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# Growth Trend Analysis of Rice Productivity in Nigeria

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**Rice is an economically important food security crop, cultivated in almost all of Nigeria's 36 States. Nigeria spends more than 356 billion naira (2.24 billion US dollars) annually on rice import. This study set out to analyses rice total factor productivity in Nigeria ecological zones and the growth trend between 1996 to 2010. Statistical information on domestic and imported quantities of rice was obtained for 15 years (1996 to 2010) from the AGROSTAT system of the statistical division of the Food and Agriculture Organization (FAO), Federal Ministry of Agriculture statistical bulletins, Central Bank of Nigeria statistical bulletins and National Bureau of Statistic.(NBS). The data were analyzed using Malmquist Index, a non-parameter methodology that uses Data Envelopment Analysis (DEA) methods. The impact of economic reforms on efficiency and productivity was examined. Evidence suggests total factor productivity registered a negative growth during the reform period in the country as a whole and almost all the ecological zones witnessed higher total factor productivity in the post 2000 period. Decomposition of the Malmquist productivity index shows that improvement in technical efficiency rather than technical progress had contributed to the observed acceleration of the growth rate.**

**Keywords:** Nigeria, rice total factor production, growth trend, economic reform, Malmquist Index

## INTRODUCTION

Nigeria is the most populous African nation with over 153 million people. The land area is almost 98.3 million hectares and has potentials for development, with her enormous natural and human resources (Ukeje, 2000; Burren, 1998). Despite these endowments**,** Nigeria is still characterized by inequality in income distribution, poor health and education standards, high unemployment rate, high debt and relatively low agricultural productivity.

According to Oshikoya (1990), the Nigerian post-independence economy can be viewed in three distinct phases namely, the first phase from 1960 to 1973; second phase 1974 to 1982 and third phase 1983 to present. During the first phase, the economy was largely sustained by agriculture and substantial expansion in infrastructure, public utilities and the construction sectors were supported by the agricultural sector (Tackie and abhulimen, 2001). Economic growths in the second phase were largely propelled by increasing oil export. This induced huge public investment and over importation of foreign-made goods. Increases in oil price in 1973/74 and 1979/80 further

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precipitated huge transfer of wealth to the country. Consequently, the government embarked on the expansion of urban based construction, transportation, communication networks, and an ambitious construction of a new national capital territory in Abuja. Increases in public sector investment were also accompanied by expansion of general government consumption. As a result, aggregate expenditure exceeded domestics output by a large margin. In the second phase, agricultural took a back seat on the oil sector, contributing only 1% to export trade.

Due to the mismanagement of the resources in the second phase, the third phase witnessed serious economic deterioration, external debt crises, financial fragility, and rising inflation

Thus, rice has become a strategic commodity in the Nigerian economy. Consequently, the Nigerian government has interfered in the rice sector over the past few decades. Public policy in this respect has neither been consistent nor appropriate and domestic production has continued to lag behind demand. Given the current globalisation trend and an increasingly competitive world economy, Nigeria faces some strategic choices in relation to the rice economy (Nghiem, 1999).

In many parts of Africa, the major challenge facing agriculture is how to increase farm production to meet changing food needs without degrading the natural resource base. The agricultural sector is the most important in African economies employing as much as 50–80 per cent of the labour force (Johnston, 1961). About two-thirds of the 627 million people living in Sub-Saharan Africa (SSA) depend on agriculture or agriculture-related activities for their livelihoods (Ehui and Pender, 2003). It is estimated that throughout the region, there are 236 million agricultural poor, which represents 60 per cent of the agricultural population and 80 per cent of the total number of poor in the region (Dixon et al., 2001). Therefore, agriculture continues to remain important in rural SSA and indicators of rural well-being are closely related to agricultural performance.

