International Journal of Research in Business Studies and Management
Volume 5, Issue 8, 2018, PP 43-51
ISSN 2394-5923 (Print) & ISSN 2394-5931 (Online)

Non-Parametric Analysis of Forestry Sector Performance in Akwa ibom State, Nigeria

Nelson, I. U., Udo, E. S., *D. E. Jacob

Forestry and Natural Environmental Management Department, University of Uyo, Nigeria

***Corresponding Author:** D. E. Jacob, Forestry and Natural Environmental Management Department, University of Uyo, Nigeria Email: danieljacob@uniuyo.edu.ng*

ABSTRACT

This paper analyzed and evaluated the efficiency of forestry sector in Akwa Ibom State, Nigeria. It examined the nature of Return to Scale (RTS) of the sector and measured the extent of overall technical efficiency, pure technical efficiency and scale efficiency (SE) of forestry sector using the non-parametric approach, data envelopment analysis (DEA). This approach also determined the causes of inefficiency in forestry sector. The data for the study was obtained from the entire forest division and forestry directorate in the state from 1996–2015. The results showed that the forestry sector was only efficient for 10 years out of the 20 years studied and had a mean efficiency score of 81.74%. Also, the sector operated at 97.96% of its productive scale size, thereby operating at decreasing Return-to-Scale (RTS) for eight years and increasing Return-to-Scale (IRS) for two years only. It is suggested that the forestry sector must vary its reduction in inputs and adopt innovations in order to optimize its scale of operation.

Keywords: *Forestry Performance, Efficiency, Resource Allocation, Revenue, Nigeria*

INTRODUCTION

The forest is important to people's livelihoods, economic growth, foreign exchange earnings, and environmental services (FORMECU, 1999; Ezebilo, 2004). It is therefore an economic treasure house of resources that supplies the people's needs (FAO, 2001). For the forest to supply these benefits in perpetuity, there is need for it to be sustainably managed. The concept of sustainable forest management (SFM) emphasizes the need to balance the social, ecological, and economic outputs from forests (Ministerial Conference on the Protection of Forest in Europe (MCPFE), 2003).However, assessing the overall sustainability of different types of forestry practice is complicated because of variation both in the nature of the forest resource and in the impacts of different management measures in space and over time (Kimmins, 1992).Monitoring and evaluation of forest management provides the basis for assessing performance both in terms of efficiency (e.g. wise use of resources relative to outputs and results),effectiveness (e.g. achievement of ecological objectives), and social and distribution issues (e.g. benefit sharing) (Pomeroy *et al*., 2005), with the aim to improving adaptive multidimensional management (Getzner *et al*., 2012). However, it should be noted that merely assessing management effectiveness by applying evaluation and/or monitoring tools, while necessary, might not be sufficient for achieving the management's objectives. To increase forest management effectiveness, there is need for the involvement and contributions of stakeholder groups. The evaluation of management effectiveness of a forest estate might not only serve as an information and management tool for the management authority, but also as an instrument for informing stakeholders and collecting tacit knowledge (Getzner *et al*., 2012). Such instruments and methods may also contribute to "good governance" and lead to social learning experiences of all stakeholders. Consequently, it was pertinent to evaluate the extent of relative (in)efficiency of the forestry sector in Akwa Ibom State to explore the areas to bringing an improvement in its performance. This study therefore uses non-parametric analysis to measures the forestry sector efficiency using Data Envelopment Analysis (DEA) method.

METHODOLOGY

Study Area

The study was carried out in Akwa Ibom State, located in the southern part of Nigeria. It lies between latitudes 4°32' and 5° 53' North and longitudes 7° 25' and 8° 25' East (Fig. 3.1). It is located within the tropical rainforest zone with a landmass of 8,412km^2(AKSG, 1989). Akwa Ibom State has a projected population of 5,671,223persons for 2017 at a growth rate of 3.46% per year (NPC, 2007). The state has 31 Local Government Areas with three gazetted forest reserves namely; Stubbs Creek, Ogu Itu and Obot Ndom forest reserves and other protected forests in each local Government Area.

Akwa Ibom State has common borders with Cross River State to the East, Abia State to the North, Rivers State to the West, and the Atlantic Ocean to the South (Akwa Ibom Agricultural Development Programme (AKADEP, 2006). Akwa Ibom is more or less triangular in shape, encompassing the Qua Iboe River Basin, the western part of the lower Cross River Basin and the Eastern part of the Imo River Basin (AKSG, 1989). With an ocean front which spans a distance of 129 kilometres from Ikot Abasi in the west to Oron in the east, Akwa Ibom presents a picture of captivating coastal, mangrove forest and beautiful sandy beach resorts (AKSG, 1989).

