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**ELECTRICITY DISTRIBUTION SYSTEM USING GEOSPATIAL TECHNOLOGY A CASE STUDY TAMBARI HOUSING ESTATE BAUCHI, BAUCHI STATE OF NIGERIA.**

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***Abstract***

*Most of Developing Countries like Nigeria are yet to achieve general and Collective electricity right to use for their society Right to use to inexpensive and dependable electricity. GIS plays a significant role in economic development, employment creation and investment. Sufficient policies on energy regulation are needed for the achievement of sustainable development goals in our society. The present of Remote Sensing data and Geographical Information System techniques is becoming one of the new modern tools for decision support system. It can play a very important role in power sector. The Geospatial information of all the property related to all power projects can be visualize at one platform in Geographical Information System. Which can assist in environmental management and equalize management of electrical power distribution and control system this can be proven as and great support for a new power project. The main goal of this project was to create geo spatial database and map and graphically display an electrical power network. A dynamic database was created for each and every individual house to understand who are paid the electrical bill for each month those that not paid the electrical due respectable and also stores the important information for decision making, future planning and analysis such as location of area that doesn't have the electrical service and any electric breakdowns in order to improve the revenue generation., Because Geographical Information System is becoming a great technique for decision support system. It can play an essential analysis in power supply sector, Operation of electricity and maintenance. The*

*previous method of record is analogue which difficult to searching previous records payment and updating them, and time consuming task.*

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**Keyword:** GIS, Electricity Distribution, Geo-database, Analysis, and Improved the system Electrical revenue generation.

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## **Introduction**

**Geographic information system in electrical power distribution system its play importance roll, it new innovation that capture spatial and non-spatial data and also easier for utility management. The impact and application of GIS is become increasingly aware of the advantages of using GIS technology for addressing their unique spatial problems. However, this is not always the case. GIS can be made up of a variety tools which will contribute to manage the electrical distribution system problem. in another hand, GIS can be explain as combined sets of hardware, software, databases and processes deliberate the data collectively, Geospatial techniques is more easier to understand the Geospatial modeling and is one of the most recent technologies introduce to minimize the electrical distribution system problem for, load forecasting, cost estimation and selection of suitable areas.**

## **Background of the Study**

Tambari housing estate is an area in Bauchi state which was constructed during the previous Administration by the former Governor Ahmad Adamu Mu'azu Administration 1999, Tambari housing state were located outside Bauchi metropolis along Jos road Bauchi, Bauchi state .the number of house will reach up to hundred (500) houses and is one the most situated area which is much quit, conducive environment. Moreover, the nature of payment of electrical bills is manually done which takes a lot time, energy, and some misunderstanding between electrical agent house clients. GIS system, is an integrated set of hardware and software tools used for the manipulation and management of spatial and non-spatial data of the area. GIS cone can be able to map out addresses of a particular location. And now a day's payment of electrical bills of Tambari housing estate is manual need to be automated by designing a system which will run electrical bills with the help of GIS to improve the standard payment for each and every individual houses in Tambari housing estate, if this GIS strategies and modalities happen the electrical power industry would achieve the high level of revenue generation at Tambari housing estate. The knowledge about physical assets of the electricity distribution network is necessary to make strategic and operational decision. Hence to make such

informed decision regarding the distribution and management of electricity and its facilities, information must be collected and analyzed to its full extent through GIS technique. **Ihiabe Y. Adejoh1, et al (2015).**

### **Statement of the Problem**

Tambari housing estate has witnessed remarkable economic growth, expansion and development, within the last few decades, which results to a rapid increase in the demand for electrical service for various purposes.

Despite the increasing demand for electrical service in the area, it has been observed that the power holding company Bauchi State chapter, which is responsible for acquiring, storing, processing, updating, retrieving the customer outstanding balance. The idea behind this project is to upgrade from manual method of payment of electrical bill to computerized based system that is geo-database which will help to identify the location of end-user, to ensure that the end-user paid the service or not paid. however, the GIS tools has ability to shows the end-user that are using heavy electrical appliance, and most of the times people in this area are over-charge which lead them to pay what they have not consume. And there is possibility of making it easy for power holding company to generate bills and print within a short minute of time this will reduce load of work on them and saves time, energy, space and resources.

Research has shown that the system is cumbersome and fraught with delays, thereby leading to a number of problems such as some people didn't paid electrical service some of them paid while the electrical management doesn't have method to verify, service line failure, lost of transformer there is no way to describe the location, difficulty/inconsistency in accessing information about customer house, due to lack of up-to-date information of electrical appliance for each and every individual house.

The distributions of electrical energy to end users in most urban area are faced with diver's spatial problems particularly with the use of analogue system. Based on this, this study seeks to use geospatial technique for effective management of electricity distribution. The study assesses the spatial relationship between power holding company of Nigeria (PHCN) assets and their customer's connectivity in the study area and makes decision on how to improve and manage electricity distribution. **Ihiabe Y. Adejoh1, et al (2015).**

Absence of up to date information about the facilities of the Power Holding Company of Nigeria, Plc is a great hindrance towards delivering effective power supply to the citizen of the country. The production of digital map and a functional geo-database of the facilities would assist in the adequate distribution of electricity in the following areas; **Olaniyi Saheed Salawudeen and Usman Rashidat (2006).**

Updating and modification of information concerning facilities for electricity Distribution such as injection station, transformers, electric poles, electric cable, etc. **Olaniyi Saheed Salawudeen and Usman Rashidat (2006)**

GIS technique is used to create database and develop map which can show the spatial relationship between PHCN asset and their customers in the study area. The production of digital map and functional geo-database about the facilities will be able to show utility transformer and the rating of the transformer which can be used to determine the capacity of energy it can distribute and the current energy demanded on it.

**Ihiabe Y. Adejoh1, et al (2015).**

### **Research Questions**

The study is poised to answer the following research questions:

- i. Can the analogue method of electrical record and utility management be transformed to digital format?
- ii. Can the records of end-user of electrical service payment be stored in a form that is physically stable?
- iii. Can the records of electrical consumption be easily differentiated?
- iv. How can the problems of end-user that no paid service par month be solved in Tambari housing estate.

### **Aims and Objectives**

The aim of the study is to generate a geospatial model for electricity consumers and facilities to provide a better understanding towards effective distribution and conservation of electricity effectively efficient

### **The objectives of the study is**

- i. to create a digital composite map of electricity distribution network map that shows the spatial location of end-user
- ii. To shows the location of end-user that paid the service or not within the study area with the respect of month.
- iii. To shows the location of end-user those that use the heavy electrical appliance for more electrical consumptions within the study area.
- iv. Create a map that will show the entity relationship between end-user and geo-database.

### **Scope and Limitation**

This study in tails the development of a comprehensive information system of electricity distribution system using GIS techniques Its requires spatial information of the study area and the coordinate of some prominent points or futures within the study area as well as attribute information like end-user

house, electrical pole, transformer, street name, major road, minor road. And also refusal of power holding company gives detailed answers and in some cases no answer at all to some questions and financial constraints. This project is limited to all the data associated with the information gotten from the power holding company, and due to time factor, not all the commissions were reached for sources of data and information. Therefore, we intend to cover Tambari housing estate, Bauchi local government metropolis Bauchi state.

### **Justification of Study**

The need of this project, will contribute to development of Bauchi state and country at large. Because its cover a comprehensive information system that provides the digital composite map of electricity, it will help the government to improve the proper revenue generation and effective electrical utility management as well as updating, processing if there is any development. And also save guard, such from unauthorized person. Finally the project, if adapted by power holding company Bauchi State chapter will serve as tools that will be effective in terms of revenue collection in the study area and the State at large. This will also show the numbers of customer attach to each transformer and the energy consumed by each customer. This will help to determine whether the transformer is overloaded or still operating within its installed capacity. At such, determine the up riser to put off from a transformer that is already overloaded for a period of time, make decision on how to carry out load shedding, how to detect illegal connection, due time for transformer replacement and when to stop new customer from connecting to a transformer. **Ihiabe Y. Adejoh<sup>1</sup>, et al (2015).**

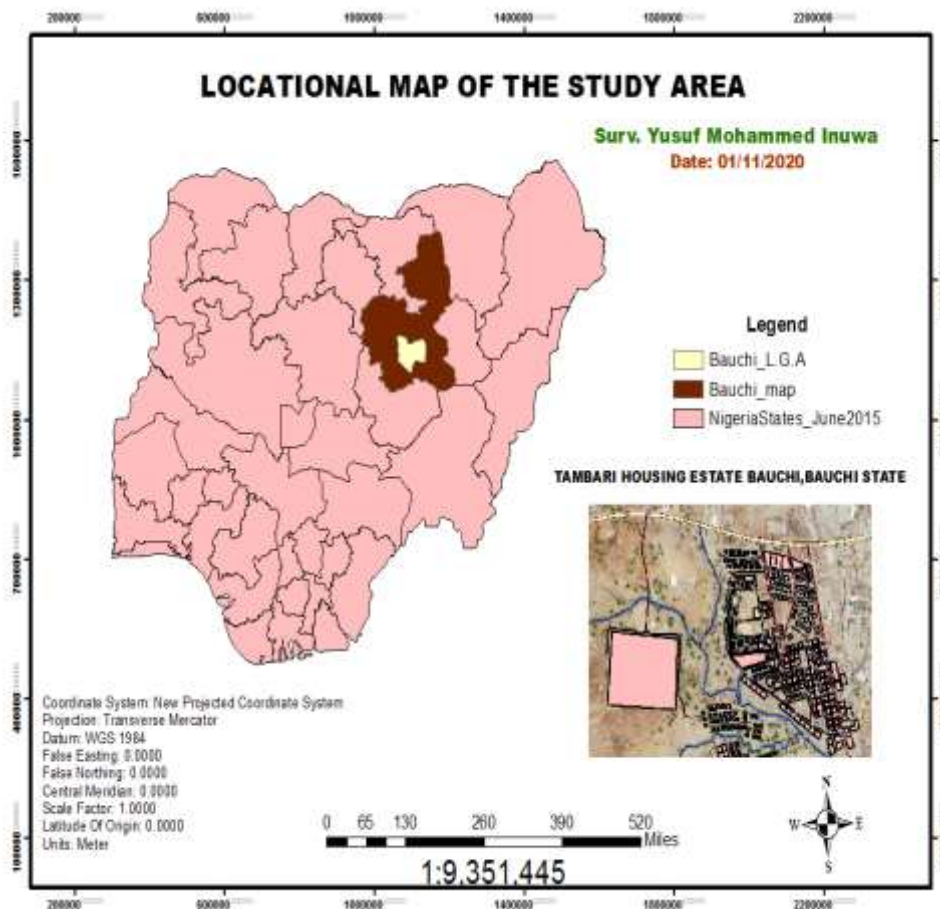
### **Significance of the Study**

Under the present circumstances of high population growth, large-scale economic globalization, climate change, natural disasters and mass migration caused by land degradation, pollution, war, mining and land encouragement. The city's fast growth has resulted in increasing pressure to convert rural land for industrial, housing or other urban use. When the electrical distribution network cover the urban area, the community will have job opportunity through industrialization, And it will serve as a platform for decision making.

