iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** X **Month of publication:** October 2017

DOI: http://doi.org/10.22214/ijraset.2017.10138

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue X, October 2017- Available at www.ijraset.com

Spatial Distribution of Public Potable Water Facilities Using GIS Technique in Misau Town, Bauchi State. Nigeria.

Mustapha Saleh Maina [1], Adamu Ahmad Haji [2]
[1]*Fderal university gashua, Nigeria,*
[2]*Bindigari constructions Nigeria*

Abstract: ***In an attempt to achieve the target for the Millennium Development Goals (MDGs) in respect of reducing halve the population without access to safe drinking water, developing countries require extra efforts to achieve this target. Misau town is an area that has inadequate pipe borne water supply due to breaking down of engines that pump the water and problems due to power supply (electricity). Other reliable sources of water are boreholes and well which also have the same problem due to improper construction and location. However, the geology of the area is a basement complex; as such the ground water is very deep.This paper presents an overview of GIS application to analyze the spatial distribution of public potable waterfacilities and to provide effective planning and distribution of water supply network. Thisstudy examine the spatial distribution of public potable water supply sources in Misau town with the intention of mapping out the supplying network, extension of the location of new facilities, depicts the pattern of the supply and analyze the area with high and low concentration and distributions of water facilities. In 2002 study was conducted by Ishaku Hamza (Geography Department Bayero University Kano) to analyze water supply problems in Misau Town and hence suggestions were made. However, there was little or no improvement in the distribution of public potable water in Misau Town. However the study shows thatIncrease in population and rapid expansion of Town are factors that result to inadequate supply and distribution of public potable water facilities in Misau Town, Bauchi State.***

I. INTRODUCTION

Water is a critical resource. As human populations increase, careful management of our water supplies becomes ever more important, both to satisfy human needs and to protect the environments of other species. In Nigeria, availability of water controls the spatial distribution of populationsand Settlements, modern water supply networks are usually those situated along the major trade and transportation networks. All improved water supply in Nigeria is from public water supplies (Oyebande 2005).

However, the pattern of water supply varies from one settlement to another, generally as the population of a settlement increases, the service efficiency to the expanding population will decreases. This usually creates the disparity in supply of water to different areas of the settlement. Access to clean water is a growing political issue around the world.In 1977, basic survival needs were stressed at the Mar del Plata conference, a major international effort to address world water problems organized by the United Nations. The issue of the right to basic water need was illustrated by the statement that “All people have the right to access drinking water in quantity and quality equal to their basic needs”. As world population grow, the societies are challenged to provide clean water sanitation services of significant concern in meeting basic human and ecological needs for water, vital for survival and good health. Many societies struggle to allocate sufficient resources to meet those needs for all of their people.

Access to safe and reliable supply and distribution of public potable water facilities is a major challenge in many communities in Nigeria. Human survival can be threatened not only by weapon, disease or starvation but also by lack of water. However the countries most recognize water as fundamental human rights. Hence, Water makes life possible as without it, life and civilization cannot develop or survive for human and economic development.

GIS is a general-purpose technology for handling geographic data in digital form. Its abilities include: preprocessing data into a form suitable for analysis, supporting spatial analysis and modeling directly, and postprocessing results (Goodchild, 1993). GISs offer a spatial representation of water resource systems.

Application of Geographical information system (GIS) in this study area provides a framework that will identify different types of water facilities in existence, Produce large scale facility map that will show the locations and distribution potable water facilities and to provide information that will help in improving the water facilities in Misau Town area of Bauchi State.

A. Aim And Objectives

The aim of this research is to analyze the spatial distribution of public potable water facilities using GIS technique in Misau Town, Bauchi State. Nigeria. The objectives of this research are:

1) Production of large scale map of Misau showing water supply network and water facilities.
2) Provide effective planning development and operation of water supply and distribution network in Misau Town.
3) To determine the coordinate location of water facilities in Misau Town.
4) To show the Spatial distribution and number of functional and nun functional water sources.
5) To provide map showing spatial distribution of water sources such as Boreholes, Wells and Tap.
6) To Geo-reference the image of the study area.
7) Creation of map and linking the spatial data with its attribute information.
8) Acquisition of Spatial Data through Field Survey and attribute data obtain in the office.
9) Presentation of information (Maps& Reports).

II. LITERATURE REVIEW

For a country with high population to have access to save drinking water, extra effort is required by both the government at various levels, and private organizations. Earth's water resources, including rivers, lakes, oceans, and underground aquifers, are under stress in many regions. Humans need water for drinking, sanitation, agriculture, and industry; and contaminated water can spread illnesses and disease vectors, so clean water is both an environmental and a public health issue. It is consequent upon this that the Millennium Development Goals calls for halving the population without access to safe drinking water by 2015. In Nigeria where only 45 percent of the population has access to safe drinking water according to Water Aids International (World Bank Group, 2011).

The Federal Ministry of Water Resources in Nigeria recently call on the private sector to partner government in the provision of potable water call (GABOMOH, 2012). Its particular interest rests on the inability of the existing private participation policy to solve problems of potable water provision in Nigeria.

