# Assessment of Species-Based Ecosystem Services and Its Usefulness in Forest-Savanna Ecological Zone

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*Authors' contributions*

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

Forest ecosystems are the main species rich ecosystem on earth, having a significant role in the provision of massive benefits to the populace who depended on them for sustenance. This study aimed at assessing the forest provisioning ecosystem service and use in Ihiala Local Government Area of Anambra State, Nigeria. The objectives of this study include the identification of forest provisioning ecosystem services and their uses, people's dependence for livelihood and quantity of ecosystem services supplied by community forests. Stratified sampling technique was used to select 8 sampled communities while Nikolopoulou convenience sampling technique was adopted for selecting sampling size of 200 persons. Also, 31 key informants were interviewed across the study area. The responses from the entire sampled questionnaire and interview were analyzed using Microsoft excel and statistical package for social sciences. The study revealed that a good

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number of the forest resources such as *Elaeis guineensis, Garcinia kola, Bambusa vulgaris, Azadirachta indica* and *Brophyllum pinnatum* have multiple uses. The result also revealed that the nature of forest determines the quantity of ecosystem service benefits supplied. Hence, those community forests with weak policies supply less than 40% of resources because their traditional laws of entering and harvesting forest resources are no longer effective, while those with strong policies like restriction into their sacred groves, forest reserves and swampy forests supply above 40%. The *chi-square* value of 352.873 with 28 degrees of freedom (DF) proved that there is strong relationship between the nature of forest and the quantity of ecosystem services provided. This research concludes that forest ecosystem in Ihiala L.G.A, supplies a wide variety of plant and animal species to the populace, which they basically use for timber, firewood, food and medicine. Nonetheless, without alternative and diversified livelihood, the supply is becoming unsustainable. It recommends that since palm tree and its resources are averagely abundant in the study area, there is need to support the establishment of basket making training centre in various communities and as such, make it an attractive skill acquisition programme.

## 1. INTRODUCTION

To live at all, to survive and as well flourish in good health, humans need a wide variety of life-sustaining benefits derived from nature known as ecosystems services, [1,2]. Ecosystem services are the direct, indirect, tangible and intangible benefits, provided by ecosystems to human society. Forest ecosystems are the most diverse terrestrial ecosystems, supporting a quite large majority of the world's terrestrial species, [3,4]. In tropical regions, forest ecosystems are highly productive and rich biodiverse ecosystems that house a large variety of flora and fauna [5,6]. We have a various means of livelihood, diverse food products and advancements in medical research as a result of Forest ecosystems. As such, medicinal plants have been used all through the millennia by the populace as basis for the medicinal treatment of diseases in both developing and developed countries. Today, there is an ever increasing interest in plant-derived medicines and sweet-smelling plants regarding their use, cultivation and conservation, [7] Ecosystem service is therefore a topical issue of concern; with much interest and focus on tropical ecosystems due to its rich biodiversity, [8,9,10].

In Nigeria, a good percentage of forest ecosystems have been studied across a variety of ecological regions, [11,12,10,13,14,15]. As there has been an increase in quantitative assessments of ecosystem services in most of the tropical forest types in Nigeria, however, there is still scarcity of data on ecosystem service assessment in forest savanna ecological zone. Even as [16] identified and evaluated some threatened indigenous medicinal plants in Eastern Nigeria, but studies that assessed the supply and use of all the tangible benefits including medicinal resources from forest-savanna ecological region is still lacking. Since research data on forest provisioning ecosystem services is scarce in the study region, this research will be very significant to the scientific community particularly environmental engineers, forest policy promulgators', forest resource allocators, decision makers biogeographers, foresters, geographers, botanists, pharmacists, ecologists, natural scientists, environmental managers and regional planners.