In most African countries, because of its importance in overall GDP, export earnings and employment as well as its forward and backward linkages to the non-farm sector, growth in the agricultural sector will continue to be the cornerstone of poverty reduction. Increased agricultural productivity and growth, driven by technology and investments, has a powerful dynamic effect that benefits the poor throughout the economy: directly through increased agricultural income and employment, and indirectly through increased food availability and lower food prices as well as through the demand created by increased agricultural incomes for non-farm goods and services produced by the very large, employment intensive non-agricultural rural economy.

However, importation of food is still needed to curb the increasing gap between food demand and food production. As shown by several studies, one of the most critical problems in Africa today is how to increase agricultural production to meet increasing food demand arising from an increase in population pressure (Mensah, 1989; Timberlake, 1990; Pretty, 1995).

The decline in food and agricultural per capita production over the years has become synonymous with the region's stagnation, social decline and marginalization in the world. Unless renewed measures are taken by the governments and people of the region to dramatically increase agricultural production, there will be continued deterioration and stagnation.

In light of the general objective of attaining regional self-sufficiency in agricultural products, governments and institutions have sought strategies that would lead to higher levels of production. A key factor for a sustained increase of agricultural production is improvement of productivity.

The study seeks to achieve the following objectives:

- Examine the trends in rice production in Nigeria.
- Estimate the total factor productivity of rice production in Nigeria
- Identify the potential for further growth level in rice production

## METHODOLOGY

The study was carried out in Nigeria, located in West Africa between latitudes $4^0$ to $14^0$ North and between longitude $2^02^1$ and $14^030^1$ . It is bounded to the north by the Niger Republic and Chad, in the west by Benin republic, in the east by Cameroon Republic and the south by the Atlantic Ocean. Nigeria has a land area of about 923,769km$^2$; a North-south length of about 1450km and west – east breadth of about 800km. Its total land boundary is 4047km while the coastline is 853km. This study was based on time series secondary data obtained from various sources spanning from 1970 -2011. Data are obtained from various AGROSTAT Bulletins which include various edition of National Bureau of Statistics review of external trade, National Bureau of Statistics summary and annual abstract of statistics, Central Bank of Nigeria's economic and financial review and an online database maintained by Food and Agricultural Organization (FAO).

The analytical techniques for this study involved the use of descriptive and inferential statistics; the descriptive statistics involved the use of graphs to examine the movement of various components of rice production while the Malmquist Productivity Index was used to examine the various component of total factor productivity of rice in Nigeria.

**Model Specification**

**The Malmquist Productivity Index Measure of Total Factor Productivity**

This study adopted the Malmquist Productivity Index measure of Total factor productivity using Data envelopment analysis (DEA) following Ajetomobi (2009).
The TFP measurement base on the Malmquist index was originally introduced in a consumer theory context as a ratio between two deflation or proportional scaling factors deflating two quantity vectors unto the boundary of utility possibilities (Malmquist, 1953). Caves, Christensen and Diwert (1982) later applied the distance function approach in a general production function framework while fare, Grosskoptf, Lindgren and Proos (1989) in a non-parametric DEA framework. The DEA framework is a natural approach which requires neither profit maximization nor cost minimization but only quantity data (Hjalmarsson and Veiderpass, 1992). The distance function can be defined in terms of inputs and outputs. An input distance function considers a production technology by looking at a minimal proportional contraction of input vector given an output vector while an output distance function vector given an input vector. The Malmquist productivity index (MPI), as proposed by Caves, et al (1982), allows one to describe multi-input and multi-output production without involving explicit price data and behavioural assumptions. The MPI identifies TFP growth with respect to two time periods through a quantitative ration of distance functions. In this study, output distance functions will be used. Assuming that for each time period t = 1, 2, …, T, $x_1 \epsilon R_+^N$ $and$ $y_t \epsilon R_+^M$ denote respectively an 1 X N input vector and an 1 x M output vector for period t. (t=1,2, …, T). The set of production possibilities is given by the closed set,

$$S_t = \{(x_t.y_t): x_t \text{ can produce } y_t\} \quad (1)$$

Where technology is assumed to have the standard properties such as convexity and strong disposability, as described in Fare, Grosskopf, Norrisand Zhang (1994). The output sets are defined in terms of $S_t$ as:

$$P_t (x_t) = \{y_t : (x_t , y_t) \epsilon S_t\} \quad (2)$$

According to Shephard (1970), the output distance function in t for any productivity unit would be:

$$d_0^t (x_t , y_t) = \inf \{\theta: (y_t /\theta) \epsilon P_t (x_t)\} \quad (3)$$

