Land Use Mapping and Tree species Diversity of Federal University of Technology, Akure

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Abstract

This paper examined the land use pattern, tree species abundance and tree species diversity at the Federal University of Technology, Akure (FUTA). Sustainable tree management requires information on the growing stock. Such information will guide manager in appropriate valuation and efficient utilization of the forest resources. Tree species diversity, stem volume and the relationships among growth variables were investigated. All the trees encountered were grouped into species, diameter at breast height; height classes and their basal area were computed. Longitude and latitude were collected from different locations within the University, with the aid of Global Position System (GPS), most especially point recognized on the imagery for the geo-referencing of the satellite imagery. All these data were processed with the aid of ArcView 3.2a GIS software. Trees within the forested area were measured and the names, family, diameter at breast height were recorded. A total of 632 stems of 42 families and 230 species were enumerated, with Ficus polita having the highest mean dbh 194 cm. The most abundant species and family were Alstonia boonei and sterculiaceae respectively. The forested areas were in form of relics of natural forests, woodlots, cocoa plantation and highly economic tree species purposefully retained on the farmlands. The map of Land Use and Vegetation of the Federal University of Technology, Akure, was produced, with the aid of Geographical Information System (GIS).

Key words: Diversity, Mapping, Trees species

Introduction

Land use and vegetation maps serve as basis for the management of land resources for all levels of environmental planning with the use of remote sensing data (Baral 2004). Land as gift of nature and fixed commodity needs adequate planning and management to reduce the level of degradation. The basic concept of land use involves both the manner in which the biophysical attributes of the land are manipulated and the intent underlying that manipulation (Turner, *et al*, 1995). The demand for land in Federal University of Technology, Akure (FUTA) over the years, has increased due to the growing population and expansion in the construction of infrastructural facilities. In fact, there has been alteration in the original master plan of the University to accommodate the rapid rate of development. Since the University is a growing one, the demand for land is bound to increase in coming years, hence the need for proper land use planning. The availability of up-to-date map is a basic requirement for effective planning. The change in land use pattern makes planning mandatory if the University is to avoid chaos in future. This research work creates an avenue for obtaining baseline information as regards the land use and land cover situation as at 2001 when the available satellite imagery was produced. The information will serve as a very useful input in the revision of the University Master Plan.

The Federal University of Technology, Akure, contains a wide range of vegetation types that reflect local climatic variations and human use. Forest management involves planning, organization and productive application of the available human, financial and physical resources to achieve the desired objectives (Apan, 1999). Remote sensing offers a means of acquiring and presenting information about resources in a timely manner. Resources such as land, vegetation as feature that are needed and used by people in diverse forms constitute important assets to any given community. Remotely sensed data from satellites are used for the thematic mapping of different features, land use and land cover and a wide range of applications (Anderson, *et al*, 1996). Remotely sensed data from satellite have been used for thematic land cover mapping at a wide range of spatial scales and for numerous applications (Cihlar, 2000). The imagery acquired from remotely sensed data is used to classify the various land use purposes and the vegetative cover of the institution. Geographic information system (GIS) data-base can be used accurately to generate information on ground and its resources. Remote sensing and GIS serve as tools that provide quick information of situation on the environment and earth surface. Finer-scale maps have been produced in which land cover is related to identifiable ground cover components (Roughgarden, *et al.* 1991). The use of this technology saves time and provides flexibility that enables various themes to be displayed as required by the users. The themes refer to different spatial features on the earth surface and could be overlaid in layers to enable study of spatial relationships between features. This facilitates efficient planning and serves as tools in decision making.

Research Methodology

The study was carried out at the Federal University of Technology, Akure, in Akure South Local Government Area of Ondo State, Nigeria. The University is one of the Federal Universities of Technology established by the Federal Government of Nigeria in 1981 in a quest for technological development. The University is located between latitudes 07^{o} 16^{I} and 07^{o} 18^{I} N and longitudes 05^{0} 09^{I} and 05^{0} 11^{I} E. It lies along Akure – Ilesa expressway, with Awule and Ibule as the neighbouring villages.