Khar et al 2010 agreed that GIS base map through the application of its features is very good for analysis of potable water in order to delineate the areas within the metropolis that are served, under-served and unserved by the water cooperation G.C Ofoegbune, A.O Erualo, J.A Awomeso and O.A Idowu et al, 2010 used hand held GPS in collecting data on the geographical location or position as well as elevation of the various facilities of the water corporation including reservoirs, pumping stations and the water distribution pipelines at Abeokuta. However, in their study, a topographic map at a scale of 1:50,000, water distribution facility map of Abeokuta (1998) of a scale of 1:1250000 and population of estimate from federal office of statistics of about 593,140 people (2005 estimate) were used. The spatial analysis were made and the result produced was map of the existing water facilities, map of the metropolis showing utility map networks, population dot map of the metropolis and the suggested extension elevation of the metropolis. Map showing digital elevation model of the metropolis with proposed location of new facilities.

They concluded that, only functional water reservoirs in the town were not capable of supplying inhabitant of the town adequate with water supply. From the map it was seen some areas without adequate pipeline connection and it should be considered for future pipeline connection. They suggested, that a new reservoir be sited at the axis of high elevation determine from DEM.

In response to this in Nigeria at national and state levels, ministries and agencies have been charged with the responsibility of regulating and monitoring the activities of the public sector through the establishment of acceptable Nigerian Standard for Drinking Water Quality provision. Such agencies and ministries include among others, National Environmental Standards and Regulations Enforcement Agency (NESREA), National Council on Water Resources (NCWR), Standards Organization of Nigeria (SON), NAFDAC, Ministry of Environment, and Ministry of Health among others.

The growing scarcity of potable water supplies is among the most important issues facing many cities, in particular those using single sources of water that are climate dependent. Consequently, urban centers are looking to alternative sources of water supply that can supplement variable rainfall and meet the demands of population growth. A diversified portfolio of water sources is required to ensure public health, as well as social, economical and environmental sustainability, hence the need for this research to be conducted.

III MATERIALS AND METHODS

A. Sources of Data and Data Collection

Attribute Data are unique information about the research site. The attribute data were obtained from the Bauchi State Ministry of Lands, Housing & Environments and Bauchi state water board Bauchi State. Such data are however very useful because they

provide the description of the objects that make up the spatial data, which facilitate easier analysis of data. Below are the attribute Data obtained:

1) Detailed Map of Misau Town from Ministry of Lands, Housing and Environments, Survey Department Bauchi State. At a Scale of 1:10000.
2) Population estimate from National Population Commission Bauchi State, of the year 2006 census.
3) Name and location of Water facilities from Bauchi State Water Board Misau.

B. Spatial Data

Spatial data were obtained through field observation by using Hand held GPS (Germin series). However the coordinate locations of all water facilities in Misau Town area of Bauchi State were obtained

C. Observation (using Differential GPS)

The field observation was carried out using Differential GPS receiver. Four control points identifiable both on the satellite image and on the earth's surface were chosen from the image and marked on ground surface. Observations were made on these points to determine their coordinate locations. The coordinate locations of the four points were obtained with Differential GPS receiver.
Four points were chosen and marked on ground prior to the observations; the procedure for the observation is as follows:

1) The Master GPS was set on one of the existing Points as static,
2) The Rover was set at 20mins as the time for the observation at each of the four points until all the points were covered.

With the Rover at each point however, observations were made, recorded and saved.The result was post processed.
The basic aim of determining the coordinates is to geo-reference the image and hence to show the spatial locations of all the water facilities in Misau Town Bauchi State.

D. Geo-referencing

The aim of geo-reference is to convert raster image in pixels to a vectorised image which is in form of lines. The process of geo-reference simply involves selecting a pixel on a raster image and specifying what coordinate it represents for the vector drawing. The procedure for *Geo-reference* is shown below. - Insert - Go to Raster image and click on file location e.g. desktop, pen drive. - Map - Select Tool - Go to Rubber sheet- gives an icon, then click on the point and insert the coordinate starting from easting, press enter, go to the second point and do the same until the last point is covered. Press enter twice It gives a forum: select object/selection: then click on S (meaning: selection) and press enter. Select the whole area, then press enter, the image disappears, click Z and enter, click E and enter. The image appears with the coordinate of every point, hence geo reference completed. Using the four coordinates of the control points obtained through field survey and the scanned layout (development plan), the plan saved in jpeg format was imported in to the AutoCAD 2000i environment as shown below.
Digitization is the process of converting analogue maps, plans, images, etc in to digital format. It can also be seen as act of tracing all the features appeared on a geo-referenced image, maps, etc.The basic spatial entities used in digitizing are point, line and polyline entities. Points were used to represent features that are too small to be represented while lines were used to represent linear features such as roads and rivers.

