FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

IMPROVED AGRICULTURAL PRODUCTIVITY AND CONQUEST OF HUNGER IN NIGERIA: WHAT NEXUS?

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INAUGURAL LECTURE SERIES 114

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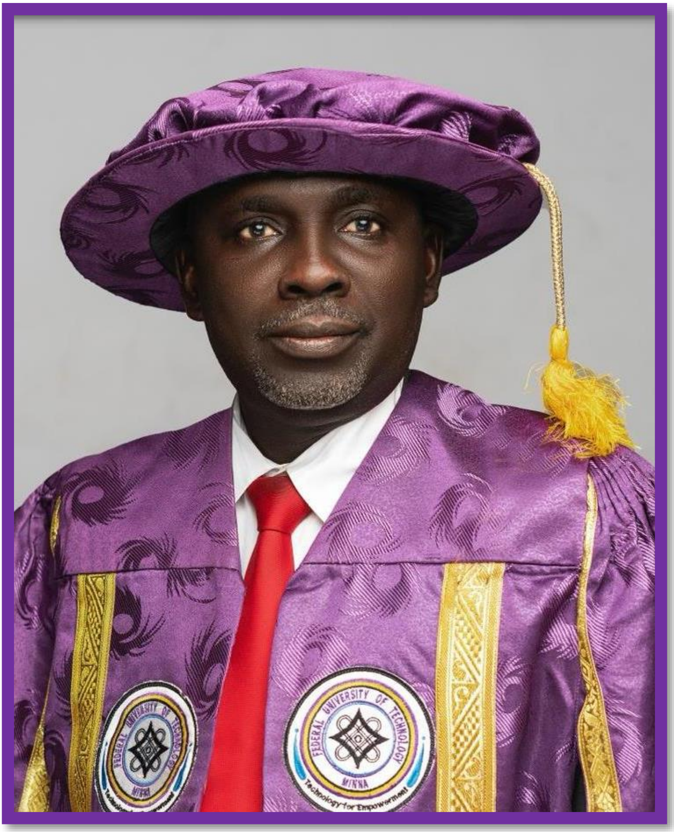

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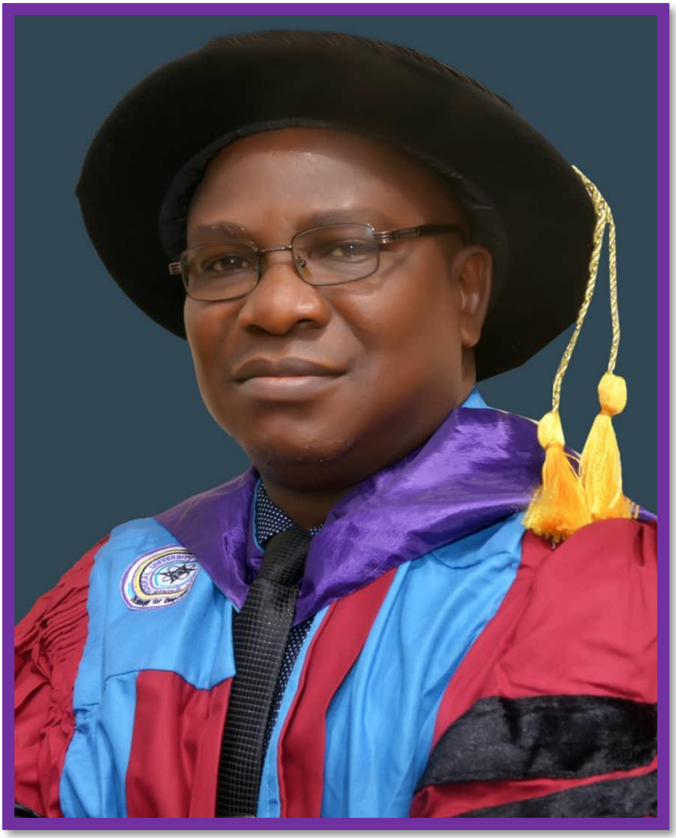

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Preamble

Of recent, the popular slogan in Nigeria is "*we are hungry*". We as a people, are faced with challenges of hunger, inflation, and the general increase in prices of food items. All these had affected the livelihoods of individuals and posed significant threats to food security and economic stability in our country. To combat hunger especially in the face of rapidly growing population and rising food prices, increasing agricultural productivity in Nigeria is not negotiable. Improved agricultural productivity will increase food availability, stimulate economic growth, and empower farmers, ultimately leading to better food security and livelihoods

1.0 INTRODUCTION

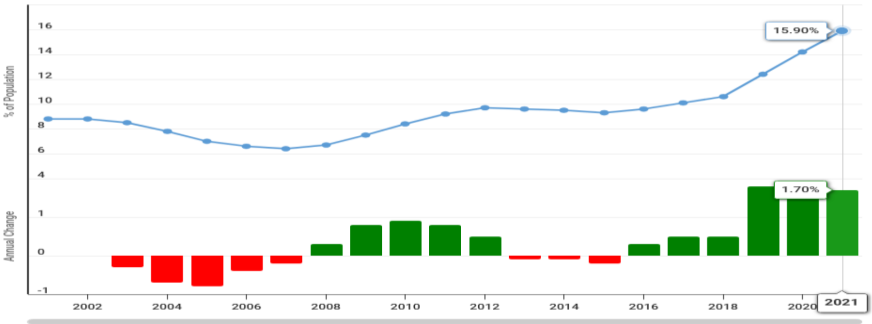
Nigeria is the Africa's most populous nation with population of about 233 million people (about 47% of West Africa's population) and has one of the largest populations of youth in the world (World Bank Group, 2021 and United Nation Population Division (UNPD), 2024). It has a total land area of about 98.3 million hectares out of which only 76.2 million hectares are cultivable, while 34.2 million hectares (about 48% of the cultivable area) are actually being cultivated and less than 10% of the arable land is irrigated (Daramola, 2004). Despite being one of the biggest producers of crude oil in the world, and also possessing large deposits of natural gas and other abundant economically viable mineral resources, about 43 percent of Nigerians (89 million people) live below the poverty line, while approximately 25 percent (53 million) are vulnerable. Nigeria was also ranked 98th out of the 107 countries in the 2020 Global Hunger Index. With all these challenges, agriculture still remains the mainstay of Nigerian economy with over 70% of the population's livelihood mainly come from farming and related activities. Hence, agriculture still remains the primary source of employment for the country's work force.

Nigeria is endowed with large expanse of land capable of growing all types of tropical and subtropical crops with tremendous potentials and resources coupled with favourable climatic conditions for producing food and other agricultural raw materials for export and domestic consumption. In other words, the country is blessed with abundant human (labour force) and material resources to alleviate hunger (food insecurity) and other manifestations of mass poverty that is threatening the peaceful existence of the country (Omoyajowo, 2008) Taking these various advantages into consideration, one would expect Nigeria to be self-sufficient in her staple food production but surprisingly, she is not. Nigeria's population growth is about 2.39% per annum, while food production growth rate is about 1.5% and food demand increases at a rate of more than 3.5% (Nigeria Bereau of Statistics (NBS), 2024 and UNPD, 2024). This implies a food deficit which has far reaching implications for the economy such as food importation. This has negative consequences such as high rates of increase in food prices and inadequate calorie intake in the diets of a large proportion of the population especially in the rural areas, which constitutes over 70% of the Nigerian population (Federal Office of Statistics (FOS), 1996).

Agricultural production in Nigeria according to Oladele, *et al*., (2008) is largely in the hand of peasants' farmers and the characteristics of these peasant farmers predispose them to low productivity. The crucial issue in the Nigerian agriculture is that of low productivity. The problem of declining crop productivity in Nigeria is important. Despite all human and material resources devoted to agriculture, the productive efficiency for most crops still falls under 60 percent. Farmers' output must therefore be expanded with existing levels of conventional inputs and technology. More than ever, farmers will have to produce more efficiently. A global hunger index report published on its website has ranked Nigeria 109 out of 125 countries as one of the countries with the most hungry population in the world (Figure1). According to the report, Nigeria was ranked below countries such as Sudan, Zimbabwe, DR Congo, North Korea and Guinea Although the most populous African nation, Nigeria battles with a record high inflation rate of 28.92% and a food inflation rate of 33.93% which is driven by increases in prices of staple food items such as Oil and fat, Meat, Bread and Cereals, Potatoes, Yam & Other

Tubers, Fish, and Milk, Cheese, and Eggs (Nairametric, 2024). Expected increase in food demand occasioned by population growth and declining per-capita incomes will require continued increase in farms productivity. Low agricultural productivity in Nigeria is due to a wide variety of factors including poor soil quality caused by pollution, erosion and leaching, the negative impact of climate change on weather patterns, the scarcity and high cost of inputs, rudimentary implements, and outdated farming practices. Poor agricultural output and widespread poverty has resulted in extensive and persistent food insecurity, with some studies showing that as many as 70 percent of Nigerians are food insecure (Ogundari and Ojo, 2006; Obayelu 2010). Previous studies on efficiency of resource utilization and productivity showed that there are wide variations in the levels of productivity and productive efficiency for the major food crops, and the levels are far from the optimum. This indicates therefore that ample opportunities exist for the farmers to increase their productivity and productive efficiency.