Data Collection

The data used in this research work was collected from the physical planning of the University which includes the satellite imagery and the topographical map of the University created in 2001. In the study area, all living trees with dbh > 10 cm were recorded by species and assigned to families, the dbh were measure and the frequency count of all the trees. The topographical map was scanned using A4 scanner which was downloaded as soft copy into the ArcView 3.2a for further processing. The background information about the study area was collected from the University library which are, existing map of the University, satellite imagery, previous research work about the study area. This information helps at the different stages of the research work. The satellite imagery of FUTA showing the main campus is presented below Figure 1 as raw data that was used for the production of the map of FUTA.

Field Work

The field work was done with the use of Global Positioning System (GPS) for the collection of the coordinates (longitude and the latitude) at specific locations on the campus for the georeferencing of the satellite imagery. A digital camera was used to capture various features in the study area.

Table 1: GPS reading of specific locations in the study area

Location	LONGITUDE	LATITUDE
South gate	5.15070	7.29261
Akindeko Hostel	5.14919	7.29392
Great Hall	5.14757	7.29586
Teaching & Research Farm	5.14641	7.29679
Senate Roundabout	5.13958	7.30316
Abiola & Jibowu Hostel	5.14173	7.30416
North gate Entrance	5.13963	7.30667
Old VC's Lodge	5.12823	7.30556
New VC's Lodge	5.12441	7.30313
School of Science Building	5.13423	7.30226
SET/PGD School	5.13546	7.29915
Usman Dan Fodio road	5.12855	7.30803
UBA Bank	5.14021	7.30016
School of Environmental	5.13728	7.29880
Senate Building	5.13964	7.30186
School of Earth Sciences	5.13662	7.29828
FWT Teak Plantation	5.14198	7.30039
FWL Fish pond	5.14611	7.29301
FUTA Boundary pillar 1	5.12744	7.29658
FUTA Boundary pillar 2	5.12772	7.29638
FUTA Boundary pillar 3	5.12178	7.30030

Geo-Referencing and Digitization the Satellite Imagery

The satellite imagery used in this study was obtained from the Physical Planning Unit of the University. It was a multispectral IKONOS imagery with spatial resolution of 4 metres. Using the coordinates of specific location already captured with the GPS, the align tool in ArcView 3.2a was used geo-reference the imagery. This process ensured that every point on the satellite imagery has specific coordinates (Latitude and Longitude). Following geo-referencing, vectorization of the raster data was done through on-screen digitization. This entails tracing out features on the satellite imageries as new themes using point, line and polygon as appropriate. Points were used to specific locations and small objects, lines were used for linear features such as road and stream, while polygons were used for area features such as land use and vegetation classes. The new themes were displayed as new map of the study area. Different colour schemes were used to depict the features for ease of recognition and distinction of the map produced.

