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Empirical Analysis of Agricultural Productivity Growth in Sub-Sahara Africa: 1961-2003

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Abstract: This study examined changes in agricultural productivity in Sub-Sahara Africa countries in the context of diverse institutional arrangements using Data Envelopment Analysis (DEA). From a time series which consists of information on agricultural production and means of production were obtained from FAO AGROSTAT and rainfall data from Steve O'Connell data base. The information was for a 43-year period (1961-2003); DEA method was used to measure Malmquist index of total factor productivity. A decomposition of TFP measures revealed the observed increase in the TFP in the sub–Sahara Africa agriculture is due to technological change rather than efficiency change which is the main constrained of achieving higher level of TFP during the reference period.

Key words: Data envelopment analysis % Efficiency % Productivity % Sub-saharan Africa

INTRODUCTION

Background to the Study and Statement of the Problem: Like many developing economies, agriculture is the dominant sector of the Sub-Saharan African (SSA) countries for growth, poverty alleviation, contribution to GDP, employment and incomes. The growth and development of this crucial sector is essential for the overall process of socioeconomic development in the region. For agricultural sector to achieve these objectives, various governments and institutions have sought strategies that would lead to higher levels of production and a key factor for a sustained increase of agricultural production is improvement of productivity, which is carried out through technological change and efficiency change. Hence, increasing agricultural productivity in Sub-Sahara Africa countries has received a wide spread attention in the literature on economic development and poverty alleviation. Since agricultural growth is linked to farm profit, there had been considerable research that examined the performance of this crucial sector in the region [1,2].

As observed by Nkamleu [3], many African farmers are still using low yielding agricultural technologies, which lead to low productivity. Also, it is always argued that, relevant question for agricultural policy makers, is whether the agricultural sector can be made more efficient, by achieving more output with the current input level, or achieving the current output with less input usage than is currently observed. An important step in answering this question is to identify the behavior of productivity and its components.

The concept of efficiency is at the core of economic theory. The theory of production economics is concerned with optimization and this implies efficiency. The crucial role of efficiency in increasing agricultural output has been widely recognized by researchers and policy makers alike. It is no surprise; therefore, that considerable effort has been devoted to the analysis of the farm level efficiency in developing countries. An underlying premise behind much of this work is that if farmers are not making efficient use of the existing technology, their efforts designed to improve efficiency would be more cost effective than introducing new technologies as a means of increasing agricultural outputs [4]. The issue of determining the pattern and the efficiency of resource use in traditional farming arises in the context of formulating development strategies designed not only to raise the productivity of resources already committed to the farming but also to ensure that the newly created resources in the agricultural development efforts are allocated to areas and for enterprises in which their productivities are higher [5].

In order to collectively raise productivity, global and regional productivity growth in agriculture has been the focus of intense research in the past few decades.

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Economists [6] have examined the sources of productivity growth over time and the productivity differences among countries and regions over this period. Productivity growth in the agricultural sector is considered important in the Sub-Saharan region of Africa if agricultural sector output is to improve at a rate equal to or greater than the population growth rate to meet the demand for food and raw materials. Also, productivity performance in the agricultural sector is critical to improvement in the economic well being of these countries. Unlike previous studies that have measured and compared intercountry agricultural productivity which have been motivated by a variety of issues including identifying the primary sources of productivity growth and comparing the structural and productivity differences among the countries. This study however goes further to examine the influence of selected governance indicator on productivity growth in SSA.

SSA has witnessed structural adjustment in recent times to promote rural development through the introduction of 'modern' technologies (e.g. hybrid maize, fertilizer and other inputs) and 'modern' public institutions like co-operatives, marketing boards and parastatals. The introduction of modern technologies was attempted largely on the basis of the public provision of seasonal credit. Co-operatives, marketing boards and parastatals were frequently granted crop-marketing monopolies partly in order to allow credit recovery through crop sales.