Where: subscript "o" stands for "output oriented". The distance function was the Farell's reciprocal measurement (Farell, 1957). This distance function represents the smallest factor, θ by which an output vector $y_t$ is deflated so that it can be produced with a given input vector $x_t$ under period t's technology. That is, $d_0^t$ $(x_t ,y_t)$ provides a standardized average of distance of a unit in the period t to frontier t of production set when inputs are constant. It will take the value of less than 1if the output vector y is an element of the feasible production set. It will take the value of 1 if y is located on the outer boundary of the feasible set value of greater that 1if y is located outside the feasible production set. The productivity change using technology of period t as reference is as follows:

$$M_0^t (x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_0^t\left(x_{t+1}, y_{t+1}\right)}{d_0^t\left(x_1, y_t\right)}\right] \quad (4)$$

Similarly, we can measure MPI with period t+1 as reference as follows:

$$M_0^{t+1} (x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_0^{t+1}\left(x_{t+1}, y_{t+1}\right)}{d_0^t\left(x_1, y_t\right)}\right] \quad (5)$$

In order to avoid choosing arbitrary period as reference, Fare et al., (1994) specify the MPI as the geometric mean of the above two indices.

$$M_0 (x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_0^t\left(x_{t+1}, y_{t+1}\right)}{d_0^t\left(x_1, y_t\right)} * \frac{d_0^t\left(x_{t+1}, y_{t+1}\right)}{d_0^t\left(x_1, y_t\right)}\right]^{½} \quad (6)$$

Equation (6) can be decomposed into the following two components, namely' efficiency change index which measures the output oriented shift in technology between two periods and when it is greater or less than one, the exist some improvements or deterioration in the relative efficiency of this unit, the second component is the geometric average of both components and measures technical change between period t+1 and t. The first component in technical change measures the position of unit t+1 with respect to the technologies in both periods. The second component also estimates this for unit t. If the technical change is greater (or less) than one, then technological progress (or regress) exists.

$$\text{EFFCH} = \frac{d_0^{t+1}\left(x_{t+1}, y_{t+1}\right)}{d_0^t\left(x_1, y_t\right)} \quad (7)$$

and Type equation here.

$$\text{TECHCH} = \left[\frac{d_0^t\left(x_{t+1}, y_{t+1}\right)}{d_0^{t+1}\left(x_{t+1}, y_{t+1}\right)} X \frac{d_0^t\left(x_t, y_t\right)}{d_0^{t+1}\left(x_1, y_t\right)}\right]^{\frac{1}{2}} \quad (8)$$

In order to take congnisance of the return to scale properties of the technology, Grifell-Lovell (1995) used a one input, one output example to illustrate that Malmquist index may not correctly measure TFP changes when Variable Return to scale (VRS) is assumed for the technology. Hence, Constant Return to scale (CRS) is imposed upon the technology used to estimate the

**Table 1: Malmquist mean distances summary**

| Year | t-1 | T | t+1 |
|---|---|---|---|
| 1996 | 0.000 | 0.593 | 1.203 |
| 1997 | 0.434 | 0.584 | 1.106 |
| 1998 | 0.421 | 0.646 | 0.022 |
| 1999 | 0.462 | 0.042 | 0.646 |
| 2000 | 0.013 | 0.506 | 0.693 |
| 2001 | 0.432 | 0.494 | 0.597 |
| 2002 | 0.551 | 0.505 | 0.624 |
| 2003 | 0.462 | 0.491 | 0.551 |
| 2004 | 0.470 | 0.502 | 0.564 |
| 2005 | 0.511 | 0.509 | 0.747 |
| 2006 | 0.507 | 0.521 | 0.646 |
| 2007 | 0.465 | 0.522 | 0.000 |
| 2008 | 0.433 | 0.513 | 0.543 |
| 2009 | 0.429 | 0.524 | 0.559 |
| 2010 | 0.452 | 0.488 | 0.492 |