Mr. Vice Chancellor Sir, before I proceed to present the trend of agricultural production and productivity in Nigeria over the period of time (pre-SAP era; SAP era; and Era of guided policy deregulation), I will like to discuss the concept of agricultural productivity and its measurements



Nigeria Hunger Statistics 2001-2025
Macrotrends, 2025

1.1 CONCEPTS AND MEASUREMENT OF PRODUCTIVITY AND EFFICIENCY

Agricultural productivity of production unit, defined as the ratio of its output to its input varies due to differences in production technology, differences in setting in which production occurs and differences in efficiency of the production process. Different types of input measures give rise to different types of productivity measures (such as capital, labour and land). The individual or a single input's productivity is referred to as partial factor productivity (PFP) and changes in input characteristic influence its measure (Li and Prescott, 2009; Ajao, 2011). Total factor productivity growth is mainly derived from technological progress, innovation, improved social infrastructure and increased technological investment. In single or partial factor productivity measures, the productivity of a single factor is compared with a particular unit of input. Multi or total factor productivity (TFP) relates a measure of the total crop yield (Y) to a bundle of inputs used, and acts as the ratio of an index of output (Y) to aggregate index of all factors employed in the production of the particular output (Kohli, 2002). Productivity can be measured for a single entity (farm, commodity) or a group of farms, at any geographical scale and this could be determined in physical terms or in value terms. Productivity measure for agriculture that is often cited is crop output per land area (commonly referred to as crop yield), with a higher yield corresponding to higher productivity. It quickly becomes apparent that the challenge with this and similar measures rests with how they are interpreted. Continuing with this example, a higher yield may be indicative of improved fertilization practices (use of a better fertilizer and/or more efficient application), land of higher quality allocated to the crop, the use of a better-educated workforce or more efficient use of capital. However, it may also just be explained by basic factors beyond the farmers control, such as the soil conditions and even the weather (FAO, 2017)

Efficiency of a production unit may be defined as how effectively it uses variable resources for the purpose of profit maximization, given the best production technology available. There are several aspects of production efficiency for measuring farm performance. The common ones include, technical, allocative, cost, economic, scale and profit efficiencies.

Technical efficiency: This refers to the maximum attainable level of output for a given level of production inputs, given the range of alternative technologies available to farmers. The greater the ratio, the greater the magnitude of technical efficiency. Formally, the level of technical efficiency is measured by the distance of farm production from the optimal production frontier. A firm that sits on the production frontier is said to be technically efficient (Henderson 2003). A technically inefficient farm operates below the frontier and could be made efficient by increasing its output with the same input level or using fewer inputs to produce the same level of output. As such, the closer a farm gets to the frontier the more technically efficient it becomes (Ogunyinka and Ajibefun, 2003).

Allocative efficiency: This is concerned with choosing optimal sets of inputs in a cost-minimizing manner. A firm is allocatively efficient when production occurs at a point where the Marginal Value Product is equal to the Marginal Factor Cost. Thus, allocative inefficiency reflects deviations from the minimum cost input ratios

Economic efficiency: This refers to the capacity of a firm to produce a predetermined quantity of output at minimum cost for a given level of technology and is derived by multiplying the technical and allocative components of efficiency (Bravo-Ureta and Pinheiro 1997). Economic efficiency occurs when a farm chooses resources and enterprises in such a way to attain economic optimum. If technical and allocative efficiency occur together, they are both necessary and sufficient conditions for economic efficiency. This implies that the farmer made right decision to minimize costs and maximize profits implying operating on the profit frontier

Scale efficiency: Total technical efficiency of a firm can be decomposed into pure technical and scale efficiency. Pure technical efficiency relates to management practices while scale efficiency relates to the residuals. Scale efficiency (SE) can be obtained residually from constant return to scale (CRS) and variable return to scale (VRS) technical efficiency (TE) as follow:

$SE = TE_{CRS}/TE_{VRS}$

SE= 1 indicates scale efficiency or constant return to scale (CRS) and SE <1 indicates scale inefficiency. Scale inefficiencies arise due to the presence of either increasing returns to scale or decreasing return to scale.

1.2 NIGERIA AGRICULTURAL PRODUCTION AND PRODUCTIVITY AT A GLANCE

Improvement in productivity is the most important factor in attaining growth in the economy and this is more so for agriculture which provide means of livelihood for over 70.0 per cent of the populace through subsistence production which is a predominant feature of agricultural production in Nigeria. Of the 98.3 million hectares of land in Nigeria, 71.2 million hectares can be cultivated. However, only about 34 million or roughly one-third of the area is under cultivation. Output of the sector is adjudged consequently, low and labour intensive. The summary information on agricultural sector in Nigeria is shown in Table 1

Table1: Nigeria Agriculture at a Glance

Items	Values
Land Area	92,3770 km^2
Agricultural land	69.1million hectares (75.37%)
Arable land	34 million hectares (49.20%)
Irrigated land	0.3% of agricultural land
Average cereal yield	1.64 ton /ha
Average vegetable yield	4.4 tons /ha
Number of functional agricultural tractors	7000
Total agricultural imports	5.6 billion USD
Total agricultural exports	1.16 billion USD
Employment in agriculture (% of total national employment)	36.55%
Employment value added per worker	62,347 USD
Agricultural population	38.97 million people

Agricultural contribution to GDP	21.02%
Food production index	122
Crop production index	117
Livestock production index	109

Agribusiness in Nigeria Fact Sheet (2022), National Bureau of Statistics (2022)

Agricultural production index which has been growing over the years at different rates can be described as low. For ease of analysis the periods is divided into three. These are 1970-1985 which is regarded as pre-SAP era; 1986 - 1993 - SAP era; and 1994 -2019 - Era of guided deregulation. The performance of the sector as measured in term of output is presented in Table 2. The average agricultural growth rate increased from 0.50% (in the pre-SAP period) to 7.54% during SAP era but declined to 2.97% during post-SAP era. The result is also the same in most of the activities during these periods. This implies that agricultural production has been declining drastically. Comparing the rate of agricultural growth with that of population over the years (1970 – 2019) as presented in Figure 2, the population growth rate has been positively stable while that of agricultural growth in most cases declined to negative percent. The implication is that there has been food shortage due to growing population with dwindling agricultural performance.

Mr. Vice Chancellor sir, considering this low agricultural sector performance with the challenges of increased population, insecurity (which has negatively affected agricultural production) and dwindling revenue to Government at all level, there is need for immediate concerted effort to increase the productivity and efficiency of agricultural sector to save Nigerians from hunger.

Table2: Average Agricultural Growth Rate by Types of Activity: 1970-2019

Year	1970 - 1985	1986 - 1993	1994 - 2019
Agriculture	0.50	7.54	2.97
Crop	-0.35	9.33	3.12
Livestock	6.46	-0.45	2.52
Cereal	3.68	6.85	2.11
Meat indigenous	6.91	-1.48	2.72
Meat	2.52	2.62	1.52
Nonfood item	1.32	9.16	0.41
Oil crops	-0.83	8.20	4.91
Root and tuber	-3.00	17.14	3.53
Sugar crops	2.50	0.63	3.33
Vegetable and fruit	1.93	3.77	3.07

Source: FAOSTAT, 2022

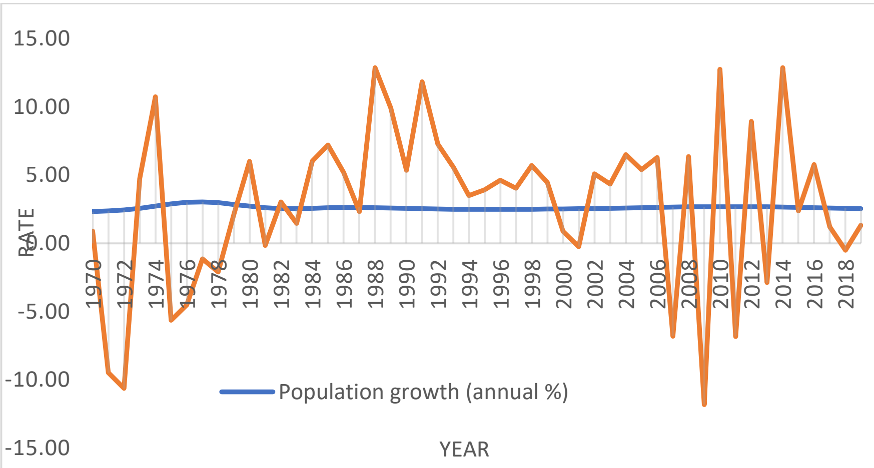


Figure1: Agricultural and Population Growth

Source: FAOSTAT, 2022

The information in Table 3 represents the agricultural productivity by crop groups in some West African countries (tonnes per hectare). The information in this Table reveals clearly that productivity in most of the agricultural activities in Nigeria performed below West Africa and World average. Comparing the Nigeria agricultural productivity with other smaller West African countries (e.g., Ghana and Senegal), the performance of the "Giant of Africa" is still very low in most of these activities.