## 2. MATERIALS AND METHODS

### 2.1 Study Site

The study area is Ihiala Local Government Area in Anambra State, Nigeria (Fig. 1) with its coordinates lying between Latitude 5° 45′ 00″ N to 5° 55′ 35″ N and Longitude 6°30′ 30″ E to 6° 50′ 35″ E. Ihiala L.G.A is located 48km North of Owerri and 40km South of Onitsha. It has a land mass of about 1,385sq.km It is located in the Southern part of Derived-Savanna (Forest-Savanna) Ecological Zone, Southeastern Nigeria, (Fig. 2). The study area is bounded at the west by Ogbaru (in Ogbaru L.G.A, Anambra State), at the North by Ozubulu in Ekwusigo L.G.A, Anambra State, at the east by Ukpor and Orsumenyi in Nnewi South L.G.A, Anambra state and at the South by Egbuoma, Ohakpu, Ozara and Oguta in Egbema / Oguta L.G.A of Imo State, (Fig. 3 and Fig. 4).
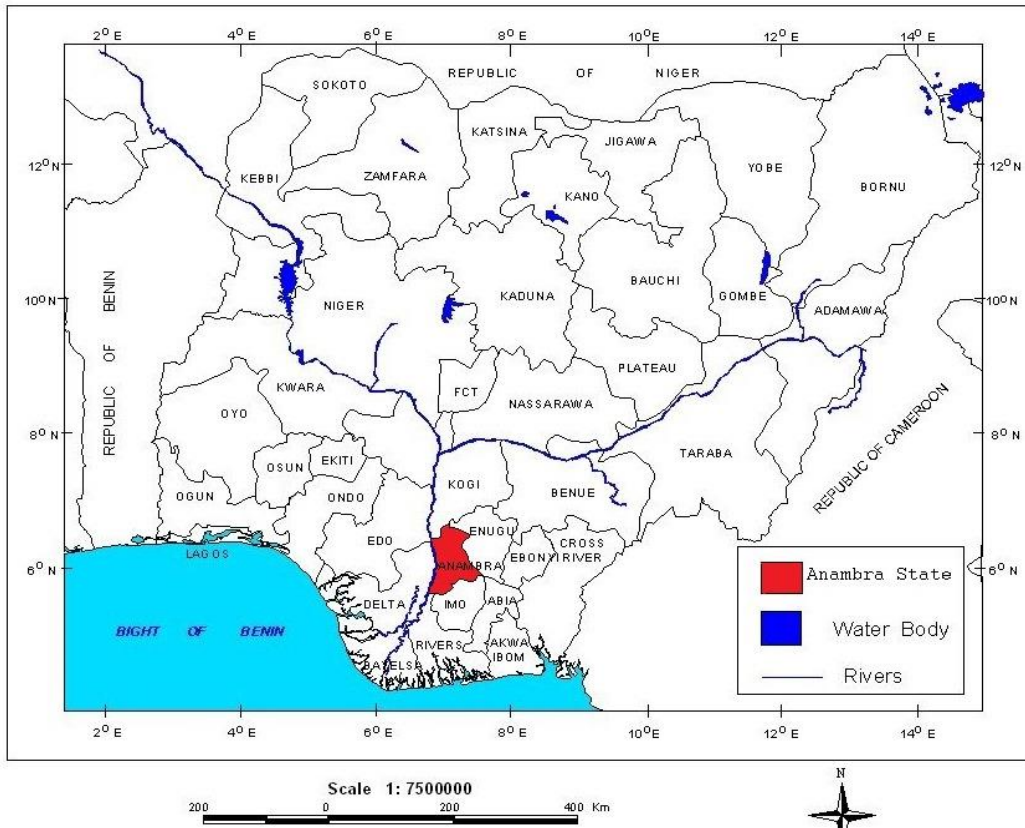
**Fig. 1. Map of Nigeria showing Anambra State**
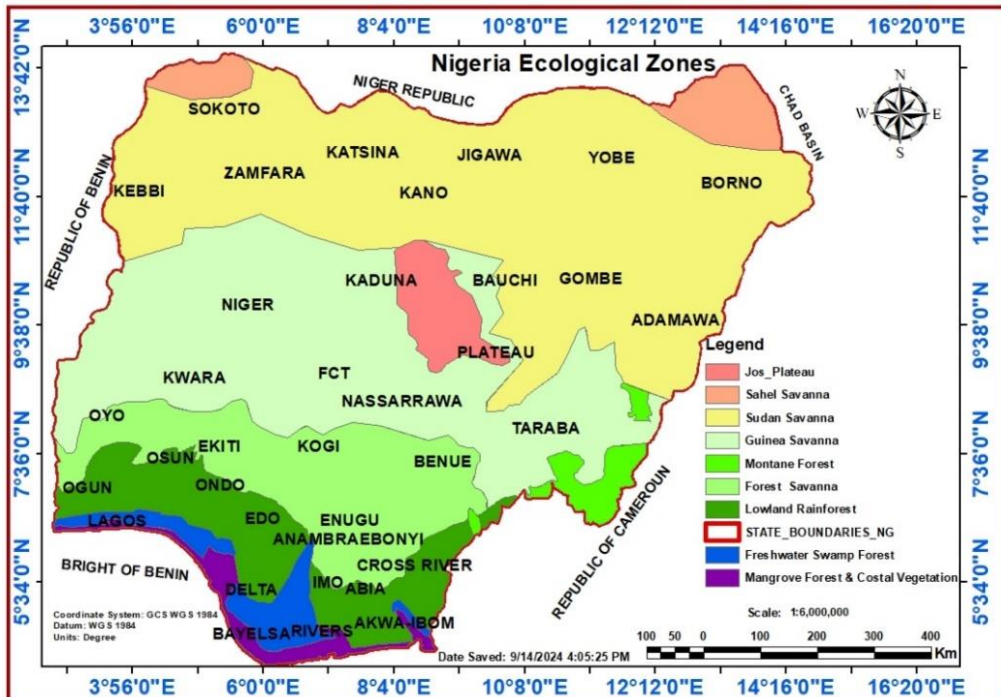*Source: Ezeomedo and Igbokwe, [17]*



**Fig. 2. Map showing Ecological Zones of Nigeria**
*Source: Adopted from FORMECU, Federal Department of Forestry, Nigeria [18]*
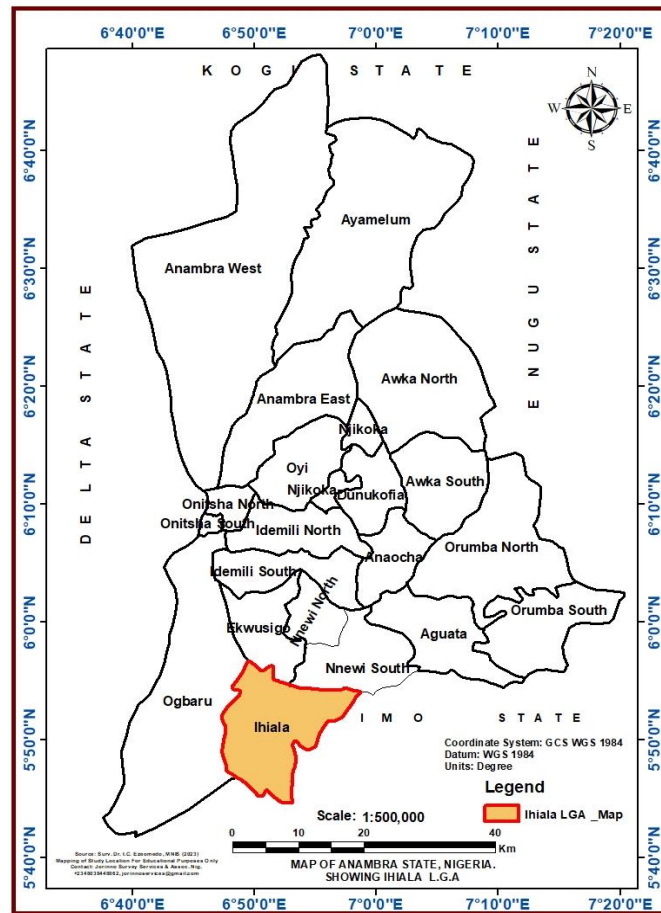
**Fig. 3. Map of Anambra State showing IhialaL.G.A (the Study Area)**
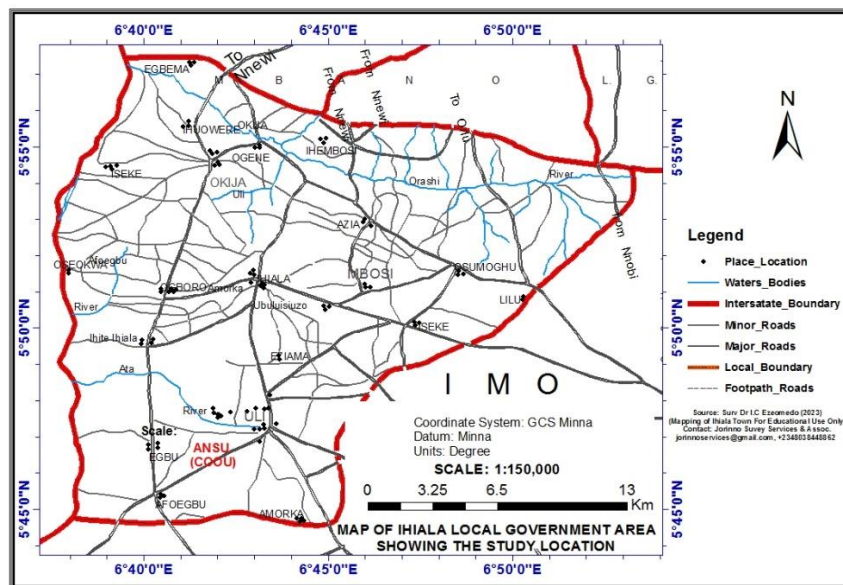*Source: Jorinno Survey Services, [19]*