The climate of the state is characterized by two seasons – rainy or wet season, which lasts for about 8 months (mid-March – November) and the dry season (December – early-March). The total annual average rainfall is about 2500mm (Ekanem, 2010). Temperatures are uniformly high throughout the year with slight variation between 26^oC and 28^oC (source). High range of relative humidity (75% - 95.6%) is common across the length and breadth of the State (AKSG, in an intricate manner, but are very similar (Peters *et al*., 1994). They are deep, having loamy sand to sandy loam surface layers over sandy loam to 1989). The soil types found in Akwa Ibom State are associated with one another sandy clay in the fresh water swamp forest and lowland rainforest ecological zones. The soils are mostly derived from sandy parent materials, highly weathered, dominated by low activity clay, and well drained (Etukudo *et al*., 1994).

The existing climatic factors in Akwa Ibom State favour luxuriant tropical rainforests with teeming populations of fauna and extremely high terrestrial and aquatic biomass. However, both the vegetation and the fauna of the State are largely degraded because of strong human population pressure (AKSG, 2017). The native vegetation has been almost completely replaced by secondary forests of predominantly wild oil palms, woody shrubs and various grass undergrowths. Farmlands mixed with oil palm and degraded forests predominate in the rest of the state (AKSG, 2017).

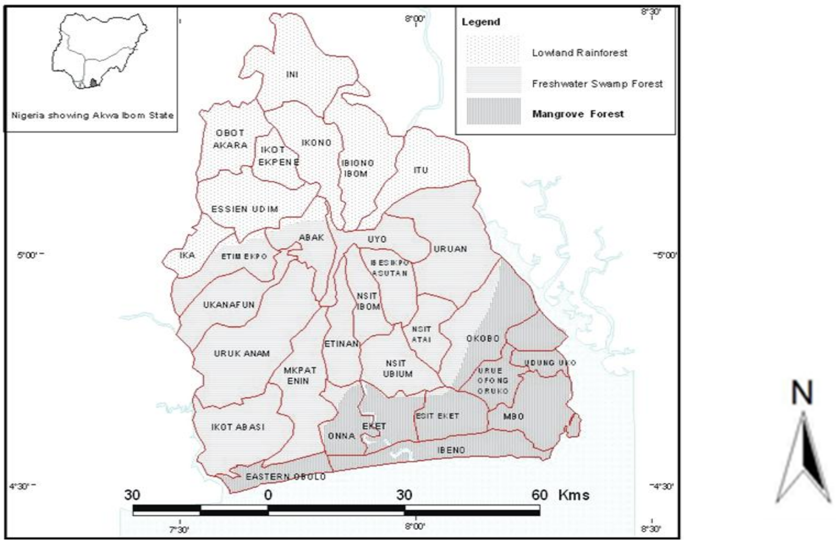

Figure 3.1 *Administrative map of Akwa Ibom State, Nigeria*

Source: *Udofia (2004)*

Data Collection

The data used in the study were obtained from all the 31 Forestry Divisions in Akwa Ibom State, in addition to the Forestry Headquarter. The choice of selected variables to be used in the study required the identification of elements considered in literature and the information available. Thus, generated and target revenues, staff strength, number of divisions, rate of afforestation, timber exploitation and amount released for forestry development in the state covering the period under review (1996 – 2015) were selected. Data on trend of deforestation was obtained using Geographic Information

System (GIS). This involved the use of satellite imagery (1986, 2001 and 2016) obtained from the United State Geological Surveys (USGS) with a resolution of 28.5m for the land use or land cover classification and change detection analysis. These datasets were all acquired in the dry season in order to minimize seasonality variations (Jacob *et al.*, 2015), and were radiometrically and geometrically corrected to allow for direct image-to-image comparison. The satellite images were classified using the unsupervised ISODATA (Iterative Self Organizing Data Analysis) classification technique as described by Jacob *et al.* (2015). These procedures were performed using the ISODATA classifier algorithm in ERDAS Imagine 2014™*software.

Data Analysis

Data collected for the study were analyzed using descriptive statistics and Data Envelopment Analysis (DEA). DEA, a non-parametric method was used to assess relative efficiency of the park's anti-poaching activities as described by Fethi and Pasiouras, 2010. The technique was originally developed by Charnes *et al.* (1978), and used to evaluate the relative efficiency of a number of homogeneous units called Decision Making Units (DMUs). The technique compares DMUs and presents a score for each one. DMUs that have a score of 1 are considered efficient, while those with a score lower than 1 are inefficient.

