

# The Role of Geographic Information Systems in Enhancing and Educating About Archaeological Site Locations: A Case Study of the Province of Setif, Algeria

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Submitted: 10/03/2024    Revised: 25/04/2024    Accepted: 02/05/2024

**Abstract:** This study addresses the role of Geographic Information Systems (GIS) in highlighting and educating about archaeological sites, using the province of Sétif as a model. We will explore the functionalities and significance of GIS and employ it to map various archaeological sites within Setif. Furthermore, we will design an archaeological tourist route for the province, detailing the different steps and phases involved. For this purpose, we will use Google Earth Pro to pinpoint the locations, which will then be imported into ArcGIS to generate a map of the sites and the archaeological tourist route of Setif.

**Keywords:** *Geographic Information Systems, archaeological landmarks, location, tourist route, Setif province.*

## Introduction:

Geographic Information Systems (GIS) facilitate many spatial studies due to their precision, speed, and ease of use compared to the significant benefits derived from their application. GIS involves a series of operations, including data creation, presentation, analysis, and extraction, all represented as a subject accurately positioned on the Earth's surface. Mathematical equations can even be used to study distances, areas, and many other features.

To promote tourism, it is essential to highlight the tourist landmarks of regions in a standardized manner (introducing them). However, it is also crucial to disclose their locations to facilitate access by emphasizing their sites and the pathways that can be utilized.

Algeria represents a point of mystery and adventure for tourists, with its enchanting nature and diverse cultures, each region having its unique history. For example, the province of Setif, the capital of the High Plateaus or "Sytifis" as it was known in Latin, is one of the most important provinces in Algeria, having witnessed several civilizations, each leaving a cultural heritage deeply embedded in the customs and traditions of the region. However, our focus is on tangible heritage; hence, we have chosen to study the archaeological landmarks of

Setif province using GIS to educate about and highlight their locations.

## Reasons for the Study:

- The significant importance of Geographic Information Systems in our current time.
- The scarcity of studies on the archaeological landmarks of the Setif province in Algeria.

## Objectives of the Study:

- To understand the importance and role of Geographic Information Systems in highlighting the components of a region.
- To use GIS to highlight and educate about the locations and tourist routes of archaeological landmarks in Setif province.

## Research Questions:

- What are Geographic Information Systems? What is their role? What are the main programs used in GIS?.
- What are the various archaeological landmarks of Setif province?.
- How can Geographic Information Systems be utilized to highlight these archaeological landmarks (their location and tourist routes)?.

## Research Methodology:

Descriptive and Deductive Methodology.

## 1. General Concepts:

### 1.1 Definition of Geographic Information Systems (GIS):

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Jack Dangermond, founder of Environmental Systems Research Institute (ESRI), defined GIS as a coherent collection comprising various components: computers, software, databases, individuals, and trainers. This system accurately captures, stores, updates, processes, analyzes, and displays spatial and non-spatial geographic information<sup>(1)</sup>.

## 1.2 Role of Geographic Information Systems:

The role of geographic information systems is to<sup>(2)</sup>:

- Digitization of the field.
- Obtaining an accurate database.
- Highlighting various components with high precision.
- Producing maps with multiple layers and high professionalism.

## 1.3 GIS Software:

### • ArcGIS:

ArcGIS is a suite that functions as an integrated platform aimed at managing, integrating, and sharing geographic data, as well as performing spatial analysis and presenting results as professional maps. ArcMap is used for displaying, digitizing, visualizing, and printing data, while ArcCatalog is for file management. ArcGlobe is utilized for creating, transferring, copying, and displaying three-dimensional global data, whereas ArcScene is employed for three-dimensional interactive simulations or presentations<sup>(3)</sup>.

### • ArcGIS Pro:

ArcGIS Pro, an ESRI release, is designed to keep pace with visual advancements in GIS software. It is characterized by ease of use, simplicity, and smooth operation. The software does not operate in a single interface, allowing transitions between 2D and 3D views. It supports the storage of multiple maps, data, layouts, tables, and charts within a single project, and keeps them open simultaneously<sup>(4)</sup>.

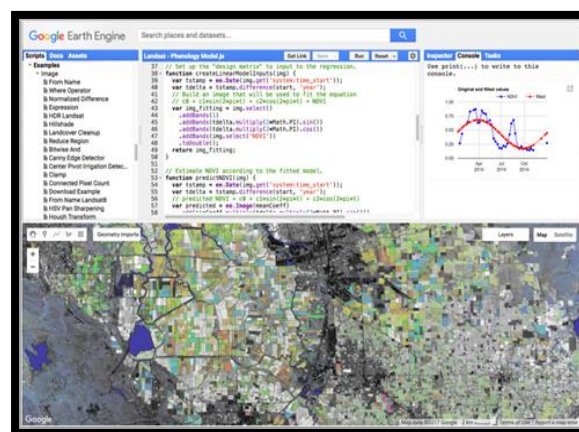


**Fig 1:** Icon of ARC GIS PRO and ARC GIS

### • Google Earth Engine (GEE):

Google Earth Engine is a cloud-based platform that makes it easy to access high-performance computing

resources for processing very large geospatial datasets, without dealing with the current IT challenges. Additionally, unlike most supercomputing centers, Earth Engine is designed to help researchers easily disseminate their results to other researchers, policymakers, NGOs, field workers, and even the general public. Once an algorithm has been developed on Earth Engine, users can produce systematic data products or deploy interactive applications backed by Earth Engine's resources, without needing to be an expert in application development, web programming, or HTML<sup>(5)</sup>.