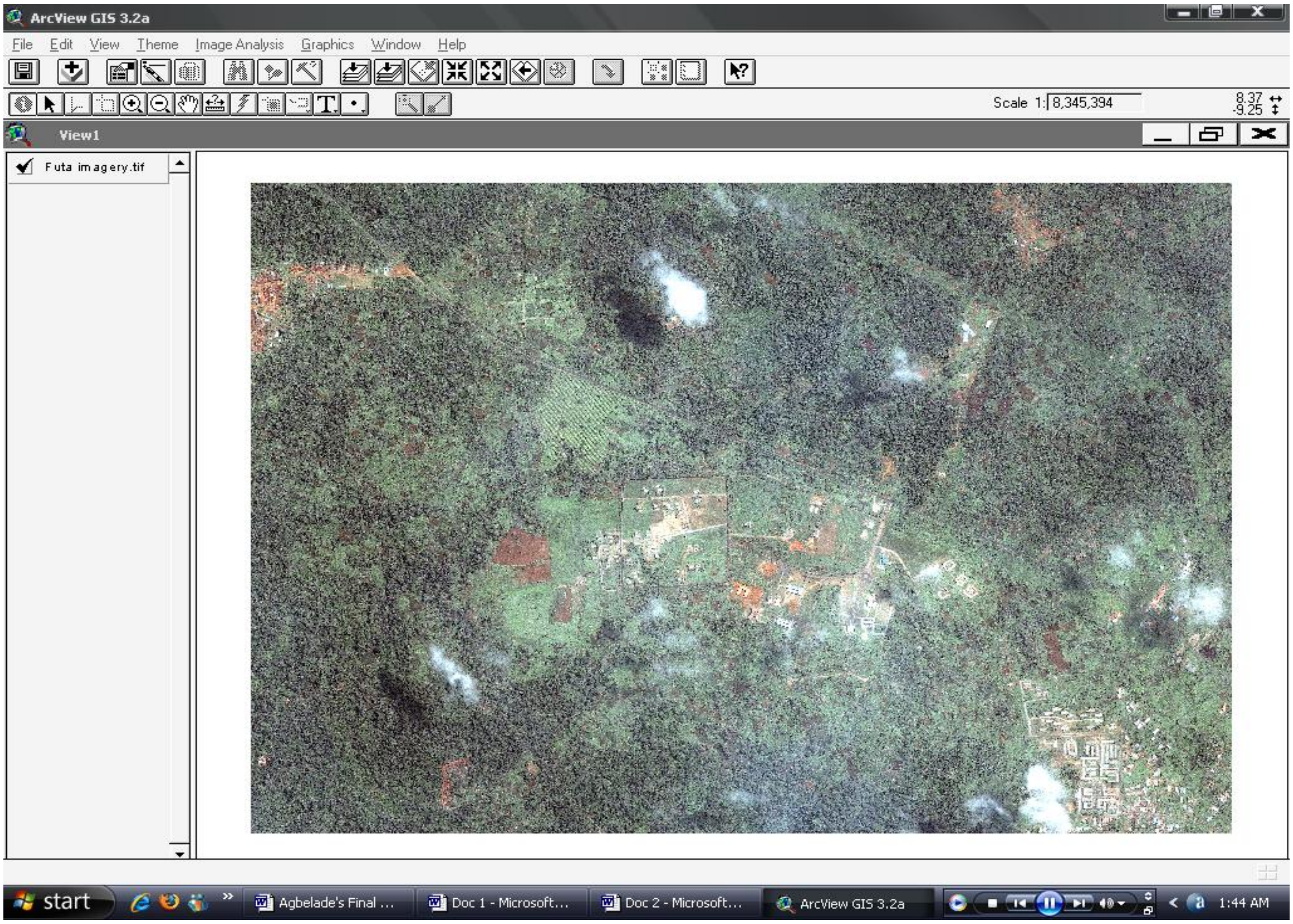

Figure 1: Satellite Imagery showing the Federal University of Technology, Akure.