DEA models are divided into two categories according to scale and orientation namely; constant return to scale (CRS) and variable return to scale (VRS). In CCR model, the efficiencies of DMUs are provided by the ratio of virtual outputs to virtual inputs (Soysal-Kurt, 2017).

Assuming that *n* is the number of DMUs, *s* is the number of outputs and *m* is the number of inputs; CCR model for DMU_o is as follows (Charnes *et al.*, 1978):

$$max h_o = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}} \quad (1)$$

subject to:

$$\frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \quad (2)$$

$j = 1, \ldots, n;\ v_i,\ u_r \geq 0\ ;\ i = 1, \ldots, m;\ \ r = 1, \ldots, s$

Because the model above is fractional programming form, for facilitating the solution, it is usually transformed into linear programming form.

The BCC input oriented (BCC-I) model evaluates the efficiency of DMU_o, DMU under consideration, by solving the following linear program (Toloo and Nalchigar, 2009):

$$\max \sum_{r=1}^{s} u_r y_r - u_o \quad (3)$$

subjectto

$$\sum_{i=1}^{m} w_i x_{io} = 1 \quad (4)$$

$$\sum_{r=1}^{s} u_r y_{rj} - u_o - \sum_{i=1}^{m} w_i x_{ij} \leq 0 \quad (5)$$

j=1,2,…,n; u_o,free; $w_i \geqslant \varepsilon$, i = 1,2,…,m; $u_r \geqslant \varepsilon$, r = 1,2,…,s

where x_{ij} and y_{rj} (all nonnegative) are the inputs and outputs of the *j*th DMU, w_i and u_r are the input and output weights (also referred to as multipliers). x_{io} and y_{ro} are the inputs and outputs of DMU_o. Also, ε is non-Archimedean infinitesimal value for forestalling weights to be equal to zero.

Results And Discussion

Demographics of Variables

The six selected input variables were staff strength, expenditure, target revenue, deforestation rate, number of forestry divisions, timber exploitation. Staff strength represented number of available work force, the human resources providing services in the sector (Jacob *et al.*, 2018a, b; Udo, 2016; Akpan-Ebe, 2015). Expenditure represented the amount spent for forestry development (Akpan-Ebe, 2015). Target revenue represents expected income to be derived from sale of forest resources (Olaseni *et al.*, 2004; Udo, 1999). Deforestation rate indicated the rate of depletion of available forest resources (Jacob *et al.*, 2015; Igben and Ohiembor, 2015; Adetula, 2008; Udo, 1999) and Divisions represented the number of functional forestry units in the study area (Udo, 2016; Akpan-Ebe, 2015). Timber exploitation was presented as the volume or stand of trees exploited in a forest area (Oyebade *et al.*, 2008; FAO, 2001; Gray, 1983).

The variables used as inputs were generated revenue and afforestation. Generated revenue was expressed as the amount of money collected from sales of forest resources (Adekunle *et al.*, 2013; Olaseni *et al.*, 2004; FAO, 2001; Udo, 1999; Gray, 1997), while afforestation representedact of establishing a forest either naturally or artificially on a piece of land on which forest vegetation has always or long been absent (Akpan-Ebe, 2015; 2006; Akpan-Ebe *et al.*, 1991).

Descriptive characteristics of the input and output variables are shown in Table 1.The highest annual generated revenue for the study period was ₦9,823,550 and the least ₦345,952, while the mean annual forest revenue for the state was ₦4,776,246.56±3206799.53. This amount was less than ₦27,261,741.90 reported by Oyebade *et al*. (2008) as the mean annual forest revenue for Osun State. This implied that Akwa Ibom State was not able to maximize its earnings from the sales of forest resources. This could be attributed to the poor forest revenue system in the state (Gray, 1983, FAO, 2001).

The highest and least revenue targets for the study area were₦14700000 and ₦1110000 respectively, with an annual revenue target of ₦7083522.70±4951459.80. The variation in target revenue indicated that there had been fluctuation in revenue targets for the study area. This was in agreement with Udo (1999) and Oyebade *et al*. (2008). However, the mean target revenue for the study area was less than₦4,884,000.00, which was the mean annual revenue target for Ondo State (Oyabade *et al*., 2008). This shortfall in revenue target for Akwa Ibom State could be attributed to the poor forest resources base in the state compared to Ondo State.