### **Location and Extend**

The study area covers the whole of Bauchi metropolis, the capital of Bauchi State and of the Bauchi Local Government within the state. The area lies between latitude 58 4 and 11 02 north of equator and longitudes 52 34 and 1

34 east of green witch meridian and cover a total area of 14.85 km<sup>2</sup> as show below.



### Historical development of Bauchi state

Bauchi state is one of the thirty-six state politically administrative state in Nigeria .it is one of the nineteen loosely referred to as the northern state and one of the eight often referred to as the far northern, dominantly Hausa/Fulani and Muslim state in the country, however created as a state in 1976 when the north-east state was split in to three difference state of business Bauchi, Borno and Gongola. Bauchi state remain intact in it 1976 boundaries surviving two subsequent state creation exercise of 1987 and 1991.

How, ever in October 1996, Gombe state was carved out, then Bauchi state with eight local government area forming the new Gombe state and remaining of local government are Bauchi,Alkaleri,Darazo,Dass,Bagor,T/Falewa,Toro,Warji,Itas/Gadau,jama’ar

e, Gamawa, kirfi, Ganjuwa, Misau, Damabam, Giade, Zaki, Shira, Katagum, Ningi and forming a new Bauchi state (Historical development Bauchi state posted online 1/29/2003).

### **Bauchi State Administration**

There are twenty local governments 1996. When Gombe state was carved out, the present Bauchi state was left with fifteen LGA. some of them were, in October 1996, further divided to make up the present twenty local the state comprised comprise several previously independent powerful emirate, including for instance Bauchi, Ningi, Katagum, Dass Kananm and Duguri. The LGA are t Sub-divided in to District which are made up of various village area/group. (Historical development Bauchi state posted online 1/29/2003).

The state now has an eight –like shape, with a blotted lower region, with about two- third of the land are being south f the latitude 11 15 N. the neighbouring state by location, clockwise, are Yobe Gombe, Taraba, Plaeau, Kaduna, Kano and Jigawa states thus Bauchi state could potentially operate in mutual development programmes and projects with up to seven others state which share border with her indeed, the state occupies a central location spatially among north-east group of state in Nigeria.

Another Location advantage which Bauchi state has is its proximity to Jos Plateau which is less than 100km south of the state by which it has access to a commercial airport and to a large market for its agriculture produce, particularly fruit and (Historical development Bauchi state posted online 1/29/2003)

### **Topography, Relief and Geology**

Bauchi state lie generally at an altitude of about 600m above the sea level, being part of the central Nigeria highland and jos plateau complex however, two broad relief zone can be identified as follow a western high land area of hill ranges, including the northern edges of the jos plateau complex.

This is part of the crystalline rock area in central northern Nigeria. The hill range is developed on basement complex rock, in an area which is also characterized by extensive plateau surface and volcanic extrusion. The base of the hill range is generally at the 600m level, while peak rise to 700.6m on the hill and 729.3m on the Bunsil hill.

A central high plain (of the Hausa Land) area belonging to the kerri-Kerri and Gombe sandstone and shale, of tertiary age, Isolated hill punctuate the high plain several place, and reach height of 798.5m on the Lamurde hill and 816.4m

on the Ligri hill. Indeed, most of the isolated hill in this zone is over 760m Bauchi town lie within the undifferentiated basement complex with old granite out crops and younger granite out crops. (Historical development Bauchi state posted online 1/29/2003

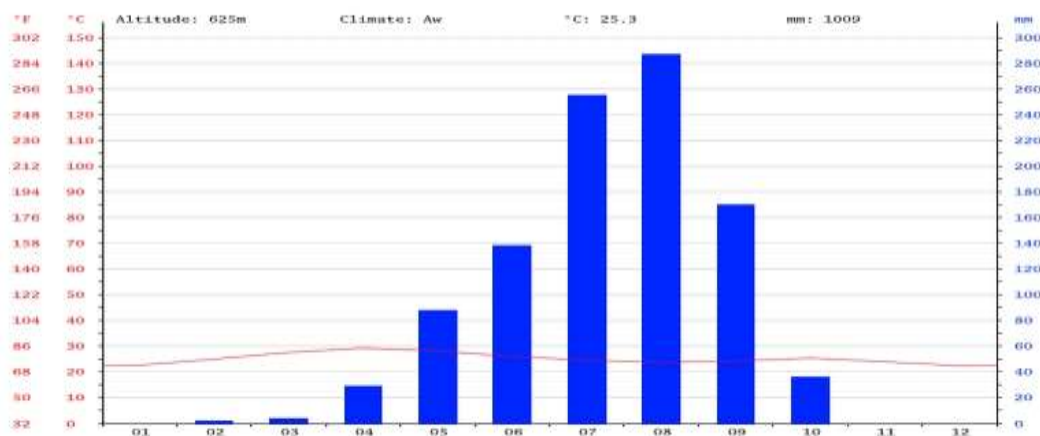
### Vegetation

the vegetation type is savannah composed of scattered tree ,shrubs and mainly flat lying grasses .the grasses along the river band tend to be greenish all year round (according to one peter who is living there, I did not see it during dry session)Vegetation has been reduced to acacia shrub of less than 35% vegetation cover at micro level. The vegetation is less uniform and grasses are shorter than what grows. The vegetation types as described above are conditioned by climatic factors, which in turn determine the amount of rainfall received in the area (BASG, 2012).

### Climate and Rainfall

The temperatures should be expected, generally high in the state. Mean daily maximum Temperature range from 29.2°C in July and august to 37.6° in March and April. The mean daily minimum range from about 11.7°C in December and January to about 24.7°C in April and May sunshine hour range from about 5.1 hour in July to about 8.9 hour in November. Indeed, October to February usually record the longest sunshine Hour in the state. Humidity range from about twelve per cent in February to about 68 per cent in august.

**BAUCHI CLIMATE GRAPH // WEATHER BY MONTH**



Precipitation is the lowest in January, with an average of 0 mm | 0.0 inch. Most of the precipitation here falls in August, averaging 287 mm | 11.3 inch.

[weather\\_nga.com/en.neria/bauchi\\_weather\\_febuary](http://weather_nga.com/en.neria/bauchi_weather_febuary).

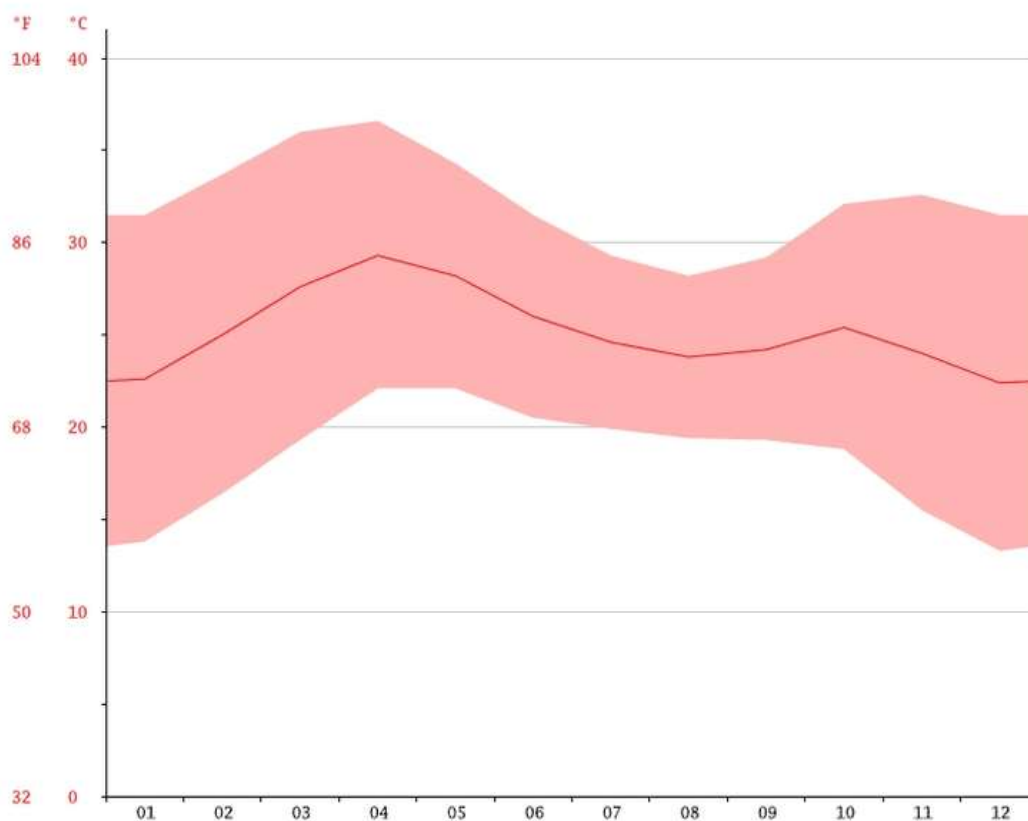


### The Rainy Season

Month it's May to September, when humidity range from about 37 per cent to 68 per cent. Monthly rainfall range from 0.0mm in December and January, though only trace of less than 0.1mm in February and November, to about 343mm in July. Onset of the rain is often in March while they end virtually by October.

Precipitation is the lowest in January, with an average of 0 mm | 0.0 inch. Most of the precipitation here falls in August, averaging 287 mm | 11.3 inch.

