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Use of GIS in Controlling and Mentoring the Road Network for the Regions of Ouargla and Touggourt

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Dedication

بسم الله الرحمن الرحيم

وصلى الله على سيدنا محمد وسلم

اللهم لك الحمد حتى ترضى، ولك الحمد إذا رضيت، ولك الحمد بعد الرضا، الحمد لله دائما وأبدا

لا يمكن للكلمات أن تعبر عن عمق الامتنان والحب الذي أحمله لكل واحد منكم. لقد كنتم أعمدة قوتي، ودعمي الذي لا يتزعزع، ومصدر فرح عظيم في حياتي.

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مع كل حبي وتقديري

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Dedication

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وصلى الله على سيدنا محمد وسلم

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محمد ضياء بناي

Abstract.

In this work, we aim to prove that geographic information systems can be a solution for managing, analyzing and controlling the roads in the regions of Ouargla and Touggourt, and we take an overview of the geographic information systems and the software used, then a brief study of the road network in the two study areas, and how GIS can be used in modeling and controlling the road network and showing all information related to it.

Keywords: **GIS**, **road network**, **GIS software**.

Résumé.

Dans ce travail, nous visons à prouver que les systèmes d'information géographique peuvent être une solution pour gérer, analyser et contrôler les routes dans les régions de Ouargla et de Touggourt, et nous faisons un tour d'horizon des systèmes d'information géographique et des programmes utilisés, puis un bref étude du réseau routier dans les deux zones d'étude, et comment le SIG peut être utilisé pour modéliser et contrôler le réseau routier et montrer toutes les informations qui s'y rapportent.

Mots-clés : **SIG, réseau routier, logiciel SIG**

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الكلمات المفتاحية: **نظم المعلومات الجغرافية، شبكة الطرق، برامج نظم المعلومات الجغرافية**.

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Introduction

General Introduction.

In recent years, the control and management of road networks has become increasingly complex in the modern society. With increasing urbanization, population density and vehicular traffic, effective and safe road network control has emerged as a critical challenge for transport authorities around the world. In this context, geographic information systems (GIS) have proven to be indispensable tools for improving road network control strategies. This introduction will explore the use of GIS, specifically the ArcGIS program, in controlling the road network of the regions of Ouargla and Touggourt.

The regions of Ouargla and Touggourt, located in the southeastern part of Algeria, are known for their extensive road networks connecting urban centers, industrial zones, and rural areas. Effective control and management of these road networks are essential for ensuring smooth traffic flow, improving road safety, and facilitating economic development in the region. This is where GIS and the ArcGIS program come into play a high part.

This work was organized as follows:

- **Chapter one:** A definition of GIS, its components and functions, examples of some areas of use. Additionally, concepts, functions, components, and uses of ArcGIS.
- **Chapter tow:** A brief definition of the two study areas, the states of Ouargla and Touggourt, and the size of the road network in them. Mention the devices and software used in the completion of the study.
- **Chapter three:** The discussion revolves around designing roads and adding related data, using GIS-related software's.

The purpose of choosing this topic is:

Most of the states of Algeria suffer from poor management and organization of information related to the road network, in this case Ouargla and Touggourt. Here, GIS offers a solution to this problem, through the optimal use of its advantages, it is possible to organize and control the huge amount of information and store it in a secure manner that facilitates access to him in the future.

Chapter I

Geographic Information Systems (GIS) & ArcGIS

Introduction

In this chapter we'll talk about the geographic information systems and the program ArcGIS, as well as what related to them (their components, features, basic elements, and benefits….).

I- Geographic Information Systems.

I-1. The history of Geographic Information Systems.

With a brief historical look, we find that geographic information systems began in Canada in 1964 by "**Roger Tomlinson"**, sometimes called the **father of geographic information systems**. During the seventies, the number of companies specialized in **GIS** software increased. The eighties witnessed an increase in the budget allocated to government agencies and private companies for **GIS**. As well as an increase in the number of specialists and a decrease in the prices of computers **GIS** and software. The nineties era witnessed an improvement in software and the ability of one program to carry out work that in the past required more than one program. With the development of computers during the third millennium, the use of multimedia and the Internet began, and the coming period will witness a revolution in the use of moving maps, thanks to the remarkable improvement in handheld computers. Internet and network connection. (By: GISGeography.19.01 2023).

I-2. The definition of GIS.

It is a computer-based system that collects, maintains, stores, analyses, outputs, and distributes spatial data and information. These systems help in planning and decision-making in relation to agriculture, urban planning, and housing expansion, in addition to reading the infrastructure of any city through what is called "layers."

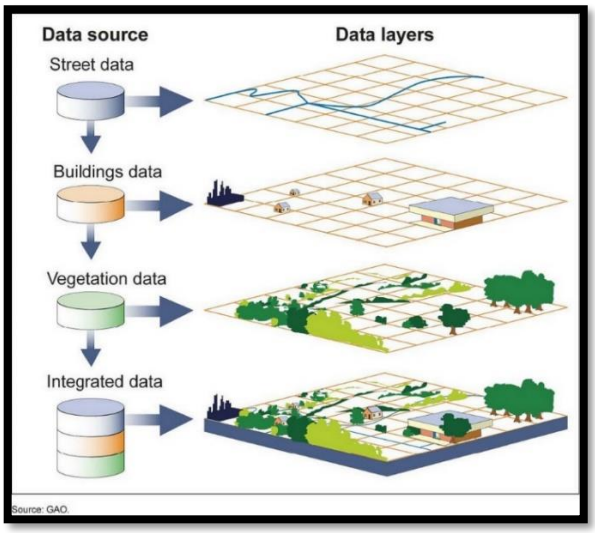

Figure (I - 1) Layers in GIS

I-3. GIS components.

GIS consists of five basic elements:

- Spatial and descriptive information (data).
- Computer equipment (hardware).
- Application (software).
- Human resources (people).
- Methods used for spatial analysis.

Figure (I - 2) Components of GIS.

3.1. Data.

Data is one of the most important components of a GIS, which in turn provides the system with data to complete the analysis process. Data within GIS is divided into:

3.1.1. Descriptive data.

It includes table data and various statistics on the elements and natural features that can be represented by nature.

3.1.2. Spatial data.

It is information that shows a place or location, and this information is linked to a location within a spatial or geographical reference (linked to geographical coordinates) and includes all the natural and artificial elements present in an area such as: civil borders, buildings, roads.

3.2. Computer equipment (hardware).

The concept of a machine in any system is a computer, where GIS operate on many types of computers, starting from the mainframe services that serve giant projects to personal computers that serve individuals.

This is in addition to the spread of GPS devices on the surface of the earth, which are used to determine the coordinates of certain points on the surface of the earth.

3.3. Application(software).

GIS programs provide the tools and methods for storing, analysing and displaying geographic information with application destinations as a tool for easy communication between the device and the user.

There are many different software programs used in GIS, each with their own strengths and weaknesses. Some commonly used GIS software programs include:

- **ArcGIS:** developed by ESRI, this is one of the most widely used GIS software programs in the world. It is a comprehensive suite of GIS tools that can handle all aspects of GIS data management, analysis, and visualization.
- **MapInfo:** a GIS software program that is often used in business settings for market analysis and demographic research.
- **Google Earth:** a popular GIS software program that allows users to view satellite imagery and maps of the world, as well as create custom maps and add their own data.
- **QGIS:** an opensource GIS software program that is free to use. It has many of the same features as ArcGIS, but may not be as polished or user-friendly.

- **GRASS GIS:** another opensource GIS software program that is widely used in academic and research settings. It is known for its powerful spatial analysis capabilities.

These are just a few examples of the many GIS software programs available. The choice of which program to use will depend on your specific needs and the types of GIS tasks you will be performing. (By: GISGeography.19.01 2023).

3.4. Human resources (people).

Human power is an important part and a key factor in GIS. Here are some ways in which people are involved in GIS:

- GIS professionals.
- Data collectors.
- Data analysts.
- Decision-makers.
- End-users.

In short, people are essential to the design, implementation, and use of GIS systems. They are responsible for collecting and analysing data, making decisions based on that data, and using GIS technology to achieve a wide range of goals.

3.5. Methods.

The strength and importance of GIS lies in its ability to perform spatial and statistical analysis, and analysis methods is the beating heart without which there is no life or benefit from the collected and revised information. There are many different methods and techniques that can be used within GIS to accomplish various tasks, including:

- Data acquisition.
- Data storage and management.
- Data analysis.
- Visualization.
- Modelling.
- Network analysis.
- Geocoding and geolocation.

These are just a few examples of the many methods and techniques that can be used within GIS, depending on the specific application and data being used.

I-4. Features of GIS.

- Assist in planning new and expansion projects.
- Speed in accessing a large amount of information with high efficiency.
- Help to make the best decision in the fastest time.
- Helps spread information to the largest possible number of beneficiaries.
- Integration of spatial information and descriptive information into one database.
- Documenting and confirming data and information with unified specifications.
- Coordination between the information and the relevant authorities before making a decision.
- High spatial analytical ability.
- The ability to answer inquiries about location or descriptive information.
- The ability to visualize spatial information.
- Reducing production time and improving accuracy.
- Reducing labour and cost.

I-5. Benefits of GIS.

GIS can provide many benefits at the economic, social, and cultural levels. Here are some examples:

Economic benefits: GIS can be used to analyze and visualize spatial data related to economic activities such as retail sales, real estate, and tourism. This can help businesses and governments make better-informed decisions about where to invest and allocate resources. GIS can also help businesses identify new market opportunities and optimize their operations by analyzing transportation routes, logistics, and supply chains.

Social benefits: GIS can be used to analyze and visualize data related to social issues such as poverty, education, and health. This can help governments and non-profit organizations identify areas of need and allocate resources more effectively. GIS can also be used to map social networks and community assets, which can help build stronger, more resilient communities.

Cultural benefits: GIS can be used to map and preserve cultural heritage sites and artifacts, such as historical landmarks, traditional land-use patterns, and indigenous cultural practices. This can help promote cultural tourism and education, and preserve cultural heritage for future generations. GIS can also be used to analyze and visualize cultural data, such as language use and migration patterns, which can help promote cross-cultural understanding and cooperation.

Overall, GIS can help promote economic development, social equity, and cultural preservation and understanding at the local, regional, and global levels.

I-6. Domain of Use GIS.

GIS can be used in many domains such: agriculture, ecology, water management, meteorology, etc.....

6-1. GIS in agriculture:

There are several specific GIS application areas in agriculture:

- including crop yield estimation, soil fertility assessment, cropping patterns monitoring, drought assessment, pest and crop disease detection and management, precision agriculture, and fertilizer and weed management.
- Evidence-informed decision-making using GIS can empower small-scale farmers to make informed decisions and implement practicable activities that increase agricultural productivity.
- Limitations and challenges to implementing GIS in agriculture include the cost of technology, lack of appropriate skills, and the challenge of simulating crop yield production due to the variety of cropping systems and levels of technology used.
- To address these challenges, there is a need for capacity building programs to train farmers and other stakeholders on how to use GIS technologies effectively. Additionally, there is a need for investment in infrastructure and resources to support GIS implementation in agriculture. (**Mwehe Mathenge, Ben Sonneveld, Jacqueline E W Broerse. 08-2022**).

6-2. GIS in climate and meteorology:

here are some examples of how GIS is used in climate and meteorology:

- **Mapping weather patterns:** GIS can be used to map and analyze weather patterns, such as temperature, precipitation, and wind speed. This information can be used to identify areas that are at risk for severe weather events like hurricanes or tornadoes.
- **Climate modeling:** GIS can be used to create models of climate change by analyzing data from various sources, such as satellite imagery and weather stations. These models can help scientists predict future climate patterns and their potential impact on the environment.
- **Disaster response:** GIS can be used to help emergency responders plan for and respond to natural disasters like floods or wildfires. By mapping the affected areas and identifying vulnerable populations, responders can allocate resources more effectively.
- **Urban planning:** GIS can be used in urban planning to analyze the impact of climate change on cities, such as rising sea levels or increased temperatures. This information can help city planners develop strategies for adapting to these changes. (**Scott Shipley, Ira A. Graffman. 01-2000**)

6-3. GIS in Environment and Ecology:

Here some ways to use GIS in the environment:

- **Environmental Impact Analysis (EIA):** GIS aids in assessing the magnitude and characteristics of environmental impact from human activities. Integration of GIS layers enables efficient EIA by analyzing natural features.
- **Zoning of Landslide Hazard:** GIS facilitates the evaluation and zonation of landslide hazard by integrating various spatial data.
- **Determination of Land Cover and Land Use:** GIS technology helps determine changes in land cover and land use over time. It enables the detection of sudden changes caused by natural forces or human activities like deforestation.