Table 3: Agricultural Productivity by Crop Groups in some West African Countries (Tonnes Per Hectare)

Crop	Nigeria	Ghana	Benin Republic	Burkina Faso	Gambia	Senegal	West Africa Average	World Average
Cereal	1.42	1.93	1.43	1.17	0.74	1.82	1.31	4.07
Pulses	0. 76	0.77	0.99	0.51	0.21	0.87	0.62	0.96
Fruits	5.99	12.99	10.57	5.97	5.01	15.37	6.97	13.68
Vegetable	3.72	9.52	6.20	9.36	6.15	12.04	4.76	19.70
Fibre(Seed Cotton)	0. 75	1.87	1.17	1.21	0.35	1.12	1.06	2.61
Tuber	7.93	7.09	12.58	8.40	3.79	15.96	8.11	13.34

Source: FAOSTAT, 2022

2.0 MY CONTRIBUTIONS

Mr. Vice-Chancellor, Sir, with my little effort I have participated in over 80 field works with about 80 percent of them involved analysis of some aspects of agricultural production efficiency and productivity. I had the privilege of working with many scientists who have demonstrated passion for excellent ideas. As a scientist and a member of several research team, I would like to mention some of my involvements in research and field works in assessing the performance of agricultural sector in Nigeria as follows:

- Resource-use efficiency in small scale maize farmers in Lavun Local Government, Niger State, Nigeria (Ojo, and Mohammed, 2007).
- Estimation of technical efficiency in peasant sorghum production in Niger State, Nigeria (Ojo and Mohammed, 2008).
- Profitability, input elasticities and resource-use efficiency in small scale cowpea production in Niger State, Nigeria (Ojo, *et al*., 2008).
- Analysis of cost efficiency in small scale irrigated tomato production: Empirical evidence from Niger State, Nigeria (Ojo, *et al*., 2008)
- Profitability and technical efficiency in irrigated onion production under Middle Rima Valley Irrigation Project in Goronyo, Sokoto State, Nigeria (Ojo, *et al*., 2009)
- Return to scale and determinants of farm level technical inefficiency among small scale yam-based farmers in Niger State, Nigeria: Implications for food security (Ojo, *et al*., 2009)
- Profit efficiency of small-scale cowpea farmers in Niger State, Nigeria (Ojo, *et al*., 2009)
- Productivity and production efficiency among small scale irrigated sugarcane farmers in Niger state, Nigeria: A stochastic translog frontier function approach (Ojo, *et al*., 2009)
- Gender analysis of allocative efficiency in small scale maize production in Kogi State, Nigeria. (Ojo, *et al*., 2010)
- Analysis of the use of tractor in arable crops production in Zamfara State, Nigeria (Ojo, *et al*., 2012)
- Profitability and resource-use efficiency of melon under sole and mixed cropping system in Niger State, Nigeria. (Ojo, *et al*., 2013)

- Farm size and scale efficiency of small holder tuber crop farmers in North Central, Nigeria. (Ojo, *et al*., 2013)
- Multinomial logit analysis of factors affecting the choice of enterprise among small-holder yam and cassava farmers in Niger State, Nigeria. (Ojo, *et al*., 2013)
- Non-parametric analysis of production efficiency of poultry egg farmers in Delta State, Nigeria (Ojo, *et al*., 2013)
- Resource productivity analysis of small-scale root and tuber crop farmers in Niger State, Nigeria (Ojo, *et al*., 2013)
- Determinants of crop diversification among small – scale food crop farmers in North Central, Nigeria. (Ojo, *et al*., 2014)
- Analysis of household labour-use in yam production: the case of Benue State, Nigeria. Nigeria (Ojo, *et al*., 2014)
- Analysis of improved household solid waste management system in Minna Metropolis, Niger State, Nigeria (Ojo, *et al*., 2015)
- Assessment of technical and resource-use efficiency of yam production in Ukum Local Government Area of Benue State, Nigeria. (Ojo, *et al*., 2015)
- Effect of HIV/AIDS infection on labour supply and agricultural productivity in Benue State, Nigeria. (Ojo, *et al*., 2015)
- Gender and productivity differentials among rice farmers in Niger State (Ojo, *et al*., 2015)
- Marginal Productivity of small-scale yam and cassava farmers in Kogi State, Nigeria: data envelopment analysis as a complement (Ojo, *et al*., 2016)
- Analysis of allocative efficiency among small-scale tuber crop farmers in North-Central, Nigeria. (Ojo, *et al*., 2017)
- Effect of insurgency on food crop farmers' productivity in Borno and Gombe States, Nigeria (Ojo, *et al*., 2018)

- Assessment of child labour among farming households in selected local government areas of Niger State, Nigeria (Ojo, *et al*., 2018)
- Effect of improved seed technology adoption on small-scale sorghum farmers' productivity in Kebbi State, Nigeria (Ojo, *et al*., 2018)
- Effect of adoption of improved technologies on poultry production in Oyo State, Nigeria. (Ojo, *et al*., 2018)
- Analysis of total factor productivity of cowpea farmers in north-central Nigeria. (Isonguyo, *et al*., 2020)
- The impact of market access on input use and agricultural productivity among cereal crop farmers in Niger State, Nigeria. (Ojo, *et al*., 2021)
- Non-parametric decomposition of total factor productivity growth in yam production in North-Central Nigeria (Isonguyo, *et al*., 2021)
- Technical progress and efficiency change in maize production in North-Central Nigeria. (Isonguyo, *et al*., 2021)

2.0 MY RESEARCH OUTPUTS

I have decided to present results of some of my studies here to establish the resource productivity and efficiency level in Nigerian agriculture.

2.1 RESOURCE PRODUCTIVITY AND EFFICIENCY LEVEL IN NIGERIAN AGRICULTURE

a) Resource-use efficiency in small scale maize farmers

A study on resource-use efficiency of maize production in Niger State, Nigeria using production functions analysis. The results of regression analysis revealed that farm size and quantity of seeds had positive and statistically significant relationship with maize production at 1% probability level (see Table 4). The estimated efficiency ratio (r) shows that all the significant inputs in the model were under-utilized (Table 5). This implies that the resources were not efficiently utilized. The elasticity of production inputs, which is also explained in terms of return to scale was less than 1 which implies that the production was characterized by a decreasing return to scale.

Table4: Estimated double-log production function

Variables	Regression Coefficient	t-value
Farm Size	0.517	5.301***
Quantity of Seed	0.239	2.372***
Quantity of fertilizer	0.124	1.075
Labour	-0.019	-0.232
Constant	5.743	9.593

R^2 = 0.511, F.ratio = 24.812*** Return to Scale (RTS) = 0.861
**** Significant at 1% level of probability,*
Source: Ojo and Mohammed (2007)

Table5: Estimated Efficiency Ratio (r)

Variables	MPP	MVP	MFC	Efficiency Ratio
Farm Size	27155.49	1493551.95	7200	207.44
Labour	36.72	2019.60	88	22.95

Note: MPP = Marginal physical product MVP = Marginal Value Product MFC = Marginal Factor Cost
Source: Ojo and Mohammed (2007)

b) Profitability, Inputs Elasticities and Resource-use Efficiency in Small Scale Cowpea Production

A study on profitability, inputs elasticities and resource-use efficiency in small scale cowpea production was conducted Niger State, Nigeria using regression analysis. The result of the production function analysis revealed that the estimated regression coefficients of farm size (X_1), labour (X_2), seed (X_3), herbicides (X_4) and fertilizer (X_5) were positive indicating that an increase in these inputs, holding others constant led to an increase in the gross output (see Table 6). The result further showed that land (X_1), labour (X_2) and fertilizer (X_5) were statistically significant at 1%, level of probability while seed (X_3) was significant at 5% level of probability. The efficiency indicator in Table 7 revealed land, labour and seed were under-utilized while fertilizer was over-utilized. Efficiency and productivity could be improved if the farmers use more of land, labour and seed and less of fertilizer.

