ISSN (Online): 2349-1183; ISSN (Print): 2349-9265
TROPICAL PLANT RESEARCH
The Journal of the Society for Tropical Plant Research
5(2): 160–166, 2018
DOI: 10.22271/tpr.2018.v5.i2.021

Research article

Environmental impact assessment of University of Ibadan international conference centre on the adjoining forest

O. Chukwu[1]*, O. Y. Ogunsanwo[2], W. A. Danladi[1] and O. M. Oluyinka[1]

[1]Department of Social and Environmental Forestry, University of Ibadan, Nigeria
[2]Department of Forest Production and Products, University of Ibadan, Nigeria

*Corresponding Author: onye20042000@yahoo.com
[Accepted: 24 June 2018]

Abstract: Trees are seen as obstacles of development in the developing countries. Despite global recognition of the role of forests in mitigation of climate change, deforestation and forest degradation continues to increase. However, there is dearth of information on the impact of situating University of Ibadan International Conference Centre (UIICC) on the University's *Tectona grandis* plantation. Hence, provision of baseline information on the impact of the Conference Centre on the environment will help management decisions on mitigation of its negative effects. Environmental impact assessment of UIICC on the adjoining forest was conducted. The data used for this study was obtained from all living *T. grandis* (332 trees) found within seven randomly laid sample plots of 25 m × 25 m. Diameters at several points of tree stems and height (total and merchantable) were measured. Hence, biomass of each sampled tree was estimated. Point coordinates were also obtained to map out the boundaries of the various land cover within the study area. The impact assessment results revealed that about 7066 trees with merchantable volume of 601.55 m^3 and total volume of 1266.58 m^3 were removed for building of UIICC covering about 9.309 ha. About 274.99 t C and 1009.28 t CO_2 e carbon and carbon dioxide, respectively were loss. Furthermore, loss of biodiversity and habitat for animals (birds, reptiles and rodents) and disruptions of biogeochemical cycles were among the identified negative impacts. Planting of avenue trees within the conference centre, proper waste disposal and use of renewable energy were recommended as mitigation measures.
Keywords: Biomass - Deforestation - EIA - GIS - *Tectona grandis*.

[Cite as: Chukwu O, Ogunsanwo OY, Danladi WA & Oluyinka OM (2018) Environmental impact assessment of University of Ibadan international conference centre on the adjoining forest. *Tropical Plant Research* 5(2): 160–166]

INTRODUCTION

The increasing rate of deforestation as a result of urbanization and its diverse effect on man and the environment has become a phenomenon of concern to the world. Inyang & Esohe (2014) asserted that deforestation exposes the forest land, mountains, hills and even valleys to erosion, subsequently, floods, landslides and mudslides, loss of wild life and increasing loss of deserts follow. However, deforestation is a recurring problem in Nigeria (Inyang & Esohe 2014). Hence, the annual rate of deforestation in Nigeria is about 3.5% which is approximately 350,000 to 400,000 hectares per year (FAO 2005).

The issue of sustainability, environment protection, health and the need to incorporate environment to management of development has triggered several international treaties and legislations. These gave birth to environmental impact assessment (EIA) (Anago 2002). EIA according to Munn (1979), refers to the need to identify and predict the impact of projects, operational procedures, policies, legislative proposals and programmes on the environment and human's well-being and/or health and further interpret and communicate information about the impacts.

In Nigeria, legislations have been put in place such as the Environmental Impact Assessment Decree number 86 of 1992 and Sections 20, 17 (2) and 16 (2) of the 1999 constitution of the Federal Republic of Nigeria (Anago 2002). Therefore, by the provisions of these laws, all developmental projects must operate within

Received: 17 February 2018 Published online: 30 June 2018
https://doi.org/10.22271/tpr.2018.v5.i2.021

environmental sustainability levels and ensure they do not constitute adversely impact on the ecosystem integrity.