- **Estimation of Flood Damage:** GIS assists in mapping flooding risk areas and estimating flood damage. It helps document the need for federal disaster relief funds and assess property loss for insurance purposes.
- **Management of Natural Resources:** GIS aids in the management of agricultural, water, and forest resources. It enables monitoring of forest conditions, managing crop yield, and analyzing the distribution of water resources.
- **Soil Mapping:** GIS helps identify and classify soil types, delineate soil boundaries, and create soil maps. It provides valuable information for land use activities, preventing environmental deterioration.
- **Wetland Mapping:** GIS allows for quick mapping and design projects for wetland conservation. Integration with remote sensing data facilitates wetland mapping on various scales.
- **Irrigation Management:** GIS assists in the proper and efficient management of water availability for irrigation purposes.
- **Identification of Volcanic Hazard:** GIS, combined with historical records of volcanic activities, helps identify potential volcanic hazard zones. also; It enables impact assessment studies on volcanic hazards, considering economic loss and the safety of populated areas.

6-4. GIS in water management:

Here are some examples of how GIS can be used in water management:

- Spatially Distributed Crop Water Use Estimation.
- Soil Moisture Mapping for Floods and Droughts.
- Spatial Land Use and Land Cover Mapping. (**W.G.M. Bastiaanssen, Muhammad Jehanzeb Masud Cheema, 12-2017**)

There is also:

- Watershed Analysis and Modelling and Simulation
- Water Supply and Distribution and Water Quality Monitoring.
- Drought Monitoring and Planning. (**Peter H. Gleick, 2000**) (**Johan Rockström, 2004**)

II- ArcGIS.

II-1 Definition of ArcGIS.

Aeronautical Reconnaissance Coverage Geographic Information System or (**ArcGIS**) is geospatial software to view, edit, manage and analyse geographic data. developed and maintained by **Esri** for mapping on desktop, mobile, and web. Their motto is **"Science of Where"**. As such, the focus for ArcGIS is on location intelligence and analytics. (By: GISGeography.19.01 2023).

Figure (I - 3) ArcGIS Logo.

Esri (Environmental Systems Research Institute) develops ArcGIS software.

In 1969, the company was first founded primarily for land use development, and ArcGIS is the leading GIS software in the market today.

GIS integrates many different subjects using geography as its common framework. Esri is the global leader in the development of GIS, location intelligence, and mapping. (By: GISGeography.19.01 2023).

II-2. Users of ArcGIS.

ArcGIS users are in a wide range of fields and industries. For example, government, education, and commercial industries use ArcGIS. But the largest user base is in the environment, military, and land planning. Because most colleges use ArcGIS, graduates are usually somewhat familiar with it.

II-3. ArcGIS Software's.

ArcGIS is a set of software consisting of:

- **ArcMap:** is the centrepiece of the Esri suite of GIS software. It's how users create maps from scratch. By analysing data, they can find location patterns and trends in ArcMap. Finally, users edit data and can call it their own. The main format for ArcMap is an MXD (Map Exchange Document).

Figure (I - 4) ArcMap Icon.

- **ArcCatalog:** ArcCatalog is more like Windows Explorer which shows only geospatial data. In a way, it's also like a library where you can organize and manage your GIS data. ArcCatalog is where you document and write metadata as well.

Figure (I - 5) ArcCatalog Icon.

- **ArcGIS Pro:** ArcGIS Pro will one day replace ArcGIS. It has several advantages over ArcGIS. For example, its main advantages are 64-bit processing, integrated 3D, and ribbon-based interface. Unlike ArcGIS, it stores your maps, data, and toolboxes as a project file (.APRX). Finally, ArcGIS Pro has tools and extensions that go a bit beyond ArcGIS.

Figure (I - 6) ArcGIS Pro Icon.

- **ArcScene:** Using the 3D Analyst extension, you can access ArcScene. ArcScene focuses on local areas like the size of a neighbourhood. If you want to save a scene, its format is SXD.

Figure (I - 7) ArcScene Icon.

- **ArcGlobe:** ArcGlobe is a 3D application for larger study areas. Instead of the size of a neighbourhood, it's well-suited for global extents. If you're going to use ArcGlobe, its file format is 3DD (ArcGlobe Document).

Figure (I - 8) ArcGlobe Icon.

- **ArcReader:** ArcReader provides GIS users with a method to share maps locally, over networks, and on the Internet. ArcReader preserves a live connection to data so your data view is dynamic. This also makes ArcReader useful for publishing maps based on ArcGIS Server content.

Figure (I - 9) ArcReader Icon.

- **ArcGIS Extensions and ArcToolbox:** By using ArcGIS extensions and add-ons, you can boost the capabilities of the stand-alone product. For example, there are extensions for GPS tracking, geostatistics, and more. Each add-on has a toolset that you can use as part of an ArcToolbox.

Figure (I - 10) ArcToolbox Icon.

II-4. ArcGIS Features.

the features of ArcGIS software include:

- **Mapping and Visualization:** ArcGIS provides a powerful set of tools for creating, managing, and sharing maps and other visualizations. Users can create dynamic and interactive maps that can be customized to display a wide variety of data and information.
- **Geoprocessing and Analysis:** ArcGIS provides a wide range of geoprocessing tools for analyzing and manipulating spatial data. These tools can be used for tasks such as data conversion, spatial analysis, and data management.
- **Data Management:** ArcGIS provides tools for managing a wide variety of spatial data including raster and vector data, geodatabases, and feature classes.
- **Spatial Analysis:** ArcGIS provides a suite of advanced spatial analysis tools for tasks such as site selection, spatial statistics, and terrain analysis.
- **3D Visualization:** ArcGIS supports the creation of 3D visualizations, including the ability to create and edit 3D models, terrain, and buildings.
- **Mobile GIS:** ArcGIS provides tools for creating and deploying mobile GIS applications, allowing users to collect and analyze spatial data in the field.
- **Web GIS:** ArcGIS provides tools for creating and deploying web GIS applications, allowing users to share and collaborate on maps and other spatial data over the web.
- **Integration with other systems:** ArcGIS can be integrated with other systems and technologies, including enterprise systems, databases, and other GIS systems.
- **ArcGIS Online:** ArcGIS Online is a cloud-based platform that provides access to a variety of GIS services, including mapping, data storage, and analysis tools. (By "ArcGIS Enterprise". 30 August 2022).

Conclusion.

In this chapter, we have seen the definition of GIS and ArcGIS, as well as their components, features, basic elements, and benefits of using them.

Chapter II

Study Area

Introduction

In this chapter we will talk about the two-study area we're working in theme; **Ouargla** and **Touggourt**, we'll talk about the location and their geographical coordinates, as well as the size of their road network.

We'll also talk about the hardware and software used to conduct this study.

I. Ouargla Area.

Ouargla a state **n˚30** located in the Sahara Desert in Algeria. Its geographic coordinates are approximately

- **31.9625** degrees north latitude.
- **5.3233** degrees east longitude.

Ouargla is an important state in south-eastern Algeria, and it has a relatively developed road network for the region. The road network connects the city with other major cities in the country, as well as with neighbouring countries in the Sahel and North Africa region.

Table (II - 1) The Size of Road Network in Ouargla.

Secteur Route	
Longueur Routes Nationales	**1211.0 Km**
Longueur Chemins de Wilaya	**129.5 Km**
Longueur des Chemins communaux	**178.8 Km**
Nombre de Chemins communaux	**30 nbr**

II. Touggourt Area.

Touggourt a state **n˚55** located in the Sahara Desert in Algeria, Its geographic coordinates are approximately:

- **33.0996078** degrees north latitude.
- **6.0785104** degrees east longitude.

Touggourt was until **2019** administratively affiliated to Ouargla, until it was considered an independent state from it.

Table (II - 2) The Size of Road Network in Touggourt.

Secteur Route	
Longueur Routes Nationales	**273 Km**
Longueur Chemins de Wilaya	**230.6 Km**
Longueur des Chemins communaux	**143 Km**
Nombre de Chemins communaux	**38 nbr**

- The road network in Ouargla and Touggourt is divided into:
  - NATIONAL ROADS.
  - ROADS OF WILAYA.
  - COMMUNAL ROADS.
  - URBAN ROADS.

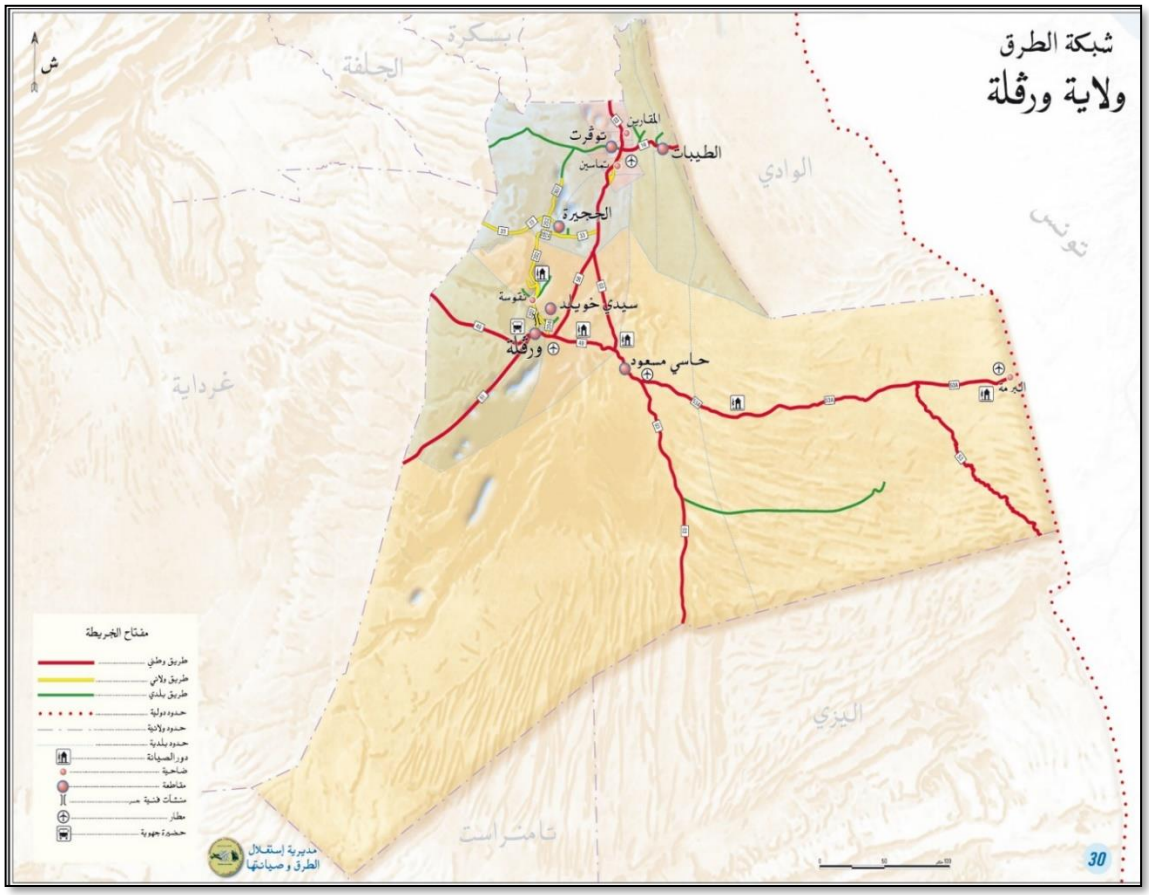

Figure (II - 1) Road Network of Ouargla and Touggourt states.

We used in this work the following information, we summaries it in a table:

Table (II - 3) The Information used in this study.