Table 6: Estimated double log production function (lead equation)

Variables.	Regression Coefficients	T-value
Constant	2.809	7.676***
Land (X_1)	1.725	2.893***
Labour (X_2)	12.300	2.731***
Seed (X_3)	0.150	2.382**
Herbicides (X_4)	0.078	1.233
Fertilizer (X_5)	0.130	3.710***

R^2 = 0.765, F-ratio = 16.369***

**** = Significant at 1% level of probability, ** = Significant at 5% level of probability*

Source Ojo *et al*., (2008)

Table 7: Estimated efficiency Ratio (r)

Variables	**MPP**	**MVP**	**MFC**	**Efficiency ratio**
Land (X_1)	144.297	23087.52	7200	3.207
Labour (X_2)	69.205	11072.92	350	31.636
Seed (X_3)	35.529	5684.65	140.00	40.604

Fertilizer (X_5)	0.151	24.19	110.00	0.220

Note: MPP = Marginal physical product MVP = Marginal Value Product MFC = Marginal Factor Cost
Source Ojo *et al*., (2008)

c) Productivity and production efficiency among small scale irrigated sugarcane farmers

A study on productivity and production efficiency among small scale irrigated sugarcane farmers was conducted in Niger State, Nigeria using a stochastic translog frontier function. The results showed a return to scale of 3.51 indicating an increasing return to scale and that small scale irrigated sugarcane production in the area was in stage I of the production region (see Table 8). The study also showed that the levels of technical efficiency ranged from 82.58% to 99.24% with mean of 95.39% which suggests that average irrigated sugarcane output falls 5% short of the maximum possible level (see Table 9). From the results obtained, the farmers, in the short run, still have room to increase the efficiency in their farming activities as about 5 percent efficiency gap from optimum (100%) remains yet to be attained by all farmers.

Table 8: Estimated elasticity of factor inputs and return to scale

Variables	Coefficients (Elasticity of production)
Farm Size (X_1)	-17.82
Labour (X_2)	0.85
Fertilizer (X_3)	18.45
Agrochemical (X_4)	-1.15
Seed yam(X_5)	6.53
Farm tools	-3.35
Return to Scale	**3.51**

Source Ojo *et al*., (2008)

Table 9: Distribution of Technical Efficiency Indices among Irrigated Sugarcane Production in the Study Area

Efficiency Class Index	Frequency	Percentage
Below 0.80	0.00	0.00
0.81 – 0.90	14.00	14.00
0.91 – 1.00	86.00	86.00
Total	100.00	100.00
Mean	0.9539	
Maximum value	0.9924	
Minimum value	0.8258	

Source Ojo *et al*., (2008)

d) Profitability and technical efficiency in irrigated onion production

A study was also carried on profitability and technical efficiency in irrigated onion production under Middle Rima Valley Irrigation Project in Goronyo, Sokoto State, Nigeria. The data were analysed using stochastic frontier production function. The estimated coefficients of the inefficiency function provide some explanations for the relative efficiency levels among individuals' farms. Since the dependent variable of the inefficiency function represents the mode of inefficiency, a positive sign of an estimated parameter implies that the associated variable has a negative effect on efficiency and a negative sign indicates the reverse. The negative coefficients for education, farming experience and extension contacts imply that educated farmers, the farmers with high farming experience and extension contacts in irrigated onion production were more technically efficient meaning that as the level of education, years of farming experience and access to extension services increased in the study area, the technical inefficiency of the farmers decreases. Also, negative coefficient for age and household size implied that the farmers' level of technical efficiency declined with increase in age and household size (see Table 10).

Table10: Maximum Likelihood Estimates of Parameters of the Cobb-Douglas Frontier Function for Irrigated Onion Production in Goronyo, Sokoto State.

Variables	Parameters	Coefficients	t-ratio
General Model			
Constant	β_0	-45.548	-19.750***
Farm Size (ha) (X1)	β_1	0.175	3.060***
Labour (Man-days) (X2)	β_2	-0.194	-2.403***
Fertilizer (kg) (X3)	β_3	8.145	51.046***
Herbicide (Litres) (X4)	β_4	0.252	2.427***
Inefficiency Functions			
Constant	δ_0	0.090	0.175
Age (years)	δ_1	0.026	0.313
Household Size	δ_2	0.007	0.215
Education Level (years)	δ_3	-0.043	-2.609***
Farming Experience (years)	δ_4	-0.022	-1.813**
Extension Contact	δ_5	-0.047	-4.84***
Diagnosis Statistics			
Sigma-square δ^2		0.7672	6.059***
Gamma γ		0.2782	7.393***
Log likelihood function		-9.43	
LR Test		2.43	

, *=significant at 5% and 1% probability level respectively
Ojo, *et al*., (2009)

The results in Table 11 further revealed a mean technical efficiency of 0.9467 (94.67%), implying that on the average, farmers in the study area were able to obtain a little over 90 percent of potential irrigated onion output from a given mix of production inputs. From the results obtained, although farmers were generally relatively efficient, they still have room to increase the efficiency in their farming activities as about 5.33 percent efficiency gap from optimum (100%) was yet to be attained by all farmers.

Table11: Distribution of Technical Efficiency Indices among Farmers in the Study Area

Efficiency Class Index	Frequency	Percentage
0.81 – 0.90	7	7.78
0.91 – 1.00	83	92.22
Total	90	100.00
Mean	0.9467	
Maximum value	0.9993	
Minimum value	0.8755	

Ojo, *et al*., (2009)

e) **Resource productivity analysis of small-scale root and tuber crop farmers**

The study on resource productivity analysis of small-scale root and tuber crop farmers was carried out in Niger State, Nigeria. Data envelopment analysis (DEA) was used to empirically determine the resource productivity in the study area. The DEA result indicate that the mean total technical efficiency of the sample farms is 0.25 implying that the farmers would have to reduce the level of inputs by 75% if they were operating at the frontier. . Decomposition of technical efficiency shows that, on average, the sample farms are more scale efficient than they are technically efficient. The mean pure technical efficiency of the sample farms is 0.76 with a lowest of 0.36 and a highest of 1.0. The mean scale efficiency of the sample farms is 0.32 see Table 12). Results in Table13 also depicts that only 6 percent farms are scale efficient while remaining 94 percent farms are scale inefficient. All the scale inefficient farms operate in an area of increasing returns to scale, implying that they could achieve higher efficiency level by decreasing the production scale. The high pure technical efficiency in comparison with scale efficiency shows that total technical inefficiency is mainly due to inefficient management practices. . The study further revealed that most of the farms could reduce total expenditures on the farm land, labour, planting material, agrochemical, fertilizer and capital inputs by 8.17%, 5.17%, 29.53%, 23.71%, 0.09% and 10.08%, respectively without reducing their current level of production (see Table 14).

Table 12: Summary statistics of efficiency estimates in root and tuber crop production in the study area.

Efficiency Estimates	Mean	Standard Deviation	Minimum	Maximum
CRS technical efficiency	0.25	0.25	0.01	1.00
VRS technical efficiency	0.76	0.19	0.36	1.00
Scale efficiency	0.32	0.26	0.02	1.00

Ojo, *et al*., (2013)

Table 13: Share of farms under CRS (scale efficient), IRS (increasing returns to scale) and DRS (decreasing returns to scale) in root and tuber production in the study area.

Efficiency Estimates	Frequency	Percentage
Scale efficient farms	9	6.00
Farms under increase returns to scale	141	94.00

Ojo, *et al*., (2013)

Table14: Input slacks and number of root and tuber crop farms using excess inputs in Niger State

Input	Number of farms	Mean Slack	Mean input Used	Excess Input use (%)
Total farm size (ha)	42	0.23	2.84	8.17

Labour	43	7.27	140.70	5.17
Total Planting Material	87	176.31	597.07	29.53
Agrochemical (₦)	47	1399.48	5902.13	23.71
Total Fertilizer(kg)	3	0.17	181.29	0.09
Total Depreciation	36	120.23	1192.56	10.08

Ojo, *et al*., (2013)

f) Non-parametric analysis of production efficiency of poultry egg farmers

In Delta State of Nigeria, a study was conducted to examine production efficiency of poultry farmers using non parametric method of analysis (DEA). The result showed that 30% of the sampled poultry farmers in the study area were operating at frontier and optimum level of production with mean technical efficiency of 1.00 (see Table 15). This shows that 70% of the poultry farmers in the study area could still improve on their level of efficiency through better utilization of available resources, given the current state of technology.

Table15: DEA Summary results

Models	Sample (Number of farms)	Percentage	Mean Technical Efficiency
Model I	120	100.0	0.771
Model II	84	70.0	0.673
Model III	36	30.0	1.00

Ojo, *et al*., (2013)

The results of production analysis of the factors affecting output of the efficient and inefficient poultry farmers are presented in Table 16. The study showed that stock capacity (number of birds), feed and medication cost positively and significantly affected the output of the poultry farmers in the study area. This implies that a unit increase in each of these variables led to increase in the poultry output in the study area. The negative coefficients of capital inputs in the first and second cases implies that a unit increase in this variable led to decrease in the poultry output in the study area. Under perfect competition, the sum of Cobb-Douglas regression coefficients measures returns to scale. In the result, in the three cases the sum of regression coefficients is greater than one (1.1615 in the first case, 1.2663 in the second case and 1.2736 in the third case). This means that the farms operated under increasing returns to scale. This is an expected result since there are a priori theoretical reasons to believe that variable returns to scale will prevail.

