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Productivity of Oil Palm Production Systems in Edo and Kogi States, Nigeria: A Total Factor Productivity Approach

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Abstract

Self-sufficiency in domestic palm oil supply remains unattainable in Nigeria, despite the various efforts of government to revive the subsector. The contribution of oil palm to employment and income in Nigeria is enormous. However, there is dominance of smallholders, low yield and inadequate documentation on productivity of the Oil Palm Production systems in the country. Thus, this study investigates Total Factor Productivity (TFP) of oil palm production systems in Edo and Kogi States, Nigeria using Tornqvist TFP index. Data were collected by administration of structured questionnaires using multistage sampling procedures. The results showed that the oil palm production in the study area is structured into small (≤ 10 hectare (ha), medium (11 – 50 ha) and large (≥ 51 ha). The TFP of the large, medium and small scale OPPS were 1.04, 0.99 and 0.82, respectively, while the overall TFP was 0.92. The large scale system had the highest productivity, followed by medium scale system in palm oil production in the study areas. Therefore, Promotion incentives should be directed to large and medium scale systems with upgrading of small scale farmers to medium scale farmers.

Keywords; *productivity, oil palm, small, medium and large scale oil palm production systems*

1. Introduction

1.1. Global Palm Oil Production

Palm oil is produced in 42 countries globally and Nigeria is the fourth largest producer [1]. The world palm oil production increased from 11 million Metric Tonnes (MT) in 1990 to 23 million MT in year 2000, and amplified to 65 million MT in 2015 [2]. Major world producers are Indonesia and Malaysia with small amount from Thailand, Nigeria, Columbia and others. It is currently the vegetable oil produced in largest quantity having pushed soybean oil into second position. It is the cheapest vegetable oil and dominates other vegetable oils in terms of yield per unit area, trade and consumption at the international scene [3].

The demand for palm oil has increased rapidly in recent years due to a combination of factors. These include: (i) increasing demand sparked off by higher consumption of edible oils, particularly in emerging countries such as China and India caused by, population growth, improving living standards and changing diets. (ii) The development of the bio-fuels industry around the world, particularly in the European Union (EU), United States of America (USA), Brazil, Argentina, China and India. (iii) Changing weather patterns, which can have major geographical impacts and can be potentially quite large [4]. In addition, many developed economies are shifting away from the use of trans-fats to healthier alternatives. Palm oil is often used as a substitute for trans-fat as it is one of the

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few highly unsaturated vegetable fats that are semi-solid at room temperature, and it's relatively low cost [5&6].

Major importers are Indian, Pakistan, Bangladesh, China, and European Union. In 2009, the world consumed approximately 6.5 kilograms of palm oil per capita, annually [7]. Malaysia and Indonesia are the dominant exporters of palm oil, exporting 90 and 70%, respectively, of the palm oil they produce. The lower proportion of Indonesia's exports compare to Malaysia's is a reflection of the population in these two countries (230 million in Indonesia and only 27 million in Malaysia). In 2011, Malaysia supplied 27.1% while Indonesia provided 27.2% of world total, so these two countries together supply annually more than half of total trade in vegetable oils at the international scene. In 2008, Indonesia exported over $14.5 billion of palm oil related products [5].

Edo State represents South-South geo-political zone, an area of high oil palm production while Kogi State represents North-Central geo-political zone, an area of low production. There is stagnation in growth and development of the industry in Nigeria, a prime producer and exporter of palm oil in the world prior 1960. The poor growth has resulted to numerous problems such as reduction of palm oil exports, non self sufficiency of domestic palm oil supply and importation to satisfy national demand. In an attempt to solve some of the aforementioned problems, the Federal and some State governments used the following measures. (i) The Nigerian Institute for Oil Palm Research (NIFOR) in 1964; (ii) Privatization of government owned oil palm estates; (iii) Directorate of Foods, Roads and Rural Infrastructures (DFRRI) sponsored oil palm seed/seedlings multiplication programme (1987-1990); (iv) The National Agricultural Land Development Authority (NALDA) oil palm development programme (1993-2002). Others are (v) the National Accelerated Industrial Crops Production Programme – NAICPP - (1994-2002). Despite the above programmes, achieving the national policy on self-sufficiency in palm oil production remains a mirage. Thus, it is imperative to carry out further research on productivity of oil palm production systems in Nigeria using Edo and Kogi States as case study.