The main policy emphases were to upgrade production systems and increasing agricultural commercialization. The model was heavily dependent on transfers of high levels of development assistance and highly expensive, it is therefore imperative to examine the growth witnessed in the sector after various reforms. Since output from agriculture can be broadly classified into two main groups: Crop and Livestock, the non-parametric DEA approach provides an attractive option. Therefore, this study used Data Envelopment Analysis (DEA) technique to calculate Malmquist TFP index numbers, hence, aims to provide understanding of agricultural productivity growth in sub-Sahara Africa.

This study addressed several questions such as: What is the status of agricultural productivity in SSA? Was the green revolution accompanied by declining productivity growth? Has SSA agricultural productivity declined sharply as perceived? Are there major differences in sub-regional productivity growth? The broad objective of the study is to examine the performances of each country in Sub-Saharan African countries agricultural productivity.

MATERIALS AND METHODS

Productivity growth is generally defined in terms of the improvement and technical change with which inputs are transferred into outputs in the production process; see e.g. Shih-Hsun *et al.*, [7]. Indexes of productivity can therefore be simply referred to as the ratio of aggregate output index to an index for total factor use. In assessing growth, sustainability and competitiveness in the agricultural sector, proper identification and measurement of agricultural productivity growth, particularly when technical change in the sector is factor-biased rather than Hicks-neutral is very important.

Broadly based empirical analyses in agriculture have focused on global [8], regional [9] and country level performance (e.g. Alabi, 2005). At the beginning of examining cross-country agricultural productivity, cross-sectional data were used to estimate a Cobb-Douglas production technology using regression methods e.g. Hayami and Ruttan, [10] and Capalbo and Antle [11]. The focus of these earlier studies were generally on the estimation of the production elasticities and investigation of the contributions of farm scale, education and research in explaining cross-country labour productivity differentials [12].

Recently, several studies have investigated cross-country differences in agricultural productivity levels and growth rates, according to Coelli and Rao [12], this is most likely driven by availability of FAO data, development of new empirical techniques and the desire to assess the degree to which the various agricultural development programmes have improved agricultural productivity in developing countries. Fulginiti, *et al.*, [9] explore agricultural productivity performance across some 41 African nations using innovative production techniques (in particular, the seldom-used Fourier functional form) and exploring the role of institutions (colonial heritage, for one) as an influence on differential productivity growth. Productivity change, estimated at an average 0.83% per year since 1960, is found to be higher in those African nations with a British heritage, less armed conflict and higher levels of political freedom.

There are different methods for estimating the total factor productivity (TFP) growth e.g. Malmquist and Tornquist indexes. The former had gained popularity in recent years since Fare *et al.,* [13] apply the linear programming approach to calculate the distance functions that make up the Malmquist index. According to Shih *et al,* [7], since Data Envelopment Analysis (DEA) type of analysis can be directly applied to calculate the index, the Malmquist index has the advantage of computational ease, does not require information on cost or revenue shares to aggregate inputs or outputs, consequently, less data demanding and it allows decomposition into changes in efficiency and technology. This method does not attract any of the stochastic assumptions restriction, however, it is susceptible to the effects of data noise and can suffer from the problem of 'unusual' shadow prices, when degrees of freedom are limited [12].

The issue of shadow prices is important and is one that is not well understood among authors who apply these Malmquist DEA methods; also, DEA methods in measuring productivity growth which made it distinct from pure index approach such as Fisher and Tornkvist indexes is that it does not require any price data, more so that agricultural input price data are seldom available and could at times be distorted by the government policies.

According to Chambers (1988), productivity can be used to measure rate of technical change in production and can be conceptualized as two main components; partial factor productivity (PFP) and total productivity. Partial factor productivity is the ratio of output to a specific input. Denoting Y as the output and x_i as any individual input factor, then partial factor productivity of input x_i is

$$PFP = \frac{Y}{x_i}$$

this only measure the contribution of one particular input to technical change, ignoring the effects from other input factors; while total factor productivity (TFP) is the partial product of all input factors. It is the ratio of output to an index of inputs. If X denote the index of all inputs, then TFP is

$$TFP = \frac{Y}{X} = \frac{Y}{\sum b_i X_i}$$

Where $\$_i$ is the weight of input x_i and can be measured using indexes.

