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# SPATIAL MAPPING OF SOME FISHERIES DEPENDENT VILLAGES AROUND SHIRORO DAM USING GIS AND REMOTE SENSING

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**ABSTRACT**
The study review the current state of science with respect to remote sensing and geographic information system applications to fisheries management including site location, mapping, socio –economic characteristics of fishing villages at the upper stream of shiroro dam. Ten villages were identified and mapped using land cover pattern of the area, river, stream and channel network on landsat 3D (3dimension) image of the study area and global position system (GPS) were used as an aid to identification of villages. The result had shown that fishing is an all year activities in all the villages mapped and a major source of livelihood with limited access to basic and social amenities. Information on demographic profile of the fisherfolk, their fishing activity, their dependency on fishing, as well as their socio-economic characteristics were obtained using structure questionnaire and oral interview, Results were analyzed using percentages, frequency distribution and descriptive statistics. All the variables used had an influence on their level of dependency on fisheries'

**KEY WORDS:** GIS, Remote Sensing, Landsat imagery, Mapping, villages, fisheries**.**

## INTRODUCTION

Delineating fisheries dependence villages around Shiroro dam is a valuable input for proposing compatible development activities in Niger state. Failure to identify fisheries dependence villages and to comprehend that these villages contribute to food and food security of the state may lead to poor economic allocation and resource management practices. As fisheries development managers need to know the distance of fisheries dependence villages from the main roads and how to access them. Aquatic environment are vulnerable to over exploitation of resources which if not checked and well planned can result to loss or benefit that can be derived from them.

In order to implement effective management for sustainable fisheries development, early consultations with fisheries expert, and water resource specialist is prudent as to alleviate the poverty situation of the fisheries dependence villagers. Fisheries generate income to community to improve their infrastructures such as schools, clinic, and the purchase of other assets to strengthen community cohesion. As shown by FAO, (2003) that around 38million people worldwide are employed in full time fishing and further 88milion in other related sectors such as processing and trading. However, Remote Sensing offers a way of assessing villages around the fishing grounds of Shiroro dam.

Remote Sensing (RS), therefore is defined as a process of obtaining information about land, water, or an object, without any physical contact between the sensor and the subject of analysis. The term most often refers to the collection of data by satellites.

Remote sensing systems are commonly used to survey, map, and monitor the resources and environment of Earth which can also be used to explore vast field of fisheries and aquaculture hence opens up a wide range of possible application as diverse as aquatic ecosystem itself. All application have one thing in common, that is, they are object that move along a path in space.

Nevertheless, it must be conceived that Remote Sensing is not a panacea, but simply an additional but very powerful tool to be added to those that are already in use. As such Remote Sensing is integrated with GIS to give a good meaning to the study. Geographical Information System (GIS), is define as a computer system that record, stores, and analyzes information about the features that make up the earth. A GIS is designed to accept geographic data from a variety of sources, including maps, satellite photographs, and printed text and statistics. GIS sensors can scan some of this data directly—for example, a computer operator may feed a map or photograph into the scanner, and the computer "reads" the information it contains. The GIS converts all geographical data into a digital code, which it arranges in its database operators program. GIS then process the information and produce the images or information as they are needed by the users.

Niger State formulates policies for provision of road network infrastructures, health facilities, market and other social amenities within the state for every potential citizen. The implementation of the policy actually comes to reality where some villages were fortunate to be among the places to be covered. Hence, neglect of some fisheries dependent villages prompted the research to determine the use of Remote Sensing and Geographic Information System in assessing and mapping these villages so as to provide all the necessary information. The applications of a GIS are vast and continue to grow. By using a GIS, a fisheries expert can also research changes in and on the water body

Many official concerned with fisheries within a region assume that the first step to take in assessing fisheries potential of an area is to map out the locations of the fisheries dependent villages around. This proves to be a futile effort since the importance of fish does not only lie in its role as a source of food and protein in the country nutritional requirement but also as a source of livelihood

to fishermen, their families and traders in the villages. The present study demonstrates the importance of GIS and Remote Sensing techniques to complement survey base on ground observations and enumeration. Also the need for vital surveillance on impact of human activities on aquatic ecosystem for sustainable development. The major aim is to develop a spatial mapping of fisheries dependence villages around Shiroro dam using land use status mapped from Remote Sensing and Geographical Information System data.

**Description Of The Study Area**

**T**he study was carried out at the upstream of Shiroro dam in Shiroro Local Government area of Niger State. The Shiroro dam is located on latitude 90.58N and longitude 60.50E respectively. The dam is about 66km away from Minna, the capital of Niger state.

The climate is typical of Nigeria, having distinct wet and dry season. Humidity is related to movement of ITD. The highest values are recorded during the raining season (about 80%), and the lowest values occur in January (approximately30%). The onset of the rain is between 20$^{th}$ and 30$^{th}$ of April and the length of raining season is between 161-200 days with highest been recorded in August and September.

The topography is highly undulating and varied in heights. They consist of a number of irregular terraces with both steep and low gradient valley steps which are separated by stretches of other steps with low gradient.

**Data collection**.

Data used in the study were collected from two main sources, primary and secondary. The primary data (directly sensed data), this is a set of data generated through field surveys. Some of these are documented in maps, photographs and are complemented with one hundred and twenty questionnaires, The secondary data**,** this is an organized primary data,which is available in various formats such as information from ministries and internet.