Mean annual staff strength of 96.90±12.21 personnel in the state forestry sector implied that state had staff strength of 30.47 persons per 10 km² of forest reserve in the state. This number was lower that the recommended number of forest personnel per 10 km² of forest reserve in the tropics (Edet *et al*., 2017; FAO, 1970). This was an indication that the state forestry sector was grossly under staffed, thus making it impossible for adequate management of the state forest estate (Udo, 2016; Akpan-Ebe, 2015; Popoola, 2014; Faleyimu and Arowosoge, 2011; Akande *et al*., 2009; Alao, 2005).

The mean forestry division in the state was 29.75±1.59. This implies that approximately every Local Government Area in Akwa Ibom State is a forest management unit. According to FAO (1998) guideline for management of tropical forest, the present size of each forest division in the state is too large to ensure effective management.

The deforestation rate in the study area was calculated as being 336,609±102,123.40ha annually. This high rate of forest destruction could be attributed to high pressure due to population growth resulting in the over-exploitation and forest degradation. This agrees with the observation by Ekpo (2001) that the state forest estate has suffered from mismanagement and has been reduced to farmlands.

Annual afforestation rate in the state was3.86±7.52 ha per year. This is an indication that plantation establishment in the state was very low. This is in accordance with Udofia *et al*. (2011) and Akpan-Ebe (2015) observation that poor plantation establishment was largely as a result of non-involvement of the host community in the plantation establishment, inadequate and untimely released of funds for the project.

Expenditure for the study period had an annual mean of ₦8,891,368.07±15,616,936.70. This amount is lesser than ₦66.91 million released for forestry development annually in Ondo State (Olaseni *et al*., 2004). This is in accordance with Famuyide *et al*. (2005) and FAO (2001) observation that the quality of public spending in forestry in Nigeria is dismal.

The highest and least number of trees exploited was 603 and 6 trees respectively, while the annual mean trees exploited was 73.55±131.52. The variation in number of trees exploited agrees with the observation by Adekunle *et al*. (2003) and Olajide *et al*. (2008) that variation in the number of merchantable timbers is as a result of pressure on the forest estate and what was removed was far beyond the natural capacity of the forest to recuperate in order to continue its normal functions. Also, the 1,471 number of trees exploited in the state was far lesser than the 111,377 stems of trees exploited in Ondo between 2003 and 2005 (Adekunle *et al*., 2013).

Table1. *Demographics of the input and output variables*

Vatiables	Mean	Standard Error	Minimum	Maximum	Sum
Generated Revenue	4776246.56	3206799.53	345952	9823550	95524931.20
Target revenue	7083522.70	4951459.80	1110000	14700000	141670454
Staff strength	96.90	12.21	87	130	1938
Division	29.75	1.59	24	31	595
Deforestation rate	336609	102123.40	172620	500598	6732180
Afforestation rate	3.86	7.52	0	32	77.25
Expenditure	8891368.07	15616936.7	0	56775000	177827361
Timber exploitation	73.55	131.52	6	603	1471

Source: *Elaborated by the authors.*

Overall Technical Efficiency And Returns-To-Scale

The result in Table 2indicates the efficiency scores of CCR and BCC models along with the magnitude of overall technical inefficiency for forestry performance for the study area. The overall technical efficiency of the state ranges between 26.20 and 100.00 with yearly average efficiency scores of 81.74% (Table 3). This efficiency score is lower than that reported by Jacob *et al.* (2018b) for Old Oyo National Park, but higher than those of Pai *et al*. (2017) and Rusielik and Zbaraszewsk (2014) for Taiwan's industrial parks and Polish National Parks respectively. The score also implies that the forestry sector in the state would only need 81.74% of the same inputs annually instead of its current level of input for it to be efficient. However, this would involve adopting effective management approach to achieve maximum efficiency.The result in table 3 also indicates that the forestry sector was technically efficient for half (10) of the twenty years period under review as it had a technical efficiency score of 100.00%. These periods of efficiency imply the forestry sector resource utilization was very functional; hence, it was not wasteful of its inputs. This is in accordance with Jacob *et al.* (2018b) and Kumar and Gulati (2008) assertion that efficient period define the best management practices or efficient frontier and, thus, can be considered as the reference set for inefficient years.Also, the sector returns-to-scale indicates that it was operating at the most productive scale size for 10 years, thereby experiencing constant return-to-scale, while in the remaining 10 years it was operating below and above its optimal scale size and thus, experiencing 8 years of decreasing return-to-scale and 2 years increasing return-to-scale (Table 2). This implies that there is still room for the forestry sector improvement in its overall technical efficiency. This is in accordance with the observation of Jacob *et al.* (2018b) that the sector needs to minimize its inputs and maximize its output in order for it to operate at a more productive scale. Also, since the sector is operating on a long-term plan, it will need to move towards a constant return-to-scale by becoming either larger or smaller to survive (Cracolici, 2004; 2005; Cracolici and Nijkamp, 2006). This involves changes its operating strategy in terms of scaling up or scaling down of its size of operations