Farrell, [14] identifies two types of efficiency: Technical efficiency that evaluates a farmer's ability to obtain maximum possible output from a given set of inputs and allocative efficiency which measures marginal revenue of products with marginal cost of inputs. Traditionally, econometric procedures were used to measure technical and allocative efficiencies given the technology and process. However, this requires the specification of production technology. In the late 1970s, a mathematical programming approach known as Data Envelopment Analysis (DEA) was developed to measure technical efficiency by comparing the individual firm's production to the best practice frontier [15]. The contribution of Farrell was path breaking as noted by Forsund and Sarafoglou [16] in their article "On the origin of Data Envelopment Analysis". Efficiency measures were based on radial uniform contractions or expansions from inefficiency observations to the frontier. Thomson and Thrall [17] observed Farrell seminal paper was followed by a relatively large number of refinement and extensions, which may be broadly classified into three schools of thought and identified as Afriat School, Charnes School and Shepherd School. Afriat School covers econometricians' parametric estimation approach, while the last two may more accurately be termed axiomatic production theory school.

The 1978 paper "Measuring the efficiency of decision making unit (DMU)" by A. Charnes, W. Cooper and E. Rhodes (CCR) is quite similar to Farrell concept of efficiency measurement. As pointed out with interest by Forsund and Sarafoglou [16], the one unique contribution of CCR is the explicit connection made between a productivity index in the form of a weighted sum of outputs on a weighted sum of inputs and the Farrell technical efficiency measurement in the case of constant returns to scale (CRS). This was the starting point in CCR: finding weight by maximization of such a productivity ratio subject to best practice and normalization constraints. The so called ratio form of CCR, corresponds to the natural science engineering concept of micro productivity ratios and economists' concept of efficiency making explicit the interpretation of primal and dual solutions. It shows how to calculate useful features like marginal productivity and in the later development when the constant returns to scale format of CCR was extended to variable returns to scale and also scale elasticity [18].

This study applied Malmquist index developed by Fare *et al.*, [13] to measure the contribution from the progress in technology and improvement in technical efficiency to the growth in agricultural productivity in Sub-Sahara African countries. The Malmquist index is constructed using the DEA based Malmquist approach and is more interesting because it allows calculation of technical progress and technical efficiency and thereby extending the Nishimuzu and Page [19] approach to a non-parametric frame work. This further decomposition is important for facilitating a multilateral comparison that may help explain and characterize the differences and similarities in growth patterns of different countries.

Fulginiti *et al.,* [9] examined the TFP in SSA from 1960 - 1999 using a stochastic frontier which introduces a number of restrictions such as aggregation of crop and livestock data as the quantity of agricultural production in Million USD. It is not necessary to assume that a production unit is operating on its production frontier and improvements in TFP can therefore occur as a result of either improvement in technical efficiency (moving closer to the production frontier) or improvement in technology (outward shifts of the production frontier). However, there is a practical limitation due to short samples in many DEA applications. This problem could not be alleviated by an approach to productivity analysis with panel data that uses the full set of observations. Brockett *et al.*, [20] present an application of rank statistics to evaluate efficiency performance trends using productive efficiency measures derived through various DEA models using full panel data, although this approach is ordinal in nature and does not use the obtained productivity scores.

Data Envelopment Analysis (DEA): DEA is linear-programming methodology, which uses data on input and output quantities of a Decision Making Units (DMU) such as individual firms of a specific sectors to construct a piece-wise linear surface over data points. In this study, the countries were used as the DMU. The DEA method is closely related to Farrell's original approach [14] and it is widely being regarded in the literature as an extension of that approach. This approach was initiated by Charnes *et al.,* [15] and related work by Fare, Grosskopf and Lovell [21]. The frontier surface is constructed by the solution of a sequence of linear programming problems. The degree of technical inefficiency of each country, which represents the distance between the observed data point and the frontier, is produced as a by-product of the frontier construction method.