Type de Route	Wilaya	Longueur	Largeur	Départ & PK départ	La fin & PK la_fin	Etat Général	Trafic
Routes Nationals	Touggourt Ouargla	-	-	-	-	Bon Moyen Mauvais	-
Chemins de Wilaya		-	-	-	-		-
Grand Routes Urban		-	-	-	-		-

PK: point Kilometrique.

III. The Hardware and Software.

In this work we used:

- Projection system: WGS_1984.
- Coordinate system: UTM.

Hardware: one pc **ASUS**:

- Intel(R) Core (TM) i7-4510U CPU @ 2.00 GHz 2.60 GHz.
- Memory (Ram) 8GB.
- 64-bit operating system x64 processor.
- Windows 11 pro.

Software: **Google Earth pro, Global Mapper 20, ArcGIS 10.8 Desktop.**

Conclusion.

In this chapter, we have seen two-study area **Ouargla** and **Touggourt**, and their location and their geographical coordinates.

Likewise, we've seen the hardware and software used to conduct this study.

Chapter III

The Practical Side of the Study

Introduction

In this chapter we're talking about how to design a road and add data about this road, by using these software's: **Google Earth pro, Global Mapper 20, ArcGIS 10.8 Desktop.**

This study was divided into three phases, and all information used dates back to 31/12/2022.

- **First,** the road is drawn and saved in **KML** format using **Google Earth.**
- **Secondly,** the saved data is converted from **KML** format to **Shapefile** format using **Global Mapper,** and the geographical projection system is modified as well**.**
- **Thirdly,** the converted data is entered into **ArcGIS,** and the information for each drawn road is added, which is information that can be modified.

These are the steps followed during this study.

I. Google Earth pro.

By using **Google Earth Pro**, the road network will be drawn, and the data will be saved and sorted by name (RN, CW, GRU). Follow the steps detailed in the following pictures:

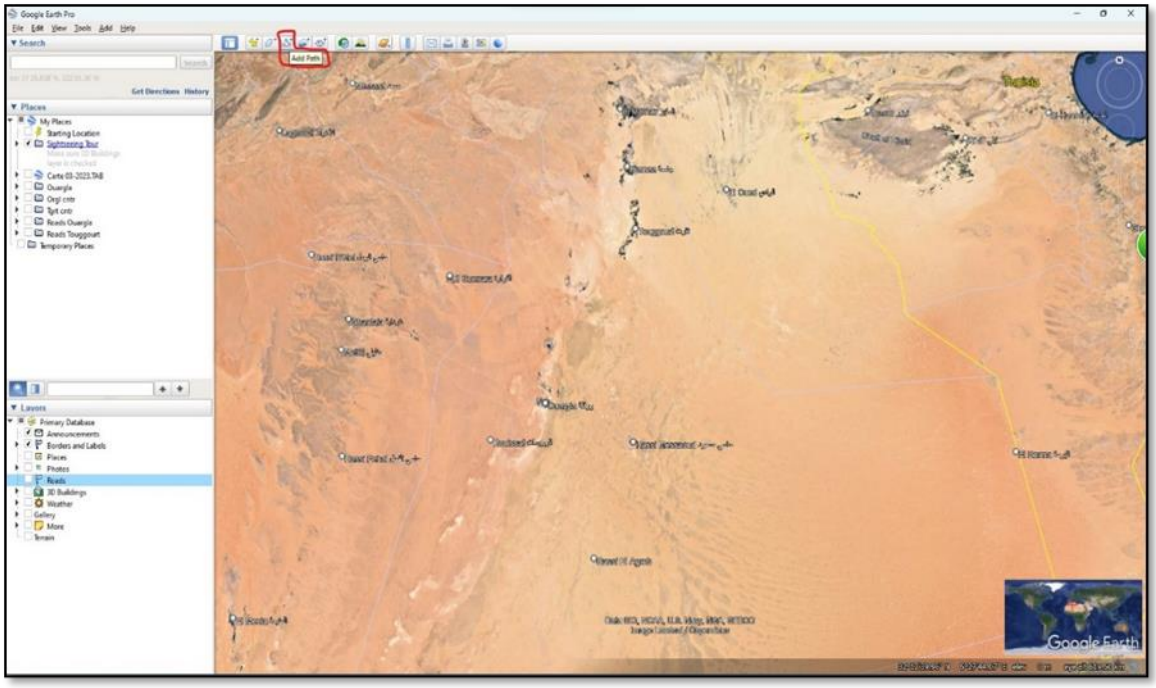

Figure (III - 1) Select "Add Path".

We select add path from the toolbar to draw the road we want.

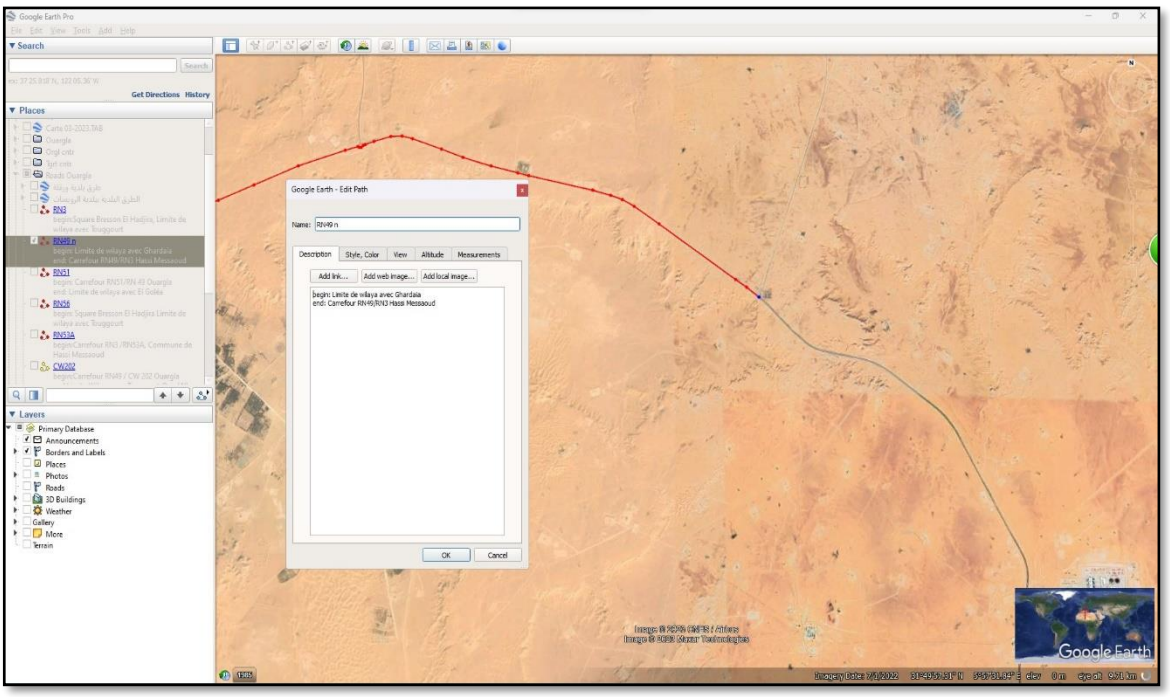

Figure (III - 2) drawing the Path.

We can add a description and choose style, color and other settings.

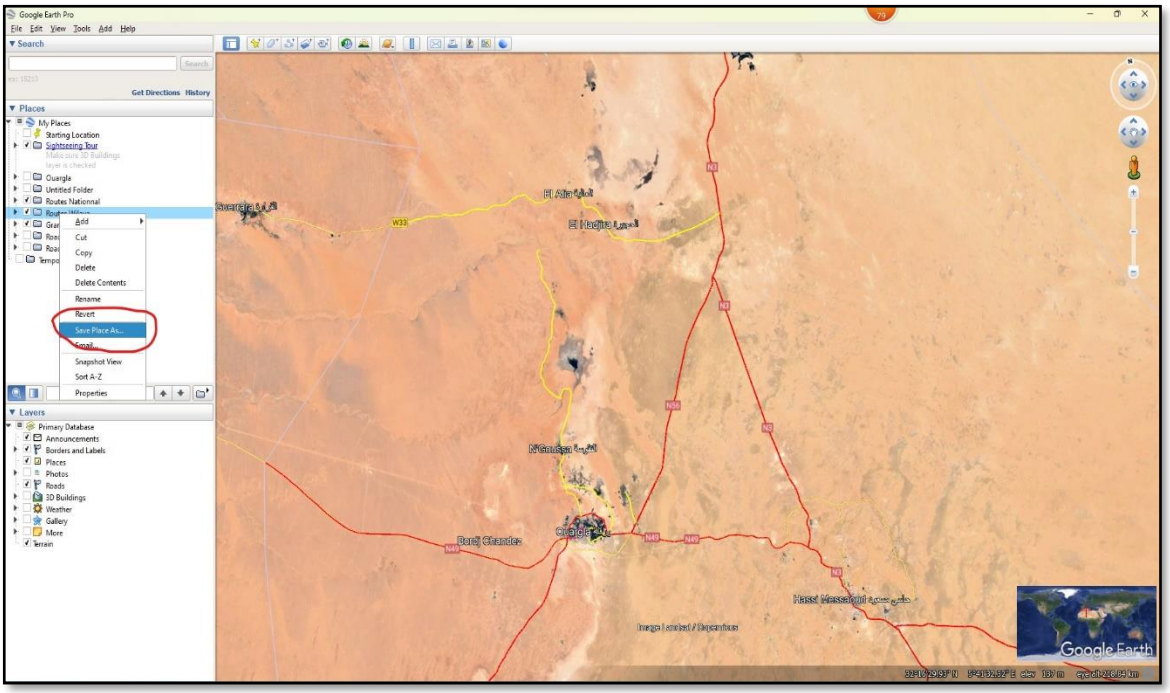

Figure (III - 3) Save drawing road.

We save all the data we have in “save place as.”.

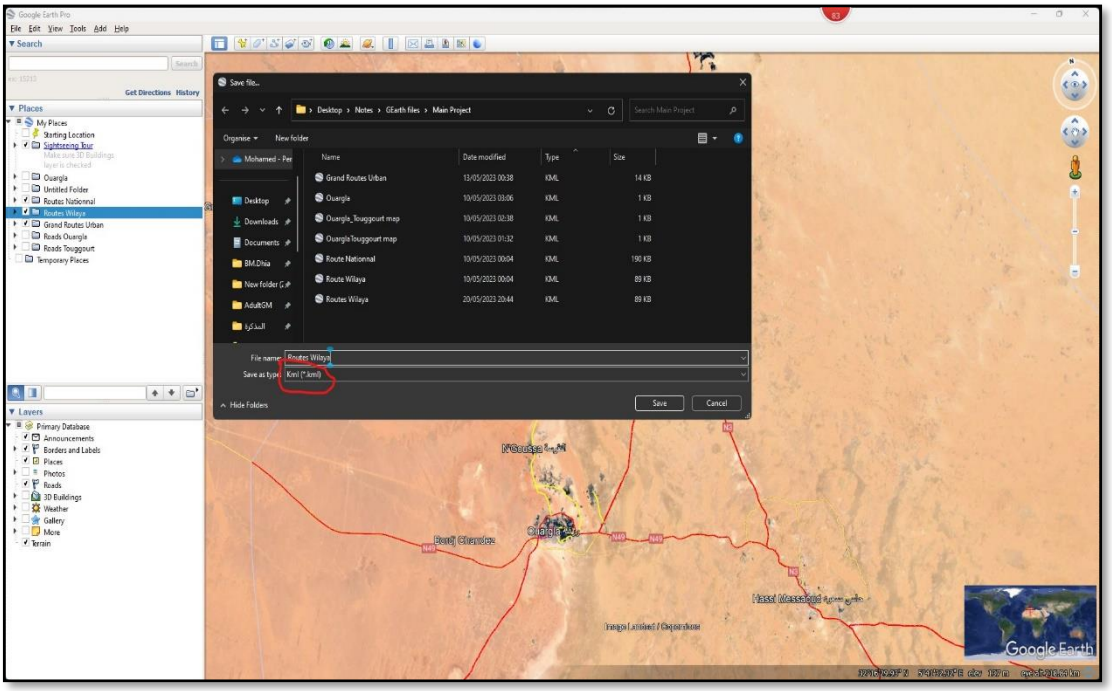

Figure (III - 4) Save file.

