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# Ecological Services of a Peri-Urban Recreation Centre in Abeokuta, Ogun State, Nigeria

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Research Article

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## ABSTRACT

**Purpose:** This study examines the consumption of renewable natural resources without market price by the people to promote conservation in the outlier of urban environment. The resources however offer ecosystem services to protect man and the environment.

**Methods:** Socio economic profile of respondents and natural resources data were gathered using two methods. Questionnaire as a socio economic tool was used to gather data from respondents for socio-economic profile and natural resources data were obtained through bio-physical study of available renewable resources. Both descriptive and inferential statistics were used for data analysis.

**Results:** The result shows gender sensitivity with female domination (64%) of the respondents and 36% male, age range 21-40 years accounted for 43% with mean age of 41 years. Further, some (44%) respondents were Christian, Tertiary education recorded the highest educational level with 53% and Ogun state had the highest State of origin distribution with 77%. A total of 30 flora species was identified and family fabaceae with 6 species contributed more to the ecosystem services of the park than other families with 3 species. Furthermore, trees with diameter >11 cm had higher carbon sequestration potential with 1009,776 $kgCha^{-1}$, Above Ground Biomass of 2456.795 kg and Below Ground Biomass of 272.33 kg. A total of 25 fauna species was recorded as offering ecosystem services and Mammals with 31 species had the highest number of species offering ecosystem services followed by Aves with 14 species and reptiles with 13 species.

**Conclusion:** In conclusion, the study revealed that flora and fauna species offer a wide range of ecosystem services ranging from cultural, supporting, regulating, and provisioning services. It is suggested that recreation policy should ensure that proper and adequate sensitization through electronic media to enlighten the general public on recreation and the significance of flora and fauna in human health and the environment.

## INTRODUCTION

Ecosystem services and human welfare are interconnected through the link of supply of environmental goods and services from natural areas. Therefore, any alteration to the supply link requires proper understanding of both tangible and intangible benefits form the environment [1]. The tangible benefits are easily measured through direct market approach because they are traded in the market with prices dictated by demand and supply for example water treatment cost or market prices of food items.

However, Intangible benefits, or non-traded products that may be referred to as Cultural Ecosystem Services (CES), are dificult to evaluate due to absence of existing markets for the products (but not impossible) using methods that rely on human preferences to measure demand for the products. Consequently, it is not an over statement that ecosystems goods and services play major role in the existence of humanity [2]. Globally, communities and societies exploit nature for array of benefits ranging from ecological, economic to aesthetic-cultural values. More than 60 percent of the global population depends on

plants for their medicine. Aesthetic cultural values like nature tourism are also provided through ecosystems. However, over dependence on these resources by man along with other anthropological activities, altered the balance between man and the environment in the negative direction towards environment thus leading to climate change, loss of habitat and a continuous loss of the earth's biodiversity [3]. The concept of peri urban and peri urbanization can be described as loose concepts. They may be used to describe newly urbanized zones at the fringes of cities mostly in developing countries, which may later be referred to as 'peri urban interface'. Perhaps, emerging European perspective shows peri urban areas to be mixed areas under an urban influence but with a rural morphology.