**Fig 2:** Interface of the GEE Program

### • Google Earth Program:

Google Earth is a program that provides a variety of information in the form of geographic maps. It displays a map of the Earth by integrating images obtained from satellites, aerial photography, and 3D geographic information systems (GIS) of the globe<sup>(6)</sup>.



**Fig 3:** Interface and Icon of the Google Earth Program

## 2. Definition of the Study Area:

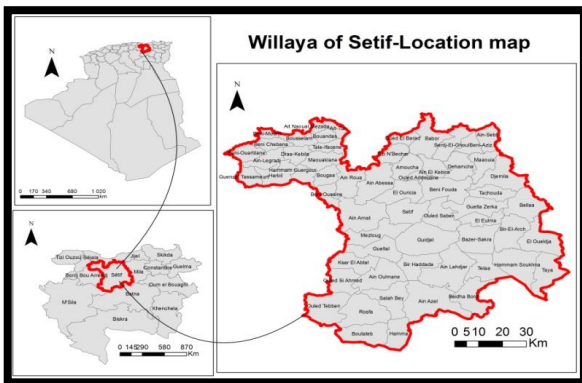
### 2.1 Location and Area:

Setif is an Algerian province located in the northeastern part of the country. Its main city is considered one of the most significant cities at the national level and serves as an economic hub in Algeria. The province is situated approximately 300 kilometers east of the capital, Algiers. It is traversed by National Road 05, which connects the capital with the eastern provinces, and National Road 09, which links the southeastern provinces with the province of Bejaia. The total area of Setif is approximately

6,549.64 km<sup>2</sup>, representing about 0.27% of the national territory<sup>(7)</sup>.

## 2.2 Administrative Organization:

According to Law No. 84-89 dated February 4, 1984, which concerns administrative divisions in Algeria, the administrative boundaries of Setif are as follows: to the northwest, it is bordered by the province of Bejaïa; to the northeast, by the province of Jijel; to the east, by the province of Mila; to the west, by the province of Bordj Bou Arreridj; and to the south, by the provinces of M'sila and Batna. Currently, the province is divided into 20 districts and 60 municipalities.



Map 1: Geographic Location of the Province of Setif

## 3. Archaeological Sites in the Province of Setif:

### 3.1 The Archaeological Site of Cucol:

Located in the commune of Djemila, approximately 43 km northeast of the city of Setif, the site covers an area of 42 hectares and was established on the ridge between two valleys during the years 96–98 AD. It was designated a World Heritage Site by UNESCO on December 17, 1972. The site contains a range of notable features:

- **The South Gate:** The South Gate consists of an archway that creates a narrow passageway between the Sytifis Road and the main street of the city<sup>(8)</sup>.



Fig 4: The South Gate

- **The North Gate:**

This gateway allows access to the valley and connects to the road leading to the area of Cucol, which defines the northern boundary of the city<sup>(9)</sup>.



Fig 5: The North Gate

- **The Market of the Two Brothers Kozenios:**

Exiting from the Basilica through the southwest gate, one reaches the main street, and through the colonnade, one can access the Market of the Two Brothers Kozenios. This market was the center of daily commercial life for the citizens of Cucol<sup>(10)</sup>.



Figure 6: The Market of the Two Brothers Kozenios

- **The Severian Forum:**

Located in the heart of the ancient city, the Severian Forum was established outside the old city walls at the end of the 2nd century and the beginning of the 3rd century AD. It is a public space of irregular shape covering an area of 3,200 m<sup>2</sup>, paved with gray limestone, and served as a new forum<sup>(11)</sup>.



Fig 7: The Severian Forum

- **The Arch of Triumph:**



Built in 216 AD by the citizens of Cucol in honor of Emperor Caracalla, son of Julia Domna and Septimius Severus, this structure features a single arch standing 12.5 m high and 10.6 m wide. Each facade is adorned with pairs of Corinthian columns, and the arch was restored by the French Historical Monuments Authority in 1921-1922.



**Fig 8:** The Arch of Triumph

- **The Temple of Septimius:**

Constructed in the 1st century, this temple was dedicated to the Triad of deities: Jupiter, Juno, and Minerva, who were believed to protect the city according to the pagan beliefs of the Cucolians.