Choose the folder where to save the data, and save it in **KML format**.

After doing these steps, we've completed **the First Phase;** and go to **Global Mapper**.

II. Global Mapper.

By using Global Mapper, the data will be transferred from **KML** format to **Shapefile** format, which can be read by **ArcGIS**.

Before doing that, the existing data needs to be exported to a **Vector Format**, and the projection system will be modified to comply with the study's projection system.

The following pictures explaining that:

Figure (III - 5) Open data files.

Here we see the **Global Mapper Interface**, we choose **Open data files.**

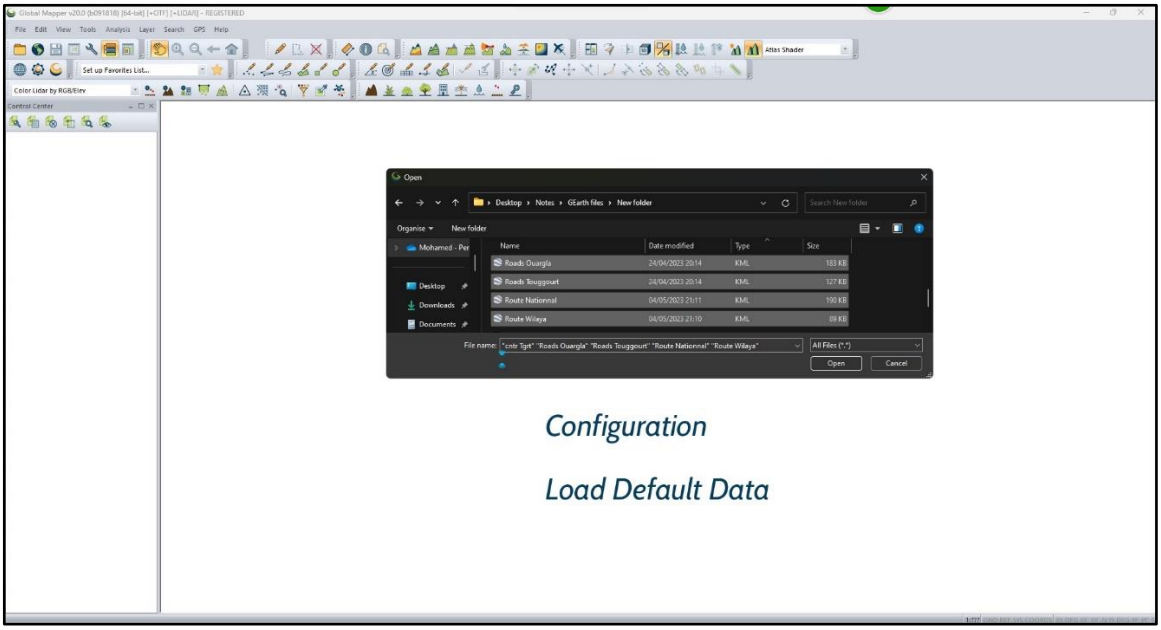

Figure (III - 6) select file and open data.

We go to the folder where save our data, and choose data whit **KML format**.

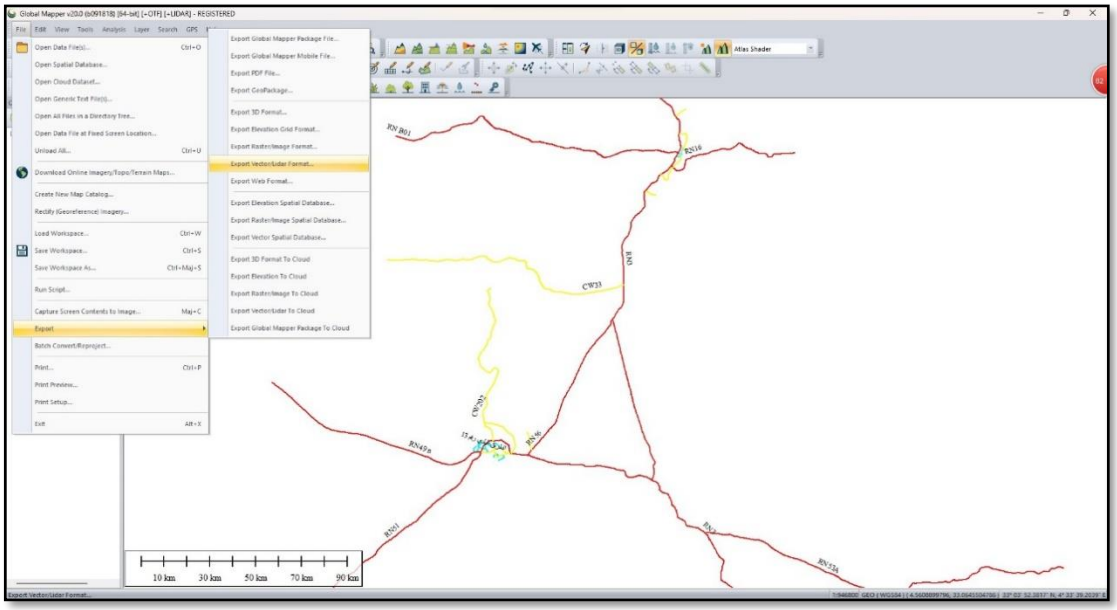

Figure (III - 7) Export Vector Format 1.

From toolbar we go to “File” then “Export” then “Export Vector Format”.

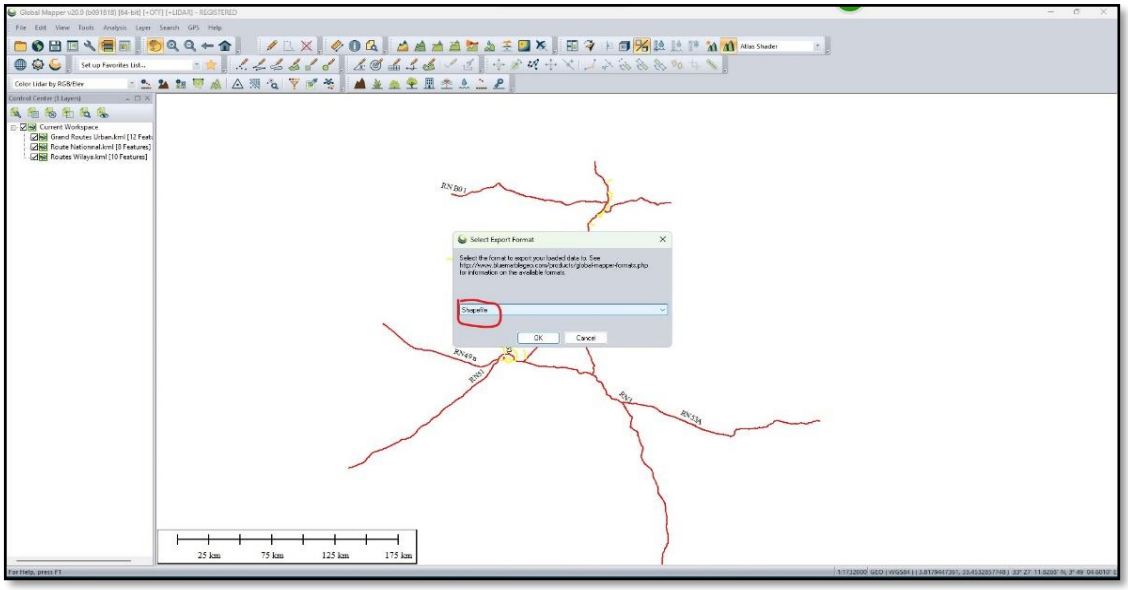

Figure (III - 8) Export Vector Format 2.

from the box we choose shapefile, this format can be readable by ArcGIS. (The Esri vector data storage format is to store the location, shape and features of geographical features).

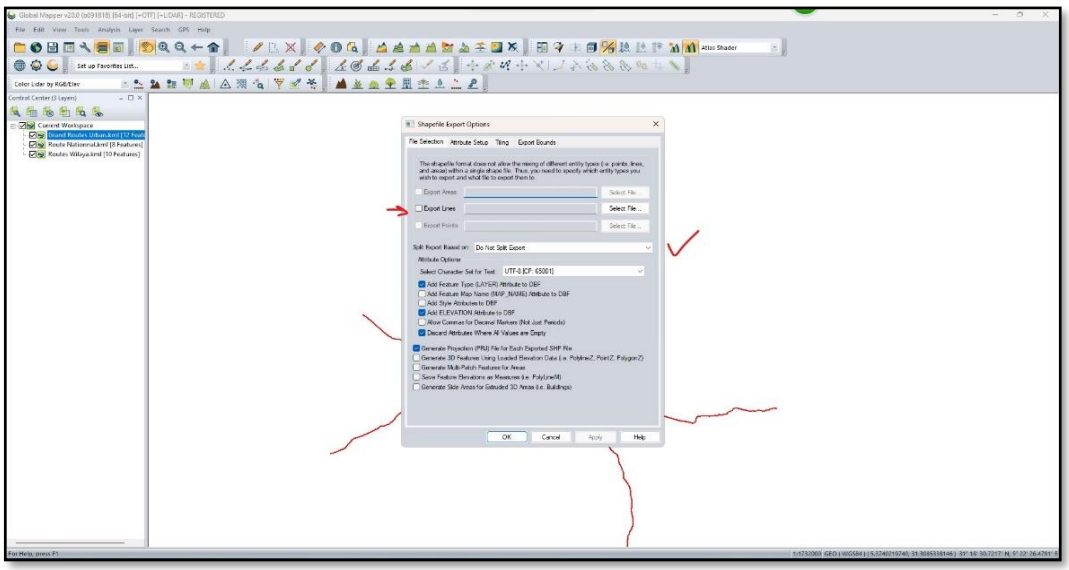

Figure (III - 9) Shapefile Expert Option.

In this step we choose where to save our shapefile data from “Export Lines” and select file, and press OK.

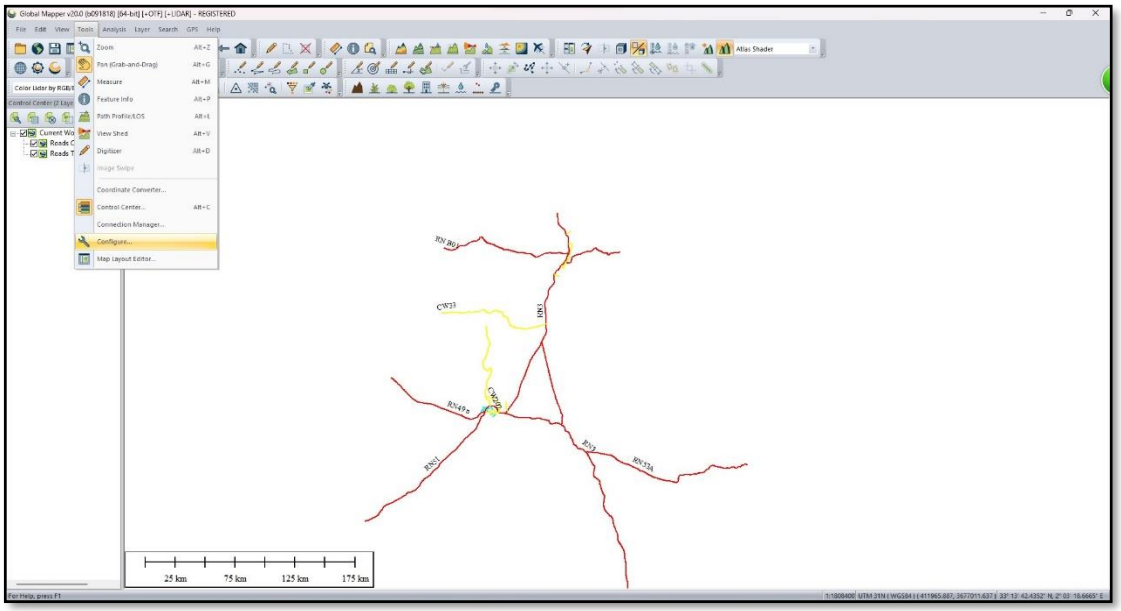

Figure (III - 10) Configure.