Source: Computed using FAO survey data

distance functions for the calculation of the Malmquist index for this study. There exist several methods of estimating the distance functions which makes up the Malmquist TFP index. The most popular and widely adopted in recent time has been the DEA-like linear programming (LP) methods suggested by Fare et. al (1994) and its parametric equivalent-stochastic frontier method. Given availability of panel data, Fare, et al, (1994) used DEA method to estimate and decompose the Malmquist TFP index. The DEA method is a non-parametric approach in which the envelopment of decision-making units (DMU) can be estimated through LP methods to identify the best practice for each DMU. For the ith firm, Fare et al 1994 calculated four distance functions to measure TFP change between two periods. Assuming CRS technology in their analysis, the requires LPs are:

$$[d_0^t(x_t, y_t)]^{-1} = Max_{ø,\lambda}ø \quad (9)$$

s.t $- øy_{it} + Y_t\lambda \geq 0$

$x_{i,t} - X_t\lambda \geq 0$

$\lambda \geq 0$

$$[d_0^{t+1}(x_{t+1}, y_{t+1})]^{-1} = Max_{ø,\lambda}ø. \quad (10)$$

st $- øy_{i,t+1} + Y_{t+1}\lambda \geq 0$

$x_{i,t+1} - X_{t+1}\lambda \geq 0$

$\lambda \geq 0$

$$[d_0^t(x_{t+1}, y_{t+1})]^{-1} = Max_{ø,\lambda}ø. \quad (11)$$

st $- øy_{i,t+1} + Y_t\lambda \geq 0$

$x_{i,t+1} - X_t\lambda \geq 0$

$\lambda \geq 0$

$$[d_0^{t+1}(x_t, y_t)]^{-1} = Max_{ø,\lambda}ø. \quad (12)$$

st $- øy_{i,t} + Y_{t+1}\lambda \geq 0$

$x_{i,t} - X_{t+1}\lambda \geq 0$

$\lambda \geq 0$

Where: $\lambda$ is a N x 1 vector of a constant and $\theta$ is a scalar with $\theta$ greater than 1

## RESULTS AND DISCUSSIONS

### Descriptive Information

The overall technical efficiencies was discussed in table 1, it indicate an overall positive trend over time for the sample states in Nigeria. The table shows the mean for the production of rice respectively. In Nigeria, there is a big increase in their productivity growth between the year 2001 - 2002 while in the year 1997 - 1998 experienced a negative trend in their productivity growth.

It is clearly shown in the table that there productivity growth in Nigeria is very low within the period considered. Nigeria experienced a big decrease of overall in term of their productivity growth. It is shown that t+1 were consistently efficient and lie on the best practice frontier during the period after period considered especially 1996-1997, and 1997-1998. 1998-1999 was the lowest in terms of productivity growth. Productivity growth increased in year 2003-2004 basically because of the market reform on rice productivity promulgated by the Nigeria government. It