### BAUCHI AVERAGE TEMPERATURE



At an average temperature of 29.3 °C | 84.7 °F, April is the hottest month of the year. December is the coldest month, with temperatures averaging 22.4 °C | 72.3 °F.

[weather.nga.com/en.neria/bauchi\\_weather\\_february](http://weather.nga.com/en.neria/bauchi_weather_february).

**BAUCHI WEATHER BY MONTH // WEATHER AVERAGES**

	Avg. Temperature (°C)	Avg. Temperature (°F)	Precipitation/ Rainfall (mm)
January	22.6	72.7	0
February	25	77.2	2
March	27.8	81.7	4
April	28.9	83.9	29
May	28.2	82.8	80
June	26	78.8	136
July	24.4	75.9	255
August	23.8	74.8	367
September	24.2	75.6	170
October	23.9	75.0	36
November	24	75.2	0
December	22.4	72.3	0

	January	February	March	April	May	June	July	August	September	October
Avg. Temperature (°C)	22.6	25	27.8	28.9	28.2	26	24.4	23.8	24.2	23.9
Min. Temperature (°C)	13.8	16.4	19.3	22.1	22.1	20.5	19.8	19.8	19.3	18.8
Max. Temperature (°C)	31.5	32.7	35	36.9	34.7	31.9	28.7	28.2	28.5	30.3
Avg. Temperature (°F)	72.7	77.2	81.7	83.9	82.8	78.8	75.9	74.8	75.6	75.0
Min. Temperature (°F)	56.8	61.5	66.7	71.8	71.8	68.9	67.6	66.9	66.7	65.8

weather\_nga.com/en.neria/bauchi\_weather\_febuary.

**Radiation**

is fairly even throughout the year, ranging from about 11.3mm in July to about 18.7mm in April. However, ever, it is relatively highest in March, April and May, when it is generally between 16.1 mm and 18.7mm similarly evaporation in the state range from 2.4mm in July and August to about 15.7mm in March, the month of January, April being the period of greatest evaporation. Bauchi state spans two distinct vegetation zones namely the Sudan savannah in

south part and the Sahel savannah in the northern part. Its generally characterized by undifferentiated (mixed) woodland, particularly mixed acacia.

**Surface Drainage and Ground Water Situation**

The state I drained by several river systems. the dominant one is river Gongola which originated in the Jos plateau area, south west of Bauchi state it traverse, in a southwest-north east direction through the southern L.GA of the state including Dass, T/balewa, Bogoro, Bauchi and Kirfi thence to Gombe state it has numerous headwater and tributaries within the state.They include rivers Surr, Lere, Maijuju, farin Bagel, Gangala and Gubi Dam in the southwest part, rivers Guji, Yuli, Ruhu, Dukut and Panana in the south and south-east parts. Through these tributaries and several other smaller stream and Rivulets, the Gongola system provide considerable advantage for the state. The western and northern part of the state are drained by the rivers bunga and jama”are systems.

The bunga, with its many tributaries, including river Fanro Magariya and Dan warra, Flow in to the jama”are system and thence to constitute part of the river yobe system.

within the north-eastern part of the state is river Dingaiye system with its tributaries such as river kasi .the letter has river farin ruwa, jiminy and amny others as its own tributaries also in the extreme northern part of the state is a considerable stretch of the river katagum system

(Historical development Bauchi state posted online 1/29/2003.

**Population and Major Economic Activities**

Bauchi state has a total of 55 tribal group in which geraw,sayawa,jarawa,kirfa,turawa,bolawakarekare,kanuri,fa”awa,butawa,warjawa,zu lawa,mbadaw,Fulani and hausawa are the main tribes. These mean that they have background, occupation, pattern, beliefs and many other things that form part of existence of the people of the state. There are cultural similarities in the people language, occupational practices, festival, dress and there is a high degree of ethics interaction especially in marriage and economic existence some of the ethics group have joking relationship that exist between them e.g Fulani and kanuri, jarawa and sayawa. Besides, there is also Major-highway which links Bauchi, Yobe and Borno states. The area has adequate telephone services and a number of hospitals.

Bauchi Urban Area Population History

1950	24,000	1951	24,000	1952	25,000	1953	26,000	1954	27,000
1955	28,000	1956	29,000	1957	30,000	1958	31,000	1959	32,000
1960	34,000	1961	35,000	1962	36,000	1963	37,000	1964	39,000
1965	42,000	1966	44,000	1967	47,000	1968	50,000	1969	53,000
1970	57,000	1971	60,000	1972	64,000	1973	68,000	1974	72,000
1975	77,000	1976	81,000	1977	86,000	1978	92,000	1979	97,000
1980	104,000	1981	110,000	1982	117,000	1983	124,000	1984	132,000
1985	140,000	1986	149,000	1987	158,000	1988	168,000	1989	179,000
1990	190,000	1991	202,000	1992	211,000	1993	219,000	1994	227,000
1995	236,000	1996	245,000	1997	254,000	1998	264,000	1999	274,000
2000	284,000	2001	295,000	2002	306,000	2003	318,000	2004	330,000
2005	342,000	2006	355,000	2007	369,000	2008	383,000	2009	397,000
2010	412,000	2011	428,000	2012	444,000	2013	461,000	2014	478,000
2015	496,000	2016	515,000	2017	534,000	2018	555,000	2019	576,000
2020	598,000								

Bauchi Urban Area Population Projections

2021	621,000	2022	645,000	2023	670,000	2024	697,000	2025	724,000
2026	752,000	2027	781,000	2028	810,000	2029	840,000	2030	871,000
2031	903,000	2032	934,000	2033	967,000	2034	1,000,000	2035	1,033,000

[weather\\_nga.com/en.neria/bauchi\\_weather\\_febuary](http://weather_nga.com/en.neria/bauchi_weather_febuary).

### **Infrastructural Facilities**

The rural infrastructures, in the state include electrification, dam and agriculture facilities. Among the numerous dam in the state are Gubi dam, Kafin Madaki Adam, Tilden Fulani dam Kastinawa dam in Bauchi state . the rural electrification have been extended to several palace, while the Nepa plc national electrification a grid lines have extended to many settlement including the L.G.A and Head Quarters.

Bauchi state agriculture and rural development agency has provide several facilities including water borehole in many location in the state .the state agriculture and rural programs, organized in zone within the state has also led to the provision of various agricultural infrastructure. Numerous model farm centres have been established in various part of the state .both of the Hadeja, Jama”are river basin authority and upper Benue river authority have also provide some facilities.

### **Literature Review**

#### **Introduction**

This investigate is intended to develop mutual understanding and networking of electricity power distribution effective efficiently. Most of the power industry is expected to keep track of the electrical facilities (poles, circuits, location of heavy consumption of power, power lines, transformers and service environment) concerned in the distribution of energy to the end-users. With the aid of GIS, variety of information can be better organized on a computer system linking the database to query about service an output map.

GIS can be explain as combined sets of hardware, software, databases and processes deliberate the data collectively, Geospatial techniques is more easier to understand the Geospatial modeling and is one of the most recent technologies introduce to minimized the environmental issued for, load forecasting, cost estimation and selection of suitable areas.

Database which is the most important asset of an organization plays a central role in the operation of electric power, can be divided into two main various data types: spatial data that describe the location and the shape of geographic features and spatial relationship of map features. Attribute data known as descriptive information of the map features. The two most frequently used GIS

models of spatial data are raster and vector. Vector data are based on co-ordinating the system where geographic object is represented by points, lines and polygon. Vector data are more suitable for features that have discrete boundaries such as roads. Raster data consists of a regular grid of cells or pixels where each cell has an individual value that in the coordinate system the cell size indicates distance and geographical position of objects. **Dare-Alao Damilola (2015).**

The quality of electricity supply, measured in terms of outages and voltage fluctuation, varies considerably between countries but is rarely measured or described (**Steinbuks and Foster, 2010**). And is thus more difficult to analyze. The quality of Nigeria's electricity supply ranks 141 out of 148 countries in the World Economic Forum's Global Competitiveness Report 2013-2014, and 13 out of 129 countries for energy security in the World Energy Council's Energy Sustainability Index.

Electricity is an aspect of the utility sector that is very essential to the smooth and meaningful development of a society. The primary purpose of an electricity distribution system is to meet the customer's demand for energy after receiving the bulk electrical energy from transmission or sub transmission substation. Complexity of electrical distribution power system is the only reason for introducing new technologies such as RS and GIS technology. Database plays an important role in planning. There exists a relation between every spatial object and its non spatial database, for example, location of pole on earth is called spatial data and its height information is non spatial data. Satellite images are used in the identification of the spatial features. If an identity is not visible in satellite image then a GPS receiver can be used to establish its location **Kanmani B et al,(2014,).**

Each set of cells constitute a layer which called coverage and several thematic layers can logically constitute a complete database .The raster data model is the most suitable format for arithmetic operations among cells. A mathematical procedure called topology is used for representing spatial relationships among the objects. GIS software and hardware are used as tools for storing, analysing, interpreting, updating, displaying information, professional's designs and maintaining the system. **Dare-Alao Damilola (2015).**

This network has the function of transmitting power from the points of generation to the points of consumption. Complexity of electrical distribution power system is only a reason for introducing new technologies as GIS (Geographic Information System) and Remote Sensing technology that carries out complex power system analyses by interfacing these to other power system analysis software to plan, to design and to analyze electrical distribution network. **Professor, EED, IIT Roorkee et al (2008)**

the potential to revolutionize the reform process in areas like consumer indexing, distribution network mapping, asset and work management, enhancing billing and collection efficiency and managing consumer relationships. They also suggested that GIS can help to reduce losses and improve energy efficiency through its contribution in different areas of Distribution reforms **L. V. Truss ell (2001).**

Frequent power surge due to natural incidences It was been observed that in the study area electrical facilities are either obsolete or too old for efficient performance. Therefore, routine maintenance and replacement are necessary for efficient performance the electrical equipment in the study area. The threshold of each electrical facility should however be noted at installation and strictly adhered to during operational period. In advanced GIS, locating the facility and finding the exact fault wherein it has occurred could be substantiated by hand held palmtops.

The notified location on the spatial network wherein the fault has occurred could be easily identified and trained engineers could be alerted to go to the exact area and rectify the problem immediately. This showed that the major advantage of GIS in Electricity distribution network is the location component. The electricity distribution network map of the study area revealed the spatial distribution and locations of the electrical facilities within 11kV feeder in the area of interest.