Table2. *Overall Technical Efficiency, Pure Technical Efficiency, and Scale Efficiency Scores*

DMUs	CCR (%)	OTIE(%)	BCC (%)	PTIE (%)	Scale Efficiency	SIE	RTS
DMU1	38.70	61.3	100.00	0.00	0.39	0.61	DRS
DMU2	71.30	28.70	85.30	14.7	0.84	0.16	DRS
DMU3	100.00	0.00	100.0	0.00	1.00	0.00	CRS
DMU4	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU5	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU6	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU7	62.70	37.30	66.60	33.40	0.94	0.06	DRS
DMU8	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU9	97.40	2.60	100.00	0.00	0.97	0.03	IRS
DMU10	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU11	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU12	50.40	49.60	100.00	0.00	0.50	0.50	DRS
DMU13	96.80	3.20	100.00	0.00	0.97	0.03	IRS
DMU14	26.20	73.80	100.00	0.00	0.26	0.74	DRS
DMU15	27.20	72.80	100.00	0.00	0.27	0.73	DRS
DMU16	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU17	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU18	100.00	0.00	100.00	0.00	1.00	0.00	CRS
DMU19	84.80	15.20	100.00	0.00	0.848	0.15	DRS
DMU20	79.30	20.70	100.00	0.00	0.793	0.21	DRS

Note: *CCR = overall technical efficiency, OTIE = Overall technical inefficiency = (100 - CCR), BCC = pure technical efficiency, PTIE = Pure technical inefficiency = (100 -BCC), SE = CCR/BCC, SIE = Scale inefficiency = (1-SE), RTS = returns-to-scale, IRS = increasing returns-to-scale, CRS = constant returns-to-scale; and DRS = decreasing returns-to-scale.*

Table3. *Descriptive statistics of overall technical efficiency scores*

Statistics	All Years	Efficient Years	Inefficient Years
N	20	10	10
Mean CCR	81.74	100.00	63.48
SD	26.35	0.00	26.91
Minimum	26.20	100.00	26.20
Maximum	100.00	100.00	97.40
MOTIE (%)	18.26	0.00	26.52
Interval	26.20 – 100.00	100.00	26.20 – 97.40

Source: *Elaborated by the authors.*

Pure Technical Efficiency and Scale Efficiency

The pure technical efficiency and scale efficiency measure for the forestry sector performance indicates that its overall technical inefficiency was 18.26% (Table 4). This could be attributed to both poor input utilization (pure technical efficiency) and inability of the park to operate at the most productive scale or scale inefficiency (Jacob *et al*., 2018). Out of the 18.26% score of the park technical inefficiency, 2.41% was due to the management incompetence as a result of inability to adopt efficient management approaches in addition to incorrect input combinations, while, the remaining 16.07% of technical inefficiency in the forestry sector could also be attributed to inappropriate scale of park operations (Jacob *et al*., 2018b). Moreover, the lower mean and higher standard deviation of the pure technical efficiency scores compared to scale efficiency scores indicates that a higher portion of overall technical inefficiency is due to pure technical inefficiency.

Table4. *Descriptive statistics of overall technical efficiency, Pure technical efficiency, and Scale efficiency scores*

Statistics	CCR	BCC	Scale Efficiency
N	20	20	20
Mean	81.74	97.59	83.93
SD	26.35	7.99	25.93
Minimum	26.20	66.60	26.20
Maximum	100.00	100.00	100.00
MTIE	18.26	2.41	16.07
Interval	55.40 – 108.09	89.60 – 105.60	57.99 – 109.86

Notes: *SD = standard deviation; MTIE = mean technical inefficiency = (100 - mean efficiency); Interval = (Average efficiency - SD; Average efficiency + SD)*

Total Potential Improvement

The result in table 5 shows areas of potential improvement for the forestry sector to be able to transform its inefficient years to be efficient. Accordingly, it will have to reduce all its inputs except expenditure while increasing its output to achieve efficiency.