**Table 2: Average Annual Changes of Index by State and Technology, 1995-2006**

| Years | Eftch | Techch | Pech | Sech | Tfpch |
|---|---|---|---|---|---|
| 1995-1996 | 0.983 | 0.584 | 1.000 | 0.983 | 0.574 |
| 1996-1997 | 1.137 | 0.583 | 1.000 | 1.137 | 0.663 |
| 1997-1998 | 0.026 | 39.235 | 1.000 | 0.026 | 1.002 |
| 1998-1999 | 28.351 | 0.024 | 0.835 | 33.933 | 0.690 |
| 1999-2000 | 0.987 | 0.824 | 1.031 | 0.933 | 0.813 |
| 2000-2001 | 1.029 | 0.875 | 1.019 | 0.957 | 0.901 |
| 2001-2002 | 0.982 | 0.876 | 1.020 | 1.009 | 0.861 |
| 2002-2003 | 1.024 | 0.909 | 1.015 | 0.963 | 0.931 |
| 2003-2004 | 1.012 | 0.929 | 1.006 | 1.009 | 0.941 |
| 2004-2005 | 1.016 | 0.879 | 1.006 | 1.005 | 0.893 |
| 2005-2006 | 0.997 | 0.878 | 1.006 | 1.010 | 0.875 |
| 2006-2007 | 0.881 | 0.901 | 1.006 | 1.110 | 0.898 |
| 2007-2008 | 0.999 | 0.921 | 1.045 | 0.934 | 0.911 |
| 2008-2009 | 0.811 | 0.856 | 1.002 | 0.982 | 0.631 |
| 2009-2010 | 0.923 | 0.934 | 1.608 | 1.303 | 0.913 |
| Mean | 0.985 | 0.833 | 0.993 | 0.992 | 0.820 |

*Effch = Efficiency Change
Techch = Technical Change
Pech = Pure Efficiency Change
Sech = Scale Efficiency Change
Tfpch = Total Factor Productivity Change.

reveals that total factor productivity registered a positive growth during the period in the country as a whole.

As shown in Table 1, the reform had the highest value in the 1997-1998 with a value added of 0.646 while it recorded the lowest productivity growth in the 2003-2004 respectively.

## Average Annual Changes of Malmquist Indexes

The result in table 2 shows the average productivity growth on rice agriculture in Nigeria in between 1995-2006. On average, the efficiency change index (Effch) was 0.983 in 1995-1996 to 1.137 in 1996-1997 respectively, efficiency change index has highest mean in 1998-1999 with a value of 28.351 and this implies a growth in efficiency change and decline in technical efficiency which suggest that increase in total factor productivity in Nigeria rice agricultural production arose from the innovation in technology rather that the improvement in technical efficiency. The decrease in technical efficiency was partially due to the decline in scale efficiency as well as the fall in pure efficiency change for that year.

Among the years under this research study, 5 years 1998-1999, 2000-2001, 2002-2003, 2003-2004 and 2004-2005 had a positive average growth rate in total productivity growth after the period considered. From the assumption of uniform agricultural technology for the 37 states (Table 2), 1997-1998 experienced the highest growth in technical change while other years had a negative average growth rate in technical change recall that a value greater than unity represents an improvement of efficiency and productivity. Therefore through out the period under the study only 1997-1998 recorded a positive growth in technical change that is above.

The component measures of (Pech C and Sech C) appears that both pure and scale technical efficiency have contributed to the growth of overall efficiency 2002-2003 had the highest in pure efficiency charge while its scale efficiency suffered the greatest decline in the country. 1998-1999 experienced the largest fall in pure efficiency while 1997-1998 had the largest fall in scale efficiency.

The positive evolution of scale efficiency suggests that the agricultural sector (Rice agriculture) succeeded in taking advantage of the growing size of the sector while the improvement we observed in pure technical efficiency over the study period, as predicted by theories of intra-form diffusion (Kalirajah and Shand 2001).

Scale efficiency experienced bug year by year fluctuation which inducing big fluctuations in the overall technical efficiency. This situation may be due to the large difference between states in performing scale efficiency change.

