates of productivity measure with selected socio-economic variables.

Table 1. Selected socio-economic variables of sampled farmers

Socio-Economic Variable	Mean Value	Standard Deviation
Age of household head in years	39.11	10.77
Average family size	8.50	4.02
Average farm size in hectare	2.05	1.21
Average total income in naira	271,238.88(\$733.1)	171,496.81
Total crop production in grain equivalence in Kg	2,147.61	1,379.39

Table 2. Distribution of single factor productivity measure of sampled farmers

Single factor productivity in Kg per Ha	Frequency	Percentage
< 500	7	2.87
501-1,000	119	48.77
1,001-1,500	80	32.79
1,501-2,000	27	11.07
> 2000	11	4.51
Mean value [1098.83]	Standard Dev. [431.60]	
Total	244	100

Table 3. Regression estimate of productivity measure with selected socio-economic variables

Variables	Coefficients	Standard Error	t Stat	P-value
Intercept	6.799	0.105	64.829	0.000*
Age of household head (years)	-0.001	0.003	-0.494	0.621
Sex of household head	0.246	0.057	4.339	0.000*
Marital status	0.097	0.027	3.659	0.000*
Education level	0.014	0.014	0.996	0.320
Household size	0.019	0.007	2.841	0.005*
Farming as primary occupation	-0.019	0.045	-0.414	0.679
Amount of credit accessed (₦)	1.221E-06	1.288E-06	0.949	0.344
Farm size (Ha)	-0.141	0.023	-5.986	0.000*
Membership of association (years)	0.007	0.004	1.713	0.088***
Access to Market	0.163	0.043	3.806	0.000*
Total income (₦)	1.122E-06	1.307E-07	8.582	0.000*
<i>Multiple R = 0.706. R Square = 0.499. Adjusted R Square = 0.475.</i>				
<i>F Value = 20.963. F Significance = 0.000*</i>				

*, ** and *** indicate 1, 5 and 10% levels of significance of the variables respectively.

DISCUSSION

The socio-economic variables are expected to play important roles in the production process of the farmers. The mean age of the respondents was 39.11 years, denoting a youthful population group. Age has been identified as one of the factors that affect labour as well as farm productivity. It determines the quality and quantity of work a farmer can do and the ease with which agricultural innovations are

accepted (Fatoba, 2007; Ojeleye, 2015). People tend to wear in energy as they advance in age and may no longer be capable of providing the type of efforts required by rudimentary farming. Household size to a large extent determines labour supply, particularly in small-scale farming. It may, therefore, indicate the quantity of crop output a given household may likely produce considering the availability of family labour. An

approximate value of 9 was obtained as mean household size for the entire study area. Furthermore, farm size determines, to a large extent, scale of agricultural production (that is small or large scale). It is used to classify the level of holdings a farmer belongs. By the overall average size of $2.05 + 1.21\text{Ha}$, the respondents constitute a population of small-scale farmers in the study area. Ayanlere (2016) found an average of 2.35ha farm size among farming households in Kogi State. The average total income of the farmers also indicates a resource-poor population of farmers, as the average monthly earnings from the total income is a paltry ₦22,603:24 (\$61.1). The average total crop output in grain equivalence is also presented in Table 1, found to be $2,147.61 + 1,379.39\text{kg}$.

Productivity index statistics show that the highest-class group of observations among the respondents is 2,000kg/ha and above which is just about 4.5% of the sampled farmers. The mean value is observed to be 1,098.83kg/ha denoting very poor productivity level. This average, compared with the national average for cereals (1,591.8kg/ha) in 2014 (FAO, 2017) is still noted to be abysmally low. Much of the disparity in productivity can be ascribed to agronomic practices, such as the use of local varieties instead of hybrids, low input rates, or poor soil management. The instances of small farm sizes of average 2-3 hectares for which no substantial technical cultivation with improved techniques particularly, with heavy machinery can take place is also a factor. Small sized holdings have been noted to lead to great waste of time, labour, difficulty in proper utilization of technology in, for instance, irrigation facilities among farmers, as asserted by Ghosh (2016). Land tenancy system which allows for sub-division and fragmentation of holdings are further reasons that could be adduced for low productivity. Other reasons could be said to be connected with

poor extension network and linkages, and non-availability of proper entrepreneurial skills to harness available resources for maximum impact among the predominantly poor and illiterate farmers.