After we done whit exporting, from **toolbar** we go to “Tools” then “Configure”.

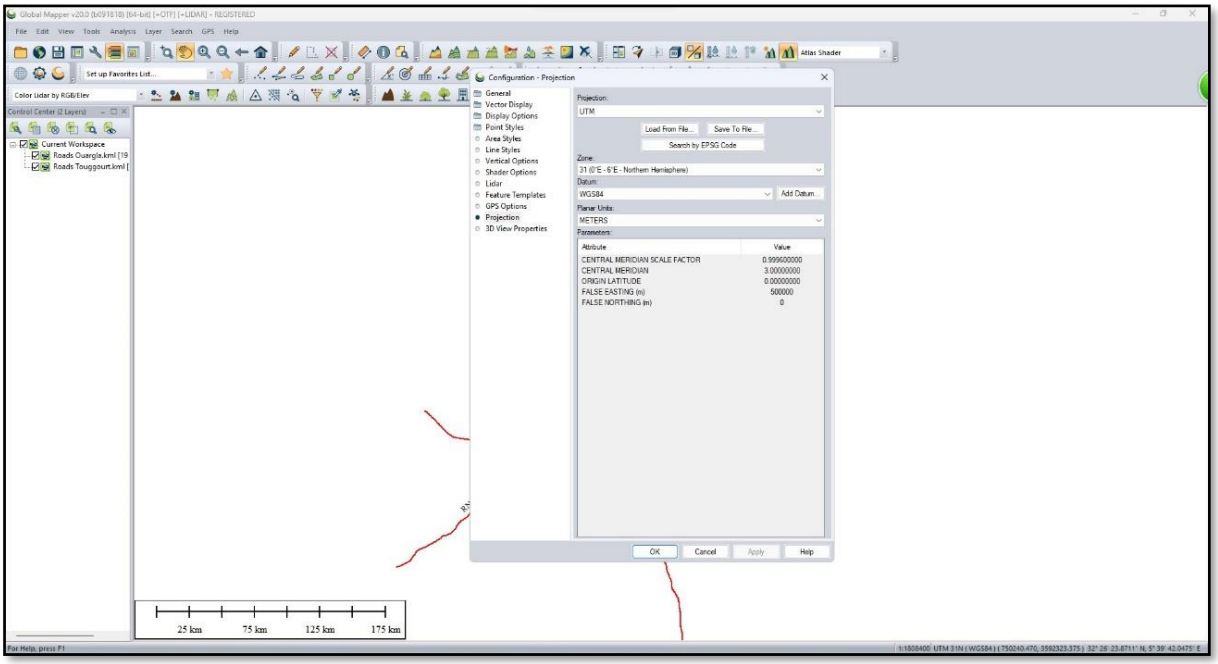

Figure (III - 11) Configuration General.

From the apparent box we go to “Projection”, then we set these parameters:

- Projection (UTM).
- Zone (31(0°E - 6°E -Northern Hemisphere)).
- Datum (WGS84).

We press Apply and OK.

We close **Global Mapper** and move on to **The Third Phase.**

III. ArcGIS 10.8 Desktop.

In **The Third Phase** of this Study, we enter the converted data into the **ArcGIS**, and then add the information for each road that was drawn, which is information that can be modified and updated.

We’ll be working with **ArcMap**; The following pictures explaining that:

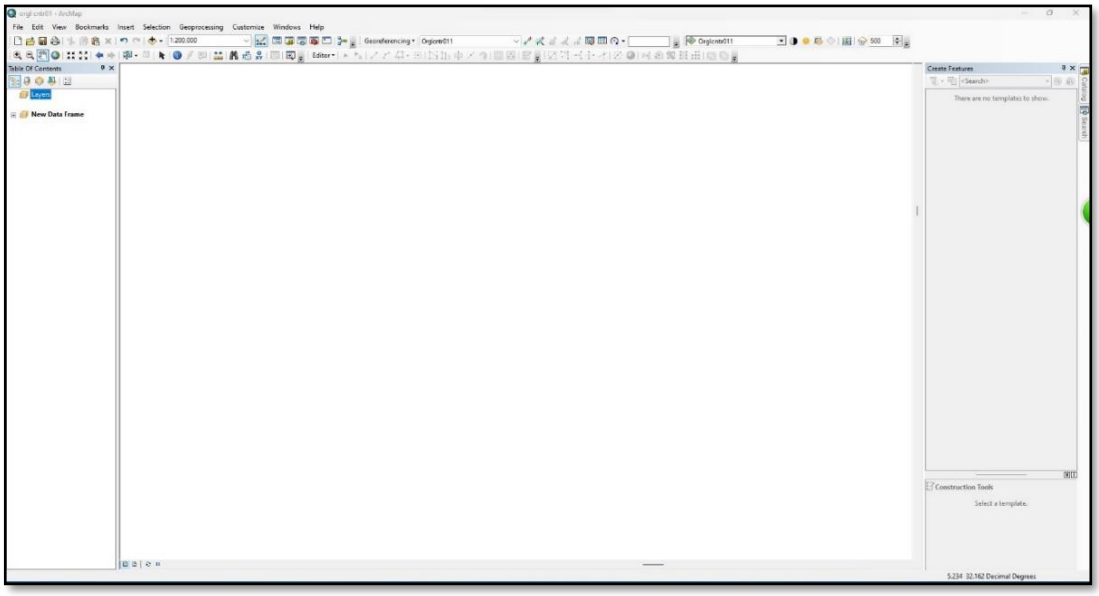

Figure (III - 12) ArcMap interface.

When we open ArcMap first time we see command bar, a large workspace, toolbar, table of contents…etc.

First step: input data to ArcMap.

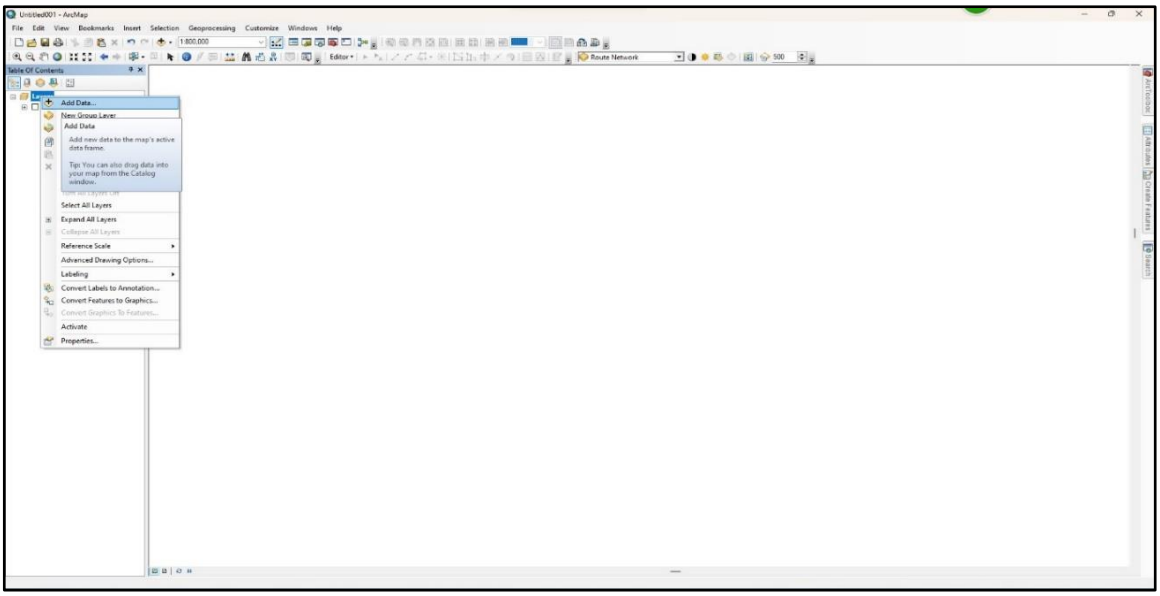

Figure (III - 13) Add Data 1.

From table of contents: Layers, by clicking right button of the mouse we choose: **Add Data**.

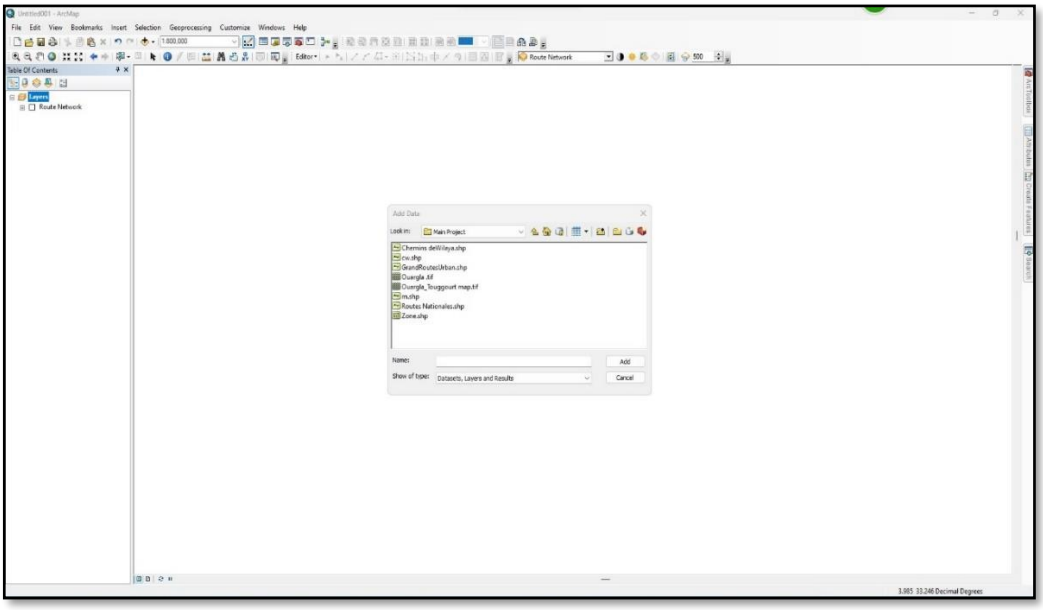

Figure (III – 14) Add Data 2.

Then we choose data we want to work with, in this case we need data with these formats: tif (for images or map), shp (for other features).

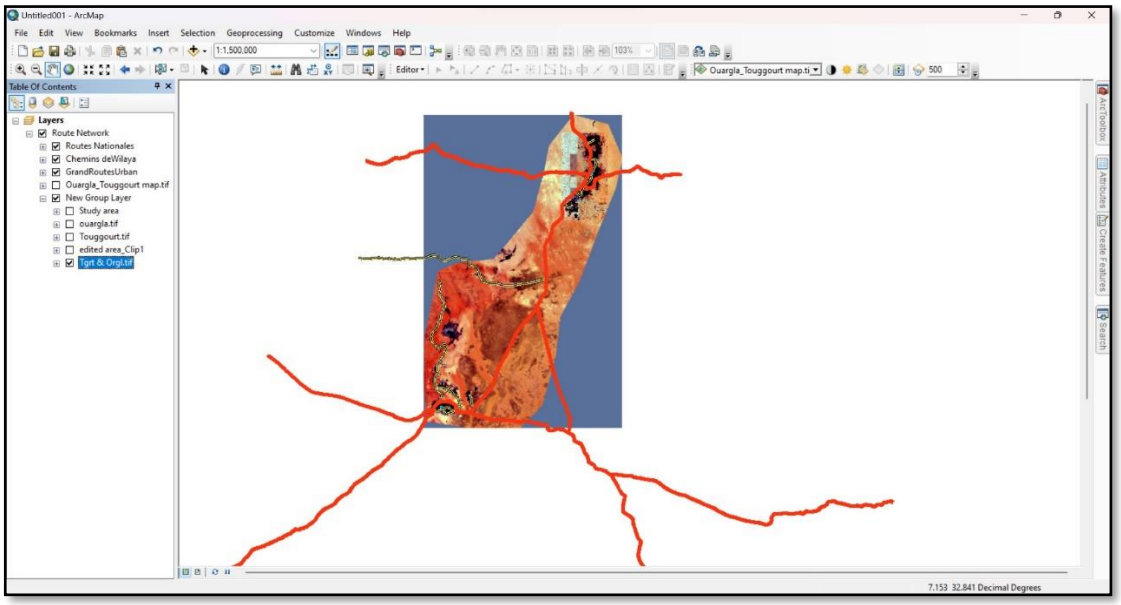

Figure (III - 15) data appeared in workspace.

we see in workspace:

- the map layer: (Tgrt&Orgl.tif).
- the road layer: (RN.shp), (CW.shp), (GRU.shp).