**TABLE 1**: Sources of Data

| Data | Type | Year | Source |
|---|---|---|---|
| Administrative map | Hardcopy | 1997 | MWTH,MINNA |
| Landsat | Satellite Imagery | 2008 | Google earth |
| Sony digital camera | DSC-P37 | 4.1 Mega pixels | Researcher |
| GPS | Germin extrex legend | | |

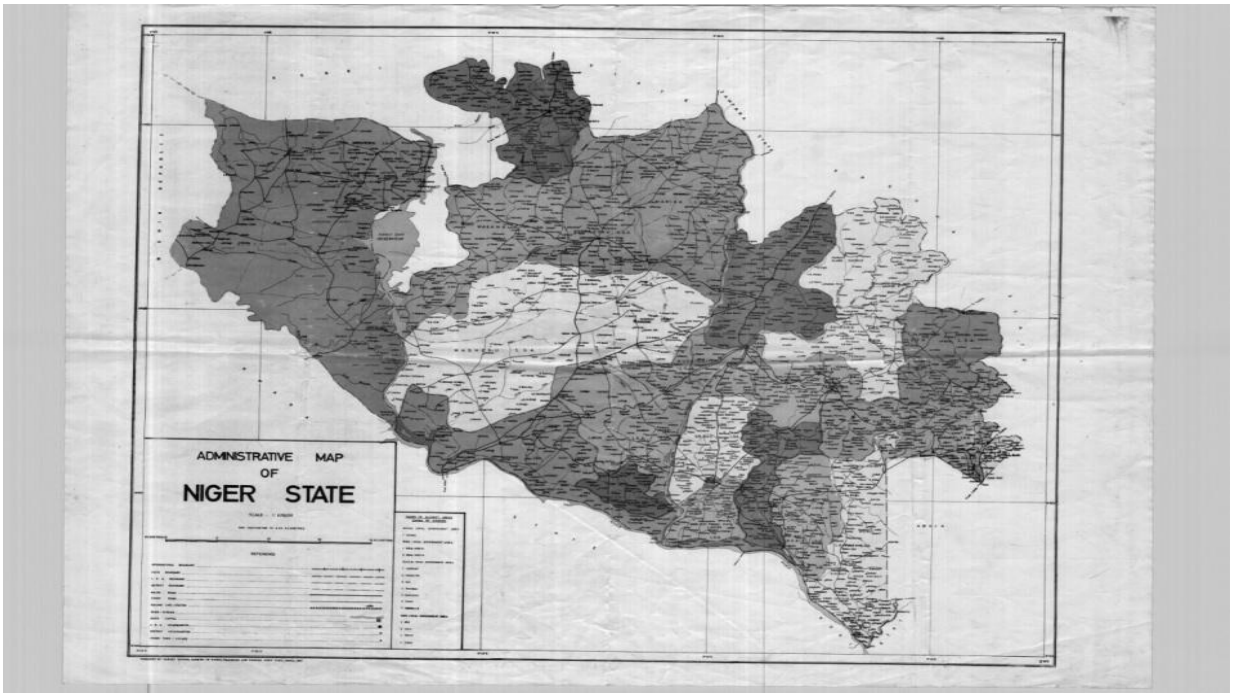
**Materials and Method**

The materials used for identification, mapping and classification of fishing villages were; administrative map, satellite imagery, journals, articles, GPS, and digital camera.

**Administrative map**

The administrative map of Niger State(fig 3.1) with scale 1:625,000 were acquired from ministry of works, transport and housing, Minna and the study area was extracted from the same. The hard copy was scanned and digitized using AutoCAD software to convert it from analogue to digital-form

Fig 1. Scanned and digitized administrative map of Niger state.




Source: Ministry of Works, Transport and Housing. Niger State

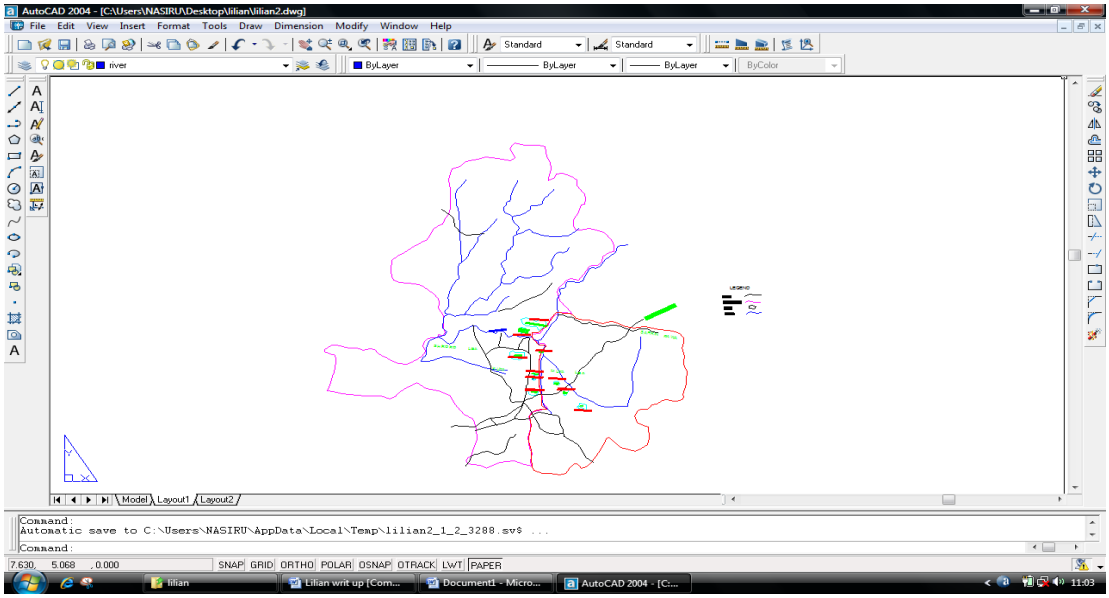



**FIGURE 2**. Digitized map of the study area (shiroro dam and its environs)

**Landsat imagery 2008**

Landsat 3-D (3 dimension) imagery of the study area was acquired from Google earth from the internet, landsat imagery have varying purposes and application to different field and profession such as agriculture, engineering, environmental and sciences etc. due to the scope of the research it will aid only the identification and to facilitate the mapping of the fishing villages around Shiroro dam. The image must be geo-registered in order to correlate with the scanned map. For purpose of this research Autocard 2000 software was used for digitizing.