DEA can either be input or output oriented depending on the objectives. The input-oriented method, defines the frontier by seeking the maximum possible proportional reduction in input usage while the output is held constant for each country. The output-oriented method seeks the maximum proportional increase in output production with input level held fixed. These two methods, that is, input-output oriented methods provide the same technical efficiency score when a constant return to scale (CRS) technology applies but are unequal when variable returns to scale (VRS) is assumed [22]. In this study, the output-oriented method will be used by assuming that in agriculture, it is common to assume output maximization from a given sets of inputs. The interpretation of CRS assumption has attracted a lot of critical discussion e.g. Ray and Desli, [23], Lovell, [24], but also monotonicity and convexity are debatable e.g. Cherchye, *et al.,* [25].

Fare *et al.*, [13] used Data Envelopment Analysis (DEA) methods to estimate and decompose the Malmquist productivity index. The DEA method is a non-parametric approach in which the envelopment of decision-making units (DMU) can be estimated through linear programming methods to identify the "best practice" for each DMU. The efficient units are located on the frontier and the inefficient ones are enveloped by it. Four linear programs (LPs) must be solved for each DMU in this study (Country) to obtain the distances defined in equation (iii) and they are:

$$\left[d_o^t(x_t, y_t)\right]^{-1} = \text{Max}_{f,l} f, \qquad \text{(I)}$$

$$\begin{aligned} s.t \quad & -f y_{it} + Y_t l \geq 0 \\ & x_{i,t} - X_t l \geq 0 \\ & l \geq 0 \end{aligned}$$

$$\left[d_o^{t+1}(x_{t+1}, y_{t+1})\right]^{-1} = Max_{f,l} f, \qquad \text{(ii)}$$

$$\begin{aligned} st \quad & -f y_{i,t+1} + Y_{t+1} l \geq 0 \\ & x_{i,t+1} - X_{t+1} l \geq 0 \\ & l \geq 0 \end{aligned}$$

$$\left[d_o^t(x_{t+1}, y_{t+1})\right]^{-1} = \text{Max}_{f,l} f, \qquad \text{(iii)}$$

$$\begin{aligned} st \quad & -f y_{i,t+1} + Y_t l \geq 0 \\ & x_{i,t+1} - X_t l \geq 0 \\ & l \geq 0 \end{aligned}$$

$$\left[d_o^{t+1}(x_t, y_t)\right]^{-1} = Max_{f,l} f, \qquad \text{(iv)}$$

$$\begin{aligned} st \quad & -f y_{i,t} + Y_{t+1} l \geq 0 \\ & x_{i,t} - X_{t+1} l \geq 0 \\ & l \geq 0 \end{aligned}$$

Where 8 is a N X 1 vector of a constant and *N* is a scalar with *N* $.

Over time best practice are natural and to include frontier shifts, that is, technical change, the Malmquist productivity index is a well established measure.

Malmquist Productivity Index: The Malmquist productivity index, as proposed by Caves, Christensen and Diewert [26], allows one to describe multi-input, multi-output production without involving explicit price data and behavioral assumptions. The Malmquist Productivity Iindex identifies TFP growth with respect to two time periods through a quantitative ratio of distance functions [27]. Distance functions can be classified into input distance functions and output distance functions. Input distance functions look for a minimal proportional contraction of an input vector, given an output vector, while output distance functions look for maximal proportional expansion of an output vector, given an input vector. By using distance functions, the Malmquist Productivity Index can measure TFP growth without cost data, only with quantity data from multi-input and multi-output representations of technology. In this study, we use output distance functions. According to Hjalmarson and Veiderpass [28], The Malmquist (quantity) index was originally introduced in a consumer theory context as a ratio between two deflation or proportional scaling factor deflating two quantity vectors onto the boundary of a utility possibility set. This deflation or distance function approach was later applied to the measurement of productivity in Caves, Christensen and Diewert [26] in a general production function framework and in a non-parametric setting by Fare, Grosskopf, Lindgren and Roos [29]. The productivity change, that is TFP change (TFPCH) using technology of period *t* as reference is as follows:

$$M_o^t(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)}\right] \quad \text{(v)}$$