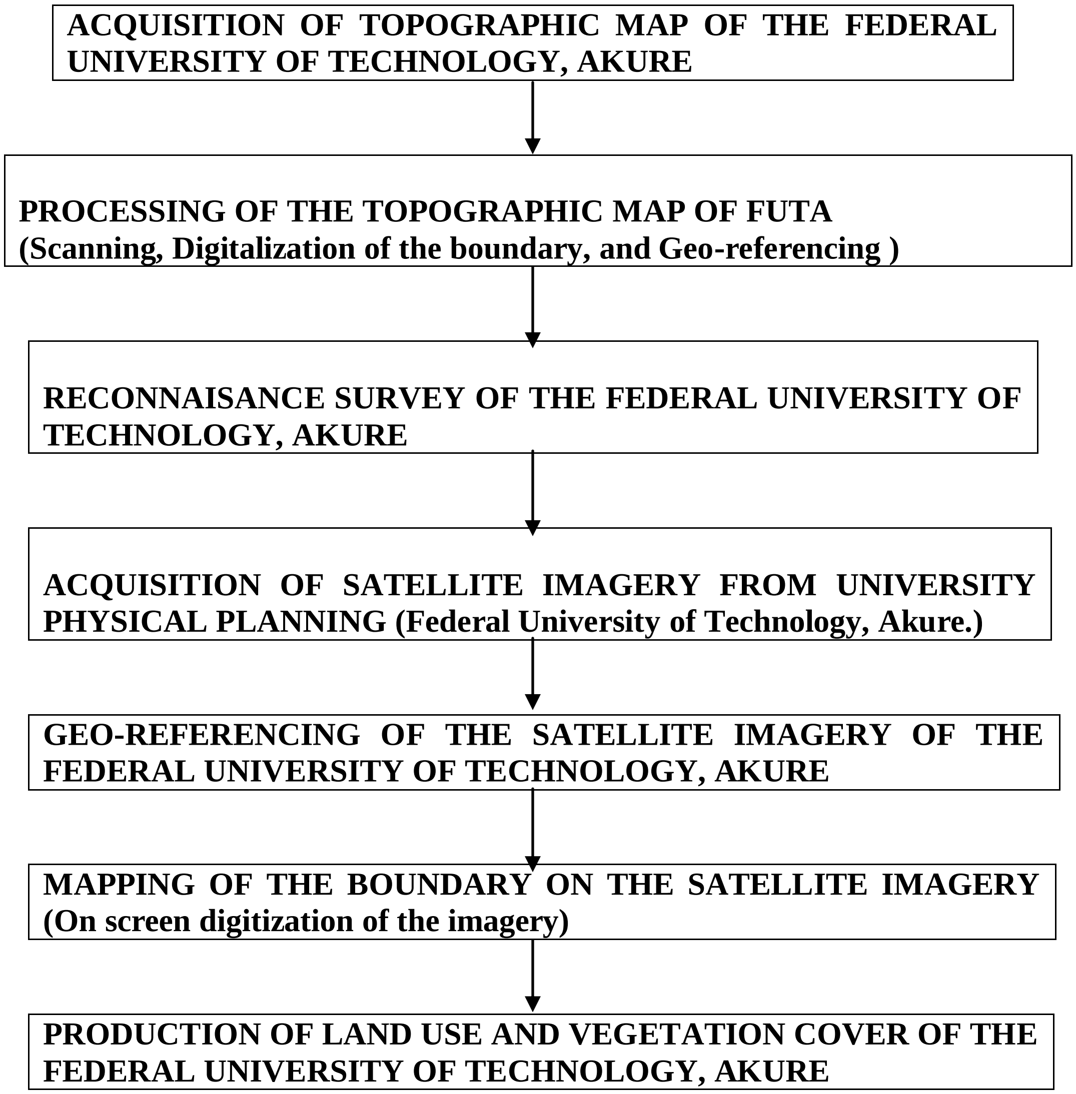

Figure 2: Flow chart illustrating different Stages involved in the production Land use and Vegetation Map of FUTA

Result

The analysis of the satellite imagery using ArcView GIS 3.2a (Figure 2) led to the generation of the land use and vegetation map of the Federal University of Technology, Akure, as shown in Figures 3 and 4 below. This map of FUTA Land Use and Vegetation Cover was geo-referenced with the attribute data collected from the field. The land use and vegetation is divided into classes, the vegetated area have the largest area of land.