**Spatial data**

Spatial data gives information about the location of an object related to earth which are usually in the form of (X,Y,Z) 3 dimensional coordinates. The acquisition of this data for the purpose of the study, GPS 01 was used to determine the x, y, z of each village (base) on the spot field validation.

**Attribute data**

These are data that gives descriptive information about specific spatial object. Data from the villages were acquired from personal interview, use of questionnaires and spot field inspection (physical observation)

**Spatial and Attribute Data Creation**

It is very essential to convert spatial and attribute data collected into a form can be used for GIS. So the analogue map, the aerial photos and the satellite images have to be converted into digital forms which can be achieved by using GIS software that can be carried out in two ways plotting and database creations.

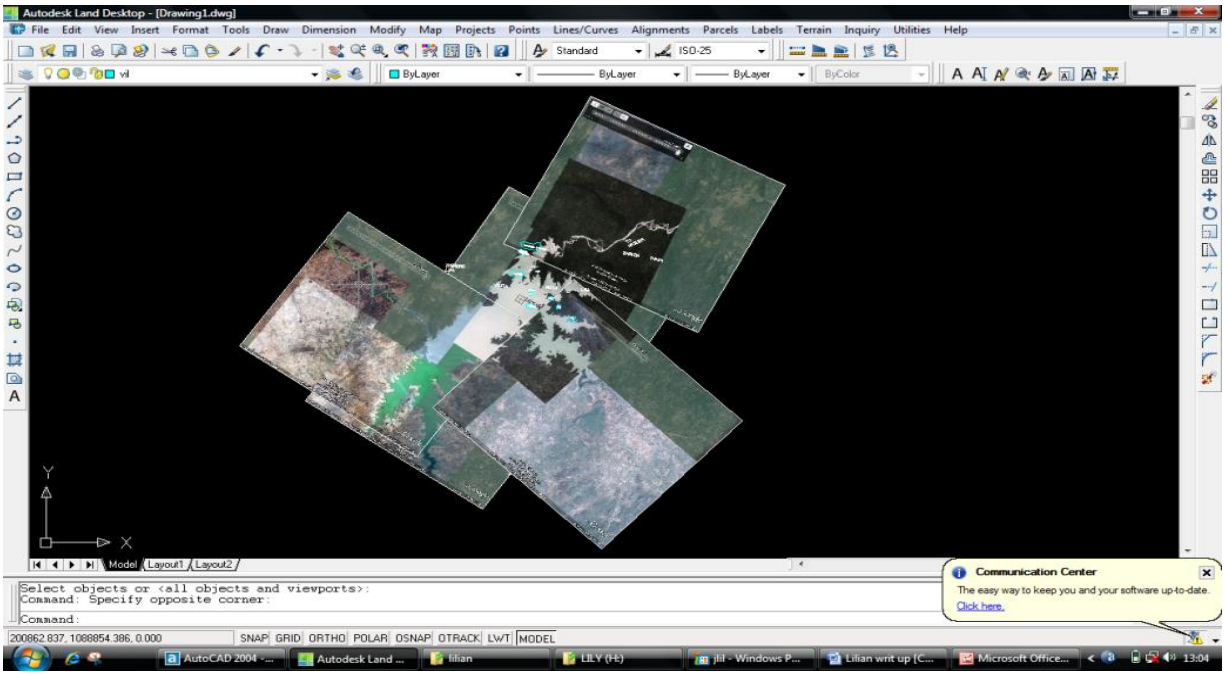



**FIG.URE 3.** Satellite imagery of the study

Source: Google earth on internet.

**Plotting**

From the data acquired of the fishing villages of the study area, AutoCAD software was used to plot the mapped villages of the study area and the distances between adjacent villages were also determined using same software. After plotting in CAD environment, the map was overlaid on the satellite imagery and digitized Niger state map and they were in-sutu, the graphics was exported to ArcGIS environment for database creation and analyses.

**Database creation and analyses**

ArcGIS 9.2 software application was used for the database creation and analyses. The software provides a unifying environment for both the spatial and the attributed data. The created database packages were linked to their corresponding object in GIS environment.