Similarly, we can measure Malmquist productivity index with period t+1 as references as follows:

$$M_o^{t+1}(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^{t+1}(x_t, y_t)}\right] \quad \text{(vi)}$$

in order to avoid choosing arbitrary period as reference, Fare *et al.,* [13] specifies the Malmquist productivity index as the geometric mean of the above two indices

$$M_o(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)} \frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^{t+1}(x_t, y_t)}\right]^{1/2} \quad \text{(vii)}$$

equation (vi) can be decomposed into the following two components namely efficiency change index (EFFCH) which measures the catching up components measuring efficiency change in relation to the frontier at different time. The second component is the geometric average of both components and measures technical change (TECHCH) which measure the technology shift between period t and *t+1.* The first component in TECHCH 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 TECHCH is greater (or less) than one, then technological progress (or regress) exists.

$$EFFCH = \frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)} \quad \text{(viii)}$$

and

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

Methodology: The study was based on the data that were drawn from the FAO web site (AGROSTAT) and it covers a period of 43 years (1961-2003). The following are some of the main features of the data series were used for the study. The data consists of information on agricultural production (Crop and Livestock index) and means of production such as total rural population and total agricultural area for each of the selected countries were FAO statistic database, while rainfall was obtained from Steve O'Connell's website.

Measurement of Variable

Output: Crop and Livestock index
Input: (a)Total agricultural area (1000ha)
(b)Total rural population (1000)
(c)Rainfall (weighted)
(d)Irrigation (1000ha)

RESULTS AND DISCUSSION

Fare *et al.,* [21] made known that the output distance function is the equivalent of the inverse of Farell's measure of output efficiency. This study used malmquist index to measure the productivity growth of agricultural sector for thirty–six countries in sub–Saharan African countries between 1961–2003. The method used constructed the best – practice frontier in agricultural production for the sampled countries and later compared according to regions which sub-Sahara African countries was broken into, that is, (West Africa; Southern Africa;

Table 1a: Malmquist Index Summary of Country Means

Country	Effch	Techch	Tfpch
Angola	0.999	1.019	1.018
Botswana	0.999	1.014	1.013
Burkina Faso	1.008	1.036	1.043
Burundi	0.984	1.031	1.015
Cameroon	0.990	1.030	1.020
Cape Verde	1.000	1.024	1.024
Chad	0.999	1.020	1.019
Côte d'Ivoire	1.005	1.034	1.039
Djibouti	1.000	1.039	1.039
Gabon	0.995	1.040	1.035
Gambia	1.000	1.002	1.001
Ghana	0.992	1.029	1.021
Guinea	0.988	1.035	1.022
Guinea Bissau	0.988	1.027	1.015
Kenya	1.007	1.032	1.039
Lesotho	0.982	1.002	0.984
Madagasca	0.983	1.034	1.016
Malawi	0.994	1.027	1.020
Mali	1.003	1.023	1.027
Mauritania	1.000	1.013	1.013
Mauritius	0.997	1.008	1.005
Mozambique	0.989	1.025	1.014
Namibia	0.996	1.016	1.011
Niger	1.006	1.011	1.017
Nigeria	1.004	1.027	1.031
Rwanda	0.998	1.022	1.020
Sao Tome	1.000	1.007	1.007
Senegal	0.985	1.028	1.012
Sierra Leone	0.961	1.027	0.987
Sudan	1.004	1.025	1.029
Swaziland	0.982	1.016	0.997
Tanzania	1.003	1.026	1.029
Togo	0.985	1.015	1.000
Uganda	0.981	1.022	1.003
Zambia	0.998	1.024	1.023
Zimbabwe	0.990	1.034	1.024
Mean	0.994	1.023	1.017

East Africa; Horn of Africa; Central Africa; and Indian Ocean). Malmquist productivity indexes as well as efficiency change and technological change components for each country in the sample were calculated. Since this index is based on discrete time, each country has an index for every pair of years.