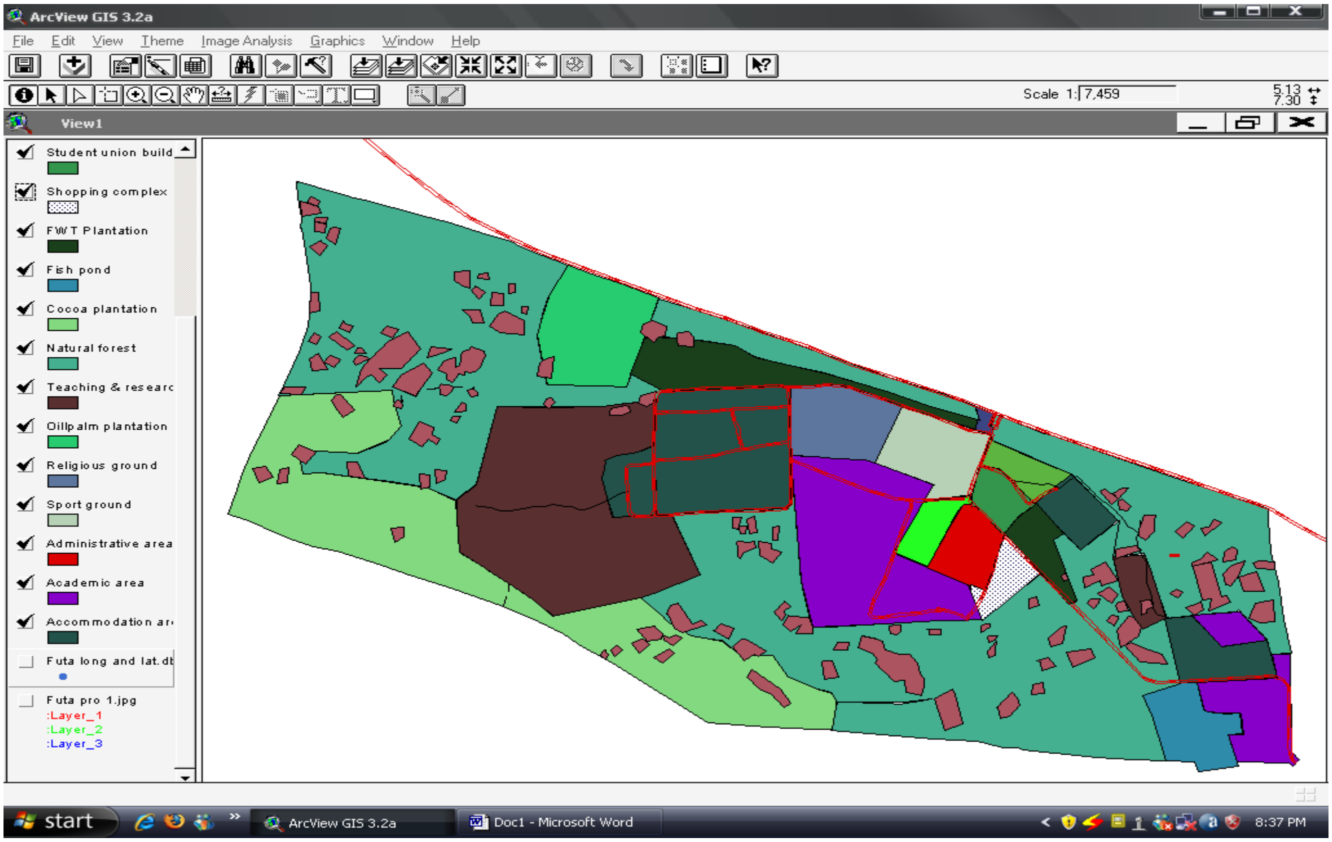

Figure 3: Map of the Federal University of Technology, Akure, showing Land Use and Vegetation Cover pattern.