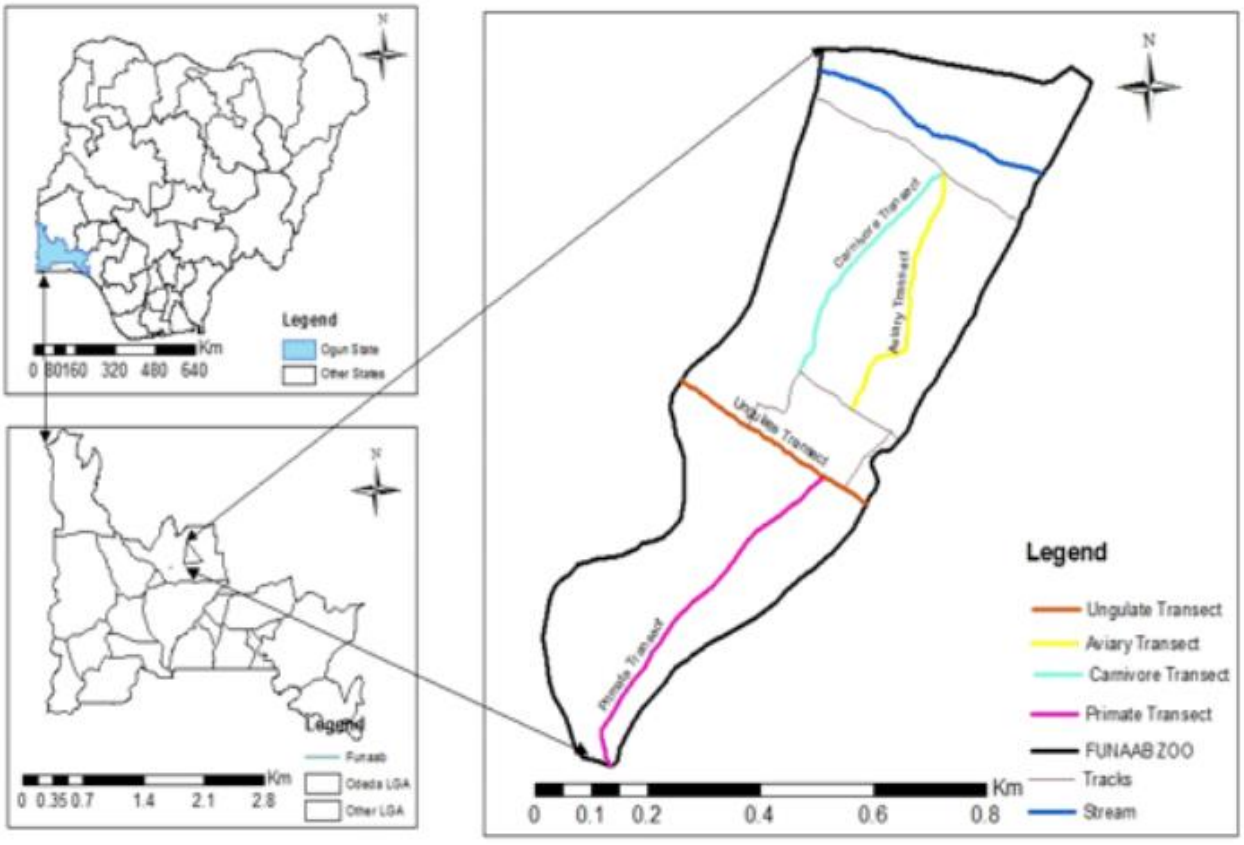
According to, reported that develops one of the most acceptable classifications in the study of ecosystem services. The classification approach divides the services into four sections: provisioning, regulating, supporting and cultural services. Provisioning services refer to tangible goods obtained from ecosystems; Regulating services refer to benefits obtained from the regulation of ecosystem processes; Cultural services intangible products or non-material benefits obtained from the ecosystem and supporting services support production of all other services [4]. Thus, ecosystem services are mostly undervalued and therefore fail to show the significance of the services to humanity on a global scale. This underscores the objectives of this study which are to identify zoo park flora and fauna providing ecological services for biodiversity conservation and climate protection and to describe the profile of visitors to the zoo park.

## MATERIALS AND METHODS

### The study area

The study was conducted in the Federal University of Agriculture, Abeokuta (FUNAAB) zoo park (Figure 1), Ogun State, Nigeria. It is located on latitude 7.2 °N; Longitude 3.4 °E. FUNAAB Zoo Park is directly managed by the university through a zoo directorate created by the institution [5].