**Fig. 4. Map of Ihiala L.G.A showing the ten communities**
*Source: Jorinno Survey Services, [19]*

Ihiala Local Government Area is naturally endowed with large forest land. Most of their forests are known for the supply of different forest products, such as timber, firewood, medicinal materials, and foods like; African star apple (*Chrysophyllum albidum*), *Treculia africana, Irvinga gabonensis* (bush mango), *Termitomyces titanicus* (Mushroom), *Ambiaya albidium*, *Cola nitida* (Oji), *Brachystegia eurycoma* (Achi), and palm products. Most families built their houses only with timber from Iroko tree (*Milicia excelsa*) and other hard wood from these forests. Some economic trees such as *Irvingia gabonensis* and *Garcinia kola*, were gathered once in a while by the village women, taken to the house of the village head and shared by all. More so, most herbalists in the area were known to be successful both in treatment and in making livelihood. This is because those forests provided all the resources they needed for the treatments of diseases [20]. Presently, most of these forests provide less than what they used to supply. Therefore, this study investigated the supply of forest ecosystem services and use in Ihiala L.G.A. The objectives of this study include the identification of forest provisioning ecosystem services, their use and peoples dependence for livelihood.

## 2.2 Data Collection

Using stratified sampling technique, the study area was divided into four quarters namely; Okija Zone, Ihiala Zone, Uli / Amorka Zone and Ebenesi Zone. Two villages were selected from each of the zones as sample locations, giving 8 sampled locations. However, this research adopted the convenience sampling technique in selecting questionnaire respondents from the total population. According to [21], convenience sampling is a type of non-random sampling used to explain a sample which has been chosen from the target population, on the basis of their accessibility to the researcher. This can be due to geographical immediacy, availability at a given time, or willingness to participate in the research.

Consequently, due to high rate of insecurity in the study area, the researcher took on the convenient sampling method to determine the sample size through the community village meetings and gatherings. 25 persons from each of the sampled communities were sampled, on the basis that at least 25 persons attend each village meeting in almost all the communities, according to some village heads. These 25 persons multiplied by 8 sampled communities gives 200 persons as the questionnaire

population sample size for this study. For the key informant interview, the study interviewed 31 persons; 8 village heads of the sampled communities, 6 herbalists, 5 hunters, 6 non-timber forest products sellers' and 6 timber/firewood sellers, Apart from village heads, interview to other categories was based on availability of data source.

## 2.3 Method of Data Analysis

The responses from the entire sampled questionnaire and interview were collected and analyzed using Microsoft Excel and Statistical package for Social Sciences (SPSS). In trying to identify the vital provisioning ecosystem services supply in the study area, the respondents were asked to indicate the numerous benefits they gather from the forest, their names and uses. These benefits include wild fruits, vegetables, bush meats, construction material, medicinal resources, and fodder. These were then presented in tables as timber and non-timber forest provisioning services; with their local, common and botanical names and individual uses. To assess the level of dependency on ESs, answers from questionnaire that referred to the use of nature-based sources were analysed using descriptive statistical technique. The results were presented in charts and tables.

## 3. RESULTS

### 3.1 Socio-Economic/ Demographic Characteristics of Respondents

To test the accuracy of the information gotten from this research, respondents' biodata were obtained, analyzed and presented in Table 1.

### 3.2 Forest Provisioning Ecosystem Services Benefits in Ihiala L.G.A

Forest resources are discussed under timber and non-timber provisioning services.

#### 3.2.1 Timber provisioning ecosystem services

Some common tree species in the study area which are used for timber, log and firewood are shown in Table 2.

#### 3.2.2 Non-Timber provisioning ecosystem services

Non-timber forest resources include fruits, vegetables, spices, animals and medicine. These are discussed as plant species utilized as foods and spices (Table 3), animals utilized as bush meat (Table 4) and some plant species utilized as medicine (Table 5).

**Table 1. Characteristics of Questionnaire Respondents**

| Biodata | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 108 | 54.0 |
| Female | 92 | 46.0 |
| **Marital Status** | | |
| Single | 48 | 24.0 |
| Married | 119 | 59.5 |
| Divorced | 1 | .5 |
| Widowed | 29 | 14.5 |
| Separated | 3 | 1.5 |
| **Age** | | |
| 30 – 40 years | 56 | 28.0 |
| 41 – 50 years | 39 | 19.5 |
| 51 – 60 years | 57 | 28.5 |
| 61 – 70 years | 34 | 17.0 |
| Above 70 years | 14 | 7.0 |
| **Educational Level** | | |
| Primary | 12 | 6.0 |
| Secondary | 103 | 51.5 |
| Tertiary | 65 | 32.5 |
| Non-Formal | 20 | 10.0 |
| **Occupation** | | |
| Trader | 60 | 30.0 |
| Farmer | 63 | 31.5 |
| Civil Servant | 45 | 22.5 |
| Palm Oil Business | 15 | 7.5 |
| Hunter | 17 | 8.5 |
| **If a native of this community** | | |
| Yes | 181 | 90.5 |
| No | 19 | 9.5 |
| **How long lived in the community** | | |
| Less than 10 years | 35 | 17.5 |
| 10 – 20 years | 61 | 30.5 |
| 20 – 30 years | 21 | 10.5 |
| 30 – 40 years | 36 | 18.0 |
| Above 40 years | 47 | 23.5 |

**Table 2. Some common tree species for timber and firewood in Ihiala L.G.A**

| S/No | Botanical Name | Common Name | Local Name |
|---|---|---|---|
| 1 | *Newbouldia laevis* | Tree of life; Fertility tree | Ogilisi (Igbo) |
| 2 | *Treculia africana* | Bread fruit | Ukwa |
| 3 | *Elaeis guineensis* | Palm tree | Nkwu |
| 4 | *Anthocleista vogelii* | Murderer's mat | |
| 5 | *Baphia nitida* | Camwood or African Sandalwood | Uhie |
| 6 | *Canarium schweinfurthii* | Bush Candle tree | Ube Okpoko |
| 7 | *Dialium guineense* | Velvet Tamarind | Cheleku |
| 8 | *Irvingia gabonensis* | Bush mango | Ugiri |
| 9 | *Brachystegia eurycoma* | | Achi |
| 10 | *Milicia excelsa* | Iroko | Orji |
| 11 | *Ambiaya albidium* | African star apple | Udara |
| 12 | *Chrysophyllum albidium* | African star apple | Udara |
| 13 | *Afzelia Africana* | Mahogany | Akparata |
| 14 | *Cola acuminata* | Kolanut | Oji |

| S/No | Botanical Name | Common Name | Local Name |
|------|----------------|-------------|------------|
| 16 | *Ceiba pentandra* | silk cotton tree | |
| 17 | *Garcinia Kola Heckel* | bitterkola | Akilu |
| 18 | *Gmelina arborea* | Gmelina | |
| 19 | *Bambusa vulgaris* | Bamboo | Achalla |