The regression estimate of productivity indices with some selected socio-economic variables are presented in Table 3. The variables that were found significant drivers are sex of household head (1%), marital status (1%), household size (1%), farm size (1%), membership of association (10%), access to market (1%) and total income (1%). The model has an adjusted R square of 47.5% and an F value of 20.963, found statistically significant at 1% level of probability (See Table 3). Some of the coefficients were positive while some were negative. A positive coefficient indicates that a higher value of the variables tends to increase productivity. Similarly, a negative value of coefficients implies that higher value of the variables would decrease productivity.

The significance of the gender of the household head is indicative that men tend to be more productive than women. This may not be far-fetched as women mostly only access marginal farmland compared to men by the reason of traditional system, and so lower productivity ensues. By the positive coefficient sign on the household size, this indicates the advantage of higher labour supply with large families. Expectedly, cheap family labour tends towards increased man-days and higher productivity, as this may positively affect the quantity of crop output a given household may likely produce considering the availability of family labour. Farm size was however observed to have a negative coefficient. The reasons for this could be due probably to the smallness of farmland, holdings of $2.05 + 1.21\text{ha}$. This finding may add to the age-long argument in agricultural development theories on the concepts of small versus large-scale farms. Small-scale farming is said to have some

advantages, since farmers operating small plots which they have considerable detailed knowledge of their soils, topography, drainage, etc. allowing them to work the land appropriately. Thus, for unmechanized farming where labour is a key input, diseconomies of scale may apply. Small farmers do benefit from their small scale.

Membership of association generates a form of social capital. Among other things, it has been suggested that information and knowledge about innovations, agricultural productivity, marketing, etcetera, spread quickly within a group compared with individual farmers, enhancing confidence about efficient implementation and application (Kolade and Harpham, 2014). As presented in Table 3, this variable, measured in summed years of group membership, was found to positively determine the productivity of food crops at 10% level of probability. Equally, the level of income of the farmers denoting their economic capacity to purchase vital inputs like seeds, agrochemicals, fertilizers etcetera, as expected, positively influenced the level of productivity. This finding is similar to Urgessa (2015).

Agriculture is a major sector of the Nigerian economy and would stay essentially so for quite some time. The

higher growth rate for the agricultural sector, largely a measure of sustainable agricultural productivity trend, is very important for a fast-overall improvement of the economy, macroeconomic constancy, employment generation, and decrease in rural poverty. Whereas in this survey, the single factor productivity measure for food crops was observed to be very low. Important socio-economic drivers for increasing food crop productivity were found to be the gender of the household head, household size, farm size, membership of the association, access to market and total income. In line with the interplay of these variables, it is therefore recommended that policy framework with regards to implementation of pro-poor, gender-sensitive, and environmentally sustainable agricultural and rural development ought to be pursued. Land use and accessibility reformed should be looked into with the desire to make land available to all without gender bias. In addition, agricultural groups in the area should also be supported and strengthened through support services like supply of inputs (such as fertilizer, other agrochemicals and improved varieties of planting materials) at a subsidized rate. Policy interventions should include also measures for sound economic programs geared to addressing economic empowerment for the farmers.

Appendix 1. Indices for conversion into kg-grain equivalents of food crops

Crop	Index	Crop	Index
Root Tubers		Okra	1.29
Cassava Tuber	0.43	Tomato	0.25
Yam Tuber	0.31	Pepper	1.12
Sweet Potato Tuber	0.31	Onion	0.13
Irish Potato	0.34	Carrot	0.11
Cocoyam Tuber	1.09	Egg Plant	0.13
Cereals		Cucumber	0.08
Maize Grain	1.17	Cochorus/Ewedu	0.14
Sorghum Grain	0.99	Spinach	0.06
Millet Grain	0.99	Bitter Leaf	0.06
Rice	0.35	Water Leaf	0.05
Wheat Grain	0.97	Cabbage	0.07
Pulses		Pumpkin	0.13
Cowpea (Beans)	1.68	Mango	0.17
Ground Nut	1.69	Pawpaw	0.09
Soybeans	1.15	Pineapple	0.09
Fruits and Vegetables		Apple	0.16
Melon (Shelled)	1.61	Coconut	0.16
Plantain	0.22	Guava	0.21
Banana	0.27	Sugarcane	0.10

(Ojeleye, 2015).

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