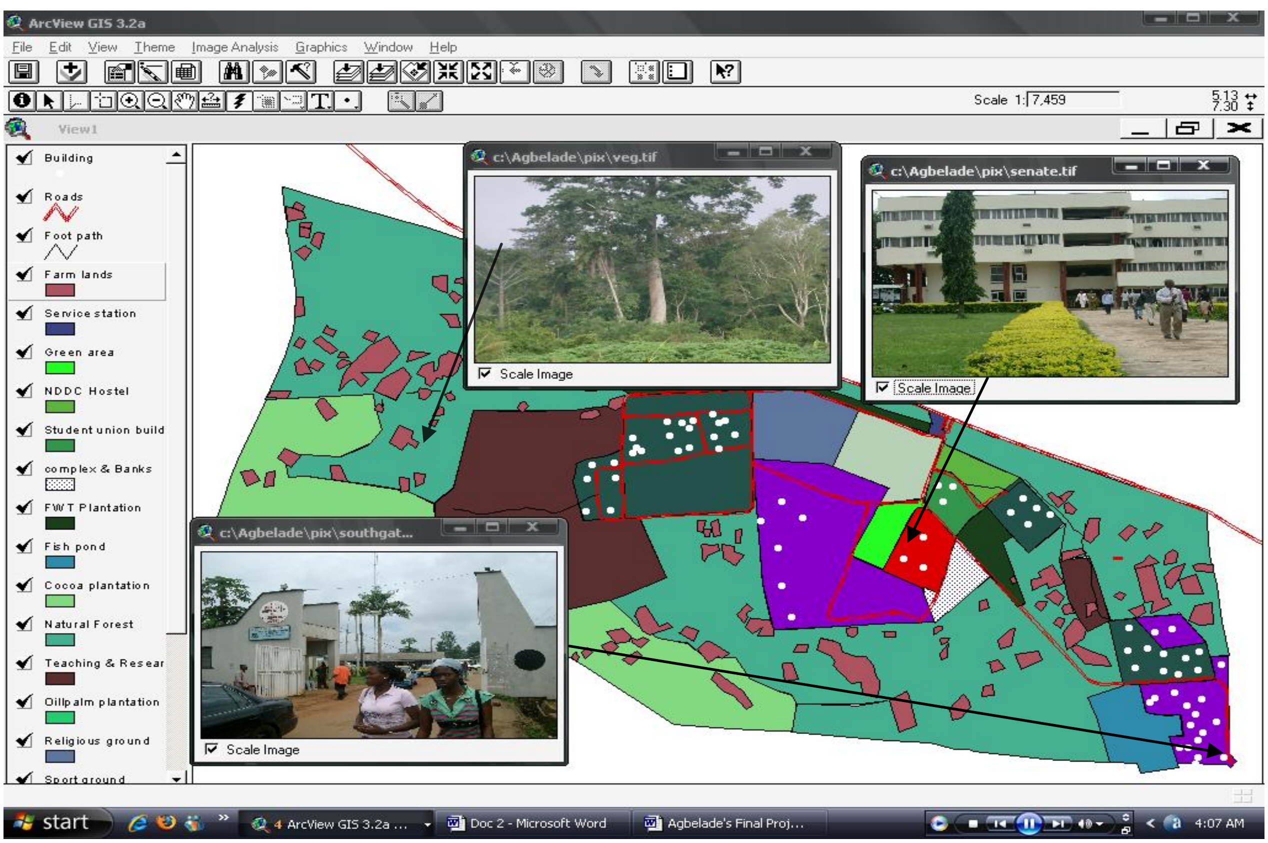

Figure 4: Screen shot of the ArcView GIS 3.2a showing attribute features of the University

The various land use and vegetation cover is added as theme to the menu of the imagery which is represented as polygon. The various polygons are depicted with different colours to facilitate quick recognition. They represent the different land use and vegetation classification which the legend of the map has displayed. The roads are shown as lines, buildings as points, and boundary of the different classes of land use and vegetation as polygons. Hot linking information, attribute table are used for the description of the map. It can also be used for management and planning of the remaining undeveloped area of the University land as shown in Figures 3 and 4. The cardinal point shows the direction of true north on the map, and the scale bar is graduated in kilometers.

Tree species diversity within the Federal University of Technology, Akure

Table 2 reveals the result of tree diversity and abundance within the Federal University of Technology, Akure. In all, 632 trees spread across 21 families belonging to 42 species were enumerated. There were 42 species with *Alstonia boonei* being the most prominent and *Ficus polita* with highest mean diameter at breast height. *Spondas mombin, Khaya ivorensis, Khaya grandifoliola, Daniellia ogea, Streculia tragancantha, Dialium dinklogie, Bridelia atroviridis, Buscia angolensis, Khaya grandifoliola, Ficus polita,* are the least dominant tree species in the area and *Dialium dinklogei* has the least mean diameter at breast height. The most abundant species is *Alstonia boonei in the family of* Apocynaceae (34 stems), this is followed by *Ricinodendron heudelotti* with (32 stems) *Pterygota macrocarpa* with 26 stems, *Albizia zygia* has 22 stems, *Cola gigantia* has 21stems, while *Funtumia elastic* and *Pycnantus angolensis* have 20 stems each. Moraceae, Annonaceae, Casuarinaceae, with the mean diameter at breast height of 194, 183, and 154 cm respectively, Apocynaceae, Euphorbiaceae, Sterculiaceae, has frequency of 34, 32, and 26 respectively as shown in (Table 2). Sterculiaceae family has the highest number of species (9 species) while Apocynaceae has 5 species (table 3).

Table 2: Tree species diversity and abundance within the Federal University of Technology, Akure, main Campus.