The table 2 further shows an average annual TFP growth of which is negative with a value of 0.820, this could have been better if the decrease in TFP had not been so intense

Graphical representations of the trend of efficiencies change over time are illustrated in figure 1

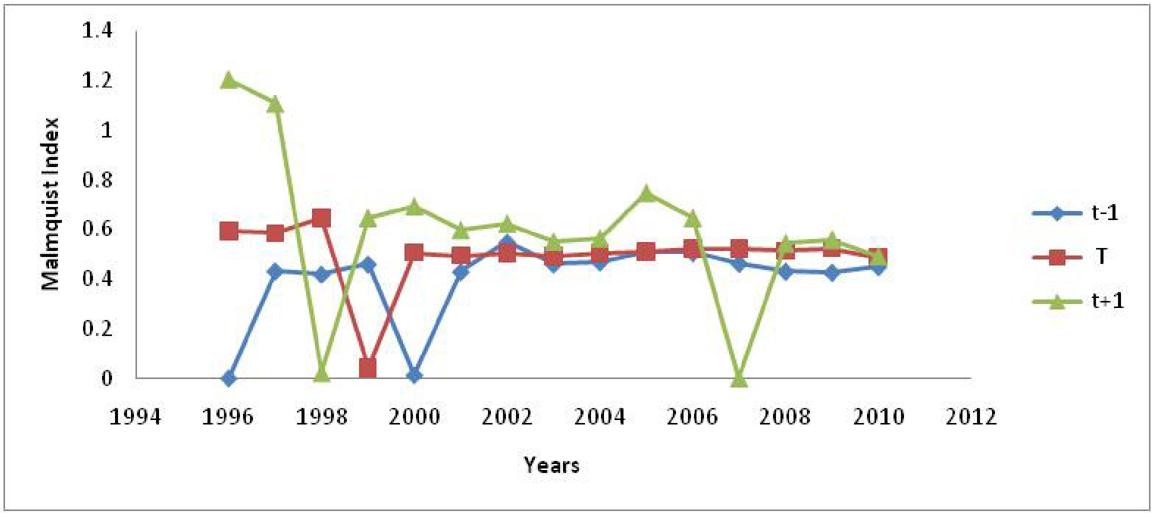


**Figure 1: Evolution of efficiencies change over time**

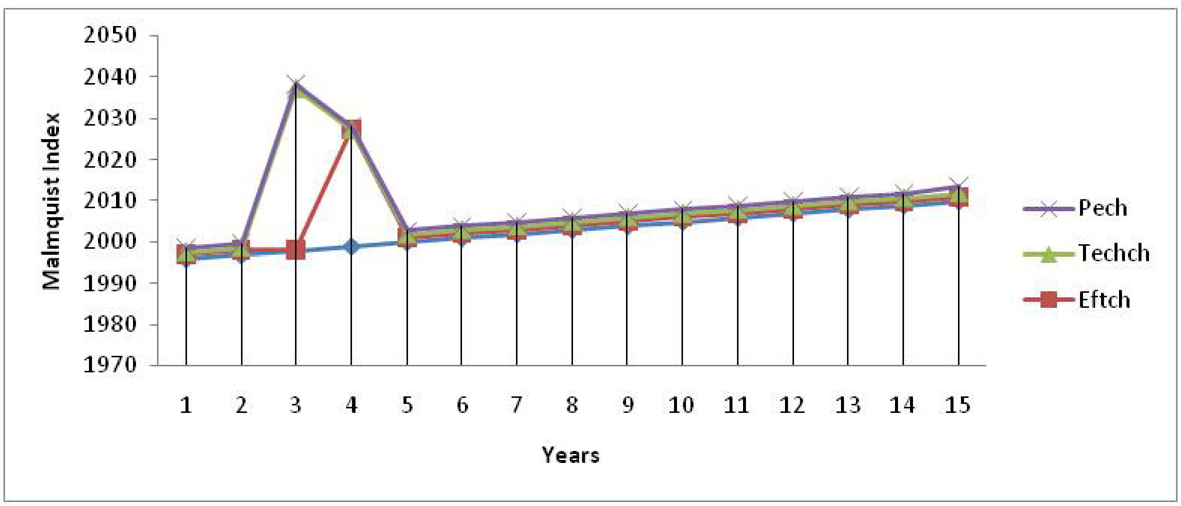


**Figure 2: Evolution of total factor productivity change over time**

during the period. The figures suggest gain in 1997-1998 which is 0.2%, but these gain are probably concentrated in a small subset of the states since both the indices of pure technical efficiency and scale efficiency present a reduction. With respect to the index of pure technical efficiency, the results indicate a constant in the dispersion in the distribution of states around the best practice during the first three years, but there is a reversal of the situation in 1998-1999. Analyzing the average performance in 1995-2006, it becomes evident that the negative performance attributed to the technical charge index could be interpreted as a contraction of the best-practice frontier and that there is a decline in terms of pure technical efficiency.