**Figure 1.** Map of FUNAAB zoo park, Abeokuta, Ogun state, Nigeria.




The zoo park was commissioned in May 23, 2012. The study accommodated feral animals *i.e.* free roaming living animals and the zoo animals *i.e.* animals under captivity (especially the carnivorous animals) in the FUNAAB zoo park. The zoo park was established on the tripodal mandate of the university of teaching, research and extension. The park, though for recreation also

serves as field laboratory for students practical in terms of teaching, conservation for research and wildlife identification for extension services [6]. The zoo park occupies a forty hectare land in the northern fringes of Ogun state, Nigeria in derived savanna vegetation.

## Scope of study

The study was divided into two; Socio economic study and biophysical study.

### Socio economic study

**Data collection:** Data were collected from 100 visitors with structured questionnaire at the zoo park using simple random sampling technique. Furthermore, personal contacts, oral interviews and observations were used during visitation; this aided the data collection.

**Biophysical study sampling procedure:** A systematic sampling technique was used to collect data from the study area. Four plots of 10 m by 10 m were laid close to the major animal sections in the park and complete enumeration was carried out within the plots to estimate carbon sequestration potential of plants and animals [7].

**Above Ground Biomass (AGB) estimation:** The rate of carbon sequestration depends on the growth characteristics of the plant species, the conditions for growth, where the plant is located and the density for woody stems. For the purpose of this research, recourse was made to the dry weight technique for biomass estimation used by Aboal JR, et al. Thus, non-destructive method of estimating tree carbon weight was adopted for the purpose of this study.

**Girth measurement:** The girth of individual tree species was obtained with the aid of girthing tape at 1.3 m and the unit of measurement (cm) and was converted to m using 0.3 m correction factor.

**Tree height:** Tree height was measured with haga altimeter calibrated before use *i.e*. 9 m for tall trees and 3 m for short trees.

Above ground biomass of a tree was calculated as follows:

For trees with diameter less than 11 cm: W=0.25D2H and W=0.15D2H for dbh ≥ 11 cm

W=Above ground biomass (Kg)

D=Dbh of the trunk (m)

H=Height (m)

**Below Ground Biomass (BGB) estimation:** Regression models were used to predict root biomass based on the Above Ground Biomass (ABG). Root to shoot (RS) ratio provide general description of the relationship between roots and shoots biomass. The allometric model proposed for the root biomass assessment is:

$$BGB=\exp(-1.3267+0.8877 \times \ln(AGB) +0.1045.\ln(AGE) \quad (1)$$

**Carbon sequestration:** The combination ratio derived from the atomic weights of the elements making up $CO_2$ molecule to that of carbon (C), *i.e*. 3.7 was used to estimate sequestered $CO_2$. Ratio (3.7) was multiplied with (AGB) and (BGB) for different trees to estimate $CO_2$ sequestered.

$$\text{Total } CO_2 \text{ sequestrated}=3.7^{*}(AGB + BGB) \quad (2)$$

**Data analysis:** Descriptive statistics were used to summarize socio economic characteristics of respondents, perception and preferences of services generated in the study area [8].

**Likert scale:** Likert scale with class boundaries of means were used to draw inferences on perception. Statements as variables in 5 perceptional arrangements were presented to the respondents for rating ranging from strongly agreed (5), agreed (4), undecided (3), disagreed (2) and strongly disagreed (1). For inferences, class boundaries are: < 1.5=Strongly disagreed, ≥ 1.5 <2.5=Disagreed; ≥ 2.5 <3.5=Undecided; ≥ 3.5<4.5 =Agreed; ≥ 4.0 ≤ 5.0=Strongly agreed.

# RESULTS AND DISCUSSION

## Socio economic characteristics of respondents

Table 1 shows that Ogun State has the highest State of origin distribution with 77%, the study is gender sensitive with majority, (64%) of the respondents were female and 36% male, household 3–6 members recorded the highest percentage of 67% with mean household size of 6 [9]. Age distribution shows age bracket (21-40 yrs) accounted for 43% with mean age of 41 years. Furthermore, some respondents were Christian with 44%, Tertiary education (53%) recorded the highest level of education. Majority, (67%) came from Abeokuta the catchment location of the park. Also, majority, (68%) visit alternative recreation centres.