Family	Scientific Name	Frequency	Mean Dbh (cm)
Anacardiaceae	*Spondas mombin*	11	70.0
Annonaceae	*Cleistopholis patens*	11	183.0
Annonaceae	*Lovoa trichilioides*	12	105.5
Apocynaceae	*Alstonia boonei*	34	88.6
Apocynaceae	*Anthocleista nobilis*	14	121.0
Apocynaceae	*Antiaris Africana*	14	83.3
Apocynaceae	*Funtumia elastica*	20	74.5
Apocynaceae	*Rauvilfia vomitoria*	12	60.0
Bombacaceae	*Bombax species*	13	102.0
Boragiaceae	*Cordia milleni*	15	134.0
Caesalpiniodeae	*Daniellia ogea*	11	59.0
Caesalpiniodeae	*Dialium dinklogei*	11	39.0
Capparaceae	*Buchholzia coriacea*	12	82.0
Casuarinaceae	*Pterocarpus soyauxii*	13	155.0
Combretaceae	*Ceiba pentadra*	15	69.8
Combretaceae	*Terminalia superba*	15	116.8
Ebenaceae	*Discoglypremna calonuera*	19	79.6
Ebenaceae	*Lecaniodiscus cupanoides*	13	58.0
Euphorbiaceae	*Bridelia atroviridis*	11	80.0
Euphorbiaceae	*Ricinodendron heudelotti*	32	81.9
Irvingiaceae	*Irvinigia gabonensis*	12	136.0
Lecythidaceae	*Napoleoraea vogelii*	12	136.0
Meliaceae	*Khaya grandifoliola*	11	65.5
Meliaceae	*Khaya ivorensis*	11	60.0
Meliaceae	*Millicia excelsa*	15	123.2
Minosaceae	*Albizia zygia*	22	88.4
Moraceae	*Ficus polita*	11	194.0
Moraceae	*Musanga cecropiodes*	14	88.3
Myristicaceae	*Buscia angolensis*	11	55.0
Myristicaceae	*Dallium guinensis*	12	117.0
Rutaceae	*Fagara xanthoxyloides*	15	61.0
Sapindaceae	*Blighia sapida*	14	67.8
Sterculiaceae	*Brachystegia eurycoma*	12	76.0
Sterculiaceae	*Cola gigantia*	21	90.5
Sterculiaceae	*Lophira alata*	14	100
Sterculiaceae	*Mansonia altissima*	12	85.8
Sterculiaceae	*Pterygota macrocarpa*	26	94.1
Sterculiaceae	*Pycnantus angolensis*	20	91.5
Sterculiaceae	*Sterculia rhinopetala*	19	91.1
Sterculiaceae	*Streculia tragancantha*	11	40.0
Sterculiaceae	*Triplochyton scleroxylon*	13	100.3
Ulmaceae	*Celtis zenkeri*	16	134.7

Table 3: Family distribution across FUTA Campus

Family	Scientific Name	Frequency	Percentage
Anacardiaceae	*Spondas mombin*	1	2.4
Annonaceae	*Cleistopholis patens*	2	4.8
Apocynaceae	*Alstonia boonei*	5	11.8
Bombacaceae	*Bombax species*	1	2.4
Boragiaceae	*Cordia milleni*	1	2.4
Caesalpiniodeae	*Daniellia ogea*	2	4.8
Capparaceae	*Buchholzia coriacea*	1	2.4
Casuarinaceae	*Pterocarpus soyauxii*	1	2.4
Combretaceae	*Ceiba pentadra*	2	4.8
Ebenaceae	*Discoglypremna calonuera*	2	4.8
Euphorbiaceae	*Ricinodendron heudelotti*	2	4.8
Irvingiaceae	*Irvinigia gabonensis*	1	2.4
Lecythidaceae	*Napoleoraea vogelii*	1	2.4
Meliaceae	*Millicia excelsa*	3	7.0
Minosaceae	*Albizia zygia*	1	2.4
Moraceae	*Ficus polita*	2	4.8
Myristicaceae	*Dallium guinensis*	2	4.8
Rutaceae	*Fagara xanthoxyloides*	1	2.4
Sapindaceae	*Blighia sapida*	1	2.4
Sterculiaceae	*Mansonia altissima*	9	21.2
Ulmaceae	*Celtis zenkeri*	1	2.4