*Source: Verified after Anoliefo et. al., (2015)*

**Table 3. Some common plant species for food and other uses**

| S/N | Botanical Name | Common Name | Local name | Use |
|-----|----------------|-------------|------------|-----|
| 1 | *Canarium schweinfurthii* | African olive or Bush candle tree | Ube Mgba or Ube Okpoko | Fruit, firewood and timber |
| 2 | *Piper guineense* | Ashanti pepper | Uziza | Leaf for vegetable, seed for spice and medicine |
| 3 | *Gongronema latifoitum* | Bushbuck Leaf | Utazi | Vegetable and Medicine |
| 4 | *Gnetum africanum* | Wild spinach | Ukazi or Okazi | Vegetable |
| 5 | *Pleurotus tuber-regium* | King tuber oyster | Osu | Spice and Soup thickener |
| 6 | *Dialium guineense* | Velvet Tamarind | Cheleku | Fruit, trunk for firewood |
| 7 | *Brachystegia eurycoma* | | Achi | Seed as soup thickener, trunk for timber |
| 8 | *Landolphia owariensis* | White rubber vine | Utu | Fruit |
| 9 | *Dennettia tripetala* | Pepper fruit | Mmimi | Fruit and spice |
| 10 | *Pachystela brevipes* | Loquat | Udaranwaenwe | Fruit |
| 11 | *Termitomyces Titanicus* | Mushroom | Ero | Food |
| 12 | *Elaeis guineensis* | Palm tree | Nkwu | Economic tree; palm oil, leaves as thatch, fodder and broom, logs for building, palm wine, etc |
| 13 | *Treculia africana* | Breadfruit | Ukwa | Economic tree, seed fried for snacks and cooked for food, trunk is for timber and firewood, leaves for fodder. |
| 14 | *Irvingia gabonensis* | African Bush mango (sweet) | Ugiri | Fruit for food, seed for making soup, leaf for fodder |
| 15 | *Irvingia wombolu* | African Bush mango (bitter) | Ogbolo | Seed for making soup, leaf for fodder, trunk for timber |
| 16 | *Chrysophyllum Albidum* | African star apple | Udara | Fruit |
| 17 | *Cola nitida* | Kola | Oji | For traditional rites |
| 18 | *Milicia exclesa (Moraceae)* | Iroko | Orji | Trunk for timber, leaves for fodder, fruit for birds |
| 19 | *Pterocarpus soyauxii* | Mututi | Oha | Vegetable, medicinal |
| 20 | *Pterocarpus santalinoides* | African coral wood | Uturukpa | Vegetable, medicinal |
| 21 | *Acanthus montanus* | Mountain thistle | Agamebu | Medicinal |
| 22 | *Bambusa vulgaris* | Bamboo | Achalla | For constructions, fodder and Medicine |
| 23 | *Ocimum gratissimum* | Scent leaf | Nchuanwu | Vegetable, medicinal |
| 24 | *Detarium microcapum* | Sweet detar | Ofo | Soup thickener |
| 25 | *Xylopia aethiopica Dunal* | Guinea pepper | Uda | Spice and medicine |
| 26 | *Aframomum melegueta* | Alligator pepper | Oseoji | Medicine and spice |
| 27 | *Pentacletra machrophyla* | Oil bean tree | Ukpaka | Food, medicinal, firewood |
| 28 | *Mucuna pruriens* | Velvet bean or devil's bean | Agbara | Vegetable, medicinal |
| 29 | *Tetrapleura tetraptera* | Soup perfume | Uraura | Spice, medicinal |

| S/N | Botanical Name | Common Name | Local name | Use |
|---|---|---|---|---|
| 30 | *Moringa oleifera* | Moringa | | Vegetable, medicinal |
| 31 | *Anacardium occidentalis* | Cashew tree | | Fruits, Nuts and firewood |
| 32 | *Garcinia Kola Heckel* | Bitter Kola | Akilu or Ugoro | Medicinal, trunk for timber |
| 33 | *Afzelia bellavarbella* | Mahogany | Akparata | Seed as soup thickener, trunk for timber |
| 34 | *Baphia nitida* | African Sandlewood | Uhie | Medicinal and cosmetic material |
| 35 | *Ficuselastica* | Rubber Tree | | Economic tree with numerous benefits |
| 36 | *Gambeya albida* | White star apple | Udalanwannu | Fruit and medicinal |

*Source: Researcher's fieldwork (2023)*

## 3.3 Dependence on Ecosystem Services

Dependence on ecosystem services benefit was assessed using the type of fuel used in cooking by households and forest related livelihoods people make from forest resources in the study area.

## 3.4 Community Forests and Ecosystem Services Benefits Supplied

The quantity of ecosystem services benefits supplied by individual forest communities are as presented in Table 6.

The result was further subjected to Chi-Square Test, to test for the relationship in the supply of ecosystem services among these community forests. The null hypothesis was postulated as: let H0 be:

There is no significant relationship between the categories of forest and the percentage of supply of ecosystem service benefits, Table 7.

Expected frequencies are below the observed frequencies, while chi-square contributions are below expected frequencies.

The result of the Chi-sq test between individual community forest and percentage of ecosystem services supply: Chi-Sq = 352.873, DF = 28, P-Value = 0.000.

## 4. DISCUSSION

From the socio-economic/demographic characteristics of respondents it observed that the highest occurring value of respondents' socio-economic features, is that 54% are male, 59% are married, 28.5% are between the age of 51-60, 51.5% attained secondary school level, 31.5% are farmers, 90.5% are native of the community and 30.5% have lived for 10-20years (Table 1). This shows that information supplied to the researcher were sourced mainly from married men, who are responsible for the wellbeing of their household, who are old enough to know their community history and who attained at least higher basic education to understand simple communication in English language. 90.5% of them are native of their communities and have lived for at least 10-20 years in the community. Being a native of the community supported the idea of [9] that indigenous people have a greater access and opportunity to their community forest.

Some common tree species in the study area are used for timber, log and firewood. More of these plants species are sturdy, but are seriously going extinct in the study area just like other tropical forests ecosystems that are threatened with extinctions and probable collapse, as proved by [9]. Nevertheless, some of these vulnerable plants are preserved till today because of traditional laws which were believed to have come from the ancestors and any desecration of these laws attracts strict penalty from the gods. Example; *Ambiaya albidium, Irvingia gabonensis, Cola nitida, Brachystegia eurycoma, Milicia excelsa and Ceiba pentandra*. Very few of them are preserved in sacred groves and used as shrines such as *Milicia excelsa* and *Ceiba pentandra*, [22].