**Mean Total Factor Productivity Change of Nigeria Ecological Zones**

Table 3 includes the mean values of measure of change in total factor productivity index and its components (efficiency change and technical change). Looking at the samples as a whole, the change in total factor productivity of the rice productivity of Nigeria was negative and on average it decreased by -0.15 percent annually.

Only tropical dry forest and tropical mountain forest experienced the greatest improvement in efficiency change at value of 1.0002 and 1.0868 respectively, while the

**Table 3: Mean Total Factor Productivity Change of Nigeria Ecological Zones**

| Nigeria Ecological Zones | Effch | Techch | Pech | Sech | Tfpch |
|---|---|---|---|---|---|
| Fresh Water Swamp | 0.9168 | 0.8760 | 0.922 | 0.924 | 0.799 |
| Sahel Savanna | 0.9748 | 0.8393 | 0.922 | 0.998 | 0.832 |
| Sudan Savanna | 1.0002 | 0.8060 | 0.993 | 1.006 | 0.805 |
| Rain Forest | 0.9655 | 0.8285 | 0.922 | 0.9733 | 0.7985 |
| Guinea Savanna | 0.987 | 0.8162 | 0.992 | 0.9964 | 0.805 |
| Mangrove Swamp Forest | 1.0868 | 0.8586 | 0.995 | 1.0914 | 0.940 |
| Mean | 0.985 | 0.8330 | 0.993 | 0.998 | 0.820 |

Source: Computed using FAO survey data (1996-2010)

**Table 4: Comparison between technical efficiency change and technological change**

| Nigeria Ecological Zones | Effch > Techchc | Techchc > Effchc |
|---|---|---|
| Fresh Water Swamp | * | |
| Sahel Savanna | * | |
| Sudan Savanna | * | |
| Rain Forest | * | |
| Guinea Savanna | * | |

(*)= Yes
( ) = No

tropical rain forest recorded a negative growth in efficiency change with a value of 0.9168

Table 3 further showed that, the Techch (Technical Efficiency) had negative growth in technical change for most years. This shows technical progress resulted in very little improvement in its agricultural productivity. All the ecological zones in Nigeria had a negative technical change throughout the years -0.167 percent annually and also experienced a big decrease in overall pure technical efficiency change which further decomposed into scale efficiency change. The results showed that both the pure and scale efficiency have contributed to the growth of overall efficiency and this suggests that, in achieving high levels of technical performance over time, technical efficiency is not a long run constraint.

The little positive value of the scale efficiency (Table 3) in tropical dry forest and tropical moist forest suggests that the unorganized market reforms has succeeded in taking advantage of the growth in size in that ecological zones, while the constant or decline in pure technical efficiency over the period in that ecological zones, suggest that there was a learning process as predicted by theories of intra-form diffusion (Kalirajan and Shard, 2001).

The constant fluctuation in pure technical efficiency and scale efficiency during the period contributed to the fluctuations in overall technical efficiency.

The total factor productivity change was negative (-0.18 percent per year). This suggests that for the sampled states all the component of total factor productivity has been the main constraint of achievement of high levels of total factor productivity during the reference period.

## CONCLUSION AND RECOMMENDATIONS

The findings of the study reflect that annual rate of productivity growth has been higher in the period as compared to the pre-forms period, the composition of productivity growth into technological change and efficiency change reveals that the latter has played a major role in the period. The period had also witnessed a decline in the pace of technical regress and a number of the ecological zones have in fact reported technological progress during the same period.