2. Theoretical Framework and Literature Review

2.1. Theory of Production

Production is the transformation of factor inputs such as land, labour, capital, water resources, and management, through the farm-firm or producing unit to other goods and services called output. Its objectives are for profit maximization, output maximization, cost minimization or the maximization of satisfaction. The theory of production presents the theoretical and empirical framework that facilitates the application of alternatives methods so that any one or a combination of the firm's objectives can be attained [8]. In production, the relationship between inputs and output could be either of one factor-one product, two factors-one product, one factor-two products and many factors-many products but the focus of this study is on many factors-one product, fresh fruit bunches.

2.2. Total Factor Productivity

Total Factor Productivity (TFP) is the ratio of total outputs to total inputs used in production [9, 10, & 11]. The origin of TFP is not clear, but [12] attributes the first mention of the output per unit input index to [13], followed by [14]. It is useful for performance measurement across firms and within firm overtime. [15] explains that TFP is the portion of output not explained by the amount of input used in production, it plays useful role on economic fluctuations, economic growth and cross-country per capita income differences. Long-run growth in income per capita in any economy is mostly driven by growth in total factor productivity.

Factors that enhance TFP growth are Research and Development (R&D)/innovation, abundance of skilled labour, (R&D) subsidies, and increases in the size of markets. It measures technical change, efficiency and effectiveness with which both labour and capital resources are used to produce output. In other words, growth in TFP means making judicious and effective use of the available labour and capital resources. It is the ratio of output to capital, labour and other inputs used in production. It can be measured in physical terms *e.g.*, number of cars produced per employee, in monetary terms *e.g.*, thousands of dollars of output per hour worked, or an index *e.g.*, output per unit of labour. However, inputs are defined in terms of: Z labour *e.g.*, number of employees or hours of work and Z capital *e.g.*, buildings, machinery and equipment, *etc*. Labour productivity is the ratio of output to the input of labour, it is measured as the amount of output produced per hour worked, while land productivity is the ratio of output to size of land used in production.

Multifactor productivity (MFP) is the ratio of output to the combined input of labour and capital. Economists sometimes use the term "Multifactor Productivity" (MFP) interchangeably with TFP but in terms of measurement, there is a difference between the two terms. The term TFP suggests that all inputs (labour, capital and intermediate inputs such as raw materials, energy, *etc*.,) are taken into account in its computation that is, the denominator of the TFP ratio includes all inputs, while MFP does not give such connotation. However, the distinction between MFP and TFP is usually made only by those concerned with measurement, and the term TFP continues to be used more widely [16].

2.3. Review of Studies on Oil Palm Production

[17] Determine the factors affecting oil palm production in Ondo State of Nigeria and found that seed adulteration, irregular palm oil measuring container, Lack of land, fund and inadequate knowledge about oil palm cultivation were the main factors hindering oil palm production in the area. The study of [17] also established that marital status, contact with extension and neighbours had positive contribution to yield while educational level attained and number of trainings attended had negative impact on yield. [18] describe the oil palm as the most efficient oilseed crop and a hectare oil palm plantation is able to produce up to ten times more oil than other leading oilseed crops in the world.

3. Methodology

3.1. Study Area

The study was carried out in Edo and Kogi States representing South-South and North-Central geo-political zones of Nigeria respectively. The choice of these two zones was based on the intensity of oil palm production in these areas and the variation in the ecologies of the two zones. South-South is a zone of high production while North-central represents a zone of low production Edo and Kogi States were selected from South-South and North-Central zones respectively. Agriculture provides employment and income for about 75% of the population of Edo and Kogi States, though traders, artisans, professionals in various fields are also found in the area. The area is characterized by wet and dry seasons of 7 - 8 months and 4 - 5 months respectively. Annual rainfall ranges from 2,500 mm in the forest zone to 700 mm in the Guinea savanna [19]. The climatic conditions prevailing in this area is favourable for oil palm production.