There is dearth of information on the impact of University of Ibadan International Conference Centre (UIICC) on the adjoining forest (Teak) which have not been exploited, as such, this study was able to bring out the various impact and ways forwards towards ameliorating the environment in line with EIA Decree number 86 of 1992 and section 20 and 16 (2) of the 1999 constitution of the Federal Republic of Nigeria. Therefore, the objective of this study was to evaluate the impact of University of Ibadan International Conference Centre (UIICC) on the adjoining forest with a view to providing baseline information for ecological management and mitigation of its negative effects.

MATERIALS AND METHODS

Study area

This study was carried out at the University of Ibadan International Conference Centre (UIICC) and the adjoining forests consisting of; *Tectona grandis* L.f. plantation, *Pinus caribaea* Morelet plantation, natural forest and farm/bare land at its Northeastern fringes. The area located along Oyo road, Ibadan in Akinyele Local Government Area of Oyo State, which lies between latitudes 7º 45.106' N to 7º 45.834' N and longitudes 3º 90.942' E to 3º 90.508' E (Fig. 1), within the tropical rainforest. With mean altitude of 227 m above sea level and total land area of 47.21 ha.

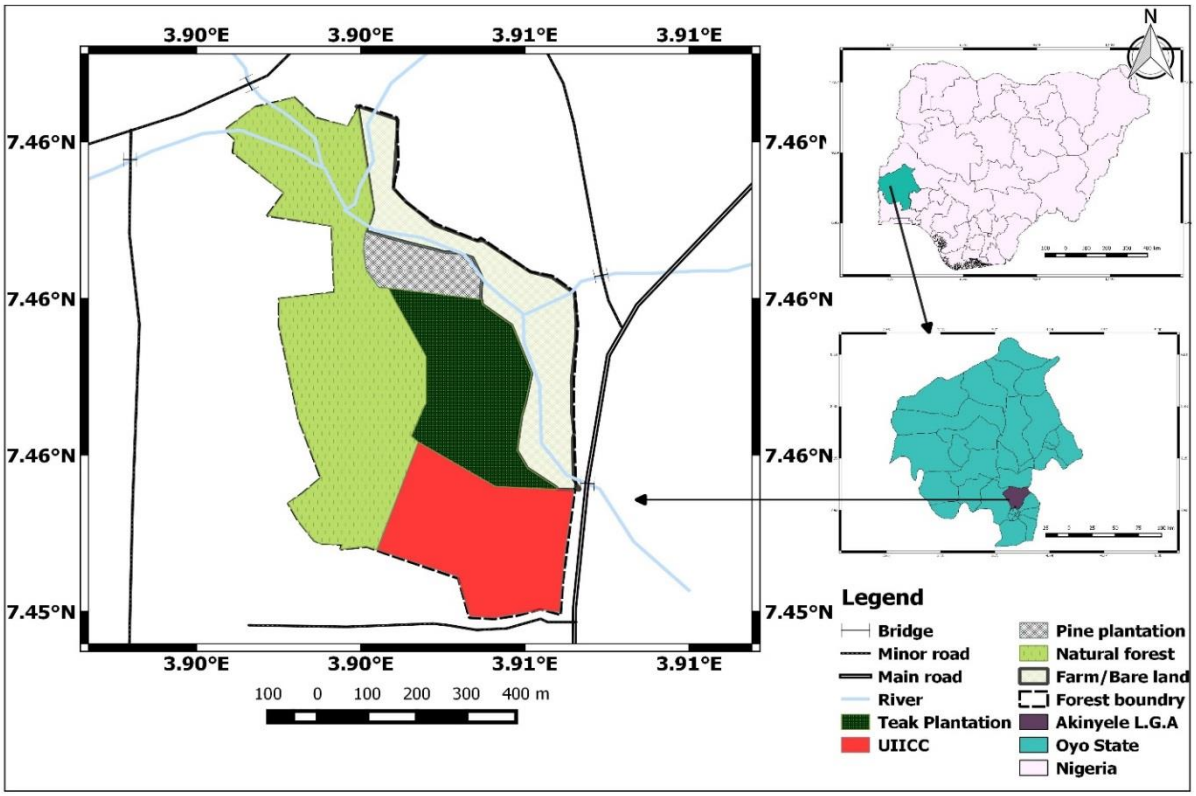

Figure 1. Map Showing the study area and different land cover.