Table 1a presents mean Malmquist Indices by country for the period of study while Table 1b shows annual means. Table 1b reveals that Burkina Faso, Cote d'Ivoire, Kenya and Djibouti as the four countries with the highest TFP growth. Burkina Faso has about 4.3% average growth in TFP; this is due to 8% growth in technical efficiency and 3.6% growth in technological change. Though, Kenya, Djibouti and Cote d'Ivoire equally have TFP growth of 3.9%, for Kenya and Cote d'Ivoire, technological change accounted for 3.2 and 3.4% while efficiency marginally changed by 0.07 and 0.05% respectively. For Djibouti, technical progress solely accounted for the TFP growth. The findings further revealed that Lesotho, Sierra – Leone and Swaziland had negative TFP growth of 0.16, 0.13 and 0.03% respectively. A decline of 1.8; 3.9 and 1.8% in the technical efficiency were responsible for the decline TFP.

Table 1b: Malmquist Index Summary of Annual Means

Year	Effch	Techch	Tfpch
1962	0.996	1.025	1.021
1963	1.062	0.956	1.016
1964	0.942	1.156	1.089
1965	0.944	1.043	0.985
1966	1.087	0.907	0.986
1967	1.062	0.935	0.993
1968	0.872	1.223	1.067
1969	1.060	0.941	0.997
1970	1.066	1.030	1.098
1971	1.007	1.006	1.013
1972	0.952	1.066	1.015
1973	1.116	0.911	1.017
1974	0.995	0.952	0.948
1975	1.077	0.966	1.041
1976	0.935	1.104	1.033
1977	0.996	1.041	1.037
1978	1.050	0.909	0.954
1979	0.845	1.190	1.005
1980	0.695	1.591	1.105
1981	1.217	0.821	0.999
1982	1.057	0.988	1.044
1983	1.187	0.905	1.074
1984	0.622	1.518	0.944
1985	1.332	0.746	0.994
1986	0.988	1.059	1.046
1987	0.865	1.209	1.046
1988	0.890	1.053	0.937
1989	1.114	0.896	0.998
1990	1.026	1.061	1.089
1991	1.091	0.917	1.001
1992	1.207	0.891	1.075
1993	0.936	1.002	0.937
1994	1.010	0.983	0.992
1995	1.078	0.924	0.996
1996	0.829	1.268	1.051
1997	1.053	0.956	1.006
1998	0.878	1.172	1.029
1999	0.882	1.099	0.968
2000	1.161	0.904	1.050
2001	0.997	1.027	1.024
2002	0.969	1.095	1.061
2003	0.994	0.997	0.992
Mean	0.994	1.023	1.017

Note that Effch (efficiency change); Techch (technological change); Tfpch (total factor productivity change)

Table 2: Comparison between technical efficiency change and technological change

Regions	Mean Effch	Mean Techch	Techch > Efffch
Central Africa	0.993	1.026	**
Horn of Africa	1.002	1.032	**
Southern Africa	0.992	1.020	**
East Africa	0.997	1.027	**
Indian Ocean Island	0.990	1.021	**
West Africa	0.995	1.023	**