3.2. Sources and Method of Data Collection

Primary and secondary data were used for this study. Secondary data were collected from Journals, bulletins and catalogues of institutions such as Nigerian Institute for Oil

palm Research (NIFOR), Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), Food and Agriculture Organization (FAO) of the United Nations, and other relevant materials. The primary data were collected using cross-section survey, which entails the administration of structured questionnaire to oil palm producers. The questionnaires were used to elicit information such as socioeconomic characteristics (age, contact with extension, years of farming experience) prices, quantities of inputs and outputs including labour, capital, farm size, fresh fruit bunches (ffb) yield, seeds, herbicides, pesticides and fertilizer. The study employed the services of Agricultural Development Project (ADP) extension agents in each state for questionnaire administration. The ADP provided personnel that led the survey team and interpreted the local language of the people.

3.3. Tornqvist TFP Index for Assessment of TFP of Oil Palm Production Systems

In order to estimate the Total factor productivity (TFP) of farms in each of the production systems, Tornqvist TFP model was used. The model was estimated by dividing the value of output (*i.e.*, total value of fresh fruit bunches (ffb) harvested by farmers) by the value of the variable inputs used in production. The model is expressed in equation 2 below. This model was used to estimate the TFP of each of the identified production systems

Total Factors Productivity (TFP); $Q_i^* = \frac{Qi}{\sum_{i=1}^{5} X_i}$ (2)

Where: Q^*_i is Total Factor Productivity (TFP) for the i^{th} farmer, Q_i is output of ffb for the ith farmer and Xi are the variable inputs.

X_1 = labour cost in (₦)
X_2 = Cost of Seedlings in (₦)
X_3 = Cost of pesticides used in (₦)
X_4 = Cost of fertilizer used in (₦)
X_5 = Cost of herbicides used in (₦)
All outputs and inputs were normalized by conversion to per hectare per year.

4. Results and Discussion

4.1. Evaluation of the Productivity of Oil Palm Production Systems in Nigeria

4.1.1. Estimation of Total Factor Productivity for the Oil Palm Production Systems

Oil palm production in Nigeria is classified into small, medium and large scale oil palm production systems (small $\leq$10 ha, medium 11 – 50 ha and large $\geq$ 51 ha). The Tornqvist total factor productivity model was used to estimate the TFP for the three oil palm production systems (small, medium and large scale). This was obtained by dividing the monetary value of ffb output by the cost of variable inputs (Seeds, labour, fertilizer, herbicides, and pesticides) using TFPIP software. The inputs and output quantities and their prices were normalized to per hectare per year. Table 6 presents the mean TFP results for the three oil palm production systems. The overall (national) TFP per hectare was 0.9175 with minimum and maximum figures of 0.84 and 1.11 respectively. The benchmark TFP of 1.000 is used in this study. Therefore, TFP less than one indicates deterioration while TFP greater than one implies progress with the difference from one indicating percentage deterioration and progress respectively [20].

Total Factor Productivity (TFP) of the three production systems, the large, medium and small scale were 1.0436, 0.9935 and 0.8240 respectively as shown in Table 6, indicating that the large scale system made progress in respect of TFP obtained from ffb production. The medium scale system was very close to the benchmark while the small scale system exhibits deterioration, which reflects decreasing returns to scale. Nevertheless, [15] define TFP as Solow residual i.e. the excess that remains after accounting for inputs used in production. Thus, these results demonstrate that the Nigerian oil palm industry has attractive and economic potentials for growth but large scale system with TFP of 1.0436 was more productive followed by medium scale system.