University of Ibadan teak plantation was established over a period of three years (1951–1953) and managed by the Department of Forest Resources Management (now; Department of Forest Production and Products and Department of Social and Environmental Forestry). Until recent years, some part of the planation was proposed to be used for construction of University of Ibadan-Five (5) Star Hotel. Later between the years 2009–2012, through the University of Ibadan Endowment Fund, some part uncompleted buildings of the proposed UI-Five (5) Star Hotel in the plantation were then converted to the present University of Ibadan International Conference Centre. The UIICC cuts across large portion of the teak plantation which was extended to the UI-second gate along Oyo road.

Data collection

Global positioning system (GPS) was used to collect coordinates round the boundaries of the study area. Coordinates of the boundaries of the natural forest, *Tectona grandis* plantation, *Pinus caribaea*, Agricultural lands and UIICC were collected.

Inventory data used in this study was collected from seven randomly laid sample plots (SPs) of size 25 m × 25 m (0.0625 ha) managed by the Faculty of Renewable Natural Resources, University of Ibadan. Total enumerations of *Tectona grandis* found within each SP were made. The following tree growth variables were measured; diameter breast height (cm), diameters at the base; middle and top (cm), total height (m) and merchantable height (m). A total number of three hundred and thirty-two (332) trees were enumerated. Spiegel relaskop was used to measure total and merchantable heights of individual trees. Diameter over bark of individual trees at breast height (1.3 m) was measured; the point of the measurement was recorded from the uphill sides of the trees and on the inside of the lean for leaning trees. Climbers, loose bark and epiphytes were lifted above the measuring tape during measurement. For trees with deformations at 1.3 m, the measurement was made at the sound point on the stem above the abnormality.

Data analysis

Point coordinates obtained from the study area were saved in text (tab delimited) file format in Microsoft Excel spread sheet; then loaded into Quantum Geographic Information System (QGIS) for mapping and demarcations of land cover types and estimation of areas covered by each land use. The Coordinate Reference System (CRS) was set to WGS84 in respect to the study region.

The following tree variables were computed:

i. Basal Area (BA)= $\frac{\pi Dbh^2}{4}$ (Chukwu & Osho 2018) [1]

ii. Total volume (Vt)= $\pi\frac{THT}{24}(D_b^2 + 4D_m^2 + D_t^2)$ (Akindele 2005) [2]

iii. Merchantable volume (Vm)= $\pi\frac{MHT}{24}(D_b^2 + 4D_m^2 + D_t^2)$ (Akindele 2005) [3]

Where Dbh= diameter at breast height (m), MHT = Merchantable height (m), D_b = Diameter at the base (m); D_m = Diameter at mid-point (m), D_t = Diameter at the top (m).

However, basal area, merchantable volume, total volume and number of trees were computed per hectare. Hence, the number of tree removed was estimated as;

$$N_{TR} = \left(\frac{\bar{N}}{Plot\ size}\right) \times \text{Hectare size} \times \text{Area covered by UIICC} \quad [4]$$

Where; N_{TR}= number of tree removed, $\bar{N}$= average number of tree per plot and UIICC = University of Ibadan International Conference Centre

The aboveground biomass (AGB) for each tree, the ecological condition of the forest was considered. Hence, a biomass equation developed by Olayode *et al*. (2015) for *Tectona grandis* Linn. f. plantations within the Southwestern Nigeria Tropical Rainforest, was adopted:

$$\ln B = 2.56 + 0.04\text{Dbh} \quad [5]$$

Where; lnB =natural logarithm of the tree aboveground biomass and Dbh= Diameter at breast height