** Indicates Yes.

Recall that the value greater than one implies increasing productivity and less than one productivity decrease from period *t* to period *t + l*. The mean values of TFP change ranged from 0.937 to 1.05; 0.985 to 1.098; 0.948 to 1.105; 0.937 to 1.089 and 0.937 to 1.075 for the whole period and sub–periods 1 to 4 respectively. The average TFP growth over the whole period was 1.8% per annum according to mean TFP change (TFPCH). The mean values for the 1st and 2nd sub–periods are 1.027 and 1.015 respectively. This implies that overall TFP growth is improving in the two periods and the highest TFP growth was observed in 1980 when TFP change is 10.5%. This is most likely due to various reforms, programs and policies adopted by countries in sub–Sahara. It is important to examine the main cause of improved productivity. The level of TFP of the agricultural sector can be improved either by change in technical efficiency or a shift in production frontier (technological change). Table 2 shows the comparison between technical efficiency change and technological change for the regions considered in the study Since efficiency change and technological change are the components measure of TFP, these two mean values were then compared to know the source of TFP growth in the sample period. On the average the efficiency change decreases by 0.06% while the technological change increased on the average by 2.3%. This suggests that the observed increase in the TFP in the sub–Sahara Africa agriculture is due to technological change rather than efficiency change which is the main constrained of achieving higher level of TFP during the reference period. It was further observed from the table that the technological change was responsible for the TFP growth in the entire region. Horn of Africa which comprises Djibouti and Sudan is the only region with both efficiency and technological change growth. This region experienced a TFP growth of 3.4%, followed by East Africa (2.3%); Central Africa (1.94%) and West Africa (1.8%). These other regions though showed technological progress without any significant improvement in the relative deviation from their corresponding frontier over the reference period. This implies that for West Africa, the region deteriorates by 0.06% in catching up with the frontier. The regional discrepancies in technical progress are obviously higher than the efficiency improvement; hence, regional TFP growth is largely determined by the technical progress.

Conclusion and Suggestions for Future Research: This study presents some important findings on level and trends in SSA agricultural productivity and further examined the political economics of agricultural productivity in SSA between 1961 and 2003. The findings revealed that the TFP growth was observed for all the countries except Madagascar, Cote d'Ivoire and Sierra Leone and the sources of the growth was found to be technological progress rather than efficiency change. In terms of sub-region, the horn of Africa which comprises Djibouti and Sudan is the only region with both efficiency and technological change growth and has a positive annual productivity change of about 0.08% given the technology. Given the fact that agriculture is a very important sector in SSA, the findings from this study revealed that activities of rural development has not really transformed into effective action despite all the funding from various donor agencies for poverty alleviation through rural development programmes.

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REFERENCES

1. Moock, P.R., 1973. Managerial Ability in Small Farm Production: An Analysis of Maize Yields in the Vihiga Division of Kenya. Ph. D. dissertation, Columbia University.
2. Lipton, M., 1988. The Place of Agricultural Research in the Development of Sub- Saharan Africa. World Development, 16: 1231-57.
3. Nkamleu, G.B., J. Gokowski and H. Kazianga, 2003. "Explaining The Failure of Agricultural Production in Sub-Saharan Africa" Contributed paper selected for presentation at the 25th International Conference of Agricultural Economists, August 16-22, 2003, Durban, South Africa.