Common species valued for food have multiple uses (Table 3). Therefore the rural populace derives food, medicine, fodder, and construction materials from their community forests just like other forest ecosystem in Nigeria. Some of the common wild animals are used as bush meat, where very few of them are used for medicine, research and economic purposes, (Table 4). Still, a good number of these animals are near threatened, where a lot of them have gone extinct; example Antelope, Porcupine and Wolf. Majority are seriously endangered such as Wild

lizard, Guinea Fowl and Grass Cutter. Nevertheless, most hunters were not discouraged by this change; rather, they go to faraway swampy forests of Imo state such as Ogbum in Egbu community, Ossemoto, Ufufu-achi and Ede-Akpu (all in Imo State) and hunt as much various species of animals as possible. Thus swamp forest ecosystems are important in meeting the needs of people who depend on them to sustenance, [9].

**Table 4. Common wild animal species in the study area**

| S/No | Common Name | Local Name | Use |
|---|---|---|---|
| 1 | Antelope | Mgbada | Bush meat, Skin used for making drum |
| 2 | Deer | Ele | Bush meat |
| 3 | Ram | Okebule | Bush meat |
| 4 | Grass Cutter | Nchi | Bush meat |
| 5 | Wolf | Edi | Bush meat |
| 6 | Chipmunk | Osa | Bush meat |
| 7 | Squirrel | Uze | Bush meat |
| 8 | unverified | Ururu | Bush meat |
| 9 | Parrot | Ichoku | Bush meat |
| 10 | Guinea Fowl | Ogazi | Bush meat |
| 11 | Cane rat | Ewi | Bush meat |
| 12 | Kite | Nkwo | Bush meat and economic |
| 13 | Shrew | Nkapi | Economic |
| 14 | Forest Cobra | Ekenweohia | Medicinal and economic |
| 15 | Bush fowl | Okwa | Economic and bush meat |
| 16 | Hog | Eziohia | Bush meat |
| 17 | Rabbit | Okeoyibo | Bush meat |
| 18 | Sparrow | Nza | Bush meat |
| 19 | Viper | Abuala | Bush meat, skin used to make shoes |
| 20 | *unverified* | Oguna | Bush meat |
| 21 | African Pygmy Goose | Obogwummiri | Bush meat |
| 22 | Peregrine Falcon | Ufu | Bush meat |
| 23 | Monkey | Enwe | Bush meat |
| 24 | *unverified* | Obuadike | Bush meat |
| 25 | Chameleon | Ogwomagala | Medicine |
| 26 | Galago (aka bush baby) | Ekiri | Medicine |
| 27 | Hawk | Agunkwo | Bush meat |
| 28 | Kite | Egbe | Bush meat |
| 29 | Snail | Ejule | Bush meat |
| 30 | Porcupine | Ebiogwu | Bush meat and economic |
| 31 | Bat | Usu | Bush meat |
| 32 | *unverified* | Nbe | Bush meat and economic |
| 32 | Wild lizard | Ngwere-oru | Bush meat |
| 33 | *unverified* | Oghu | Bush meat |

*Source: Researcher's fieldwork (2023)*

**Table 5. Some common plant species for traditional treatment of diseases**

| S/N | Botanical Name | Common Name | Local Name | Plant Part(s) Used and Ailment(s) Treated |
|---|---|---|---|---|
| 1 | *Azadirachta indica* | Neem; Indian liliac | Ogwu-iba (Igbo); Dogoyaro (Hausa) | The whole plant is used for treatment of malaria and fever; as expectorant, liver tonic, intestinal worms anti-microbial and inflammation. Also soaked and used as pesticide. |

| S/N | Botanical Name | Common Name | Local Name | Plant Part(s) Used and Ailment(s) Treated |
|---|---|---|---|---|
| 2 | *Brophyllum pinnatum* | Resurrection plant; African never die; | Odaaopue (Igbo) | The leaves are used for treatment of stroke and strengthening of bones; used to treat convulsion, boils, cough, catarrh, anti-diarrhea and anti-ulcer.. Intestinal pains and used to resuscitate somebody in coma. |
| 3 | *Chromoalena odoratum* | Siam weed | Obiara-ohuru or Ahihia Eliza or abalidiegwu (Igbo) | The leaves are used in treatment of fever and diabetes. The leaves are also squeezed fresh on cut to stop bleeding and sterilize the wound. The leaves are also used to treat skin rashes. The leaves and stem are used to ferment cassava for easy softening. |
| 4 | *Newbouldia laevis* | Tree of life; Fertility tree | Ogilisi (Igbo) | The leaves are used as eye ash for conjunctivitis. The stem bark is used for treatment of skin infection. The root is used for treating ear problem. For boundary demarcation. |
| 5 | *Sida acuta* | Stubborn grass; common wire weed | Udo-asi (Igbo) | The whole plant is used to cure low sperm count, stop diarrhea and dysentery. It is also used to aid child's birth. |
| 6 | *Jatropha gossiplifolia* | Wild cassava | Ake mgbogho | The latex is applied to cure ringworm. The leaves are used as a purgative and to treat hemorrhage. |
| 7 | *Amaranthus spinosus* | Thorny pig weed, African spinach, Picric amaranth | Inineogwu | The leaves are used to stop hot and discomforting stomach. The whole plant is used for waist pain and as vegetable. The roots are used for the treatment of STDS. |
| 8 | *Syndrella nodiflora* | Node weed, Cindrella weed, Start work | Ogwuafo (Igbo) | The leaf is used to treat stomach upset. It is also used as laxative. The leaves juice is used to stop bleeding in wound. |
| 9 | | | Ijigara | For treating Arthritis and toothache |
| 10 | *Ocimum gratissimum* | Scent leaves, fever plant, Basil | Nchuanwu (Igbo) | The whole plant is used to prevent mosquito bite. The leaves are used as laxative, treatment of stomach pain, catarrh, treatment of nose bleeding, and treatment of sore throat etc. |
| 11 | *Cymbopogon citratus* | Lemon grass | Irirooyibo (Igbo) | The leaf is used for the treatment of malaria, typhoid fever, headache, cough and mosquito repellant. |
| 12 | *Jatropha carcas* | Physic nut | Ugbelu (Igbo) | The leaf poultice is used to stop bleeding and for hastening healing. The latex is used for the treatment of ringworm. |
| 13 | *Euphorbia heterophylla* | Spurge weed; Fire plant | Ogwuafo (Igbo) | The plant when soaked is used as a laxative. When boiled, it is used as purgative. |
| 14 | | | AnaraOfia and Akaito leaves(Igbo) | To stop miscarriage |
| 15 | *Ageratum conyzoides* | Goat weed | Agadi-nwaanyi-isi- | The leaves are used as a lotion for scabies, for treatment of fever. The juice of the leaf is |