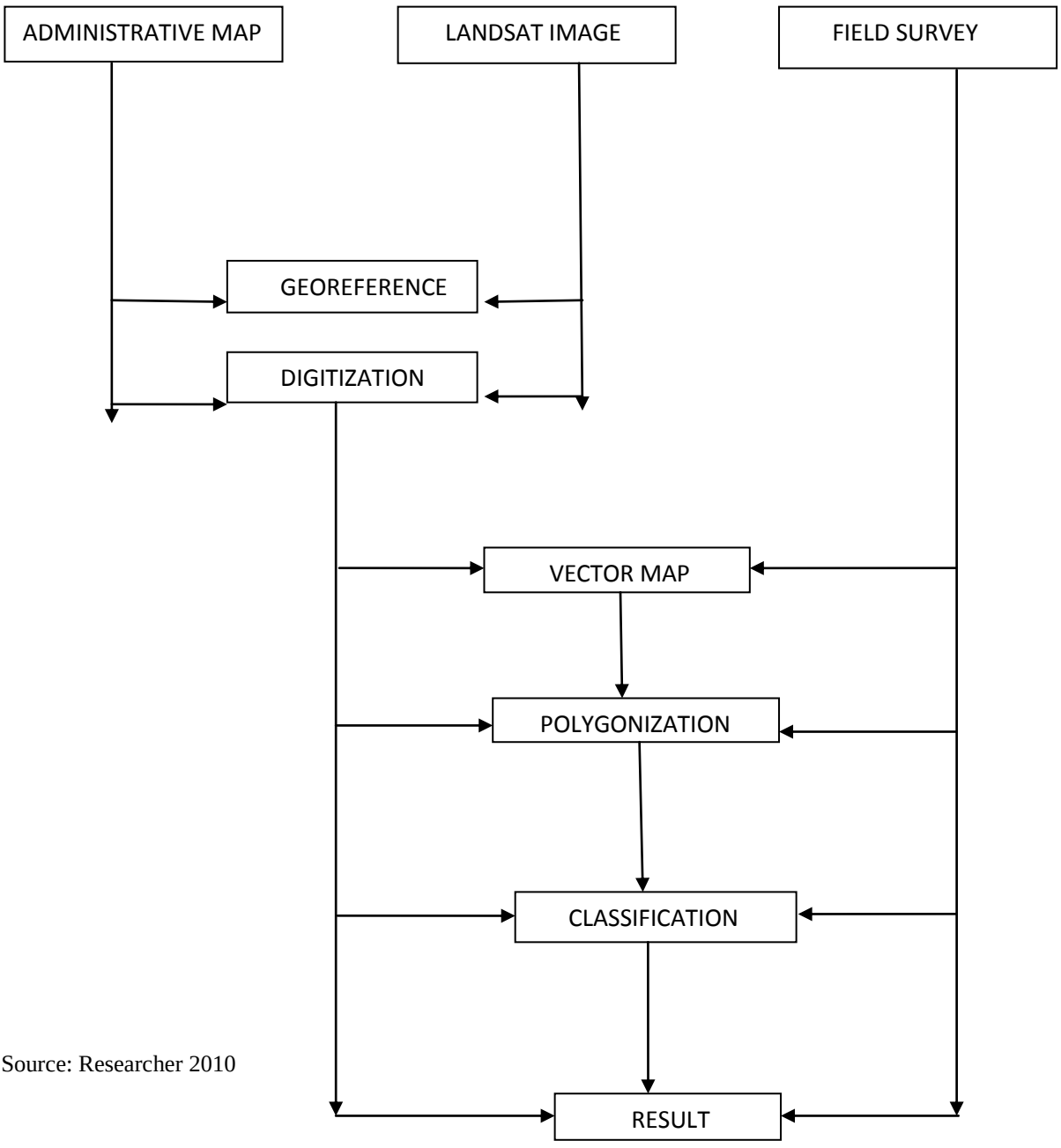
**Analyses of data.**

Arc view 3.9 which is the latest soft used to analyze geographic information to create your own geographic data. Once the map is made, it is easy to add tabular data (attribute data) on the map. So that the map can be query, summarize and organize geographically. Fig 3.2 entails the processes involved in executing the research.

**Software Used.**

For the purpose of this study the software used is: Arcview GIS 3.9 and AutoCAD 2010 In order to get fair representative information from the mapped villages a total of one hundred and twenty questionnaires were administered and then tabulated and rated with percentages for easy interpretation.

**FIGURE 4**. Flow chart of the analysis.




Source: Researcher 2010

**Field Procedure Data Acquisition**

The administrative map and satellite imagery gotten were only to facilitate the field procedure (actual field data acquisition). The actual field work was carried out by visiting and mapping out
the identified and selected villages of the study area using Global position system (GPS0). Snap shot (pictures) of the fishery dependent villages were captured using digital camera.

**Data Processing**

After acquiring the field data automated from site, they were processed using AutoCAD and ARCGIS 9.2.

**AutoCAD plotting**

This is graphic software. The processed data were entered in notepad and run as script in CAD environment, to give the visual of the location and boundary of the fishing villages. Different layers were created for each feature for easy identification and editing, with this we were able to get the vector map, this was overlaid on the Satellite imagery (raster map) of fishing villages.

Table3 The villages mapped and their co-ordinates

| S/N | Villages | Northing Co-ordinates | Easting Co-ordinates |
|---|---|---|---|
| 1 | Kwata | 1094259 | 262365 |
| 2 | Shakwana | 1091266 | 262409 |
| 3 | Kam | 1086313 | 260202 |
| 4 | Chiri | 1083942 | 261159 |
| 5 | Galadima kogo | 1110299 | 259940 |
| 6 | Zumba | 1097338 | 259524 |
| 7 | Guni | 1084199 | 275322 |
| 8 | Tunga lemu | 1085328 | 273181 |
| 9 | Tunga alhaji | 1083219 | 266539 |
| 10 | Gwada | 1076618 | 256814 |

**Arcgis 9.2**

It is a database software, it's is user friendly. The data based in ARCGIS used in this study was done in the following way;
Launch ArcGIs9.2. The click catalog and select the location of the file or data.
Go to add tool, click on it select the file name, it will display in the working widow.

**Data Capture in Arcgis**

On automatic analogue digital conversion with head-on digitising:
The following steps was followed:
Load ArcGIS
Load the editor tool bar
Load the Geo-referencing toolbar
Use add data button to add the scanned map
Geo-reference the imported image
Analog-digital conversion of map data
Import the scanned map into arcmap
Geo-reference the scanned map using the georeferencing tool bar
Analog-digital conversion of map data
Activate the editor tool bar
Enable the target layer for editing
Select the task from the task drop down
Set the target layer option to the enabled layer
Pick the edit tool (preferably the sketch tool)
Start map conversion as follows
Click left mouse to start,
Click left mouse to follow line and boundary of polygon and
Double click to conclude.

**The task was modify to edit layer**

Import scanned map to arcmap
Load georeference tool bar
Add x and y coordinates to at least four points
Create layer in arc catalog
Specify new shape file (arc view format)
Specify the type of feature file
In arcmap add the empty layer(s)
Load the editor tool bar
Activate the layer for editing
Set the task to create new features
Set the target layer
Select edit tool (sketch tool)
Use your cursor to trace map
Adding attribute data
Right mouse click to open attribute table of map data
Use option menu to add field
**stop edit before you can add field**
Enter the field information
Add records to your tabular data
**you must activate the layer for editing before you can add records**
**Its is advisable that you repeat these sets of procedures**

Querying was done on ArcGIS 9.2 by the following steps:

- Open attributes table
- Right-click on OPTIONS Tab and left click SELECT ATTRIBUTES
- In the dialog box METHOD click CREATE NEW SELECTION ("DISTANCE APART")
- Using SQL, write "DISTANCE APART"Z>"to Zumba, to shiroror village" for kilometer delineation query.
- Using SQL, write "DIALY INCOME">"N500" for dependency of fishing villages.