Table16: Cobb-Douglas Analysis Results

	All farms (n = 120)	Inefficient farms (n = 84)	Efficient farms (n = 36)
Variables	Coefficients & T values	Coefficients & T values	Coefficients & T values
Constant	-3.9632 (-4.24)***	-4.5095 (-2.39)**	-5.6795 (-3.76)***
Stock capacity	0.4912 (5.70)***	0.7566 (6.08)***	0.2963 (2.81)***
Feed (kg)	0.4699 (3.94)***	0.4207 (2.53)**	0.4837 (3.44)***
Labour (manday)	0.0784 (0.91)	-0.0202 (-0.17)	0.0501 (0.48)
Medication cost	0.2074 (2.13)**	0.1902 (2.56)**	0.3987 (3.19)***
Capital Inputs (Deprciation)	-0.0854 (-2.24)**	-0.0810 (-2.79)***	0.0448 (2.19)**
R^2	0.6715	0.7312	0.8007
Adjusted R^2	0.6571	0.7140	0.7675
F-Ratio	46.61***	42.43***	24.11***
Return to scale (RTS)	1.1615	1.2663	1.2736

Numbers in parentheses are t values
*** = Significant at 1% level of probability, ** = Significant at 5% level of probability.
Ojo, *et al*., (2013)

The study further revealed that 16 poultry farms together could reduce total expenditures on the number of birds purchased by 20.43% without reducing their current level of production. Similarly, excess expenditures on feed, labour, medication and capital inputs were estimated at 3.20%, 3.53%, 7.10%, and 31.80%, involving 20, 17, 25, and 27 farms, respectively (see Table17).

Table17:. Summary of Slack Inputs

Input	Number of farms	Mean Slack	Mean input Used	Excess Input use (%)
Stock capacity	16	272.298	1332.729	20.43
Feed (kg)	20	220.473	6894.167	3.20
Labour (manday)	17	5.30	150.30	3.53
Medication cost	25	31391.519	441935.3	7.10
Capital Inputs (Deprciation)	27	329626.263	1036549	31.80

Ojo, *et al*., (2013)

g) Gender and productivity differentials among rice farmers

In Niger State of Nigeria, a study was conducted to compare the productivity of male and female rice farmers using data envelopment analysis. The results show the overall technical inefficiency ranges from 43% on male rice farms to 55% on female rice farms, suggesting that male rice farms are more technically efficient than female rice farms. The decomposition of technical efficiency into pure technical efficiency and scale efficiency further reveals that male rice farms are pure technically more efficient (0.79) than female rice farms (0.68).

The high level of technical efficiency observed on male rice farms was mainly due to scale efficiency (see Table 18). The comparison test for significant differences in mean technical efficiency among the two farm categories, summarised in Table 19, confirms that mean total and pure technical efficiency with scale efficiency are statistically and significantly higher on male rice farms than on female rice farms.

Table 18. Estimated mean efficiency measures and proportion of efficient farms.

	Male farmers		Female farmers	
Efficiency Measures	Mean	%	Mean	%
CRS Technical Efficiency	0.57	0.10	0.45	0.13
VRS Technical Efficiency	0.79	0.29	0.68	0.16
Scale Efficiency	0.71	0.10	0.63	0.13

Source: Field survey, 2014

Table 19. Comparison tests for the differences in mean efficiency estimates between male and female farmers

Efficiency Measures	Male versus Female	
	Mean difference	Sig
CRS Technical Efficiency	0.123	0.000***
VRS Technical Efficiency	0.112	0.000***
Scale Efficiency	0.081	0.050**

Note: *** and ** denote significance at 0.01 and 0.05 probability level respectively

Source: Field survey, 2014

h) Marginal productivity of small-scale yam and cassava farmers

In Kogi State of Nigeria, a study was conducted to examine marginal productivity of small-scale yam and cassava farmers using DEA as complement. The result shows that 40% of the sampled yam and cassava farmers in the study area were operating at frontier and optimum level of production with mean technical efficiency of 1.00. This shows that 60% of the farmers in the study area can still improve on their level of efficiency through better utilization of available resources, given the current state of technology (see Table 20). The results of the Cobb-Douglas analysis of factors affecting the output of yam and cassava farmers in Table 21 showed that labour, planting materials, fertilizer and capital inputs positively and significantly affected the output of the yam and cassava farmers in the study area. The study further revealed that yam and cassava farms in the study area operated under increasing returns to scale

Table 20: DEA Summary results

Models	Sample (Number of farms)	Percentage	Mean Technical Efficiency
Model I	150	100.0	0.8707
Model II	90	60.0	0.8698
Model III	60	40.0	1.0000

Source Ojo *et al*., (2016)

Table 21: Factors affecting output of the yam and cassava efficient and inefficient farmers in Kogi State using Cobb-Douglas production function

	All farms (N = 150)	Inefficient farms (N = 90)	Efficient farms (N = 60)
Variables	Coefficients & T values	Coefficients & T values	Coefficients & T values
Constant	-6.8545 (-6.2714)***	-9.7106 (-8.9676)***	-8.6387 (-6.1327)***
Farm Size (ha)	-0.0536 (-0.6582)	-0.1553 (-2.1043)**	0.1041 (1.1048)
Labour (manday)	0.7908 (8.2785)***	1.0490 (8.9253)***	0.7898 (6.5065)***
Planting material (kg)	0.1257 (3.4027)***	0.1795 (4.2777)***	0.0934 2.5725***

Agrochemical (₦)	0.0430 (0.6361)	0.0911 (1.4579)	0.1731 (1.7993)*
Fertilizer (kg)	0.1586 (1.7201)*	0.0621 (2.5990)**	0.2348 2.7946***
Capital Inputs	0.2714 (2.7036)***	0.4311 (4.2923)***	0.3662 (3.2596)***
R^2	0.4189	0.5807	0.6371
Adjusted R^2	0.3945	0.5504	0.5960
F-Ratio	17.18***	19.16***	15.51***
Return to scale (RTS)	1.3358	1.6575	1.1714

*, **, ***=significant at 10%, 5% and 1% probability level respectively

Source Ojo *et al*., (2016)

The sample means of the variables, and the marginal productivities of the production inputs are presented in Table 22. The sample means of the independent variables were computed for 1000kg of output for a comparison between the different cases. The result shows that farms that were relatively efficient (farms in third model) utilized inputs in a more productive sense than inefficient farms in the model II. In model III all inputs, apart from planting material (which is considered negligible), decreased in order to produce the same level of output meaning that fewer inputs are demanded for the production of the same output, thereby releasing resources for other economic activities. The marginal products of the production inputs in the models came out in the expected way i.e. for decreasing inputs the marginal products increased and vice versa. This result shows that efficient farms in model III were more marginally productive in resource utilization. This also shows that estimating production functions without separating the farms to efficient and inefficient farms bias the parameter values obtained from such production

Table 22. Marginal products of production factors used

Sample Means	Model I (n = 150)	Model II (n = 90)	Model III (n = 60)
Output (kg)	1000.00	1000.00	1000.00
Farm Size (ha)	2.42	3.64	2.10
Labour (manday)	135.91	173.84	130.64
Planting material (kg)	2080.81	2167.73	2245.79
Agrochemical (₦)	8978.13	10568.88	6657.21
Fertilizer (kg)	253.35	258.43	245.93
Capital Inputs	2520.36	2833.18	2355.76
Marginal Products			
Farm Size (ha)	22.17	42.71	49.61
Labour (manday)	5.82	6.03	6.05
Planting material (kg)	0.06	0.08	0.04
Agrochemical (₦)	0.00	0.01	0.03
Fertilizer (kg)	0.63	0.24	0.95
Capital Inputs	0.11	0.15	0.16

Source Ojo *et al*., (2016)

i) Analysis of total factor productivity of food crop farmers

In North-central Nigeria, a study was conducted to analysis of total factor productivity of food crop farmers over a period of time. The secondary production data on the selected food crops from 1992 to 2016 for each State and the zone were analysed using malmquist total factor productivity index (MTFPI) obtained from data envelopment analysis (DEA). The results based on each crop productivity are presented in Table 23

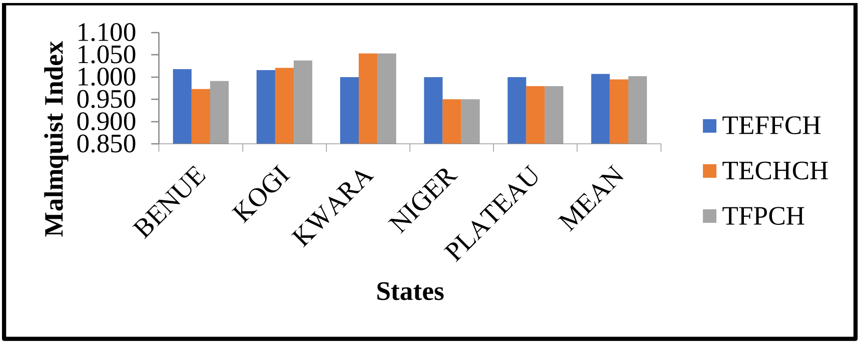
Table 23: Mean technical efficiency changes in the food crops production in North-Central Nigeria