#### **Dare-Alao Damilola (2015).**

The Information System will integrate the assets, drainage, roads related to power stations and controls on one platform. When all minor and major power generation, distribution and transmission projects will be on one platform, it will create a great help to the State Government. The information system will

also be helpful to decision makers, planners and disaster Management department to give their input in the field of optimum energy distribution, water distribution for irrigation and flood water management and rectification. **Rani A, Kumar R (2018).**

Let us assume that an engineer wants to know how many transformers are installed in a given locality. The software will quickly process his information need by taking the feeder network data and processing it within the buffer zone showing the locality of the engineer's interest and give him the results. At another time if he wants to assess the requirement of a cable to be laid along a certain road, the GIS will return him the results of processing considering even all the bends and turns the road may have. The cable length so shown by the GIS will be precise and will therefore help him procure the exact required Quantity of the cable. **Kumar Yadav (2013).**

Database plays an important role in the planning. There is a relation between every spatial object and its non spatial database, e.g. in a distribution system network the location of poles on the earth is the spatial data and the height of pole is non spatial data. Geographic Information System provides the facility to attach the non spatial database to the corresponding spatial data or geographic features. That database can be used by different software programs (interfaced with GIS software) which uses, stores, retrieves, modifies and perform analyses with data on the distribution network. Hence GIS keeps the data stored, works as a data analyzer with a visualization of area of interest. **Professor, EED, IIT Roorkee et al (2008).**

Consider that the same engineer now wants to know more complex information. He only wants to see on the map, which are the 100 KVA transformers in a given area that were installed prior to a given date. The query facilities of the software will quickly process this requirement of his, and show on the map only those transformers that qualify his requirement, hiding all other transformers that do not qualify it. **Kumar Yadav (2013).** The distribution system is important to an electrical utility because of its proximity to the ultimate customer and its high investment cost. The distribution system planning is necessary to fulfill the growing demand of electricity in an optimum way to make the techno-economic feasibility of the Distribution system expansion. The planning of electrical distribution networks is a continuous development

process for the customer point of view; increase in load demand and in Research and development. **Professor, EED, IIT Roorkee et al (2008).**

The solar radiation on the rooftop of each building was determined using the solar radiation tools in the arc tool box of Arc GIS. The thematic layers were finally integrated into Arc GIS software to estimate the regions that are prone to high solar radiation for the installation of Photo Voltaic panels. **Kanmani B et al, (2014).**

The distributions of electrical energy to end users in most urban area are faced with divers' spatial problems particularly with the use of analogue system. Based on this, this study seeks to use geospatial technique for effective management of electricity distribution. The study assesses the spatial relationship between power holding company of Nigeria (PHCN) assets and their customer's connectivity in the study area and makes decision on how to improve and manage electricity distribution. **Y. Adejoh1, et al, (2015).**

The problem of electric power station, they were responsible for distribution of electrical power from the points to another sorry to say they doesn't have any tool that shows the location of service, people that paid for service and those that not paid for the service for each and every individual house. GIS tools is the only solution to power industry Because, it has a package that capture the location of customer, no of electrical appliance used in house, full information of customer include his phone number for contact. That is the only a reason we emphasis the used of remote sensed data and GIS technique new technologies that help the industry understand the way to modify method of revenue generation.

### **Overview of Customary Land Dispute**

The growth of industrialized societies over the last three centuries has been strongly dependent on the ever increasing use of fossil fuels such as gas, oil, coal, hydroelectric power and more recently nuclear power. For example France, Belgium, Switzerland, Japan, United States of America and United Kingdom are called developed nations because they have advanced industrially and economically due to improved technology and steady power supply. **Issac A. Adeyemi and Joseph O. Folorunsho (2017).**



The database in the cause of this study supports an object-oriented vector data model. In this model, real world entities were represented as objects with their various properties, behavior and relationships. In GIS, database is often referred to as a spatial database or geo-database and it is the heart of GIS. This process involved the analysis and modeling of real world entities and their interrelationships in such a way that benefits were derived while utilizing minimum amount of data. Data were formally entered into their respective tables, created in Arc Catalogue, in the Arc Map environment. After the data entry process, the personal geo database was saved in Arc Map in a folder for easy recovery, geo spatial analysis and queries carried out on them. The data stored in the database forms the information base. **Dare-Alao Damilola (2015)**. Once the layers were digitized, the non-spatial data were then added as attributes to the digitized features. This attribute table was linked to the spatial themes containing geographic information. The database created included location and descriptive information for all the different components of the system. To estimate the areas in the study area that were of short comings in terms of the distribution and develop an estimation trend in the consumption of electricity, the following were operations carried out during the course of this study; overlay operations, spatial queries, proximity analysis and measurement of electricity consumption trend pattern. **Dare-Alao Damilola (2015)**.

Above all the greatest supremacy of GIS is visualization. The entire electrical network can be visualized as it's laid on the ground. Just by looking at the map and clicking at a particular feature (say a transformer), all the information (both location and engineering information) is displayed. This provides a more flexible understanding of the network and hence a faster approach to the solution. However, GIS are not only computer systems designed to produce maps, but also powerful **Dare-Alao Damilola (2015)**.

This study is meant to improve the understanding and networking of electricity power distribution towards effective power distribution. Most importantly, the power industry is expected to keep track of the electrical facilities (poles, circuits, power lines and transformers) involved in the distribution of energy to the end-users. With the aid of GIS, variety of information can be better organised on a computer system linking the database to an output map. **Emengini, E. J. (2004)**.

Noted that knowledge about physical assets of the enterprise is necessary to make strategic and operation decisions. Therefore, to take wise decisions vital to the operations, growth and management of electricity distribution facilities, information must be collected and analysed to its full extent, such information contributes not only to efficient services, but also to the operation and maintenance of assets, and to the sensible planning of extensions and new works. This information helps in spatial decision making and it makes the information easily updateable and can cater for the needs of maintaining large power infrastructure. GIS can effectively be used to manage and monitor information on the distribution of electricity to end-users including information describing their spatial and non-spatial attributes such as geographical location and electricity use. **Dare-Alao Damilola (2015).**

In recognition of the consolidating linkage between the energy sector and the other sectors of the economy, electricity development and utilization therefore have pervasive impacts on a range of socio-economic activities and consequently on the economic progressiveness and wellbeing of citizens of the country. **Issac A. Adeyemi and Joseph O. Folorunsho (2017).**

GIS tool to improve electricity distribution in Nigeria. There is a need for greater awareness to be created at all level of government of the need and what is required to establish GIS. Briefing, training and re-training sessions among staff of PHCN and other municipal authorities in GIS is also needed. **Ihiabe Y. Adejoh1, et al (2015).**

The use of GIS in power system has greatly enhanced the efficiency in energy sector. Proximity to the furthest customer and high cost to invest capital, are the reasons that make the distribution system as an important part of electrical utility, which Endeavour to improve the reliability of general power system. The power industry is expected to keep track of the electrical facilities (poles, power lines and transformers) involved in the distribution of energy to the end-users. With the aid of GIS, variety of information can be better organized on a computer system linking the database to an output map. **Kanmani B et al,(2014).**

Conceptual model of a GIS provides a useful way to visualize it as a set of map layers or themes, all registered together to a common map base or geographic area. In the last few decades, the electric power industries have been developing

power transmission systems to follow up with the rapid growth of the power demand. On the other hand, the suitable site for new transmission lines has been getting restricted, because of development of rural areas and the growing concern over environmental issues. Power Industry consequently has to keep track of numerous poles, circuits, power lines, and transformers. Information of location **Surendra Kumar Yadav (2013)**.

Although the needs and uses of GIS are slightly different in the power sector than other industries, GIS can be just as valuable an information technology in the electric utility industry. In automated mapping (AM), this facility helps the utilities to quickly create digital maps of their supply area using the digitization facilities of the software. These maps when so digitized contain detailed information about the land serviced by the utility, and the precise location and engineering information of the distribution network equipment of the utility that are installed in the field. In facilities management (FM), the digitized map files that are so created with all the required intelligence built into them can now be used to satisfy the facilities management needs. So, GIS in the field of electric power is used for the study and analysis for electrical distribution system, analysis and design, applications are also being developed for tackling problem of designing the electrical supply system **Surendra Kumar Yadav (2013)**.

GIS play important role in information retrieval aspects. The maps created by using AM facilities can be made as intelligent as one can imagine. For example, if an engineer needs to know the date of installation of a given transformer, all that he has to do is to click onto that transformer symbol. The attributes attached to this transformer will appear in which one of the attributes will show him the installation date. **Surendra Kumar Yadav (2013)**.

Utility services are an important component of the physical structure of towns and there is a need for detailed information about the location and condition of their infrastructure, Acquiring data in the conventional way is time consuming and costly. The integration of GIS with electric utilities is tremendously improving the planning and operation of the system. GIS and GPS are also integrated for mapping and analysis of electric distribution system **Kanmani B et al, (2014)**.

Voltage fluctuations are defined as repetitive or random variations in the magnitude of the supply voltage. The magnitudes of these variations do not

usually exceed 10% of the nominal supply voltage. The characteristics of voltage fluctuations depend on the load type and size and the power system capacity. However, some appliances and equipment require stable incoming voltage for them to perform accurately. Lamp flicker occurs when the intensity of the light from a lamp varies due to changes in the magnitude of the supply voltage. This changing intensity can create annoyance to the human eye. Susceptibility to irritation from lamp flicker will be different for each individual. **Issac A. Adeyemi and Joseph O. Folorunsho (2017)**

Voltage fluctuations may also cause spurious tripping of relays; interfere with communication equipment; and trip out electronic equipment. Severe fluctuations in some cases may not allow other loads to be started due to the reduction in the supply voltage. Additionally, induction motors that operate at maximum torque may stall if voltage fluctuations are of significant magnitude. **Issac A. Adeyemi and Joseph O. Folorunsho (2017).**

GIS allows for creating, maintaining, and querying of electrical database to generate information, with an added capability to analyze spatial data, through attribute and location analysis or spatial modeling. User can query any layer of the GIS map to get the attribute data for a particular feature of that layer. User has to click on any feature of a particular layer to get the attribute of that feature as indicated in table 5 and figure 9. GIS can be used to monitor power loss as a result of metering inaccuracy in the distribution sector by knowing the total number of customers using prepaid meter and those using post paid meter as well as those that their energy are not metered at all by the use of query. This system provides timely, accurate and easier way of acquiring information, which is very vital in taking prompt and accurate decisions. **Ihiabe Y. Adejoh1, et al (2015).**

The introduction of remote sensed data and GIS technique use in electric utilities is very important during planning of electrical decision making. Geographical information system techniques with assist of GPS are used for mapping of electrical poles, electrical transformer and analysis of electric distribution for each environment, The present of this paper, it's trying to shows the impact of remote sensed data and geographical information system play a significant role in electrical networking system, especially during electrical expansion and proposed for new generation.