| S/N | Botanical Name | Common Name | Local Name | Plant Part(s) Used and Ailment(s) Treated |
|---|---|---|---|---|
| | | | awo-ocha (Igbo) | dropped in the eye to cure inflammation. |
| 16 | *unverified* | *unverified* | Akanta (Igbo) | A root peeled, pounded and the liquid used for treating madness |
| 17 | *Costus afer* | Spiral ginger or bush cane | Okpeteohia (Igbo) | For treatment of stroke, stomach ache and disorder, infection, and arthritis. The leaves are used in treatment of cough, measles, malaria and eye defect. |
| 18 | | | Ijeara (Igbo) | For treating toothache and decay |
| 19 | *Aspilia africana* | wild sunflower; Hemorrhage plant | Orama – ejula (Igbo) | Leaves and flowers stop bleeding; Seeds used in treating cold and coughs |
| 20 | *Garcinia kola* | Bitter kola | Akilu or Ugoro (Igbo) | Used as anti-poison, antibacterial, immune booster and for treatment of cough and catarrh |
| 21 | *unverified* | *unverified* | Uteagu (Igbo) | Roots for treating infection |
| 22 | *unverified* | *unverified* | Njoabahu leaf (Igbo) | For detoxication of any kind of poison in the body |
| 23 | *Tetrapleura tetraptera* | *unverified* | Osakirisa or Uraura (in Igbo) | The leaves and fruits are used to manage convulsion, serves as immune booster, used for post-partum care, boosts blood, used as antibacterial, used to treat stomach disorder etc. |
| 24 | *Mucuna pruriens* | Velvet bean or devil's bean | Agbara (Igbo) | Used in treating muscle pain, toothaches, infertility, scorpion and snake bites, lowers blood sugar, serves as blood purifier, etc. |

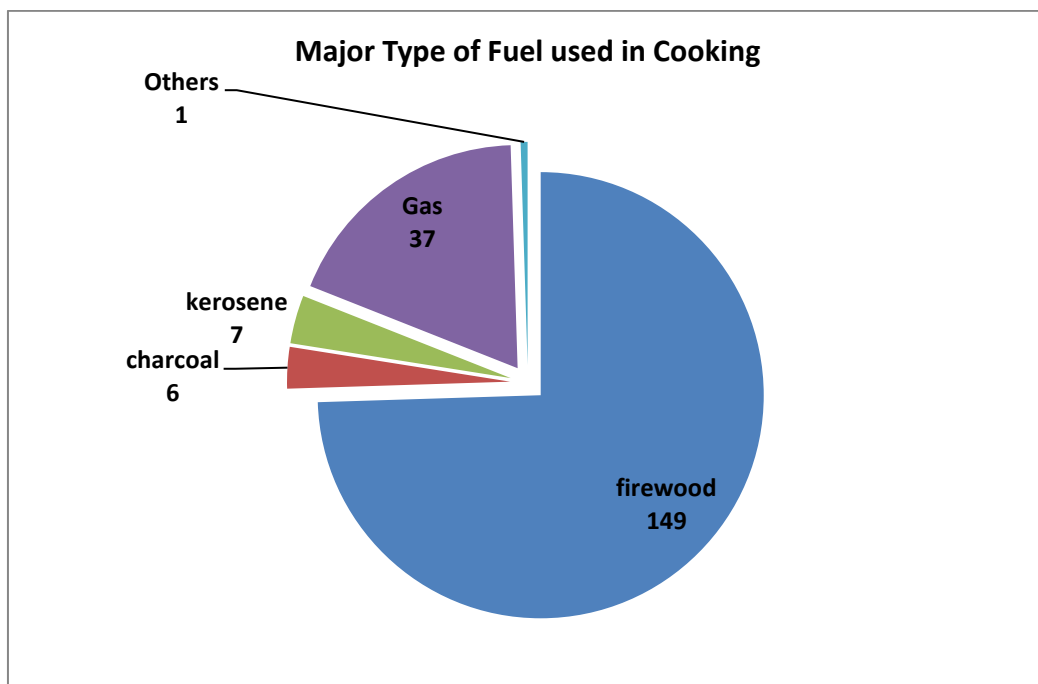*Source: Researchers fieldwork: (2023)*



**Fig. 5. Major type of fuel used in cooking**

**Table 6. Quantity of ecosystem services benefits supplied by sampled forests**

| Percentage Supplied / Forest | 0-20% | 20-40% | 40-60% | 60-80% | Above 80% | Remark |
|---|---|---|---|---|---|---|
| Ikpa Ogwugwu forest | 52.0 | 32.0 | 16.0 | 0.0 | 0.0 | Poor |
| Umuogu forest | 8.0 | 12.0 | 60.0 | 12.0 | 8.0 | Average |
| Mgbu and Okotoba Forests | 16.0 | 60.0 | 16.0 | 4.0 | 4.0 | Poor |
| Ogwugwu Ubahuekwem | 24.0 | 8.0 | 24.0 | 12.0 | 32.0 | Plentiful |
| Atammiri forest | 20.0 | 20.0 | 44.0 | 16.0 | 0.0 | Average |
| Ogada forest | 24.0 | 8.0 | 24.0 | 12.0 | 32.0 | Plentiful |
| Ihueke Forest | 16.0 | 44.0 | 20.0 | 4.0 | 16.0 | Poor |
| Akaba Forest | 44.0 | 4.0 | 32.0 | 8.0 | 12.0 | Poor |
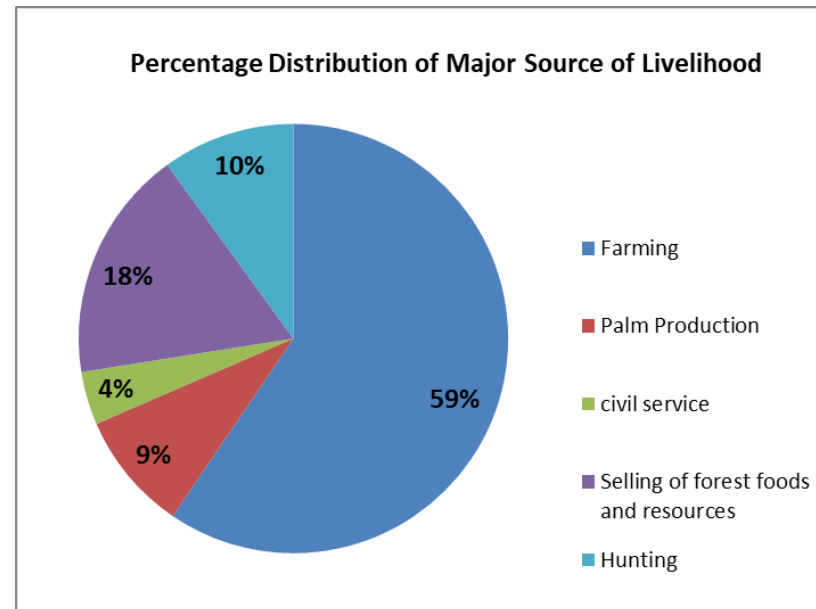