Second Step: Enter Road data; At this point, we're going to set up a road database.

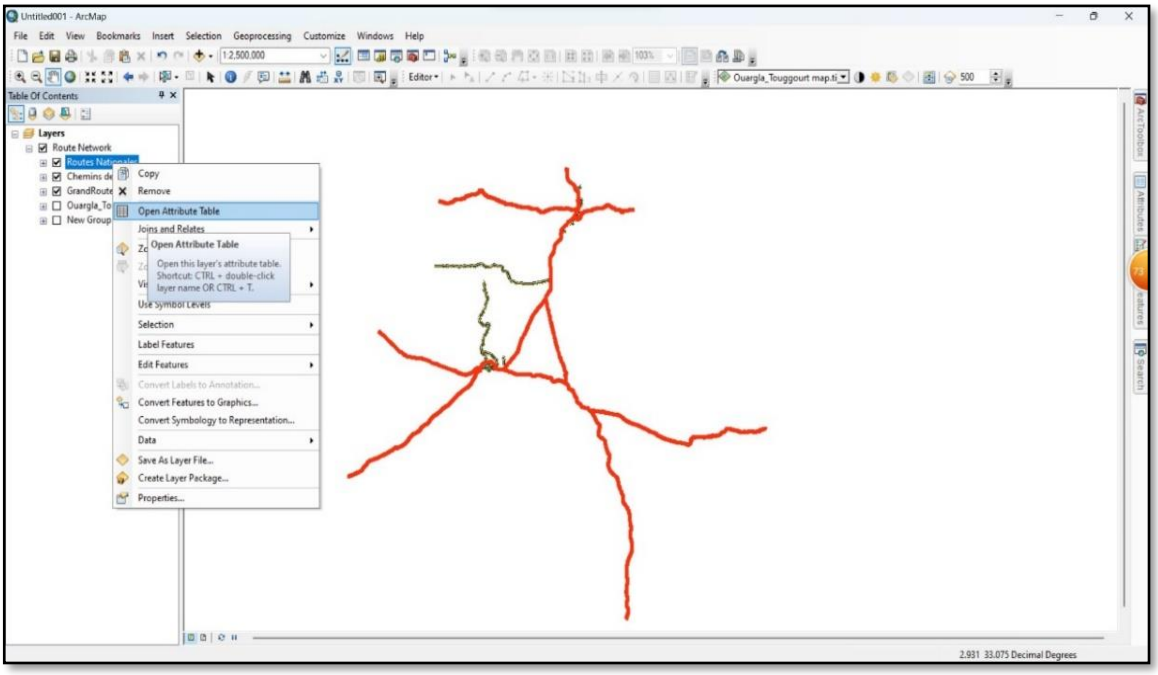

Figure (III - 16) Open Attribute Table.

After adding data, we go for adding information about the road we draw before.

exp: **Routes Nationals** then **Open Attribute Table.**

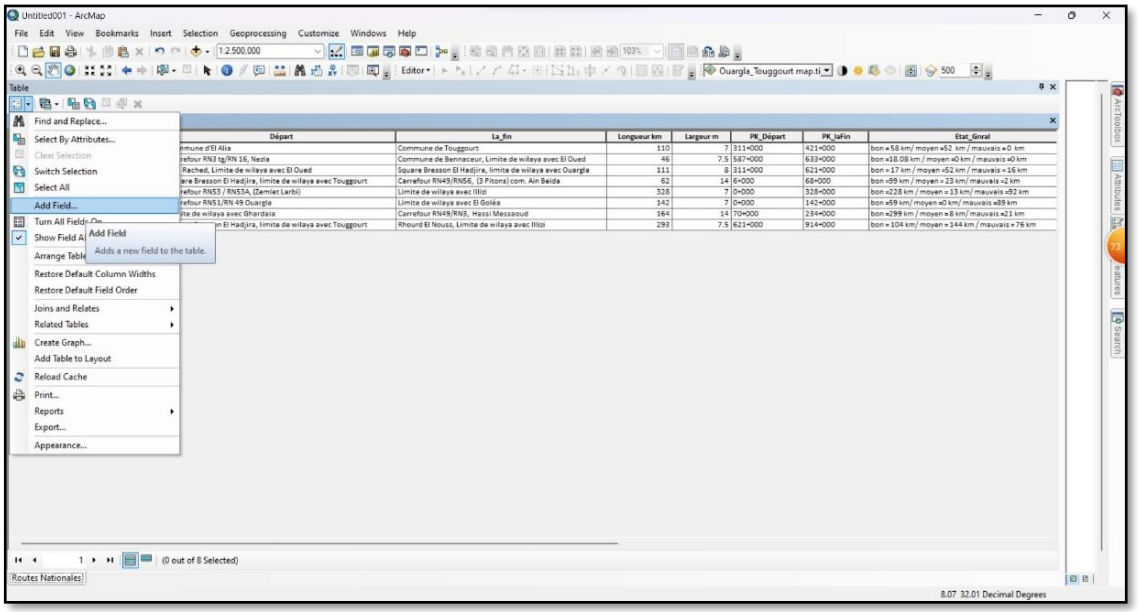

Figure (III - 17) Attribute Table and Add Field.

When open attribute table, we can see all information that has a relation with our data, such name, shape, départ…. etc.

From table option we can add field to our table if we need one.

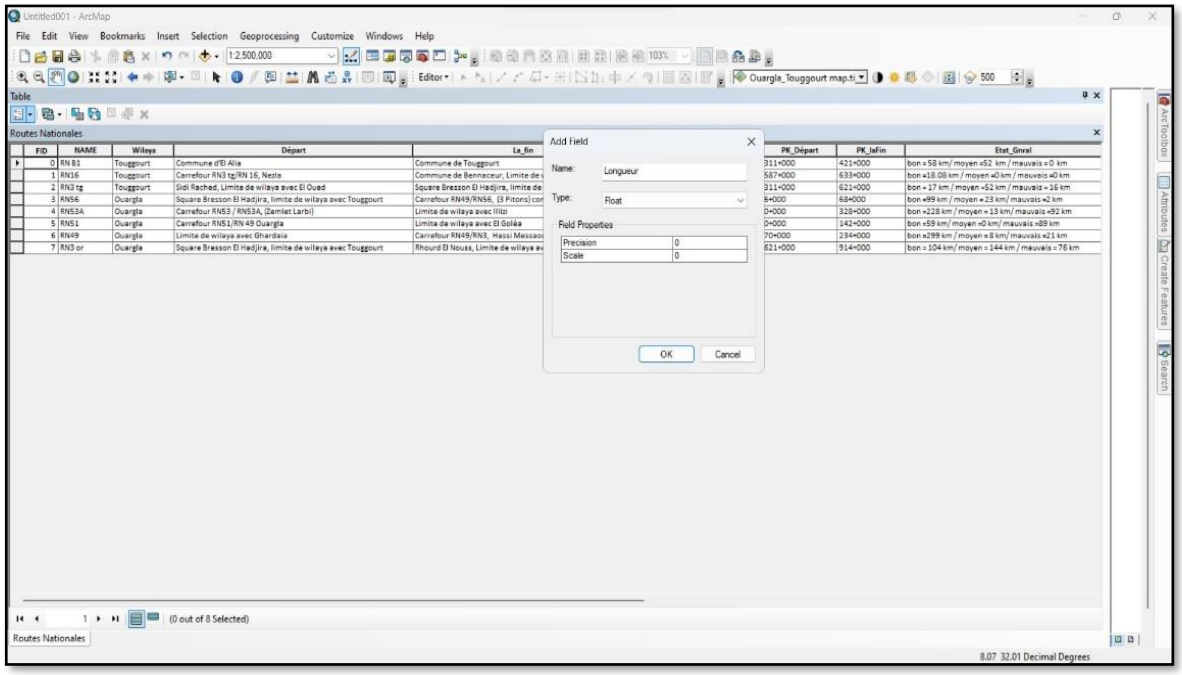

Figure (III - 18) Add Field Numeric format.

To add field with numeric format we go for: Type **Float**.

Our field with **Float type** is: Longueur, Largeur.

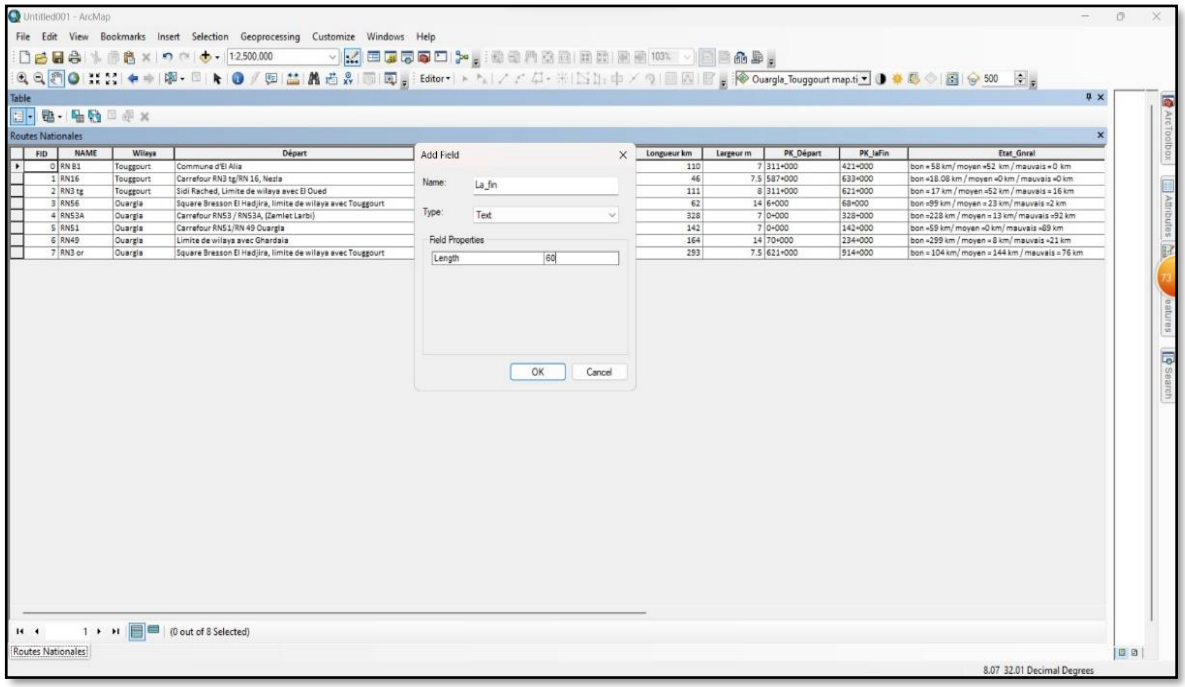

Figure (III - 19) Add Field Alphabet format.

To add field with Alphabet format we go for: Type **Text**.

Our field with **Text type** is: Name, Wilaya, Départ, La fin, Etat General, Trafic.