Equation [5] was used to compute AGB for each tree. The biomass stock (kg ha^{-1}) of each sampling plot was obtained by dividing the sum of all the individual biomass weights (in kilogrammes) by the area of the sampling plot (0.062 ha). Hence, the AGB value was converted to tonnes per hectare upon dividing by 1000. Later, biomass value was converted into carbon stock upon multiplying by the default carbon fraction of 0.47 (IPCC 2006). Tree belowground biomass (BGB) was calculated following Mokany *et al.* (2006):

$$\text{BGB} = \text{AGB}(\text{t C ha}^{-1}) \times 0.235 \quad [6]$$

Where; BGB= tree belowground biomass and AGB = tree aboveground biomass

Tree carbon (TC) was then obtained by the addition of AGB and BGB. Hence, its carbon dioxide equivalent (CO_2e) was estimated by multiplying TC by default carbon dioxide fraction of 3.67 (Pearson *et al.* 2007). Furthermore, mean plot stand variables was computed and average for each stand variable (per ha) was multiplied by the area covered by UIICC (9.309 ha) to estimate for the growth variables value for *T. grandis* removed.

RESULTS

The results of land cover classification reveals that, maximum area (19.348 ha) is covered by the natural forests, the international conference center (9.309 ha), farm/bare land (8.322 ha), teak plantation (7.951 ha) and minimum (2.284 ha) by pine plantation (Fig. 2).

The data used in this study comprise of tree growth variables measured from 7 SPs of *Tectona grandis* stand in the University of Ibadan, Nigeria. A total of 332 trees were measured and the summary statistics presented in table 1. The distribution of Dbh ranged from 21.56 to 68.29 cm, THT ranged from 7.58 to 27.80 m, MHT

ranged from 3.01 to 15.45 m, Vm ranged from 0.0104 to 0.383 m^3, Vt ranged from 0.0247 to 0.5996 m^3 and BA ranged from 0.0365 to 0.3663 m^2.

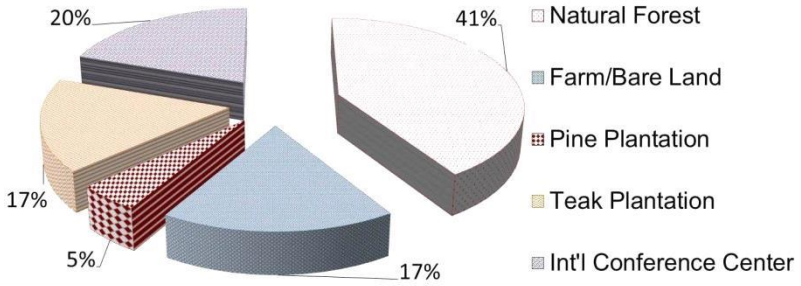

Figure 2. Land cover classification of the study area.

Table 1. Summary statistics of tree growth variables.

Tree Variables	Descriptive Statistics		
	Minimum	Maximum	Mean ± SE
Db (cm)	24.27	115.42	53.9445 ± 0.8488
Dbh (cm)	21.56	68.29	39.8368 ± 0.4361
Dm (cm)	15.00	57.00	34.4608 ± 0.4360
Dt (cm)	10.00	41.00	22.1084 ± 0.3604
THT (m)	7.58	27.80	18.6170 ± 0.1860
MHT (m)	3.01	15.45	8.9390 ± 0.1373
BA (m^2)	0.0365	0.3663	0.1296 ± 0.0028
Vm (m^3)	0.0104	0.383	0.0852 ± 0.0029
Vt (m^3)	0.0247	0.5996	0.1793 ± 0.0056

Note: SE= standard error, Db= diameter at the base, Dbh= diameter at breast height, Dm= diameter at middle, Dt= diameter at top, THT= total height, MHT = merchantable height (m), BA=Basal area, Vm= Merchantable volume and Vt= Total volume. The Total number of tree= 332.