E. Data Processing

The map of the study area was scanned using AO scanner; it was then taken into Arc Catalog environment where it was spatially reference to WGS 84 ZONE 32. Then the pyramid was created for the image and the map, so that it will appear with three (3) primary colors (i.e. red, blue and green), finally the statistics for the image and the map were calculated.
The image and map of the study area were then added into an Arc Map work station. Both the image and the map were geo-referenced one after the other. The digitization was carried out using polygon for features that are too large to represent as line, and polyline for features that are too tiny to be represented with shape and finally points for features that are disperse and are too small to be represented as polygon. The attributes table was created in a tabular form where the location and type of water sources were recorded.

IV RESULTS AND ANALYSIS

The data manipulation and analysis functions determine the type of information that can be generated by any GIS Techniques. The table below shows the coordinate locations of the four chosen points that were obtained through field observation using Differential GPS.

Points	EASTINGS	NORTHINGS
P1	657156.08	1251913.73
P2	661112.52	1251976.82
P3	661180.26	1251114.78
P4	659116.13	1251082.46

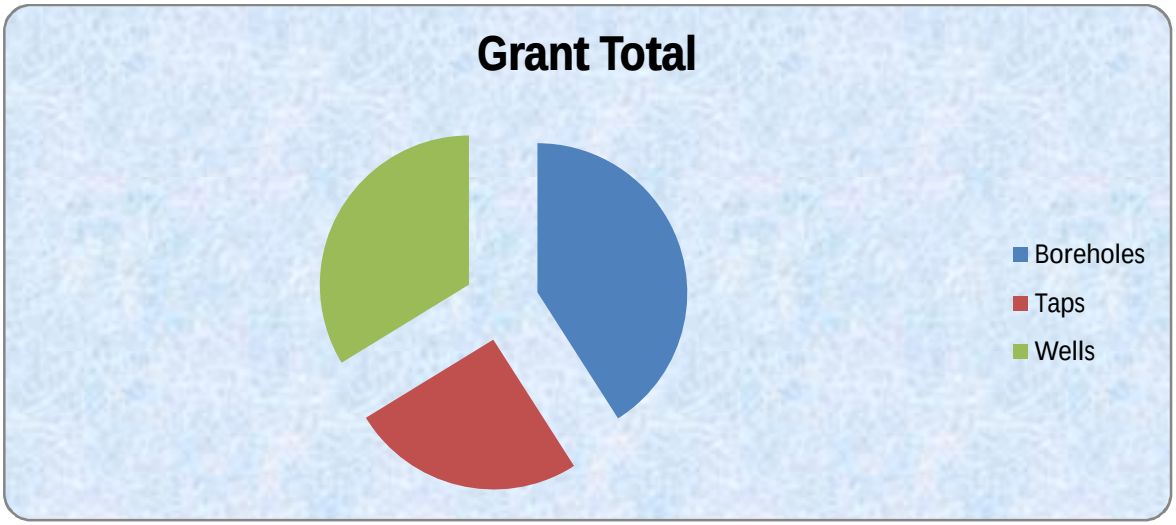
A. ANALYSIS OF RESULTS

From the table below it will be seen that there are three sources of water of which are boreholes, taps and wells. The totals of water points are one hundred and sixty six (166), 68 are boreholes and only 39 are functional among them which have a total of 57.35 percent.

Secondly, the total number of taps are 42, of which only nine are functioning and the remaining 33 are non functional which account for 78.57 percent of the total. Thirdly the wells are 56 in number, of which 29 are functional and account for 51.79 percent out of total. The maximum distance between water points is 500 meters and the Buffer zone used is 200 meters.

From the maps it will be clearly seen that the served areas are the areas within the Buffer zone, while the under serve areas are those areas around the Buffer which includes Lagori, Maluri, Jagul-dagur, Low cost, makara huta, Kukadi and Fawari e.t.c. the un-serve areas are the areas outside the Buffer which include Area 1, A.D Rufa'i qtrs, Area 2, GRA and some part of Sabon layi.