4. Bravo-ureta, B.E. and R.E. Evenson, 1994. Efficiency in Agricultural Production: The Case of Peasant Farmers in Eastern Paraguay, The J. International Association of Agricultural Economics, 10(1): 27-28.
5. Awoyemi, T.T, J.O. Amao and N.C. Ehirim, 2003. Technical Efficiency in Aquaculture in Oyo State, Nigeria, Indian J. Agricultural Economics, 58(4): 812-813.
6. Block, S.A., 1995. The recovery of Agricultural Productivity in sub-Saharan Africa, J. Food Policy, 20(5): 385-405.
7. Shih-Hsun, H., Ming-Miin Yu and Ching-Cheng Chang, 2003. Analysis of Total factor Productivity Growth in China's Agricultural sector, Paper presented at the American Agricultural Economics Association Annual Meeting, Montreal, Canada, July, pp: 27-30.
8. Rao, D.S.P. and T.J. Coelli, 1998. Catch-up and Convergence in Global Productivity 1980-1995. Center for Efficiency and Productivity Analysis, Working Paper No 4/98, Department of Econometrics, University of New England, Armidale, Australia.
9. Fulginiti, L.E., K. Perin and B.Yu, 2004. "Institutions and agricultural productivity in Sub-Saharan Africa" Agricultural Economics, 31: 169-180.
10. Hayami, Y. and V. Ruttan, 1970. Agricultural Productivity Differences Among Countries, American Economic Review, 40: 895-911.
11. Capalbo, S.M. and J.M. Antle, (eds.) 1988. Agricultural Productivity: Measurement and explanation, Washington D.C. Resource for the future.
12. Coelli, T.J. and D.S. Rao, 2003. Total Factor Productivity Growth in Agriculture: A Malmquist Index Analysis of 93 Countries, 1980-2000, CEPA Working Papers, No. 2/2003, School of Economics, University of New England, Armidale, pp: 31.
13. Fare, R., S. Grosskopf and C.K. Lovell, 1994. Production Frontier. Cambridge University Press, Cambridge.
14. Farrell, M.J., 1957. The measurement of Productive Efficiency, J. the Royal Statistical Society, 120: 252-290.
15. Charnes, A., W.W. Coopers and E. Rhodes, 1978. "Measuring Efficiency of Decision Making Units, J. Operation Research Society, 2: 429-444.
16. Førsund, F.R. and N. Sarafoglou, 2000. On the Origins of Data Envelopment Analysis (DEA), Memorandum No 24/2000, ISSN: 0801-1117 Department of Economics, University of Oslo.
17. Thompson, R.G. and R.M. Thrall, 1993. Need for MS/OR in Public Policymaking. In: E.L. Rhodes, (ed.), Public policy applications of management science, Applications of Management Sci., 7: 3-21. Greenwich: JAJ Press.
18. Banker, R.D., A. Charnes and W. Cooper, 1984. Some Models for Estimating Technical and Scale Inefficiency in DEA. Management Sciences, 30: 1078-1092.
19. Nishimizu, M. and J.M. Page Jr., 1982. Total Factor Productivity Growth, Technological Progress and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia, 1965–1978. Economic J., 92: 920-936.
20. Brockett, P.L., W.W. Cooper, H.C. Shin and Y. Wang, 1998. Inefficiency and Congestion in Chinese Production Before and After the 1978 Economic Reforms. Socio-Econ. Planning Science, 32: 1-20.
21. Fare, R., S. Grosskopf and C.K. Lovell, 1985. Technical Efficiency of Phillipine Agriculture Applied Economics, 17: 205-214.
22. Coelli, T.J. and D.S. Rao, 2001. Implicit Value shares in Malmquist TFP Index Numbers. CEPA Working Papers, No. 4/2001, School of Economics, University of New England, Armidale, pp: 27.
23. Ray, S.C. and E. Desli, 1997. 'Productivity Growth, Technical Progress and Efficiency Change in Industrialized Countries: Comment. American Economic Review, 87(5): 1033-1039.
24. Lovell, C.A.K., 2001. 'The Decomposition of Malmquist Productivity Indexes. J. Productivity Analysis, 20(3): 437-458.
25. Cherchye, L., T. Kuosmanen and G.T. Post, 2000. 'What is the Economic Meaning of FDH, A Reply to Thrall. J. Productivity Analysis, 13(3): 259-263.
26. Caves, D.W., L.R. Christensen and W.E. Diewert. 1982. The Economic Theory of Index Numbers and the Measurement of Input, Output and Productivity. Econometrica, 50: 393-1414.
27. Malmquist, S., 1953. Index Numbers and Indifference Surfaces. Trabajos de Estadistica 4: 209-242.
28. Hjalmarsson, L. and A. Veiderpass, 1992. Efficiency and Ownership in Swedish Electricity Retail Distribution, J. Productivity Analysis, 3 nr.1/2.