The result of the study shows that the tree density (N) ranges from 624 to 928 tree ha^{-1} with a mean value of 759 tree ha^{-1}. The basal area (BA) from 82.77 to 121.73 (mean 98.34) m^2 ha^{-1}; merchantable volume (Vm) from 52.39 to 85.78 (mean 64.62) m^3 ha^{-1}; total volume (Vt) from 109.58 to 161.84 (mean 136.06) m^3 ha^{-1}; aboveground biomass (AGB) from 42.27 to 62.75 (mean 50.89) t ha^{-1}; above ground carbon (AGC) from 19.87 to 29.49 (mean 23.92) t C ha^{-1}; belowground carbon (BGC) from 4.67 to 6.93 (mean 5.62) t C ha^{-1} and Tree CO_2 from 90.04 to 133.68 (mean 108.42) t CO_2 e (Table 2).

Table 2. Summary statistics of tree stand variables.

Plot	N (Tree ha^{-1})	BA (m^2 ha^{-1})	Vm (m^3 ha^{-1})	Vt (m^3 ha^{-1})	AGB (t ha^{-1})	AGC (t C ha^{-1})	BGC (t C ha^{-1})	Tree CO_2 (t CO_2 e)
1	672	93.04	57.26	121.27	47.72	22.43	5.27	101.65
2	768	92.36	58.58	133.21	48.36	22.73	5.34	103.02
3	688	94.23	62.31	134.03	48.95	23.00	5.41	104.27
4	928	121.73	77.61	161.84	62.75	29.49	6.93	133.68
5	624	82.77	52.39	109.58	42.27	19.87	4.67	90.04
6	736	86.89	58.42	121.39	45.40	21.34	5.01	96.71
7	896	117.34	85.78	171.09	60.82	28.58	6.72	129.56
Mean	**759**	**98.34**	**64.62**	**136.06**	**50.89**	**23.92**	**5.62**	**108.42**

Note: N= Number of tree, BA= basal area, Vm= merchantable volume, Vt= total volume, CO_2= Carbon dioxide, AGB= aboveground biomass, AGC= above ground carbon, BGC= belowground carbon.

Furthermore, about 7064 *Tectona grandis* trees, with estimated basal area (BA) of 915.4471 m^2; merchantable volume (Vm) of 601.5476 m^3; total volume (Vt) of 1266.583 m^3; aboveground biomass (AGB) 473.74 t; above ground carbon (AGC) 222.67 t C; belowground carbon (BGC) 52.32 t C and Tree CO_2 1009.28 t CO_2 e were removed from the study area to build UIICC (Table 3).

Table 3. Estimated quantity of *Tectona grandis* variables removed of the study locations.

N (Trees)	BA (m^2)	Vm (m^3)	Vt (m^3)	AGB (t)	AGC (t C)	BGC (t C)	Tree CO_2 (t CO_2 e)
7066	915.45	601.55	1266.58	473.74	222.67	52.32	1009.28

Note: N= Number of tree, BA= basal area, Vm= merchantable volume, Vt= total volume, CO_2= Carbon dioxide, AGB= aboveground biomass, AGC= above ground carbon, BGC= belowground carbon.

DISCUSSION

In this study, information on the tree growth variables from the University of Ibadan Teak plantation was presented in table 1. Effort was directed towards estimating number of trees with corresponding stand variables for the portion of the plantation used to construct the University of Ibadan International Conference Centre (UIICC).