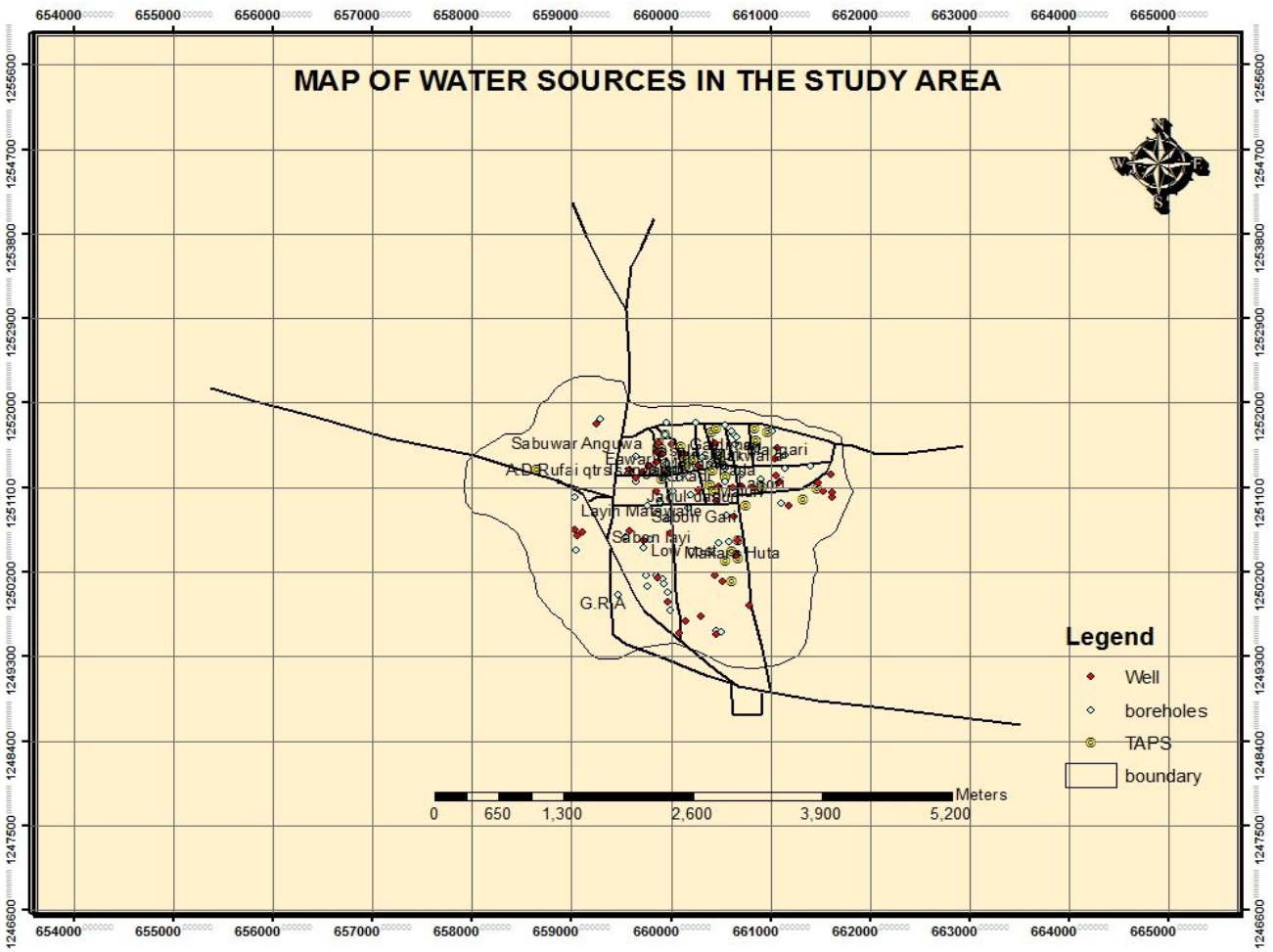
S/no	Water Sources	Functional Water Sources	% of functional Water Sources	Non functional Water Sources	% of non functional Water Sources	Grant total	Max. Distance btw water point in meters.	Buffer Zone used in meters
1	Boreholes	39	57.35	29	42.65	68	500	200
2	Taps	9	21.43	33	78.57	42	500	200
3	Wells	29	51.79	27	48.21	56	500	200
						Total= 166		



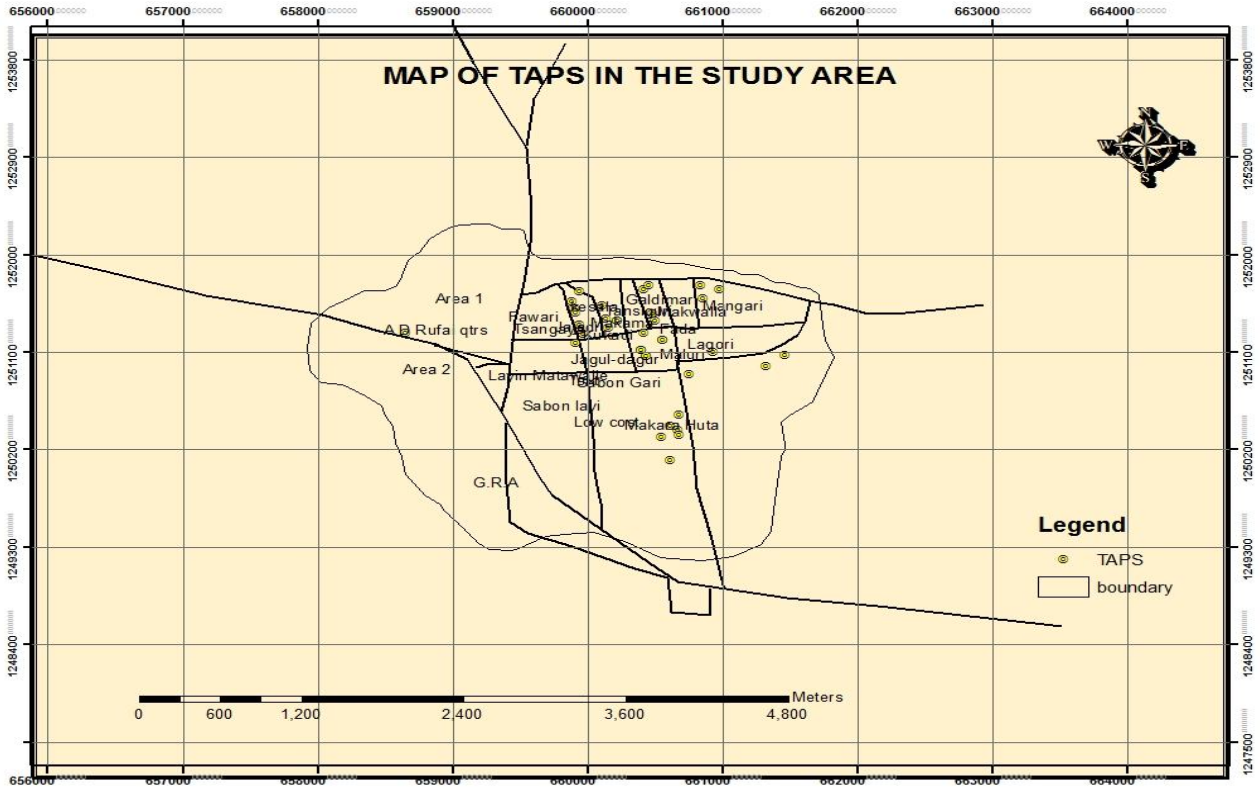
The following figures show the image of the study area, map showing the existing water facilities in Misau Town in terms of Taps, Boreholes and wells. And the field coordinates location of all the water facilities in the Study area. From the maps it will be seen that some areas including Area 1, A.D Rufai qtrs Area 2, GRA, Lowcost, Matawalle, Jagul-dagur, Maluri, Lagori and Makama do not have adequate water supply. The Map however shows the spatial distribution of all the water facilities in Misau Town.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue X, October 2017- Available at www.ijraset.com