The application Geographical information service will help electrical industry to find out the total number of electric line, area that has electric service, area that need electrical service, area that has problem with electrical service, area that has heavy machine, location of industry that need reliable power and total area cover with the electrical service. We need to highlight power industries the importance GIS is over emphasis in utility management and also we need to give confidence electrical industry to establish the GIS centre for each and every state and take GIS personal that will train the rest staff to handle the utility management and operation effectively efficiently.

### **Theoretical Framework**

As power supply through the Power Holding Company of Nigeria (formerly, National Electric Power Authority) has proved very unreliable. It has become imperative for most industrial or commercial establishments or even individual consumers to acquire diesel standby generating plants at exorbitant costs. Besides, the hazards of diesel fumes to the environment, the situation has contributed significantly to increase in production costs in a highly depressed economy. **Issac A. Adeyemi and Joseph O. Folorunsho (2017).**

In this regard, adequate supply and distribution of electricity constitute a central development issue which cannot be over-emphasized. Apart from serving as the pillar of wealth creation in Nigeria, it is also the nucleus of operations and subsequently the engine of growth for all sectors of the economy (**Ayodele, 2001**). **Ayodele, A.S. (2001).**

This study was carried out to analyse the quality of Public Electricity supply in Kaduna South Local Government Area, Kaduna State, Nigeria. Descriptive statistics were used to analyse the quality of public electricity supply. The result of the study has clearly confirmed the epileptic electric power supply in Kaduna South and this has adversely affected every sector of the economy of the study area. Also, the study has identified that irregular supply of electricity has created an additional strain on the financial burden of the households in the study area as most respondents' uses generators which are usually more expensive to maintain as opposed to direct power supply from distribution companies. **Issac A. Adeyemi and Joseph O. Folorunsho (2017).**

On the other hand, developing countries like Bangladesh, South Africa, Botswana, Philippines and Nigeria have been struggling with power supply which is a major driver of industrial advancement (GEI, 2014).

The use of electricity as a tool for socio-economic development of the nation cannot be overemphasized. Hence, there is a need to keep a comprehensive and accurate inventory of their physical assets, spatial location, both as part of normal service provision, extending the network and undertaking maintenance by the use of geospatial technique (Geographic Information System). GIS as an emerging technology is a software application, used to create and display cartographic information. In practice, however, GIS consists of five Components: software, data, procedures, hardware, and people. These five components work together to capture, store, retrieve, analyze, and display geographically referenced information. It has an added capability to analyze spatial data, through attribute and location analysis or spatial modeling. **Ihiabe Y. Adejoh1, et al (2015).**

High spatial resolution Satellite image was acquired and integrated into GIS environment whereby thematic layers such as buildings and road network were extracted and represented in form of polygons and lines, also service lines and customer connection point were digitized. A personal geo data base was involved with dataset projected using coordinate system WGS 1984 UTM zone 31N. The personal geo database contains features named as building, roads, consumer points and service lines. The area of interest was delineated from the satellite image and subsequently used to subset others thematic layers. The coordinate point of the transformer and low tension poles acquired with the hand-held GPS, and customers records were linked together and captured into the geo database using add x. y coordinate in Arc Map environment. Electricity Distribution network map and data was created which shows the spatial location of the transformer, low tension poles, as well as the spatial relationship between all PHCN asset and customer's connectivity to the station. **Ihiabe Y. Adejoh1, etal (2015).**

With the contribution of Geographical information system will solve a lot of environmental problem. Because GIS is software, it has tools for capturing, data, data analyzing and query through attribute table, interpretation of data, updating, displaying information, maintenances, and professional's designs and

control the system. we try to introduce the important of GIS in Utilities management worldwide, is more easier to manage utility problem, GIS it has facility to shows the location of millions of area of interest, overhead and underground circuits. GIS should have ability to map the utility's assets can be linked directly to your customer information system, Geographical information system allowing power industry select best possible way to make a reliable revenue generation through techno-economic. **Ihiabe Y. Adejoh1, et al (2015)**. It is the talk that Information Technology has come to stay in the 21st century, though it has been in existence for long but little cognizance was paid to it. The aspect of the Information Technology that is saddled with the usage of Computer wares to solve spatial problem is refer to as Geo-Information and Communication technology (Geo-ICT) or Geographic Information System (GIS). GIS is the computerized tools for capturing, storage, checking, integrating, manipulating, analyzing and displaying of geo-information. Electricity distribution is the process of transporting electrical energy from the transmission point to the end users points. **Olaniyi Saheed etal (2006)**.

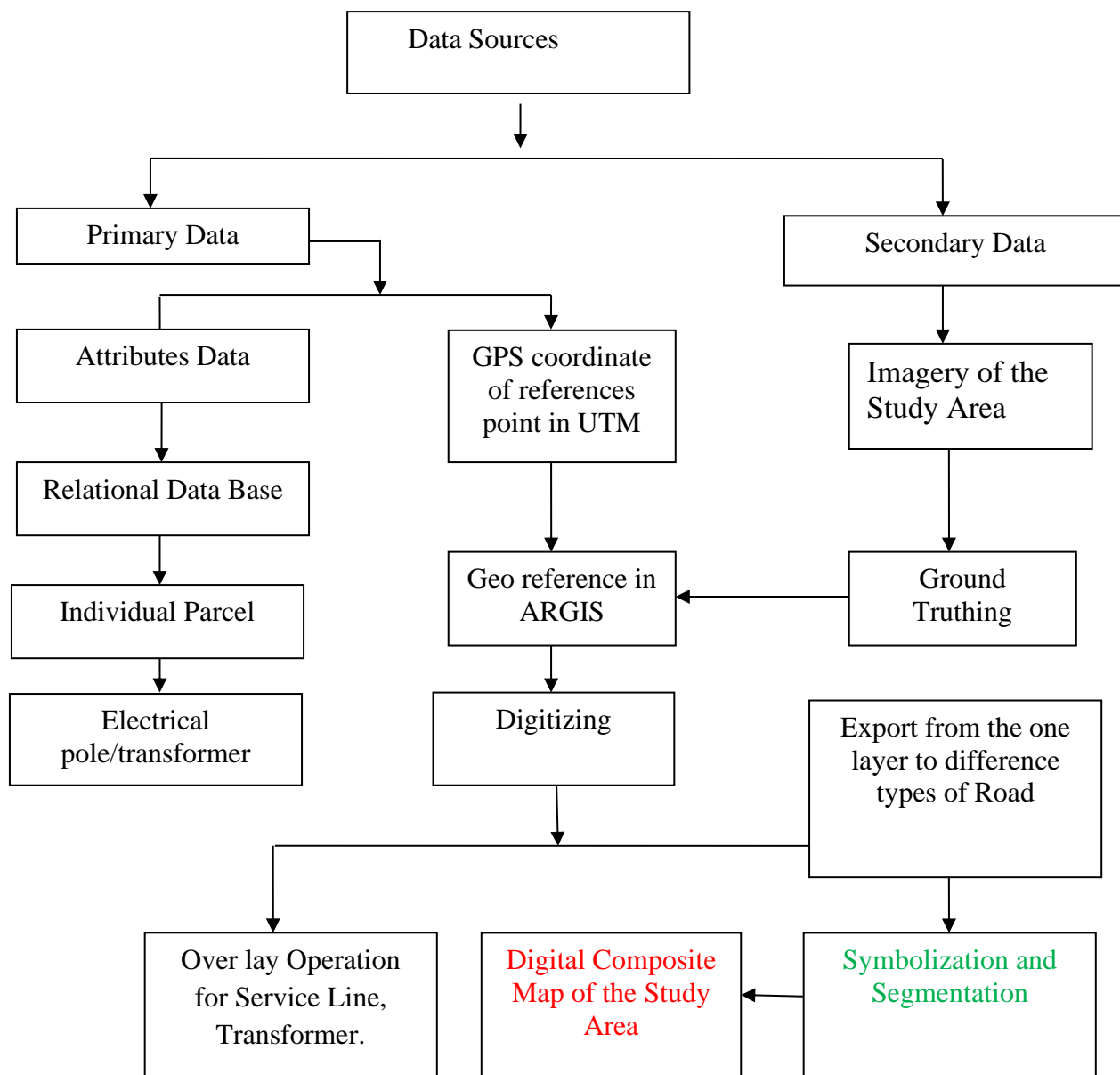
Electricity is an essential part of our everyday lives that we often take for granted. We take it for granted, that is, until we have to do without power for one reason or another. We don't often actually see them, but behind the scenes many people are working to ensure that we have a clean, safe, reliable source of power; that we don't have unpredictable or inappropriate current to power our infinite variety of devices; and that the supply is there when we need it; and that it is, more or less, reasonably priced. The evolution of Geo-ICT has revolution a lized the utility industries. **Olaniyi Saheed etal (2006)**.

Nigeria is not left out in the race of ICT, so also is Geo-ICT. Power Holding Company of Nigeria, Plc is one of the vibrant utility industries in the West Africa with over five (5) million subscribers. The ever increasing numbers of subscribers to the services of electricity call for the re-engineering of the electricity distribution strategy using the appropriate technology – GIS **Olaniyi Saheed etal (2006)**.

### **Methodology**

The methodology here is referring to the systematic approach taken to accomplish the stated aim and objectives of the entire research work. It involves

the sequential order or procedure in execute Electricity Distribution System of Tambari housing state Bauchi metropolitan Bauchi state.