The result of the spatial analysis shows that the UIICC perimeter fencing covered about 9.309 ha which is about 19.7% of the total forest area and 53.9% of the teak plantation. This result revealed that more than half of the teak plantation was deforested for the construction of the conference centre. However, Mohammed *et al.* (2013) averred that trees are seen as obstacles to development and their removal is viewed as the first stage in development. Adeniyi and Omojola (1999) confirmed that most land development programmes and projects in Nigeria have evolved without an appreciation of the value of land use and land cover information. Hence, this has given rise to uncontrolled conversion of forests into other land cover types (Mohammed *et al.* 2013).

High tree carbon value of 29.54 t C ha^{-1} with corresponding tree CO_2 values of 108.42 t CO_2 e was estimated for the *T. grandis* in the study area. Similar results were obtained by Olayode *et al.* (2015) for Teak plantations in Osho Forest Reserve (29.36 t C ha^{-1}) and Shasha Forest Reserve (24.36 t C ha^{-1}) in Southwestern Nigeria. Teak plantation was confirmed by studies to store substantial amount of carbon (Khanduri *et al.* 2008, Boonyanuphap & Kongmeesup 2016). Olayode *et al.* (2015) affirmed that the high value obtained from Osho forest reserve was because the plantation has not been harvested. This further confirms the result of this study as UI Teak plantation is still within its first rotation.

Negative impacts

This study revealed that about 53.9% (9.309 ha) of the teak plantation was deforested. Wilcox (1995) stated the forest degradation is usually accompanied by species extinction, reduction in biodiversity and decrease in primary productivity. The long-term effect of this pressure is usually destruction of the quality and quantity of rainforests (Mohammed *et al.* 2013). The bare land within UIICC and fence demarcating the Teak Plantation has been shown in figure 3.

Figure 3. Bare land within UIICC and fence demarcating the Teak Plantation

Hence, about 7066 teak tree stands were removed from the plantation to construct the UIICC. These large numbers of tree removed constitute high environmental degradation. Gibbs *et al.* (2007) upheld that trees (aboveground tissues) are reservoir for majority of atmospheric carbon sequestered in tropical forests. Malhi (2010) also stressed the importance of tropical forests as a major influence on global patterns of biodiversity, ecosystem ecology, productivity and biogeochemical cycles. However, the removal of more than a half of the teak trees in the study area implies loss of habitat for animals (birds, reptiles and rodents) and great deficit to the environment (Fig. 4).

Furthermore, about 274.99 tonnes of tree carbon with a corresponding carbon dioxide value of 1009.28 t CO_2 e was loss following the destruction of the plantation. Couple with the exposure of the deforested land to direct sunlight over years. Hence, this exposure tends to increase in both soil and atmospheric temperature and decrease in relative humidity of the area leading to the degrading of the land area under investigation. Stern (2007) revealed that, 18% of total global anthropogenic greenhouse gas emissions are contributed by deforestation and forest degradation.

Suggested Mitigations for Negative Impacts

According to FAO (2006), global carbon retention resulting from reduced deforestation, increased forest regrowth and more agroforestry could make up for about 15% of carbon emissions from fossil fuels over the

next 50 years. Therefore, planting of avenue trees within the premises of the conference centre is necessary. It is suggested that renewable source of energy (Solar system) should be adopted and environmental friendly means for waste disposal (bio-digester) for operations in the conference center.

Figure 4. Some buildings and Hall Complex within UIICC.

CONCLUSION

This study has provided baseline information on the environmental impact of the University of Ibadan International conference centre on the adjoining forest and the status of the *Tectona grandis* stand in the study area. Nevertheless, the assessment revealed high level of deforestation and forest degradation, coupled with large amount of carbon loss to the environment as the result on situating the UIICC within the Teak forest.

However, Government law enforcement agencies should ensure that environmental impact assessments are conducted before any developmental project is executed as prescribed by law, also ensuring strict compliance with the EIA recommendations during and after the project.

ACKNOWLEDGEMENTS

Authors appreciation goes to the Forest Biometrics and Remote Sensing Unit, Department of Social and Environmental Forestry, University of Ibadan, Nigeria for technical and material support toward the success of this research work.