This implies a reduction in its target revenue (7.1% and 6.82%), staff strength (6.15% and 5.88%), number of divisions (4.60% and 0.64%), deforestation rate (2.79% and 5.75%) and timber exploitation (12.29% and 13.39%). The forestry sector will also need to increase its generated revenue by 33.61% and 6.69%, afforestation rate 32.81% and 60.31%, and expenditure 0.66% and 0.00% for its overall technical efficiency and pure technical efficiency respectively. This is in accordance with Jacob *et al*. (2018), Pai *et al*. (2017),Yu *et al*. (2014), Yang and Zhoa (2009) and Bosetti and Locatelli (2006) that total potential improvements is only feasible if all the inefficient data management units are aggregated together to provide guidelines for proper allocation of resources.

Also, the output of the park must increase to ensure that the goal of creating the sector is achieved. Deforestation of the forest reduce the benefits (revenue, employment, preservation of wildlife habitats, etc.) of the forest (Jacob *et al*., 2015; Igben and Ohiembor, 2015; Adetula, 2008). Increase in the sector output will ensure there is no further biodiversity erosion and proper management.

Table 5. *Total potential improvement*

Variables	CCR Efficiency	BCC Efficiency
Generated Revenue	33.61	6.69
Target Revenue	-7.1	-6.82
Staff strength	-6.15	-5.88
Division	-4.6	-0.64
Deforestation rate	-2.79	-5.75
Afforestation rate	32.81	60.31
Expenditure	0.66	0
Timber exploitation	-12.29	-13.39

Source: *Elaborated by the authors.*

Conclusion

Evaluation of the performance of the forestry sector is important as it helps in improving its planning and management processes. The study shows the sector was performing below its optimum efficiency given the inputs for the study periods. It was only efficient for half (10) of the study period with an annual mean of about 81.74% of its productive scale and 97.56% of its productive scale size, thus experiencing a decreasing return to scale most for most of the inefficient periods.The study recommends a variable reduction in all the forestry sector's inputs except expenditure and an increase in all its outputs to achieve efficiency. An increase in output, especially afforestation will ensure the forest stock of timber in sustainable in the state translating to increased revenue for the study area.

References

[1] Adekunle, V. A. J., Olagoke, A. O. and Ogundare, L. F. (2013). Timber Exploitation Rate in Tropical Rainforest Ecosystem of Southwest Nigeria and Its Implications on Sustainable Forest Management, *Applied Ecology and Environmental Research* 11(1): 123-136

[2] Adetula, T. (2008). Challenges of Sustainable Forest Management in Ondo State: Community Based Forest Management System as a Panacea. – In: Onyekwelu, J.C., Adekunle, V.A.J., Oke, D.O., (eds) *Research for Development in Forestry, Forest Products and Natural Resources Management*. The 1st National Conference of the Forest and Forest Products Society held at the Federal University of Technology, Akure, Nigeria, 16th-18th April, 2008. P242-247

[3] Akwa Ibom Agricultural Development Programme (AKADEP) (2006). *Office Records of Department of Planning, Research and Statistics.* Uyo Akwa Ibom State, Nigeria: AKADEP Headquarters

[4] Akpan-Ebe, I. N. and K. S. Amankop (2001). The Dearth of Timber and Non-Timber Forest Products in Akwa Ibom State. *Proceedings of the 1st Workshop of the Forestry Association of Nigeria, Akwa Ibom State branch*, pp.44-55

[5] Akpan-Ebe, I. N. (2006). Sustained Afforestation Programme for Akwa Ibom State: The Imperative Action. Paper presented at Akwa Ibom State Environment Roundtable, June 2006

[6] Akpan-Ebe, N. I. (2015). Reforesting the Tropical Rainforest in South-Eastern Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, 10(4):128-134

[7] AKSG (1989). Akwa Ibom State: Physical Background, Soils and Land-Use and Ecological Problems. Technical Report of the Task Force on Soils and Land Use Survey, Akwa Ibom State. Government Printer, Uyo

[8] AKSG (2017). About Akwa Ibom State. Available at https://akwaibomstate.gov.ng/about-akwa-ibom/. Accessed 23May, 2017

[9] Bosetti, V.; Locatelli, G. (2006). A Data Envelopment Analysis Approach to the Assessment of Natural Parks' Economic Efficiency and Sustainability. The Case of Italian National Parks. *Sustainable Development*4, No. 4, pp. 277 - 286 DOI: 10.1002/sd.288.