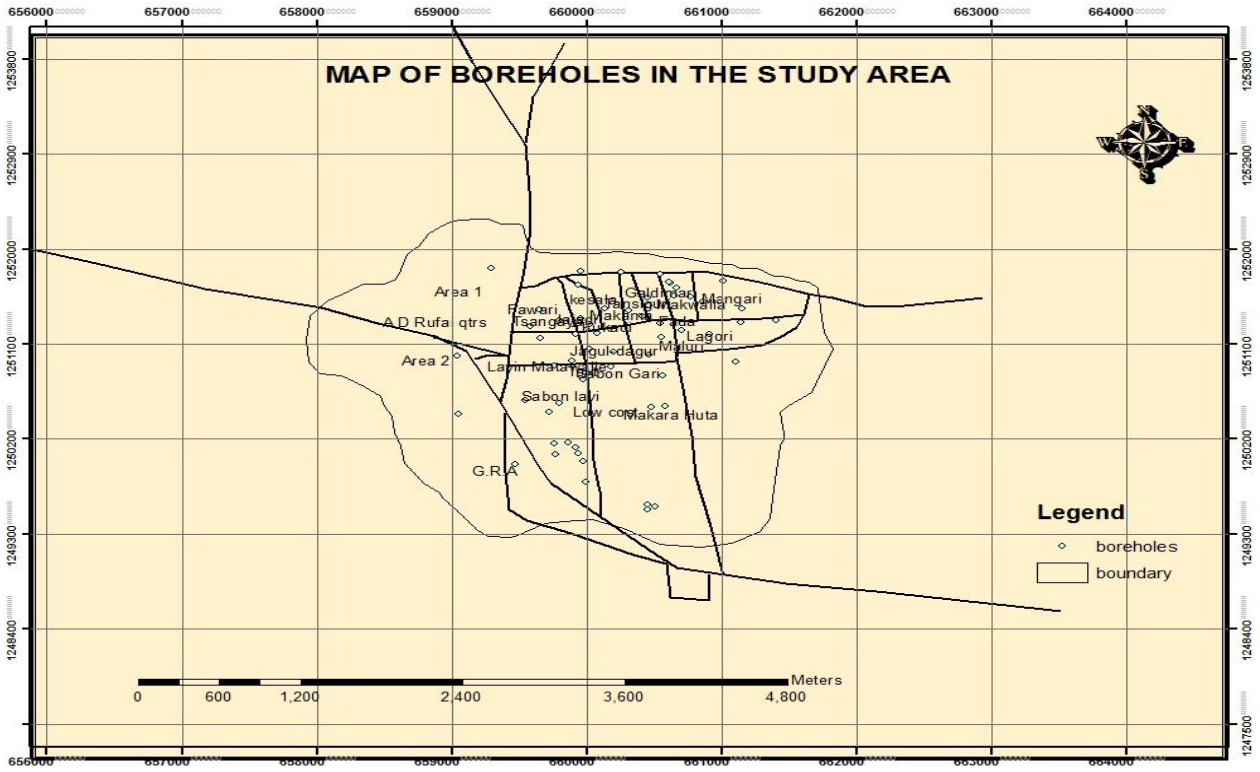
Satellite imagery showing Misau Town, Bauchi State. Nigeria.