**RESULT**

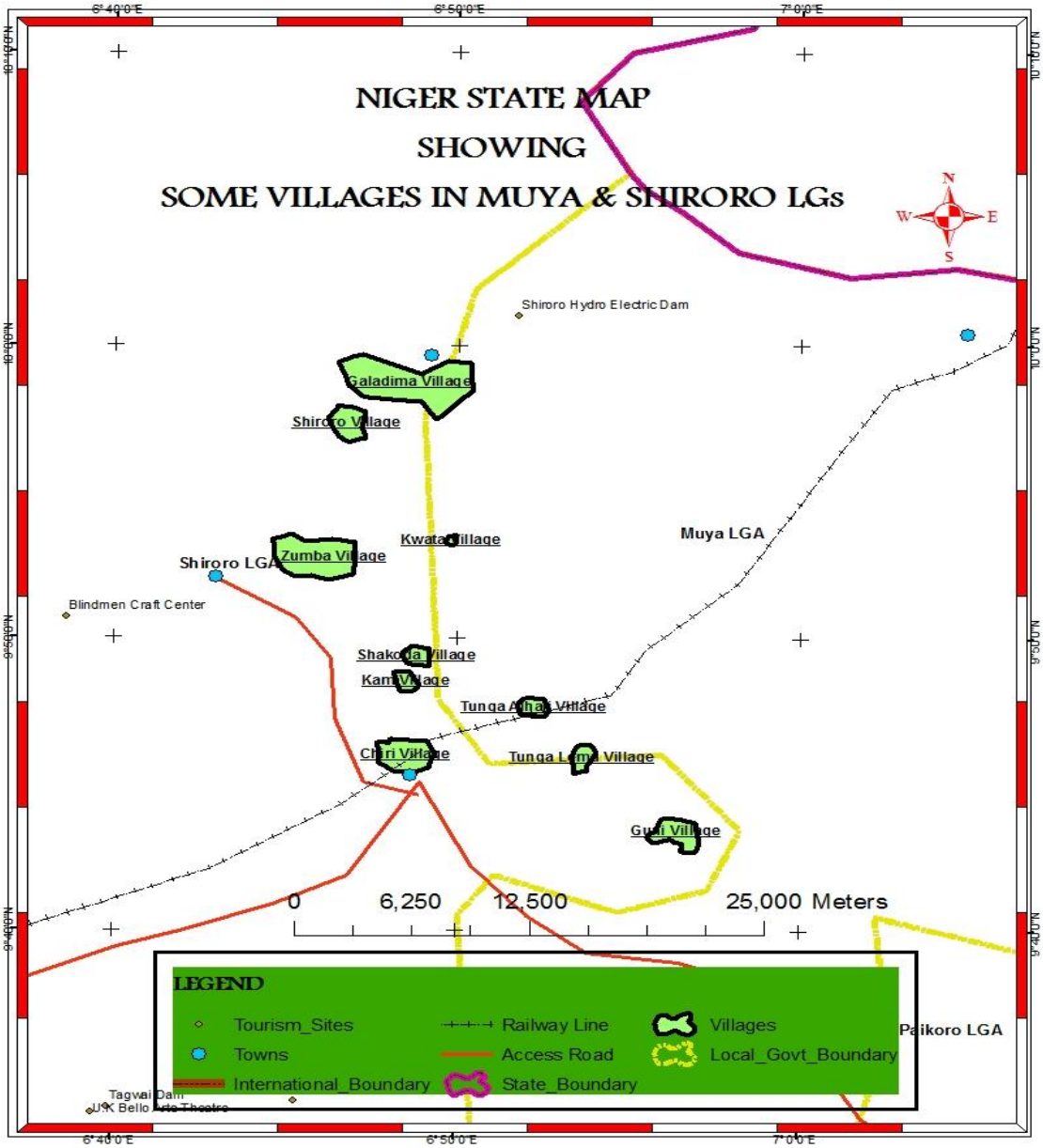
**Field Data Analysis**

A hundred and twenty questionnaires were administered to generate data which were into four groups: Demographic profile of fishermen, fishing activities of the villagers, dependency of villagers on fishing as well as their socio-economic characteristics. These data were tabulated and rated with percentages to facilitate easy interpretation and their activities.

**Theme of The Fishing Villages**

Theme is a pictorial representation of the various villages within the study area with different colours

**FIGURE 5**. Diagrammatic representation of the theme




**The Demographic Profile of the Fishermen**

In term of age characteristics, the study shows that about 55% of the fishermen are within the age range of 20 – 40 years, 20% teenagers and 21% are within the age range of 41 – 60 years who are actually involved directly in fishing. About 77% of the respondents are married, 21% single with 11% being either widowers or divorcees. 63% are from monogamous homes 97% of the respondent were male while 3% were female. This is an indication that males are more involved in fishing than females in the study area and are very much interested in fishing to ensure continuity.

Closely related with the marital status is the size of the families. The study shows that about 62% of the fishermen have large families (>10), 20% small (>5) and 12% moderate (5 – 10). Ten fishing villages were mapped out and used for the survey. The study shows that 72% of the children are not in school, 15% are in primary school and only 5% attend secondary school. About 70% of the villagers speak Hausa, 26% Gwari, 4% Nupe

**Fishing activities of the villagers.**

Fishermen in the villages around Shiroro dam exploit a large number of fish species by a range of fishing gears and craft such as lines, net, dugout wooden canoe since only a few own motorized boats.