REFERENCES

Adeniyi PO & Omojola A (1999) Landuse/landcover change evaluation in Sokoto-Rima Basin of North-western Nigeria on Archival Remote Sensing and GIS techniques. *Journal of African Association of Remote Sensing of the Environment* 1: 142–146.

Akindele SO (2005) *Volume functions for common timber species of Nigeria's Tropical Rain Forests, a Technical Document*. International Tropical Timber Organization (ITTO), pp. 1–85.

Anago I (2002) *Environmental Impact Assessment as a tool for Sustainable Development: The Nigerian experience: sustainability*. FIG XXII International Congress Washington D.C., USA, pp. 1–13.

Boonyanuphap J & Kongmeesup I (2016) Carbon Stock of Teak Plantation in Subtropical Region of Lower Northern Thailand. *Naresuan University Journal: Science and Technology* 24(1): 64–71.

Chukwu O & Osho JSA (2018) Basal area-stump diameter models for *Tectona grandis* Linn. f. stands in Omo Forest Reserve, Nigeria. *Journal of Forest and Environmental Science* 34 (2): 119–125.

FAO (2005) *Global forestry resource assessment*. Food and Agriculture Organization (FAO) Forestry Paper 147, Rome.

FAO (2006) *Newsroom: Focus on the issues. Forests and Climate*. Food and Agriculture Organization, Rome.

Gibbs HK, Brown S, Niles JO & Foley JA (2007) Monitoring and estimating tropical forest carbon stocks: making REDD a reality. *Environmental Research Letters* 2(4): Article ID 045023.

Inyang MP & Esohe KP (2014) Deforestations, environmental sustainability and health implications in Nigeria: a review, *International Journal of Science, Environment and Technology* 3(2): 502–517.

IPCC (2006) Agriculture, Forestry, and Other Land Use. In: Eggleston HS, Buendia L, Miwa K, Ngara T & Tanabe K (eds) *IPCC Guidelines for the National Greenhouse Gas Inventories Programme Hayama, Japan, Volume 4*. Institute for Global Environmental Strategies.

Khanduri VP, Lalnundanga & Vanlalremkimi J (2008) Growing stock variation in different teak (*Tectona grandis*) forest stands of Mizoram, India. *Journal of Forestry Research* 19(3): 204–208.

Malhi Y (2010) The carbon balance of tropical forest regions, 1990- 2005. *Current opinion in Environmental Sustainability* 2: 237–244.

Mohammed SO, Gajere EN, Eguaroje EO, Shaba H, Ogbole JO, Mangut YS, Onyeuwaoma ND & Kolawole IS (2013) Spatio-temporal analysis of the National Parks in Nigeria using geographic information system. *Ife Journal of Science* 15(1): 159–166.

Mokany K, Raison RJ & Prokushkin AS (2006) Critical analysis of root: shoot ratios in terrestrial biomes. *Global Change Biology* 11: 1–3.

Munn RE (1979) *Environmental impact assessment: Principles and procedures, 2nd Edition*. John Wiley, New York.

Olayode OO, Bada SO & Popoola L (2015) Carbon stock in Teak stands of selected forest reserves in Southwestern Nigeria. *Environment and Natural Resources Research* 5(3): 109–115.

Pearson TR, Brown SL & Birdsey RA (2007) *Measurement guidelines for the sequestration of forest carbon*. US: Northern Research Station, Department of Agriculture. 32 p. Available from: http://www.nrs.fs.fed.us/pubs/gtr/gtr_nrs18.pdf (accessed: 23 Jan. 2018).

Stern NH (2007) *The economics of climate change:* The Stern review (pre-publication edition). Cambridge University Press, Cambridge.

Wilcox BA (1995) Tropical forest resources and biodiversity: The risks of forest loss and degradation. *Unasylva* 46: 43−49.