[10] Charnes, A.; Cooper, W.; Rhodes, E. (1978). Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research*, *2*(6), 429-444.

[11] Cracolici, M.F., Nijkamp, P. (2006) Competition among Tourist Destination. An Application of Data Envelopment Analysis to Italian Provinces, in Giaoutzi M. and Nijkamp P. (eds.), *Tourism and Regional Development: New Pathways*, Ashgate, Aldershot, UK.

[12] Cracolici, M. F. (2004) Tourist Performance Evaluation: A Novel Approach, Atti XLII Riunione Scientifica della Società Italiana di Statistica, June 2004, Bari.

[13] Cracolici, M.F. (2005). La Competitività tra Destinazioni Turistiche. Un'Analisi di Destination Benchmarking, PhD Dissertation, Faculty of Economics, University of Palermo, Italy.

[14] Ekanem, E. (2010). Climate Characteristics, In: Usoro, E and Akpan, P. *Akwa Ibom State- A Geographical Perspective*, Enugu: Immaculate Publications Limited, pp 10-13

[15] Ekpo, J. U. (2001). Forestry Policy Direction in Akwa Ibom State. In: *Forestry and Sustainable Development, Proceedings of the* 1*st Workshop of the Forestry Association of Nigeria*, Uyo, 10-11 April 2001, pp 56-64.

[16] Etukudo, I. G., Akpan-Ebe, I. N., Udofia, A. and Attah, V. I. (1994). *Elements of Forestry*. Uyo: Usanga and Sons Enterprises, 176p

[17] Ezebilo, E. E. (2004). Threats to Sustainable Forestry Development in Oyo State, Nigeria. Unpublished M.Sc Thesis. Swedish University of Agricultural Sciences. 42p.

[18] Famuyide, O. O., Bagarawa, A. J., Owonubi, J. J. and Usman, J. M. (2005). Funding of Forestry Sector in Nigeria between 1999-2004. *Nigerian Journal of Forestry* 35(1): 8-16

[19] FAO. 1998. Guidelines forthe management of tropical forests. 1. The production of wood. FAO Forestry Paper 135. Food and Agriculture Organization of the United Nations. Rome.

[20] FAO (2001). Forest Finance. The Forest Revenue Systems and Government Expenditure of Forestry in Nigeria. Working paper: FSFM/ WPO2, Accra. Ghana.

[21] Fethi, M.D. and Pasiouras, F. (2010). Assessing Bank Efficiency and Performance with Operational Research and Artificial Intelligence Techniques: A Survey.*European Journal of Operational Research*, 204, 189-198.

[22] FORMECU, (1999). Forest Resources Study: Nigeria Market Assessment and Pricing Policies, FORMECU, Abuja. 32pp.

[23] Getzner, M., Jungmeier, M. and B. Pfleger (2012). Evaluating Management Effectiveness of National Parks as a Contribution to Good Governance and Social Learning, Protected Area Management Barbara Sladonja, IntechOpen, DOI: 10.5772/50092. Available at: https://www.intechopen.com/books/protected-area-management/evaluating-management-effectiveness-of-national-parks-as-a-contribution-to-good-governance-and-socia.Accessed 04/09/2018.

[24] Gray, J. A. (1983). Forest Revenue Systems in Developing Countries. FAO Forestry Pape, 43, Food and Agriculture Organization of the United Nations, Rome.

[25] Gray, J. A. (1997). Under Pricing and Overexploitation of Tropical Forest Management, Conservation and Preservation of Tropical Forests. *Journal of Sustainable Forestry* .4(3):363-399.

[26] Igben, J. L. and O. M. Ohiembor (2015). Lumbering as a Factor of Deforestation in the Freshwater Swamp Forest in Delta State Nigeria, *International Journal of Research in Agriculture and Forestry*, 2(9): 1-9

[27] Jacob, D. E.; Eniang, E. A.; Nelson, I. U.; U. I. Udoakpan (2015). Vegetation Assessment of Sclater's Guenon Habitat in Ikot Uso Akpan Forest, Itu, Southeastern Nigeria, *Intl. J. of Mol. Ecol. and Conserv*. 2(6): 32-38 (doi: 10.5376/ijmec.2015.05.0001)

[28] Jacob, D. E.,Etuk, I. M. andNelson, I. U**.** (2018a). Assessment of Anti-Poaching Effectiveness in Old Oyo National Park, Nigeria. In: Eniang, E. A., Umoh, G. S. and F. Babalola (eds.). Ecotourism and National Development in Nigeria: Prospects and Challenges.Proceedings of 6th 3rd BiennialBiennial NSCB Biodiversity Conference held in University of Uyo, Uyo, Akwa Ibom State, Nigeria from May 6 - May 10, 20018, 422 - 429pp.