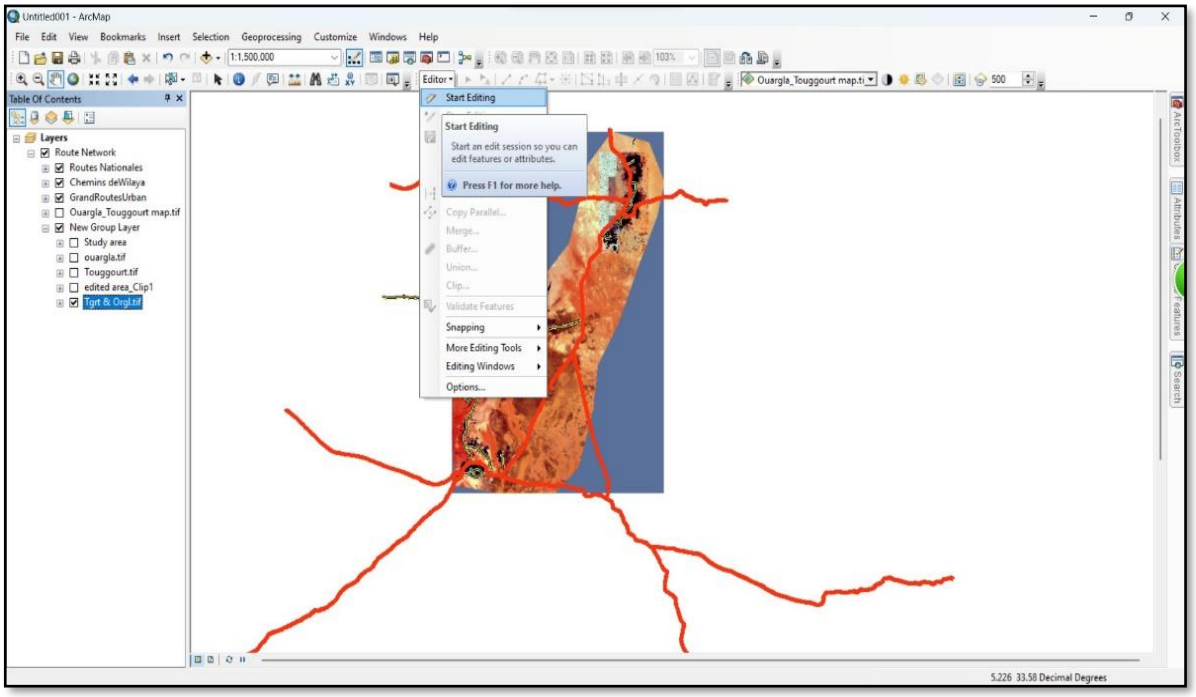

Figure (III - 20) Start Editing 1.

To input information to road network, we go to **Toolbar** then **Editor** then **Start Editing.**

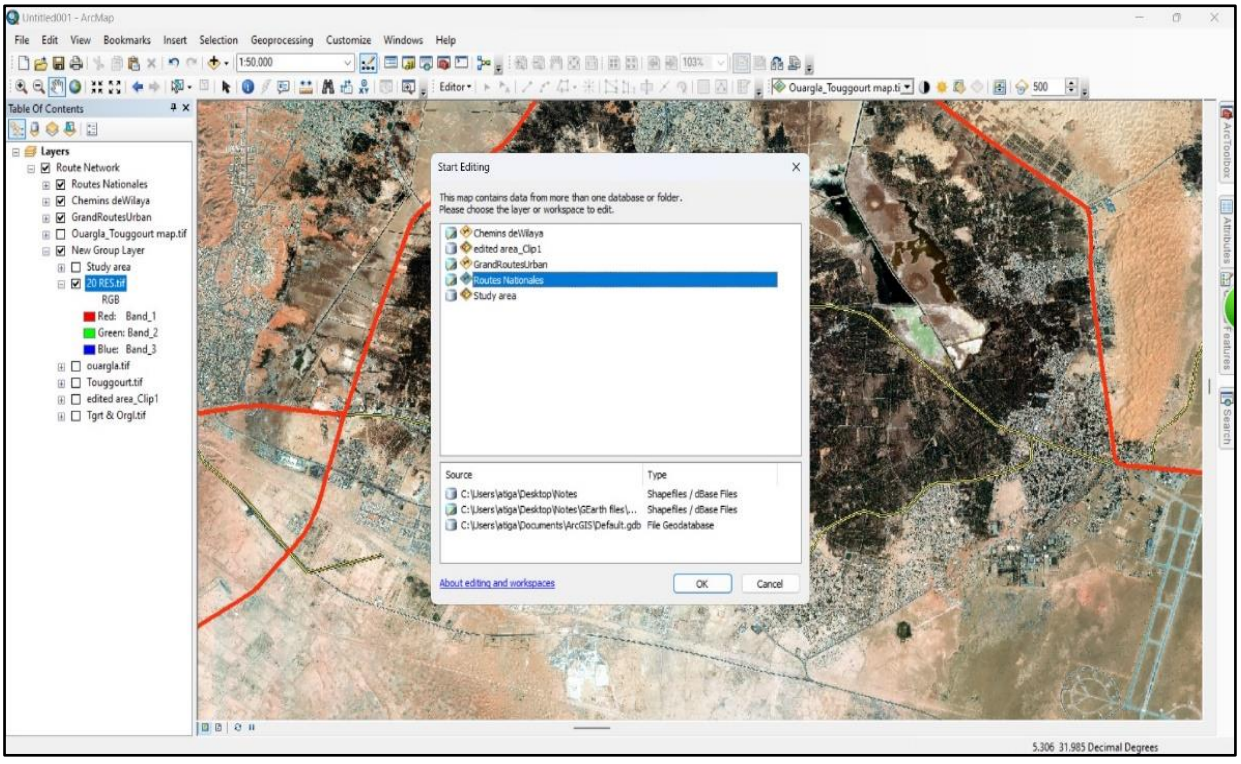

Figure (III - 21) Start Editing 2.

After start editing, we select the layer that we want to edit or modify.

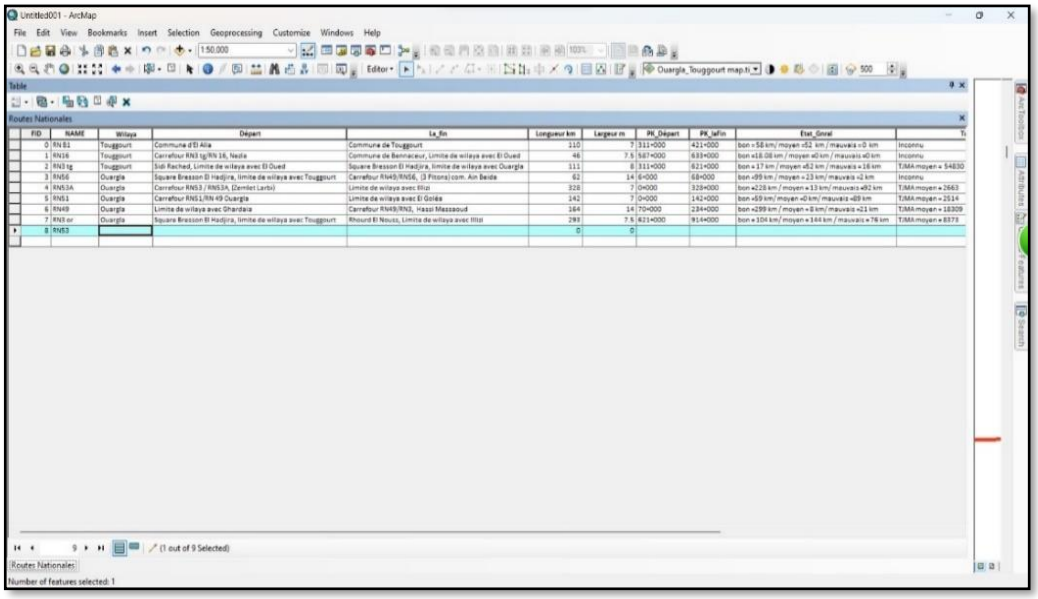

Figure (III - 22) input info to Attribute Table.

By starting edit we can add info to Attribute table, we can notice, you can't add field when you start editing.

- There is an important note, which is that other roads and paths can be added by **Start Editing** without the need to go back to **the first** and **second phase**. (Going back to steps of google earth & global mapper). The following pictures explain that.

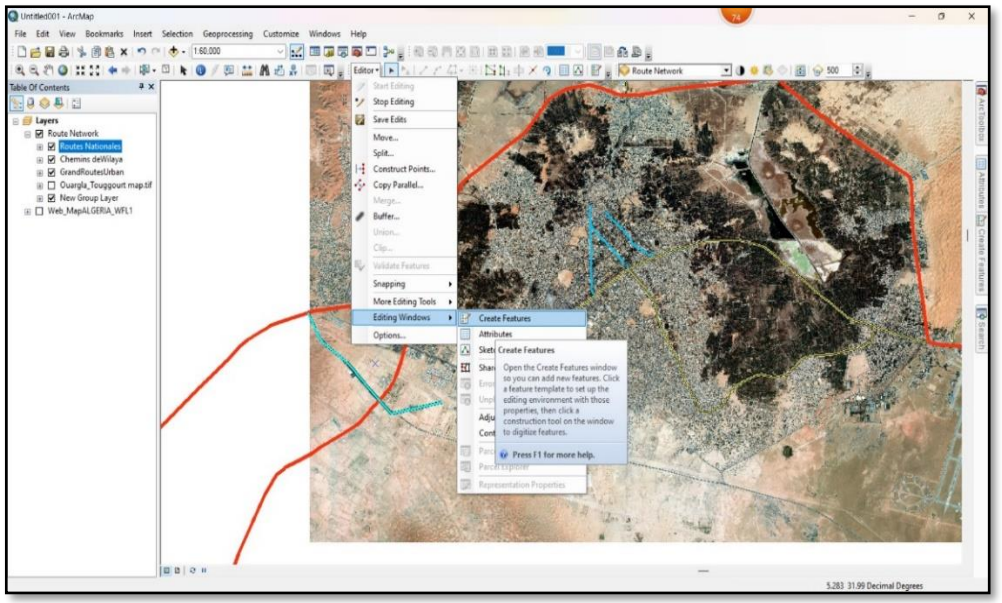

Figure (III - 23) Create Features.

From **Editor** then **Editing Windows** Then **Create Features,** we can create features such: line, Rectangle, circle, ellipse, freehand.

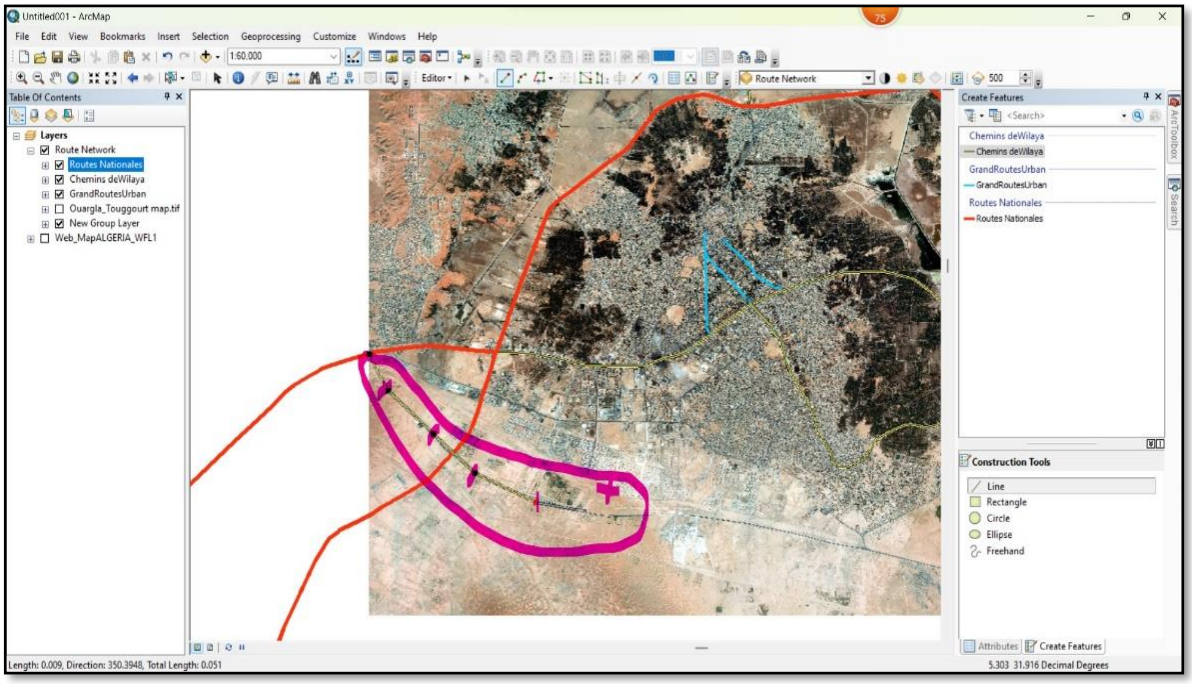

Figure (III - 24) Create Road (Shape: line).