**Figure 1: flow chart of methodology**



### Data Acquisition, software and hardware used

The data used in this study, Bauchi Metropolis imagery dated April, 2013 which was from Bauchi geographical information system with 500mm spatial resolution based on WGS84, zone 32N spatial reference grid. The positions of some prominent places were captured with handheld GPS receiver; the northing and easting of some distinct locations on the image were also captured for georeferencing purpose. Names of street and locations of each and every individual end-user building were Vectorise from imagery of the study area collected from the Bauchi ministry of land housing. A Handheld GPS receiver version 75x was used for navigation and capturing the locations some points. Arc GIS versions 10.4.1 were used for map making and Microsoft accessories such as office and excel was used for reporting and database conversion.

**Table 1: GPS Coordinates of Some Prominent Points in UTM.**

S/N	Points	Easting(m)	Northing(m)	Accuracy(m)
1	Main Gate State Polytechnic Bauchi	584570	112211	±2
2	Tambari sign board for Main Gate Along Jos Road	583213	112216	±3
3	Tambari village Bau	583230	112380	±4
4	Bauchi government house	582102	112721	±3
5	Tambari bridge	582313	112884	±2

The positions of some prominent places were captured with handheld GPS receiver; the northing and easting of some distinct locations on the image were also captured for georeferencing purpose.

### Georeferencing

During the process of geo-referencing, a total Remote sensed data error of 3.137m was achieved comparing the source points with the destination control point. The average displacement of hand-held GPS track logs off the digitization polygon, center lines of road is estimated at 10m. This suggests that the track logs themselves were likely in error; recognizing the fact that

code-based receivers are susceptible to errors of about 5 to 10 meters. The positional accuracies of details shown on this layout and street guide are within 5 to 10 meters since the hand-held receivers were used in capturing their spatial locations. This is however negligible since the intended purpose is to guide navigation.

### **Mapping**

Immediately after georeferencing, three types of layers were created in the Arc Catalog namely, points layer for digitizing the location of scattered features, such as prominent structure, line layer for representing some linear features such as road, water canal etc, and polygon layer for digitizing homogeneous features respectively. These layers were used to digitizing the location of roads, markets, water bodies' schools etc, from the Image. After digitizing, the digitized features were represented with their respective conventional symbols. Map element that are related to the data were added such North arrow, Legend, Scale, Grid, Title etc

### **Ground -Truthing / Field Completion**

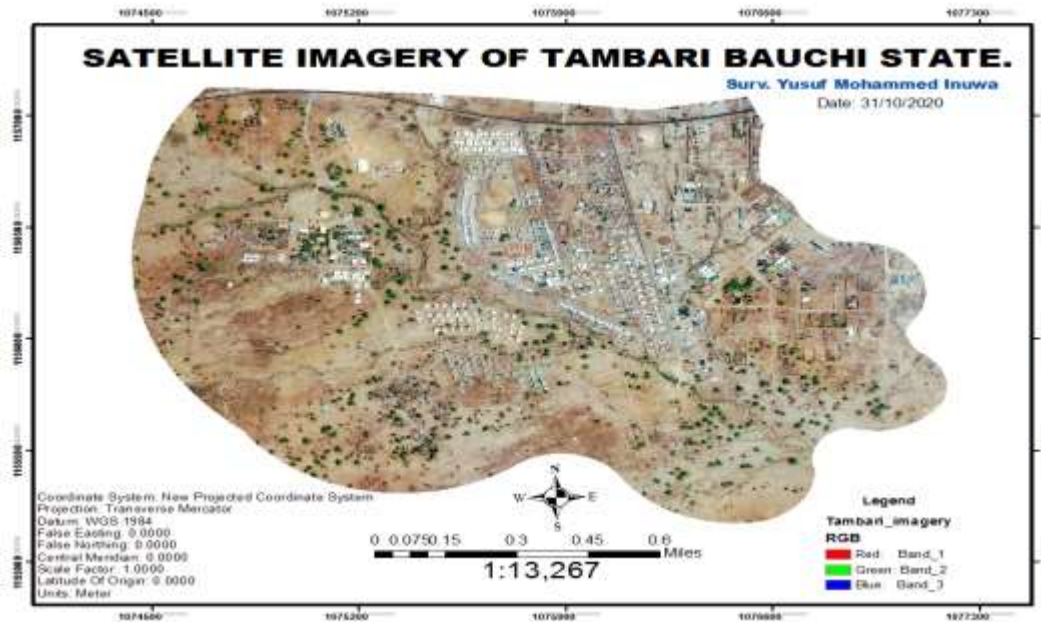
At this stage, the electrical layout map was printed and taken to the field for assessment; missing details were immediately included, where blunders existed, they were also corrected.

### **Generation of digital Composite Map**

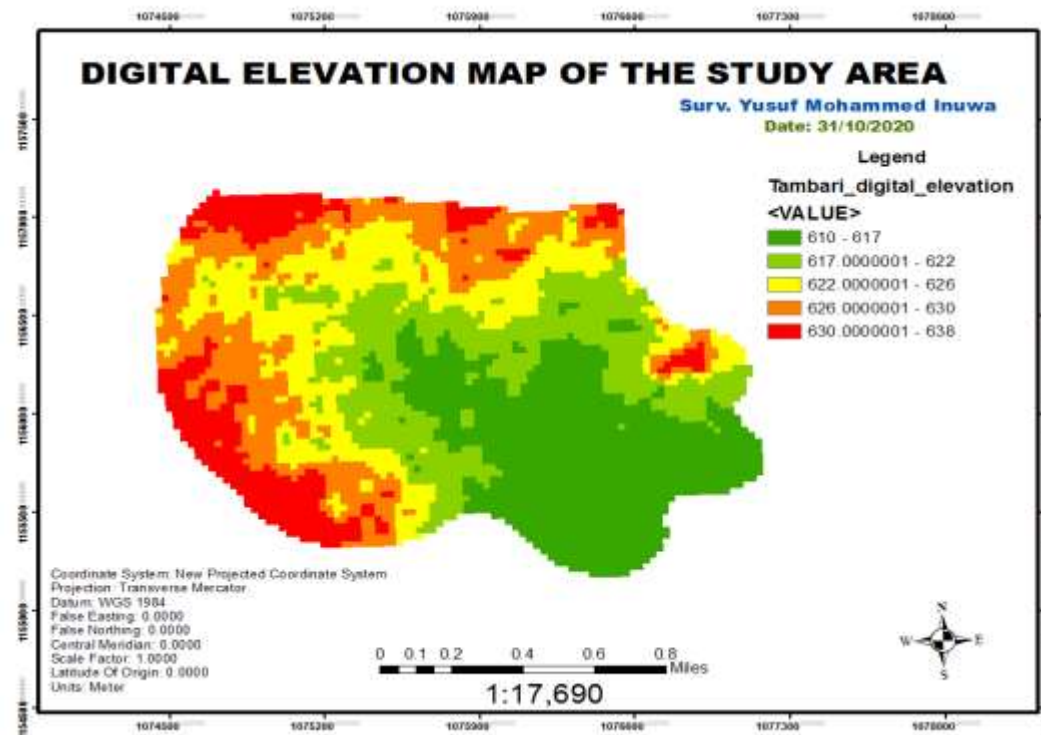
The digital composite map of the study area was generated by overlaying the individual building and electrical poles in the arc map environment after which grids; names of street, information of each and every individual end-user house been updated and appropriate annotation were added to give it a cartographic outlook.

### **Presentation and Analysis of Result**

Collection of Geometric and Attribute Data of Study Area Looking back at the objectives of the study, it will be seen that the first one is to create a digital composite map of electricity distribution network map that shows the spatial location of end-user. This objective has been achieved as can see in the table below.

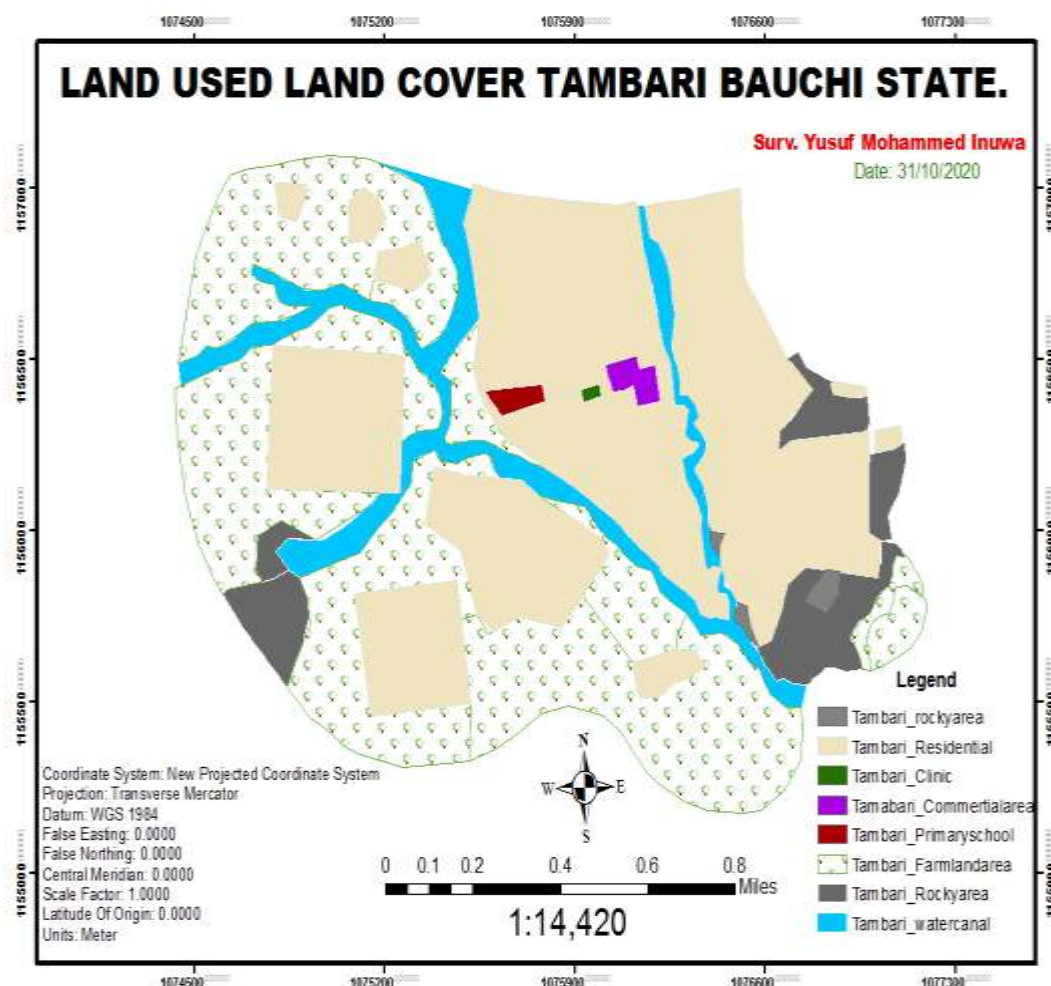


**Figure: 1** Imagery of the study area  
Imagery of the study area Tambari Housing Estate along Jos road Bauchi, Bauchi state