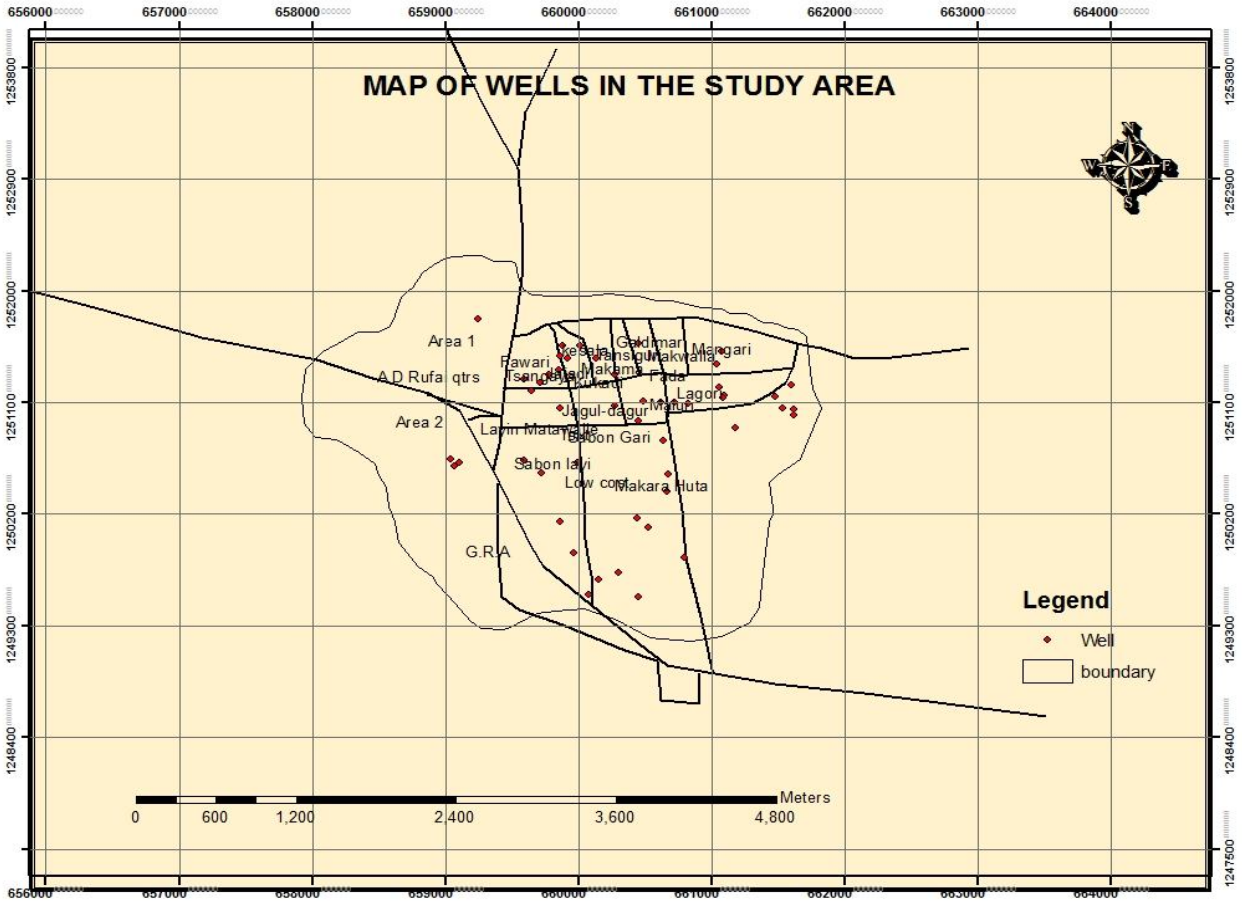
Map showing the spatial distribution of public potable water facilities in the Study area