STATES	PECH	SECH	TEFFCH	TECCH	TFPCH
COWPEA	1.005	1.002	1.007	0.995	1.002
MAIZE	1.000	0.996	0.996	1.002	1.018
YAM	0.995	0.991	0.986	0.982	0.968

Isonguyo, *et al*., 2020

i. Cowpea

Technical efficiency change for cowpea production was positive for all the states studied and the mean was 1.007, as shown in Table 23. This indicated a 0.7% increase in technical efficiency change of cowpea production. The most efficient state in the production of cowpea was Benue, although, the evolution of technical efficiency by the states was positive in all the states. As shown in Figure 2, Benue State achieved a 1.018 technical efficiency change, which indicated a 1.8% increase in cowpea production. Kogi and Kwara States recorded 1.021 and 1.053 technological changes, which indicated 2.1% and 5.3% improvement in the production technique used, respectively, in the production of cowpea by the two states. Benue, Niger and Plateau States achieved 0.973, 0.950 and 0.980 technological changes respectively, which suggested 2.7%, 5% and 2% reduction in technological changes respectively by the three states. These led to the reduced mean technical change to be 0.995, implying a 0.5% reduction in the cowpea production technique. However, Benue, Niger and Plateau States' total factor productivity changes were 0.991, 0.950 and 0.980, indicating 0.9%, 5% and 2% productivity regress for the optimum technological change, respectively by the three states. The mean total factor productivity change for all the states was 1.002, implying a 0.2% increase in productivity growth in the crop's production over the period studied.



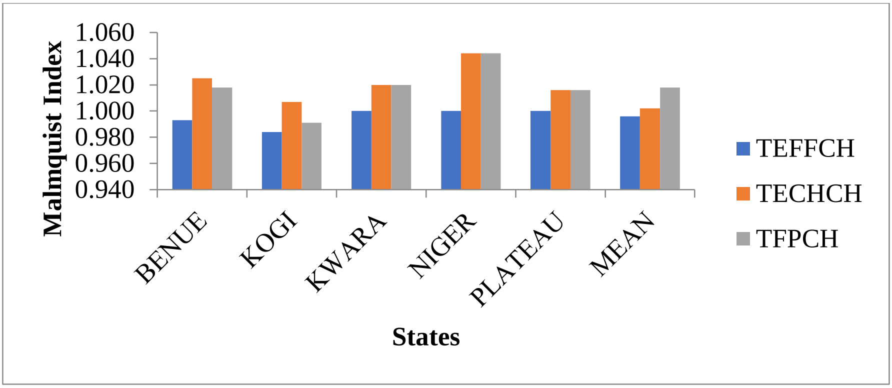
Note: TEFFCH = Technical Efficiency Change, TECHCH = Technological Change, TFPCH = Total Factor Productivity Change

Figure 3: Efficiency and productivity changes in cowpea production in North-Central Nigeria

Source: Isonguyo, *et al*., 2020

ii. Maize

In maize production, the mean technical efficiency change was 0.996, indicating a 0.4% reduction in technical efficiency change of the crop's production from optimum efficiency (See Table 21). Benue and Kogi States recorded 0.993 and 0.984, suggesting 0.7% and 1.6% reduction respectively in technical efficiency change. All the states studied achieved positive technological change in the maize production and the overall mean technological change was 1.002. This implied a 0.2% improvement in the maize production techniques. The mean total factor productivity change was 1.018, suggesting a 1.8% productivity growth in the crop's production by the states studied (See Figure 4).



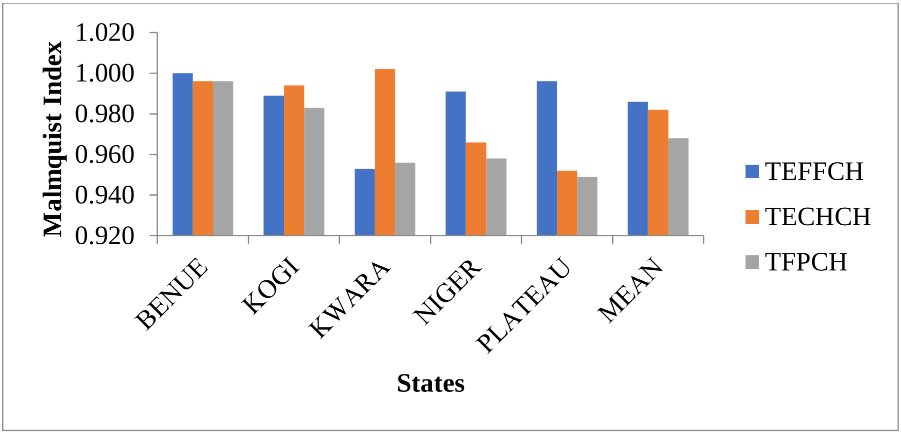
Note: TEFFCH = Technical Efficiency Change, TECHCH = Technological Change, TFPCH = Total Factor Productivity Change

Figure 4: Efficiency and productivity changes in cowpea production in North-Central Nigeria

Source: Isonguyo, *et al*., 2021

iii. Yam

The mean technical efficiency change for yam production was 0.986, as shown in Table 23. This suggested a 1.4% reduction in the contribution of technical efficiency change to the productivity growth of the crop. Only Benue State, among the states studied, recorded optimum technical efficiency change (1.000) in the yam production over the period studied in the study area. The mean technological change, was 0.982, suggesting a 1.8% reduction in the contribution of the production technique to the productivity growth of the crop (see Figure 3). These reduced technical efficiency and technological changes led to the reduced total factor productivity change to 0.968, which indicated a 3.2% reduction in productivity growth.



Note: TEFFCH = Technical Efficiency Change, TECHCH = Technological Change, TFPCH = Total Factor Productivity Change

Figure 5: Efficiency and productivity changes in yam production in North-Central Nigeria

Source: Isonguyo, *et al.*, 2021

2.2 FACTORS AFFECTING FARMERS' PRODUCTION EFFICIENCY AND PRODUCTIVITY IN NIGERIA

Having confirmed the production efficiency and productivity level of farmers in Nigeria, I will like to talk about identified factors affecting farmers' production efficiency and productivity in Nigeria.

1 The Impact of Market Access on Input Use and Agricultural Productivity among Cereal Crop Farmers in Niger State, Nigeria

a. Input Use and Aggregate Productivity by Farm Size and Market Access in the Study Area

The results of input use and aggregate productivity by farm size and market access in the study area are presented in Tables 24 and 25. In Table 24, the difference in the use of agrochemical and manure across market access group was significant at 5% while the difference in the use of fertilizer and improved seed was significant at 1% and 10% respectively, meaning that market access of cereal crop farmers led to increase in inputs used in the study area. A similar trend was observed in Table 25, the results revealed that there was a significant difference in the farmers' productivity across farm size groups with variations in market access in the study area. The finding shows that cereal crop farmers' productivity increased with easy market access to variable inputs across farm size in the study area. The farmers with easy access experienced greater productivity than those with difficult market access in the study area.

Table 24: Input use by market access in the study area

	Easy Access		Difficult Access		
Inputs	Mean	Standard Deviation	Mean	Standard Deviation	T value
Agrochemical	23.06	12.50	27.35	13.64	2.59**
Fertilizer	355.80	34.87	421.88	39.84	2.72***
Manures	9.23	5.06	10.55	3.43	2.56**
improved seed	7.36	4.02	4.59	2.28	1.79*

*, ** and *** significant at 10%, 5% and 1% probability level respectively

Source: Ojo *et al.*, 2021

Table 25: Aggregate productivity by farm size and market access in the study area

	Mean values of aggregate productivity				
	Easy Market Access		Difficult Market access		T-value
Farm Category	Mean	Standard Deviation	Mean	Standard Deviation	

Small Scale	14.85	2.47	6.22	3.65	0.78
Medium Scale	9.66	1.29	8.31	3.55	2.24**
Large Scale	9.82	2.17	7.87	1.63	3.14***
All farms	10.35	2.21	8.14	3.20	2.19**

*** Significant at 1% probability level respectively
Source: Ojo *et al*., 2021

b. Effect of Market Access on Productivity and Input Use Of Cereal Crop Farmers in the Study Area

The results of three stage least squares regression showing the effect of market access on productivity of cereal crop farmers is presented in Table 26. The results revealed that the market access (MA) had positive and significant effect on cereal crop farmer's productivity in the study area. The results in Table 26 further show the effect of market access on input use of cereal crop farmers in the study area. The results in Table 26 further revealed that market access had positive and significant effect on fertilizer (FERT); agrochemical (AGCH) and high yielding seed used (HYS) at 5%, 5% and 1% probability levels respectively. This implies that the quantities of fertilizer, agrochemical and high yielding seeds used increased with easy market access (or decrease in time to market).