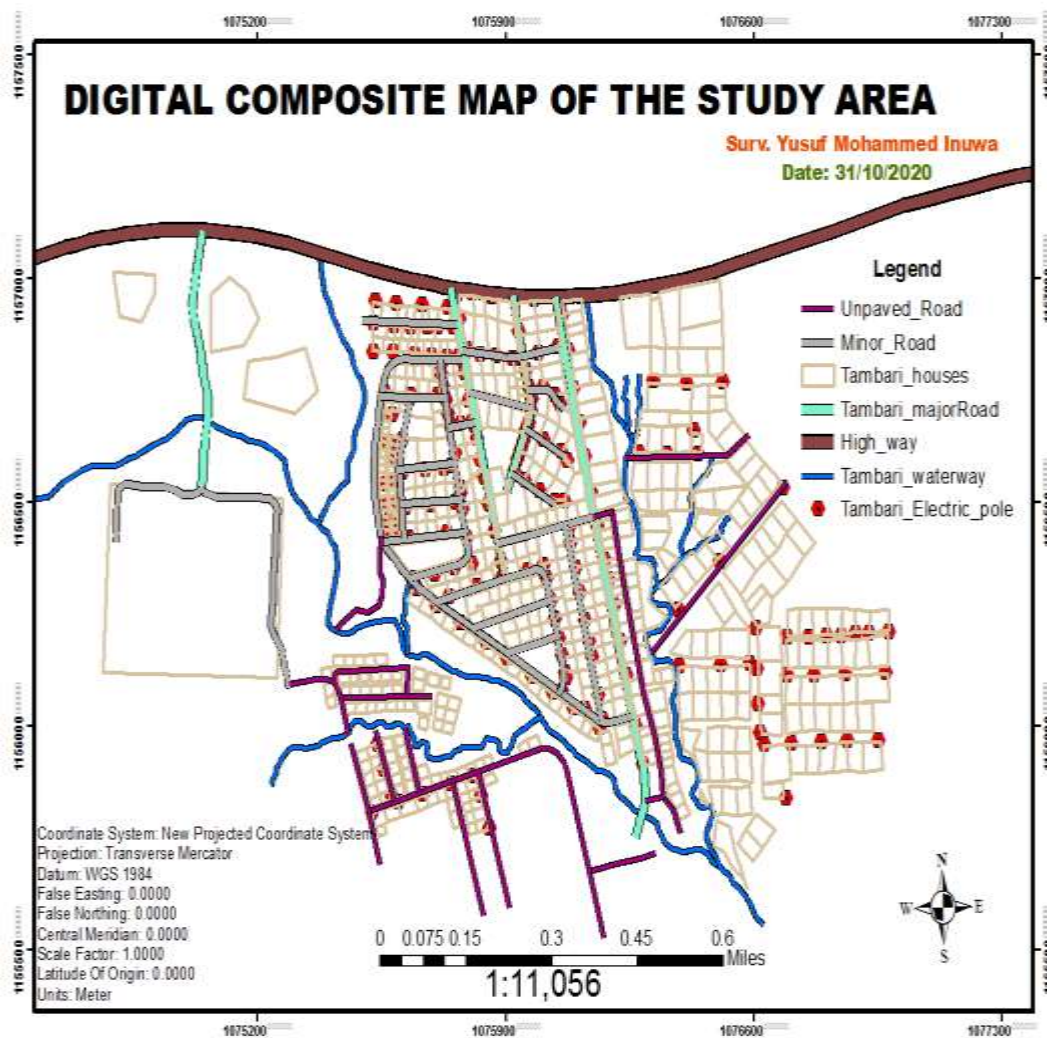
**Figure : 2** Digital elevation of the study area

Digital elevation of the study area Tambari Housing Estate along Jos road Bauchi, Bauchi state .DEM image downloaded from earth explore we were used to prepare slope map after georeferencing and clipping our location of the study area using Arc GIS software.



**Figure: 3** Land used land cover change of the study area

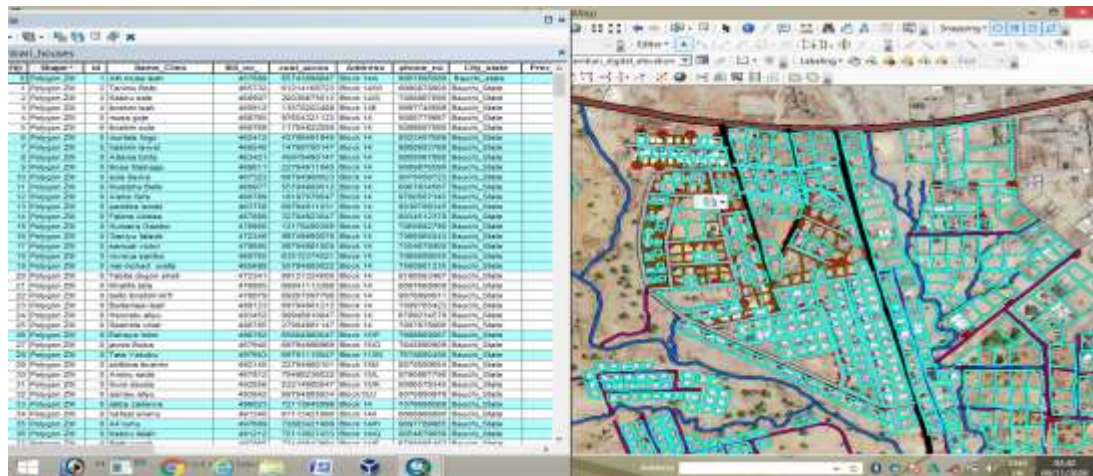
Land used land cover change of the study area Tambari Housing Estate along Jos road Bauchi, Bauchi state .Land use includes agricultural land, built up land, recreation area,. The Land cover reflects the biophysical state of the earth's surface and immediate subsurface, therefore implementation the soil material, vegetation, residential area, commercial area, industrial area and agricultural land and water. Land use refers to man's activities on land which are directly related to the land.



**Figure: 4** the digital electrical composite map that show the position of electrical pole, location of end-user house, street guide map, and water ways within the study area.

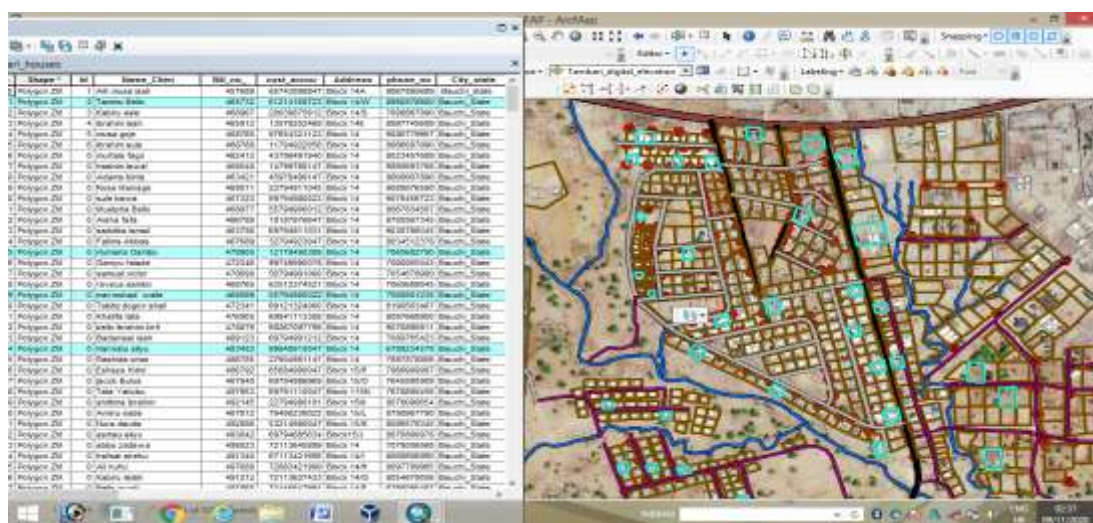
There were approximately 500 buildings in the study area. ArcGIS10 is used for vector layer generation, maintaining of database and layout preparation. The imagery of study area from Bauchi ministry of land and housing, Land use/land cover map has been created for the study Area. Secondary data are collected through house inspection for each and every individual house by field survey ad stored in database

The second objectives of the study are to shows the location of end-user that paid the electrical service or not within the study area with the respect of month. This objective has been satisfactorily fulfilled as can see in Figure below.



**Figure 5:** the Geo-database shows almost who has paid the electrical service. The query within the geo-database shows almost 98% of the end-user has paid the electrical service. Therefore, the management team of the electrical service they should have more orientation about the location, understand the nature of end-user and document properly those that paid the service and concentrate with rest end-user that not paid.

The third objectives of the study are, at this stage, to shows the location of end-user those that use the heavy electrical appliance for more electrical consumptions within the study area. This objective has been satisfactorily fulfilled.



**Figure 6:** the location of end-user house that use the heavy electrical appliance

The query through geo-database has shows the impact of GIS techniques by showing the end-user house which they use the heavy electrical appliance, while the electrical management will not have access to capture their house. The GIS has ability to capture the information of each and every individual and linked information to geo-data base whenever there is problem the database would be identified the problem respectively.

The fourth objectives of the study to design to design a map that will show the entity relationship between end-user and geo-database. This objective has been satisfactorily fulfilled as can see in Figure below.