Table 6. Total Factor Productivity (TFP) of Oil Palm Production Systems Per Hectare

Production Systems	Mean	Standard Deviation	Minimum	Maximum
National (All farms) TFP	0.9175	0.05989	0.84	1.11
Large scale system	1.0436	0.03291	1.00	1.10
Medium scale system	0.9935	0.03947	0.83	1.07
Small scale system	0.8240	0.07647	0.76	1.0

Source: Computed from field survey data, 2013

These findings are in line with that of [21, 22, 23, 24 & 25] who found that agricultural TFP growth was a little greater than one and it dominates input progress as source of economic growth in the study areas. The frequency distribution of TFP presented in Table 7 shows that 71% and 60% of large scale and medium scale farmers respectively had TFP of 0.96 – 1.00, against 5% recorded for small scale farmers. The implication of this is that large and medium scale systems have significant contributions to growth and development of the oil palm industry while that of small scale system is insignificant. Therefore, government interventions should be directed towards the promotion of large and medium scale oil palm producers with upgrading of small scale farmers to medium scale farmers. Findings from the field survey showed that many of the small scale producers need incentives in the form of financial assistance and land with fertilizer supply at affordable prices for improvement of total factor productivity.

Table 7. Frequency Distribution of Total Factor Productivity by Production Systems

Range of TFP	Frequecy			Percentage		
	LSS	MSS	SSS	LSS	MSS	SSS
≤ 0.75	0	0	0	0	0	0
0.76 – 0.80	0	0	68	0	0	49.3
0.81 – 0.85	1	1	20	5.9	4	14.5
0.86 – 0.90	1	3	20	5.9	12	14.5
0.91 – 0.95	1	3	19	5.9	12	13.5
0.96 – 1.00	**12**	**15**	**7**	**70.5**	**60**	**5.0**
1.01 – 1.05	1	2	4	5.9	8	2.9
1.06 – 1.10	1	1	0	5.9	4	0
Total	17	25	138	100	100	100

Source: Computed from field survey data, 2013

Legend: LSS = large scale system, MSS = medium scale system, SSS = small scale system

Table 8 presents the results of independence sample test for TFP of the three oil palm production systems. The t-test for medium and large scale production systems compared with small scale production system were statistically significant at 1% level, implying that

TFP for medium and large scale production systems are significantly and statistically different from that of small scale oil palm production system. However, there was no significant difference between the TFP of medium scale and large scale systems. Similarly, the robust test of equality of variance shown in Table 8 confirmed the t-test result.

In summary, the TFP results have shown that the national TFP of 0.9179 is close to the benchmark of 1.0000 for United States, The TFP of large scale system was greater than one, which implies progress and that of medium scale was close to benchmark while that of small scale was less than one, which infers deterioration. In other words, large scale system is most profitable followed by medium scale system while small scale system is the least. Nevertheless, investment in the three oil palm production systems is profitable. Frequency distribution of TFP showed that 65% of large and medium scale farmers had TFP close to benchmark while only 5% of small scale farmers obtained similar results. The implication of this is that government efforts should be directed to promotion of large and medium scale systems with improvement of small scale farmers to medium scale.

5. Conclusion, Recommendations and Suggestions for Further Studies

5.1. Conclusion

Self-sufficiency in domestic palm oil supply remain unattainable in Nigeria, despite the various efforts of government to revive the subsector, a country that played a leading role in production and export of this commodity in the world prior 1965. The poor growth and development of the Nigerian oil palm industry requires research to gain a better understanding of the productivity of oil palm production systems in the country. Against this background, productivity of oil palm production systems was studied using primary and secondary data. Oil palm production in Nigeria is classified into small ($\leq$10 ha), medium (11 – 50 ha) and large ($\geq$ 51 ha) scale oil palm production systems.

Table 8. T-test and Robust Test for TFP Mean Comparison of the Three Systems

T-test			
Variables	**Mean difference**	**Standard error**	**T-test**
Small scale vs. Large Scale	-0.1697***	0.0196	-8.6818
Small scale vs. Medium scale	-0.1674***	0.0159	-10.5092
Medium scale vs. Large scale	0.0106	0.0129	0.8223
Robust test			
Variables	**Mean**	**Standard Deviation**	**Probability**
Small scale vs. Large scale	0.9075***	0.0821	0.0000
Small scale vs. Medium scale	0.9918***	0.0765	0.0000
Medium scale vs. Large scale	1.0025	0.0509	0.5682

Source: Computed from survey Data, 2013

*** *Significant at 1%*

The Total Factor productivity (TFP) of the Nigerian oil palm production systems were 1.0436, 0.9935 and 0.8240 for large, medium and small scale oil palm production systems respectively, while the national TFP was 0.9175. Robust test showed that the TFP for large and medium scale systems differ from that of small scale system, but there was no significant difference between the TFP of large scale and medium scale oil palm production systems. This study concludes that the large and medium scale systems have greater contributions to TFP of oil palm production systems in the study area.