Table 26: Three stage least square (3SLS) regression coefficients and t values

	Productivity (ModelI)	Fertilizer used (Model II)	Agrochemical used (Model III)	High yielding seed (Model IV)

Explanatory Variables	Coefficient (T-value)	Coefficient (T-value)	Coefficient (T-value)	Coefficient (T-value)
FERT	0.15*** (8.13)	-	-	-
AGCH	0.41** (2.40)	-	-	-
HYS	0.12 (0.02)	2.56*** (6.17)	-0.03 (-0.89)	-
MA	0.02*** (2.73)	0.25** (2.05)	0.0046** (2.30)	0.01*** (2.68)
LBR	0.07 (7.73)***	-	-	-
CRED	-	-3.60 (-0.82)	0.04 (0.14)	1.08** (2.05)
FSIZE	-	0.58*** (3.06)	1.22*** (9.18)	1.79*** (9.86)
EXTN	-	-	-0.01 (-0.55)	-0.02 (-0.86)
R^2	0.26	0.18	0.30	0.30
Chi^2	25.01***	453.19***	257.26***	8.57**

*, **, ***=significant at 10%, 5% and 1% probability level respectively

Figures in parentheses are t-values

Source: Ojo *et al*., 2021

2. Effect of Insurgency on food crop Farmers' productivity in Borno and Gombe States, Nigeria

a. Input Required and Obtained by Food Crop Farmers in both the States

The summary of inputs required and obtained by the food crop farmers in both States are presented in Tables 27. The results in Tables 27 revealed that in Borno State, the mean pesticides, fertilizer, seed and farm size required were 3.37 litres, 88.58kg, 3.30kg and 2.83ha, while the quantity used were 0.58 litres, 11.51kg, 0.06kg, and 1.35ha respectively and the differences were statistically significant ($p<0.05$).

Also, in Gombe State, the mean pesticides, fertilizer, seed and farm size required were 3.5litres, 178.6kg, 6.6 and 5.3ha, while the quantity used were 1.3 litres, 39.3kg, 1.7kg, and 2.4ha respectively and the differences were statistically significant ($p<0.05$). This is an indication that farmers had less access to productive inputs and this might have been due to the conflict caused by the insurgency in the study area thereby affecting their productivity.

Table 27: Summary statistics of food crop farmers' access to various farm inputs in Both States

	Borno States			Gombe State		
Inputs	Input Required	Input Obtained		Input Required	Input Obtained	
	Mean	Mean	Difference	Mean	Mean	Difference
Herbicide (litres)	10.93	1.04	9.89***	19.80	2.60	17.20***
Insecticide (litres)	3.37	0.58	2.79***	3.50	1.30	2.20***
Fertilizer (kg)	88.58	11.51	77.07***	178.60	39.30	139.30***
Farmyard manure (kg)	262.63	62.97	199.66***	359.60	223.10	136.50***
Improved Seed (kg)	3.30	0.06	3.24***	6.60	1.70	4.90***
Farm Size (Ha)	2.83	1.35	1.48***	5.30	2.40	2.90***

*** = Significant at 1% level of probability.

Source: Ojo *et al.*, 2018

b. Output of Food Crop Farmers in Borno and Gombe States

The mean outputs of food crop farmers in Borno and Gombe States during the study period are as presented in Table 28. The result showed that in Borno State a mean output of 706.85Kg was obtained which was less than what was obtained in Gombe State (2,846.19kg) with a mean difference of 2139.34kg which is statistically significant at 1% level of probability. This could be as a result of less insurgency attack experienced in Gombe State.

Table 28: Summary statistics of food crop farmers output in the study area.

Variables	Mean	Minimum	Maximum	Mean Difference
Borno Output (Kg)	706.85	225.00	3200.00	2139.34***
Gombe Output (Kg)	2846.19	400.00	31810.00	

*** = Significant at 1% level of probability

Source: Ojo *et al*., 2018

c. Partial Factor Productivity of Food Crop Farmers in the Study Area

The results of partial productivity indices of inputs such as farm size, labour, fertilizer, seed and agrochemical are presented in Table 29. The partial productivity of land use, fertilizer, seed, agrochemical and labour were greater in Gombe State than Borno State and the differences were statistically significant. This differences in partial productivity could be attributed to the instability resulting from insurgencies experienced in Borno State because most farm operations are planned and timed, but with the challenges associated with insurgencies most of the farm resources were wasted due to improper timing of weeding and harvesting.

Table 29: Summary statistics of the partial productivity of inputs used by the food crop farmers in the study area.

	Borno State	Gombe State	
	Mean Partial Productivity	Mean Partial Productivity	Difference
Farm Size (Ha)	499.86	1104.22	604.36***
Labour (man day)	11.08	15.38	4.30**
Fertilizer (kg)	10.94	29.39	18.45***
Seed (kg)	217.79	459.84	242.05***
Agrochemical (Litres)	403.37	1541.77	1137.63***

*** = Significant at 1% level of probability, ** = Significant at 5% level of probability
Source: Ojo *et al*., 2018

d. Effect of Insurgency on Food Crop Farmer's Productivity in the Study Area

The result showing the effect of insurgency on food crop farmers' productivity in the study area is presented in Table 30. The results revealed that quantity of fertilizer applied, farming experience, level of education and farm size were directly related to productivity and significant at 1%, 5% and 10% level of probability respectively. This indicates that a unit increase in these variables holding other factors constant led to increase in the productivity of the farmers by 0.7520, 1.086, 0.1695, 0.4925 and 0.2535 respectively. Conversely, insurgency was indirectly related to productivity and was statistically significant at 1%, level of probability. This indicates that incidence of insurgency led to a decrease in food crop farmers' productivity.

Table 30: Effect of insurgency on food crop farmers' productivity in the study area

Variables (n=238)	**Coefficients**	**t values**
Constant	4.1434	4.95

Farm Size (ha)	0.2535*	1.74
Labour (man-days)	0.3577	0.45
Fertilizer (kg)	1.0861***	7.32
Seed (Kg)	-0.0046	-0.05
Agrochemical (Litre)	-0.0689	-1.34
Age (Years)	-0.7520***	-4.72
Household Size	0.0667	1.10
Level of Education (Years)	0.4925*	1.81
Farming Experience	0.1695**	2.24
Insurgency	-0.4971***	-8.96
Gender	-0.0850	-0.77
R^2 Square	0.5248	
Adjusted R^2 Square	0.5017	
F- Ratio	13.55***	

*** = Significant at 1% level of probability, ** = Significant at 5% level of probability, * = Significant at 10% level of probability
Source: Ojo *et al*., 2018

3. Effect of Adoption of Improved Seed Technologies on Productivity of Small Scale Sorghum Farmers

The results on the effect of adoption of improved seed technologies on productivity of small scale Sorghum farmers are presented in Table 31 with double-log production function as the lead equation. The results showed that quantity of Samsorg-5 seeds (X_1), Samsorg-14 seeds (X_2) and Samsorg-17 seeds (X_3) had positive and statistically significant relationship with productivity of the farmers in the study area. This implies that a percentage increase in these inputs holding others constant led to increase in productivity in the study area. The results further revealed that, farm size (X_4), fertilizer (X_5) and agrochemicals (X_8) had direct relationship with productivity of sorghum farmers and they were statistically significant at 1% levels of probability.

Table 31: Effect of adoption of improved seed technologies on productivity of small scale sorghum farmers in the study area (Double-log production function as lead equation)

Variables	**Linear**	**Semi-log**	**Double-log**	**Exponential**
Samsorg-5 seeds (kg) (X_1)	-3.8991 (-0.90)	-2.6922 (-0.51)	0.0484 (2.26)**	-0.1320 (-1.05)
Samsorg-14 seeds (kg) (X_2)	3.8629 (2.11) **	6.2486 (2.53) **	0.2782 (3.02) ***	0.1865 (2.47) **
Samsorg-17 seeds (kg) (X_3)	-5.0900 (-1.07)	-5.0494 (-0.89)	0.2367 (2.34)**	0.0772 (0.62)
Farm size (Ha) (X_4)	1.5519 (1.48)	3.9066 (1.45)	0.3741 (3.03) ***	0.1521 (2.36) **
Fertilizer (kg) (X_5)	0.0430 (5.68) ***	13.1911 (7.73) ***	0.8918 (10.19) ***	0.0030 (8.34) ***
Labour (manday) (X_6)	0.0036 (0.11)	2.7851 (0.85)	0.0337 (0.22)	-0.0006 (-0.32)
Capital (Dep. Naira) (X_7)	-0.0004 (-1.89) *	-2.3684 (-1.31)	-0.0583 (-1.15)	-0.00001 (-1.29)
Agrochemicals (litre) (X_8)	0.2141 (1.21)	5.1915 (3.20) ***	0.2150 (4.37) ***	0.0087 (1.07)
Age (years) (X_9)	0.02116 (0.41)	1.4188 (0.80)	0.0279 (0.37)	0.0008 (0.27)