**Table 1.** Socio economic characteristics of respondent.

| Variables | Frequency | Percentage | Mean/Mode |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Age (Years) | | | |
| ≤ 20 | 21 | 21 | |
| 21-40 | 43 | 43 | 41 Years |
| 41-60 | 19 | 19 | |
| ≥ 60 | 17 | 17 | |
| Total | 100 | 100 | |
| Gender | | | |
| Male | 64 | 64 | |
| Female | 36 | 36 | |
| Total | 100 | 100 | |
| Family size | | | |
| ≤ 2 | 21 | 21 | |
| 03-06 | 67 | 67 | 6 |
| ≥6 | 12 | 12 | |
| Total | 100 | 100 | |
| Location | | | |
| Ogun | 77 | 77 | Ogun |
| Oyo | 12 | 12 | |
| lagos | 11 | 11 | |
| Total | 100 | 100 | |
| Religion | | | |
| Christian | 44 | 44 | |
| Muslim | 35 | 35 | |
| Traditional | 21 | 21 | |
| Total | 100 | 100 | |
| Education | | | |
| Tertiary | 53 | 53 | Tertiary |
| Secondary | 23 | 23 | |
| No formal education | 11 | 11 | |
| Total | 100 | 100 | |
| Income (₦) | | | |
| 5,000 – 10,000 | 18 | 18 | ₦26,521 |
| 10,000 – 15,000 | 24 | 24 | |
| 15,000 – 20,000 | 12 | 12 | |
| ≥ 20,000 | 46 | 46 | |
| Total | 100 | 100 | |
| Native of Abeokuta | | | |
| Yes | 67 | 67 | Yes |
| No | 33 | 33 | |
| Total | 100 | 100 | |
| Occupation | | | |
| Civil servant | 33 | 32 | |

| | | | |
|---|---|---|---|
| Farming | 21 | 21 | |
| Artisan | 22 | 22 | |
| Self employed | 25 | 25 | |
| Total | 100 | 100 | |
| Are you aware of substitute recreation centres | | | |
| Yes | 67 | 67 | Yes |
| No | 33 | 33 | |
| Total | 100 | 100 | |
| Source: Field survey, 2018 | | | |

## Bio physical study

Table 2 presents a checklist of flora species in the zoo park. A total of 30 plant species was identified with 17 families. Fabaceae family with 6 species recorded the highest number of species. Other families were as follows; Moraceae (2), Anacardiaceae (2), Euphorbiaceae (3), Apocynaceae (2), Gentianaceae (1), Poaceae (1), Sapindaceae (2), Malvaceae (3), Ulmaceae (1), Ebeneceae (1), Meliaceae (1), Areceae (1), Samydaceae (2).