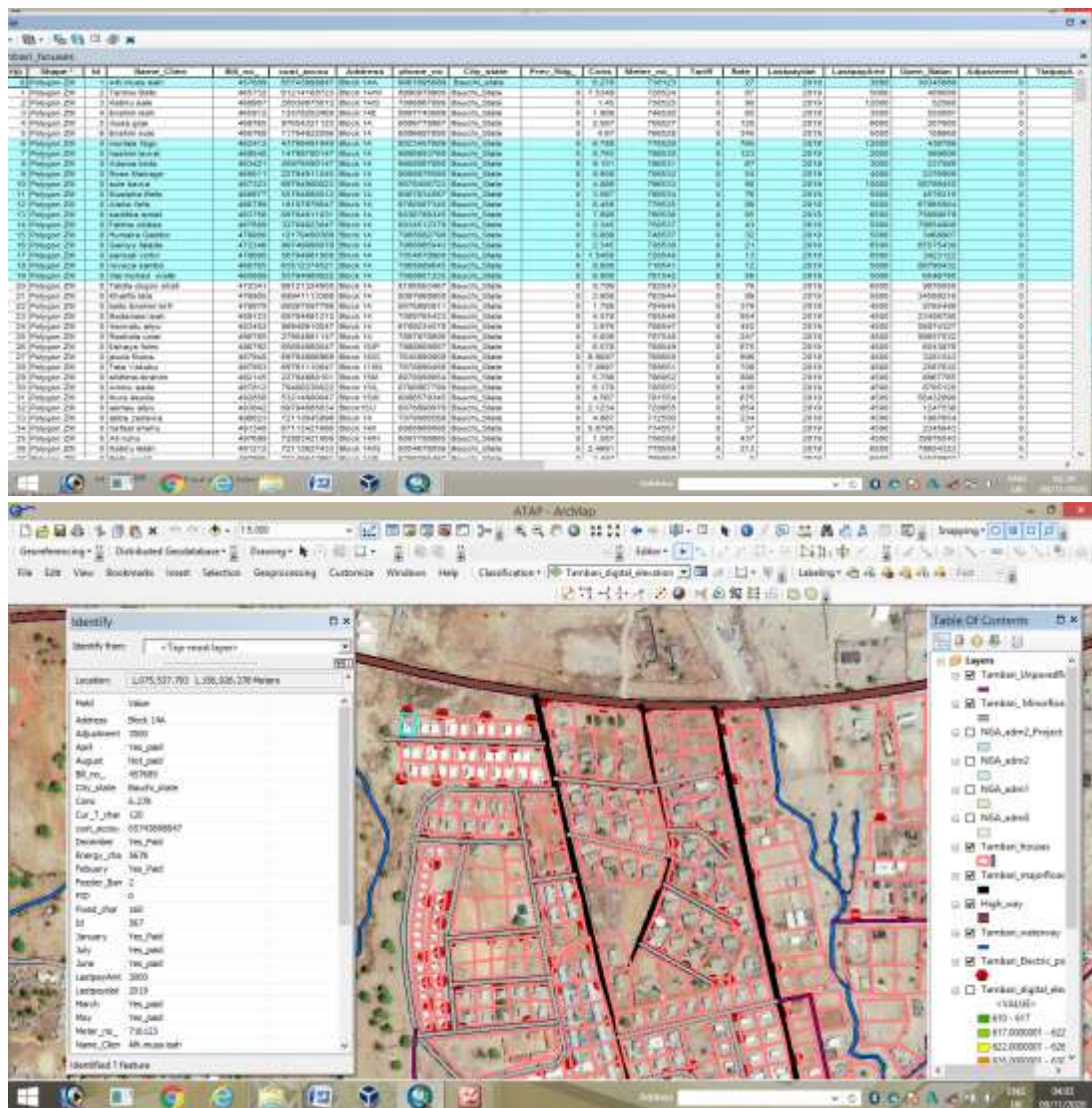


Figure 7: the GIS techniques display the information for each house.

The query shows the impact of GIS in electrical industry should have access to document the profile of each and every individual house when need arise the GIS techniques will display the information respectively.

The importance of a digital composite electrical map is less expensive, handy portable, and allows for unlimited sharing of information of the soft copy, the digital electrical composite map be denounce the risk of being destroyed by termites, bad handling or hiding by greedy and selfish individuals, etc. Form this map mono thematic map can be produced at any required scale very quickly and cheaply and affordable. Therefore, the map will served as a tool for proper and effective of electrical payment as well as electrical utility management and development within the area. The grid lines will make it possible to compute bearing and distance between any points or feature on the map and another point or features outside the map (if the UTM Coordinates of that point or feature are known the map is available in soft and hard copies for future reference and update.

### **Queries by Attributes**

The most basic of all tools provide in geographical information system are those related to database query. Queries are specific question asked what is where and (what the distribution of a phenomena over time is) and answers provided through manipulation and processing of the spatial database of the link between the graphic (geometric) data and attributes information which must be acceptable to the implementing software (Arc GIS) using the query builder already predefined in the database from the arc map.

### **Summary, Conclusion and Recommendations**

#### **Summary**

It's high time that surveyors should consider and understand don't engage their self totality on practical aspect surveying doing four corner job, they should retire for nothing. is better to diversifying their self in to management aspect of surveying geo-informatics profession such as Geographical information system, Spatial analysis and also form association with other professionals such ICT expert and networkers for handling a billionaire projects of establishing GIS office across the country instead of allowing the profitable jobs to non-surveyors that deliver a work for surveyor to come and adjust Their efforts will



serve a dual purpose; examination and commercial products credited to the survey community, The study shows how computer technology has come to play a vital role in modifying the tedious and manual method of utility management.

Since the division network of a power utility have a geographical reference, it is useful to create the network on GIS map and regularly update the same as per field parameters. With periodic updating and monitoring, GIS mapping of the Electrical Network and Consumer database helps in improved planning, load management, loss reduction, better revenue realization, asset and management standard of the distribution network and possibly better consumer relationship. GIS technology helps in fast, accurate and reliable data management, provides timely, accurate and easier.

The technique and the general procedures for digital composite of electrical mapping and spatial database design and creation have been fully demonstrated in the study. The study proves that digital survey equipment in conjunction with geographic information system (GIS) software can be a good and sufficient tool for managing environment and land resources because of their easy simple and automatic operation as well as their ability to captured large amount of data in a short period of time.

### **Conclusions**

the fundamental nature the study, has achieved its objectives with full information of digital electrical composite mapping and shows the relationship between end-user different between high way, major road, minor road, water canal and some prominent area etc. Then, this information is properly managed and supported with the right decision and implementation would go a long way in addressing the problem highlighted earlier in the study. benefit of this digital composite map are noticeable in increased catchment areas for services and facilities like shops, schools, offices, banks, and leisure activities. Access to unpaved roads provides relative advantages resultant upon which Commercial users located to enjoy the advantages.

Improving the performance of distribution systems to meet the required target is a matter of selecting the most effective and appropriate technology with right operating practices. It is not sufficient to analyze how a particular portion of the

network may be modified to improve its performance today, rather in determining the optimal solution based on future demand scenario.

The meth of acquiring information, which are very vital in taking prompt and accurate decisions necessary in electricity distribution network, GIS principal task is to model "real world", perform spatial analyses and ensure high accuracy of optimization procedure. This help to carry out different analysis like, load analysis, location analysis, and problem identification analysis, also to find the average distributed power and utilized power. With this, the growing demand for electricity with growing rates and high densities can be satisfied in an optimum ways. This study has demonstrated that geographic information system (GIS) can be used as a decision making

we have understand that Modern businesses, industries, trades and general activities depend on power supply and power infrastructure, with becoming very important and indivisible aspects of global and urban economic survival. Developments of various power station modes have become important to physical and economic developments. Such modes include human porter age, introduction of new modern transformer, reliable electrical poles urban locations with such relative advantage are found where different method of utility management converge with high degree of compactness, connectivity, density, length and accessibility exhibited within the intra- and inter- urban electric networks.

### **Recommendations**

This research has no doubt uncovers the current condition of most land and survey ministries, agencies, organizations, etc in terms of their non adoption and implementation of (GIS) techniques that will help in collecting and managing spatial and non spatial information.

Therefore, it's recommended that the bodies concerned should adopt the current trend in order to rescue the large amount of valuable hard copy maps, plans and other related data that are slowly decaying and eating away by the insect. The study stops only at designing digital composite map of the study area.

Also, it is at always easier for a change to manifest if decision and directives comes from the top to the bottom rather than the other way round. Therefore, in order to have a change from analogue to digital system in the ministries,

agencies, organization should adopt the new modern research tool GIS technique is easier to deals with all outdated map record such as.

- (i) The electrical distribution system should be embraced as it assures dimensional stability of storage medium, eliminates loss of data or detail by transfers from one medium to the other and maintains positional accuracy since the data are help in numerical form.
- (ii) Remote sensed data and GIS centre should be established at each and every individual tertiary institute, military centre and paramilitary department, so that to handle the responsibility of coordinating and managing related information, controlling electrical utility and management.
- (iii) Government should make it a condition or requirement for the appointment of the heads of these ministries, agencies, transportations system, community agency and organization etc. knowledge of remote sensed data and GIS or any relevant field.
- (iv) We try to highlight the important of GIS technique and engage their self for GIS training in order to provide solution of environmental problem, because GIS is bedrock of any sustainable development.
- (v) It will help the student during the research project because the GIS are the key of any sustainable project. That shows where, that are the location and when, that is time that problem happen and typical view of study area with full detail of natural and artificial feature of the area. From the above it is evidently clear that electrical mapping network density in Bauchi metropolis is very high, well connected and evenly distributed with a high corresponding spatial mobility index.

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### **List of Figures**

**Figure: 1.** imagery of the study area.

**Figure: 2.** Digital elevation of the study area.

**Figure: 3.** Land used land cover change of the study area.

**Figure: 4.** the digital electrical composite map that show the position of electrical pole, location of end-user house, street guide map, and water ways within the study area.

**Figure : 5.** the Geo-database shows almost who has paid the electrical service.

**Figure: 6.**the location of end-user house that use the heavy electrical appliance.

**Figure: 7.** the GIS techniques display the information for each house.

The query shows the impact of GIS in electrical industry should have access to document the profile of each and every individual house when need arise the GIS techniques will display the information respectively.

### **List of Table**

**Table 1:** GPS Coordinates of Some Prominent Points in UTM. \_