5.2. Recommendations

Promotion of large and medium scale systems with upgrading of small scale system to either medium or large scale system is recommended to enhance the pace of growth and development of the industry. This recommendation emanates from the results of Total Factor Productivity (TFP), which showed that the large and medium scale production systems were more productive than the small scale system. In order to archive this, planned growth such as provision of necessary incentives like land availability, land preparation, planting and supervision of maintenance of immature palms till fruiting, followed by careful allocation of the farms to small scale farmers should be carried out by government to ensure the achievement of the following:

i. Growth and development of the small scale oil palm farmers to medium scale farmers

ii. Poverty alleviation among the small scale farmers

iii. More income to the government through income tax

iv. Self-sufficiency in palm oil production in Nigeria in the near future.

5.3. Suggestions for further studies

This study examines productivity of oil palm production systems in Nigeria using total factor productivity indices. The following suggestions are offered for further studies to expand the findings and policy recommendations:

i. Determination of TFP of palm oil processing and marketing

ii. Assessment of the factors influencing palm oil processing and marketing.

References

[1] Initiative for Public Policy Analysis (IPPA), African Case Study: "Palm Oil and Economic Development in Nigeria and Ghana", Recommendations for the World Bank's Palm oil Strategy. IPPA, Lagos, Nigeria. info@ippanigeria.org www.ippanigeria.org, **(2010)**.
[2] United States Department of Agriculture (USDA), "Palm oil production by country", **(2015)**.
[3] S. A. Yusuf, M. I. Abdul-Qadir and J. O. Lawal, "Determinants of Risk and Uncertainty in Oil Palm Nursery", Journal of Economics and Sustainable Development, ISSN (Paper)2222 1700 ISSN (Online) 2222-2855, **(2014)**.
[4] F. Rosillo-Calle, L. Pelkmans and A. Walter, "A Global Overview of Vegetable Oils, with Reference to Biodiesel", A Report for the IEA Bioenergy Task 40. IEA Bioenergy, **(2009)**.
[5] World Growth, "The Economic Benefit of Palm Oil to Indonesia", A Report by World Growth, Palm Oil Green Development Campaign. Arlington. www.worldgrowth.org, **(2011)**.
[6] M. R. Chandran, "Sustainability of Malaysia palm oil Industry: Challenges and opportunities", Oil palm world, Sdn. Bhd. Biomass Asia Forum, UN, House, Tokyo, **(2006)**.
[7] Food and Agricultural Policy Research Institute (FAPRI), "United States and World Agricultural Outlook", FAPRI, Iowa. Available at: http://www.fapri.iastate.edu/outlook. In World Growth (2011) The Economic Benefit of Palm Oil to Indonesia. A Report by World. Growth, Palm Oil Green Development Campaign. Arlington. www.worldgrowth.org, **(2010)**.
[8] S. O. Olayide and E. O. Heady, "Introduction to Agricultural Production Economic", Ibadan University Press, University of Ibadan, Ibadan, Nigeria, **(2006)**.
[9] K. Wiebe, M. J. Soule, C. Narrod and V. E. Brenneman, "Resource quality and agricultural productivity: A multi-country comparison", Liverpool-Tasie, L. S., KuKu, O. and Ajibola, A., 2011. A Review of