**Fig. 6. Major source of livelihood**

Traditional treatment of diseases is practiced by many people in the study area. The leaves, barks, roots and even whole plants of some species of plants are infused or soaked or boiled to obtain a liquid drink that is used to treat various ailments, (Table 5). Some of these common species of plants have multiple uses and are very beneficial to the people of the area, example *Sida acuta, Mucuna pruriens, Garcinia* *kola, Azadirachta indica, Syndrella nodiflora, Chromoalena odoratum, Cymbopogon citratus, Ocimum gratissimum and Brophyllum pinnatum* (Plate 1). Therefore a substantial percentage of the population depended on traditional medicines for treatment and prevention of diseases and as well a means of livelihood for traditional doctors, [16,23,24].

**Table 7. Chi-square test result of quantity of ecosystem services benefits supplied**

| Ecosystem services Supply (%) Forest | 0-20% | 20-40% | 40-60% | 60-80% | Above 80% | Total |
|---|---|---|---|---|---|---|
| Ikpa Ogwugwu forest | 52 (25.5) (27.539) | 32 23.5 3.074 | 16 29.5 6.178 | 0 8.5 8.5 | 0 13.00 13.00 | 100 |
| Umuogu forest | 8 (25.5) (12.01) | 12 (23.5) (5.628) | 60 (29.50) (31.534) | 12 (8.5) (1.441) | 8 (13.00) (1.923) | 100 |
| Mgbu and Okotoba Forests | 16 (25.5) (3.539) | 60 (23.5) (56.691) | 16 (29.5) (6.178) | 4 (8.50) (2.382) | 4 (13.00) (6.231) | 100 |
| Ogwugwu Ubahuekwem | 24 (25.5) (0.088) | 8 (23.5) (10.223) | 24 (29.5) (1.025) | 12 (8.50) (1.441) | 32 (13.00) (27.769) | 100 |
| Atammiri forest | 20 (25.5) (1.186) | 20 (29.50) (7.127) | 44 (29.5) (7.127) | 16 (8.50) (6.618) | 0 (13.00) (13.00) | 100 |
| Ogada forest | 24 (25.5) (0.088) | 8 (23.5) (10.223) | 24 (29.5) (1.025) | 12 (8.50) (1.441) | 32 (13.00) (27.769) | 100 |
| Ihueke Forest | 16 (25.5) (3.539) | 44 (23.5) (17.883) | 20 (29.50) (3.059) | 4 (8.50) (2.382) | 16 (13.00) (0.692) | 100 |
| Akaba Forest | 44 (25.5) (13.422) | 4 (23.5) (16.181) | 32 (29.5) (0.212) | 8 (8.50) (0.029) | 12 (13.00) (0.077) | 100 |
| Total | 204 | 188 | 236 | 68 | 104 | 800 |



**Plate 1. Domesticated sample of *Brophyllum pinnatum***

Out of the 200 sampled questionnaires used for this study, 149 respondents indicated that firewood is the major type of fuel used by the populace in the area. This proves that, although the village people seldom visit the forests, their major source of fuel for cooking is firewood. A village head interviewee said that as a rural area, people mostly use firewood in cooking. They either buy from the firewood sellers in their various village markets or once in a while they go to the far away forests and cut large quantity that can sustain them for a long time. Consequently, this proves that 1.2 billion people across tropical countries are highly dependent on nature for their basic needs including firewood, [25]. Although every village setting is mostly known for farming (Fig. 6), but some villages have other means of livelihood that is peculiar to them which is forest-related. Example, Okija is known for palmwine tapping and hunting such that presently, the community has hunters association of about 20 persons [26]. On the other hand, Isseke community is known for basket making, such that everybody in every household knows how to weave basket including their wives, [27]. These are sold to the major dealers at the collection point and transported to different parts of the country especially the northern region and other agricultural regions for the packaging of tomatoes, onions, carrots, pepper and others, [28].

The quantity of ecosystem services benefits supplied by individual forest communities are presented in Table 6. It was observed that poor supply of forest resource falls within 0-40%. While, those between 40-80% shows result of averagely supply benefits and above 80% indicates plentiful supply of ecosystem services benefits to the populace. The result revealed that the supply of forest resources from Ikpa Ogwugwu and Akaba is about 20%; Ihueke, Mgbu and Okotoba forests supply 20-40%; Umuogu and Atammiri forests supply 40-60% while Ogwugwu Ubahuekwem and Ogada forests supply above 80%. Those forests that still provide up to 80 % are those that mostly border with Osseakwa, River Niger and other large water bodies. Hence, those community forests with weak policies supply less than 40% of resources because their traditional laws of entering and harvesting forest resources are no longer effective, while those with strong policies like restriction into their sacred groves, forest reserves and swampy forests supply above 40%. The result of the chi-square test indicates a significant association between the categories of

forest and the percentage of supply of ecosystem services. The Chi-square value of 352.873 with 28 degrees of freedom (DF) suggests a strong relationship between the two variables. Additionally, the p-value of 0.000 indicates that the observed association is highly unlikely to have occurred by chance alone. Therefore, we reject the null hypothesis, concluding that there is a statistically significant relationship between the type of forest and percentage of ecosystem services supplied.