From the survey, 29% of fishermen used nets, 15% use traps, and 5% lines with about 51% using more than one type of gear in terms of fishing activity.

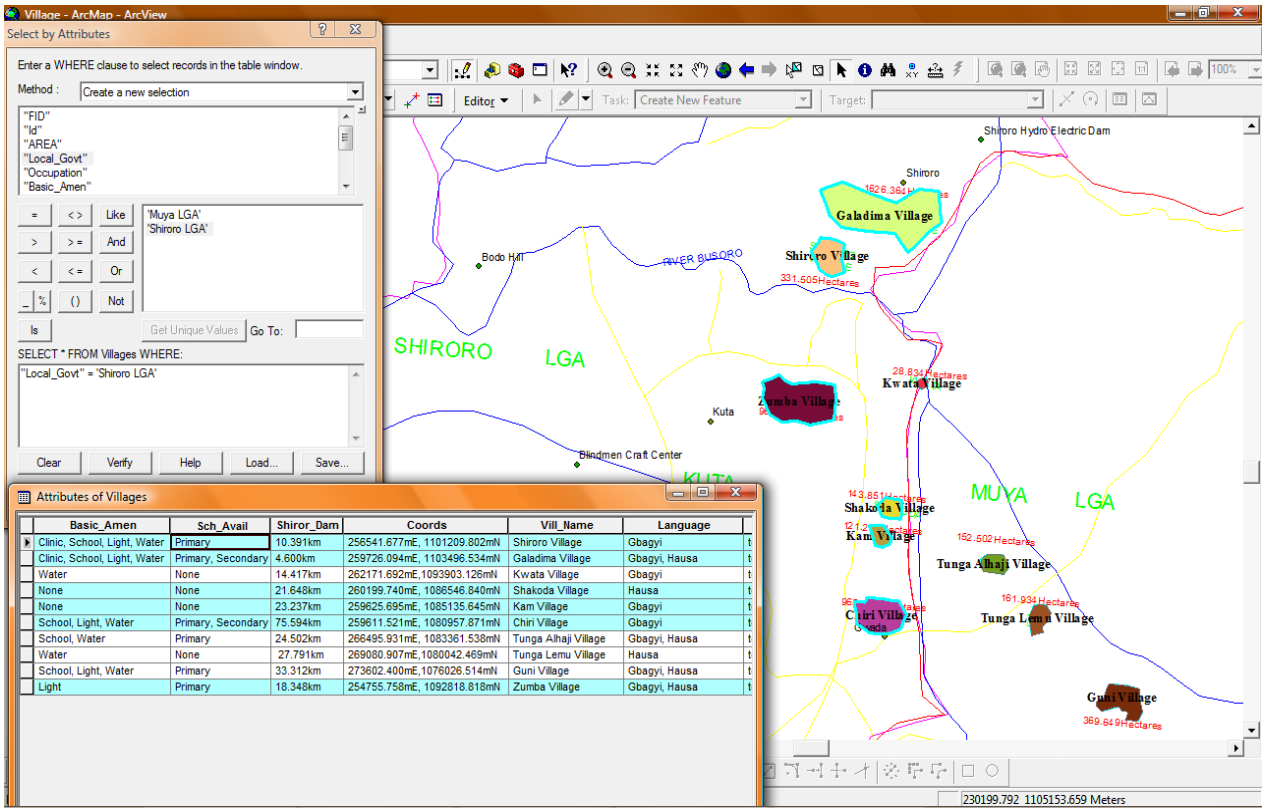
The types of fishing activities taking are both active and passive and 87% practicing both. Most of their fishing operations are carried out in the mornings and evenings. They normally set up their gears in the morning and inspect then the morning and inspect them, the following or morning or evening.

In term of the frequency of fishing 90% of the fishermen fish daily with only 10% who fish weekly. Their intention for fishing variety 53% of the fishermen said, they engage in small – scale commercial fishing, 28% said, medium –

scale commercial fishing, 12% subsistence fishing and 7% and large scale.

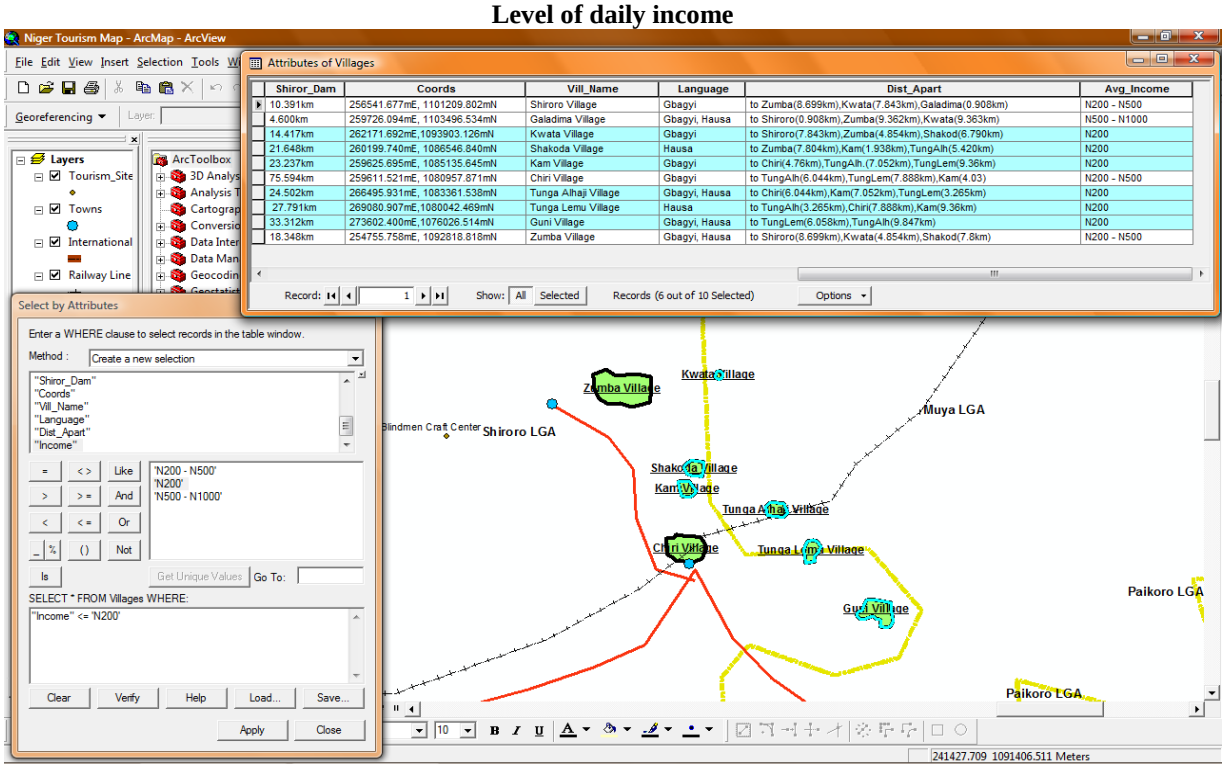
For the catch volume 68% claimed large catch of less than 30 numbers a day while 21% say they get medium volume catch less than 20 numbers a day and 10% make a small catch of between 5 – 10 numbers a day. Within regards to the sizes of catch, 65% of the fishermen catch all sizes while 10% go for medium sizes using gears such as gillnet is available in different mesh sizes.

Based on the survey and information obtained, the population of sizes of the species, especially Heterotis species, Labeo species, Mormysus species have reached such a low level and there is a low a drastic reduction in daily landing of adult Lates niloticus.




Query map on spoken languages among the fishing villages

**Level of daily income**



**Socio-Economic Status**

The Socio – Economic status of the fishermen

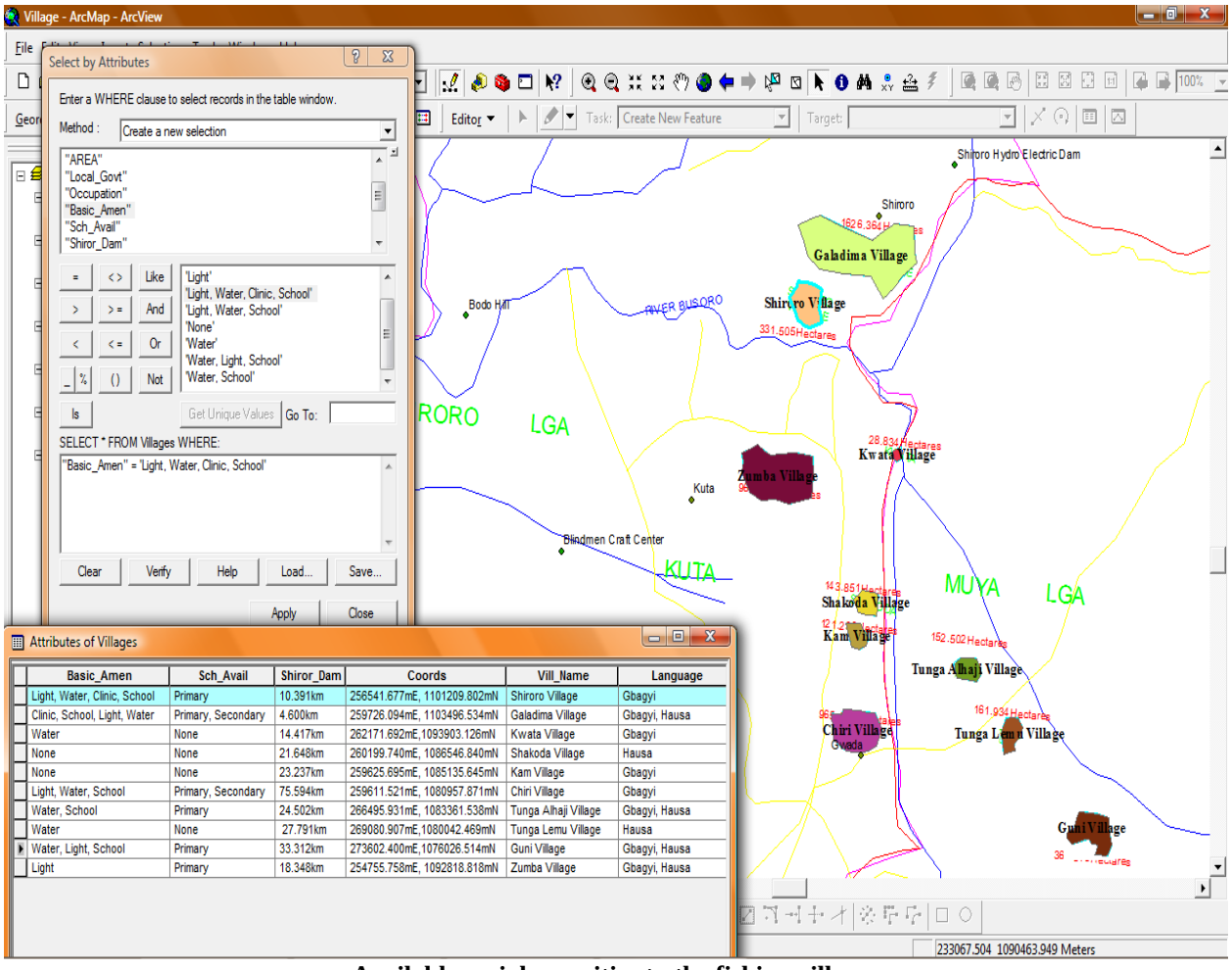
| Major Source Of Income | Frequency | % |
|---|---|---|
| Farming | 36 | 30 |
| Fishing | 74 | 62 |
| Other (canoes peddler) | 10 | 8 |
| LEVEL OF INCOME | | |
| Low (<₦200) per day | 72 | 60 |
| Medium (₦200 – 500) per day | 34 | 28. |
| High (₦500 – 1000) per day | 14 | 12 |
| Availability of health institution | | |
| Dispensary | | |
| Basic health | 24 | 20 |
| Other (visiting doctor) | 96 | 80 |
| Level of health care delivery | | |
| Poor | 96 | 80 |
| Fair | 24 | 20 |
| Good | | |

Table above reflects that 60% of transportation available to fishermen are through the water with 40% through the poor access road. Responding to question on the effectiveness of the available means of transportation 73% said it is fair while 27% said it is good.

90% of the fishermen who use the reservoir claim that the quality of drinking water is good. 10% of people whose drinking water source is well said it is fair.

Results on housing facilities shows that 58% of respondents live in permanent rural shelter made up of clay blocks, 27% live in make shift houses constructed with thatch with 15% living in permanent urban houses constructed with concrete bricks and cement.

This depicts that the standard of living of the fishermen around the water is poor on the literacy level 36% have primary certificates, 15% said they have secondary school certificates, while 53% are versed in quranic education.




**Available social amenities to the fishing villages**

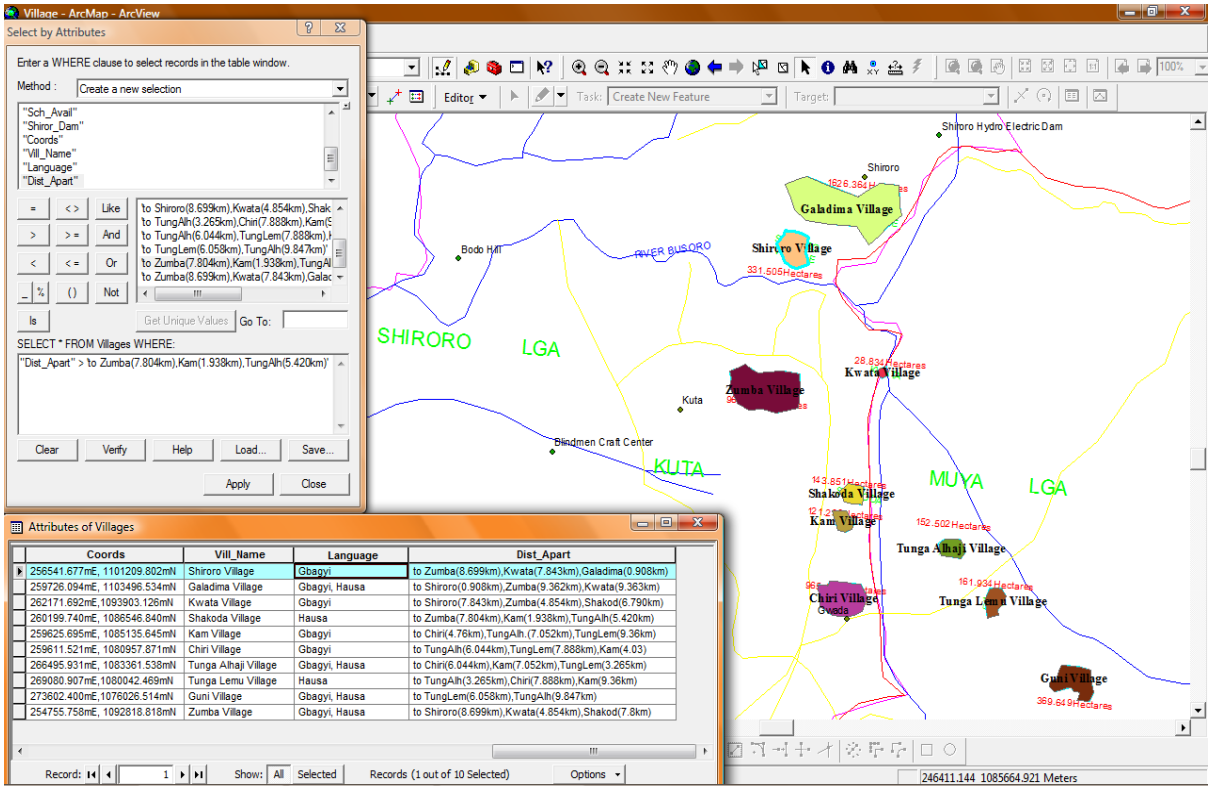
**Queries**

It is a way of processing or manipulating data to aid decision making. For his project, the queries carried out or processed were done based on the data acquired with the questionnaire and entered into the database.

From the above analyzed and interpreted field data acquired, a further analysis was done using ArcGIS 9.2 with a graphical approach. Examples includes query showing below.

**Kilometer Delineation Within Fishing Villages**

This shows the distance apart among the fishing villages.




Kilometer delineation of the fishing villages

## CONCLUSION

**T**his study provides information on the fishing villages around shiroro dam using Geographical Information System and Remote Sensing, Which depicts that the ten villages mapped were all fishery dpendent.their income depend largely on the volume of their catch, a situation that might threaten the conservation of fishery resource of the dam if left unchecked. Remoteness and poor existence of basic social infrastructure could also be a constraint to management of fisheries resources around the dam. With the identification,mapping and information obtained on fishing villages could be used by the government and policy makers ,to improve the standard of living of the fisherfolk.

## RECOMMENDATION

- Government should provide social amenities to the fishing villages to enhance their social well being and economic improvement.
- Constant monitoring of fishing craft, fishing gear and fishing activities of the villagers should be enforced to prevent over exploitation and extinction of some fish species.
- The use of geographic information system and remote sensing should be given more priority as this would aid plaining and management of fisheries resources.

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