Literature on Agricultural Productivity, Social capital and Food Security in Nigeria. Nigeria Strategic Support Program (NSSP) working paper No. 21. **(2003)**.
[10] L. Zepeda, "Agricultural Investment, Production Capacity and Productivity", In: Liverpool-Tasie, L. S., KuKu, O. and Ajibola, A., 2011. A Review of Literature on Agricultural Productivity, Social capital and Food Security in Nigeria. Nigeria Strategic Support Program (NSSP) working paper No. 21 **(2001)**.
[11] T. J. Coelli, D. S. Prasada Rao, C. J. O'Donnell and G. E. Battese, "An Introduction to Efficiency and Productivity Analysis", 2nd ed. Springer, Australia, **(2005)**.
[12] Z. Griliches, "Productivity, R&D, and the data constraint", American Economic Review 84 (1): 1-23. In: Hulten, C. R., 2001. "Total Factor Productivity". A short Biography. University of Chicago Press. ISBN: 0-226-36062-8. http://www,nber,org/books/hult 01-1. **(1996)**.
[13] M. A. Copeland, "Concepts of national income", Studies in income and wealth, Hulten, C.R., 2001. Total factor productivity, a short biography. ISBN: 0-226-36062-8. University of Chicago press, vol. 1, pp. 3-63, **(1937)**.
[14] M. A. Copeland and E. M. Martin, "The correction of wealth and income estimates for price Changes", Studies in income and wealth, Hulten, C.R., 2001. Total factor productivity, a short biography. ISBN: 0-226-36062-8. University of Chicago press, vol. 2, **(1938)**, pp. 85-135.
[15] D. Comin, "Total Factor productivity", New York University and NBER, **(2006)**.
[16] D. Parham and D. Economics, "Productivity and Policy Workshop for the Public Sector Linkages Program", Structural Reform, Services and Logistics University of Adelaide August 2011 parham.dean@gmail.com **(2011)**.
[17] O. O. Ibitoye, A. O. Akinsorotan, N. T. Meludu and B. O. Ibitoye, "Factors affecting oil palm production in Ondo state of Nigeria", Journal of Agriculture and Social Research (JASR), vol. 11, no. 1, **(2011)**.
[18] S. Darby, "Palm oil facts and figures", www.simedarbyplantation.com, **(2014)**.
[19] R. A. Sanusi, "Demand for small and Medium Scale Firms' Cocoa Beverages in Urban areas of Southern and North-central Nigeria", An unpublished Ph. D thesis. Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria, **(2006)**.
[20] L. Latruffe, "Competitiveness, Productivity and Efficiency in the Agricultural and Agri-Food Sectors", OECD Food, Agriculture and Fisheries Papers, No. 30, OECD Publishing. Rennes, France., http://dx.doi.org/10.1787/5km91nkdt6d6-en, **(2010)**.
[21] K. Cao, R. Forbes and P. Gardiner, "Productivity in the New Zealand Primary and Downstream sectors", 51st Australian Agricultural and Resource Economics Society Annual Conference 14-16 February Queenstown, New Zealand, **(2007)**.
[22] S. Davidova, M. Gorton, B. Iraizoz and T. Ratinger, "Variations in farm performance in transitional economies: Evidence from the Czech Republic", Journal of Agricultural Economics, Latruffe, L., 2010. Competitiveness, Productivity and Efficiency in the Agricultural and Agri-Food Sectors. OECD Food, Agriculture and Fisheries Papers, No. 30, OECD Publishing. Rennes, France. http://dx.doi.org/10.1787/5km91nkdt6d6-en, vol. 54, no. 2, **(2003)**, pp. 227-245.
[23] E. Ball, S. L. Wang, and R. Nehring, "Productivity and economic growth in United States Agriculture", Economic Research Service, U.S. Department of Agriculture, **(2015)**.
[24] M. Gopinath, C. Arnade, M. Shane and T. Roe, "Agricultural Competitiveness: The case of the United states and major EU countries", Canadian Journal of Agricultural Economics, Latruffe, L., 2010. Competitiveness, Productivity and Efficiency in the Agricultural and Agri-Food Sectors. OECD Food, Agriculture and Fisheries Papers, No. 30, OECD Publishing. Rennes, France. http://dx.doi.org/10.1787/5km91nkdt6d6-en, vol. 16, **(1997)**, pp. 99-107.
[25] C. E. Ludena, "Agricultural Productivity Growth, Efficiency Change and Technical Progress in Latin America and the Caribbean", Inter-American Development Bank (IDB). www.iadb.org, IDB working paper series; 186. HD1790.5 L83 **(2010)**.