**Table 2.** Checklist of plant species in the study area.

| S/N | Species | Common name | Local name (Yoruba) | Forms | Family |
|---|---|---|---|---|---|
| 1 | *Ficus exasperate* | Sandpaper tree | Ipin | Tree | Moraceae |
| 2 | *Mangifera indica* | Mango | Mangoro | Tree | Anacardiaceae |
| 3 | *Anarcadium occidentalis* | Cashew | Kasu | Tree | Anacardiaceae |
| 4 | *Albizia adianthifolia* | Flat crown | - | Tree | Fabaceae |
| 5 | *Albizia ferruginea* | Albizia | - | Tree | Fabacea |
| 6 | *Albizia zygia* | Albizia | - | Tree | Fabacea |
| 7 | *Alcornea cordifolia* | Christmas bush | - | Shrub | Euphorbiaceae |
| 8 | *Alcornea laxifora* | Lowveld bead-string | - | Shrub | Euphorbiaceae |
| 9 | *Alstonia boonei* | God's tree | - | Tree | Apocynaceae |
| 10 | *Antiaris Africana* | Mull berry | - | Tree | Moraceae |
| 11 | *Anthocleista vogelii* | Planch tree | - | Tree | Gentianaceae |
| 12 | *Bambusa vulgaris* | Bamboo | Oparun | Grass | Poaceae |
| 13 | *Baphia nitida* | Camwood | - | Tree | Fabaceae |
| 14 | *Blighia sapida* | Achee | - | Tree | Sapindaceae |
| 15 | *Blighia unijugata* | Triangle tops | - | Tree | Sapindaceae |
| 16 | *Bridelia artroviridis* | Bredelia | - | Tree | Euphorbiaceae |
| 17 | *Ceiba pentandra* | Kapok | - | Tree | Malvaceae |
| 18 | *Celtis zenkeri* | African celtis | - | Tree | Ulmaceae |
| 19 | *Chrysophyllum albidum* | Cherry | Agbalumo | Tree | Sapotaceae |
| 20 | *Cola nitida* | Kola | Obi | Tree | Malvaceae |
| 21 | *Cola millenii* | Kola | Obi | Tree | Malvaceae |
| 22 | *Delonix regia* | Royal tree | - | Tree | Fabaceae |
| 23 | *Diospyros dendo* | Yellow persimmon | - | Tree | Ebenaceae |
| 24 | *Entandrophragma* | Utile | - | Tree | Meliaceae |

| | | | | | |
|---|---|---|---|---|---|
| | *angolense* | | | | |
| 25 | *Elaeis guineensis* | Oil palm | - | Tree | Arecaceae |
| 26 | *Funtumia elastica* | | - | Tree | Apocynaceae |
| 27 | *Guarea thomsonii* | Black guarea | - | Tree | Meliaceae |
| 28 | *Gliricidia sepium* | Gliricidia | - | Tree | Fabaceae |
| 29 | *Holoptelea grandis* | | - | | Samydaceae |
| 30 | *Homalium africanum* | | - | | Samydaceae |
| Source: Field survey, 2018 | | | | | |

Above ground biomass of tree species <11 cm DBH
Table 3 shows the species with diameter less than 11 cm. Tree height with diameter was used to calculate the above ground biomass using model 1.

**Table 3.** Above ground biomass of tree species <11 cm DBH.

| Species | No of stem | Mean DBH | Mean height | Model | AGB (kg) |
|---|---|---|---|---|---|
| *Delonix regia* | 3 | 7.8 | 11.1 | W=0.25D2H | 43.29 |
| *Bridelia artroviridis* | 3 | 10.7 | 19.9 | W=0.25D2H | 106.47 |
| *Ceiba pentandra* | 10 | 7.8 | 17.7 | W=0.25D2H | 69.03 |
| *Cola millenii* | 7 | 7.8 | 23.8 | W=0.25D2H | 185.64 |
| *Diospyros dendo* | 8 | 10.8 | 25.6 | W=0.25D2H | 138.24 |
| Total | | | | | 542.67 |
| Source: Field survey, 2018 | | | | | |

## Below ground biomass computation

BGB=exp (-1.3267+0.8877 × ln (AGB) +0. 1045. ln (Age)
BGB=exp (-1.3267+0.8877 × ln (542.67) +0. 1045. ln (542.67)
BGB=exp (-1.3267+0.8877 × 6.297) +0.1045. (6.297)
BGB=exp (4.263) +0.6580
BGB=71.023+0.6580
BGB=71.681 kg
Total $CO_2$ sequestrated
Total $CO_2$ sequestrated=3.7* (AGB+BGB)
=3.7* (542.67+BGB)
=3.7* (542.67+71.681
Total $CO_2$ sequestrated =227310 $kgCha^{-1}$

Above ground biomass of tree species >11 cm DBH
Table 4 indicated the species with diameter greater than or equal to 11 cm. Tree height along with the dbh was used to calculate the above ground biomass using model 2.