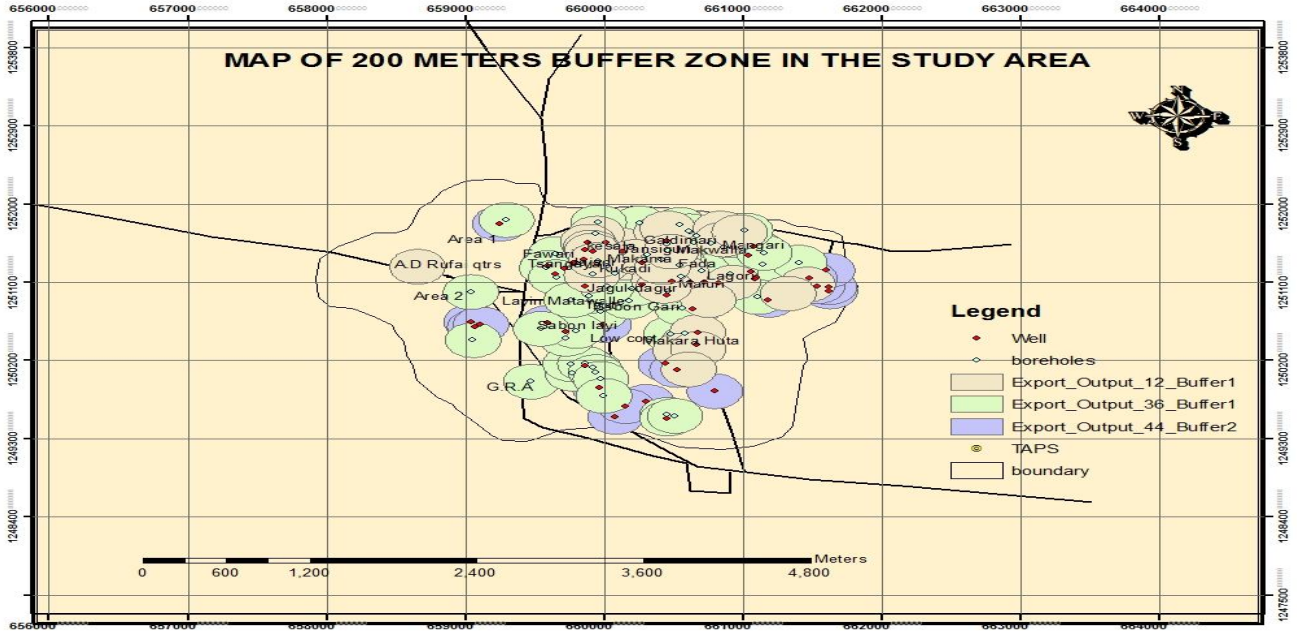
Map showing the spatial location of taps in the Study area.



Map showing the spatial location of Boreholes in the Study area



Map showing the spatial location of Wells in the Study area



Map showing 200metersBuffer zone in the Study area.

V CONCLUSION AND RECOMMENDATIONS

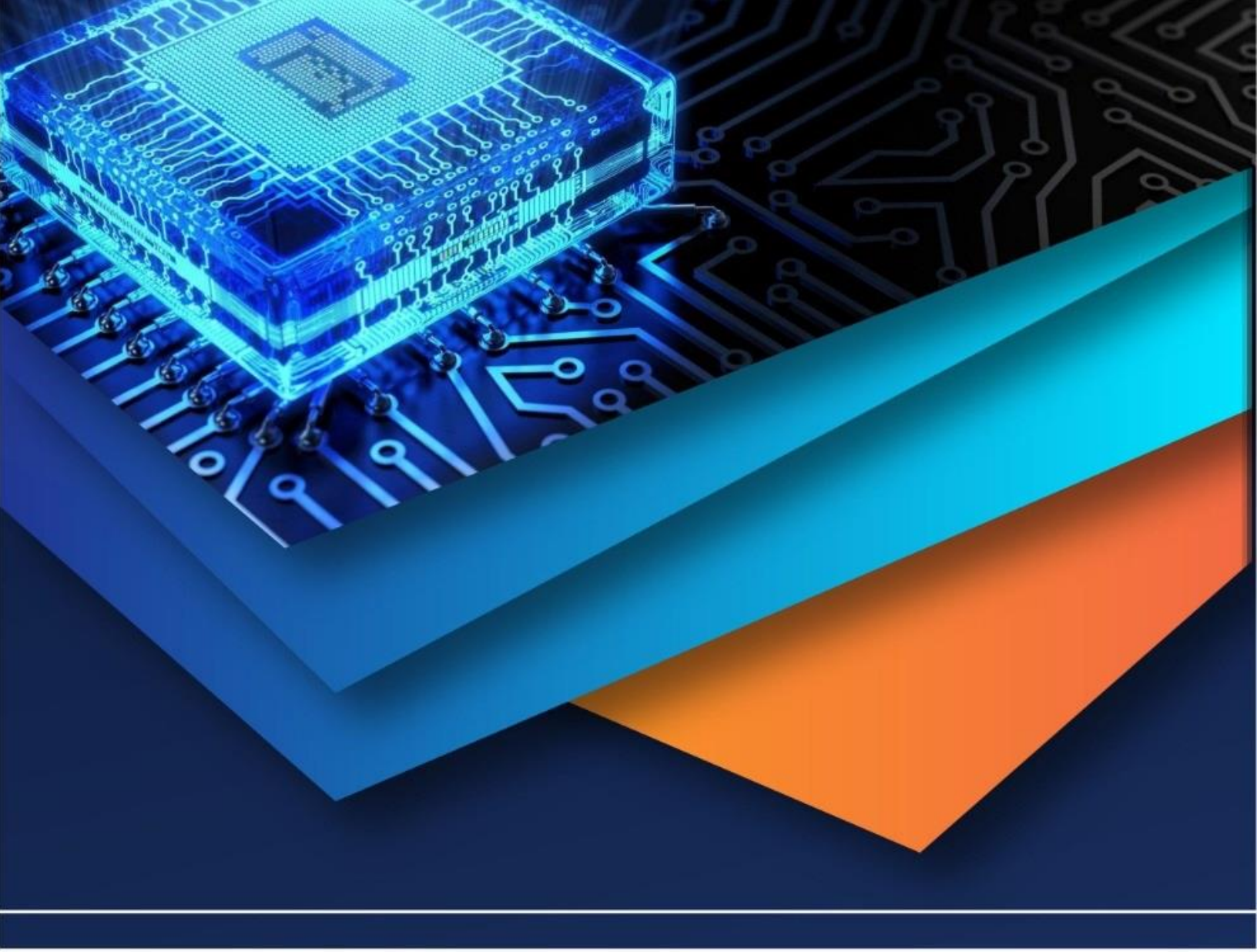
This study examined the spatial content of Public Potable Water supply and it was able to identify the different sources of water supply which are pipe Borne Water, Boreholes and Wells. However, it was found that various areas are not evenly distributed due to the increase in population, growing community and the negligence of both government as well as the people of the study area. Therefore having seen the problems related to the water supply in the study area it was found that the only functional water reservoir in the town was not capable of supplying the inhabitants of the town adequate water supply.