Educational (years) (X_{10})	-0.3031 (-1.75) *	-1.2368 (-1.51)	-0.0374 (-1.13)	-0.0084 (-1.17)
Sex (X_{11})	1.1327 (0.38)	1.3984 (0.39)	0.0578 (0.37)	0.0540 (0.40)
Marital status (X_{12})	4.8962 (2.77) ***	5.7755 (2.47) **	0.3375 (3.15) ***	0.2886 (2.05) ***
Constant	24.2048 (1.65) *	94.0789 (4.47) ***	7.3381 (10.32) ***	2.3216 (4.40) ***
R^2	0.2487	0.3664	0.6120	0.4771
Adjusted R^2	0.2090	0.3329	0.5915	0.4495
F-Ratio	11.13***	15.79***	47.38***	23.43***

Figures in parenthesis are t-values, *** = significant at 1%, ** = significant at 5% and * = significant at 10% level of probability
Source: Ojo *et al.*, 2019

4. Determinants of Total Factor Productivity Change (TFPCH) in the Production of Yam in North-Central Nigeria

The results of the factors that determined the total factor productivity change in the study area is as presented in Table 32. The results indicate that institutional factor (amount of credit borrowed), government policy (ATA), capital and labour had positive and significant relationship with yam productivity growth at $P \leq 0.05$, $P \leq 0.05$, $P \leq 0.05$ and $P \leq 0.01$, respectively, during the period of the study. This implies that increase in the farmers' utilization of these factors led to increase in yam's productivity growth. Capital-labour was significant at $P \leq 0.01$ but was negatively related to the crop's productivity growth in the study area.

Table 32. Tobit model of the determinants of total factor productivity change in yam in North-Central Nigeria

	Coefficient	t-value

Variables		
Amount of Credit (₦/K)	3.00e-06**	2.58
Rainfall (mm^3)	0.035	0.68
Government Policy: ATA	0.22**	2.56
Capital (₦/K)	0.03**	2.54
Labour (Man-day)	0.02*	1.87
Capital-labour (Ratio)	0.41*	-1.80
Constant	0.31	
Chi^2	3.25	
PseudoR^2	0.85	
Log Likelihood	-25.26	

*= significant at 0.10; ** = significant at 0.05; *** = significant at 0.01.

Source: Isoguyo *et al*., 2021

In summary, research findings had shown that most farms in Nigeria are operating below optimum productivity and efficiency frontier because of the following reasons:

- Low market access to farm inputs e.g. land, labour, water, chemical and organic fertilizers and physical capital
- High level of Insecurity which had made farmers to abandoned their farms in the affected area
- Low public investment in agricultural research, extension services and infrastructural development
- Inconsistent agricultural policy reform
- Low level of education, training and human capital on agricultural productivity growth
- Low access to credit facilities
- low quality seeds supply

- Nigerian agriculture is dominated by small holders and aged farmers who use rudimentary production techniques

RECOMMENDATIONS

Having confirmed the low level of productivity among farmers and identified the sources of inefficiency in Nigerian agriculture, the following recommendations are made to improve on the productivity and production efficiency in Nigerian agriculture:

1. **Improved market access to farm inputs**: Improved market access to production inputs such as fertilizer, herbicides and other agrochemicals will enhance timely operations which will ultimately improve agricultural productivity in Nigeria.
2. **Agricultural extension Services**: Information on new production technologies and resource allocation could easily be disseminated to farmers through extension agents, therefore, the ratio of extension agents to farmers should be increased. This will improve the managerial ability of farmers and promote efficient utilization of existing technologies with consequent increased productivity and efficiency in agriculture.
3. **Adequate credit facilities**: There should be provision of adequate credit facilities which will ensure timely and adequate utilization of agricultural inputs for improved farm productivity and production efficiency.
4. **Increase in the use of fertilizer**: Fertilisers increase farmers' productivity. It helps increase production and improve food security, which is especially important since Nigeria is expected to have the third-largest population by 2050. As soil fertility deteriorates, fertilizer use must increase. Governments need to

ensure the right type of fertilizers are available at the right price, and at the right times.

5. **Provision of high yield seed**: More research into high yield seeds technology should be given attention. This will boost crop production and productivity
6. **Farmers' capacity building**: The Nigerian farmers through their cooperative societies should concentrate on building self-capacity, through trainings on how to allocate their production resources to increase the efficiency and obtain optimum output.
7. **Provision of Irrigation facilities**: Due to climate change which has affected weather patterns, government in collaboration with all stakeholders in agriculture should make irrigation facilities available which will encourage all seasons' crop production

CONCLUSION

Mr. Vice-chancellor Sir, distinguished academics, ladies and gentlemen, permit me to conclude this lecture by saying that the existence of inefficiency in Nigeria agriculture implies that there is still room to improve the productivity and efficiency in the farming activities in order to meet the food need of the teeming population of Nigeria, if the above-mentioned inefficiency sources can be adequately addressed. This requires an urgent attention because a hungry man is not only an angry man, he can be violent and unreasonable. The only medication for hunger is food.

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Almighty God

I want to give praise, honour and adoration to the Lord God Almighty who raises up the poor out of the dust, and lifts up the beggar from the dunghill, to set them among princes, and to make them inherit the

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Vice Chancellors

First and foremost, I want to extend my sincere appreciation to Prof. Kuta Farouk (The incumbent Vice Chancellor of our own dear University-Federal University of Technology, Minna) and all the management staff for having me here today. Thanks so much Sirs and Ma. I am also most gratefully indebted to all the F.U.T., Minna Vice Chancellors since I joined the service of the University (Profs. Tukur Sa'ad, M.S. Audu, Mufutau .A. Akanji and Abdullahi Bala) under whom I have had the privilege to serve in various capacities. I appreciate you Sirs for this great opportunity and for creating conducive environment to work under your leaderships.

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THE BRIEF PROFILE OF THE INAUGURAL LECTURER

Professor Ojo Michael Akindele was born on June 6, 1971 to the family of Late Mr and Mrs Ojo Samuel Ogundana in Itapa Ekiti, Oye Local Government Area, Ekiti State. He had his primary education at Methodist Primary School, Itapa Ekiti in 1982 and secondary education at Itapa-Osin Community Grammar School Itapa Ekiti in 1987. On completion of his secondary education, Prof. Ojo proceeded to Federal College of Agriculture Akure, Ondo State where he bagged his National Diploma in General Agriculture in 1992. In 1999, he graduated from Federal University of Technology, Akure, Ondo State with Second Class Honour (Upper Division) in B. Agric. Tech. Agricultural Economics and Extension. He did his mandatory National Youth Service Corps (NYSC) at Methodist High School, Ogwule-Agatu Benue State, Nigeria. He went further to Nigeria Premier University-The University of Ibadan, where he obtained his M.Sc. Agricultural Economics in 2003. He later obtained his Ph.D Agricultural Economics in 2013 from Federal University of Technology, Minna, Niger State.

Before he joined the service of the University, he worked as the General Manager in Primax Solution Company Nig. Limited between 2004 and 2006. He joined the service of Federal University of Technology Minna in 2007 as Lecturer II in the Department of Agricultural Economics and Extension Technology. He grew through the ranks and became Professor of Agricultural Economics in 2019. He has occupied several positions at the Departmental and School Levels, respectively. In the Department, he served at various times as Association of Agricultural Economics and Extension Students' adviser, 200 Level Adviser and Post Graduate Coordinator, At the

School Level, he emerged as the Deputy Dean of School of Agriculture and Agricultural Technology between 2015 and 2019) and he is currently the Deputy Dean, Postgraduate School of this University He was also the Secretary, National ASUU Finance and Investment Committee between 2011 and 2013. Further, he has also served at various committees at the University, School and Department levels.

He has over 17 years of teaching and research experience in the area of Agricultural Production Economics with special interest in establishing and improving the efficiency and productivity of farmers with the aim of enhancing food production and security. Moreover, he has conducted researches ranging from small, medium and large-scale farm production with the aim of identifying the factors and constraints that affect the food crop and poultry farmers production, productivity and efficiency in order to proffer solutions to them thereby increasing food security status of the people.

As a mentor, he has supervised over 50 undergraduate research projects, more than 25 Masters theses and 10 PhD theses. Prof. Ojo has over 90 publications covering his areas of research interest and has also attended professional, local and international conferences. He has also taught Introductory Economics, Introductory Statistics, Introduction to Agricultural Economics, Agricultural marketing, Econometrics and Application of computer to agriculture at undergraduate level, Mathematical Economics, Advanced Statistics and Research Methodology at Postgraduate level. He has also been involved in research consultancy in various Federal Government and World Bank Assisted Projects. He is happily married to Dr. Ojo Alaba Olanike and they are blessed with children.

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