**Table 4.** Above ground biomass of tree species > 11 cm DBH.

| Species | No of stem | Mean DBH | Mean height | Model | AGB (kg) |
|---|---|---|---|---|---|
| *Ficus exasperata* | 9 | 11.8 | 9.3 | W=0.15D2H | 32.92 |
| *Anarcadium occidentalis* | 12 | 12 | 10.4 | W=0.15D2H | 37.44 |
| *Albizia adianthifolia* | 5 | 13 | 11.7 | W=0.15D2H | 45.63 |
| *Albizia ferruginea* | 7 | 12.4 | 9.2 | W=0.15D2H | 34.22 |

| | | | | | |
|---|---|---|---|---|---|
| *Albizia zygia* | 4 | 24.1 | 11 | W=0.15D2H | 72.22 |
| *Alstonia boonei* | 8 | 18 | 18.2 | W=0.15D2H | 98.28 |
| *Antiaris africana* | 9 | 16 | 16.5 | W=0.15D2H | 79.2 |
| *Anthocleista vogelii* | 2 | 14.4 | 20.5 | W=0.15D2H | 88.56 |
| *Bambusa vulgaris* | 10 | 26.1 | 24.2 | W=0.15D2H | 189.49 |
| *Baphia nitida* | 10 | 40 | 18.4 | W=0.15D2H | 220.8 |
| *Blighia sapida* | 5 | 18.1 | 16.9 | W=0.15D2H | 91.77 |
| *Blighia unijugata* | 7 | 21.9 | 18 | W=0.15D2H | 118.26 |
| *Celtis zenkeri* | 9 | 12 | 31.5 | W=0.15D2H | 113.4 |
| *Chrysophyllum albidum* | 5 | 13 | 20.6 | W=0.15D2H | 80.34 |
| *Cola nitida* | 8 | 11.8 | 16.1 | W=0.15D2H | 56.99 |
| *Entandrophragma angolense* | 11 | 12 | 22.7 | W=0.15D2H | 81.72 |
| *Elaeis guineensis* | 6 | 13 | 22.5 | W=0.15D2H | 87.75 |
| *Funtumia elastica* | 8 | 12.4 | 32 | W=0.15D2H | 119.04 |
| *Guarea thompsonii* | 10 | 24.1 | 34.5 | W=0.15D2H | 249.435 |
| *Gliricidia sepium* | 11 | 39 | 17.8 | W=0.15D2H | 208.26 |
| *Holoptelea grandis* | 11 | 17.1 | 24.2 | W=0.15D2H | 124.15 |
| *Homalium africanum* | 6 | 20 | 24.2 | W=0.15D2H | 145.2 |
| *Mangifera indica* | 8 | 12.2 | 15.9 | W=0.15D2H | 81.72 |
| Total | | | | | 2456.795 |

Below ground biomass computation
BGB=exp (-1.3267+0.8877 × ln (AGB) + 0.1045. ln (AGE)
BGB=exp (-1.3267+0.8877 × ln (2456.795) + 0.1045. ln (2456.795)
BGB = exp (-1.3267+0.8877 × 7.807) +0.1045 (7.807)
BGB=exp (5.604) +0.8158
BGB=271.51+0.8158
BGB=272.33 kg
Total $CO_2$ sequestrated: 3.7* (AGB+BGB)
=3.7* (2456.795+BGB)
=3.7* (2456.795+272.33)
=3.7* (2729.125)
=10097.76=1009776 $kgCha^{-1}$

## Ecosystem services of the flora species

**Provisioning services:** These are services that describe the material or energy outputs from the ecosystems. Provisioning services offered by the floristic resources of the study were categorized into food/fruit production and medicinal values [10]. Majority, (60%) of the plants encountered offers provisioning services while Fabaceae (33%) recorded the highest percentage of plants offering this service (Table 5).