From the Maps, it was also seen that some areas including Area 1, A.D Rufai qtrs Area 2, GRA, Lowcost, Matawalle, Jagul-dagur, Maluri, Lagori and Makama do not have adequate Water supply. It was ascertained that communities without adequate Water supply including Area 1, A.D Rufai qtrs, Area 2, GRA, Lowcost, Matawalle, Jagul-dagur, Maluri, Lagori and Makama which do not have adequate Water supply should be given priority for future pipeline development because of the growing size of these communities. The new development areas around Area 1, Area 2, Area 3, Lagori and Jagul-dagur should also be considered for additional sources. Therefore, the following recommendations should be taken into considerations;

A. Government should renovate all the existing non functional taps, boreholes and wells within the study area.
B. The present water supply should be upgraded regularly because of the increasing demand due to the population increase in the case study area.
C. Government should construct more Boreholes and pipe borne Water to areas that have lesser Water supply.
D. The Boreholes and Wells should be properly constructed and located at strategic places to avoid being polluted.
E. Government should sensitize the general public on the importance of healthy Water supply.
F. Government should set up a committee to ensure that the Boreholes are regularly checked to avoid vandalism.
G. Boreholes that are un-commissioned should be put into account toward commissioning them.
H. Government should provide new generators and proper funding should be made to the Water board in case of power failure.

REFERENCES

[1] Alao, A.A(2004), Problems of domestic water supply in Saki Town, The Environ scope. A Multidisciplinary Journal, Vol. 1 (April 2004), PP. 29-36.Anderson J. (2003) The environmental benefits of water recycling and reuse, water science andTechnology: Water Supply Vol. 3 No. 4PP. 1-10.
[2] Agajelu, S. I. And Moka, E. C. (1989): A Design of a Geo-information Techonolgy: What are the Issues? In ezeigbo, et al. (1999): eds. surveying and spatial information technology. Series in surveying and geo-informatics, No.3, University of Lagos, Lagos.
[3] Application to Municipal Water Supply Planning in Abeokuta Metropolis, Southwestern Nigeria. J. Met. Clim. Sci. 7: 23-27.
[4] Ayoade JO (1988). Tropical Hydrology and Water Resources, Macmillan, Nigeria.
[5] Chaudhery K (2005). Wastewater Infrastructure Planning Using GIS; Proceedings of MAP India 2005 Conference, India.Chinemelu,N.E. (1999): Digital Mapping : a Review of Theory and Application. Unpublished M.Sc. project, Department of Survey, Geodesy and Photogrammetry, University of Nigeria, Enugu Campus.
[6] GIS for health and human services (2009 Summer). Water sources mapping contributes to Health and Development Goals in Rwanda. Journal.
[7] , Nig.Chaudhery K (2005). Wastewater InfrastructurePlanning Using GIS; Proceedings of MAP India 2005 Conference,India
[8] Martin D (1991). Geographic Information Systems and their Socio-Economic Applications. Routledge, Chapman and Hall. p. 182.
[9] Ogun State, Nigeria (1986). Digest of Agricultural Statistic in OgunState, Min. Finance Econ. Planning, Abeokuta.
[10] Musa, A. A. (2001): Building a GIS database for a typical urban setting: A case study of the FUT Yola main campus. Nigerian Journal of Cartography & GIS, Vol 1, No 2.
[11] Orisakwe, K. U. (2008): Remote sensing and GIS application in the determination of land use/land cover changes in Oweri urban in Imo State. Journal of environmental sciencesUfoegbune, G.C., Ladipo-Ajayi, O., Oyedepo, J and Eruola, A.O. 2009 GIS Application to Municipal Water Supply Planning inAbeokuta Metropolis, Southwestern Nigeria. J. Met. & Clim. Sci. 7:23-27
[12] Warner, D.B. 1995 "Water Needs and Demands: Trends and Opportunities from a Domestic Water Supply, Sanitation and HealthPerspective". Workshop on Scenarios and Water Futures, Stockholm Environment Institute, Boston, Massachusetts, 28-30 September



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY