

GIS-Based Road Transport Infrastructure Management System for Adamawa Central, Adamawa State, Nigeria

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Abstract
This study focus on the GIS-Based Road Transport infrastructure Management System for Adamawa Central, Adamawa State, Nigeria. The study covered Adamawa central which comprises of seven local government areas namely; Yola North (Jimeta), Yola South, Fufore, Gerei, Song, Gombi and Hong. Satellite images, road transport map, road transport documents, bridges pictures, road pictures as well as the bridges and the roundabout coordinate were all used to obtain the final results for the study. The satellite images were Spot image of 2012 and Geogle Earth image of 2013. The satellite images and road map were used in updating the road transport map, the road transport documents as well the road, bridge and roundabout picture were used as an inventory in building the geodatabase for the GIS-Based road transport infrastructure management system and some of the roads, bridge and roundabout coordinates were used for hyperlinking the pictures to the spatial reference.ArcGIS 10.1, Microsoft 2013 and AO scanner was used for the entire thesis work, the thesis critically observed the process involved in GIS-Based road transport infrastructure Management system for the selected road transport Infrastructures for Adamawa central, analysis were performed for proper decision-making on how to manage the road transport infrastructures. The result reveals that Geographic Information System as a very important system can be used in data collection, entry, development, management and analysis. The research also show that the process of converting the traditional database system to a Geographical Information System (GIS) required in the planning will and commitment. It is recommended that government should establish GIS unit in the federal and state ministry of transports board and also encourage the local government areas to do the same for proper planning and development of road transport infrastructure and management system for easy management and control of its facilities.
Keywords: ArcGIS 10.1, GIS, bridges pictures, road pictures, Road Transport Inventory, Road Transport Map, Road Transport Documents, Geodatabase. Sport Image, Google Earth Image

INTRODUCTION

Road transport infrastructure management system starts form the premise that the road network is an asset which need to be maintained and improved so as to secure the best performance and value for money and the maximum service life (Transport Research Laboratory, 1998). They went on to say that the aims of road managers are to enable the network and surface to withstand the damage cause by wear and tear, to prevent substandard conditions from development, and to ensure that traffic can continue to travel, in a manner which is safe, efficient, reliable and which causes the list damage to the environment. These aims are achieved through a series of works and activities which depend for their effective management on the maintenance of up-to-date information about the features and surface condition of the road network.

Ideally we would utilize this information system in an automated manner using a range of advanced technologies. This type of system is complex and mandates a need for integration and consideration of data sharing and security. Addressing these issues and needs is critical to building an information system to meet the ever increasing social, economic, and environmental demands placed upon our road transport infrastructure (Rasdorf *et al.*, 2000).

Rasdorf *et al.*, (2000) pointed out that the infrastructure departments of the Portuguese municipalities, including Lisbon, Coimbra, Oliveira do Hospital, Oliveira do Bairro, and other municipalities, manage their infrastructures using a number of systems or programs maintained by different divisions inside the department of infrastructures. Each system or program generates and maintains a large amount of information in separate and independent databases. Many of this information are processed, analysed, and shared/used by more than one division in more than one format.

All data about municipal infrastructures have a spatial component. That spatial component represents an area such as a highway corridor, a linear feature such as a road and a point feature such as a sign or the location of an accident. The existing municipal databases and data management system design traditionally have not been effective at allowing division within the departments of infrastructures to use or share data as extensively or as easily as should be the case.

Thill (2000) highlights the requirements of GIS in transportation applications and the core transportation research themes which employ GIS for "research, planning, and management" (referred to collectively as GIS-T). Like Goodchild, he provides a classification, but gives more attention to the use of GIS to handle large amounts of transport data rather than to the other aspects. According to Thill, (200) GIS-T need a data management system (whose aim is to facilitate the maintenance and the integration of the inventories of transportation infrastructures held by public authorities) data interoperability (in order to allow transportation data sharing among several agencies, each with its own data base) real-time GIS-T (for real time geo-referenced data storage, retrieval, processing, and analysis) large data sets (which involve the optimization of algorithms and analytical tools, and the discovery of innovative system designs) distributed computing (to allow the spread of GIS-T data over users and community, by means of web services). Identifying the main fields of transport in which GIS could contribute and how, represented a serious challenge at the beginning of this decade. However, not only because of the rapid technology development and computing improvement but also thanks to the increasing interest from public academic authorities, GIS have undergone rapid enhancements in recent years, spreading and becoming systematic throughout the scientific world.

Diverse areas of transportation, including high way and rail way infrastructure management, international shipping, airport management, fleet logistics, traffic management and intelligent transportation systems (ITS), transit bus and rail service planning, transportation modeling, supply chain modeling, and others, are applying GIS to their work, ESRI (2003). The breadth of the field of integration of GIS and transportation system provides large opportunities for the development of new and innovative applications in transportation system of different transportation organizations Curtin (2003).

Public and private agencies have always tried to maintain their infrastructure assets in good and serviceable condition at a minimum cost; therefore, they practiced infrastructure management. However, as most of the nation's infrastructure systems reached maturity and the demands placed on them started to rapidly increase in the mid- 1960s, infrastructure agencies started to focus on a systems approach for infrastructure management. This process has led to today's Asset Management concept. The process started with the development of pavement management systems (PMS), continued with bridge management systems (BMS) and infrastructure management systems (IMS), and has recently evolved into asset management (Ferreira and Flintsch, 2004).

Ferreira and Flintsch, (2004). Stated that an infrastructure management system is defined as the operational package that enables the systematic, coordinated planning and programming of investments or expenditures, design, construction, maintenance, rehabilitation, renovation, operation, and in-service evaluation of physical facilities. The system includes methods, procedures, data, software, policies, and decision means necessary for providing and maintaining infrastructure at a level of service acceptable to the public or owners.

To effectively plan, construct, manage, and maintain our road transport infrastructure requires that we first effectively model it using some form of an information system (Hall, 2004)

Managing the road transport information management system is a function that needs to be treated like any other operational activity undertaken by road administrator. The benefit which is the GIS-based system can be offer, in term of improved management of the road transport network and infrastucture, which will be lost if this aspect of its operation is neglected.

Road transport is by far the most dominant mode of transport in the country, carrying well over 90% of passenger and freight traffic and serving as a true backbone for Nigeria's economy (Transport Research Board, 2004). Because a well maintained road transport asset is very important for the economic development of the nation, Road surface Management Information System is a prerequisite for the successful management of road transport. Geospatial data are foundation for relevant and critical information for planning, engineering, asset management, and operations associated with every transportation mode at all levels of government and administration, (TRB, 2004).

Since GIS have a seamless relation with space and location, given that their main objective as a tool is to store, retrieve, and facilitate the analysis of spatial data (Goodchild and Janelle, 2004), they have become one of the most powerful tools to support transportation studies and applications. Transportation is one of the fastest growing of many fields in which GIS is used Rodrigue *et al* (2006). In 2006, Shaw and Rodrigue reviewed Goodchild and Thill's classifications. They considered that GIS-T studies can be classified into three groups, namely data representations, analysis and modelling, and applications.

The understanding of GIS based Road Transport surface Information management, effective use of geographical information and the knowledge of their advantages is critical to the planning and decision making process for asset management and transport departments.

Curtin, *et al* (2003). Stated that, researchers/transportation professionals are increasingly realizing that the synthesis of traditional transportation research methods with the added value of GIS resources provides a robust platform for both traditional and innovative transportation management activities. ElBehairy and Hegazy (2004) reported that a Decision Support System for Transportation Management systems (BMS) are used "to prioritize bridges, allocate funds, and select appropriate repair strategies so that a network of bridges is kept serviceable and safe with low cost. The proposed system supplements BMS by providing a simplified but comprehensive model for execution planning of bridge maintenance system. The model uses a genetic algorithm procedure in a spreadsheet environment to determine optimum execution order, considering practical constraints (e.g., deadlines, owner supervision capacity, cash flow), and other political/user constraints.

Li, et al. (2004) developed a transit asset management system (TAMS) using GIS intended to support decision-making for rural and small urban transit systems. The purpose of the TAMS is to: Identify current maintenance deficiencies, Predict the future bus conditions and estimate the investment requirements and Recommend a cost effective maintenance strategy to sustain or improve vehicle condition. They found out that Knowledge of the current and future condition of transit vehicles is "valuable in budget planning processes to identify cost-effective maintenance policies." The spreadsheet-based decision analysis model provides quantitative measurements and optimization procedures to help allocate sufficient funding to sustain future wellbeing of transit vehicles.

Vasudevan, (2004) implemented a program of road asset management according to (GASB 34) using GIS as a small public works agency for Missouri, Columbia. The tasks of this study are creating condition estimation manual, assets inventory, which include Global Positioning System (GPS) coordinates and asset evaluation then integrate it with GIS. This information inputted into Microsoft Excel and updated it manually at the different levels of program then integrated it with GIS which develop the program by better data query, analysis, and display. The methodology applied in Cole Country Public Work Department in Missouri, Columbia. The study follow the principles of modify asset management method because asset has an expensive maintenance cost and it is need periodic maintenance and can provide a political support, at these factors modify method is better (FHWA, 2000). Asset inventory include roads, sign, culverts, guardrails, and pipes. Road inventory include four types of road in the country: asphalt, gravel, gypsy, and concrete. Each type of road classified as one of five condition levels: excellent, good, fair, poor, and failed. Other assets (signs, culverts, guardrails, and pipes) classified as one of three condition levels: good, fair, and poor. The study provides "Unique Identifier" (UI) to link the program with GIS. He stated that the work will enhance the capability of government to identify asset performance level and help them to estimate the actual needs to maintain roads assets according to their condition. The study recommended the country to inventory one-third of assets every year and check the actual replacement cost for construction costs in the country.

Furthermore, Ferreira A. and Duarte A., (2005) develop GIS-Based Integrated Infrastructure Management System for Portugal. The paper focuses on the issues and needs that emerged from some studies developed by the authors involving the implementation of transportation management systems in local municipalities and developing a comprehensive database and design with focused attention given to the types of data analysis functions performed by each division. The paper includes the application of the IMS in road maintenance management and road safety management. The method adopted was based on the two sub-systems, a road maintenance management system and a road safety management system use the same base linear referencing system. In both subsystems, in order to handle dynamic segmentation, the road network model is composed by road segments with (x, y) coordinates and measure (m) values. They recommended that the infrastructure departments of the Portuguese municipalities need to make great efforts in beginning or continuing to use advanced information technology tools to increase institutional productivity and effectiveness in managing their municipal infrastructures. Nowadays they use or are beginning to use independent management systems for each type of infrastructure, i.e., road pavements, bridges, signs, water pipelines, sewer pipelines, parks, etc. In the future, they need to begin the development of an Integrated Infrastructure Management System (IMS).

Similarly, Rao *et al.* (2006) developed a GIS Based Maintenance Management System (GMMS) for major roads of Delhi. This development was made so as to benefit from the realistic representation of real-world entities, an organised data structure and the powerful analysis and presentation capabilities of GIS.

Anastasopoulos, (2009) studied a case of infrastructure asset management as a pavement rehabilitation study. The researcher concerned is to evaluating infrastructure service life, and particularly to implement treatment of pavement rehabilitation. He extend the traditional management way of infrastructure assets, in general, and of road, in particular, by formulating methodologies that enable transportation agencies to evaluate the effectiveness of their asset and road infrastructure maintenances with respect to each maintenance service life. The study focused on six road rehabilitation maintenances in India: Two-course hot-mix asphalt (HMA) overlay with or without surface milling, Concrete road restoration, Three-course HMA overlay with or without surface milling, Three-course HMA overlay with crack and seat of Portland cement concrete (PCC) road, R (resurfacing, restoration and rehabilitation) and 4-R (resurfacing, restoration, rehabilitation and reconstruction) overlay treatments and 3-R/4-R road replacement maintenance.

The analysis implemented separately for urban and rural interstates, non-interstates of the National Highway System (NHS), and non-interstates that do not belong to the NHS. As road condition indicators, the international roughness index (IRI), road condition rating (RCR), rut depth, and surface deflection (which can be used only for the structural treatments) are utilized. The study selected nine years from 1999 to 2007. It selected the roads that have information over the selected period such as road condition, rehabilitation cost, road section length, traffic loads, weather and soil information, etc.

Based on the literature reviewed, a lot of research has been carried out in various part of the globe, but none of such research has been carried out in Adamawa central of Nigeria but none the researcher's carryout on integrations of the roads transport infrastructure management system in Adamawa central, this the gap I intended to fill by the development of GIS-based Road Transport management Management System.

This study is important and timely because Adamawa central still faces problems of traffic congestion, high road accidents, lack of road transport infrastructure geospatial database, weak institutional support leading to poor definition of the problem at hand and differing technology transfer priorities in problem resolution. This could be linked to the non-availability of adequate information on road transport infrastructures due to increase urbanization, growth of commercial activities.This development comes up with different characterisation of road transport infrastructure and operation methods. This study will provide decisions makers with a system which could be used for road transport inventory, physical road maintenance, as well as any other road-related road transport infrastructure management issues. The focus of this study is to develop a GIS based road transport infrastructure management system in Adamawa central, as support to the traditional pattern matching (majorly based on human judgement), that has been used over time.

The aim of this study is to develop a GIS based Road transport infrastructure Management System for Adamawa Central, Nigeria. This were achieved through the following objectives which include to: Mapping the existing roads infrastructures in Adamawa Central, Build Geodatabase for the selected roads infrastructures in Adamawa Central, Use the Geodatabase to analyse and queries road characteristics and Characterise in form of road transport document, road transport infrastructure map, table, statistic graphs, charts and ArcMap Documents.

THE STUDY AREA

The study area (Adamawa central) is located between latitude 8°30'N and 13°00'N of the equator and between longitude 10°30'E and 13°00'E of the Green meridian with an elevation of 135 metres. Adamawa central is bordered by Borno State and Shelleng LGA to the northwest, Demsa, Mayo-Belwa and Jada LGA to the southwest, Mubi north and Maiha LGA to the northeast, its eastern border also forms the national eastern border with Cameroon. Adamawa central is one of the largest central of Nigeria and occupies about 12,914 square kilometres respectively. See figure 1.1 for study area map.The Adamawa central which is the study area consists of seven Local Government Areas namely; Yola North, Yola South, Fufure, Gerie, Song, Hong and Gombi. The relief of Adamawa central is that of the cretaceous rocks overlying Bima Sandstone underlies restricted area of low-lying plains, (Carter et al, 1963).

Drainage nearly all water supplies are at present obtained from rivers and streams. Yola is drained by the Benue River which rises from the Cameroon Republic and flows from east to west along the northern borders of the area to join the River Niger at Lokoja. The climate of the study area is typical of the West African Savanna climate. Temperature in this climatic region is high because of the radiation income. A slight increase after the cessation of rain (October to November) is common before the onset of harmattan in December when the temperature in Yola reach 40°C particularly in April (Adebayo et al, 1999).

Vegetation falls in the Sudan Savannah zone of Nigerian, most of which is subjected to regular cultivation. Restricted areas of anogeissus /combertum/ propopsdis woodland occurred but the farmland carry a mixed shrub dominated by pilostigma reticulation. Soils like most areas of northern Nigeria, most of the soils of the area have sub-surface horizons with high content of iron concretions and fissile iron stone occurring in many areas (Helen, 1994).

MATERIALS AND METHODS

The research methodology workflow is presented in figure 1.2

Materials used for the Study

Hardware

The hardware used are show on table 1.1

Table 1.1 shows the hardware required and the usage

Hardware	Usage
A hand-held Garmin 76CSX GPS	Used for capture of control points of bridges, roads and junctions
A digital camera	Used for capture picture of some road infrastructures, e.g. bridges, roads and junctions
An A0 scanner	Used for scanning hardcopy topographic map of the study area in order to convert it in to digital format in ArcGIS 10.1 environment.
An A0 scanner	Used to print out hardcopy maps of the GIS based RTIMS
A digital electronic Laptop computer	Used for processing all the information gathered in this study

Software

The software to be used are show on table 1.2
Table 1.2 shows the software required and the usage

Software	Usage
Microsoft Word 2013	Used for compiling and documentation of the research document
ESRI ArcGIS 10.1	Used as for mapping, designing and creation of geosdatabase analysis, querying, and production of road transport maps, chart and tables of the Adamawa central.

Types and Sources of Data
In order to achieve the stated objectives, the following data were obtaind; Spot5 satellite images of 2012, with 1m resolution, road transport map of Adamawa state, documents on road information and attributes, GPS coordinates of the junctions (T and Y) and culvert of Adamawa central. See Table 1.3 for types, sources and usage.
Table 1.3 shows Data type, sources and usage

Dada required	Sources	Usage
Road transport base map	Ministry of Urban and Regional Planning Yola	Serve as base map from which to be digitize and delineate the roads for geospatial database creation.
Spot5 satellite images (2012) of 1m resolution	National Centre of Remote Sensing Jos	The base road map will be overlay on the image in order to update the road map.
Road information Documents (attribute data)	Ministry of Works, Yola.	It provide attribute data to be used as an inventory for creation and populating database
GPS Data (Spatial data)	Field survey	For taking coordinates points of the roundabout that were used for hyperlinking.
Digital camera data (picture)	Field survey	Provide road pictures for hyperlinking in order to see the nature of some of the roads and roundabout.

Method and Technique of Data Collection
Spatial data collection
Road map, is obtained from Ministry of Urban and Regional Planning Yola. Spot5 image of 2012 will be acquire from National Centre of Remote Sensing JOS and field work was carryout in order to take the coordinates of the roundabout GPS as well as snapping some of the road picture using digital camera.
Attribute data collection
Field work, these include the collection of road transport information documents from Ministry of Urban and Regional Planning Yola and Ministry of Works.

METHODS OF DATA ANALYSIS AND PRESENTATION OF RESULTS
Methods of data analysis and presentation of result adopted in this research work formed the basis for the mapping, building, creation and the development of a GIS based road information management system in Adamawa central.

Mapping the existing road infrastructures in Adamawa Central (Objective I). In achieve that, Remote Sensing Data: Road base map will be scan, georeference, digitise to delineate the roads map and together with Sport5 (2012) with 1m resolution satellite images will be used to overlay the two map in order to updating the roads transport map for Adamawa central so as to generate an up-to-date road map . Necessary spatial layers of road transport network will be generated from the sport5 image and road maps.

Designing and Building Geodatabase of road infrastructures in Adamawa Central (Objective II). This is achieving through the use of ArcCatalog Tool to Building Geodatabase and the coordinates of the selected road transport infrastructure taking from the field with the aid of GPS will be add on the map in order to hyperlink the digital image capture from the field for the management and decision making as the case may be.

RESULTS AND DISCUSSIONS
Research shows that about 70% of GIS task lies on editing and data compilation, starting from coordinate registration, mapping and geo-processing of spatial data, to attribute database development. The establishment of robust database is the cornerstone of every successful GIS, therefore, this chapter seeks to establish database manipulation for theme attributes, the information will however be used for query and analysis in the later part of this chapter. This chapter examines the objectives of the study by analysing the primary and secondary data collected. The primary data were collected using GPS and digital camera while the secondary data were collected using satellite imageries and road documents from the federal and state ministry of works and land and survey.

The first objective: Mapping the existing road infrastructure in adamawa central. Figure 1.2 below shows the digitized up-to-date road transport map of Adamawa central at 1:800,000 scale which is updated from the Spot-5 image of 2012 and Google Earth images of 2013. The final output of the road map is printed in using AO scanner.

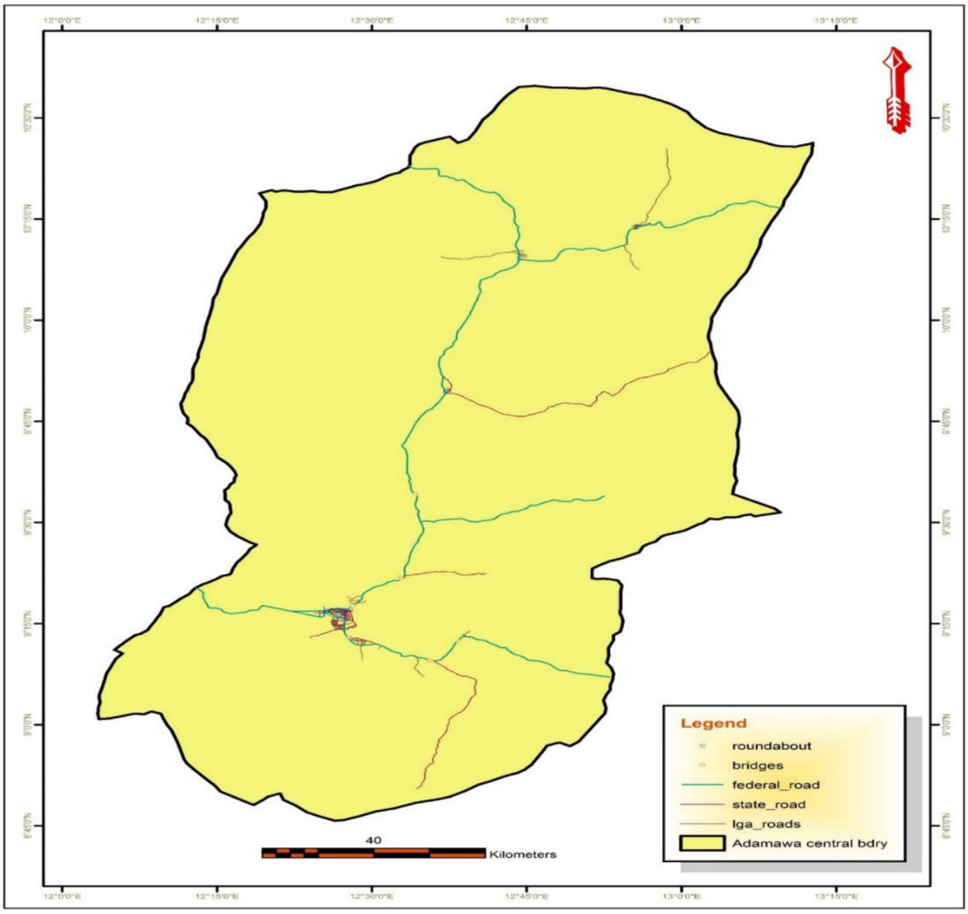

Figure 1.1 showing the up-to-date Road Transport map of Adamawa Central
Source: Author's analysis
ANALYSIS 1. Showing the some of the roundabout in Adamawa central.

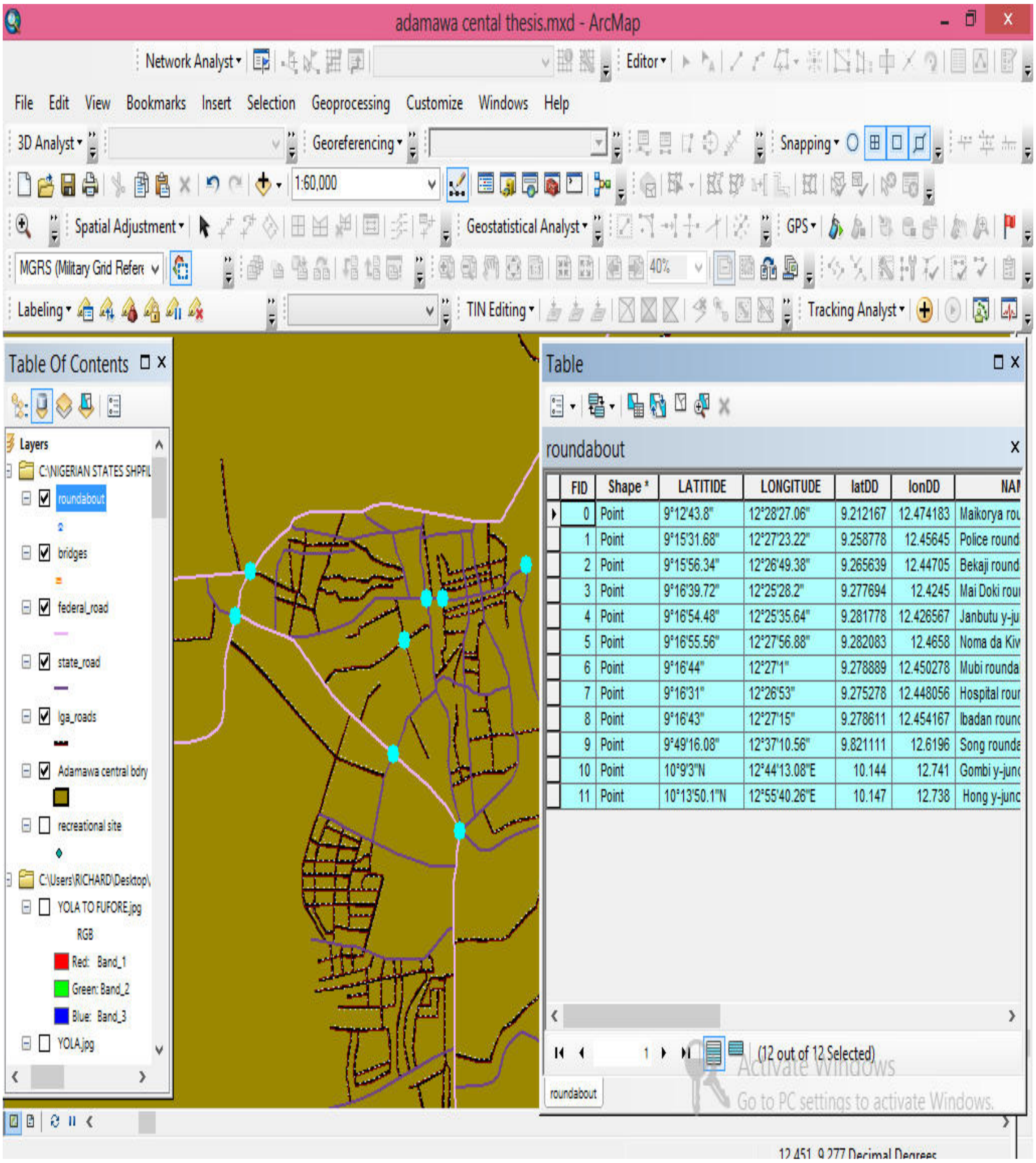

Figure 1.2. *showing all the rounabout in Adamawa central.*
Source: Author's analysis

Discussion of Results: The dot spot beryl green colour on map in the figure automatically found the location and attribute of the roundabout in the Adamawa central.

ANALYSIS 2. Showing the some of the bridge in Adamawa central.

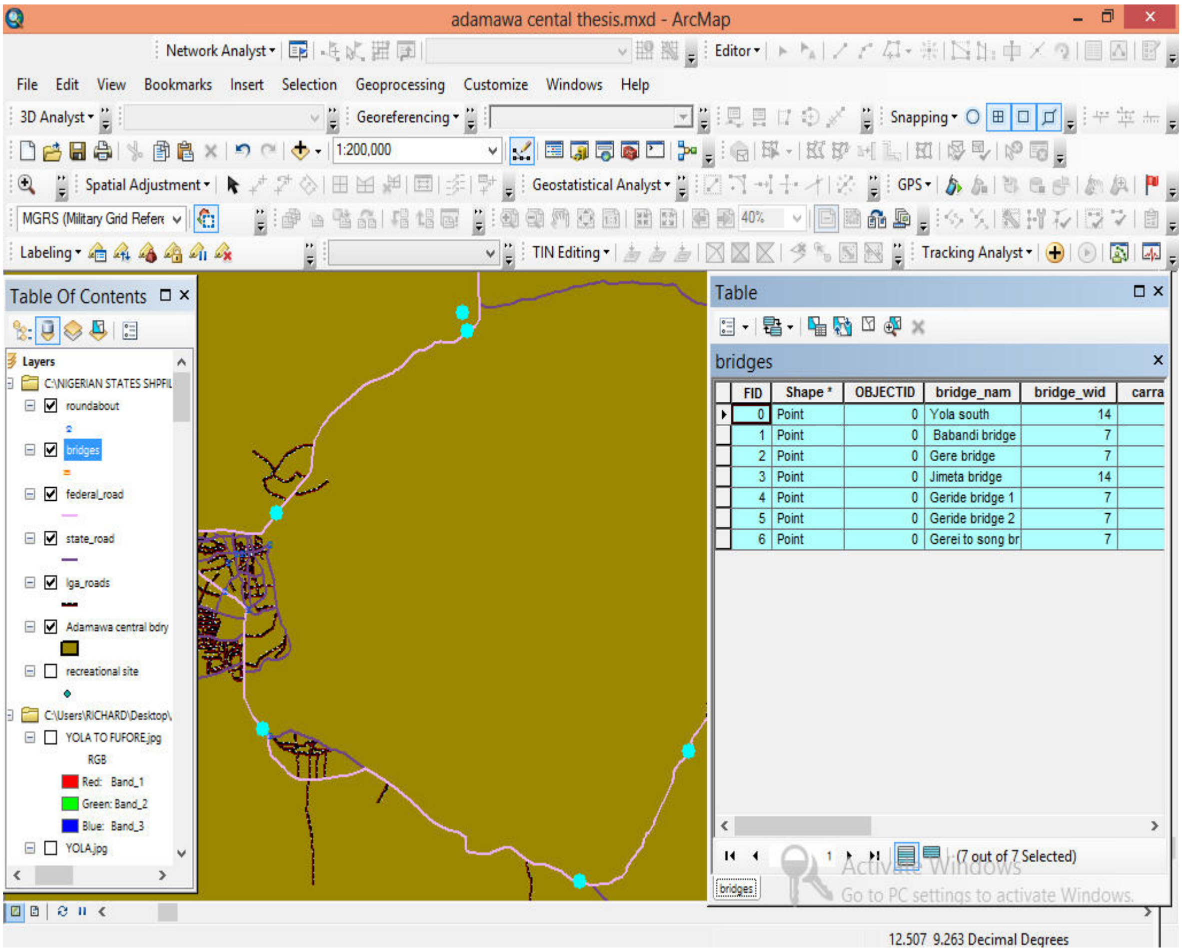

Figure 1.3 *showing all the federal roads in Adamawa central.*
Source: Author's analysis

Discussion of Results: The dot spot beryl green colour on map in the figure automatically found the spatial locations and attribute of the bridges in the Adamawa central.

ANALYSIS 3: Seeing the physical nature of the road, bridge and junction on the map using HYPERLINK TOOL.

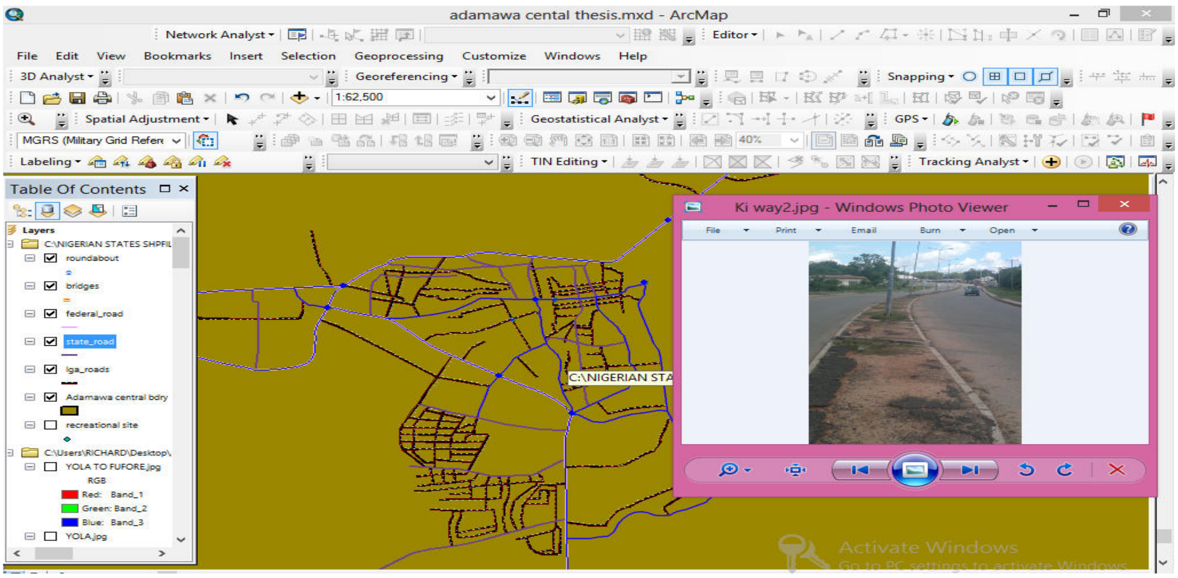

Figure 1.4a *Showing the physical structure of a Kashim Ibrahim road Yola south.*
Source: Author's analysis

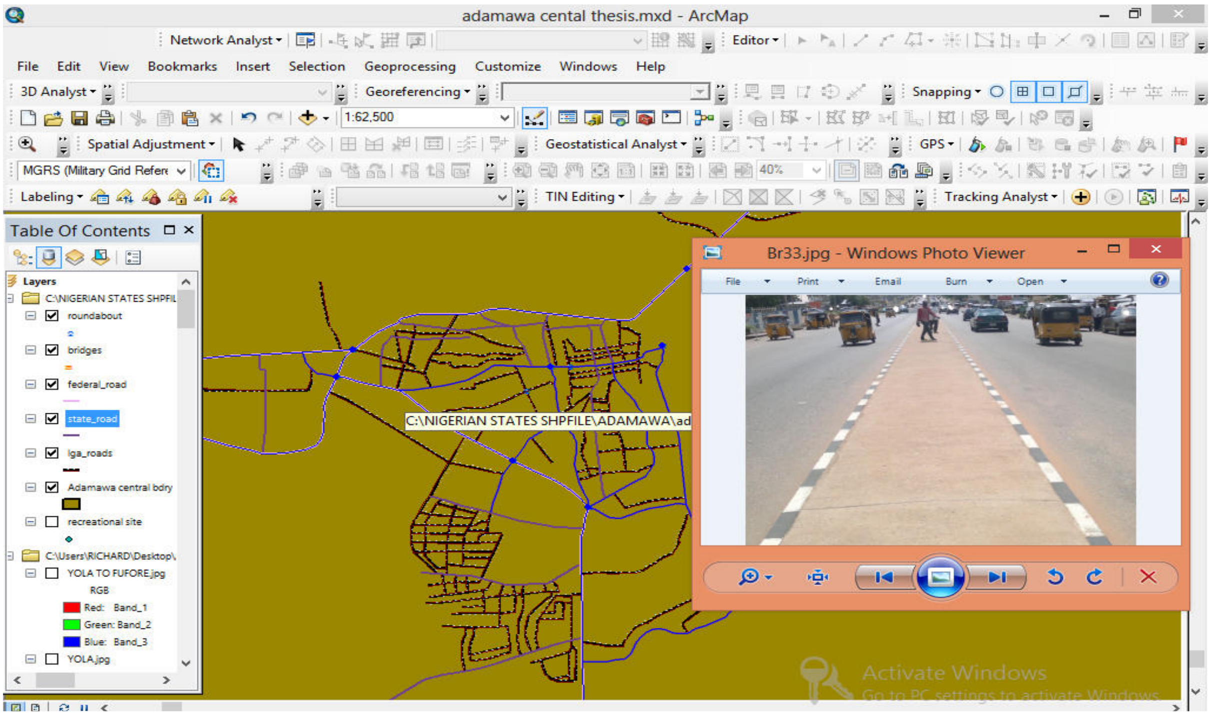

Figure 1.4b *Showing the physical structure of a Galadima Aminu road in Yola south LGA.*
Source: Author's analysis

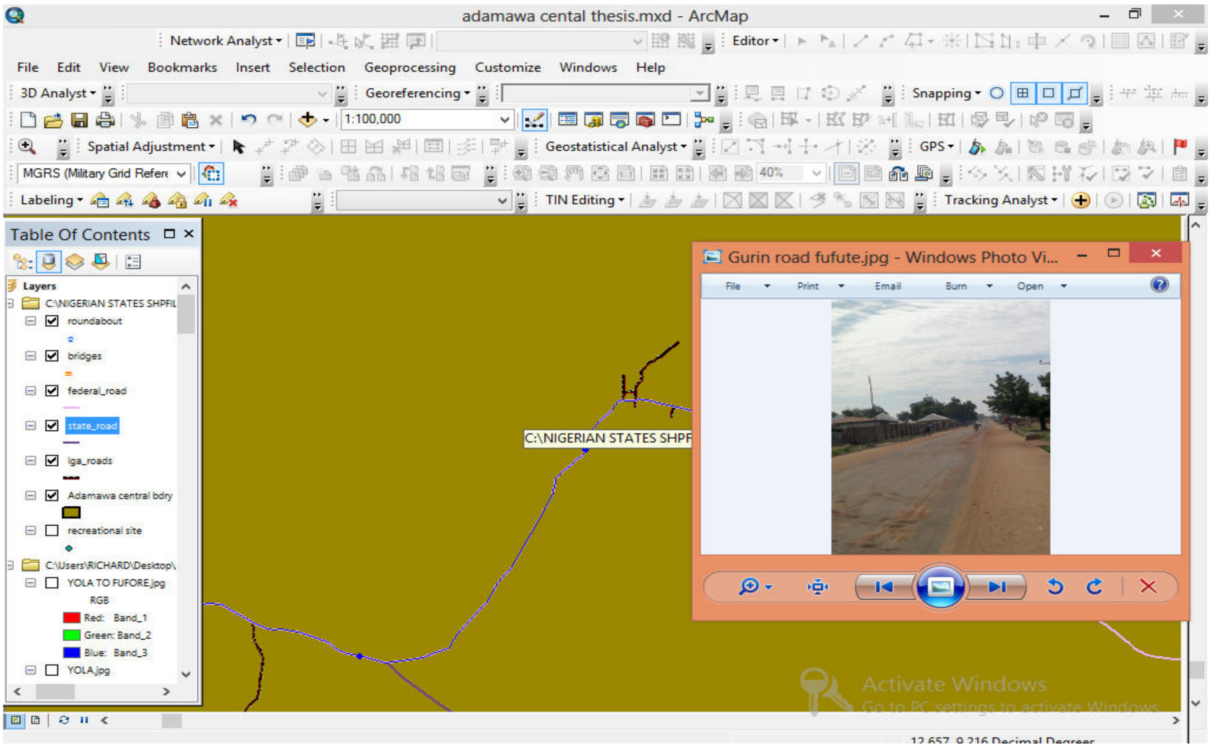

Figure 1.4c *Showing the physical structure of a Gurin road in Fufore LGA.*
Source: Author's analysis

Discussion of Results: By making the building themes active, the HYPERLINK TOOL is used, the selected road in white pops out an image of the structure of the road above by clicking it out. This analysis was carried out to show physical nature of the road for decision making in terms of maintenance and to see whether the road is due for reconstruction. And these are the pictorial representation of the road. There is no need of physical site visitation or inspection. Every detail is shown on the screen of the computer reference to spatial reference.

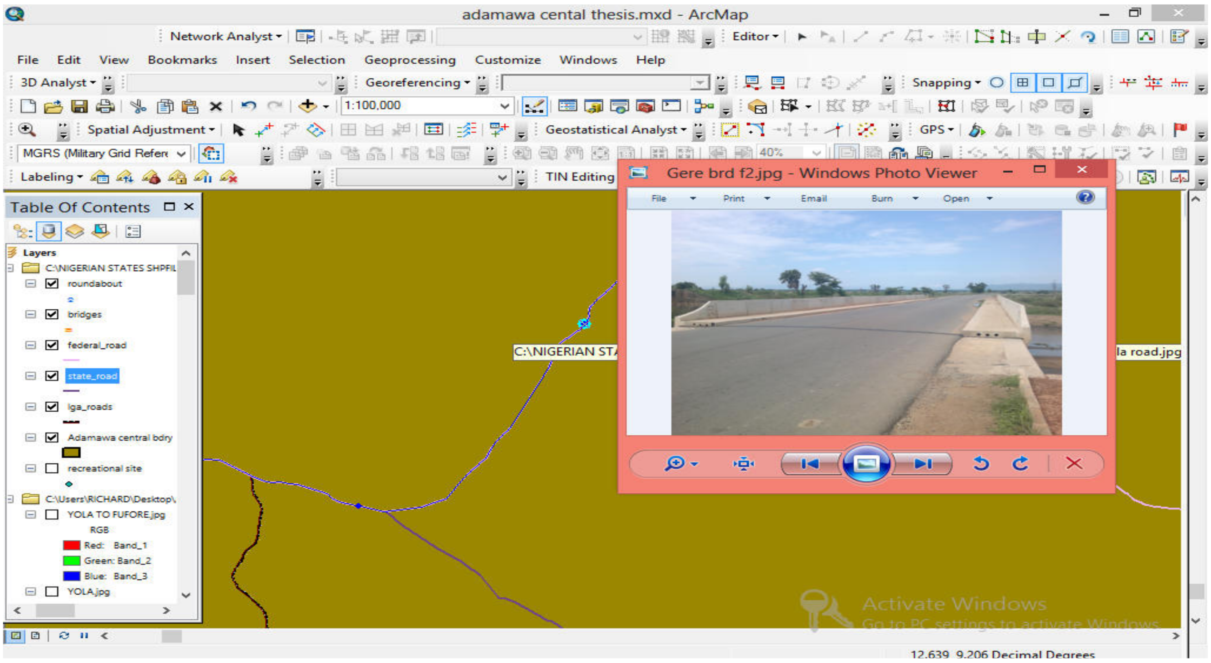

Figure 1.5a *Showing the physical structure of a Gere bridge in Fufore LGA.*
Source: Author's analysis

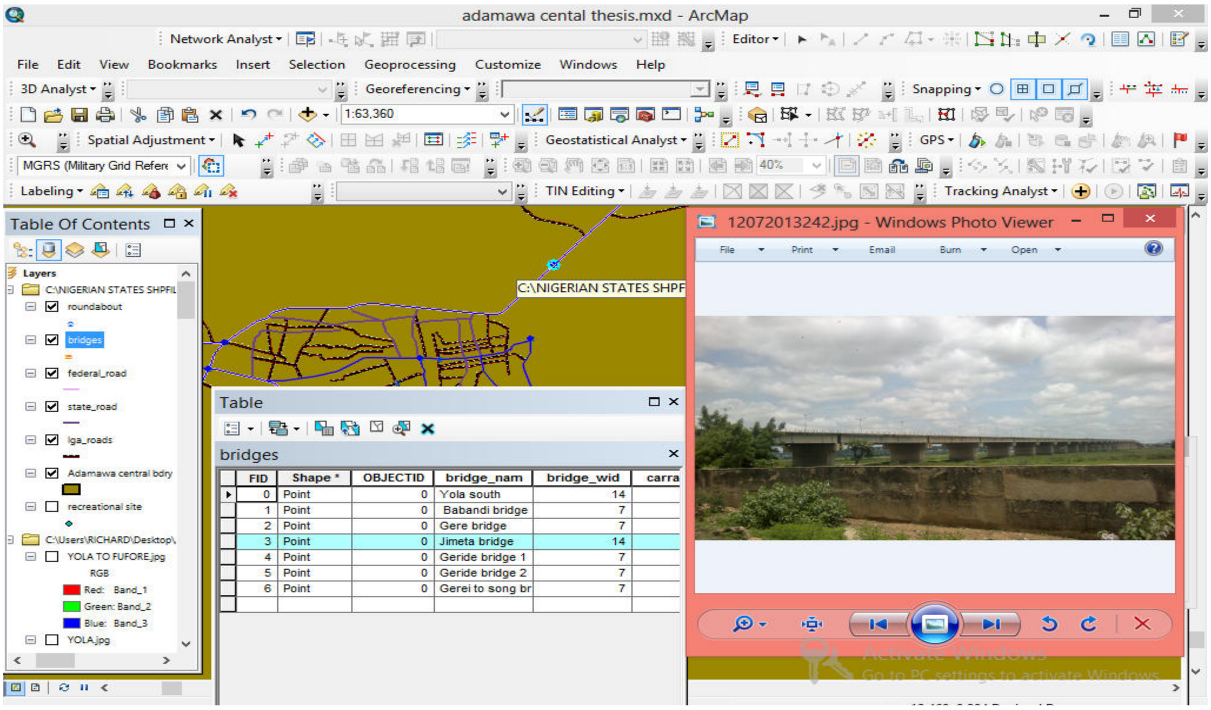

Figure 1.5b *Showing the physical structure of a Jimeta bridge, Yola North LGA.*
Source: Author's analysis

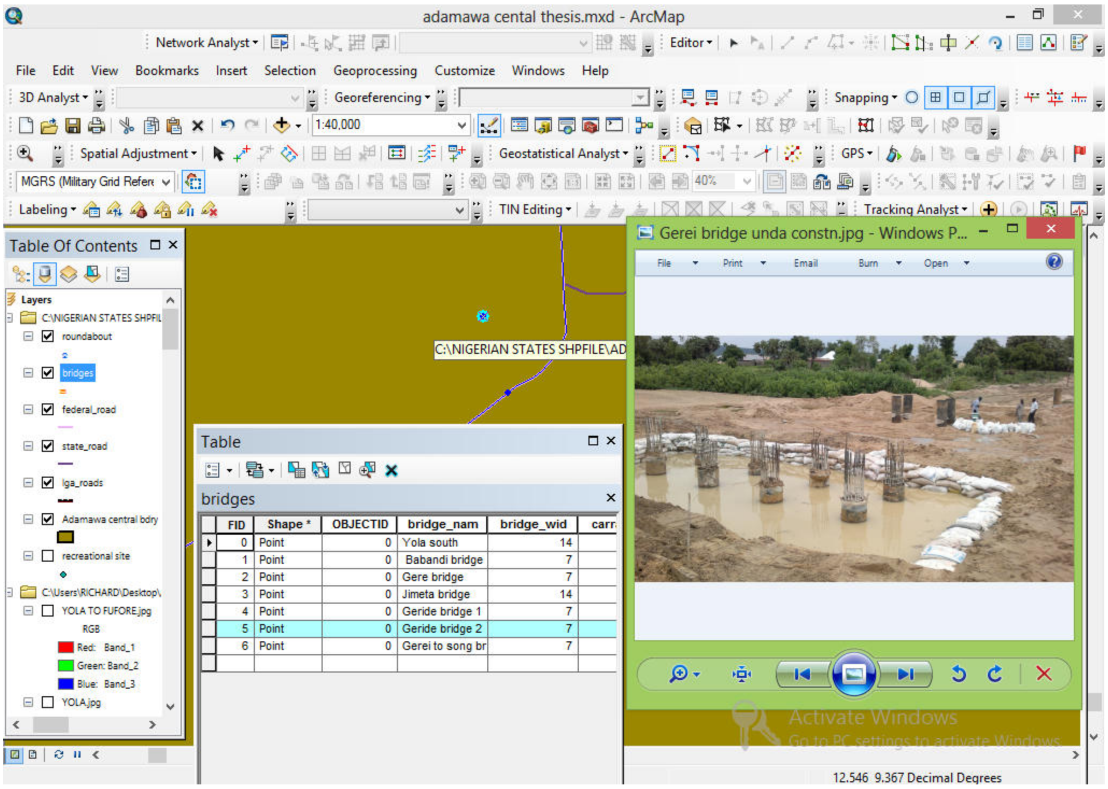

Figure 1.5c *Showing the physical structure of a Geride bridge, Gerei North LGA.*
Source: Author's analysis

Discussion of Results: HYPERLINK TOOL is used for the analysis, the selected bridge in beryl colour pops out an image showing the pictorial representation of the structure of the bridge above by clicking it out. This analysis was carried out to show physical nature of the bridge for maintenance and to see whether the road is due for reconstruction and development. And the attribute table indicate by beryl colour shows the details of the bridge in respect to the spatial reference as showed in figure 4.4.5 a and b above while figure 4.4.5c shows that the bridge is still under constructions.

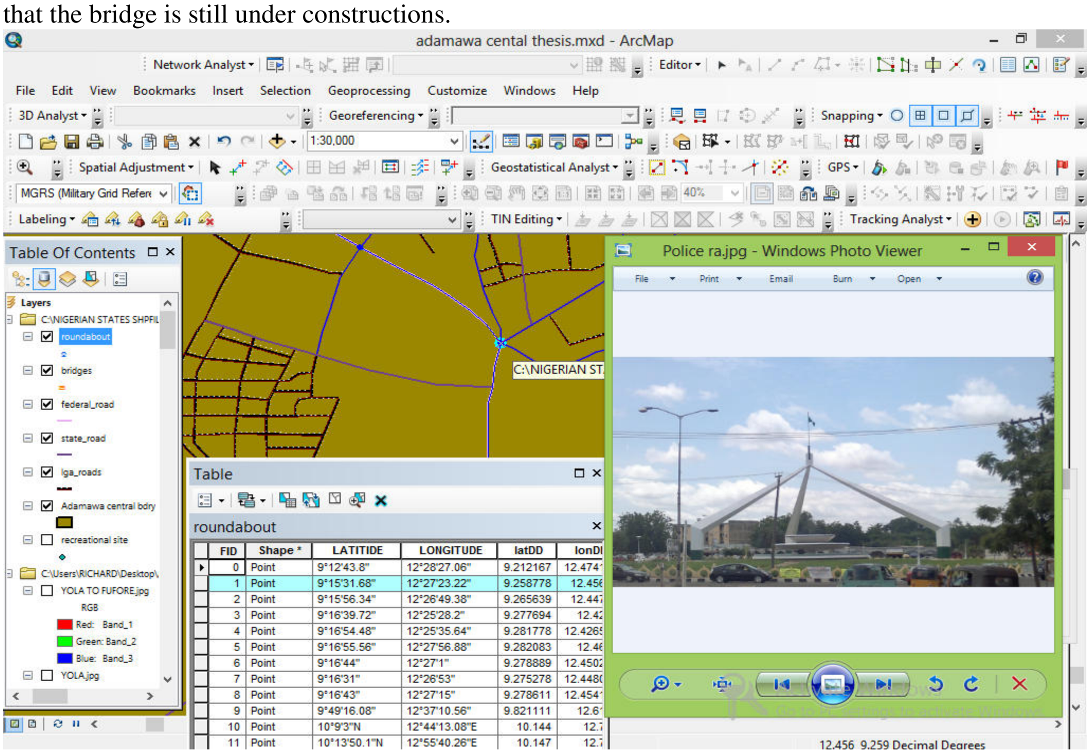

Figure 1.6a *Showing the physical structure of a Police roundabout, Yola North LGA.*
Source: Author's analysis

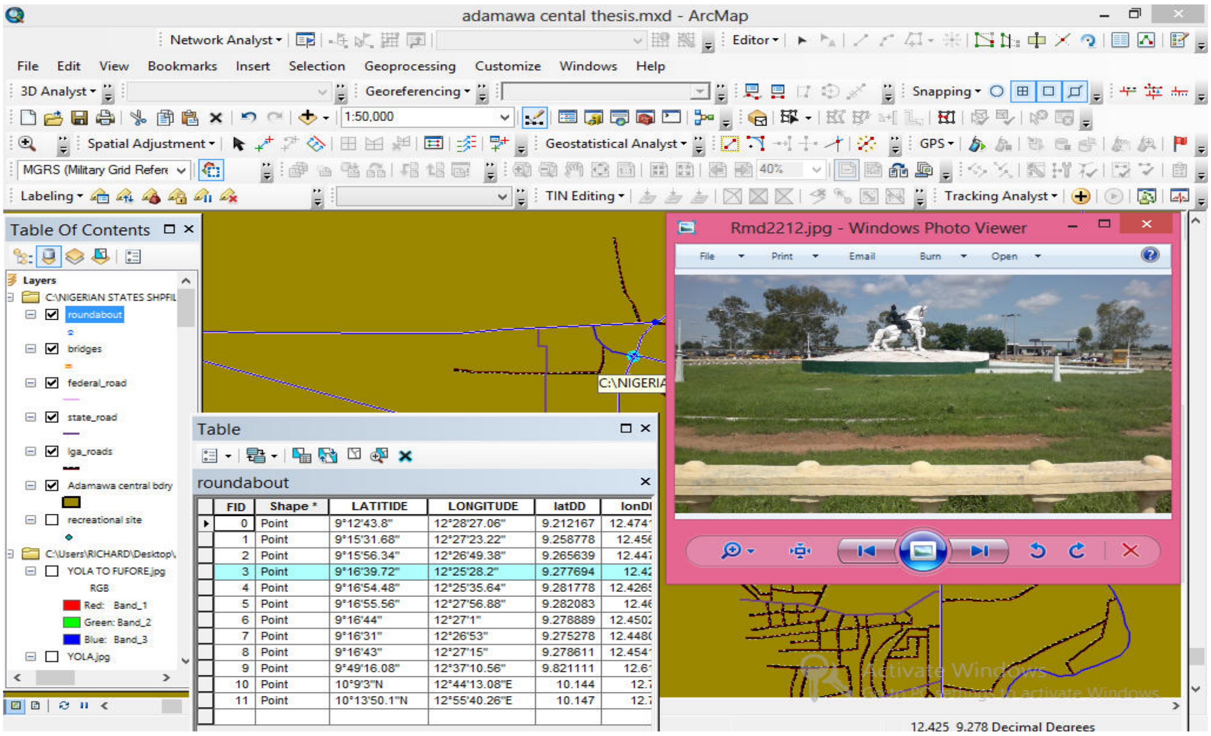

Figure 1.6b *Showing the physical structure of a Maidoki roundabout, Yola North LGA.*

Source: Author's analysis

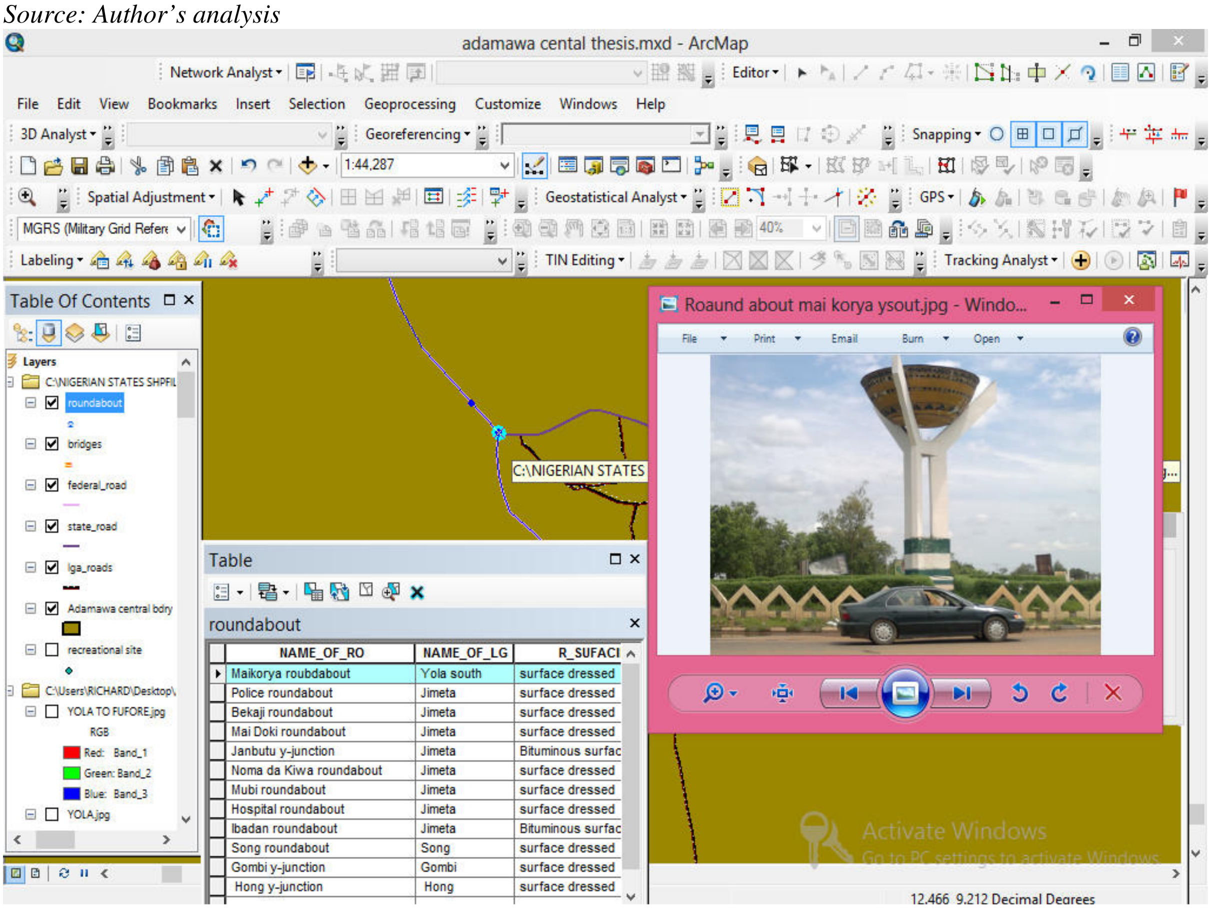

Figure .6c *Showing the physical structure of a Maikorya roundabout, Yola South LGA.*

Source: Author's analysis

Discussion of Results: HYPERLINK TOOL was also use in performing these analysis and beryl green colour also shows the point at which the picture is represented as showed in figures 1.6a, b and c.

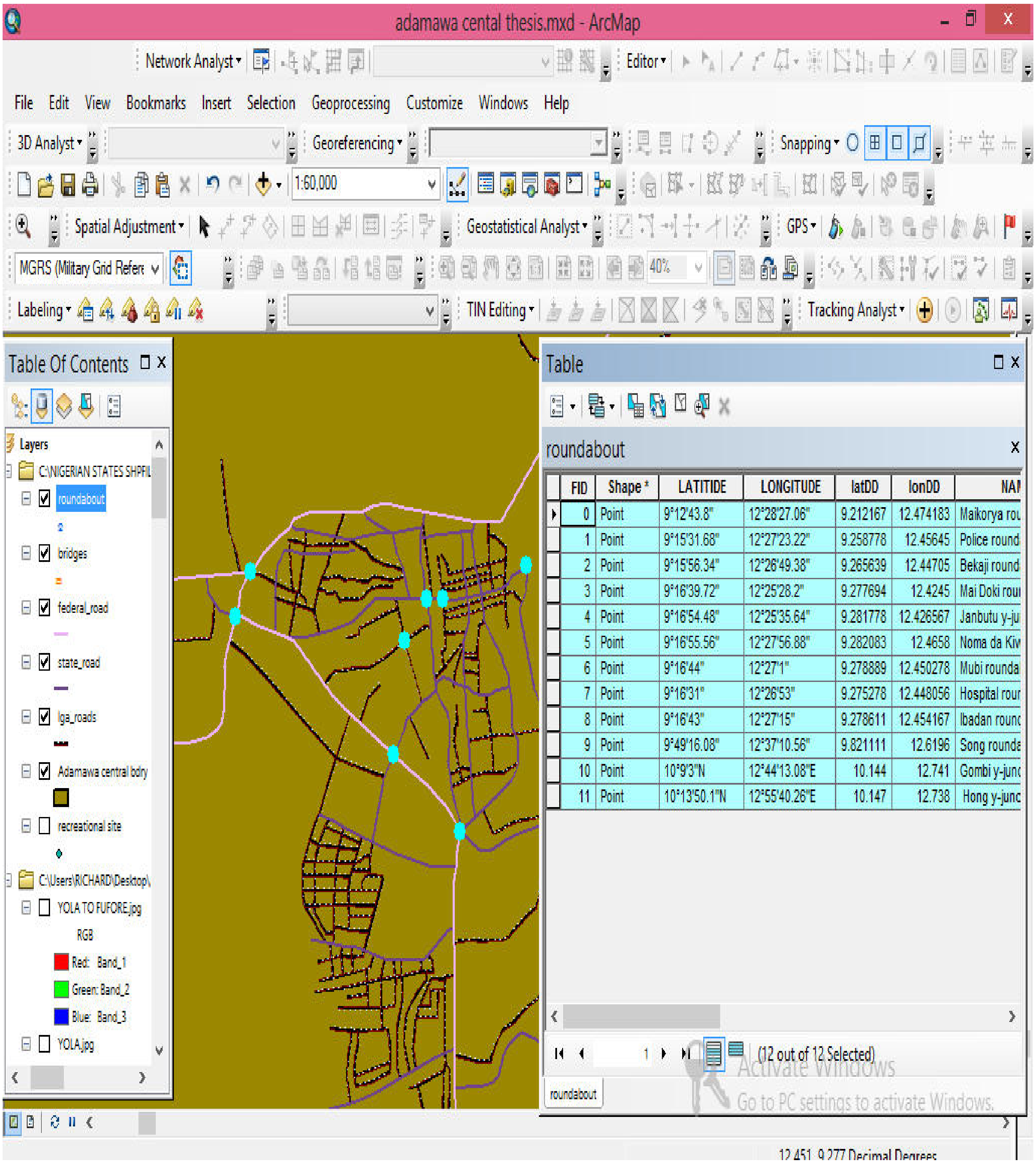

Figure 1.7 *showing some selected roundabout in Adamawa central.*
Source: Author's analysis

Discussion of Results: The dot spot beryl green colour on map in the figure automatically found the location and attribute of the roundabout in the Adamawa central.

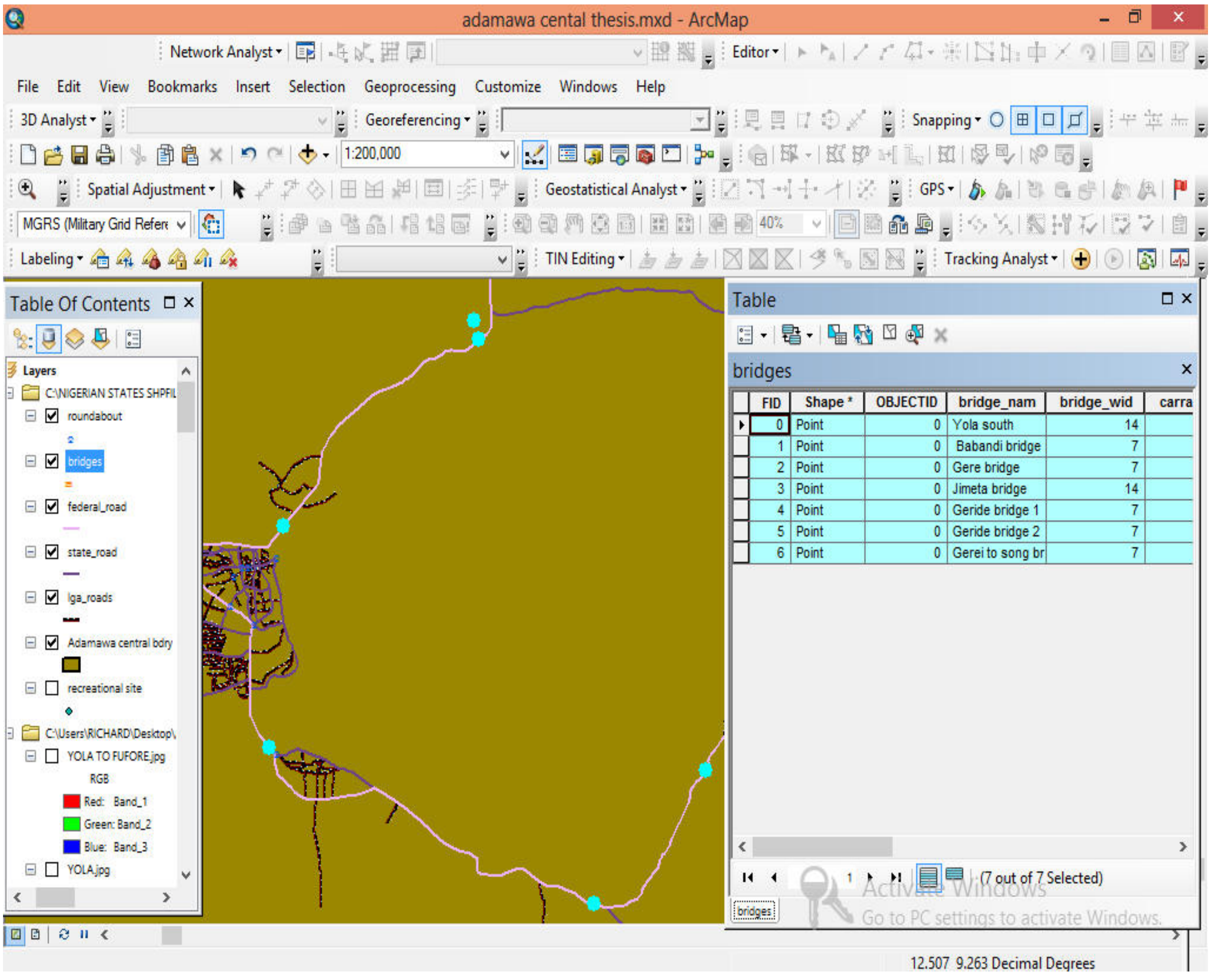

Figure 1.7 *showing some selected attribute of bridge in Adamawa central.*
Source: Author's analysis

Discussion of Results: The dot spot beryl green colour on map in the figure automatically found the spatial locations and attribute of the bridges in the Adamawa central.

CONCLUSION

GIS could provide a mechanism for data integration, management and output generation in its spatial environment. In this study, federal roads, state roads, local government roads, bridges and roundabout depicting the availability, distribution and extent or abundant of physical features in the Adamawa central were derived using GIS technology, various maps, design and layer designed for the Adamawa central provide valuable records (information) for the assessment, management, monitoring and development of the physical features on the map. To start with, it can be used for making queries on the Geodatabase in a series of what lies here or there is this mode. A logical query has been translated into a series of what lies here and/or what lies there. The results received descriptive and analytical answers which are for road planners, managers and decision-making because the types of inference, deduction and conclusion made is left entirely with the road transport authorities. Since the geodatabase has not been officially implemented in the state planning board, it is difficult to ascertain the likely problem that may arise during the implementation.

Within this road transport infrastructures, it is possible to compare themes without overcrowding screen with too much information. For instance, the roundabout themes would be compared with the road themes and a simple result would be given unlike the present analogue system in use where for each theme, there is a separate map sheet, and the map sheets are not on the same scale. The identifier tool; in the GIS allows the attribute data for any spatial data to be displayed on the screen immediately the spatial data is clicked with the mouse.

With the use of find tool, the roads of any type could be located by nearly typing the road name. The GIS finds the road bringing it to the centre of the screen and changing its colours so that it appears different from the rest. The geodatabase could be queried and the query result displayed on the screen. Thus, if bridge, roundabout or roads of the Adamawa central were selected, then only the bridge, roundabout or roads would be displayed.

Development of GIS-Based Road infrastructure Management system could be viewed as integrated computer software and hardware package, in spatial context, using Geographical Information System (GIS) and Road Transport Information System (RTIMS), its functionality on geodatabase development and road transport infrastructure management, its analytical modelling, mapping and spatial tabular and pictures display together with a framework for the decision-makers and expert, it has certain characteristics which differentiate it from any other software system.

The research has tried to show that the process of converting the traditional database system to a Geographical Information System (GIS) required planning will and commitment.

RECOMMENDATION

a. The government should establish GIS unit in the federal and state ministry of transports board and also encourage the local government areas to do the same for proper planning and development of road transport infrastructure and management for easy management and control of its facilities.
b. The government should encourage its ministries and other parastatals to use GIS for its decision-making tool because the system provides easy and flexible way of handling Geodatabase.
c. There is the need for a research like this to be carried out on areas such as pavement information system, roads accident information system, etc. for proper and adequate development of their Geodatabase for quick decision-making in the areas mentioned.
d. Development of a national Geo-spatial data clearing board in the federal, state and local government levels of the country.

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