[29] Jacob, D.E., S.A. Onadeko, I.U. Nelson and A.L.A. Shotuyo (2018b). Evaluation of Old Oyo National Park efficiency using DEA Approach. *Economic and Environmental Studies* 18 (1), 203-222.

[30] Kimmins, H. (1992). *Balancing Act: Environmental Issues in Forestry*. UBC Press, Vancouver, British Columbia, Canada.

[31] Kumar, S. and Gulati, R. (2008). An Examination of Technical, Pure Technical, and Scale Efficiencies in Indian Public-Sector Banks Using Data Envelopment Analysis. *Eurasian Journal of Business and Economics*1 (2), 33-69MCPFE), 2003

[32] National Population Commission (NPC) (2007). Details of the Breakdown of the National and State Provincial Population Totals 2006 Census. Federal Republic of Nigeria Official Gazette 94(24):1-26.

[33] Olajide, O., E. S. Udo and D. O. Otu (2008). Diversity and Population of Timber Tree species producing valuable Non-Timber Products in Two Tropical Rainforests in Cross River State, Nigeria. *Journal of Agricultural and Social Sciences*. 4 (2): 65-68.

[34] Olaseni, O., Agbeja, B. O. and Adeyoju, S. K. (2004). Dynamics of Forest Revenue System Collections and Forestry Development in Ondo State, Nigeria. *Food, Agriculture and Environment*, 2 (1): 365-369.

[35] Oyebade, B. A., P. O. Adesoye and A. A. Aiyeloja (2008): Modelling revenue and timber exploitation in Osun State, Nigeria between 1991 and 2001.*Research Journal of Social Sciences, 3:17 – 22.*

[36] Pai, J. T.; W. Liao; D. Hu. (2017). *Research on Eco-efficiency of Industrial Parks in Taiwan*. Proceedings of 2017 International Conference of Asian-Pacific Planning Societies, 20pp.

[37] Peters, W. S., Edet, R. and Okon E. U. (1994). *Akwa Ibom State the Land of Promise Compendium.* Uyo: Akwa Ibom State Government Press, pp. 261-358

[38] Rusielik, R. and W, Zbaraszewski (2014).The Efficiency of Scientific and Tourism Activity of *Polish* National *Parks* with use DEA method. *Economic and Environmental Studies* 14 (3 (31)), 283-297

[39] Udofia, S. I. (2004). The Role of Churches in the Development of Social Forestry in Uyo Local Government Area of Akwa Ibom State, Nigeria. Unpublished Ph.D Thesis. Faith University Inc. Columbus, USA. 35p.

[40] Udofia, S. I., Akpan-Ebe, I. N., Uluocha, O. B. and Ekpoh, G. I. (2011). Survival Assessment of Forest Plantations n Abak Local Government Area, Akwa Ibom State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment* 7(4):

[41] Udo, E. S. (1999). Forest Revenue Generation Trend in Akwa Ibom State, Nigeria. *Journal of Tropical Forest Resources*, 15(1): 52-63.

[42] Udo, E. S. (2016). Our Forests: Uses, Management and Abuses. The 51st Inaugural Lecture Deliverd in the University of Uyo, Uyo, Akwa Ibom State, Nigeria, 95pp.

[43] Yang, Y. and Zhao, J. (2009), Study on Commercial Bank Credit Risk based on AGA and Camel Rating System., Knowledge Discovery and Data Mining, pp. 562-565.

[44] Yu, Z.; Chen, H.; Liu, J.; Zhang, H.; Yan, Y.; Zhu, N.; Guo, Y.; Yang, B.; Chang, Y.y Dai, F.;*et al*. (2014). Various Applications of TALEN and CRISPR/Cas9-mediated Homologous Recombination to Modify the Drosophila genome. *Biol Open*. 3:271–280.

Citation: *Nelson, I. U., Udo, E. S., D. E. Jacob" Non-Parametric Analysis of Forestry Sector Performancein Akwa ibom State, Nigeria". International Journal of Research in Business Studies and Management, vol 5, no. 8, 2018, pp. 43-51.*