Discussion

The result of this research work carried out at the Federal University of Technology, Akure, shows that the application of remote sensing technology can be used in map production to give reliable information about the current state of land use and land cover. Congalton (2001) reported that information about different forest cover types and extents is important in the assessment and preparation of management plans for conservation development. Remote sensing method is an effective means of obtaining information in real-time manner. Wanger *et al.* (2003) submitted that Landsat and other high resolution satellite images have recently been applied for land resources management in a number of countries. The land use of the Federal University of Technology, Akure can be classified into two broad types as built-up area (developed) and the forested area (undeveloped). The forested area occupied the vegetative cover of the University which is designed in themes FWT plantation/nursery site, Teaching and Research farm (Livestock section), cocoa plantation, natural forest, farm lands, green area, wildlife park/fish pond, research farms *etc*.

The developed area comprises of the following features design as themes, academic area, administrative area, accommodation area, business/banking area, buildings, religion area, roads, car parks, sporting area *etc*. The land use and vegetation classifications support the purpose for which the University is established. These features were represented in polygons, roads in lines, buildings in dots, in the Figure 3. With the different colours indicating each land use and vegetation pattern of the University. The shape and the boundary layout of the University map was to indicate the area left for the developmental project and the ways it can be planned properly. The different screen shot display the various functions of GIS in manipulation of data and to indicate the land use pattern and the vegetation classes of the University as shown in Figures 3, and 4. The locations of the different exciting feature can also be located easily on the map without any difficult. The attribute information about the different feature in the attribute table is a way of analyzing the map to the viewers for easy understanding and interpretation of the map for planning most especially the University community. With the map scale, longitude and latitude, The result indicated that *Alstonia boonei, Ricinodendron heudelotti, Pterygota macrocarpa,* have the highest frequencies.

It shows that the area is truly disturbed as these are species commonly found in area of secondary forest as reported by Salami (2003). *Ficus polita, Cleistopholis paten, Pterocarpus soyauxii,* have the highest mean diameter at breast height in centimeter. The reason for this being that the area where these trees were located had bad terrains which make the area undisturbed. It shows the structural characteristics of the tropical rainforest as reported by Salami (2004). Moraceae, Annonaceae, Casuarinaceae, with the mean diameter at breast height of 194, 183, and 154 cm respectively, Apocynaceae, Euphorbiaceae, Sterculiaceae, has frequency of 34, 32, and 26 respectively as shown in (Table 2). This is an indication of secondary growth of forest land which was disturbed by the cocoa plantation establishment in the area. Some logging activities have also taking place in the area. There is abundance of medium diameter tree species in the area due to encroachment activities from the surrounding communities for arable crops. The large area used for *Theobroma cacao* plantation and scattered batches of farm land areas, is an indication of intensive deforestation for cash crop and arable crops. This result correlates with the view of Bilsborrow (1994) that deforestation is largely due to clearance of forest land for agriculture. Natural forest of the study area is large with lot of small pieces of farm lands all over the forest area. Peasant farmers have dominated the forested area with their arable crops all over the place.

Conclusion

The study examined the potentials of Remote sensing technology in land use and vegetation map production which can be used in all areas of human endeavour such as Agriculture, Forestry and Environment Management, Natural resources development and Engineering, monitoring of the space and earth structures *etc*. Land as a natural resource provides an avenue for infrastructural development and other forms of land use. The development of a new map for FUTA shows how remote sensing technology and GIS can be used accurately to identify the different land use and vegetation type of an area. The research work has shown how remote sensing and GIS technology has capability to generate reliable information that can be used in mapping land use and vegetation.

Recommendations

It is recommended that the different institutions in Nigeria should take the advantage of remote sensing and GIS in the development of their master plan. The state and Federal Government should also be alert on the usefulness of remote sensing and GIS in the production of different maps of the state capitals and their master plan. Human capacity development in the area of remote sensing and GIS should be put in place to cater for the high rise in the knowledge base of the technology.

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