**Table 5.** Plant species offering provisioning services in the park.

| Family | Plant species | Number of species | Percent |
|---|---|---|---|
| Anacardiaceae | Mangifera indica<br>Anarcadium occidentalis | 2 | 11 |
| Fabaceae | *Albizia adianthifolia* | 6 | 33 |

| | | | |
|---|---|---|---|
| | *Albizia ferruginea* | | |
| | *Albizia zygia* | | |
| | *Baphia nitida* | | |
| | *Gliricidia sepium* | | |
| | *Delonix regia* | | |
| Poaceae | *Bambusa vulgaris* | 1 | 6 |
| Malvacea | *Ceiba pentandra Cola nitida* | 3 | 17 |
| | *Cola millenii* | | |
| Palmae | *Elaeis guineensis* | 1 | 6 |
| Euphorbiacea | *Alcornea cordifolia* | 3 | 17 |
| | *Alcornea laxiflora* | | |
| | *Bridelia artroviridis* | | |
| Sapotaceae | *Chrysophyllum albidum* | 1 | 6 |
| Apocynaceae | *Funtumia elastica* | 1 | 6 |

**Cultural services:** These are non-material benefits people obtained from ecosystems through spiritual enrichment cognitive development, reflection, recreation and aesthetic experiences. Accordingly, plants at children play ground provides educational values and these plants are *Ficus exasperata, Albizia zygia, Alstonea boonei, Antaris africana, Ceiba pentandra*. Table 6 shows that moraceae (40%) recorded the highest percentage of plants offering this service.

**Table 6.** Plant species offering cultural services in the park.

| Family | Plant species | Number of Species | Percent |
|---|---|---|---|
| Fabaceae | *Albizia zygia* | 1 | 20 |
| Apocynaceae | *Alstonia boonei* | 1 | 20 |
| Moraceae | *Antiaris africana* | 2 | 40 |
| | *Ficus exasperata* | | |
| Malvaceae | *Ceiba pentandra* | 1 | 20 |
| Source: Field Survey, 2018 | | | |

**Regulating services:** These are services rendered by trees to address all forms of biological control. All plants encountered perform various regulating services varying from air quality regulation, water regulation and climate regulation. Table 7 shows that Fabaceae had the highest percentage (20%) of plants offering regulating services in the park [11, 12].

**Table 7.** Plant species offering regulating services in the park.

| Family | Plant species | Number of Species | Percent |
|---|---|---|---|
| Anacardiaceae | *Mangifera indica* | 2 | 7 |
| | *Anarcadium occidentalis* | | |

| | | | |
|---|---|---|---|
| | *Albizia adianthifolia* | | |
| | *Albizia ferruginea* | | |
| | *Albizia zygia* | | |
| | *Baphia nitida* | | |
| | *Gliricidia sepium* | | |
| Fabaceae | *Delonix regia* | 6 | 20 |
| Poaceae | *Bambusa vulgaris* | 1 | 3 |
| | *Ceiba pentandra Cola nitida* | | |
| Malvaceae | *Cola millenii* | 3 | 10 |
| Palmae | *Elaeis guineensis* | 1 | 3 |
| | *Alcornea cordifolia* | | |
| Euphorbiaceae | *Alcornea laxiflora Bridelia artroviridis* | 3 | 10 |
| Sapotaceae | *Chrysophyllum albidum* | 1 | 3 |
| Apocynaceae | *Funtumia elastica* | 1 | 3 |
| | *Antiaris africana* | | |
| Moraceae | *Ficus exasperata* | 2 | 7 |
| Gentianaceae | *Anthocleista vogelii* | 1 | 3 |
| Poaceae | *Bambusa vulgaris* | 1 | 3 |
| | *Blighia sapida* | | |
| Sapindaceae | *Blighia unijugata* | 2 | 7 |
| Ulmaceae | *Celtis zenkeri* | 1 | 3 |
| Ebenaceae | *Diospyros dendo* | 1 | 3 |
| | *Guarea thomsonii* | | |
| Meliaceae | *Entandrophragma angolense* | 2 | 7 |
| | *Holoptelea grandis* | | |
| Samydaceae | *Homalium africanum* | 2 | 7 |
| Source: Field survey, 2018 | | | |

Ecosystem services of the fauna species

Ecosystem services provided by the fauna species across the fauna group was conducted. The ecosystem services reviewed are provisioning services, supporting services, regulatory services and cultural services. Details of the ecosystem services are presented in Table 8 [13]. A total of 25 fauna species were recorded as offering ecosystem services [14-17]. A breakdown of the number of species with respect to fauna group revealed that mammals with 31 species had the highest number of species offering ecosystem service, followed by Aves with 14 species and reptiles with 13 species.