If we want, we can add another road to our network, and start drawing it in the map directly.

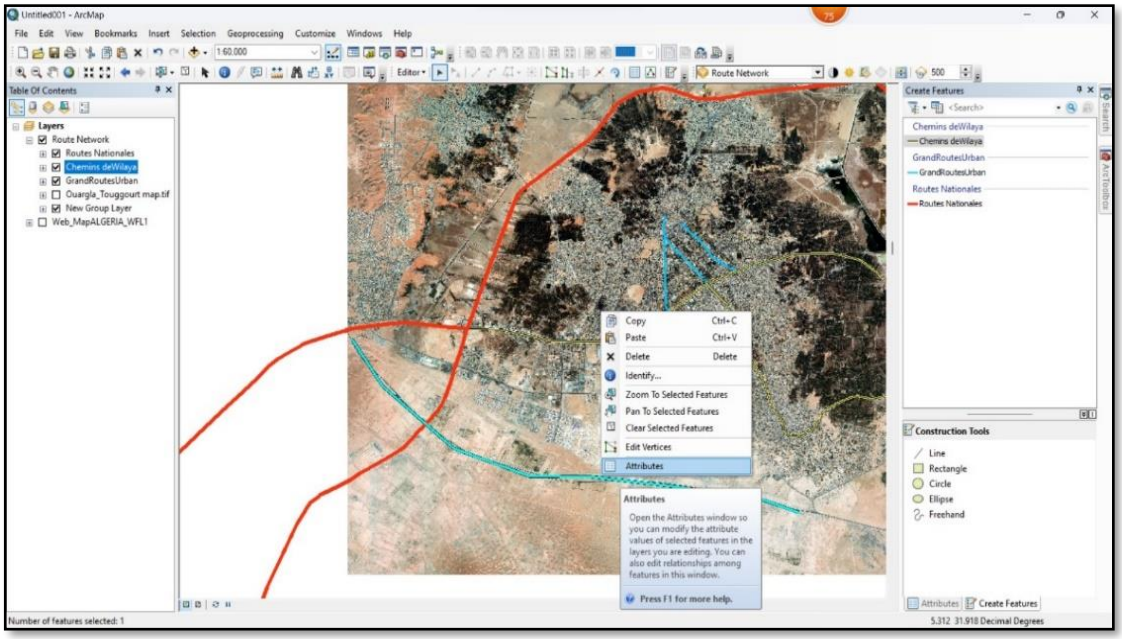

Figure (III - 25) Add to Attribute Table 1.

To add the new road to attribute table, we select the road, right click, Attribute.

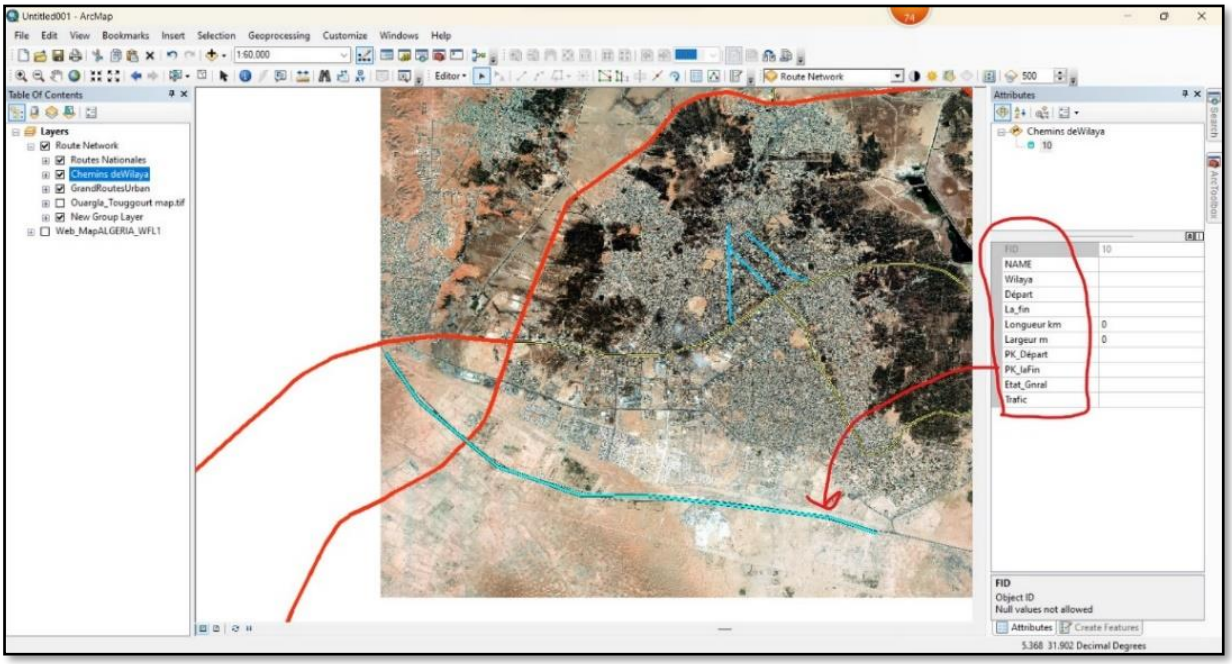

Figure (III - 26) Add to Attribute Table 2.

Now we can put all info about the road in Attribute table, and will be directly added to it with the other roads.

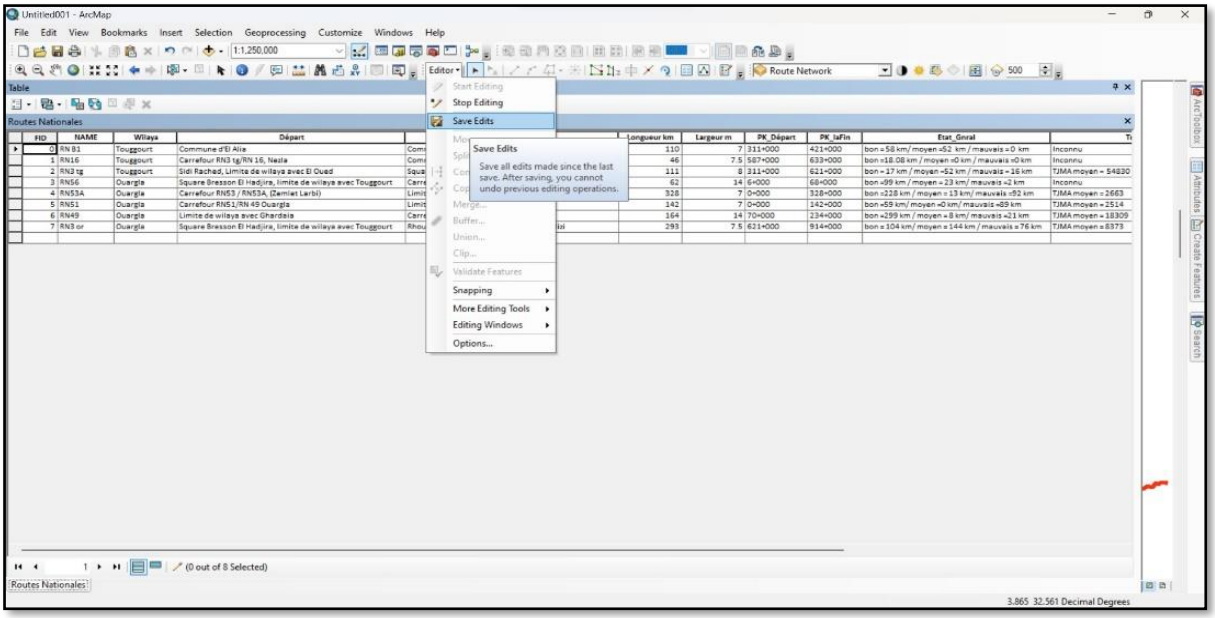

Figure (III - 27) Save Edits and **stop Editing.**

After we done editing, we can simply **Save Edits** and **stop Editing** from **Editor.**

IV. The Results.

If we want to show information about each road drawn, we take the following steps:

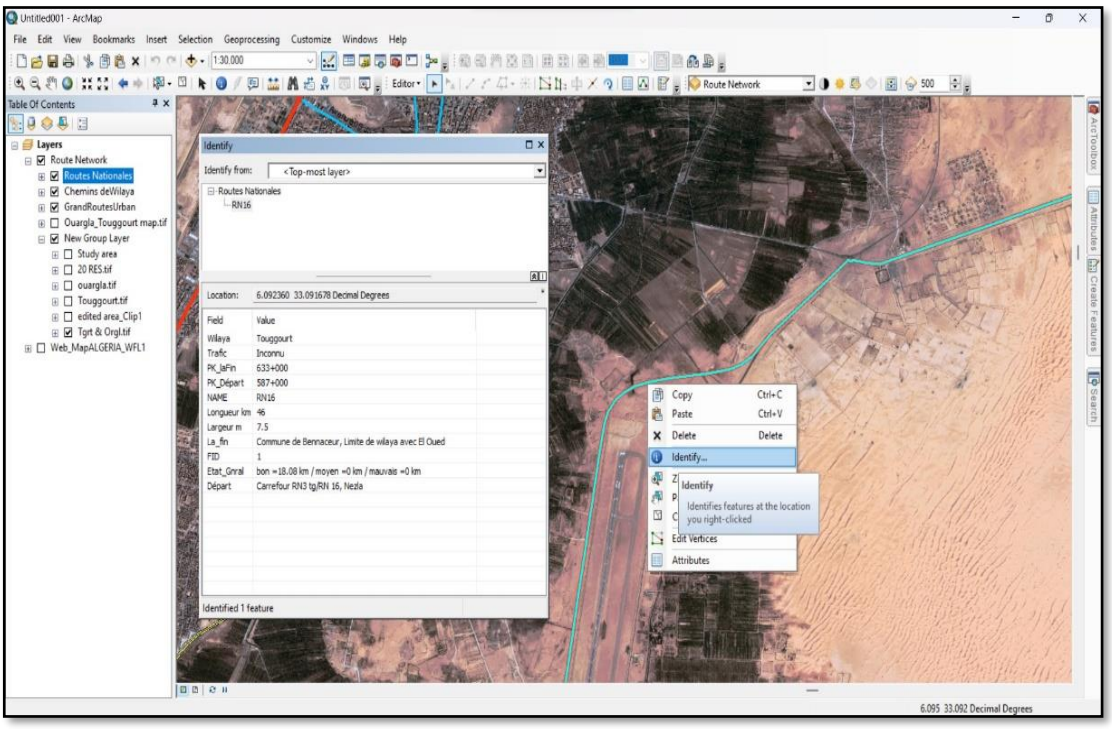

Figure (III - 28) Show data.

From **Toolbar** then **select tool** then right click in the road figure then **Identify**, we can see all the info we put earlier in Attribute Table, this information changes whenever we choose another road.

By doing that we've been able to achieve our purpose from this study.

Conclusion.

In this chapter, we have seen how to design a road network and add data about this network, by using software's related to GIS, and we explained how to do so with pictures & steps.

General Conclusion

General Conclusion.

In conclusion, the use of GIS and the ArcGIS program in controlling the road network of the regions of Ouargla and Touggourt offers tremendous potential for effective management. By harnessing the power of spatial data and analysis, GIS enables authorities to make informed decisions, optimize resources, and enhance the overall transportation infrastructure.

Through ArcGIS we can eliminate tons of paper and free up large areas of archive bins, all by putting valuable information in one place that is safe from damage and easy to access, through it, it is possible to facilitate the extraction and display of information with a click of a button, and it can also be changed and modified quickly.

For the greatest benefit, engineers and decision makers must provide the program with constantly updated information, to get the most benefit from its advantages.

Embracing GIS technology and investing in its continued development and implementation will undoubtedly contribute to the sustainable growth and development of the road network in the future.

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