The observed technical regress may be due to deterioration in the quality of inputs, an issue that need to be addresses. Poor performance in technical efficiency and total factor productivity in many ecological zones in Nigeria indicated a great potential for Nigeria to increase agricultural productivity through improved technical efficiency.

Furthermore, continuously expanding market economy and enhancing rural education may also help farmers to adopt new technology to improve technical efficiency and productivity that helps increase efficiency, transfer technology, implement best agricultural practices and provides access to credit market opportunities and inputs such as fertilizer and other chemicals.

Efforts are needed not only from within the ecological zones but also from the international community to ensure that the right mixture of policies is put in place to promote and sustain agricultural production.

The results of this study have important policy implication for policy targeting. The principal difficulty in the long run lies in the slow or negative rate of increase in technical change. This indicates that there is a growing urgency for sustained improvements of technology, which require a more active role for the public sector and international agencies in research and extension activities in collaboration with farmers to raise the technology level significantly over time.

This suggests a possible avenue for public policy action, incentives for the dissemination of the best practice production in order to reduce the degree of dispersion in the observed levels of Nigerian farmers' technical efficiency.

It is therefore recommended that governments in the ecological region should implement economy side and sectoral policies that promote agricultural productivity growth. These policies should be included within an agricultural development framework with the same production technology.

**REFERENCES**


Burren R (1998). Africa South of the Sahara (27ed) Europa publication Ltd, New York

Cave KP (1982). *Fundamental Methods of Mathematical Economics 4th Edition*. Boston: McGraw-Hill

Dixon R, Maddala GS, Trueblood M (2001). Modeling technology as a dynamic error components process: the case of the inter-country agricultural production function. Econ.Rev. 22:289-306.

Ehui D, Pender A (2003). North-South Research and Development Spillover. Econ. J. 107(440): 78 – 84

Fare R, Grosskopf S, Lindgren B, Proos P (1989). Productivity development in Swedish hospitals: A Malmquish output index approach. Southern Illinois University, Carbondale.Department of Economics Discussion Paper 89-3.

Färe R, Grosskopf S, Norris M, Zhang Z (1994). Productivity growth, technical progress, and efficiency change in industrialized countries.*American Economic Review* **84**: pp. 66–83.

Farrell MJ (1957). The Measurement of Production Efficiency. J. Royal Stat. Soc.20 A. 257 - 281.

Hjalmarsson L, Veiderpass P (1992). Productivity in Swedish electricity retail distribution. Scand. J of Economics, 94 supplement 193-205.

Johnston B, Mellor J (1961). The role of agriculture in economic development. Am. Econ. Rev. 51(4), 566–593.

Kalirajrar K, Shand RT (2001). "Estimating Location-Specific and Firm-Specific Technical Efficiency: An Analysis of Malaysian Agriculture." ***Journal of Economic Development*** 11(3):147–60.

Malmquist S (1953). Index numbers and indifference curves. Trabajos de Estatistica, 4, 1, 209 - 42.

Mensah J (1989). "Argentina's economic reforms expand growth potential for agriculture." *Agricultural Outlook* (1989) 24-30.

Nghimen M (1999). Productivity change and dynamic comparative advantage. Rev. Econ. Stat. 68:241-247.

Oshikoya TW (1990). The Nigerian Economy: A macro-econometric and Input-Output Model Preager, New York

Pretty PL (1995). Vietnam: decollectivization and rice productivity growth. *Economics Development and Cultural Change* **40(4)**, pp. 697–718.

Takie NO, Abhulimen OS (2001). ''Impact of Structural Adjustment Programme on the Agricultural Sector and Economy of Nigeria'' A staff paper for the University of Tuskegee.

Timberlake NC (1990). Market reform, incentives and economic development in Vietnamese rice production. *Comparative Economic Studies* **48(2)**, pp. 277-301.

Ukeje EU (2000). '' Productivity in the Agricultural Sector'' A staff paper from CBN, pp 137- 156