**Table 8.** Ecosystem services of the fauna species.

| **Ecosystem services** | **Mammals** | **Aves** | **Reptiles** |
|---|---|---|---|
| Provisioning | 12 | 7 | 6 |
| Regulating | 2 | - | 1 |
| Cultural | 11 | 7 | 6 |
| Supporting | 6 | - | - |
| Total | 31 | 14 | 13 |

Table 9 shows the list of animals in the park offering the different ecosystem services. Thus, various animal groups offer ecosystem services from the avian and reptiles to mammals [18].

**Table 9.** Fauna species in the park offering ecosystem services.

| **Provisioning services** | **Regulating services** | **Cultural services** | **Supporting services** |
|---|---|---|---|
| Avian | Avian | Avian | Avian |
| African grey parrot | - | African grey parrot | - |
| Rose ringed parakeet | - | Rose ringed parakeet | - |
| Crown crane | - | Crown crane | - |
| Mallard duck | - | Mallard duck | - |
| White geese | - | White geese | - |
| Yellow billed kite | - | Yellow billed kite | - |
| Ostrich | - | Ostrich | - |
| Reptiles | Reptiles | Reptiles | Reptiles |
| Water turtles | - | Water turtles | - |
| Monitor lizard | - | Monitor lizard | - |
| Crocodile | Crocodile | Crocodile | - |
| Gabon viper | - | Gabon viper | - |
| Puff adder | - | Puff adder | - |
| Rock python | - | Rock python | - |
| Mammals | Mammals | Mammals | Mammals |
| Antelopes | Common jackal | Donkeys | Antelopes |
| Donkeys | Civet cat | Common jackal | Donkey |
| Common jackal | - | Civet cat | Mona monkey |
| Civet cat | - | Crested porcupine | Vervet monkey |
| Crested porcupine | - | Giant Tortoise | Red capped mangabey |
| Giant Tortoise | - | Patas monkey | White putty nosed monkey |
| Patas monkey | - | White putty-nosed monkey | - |
| White putty-nosed monkey | - | Mona monkey | - |
| Mona monkey | - | Vervet monkey | - |
| Vervet monkey | - | Red capped mangabey | - |
| Red capped mangabey | - | Baboon | - |
| Baboon | - | - | - |

## CONCLUSION

This study has shown that zoopark as a recreation centre offers a wide range of ecosystem services in terms of provisioning, cultural, supporting and regulating services. Supporting services, such as, microclimate regulation, soil formation, primary production, nutrient cycling or biogeochemical cycling, water cycling, photosynthesis and pollination are services that support the production of all other ecosystem services; therefore, they are non-marketable within the park. The carbon sequestration evaluation in FUNAAB zoo park was in line with UNFCCC and Kyoto carbon credit trading while substantiating the importance of

preserving our tree species. This is because recent importance has been attached to emissions reduction from tropical deforestation in future climate change policy. Thus, it will be wise to consider the possibilities of having more plant species in our recreation centers for biodiversity conservation and climate mitigation. These species of trees will not only aid in $CO_2$ sequestration but also provide services ranging from shade, food and other unquantifiable benefits for the populace.

Suggestions include government to put in place appropriate measures to include peri urban recreation centers with more flora and fauna as part of community development plans since Zoo Park is part of the environment. Thus, recreation policy should ensure proper and adequate sensitization through electronic media to enlighten the general public on the importance of flora and fauna and most especially the flora (trees) in our entire environment while ensuring sustainable development.

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