## 5. CONCLUSION

The supply of forest ecosystem benefit and their use are commonly the same in all the communities of the study area. Very few of the forest resources are averagely available. Some of them have multiple uses and the people intensively use them in various ways, where majority of the common wild animals used as beef are endangered. The variation in supply of ecosystem services is as a result of the type of forest in the study area. The type that supplies much resource is few in number, such that without more sustainable means of survival, those forests will seriously deplete. Therefore, this research recommends that since palm tree and its resources are averagely abundant in the study area, there should be establishment of palm production industry which will include soap and cream factory, palm kernel factory and a mechanized oil mill industry. These ventures will create more sustainable livelihood for the rural populace. Similarly, there is need for the establishment of basket making training centre in various communities of the study area; and make it an attractive skill acquisition especially in Isseke and Uli. This will enhance the wellbeing of everyone including the less privileged that can just sit at a place and make their livelihood out of basket making. It is significant to strengthen the traditional regulations as a means of conserving the species of the forest-savanna ecosystem from extinction in the study area.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1.  Millennium Ecosystem Assessment (MEA). Ecosystems and human well-being: biodiversity synthesis. Washington (DC): World Resources Institute. 2005;408.
2.  Díaz S, Pascual U, Stenseke M, Martín-López B, Watson RT, Molnár Z, Hill R, Chan KMA, Baste IA, Brauman KA, Polasky S, Church A, Lonsdale M, Larigauderie A, Leadley PW, Van Oudenhoven APE, Van Der Plaat F, Schröter M, Lavorel S, Aumeeruddy-Thomas Y, Bukvareva E, Davies K, Demissew S, Erpul G, Failler P, Guerra CA, Hewitt CL, Keune H, Lindley S, Shirayama Y. Assessing nature's contributions to people: Recognizing culture, and diverse sources of knowledge, can improve assessments. Science. 2018; (80-.):359, 270–272.
    DOI:10.1126/science.aap8826.
3.  Anderson D, Grove R. The scramble for Eden: past, present and future in African conservation. In: ANDERSON, D. & GROVE, R. (eds.) Conservation in Africa people policies and practice. Cambridge: Cambridge University Press; 1987.
4.  Oyediji OT, Adenika OA. Forest Degradation and Deforestation in Nigeria; Poverty Link International Journal of Multidisciplinary Research And Analysis (IJMRA). 2022;05:10.
    ISSN(print): 2643-9840, ISSN(online): 2643-9875
    DOI: 10.47191/ijmra/v5-i10-35, Impact Factor: 6.261 Page No. 2837-2844 IJMRA, Volume 5 Issue 10 Page 2837.
5.  Jermy C, Chapman R. Tropical forest expeditions. RGS-IBG Expedition advisory centre. Royal Geographical Society; 2002.
6.  Malhi Y, Baker TR, Phillips OL, Almeida S, Alvarez E, Arroyo L, Chave J, Czimczik CI, Di Fiore A, Higuchi N, Killeen TJ, Laurance SG, Laurance WF, Lewis SL, Montoya LMM, Monteagudo A, Neill DA, Vargas PN, Patino S, Pitman NCA, Quesada CA, Salomao R, Silva MJN, Lezama AT, Martinez RV, Terborgh J, Vinceti B, Lloyd J. The above-ground coarse wood productivity of 104 Neotropical forest plots. Global change Biology. 2004;10:563-591.
7.  FAO. Forest Resources Assessment 2022.
8.  FAO Forestry papers 140, Rome; 2001.
9.  Igu NI, Marchant R. Patterns of freshwater swamp forest use and degradation in the Niger Delta, York Institute for Tropical Ecosystem Dynamics (KITE), Environment Department, University of York, YO10 5NG, UK; 2016.
10. Igu NI. Species Diversity and Structure of an Intact Freshwater Swamp Forest ecosystem in the Niger Delta, Journal of Forestry. 2017;7:2.
    DOI: 10.4236/ojf.2017.72015.
11. Ezenwaka J, Graves A. Ecosystem Services of the Niger Delta Forests, Nigeria, Journal of Agriculture and Social Research. 2014;14:1.
12. Igu, NI. Freshwater Swamp Forest Ecosystem in the Niger Delta: Ecology, Disturbance and Ecosystem Services, Published PhD Thesis, Environment Department, University of York, UK; 2016.
13. Olajide A, Popoola OO, Otokiti KV. Ecosystem Cover Dynamics and its Implications in the Coastal Zone of Ondo State; 2020.
    DOI:10.3923/ecologia.2020.50.62
    Available:https://scialert.net/abstract/?doi=ecologia.2020.50.62.
14. Ancha PU, Verinumbe I, Jande JA, Abakpa SO. Assessment of the Impact of Urbanization on Forest Resources in Otukpo Local Government Area Benue State, Nigeria. Journal of Research in Forestry, Wildlife & Environment. 2021; 13(4):137-149.
15. Ajayi D, Olusola P, Olajide A. Ecosystem Services Assessment for Human Well-Being and Poverty Alleviation in the Ondo State Coastal Region, Nigeria, In book: The Just City: Poverty, Deprivation and Alleviation Strategies. Publisher: YEMPET Prints Ltd.; 2019.
16. Ezenwaka J, Ekeke BA, Oyebade BA, Anyadiegwu OA. Identification and Evaluation of some Threatened Indigenous Medicinal Plants of the Tropical Rainforests of Eastern Nigeria, Roan, The Journal of Conservation, Nigerian Conservation Foundation. 2004;3(1&2): 131-142.
17. Ezeomedo IC, Igbokwe JI. Accessing Agulu Lake through the Application of Remote Sensing and Geospatial Information Technology, African Journal of Environmental Research. 2018;1(2):78-89.
    Available:https://www.ajol.info/index.php/fje/article/view/176068/165468
18. FORMECU: Forestry Management and Evaluation Coordination Unit. Block 27, Nouakchott Street, Wuse Zone 1, Abuja

FCT Nigeria. Available:https://www.finelib.com/listing/Forestry-Management-Evaluation--Coordination-Unit-FORMECU/148/

19. Ezeomedo IC. Digitizing and Updating of Existing Administrative Maps for Educational Purposes. Jorinno Survey Services, Ihiala Local Government Area, Nigeria; 2023.

20. Ejezube H. personal communication; 2023.

21. Nikolopoulou K. What Is Convenience Sampling? | Definition & Examples. Scribbr; 2023.
    Retrieved June 24, 2024,
    Available:https://www.scribbr.com/methodology/convenience-sampling/

22. Anoliefo G, Nwokeji A, Ikhajiagbe B. Influence of Traditional Taboo Practices on Natural Resource Conservation in Uli, Ihiala Local Government Area of Anambra State Nigeria; Sustainable Community Development, Journal of Environmental Sustainability. 2015;4(4):2.

Available:https://www.researchgate.net/publication/290192220.

23. Obute GC. Ethnomedicinal Plant Resources of Southeastern Nigeria, Ethnobotanical Leaflets. 2005;1(1):5.

24. Ogbe FMD, Eruogun OL, Uwagboe M. Plants used for female reproductive health care in Oredo local government area, Nigeria, Scientific Research and Essays. 2009;4(3):120-130.

25. Fedele G, Camila I, Donatti, Ivan Bornacelly, Hole DG. Nature-dependent people: Mapping human direct use of nature for basic needs across the tropics. Global Environmental Change. 2021;71: 102368
    Available:https://doi.org/10.1016/j.gloenvcha.2021.102368.

26. Echefu, C. 2023 personal communication, August 26, 2023

27. Ejenobi, S. personal communication, August 26, 2023.

28. Ndubueze V. Key Informant Interview; 2023.

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