**Fig 9:** The Temple of Septimius

- **The Theater:**

Located to the south of the ancient city and dating back to the 2nd century AD, the theater consists of two tiers of seating and several aisles, with a capacity of about 3,000 people. It measures 33.80 m in width and 6 m in depth, with a stage decorated with small niches and surrounded by columns and a square support structure, housing a spring.



**Fig 10:** The Theater

- **The Baths:**

Constructed in 183 AD under Emperor Commodus, these baths originally consisted of three cold pools, but only their ruins remain today.



**Fig 11:** The Baths

- **The Northern Basilica (Basilique Julia):**

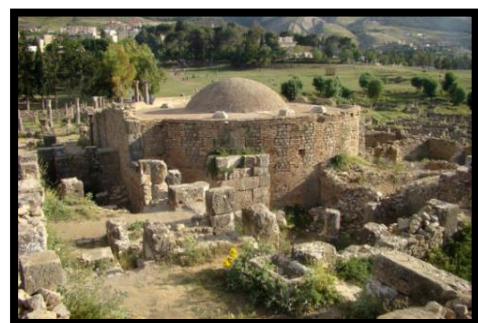
Measuring over 15 m in width and approximately 35 m in length, this basilica features three aisles separated by columns and contains mosaics with similar decorations and some animal images<sup>(12)</sup>.



**Fig 12:** The Northern Basilica (Basilique Julia)

- **The Southern Basilica (Basilique Cresconius):**

This ancient church has a central nave with two identical colonnades on either side. It was named after the priest Cresconius, to whom the site is attributed<sup>(13)</sup>.



**Fig 13:** The Southern Basilica (Basilique Cresconius)

### 3.2 The Prison of Ksar El Tir:

Located in the municipality of Ksar El-Abtal, about 30 km south of Setif, this site was established in 1956 and later converted into a prisoner-of-war camp for Algerian freedom fighters in 1957. It was a political detention facility used by the French to undermine the revolutionary ideas and beliefs surrounding the Algerian War of Independence<sup>(14)</sup>.



**Fig 14:** The Prison of Ksar El Tir

### 3.4 The Old Museum or Museum of Antiquities:

Built in 1984 in the main city of the Province of Setif, the museum is situated between Barachi Obeid Street and Sawakir Mohamed Street. It opened to the public on April 30, 1985, and was designated as a museum of antiquities on July 6, 1992. It is the first museum inaugurated nationwide<sup>(15)</sup>.



**Fig 15:** The Old Museum or Museum of Antiquities

### 3.5 The Ancient Mosque:

Dating back to the French colonial era, this mosque is one of the rare examples of local religious architecture and was the first monumental structure built in Setif. It features Ottoman-style decorations<sup>(16)</sup>.



**Fig 16:** The Ancient Mosque

### 3.6 Ain El-Fouara:

This historic landmark is a water spring fed by four channels topped by a statue of a woman. Located in Independence Square in Setif, it was created on February 3, 1898, by the French sculptor Francis de Saint-Vidal<sup>(17)</sup>.



**Fig 17:** Ain El-Fouara

### 3.7 The Prince Abdelkader Park:

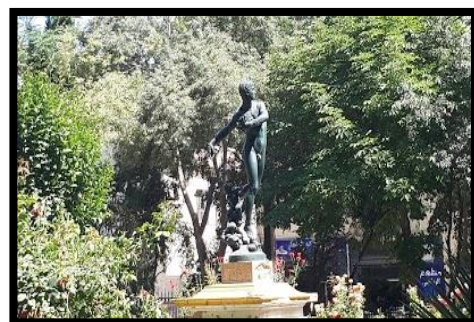
Previously known as Aurélien Park, this public garden contains a collection of Roman relics, including sculptures and columns with Latin inscriptions, with artifacts discovered in the garden dating back to 1940. The park currently features 200 sculpted monuments from the Roman and Byzantine periods<sup>(18)</sup>.



**Fig 18:** A Sculpture in the Prince Abdelkader Park

### 3.8 The Saïd Rfawi Park:

This French-style garden contains a statue of a young boy and his father, created by the French sculptor Lyong Kignot. It also features Roman-era relics such as a water temple and reservoirs discovered by the French in 1876<sup>(19)</sup>.



**Fig 19:** The Statue in Saïd Rfawi Park



### 3.9 The Byzantine Fortress:

Located northwest of the ancient city, this site was classified as a national heritage site on November 20, 1979. Constructed by the Byzantines in 539 AD, it experienced significant expansion during the Fatimid period, which continued until the 14th century. The fortress retained its original character during French occupation, which included additional military fortifications<sup>(20)</sup>.



**Fig 20:** The Byzantine Fortress

### 3.10 The Roman Baths in Hammam Gurgour:

Considered the most recent discovery of the region as of February 2024, this site reveals the Romans' interest in hot springs and their use in constructing baths. Dating to the 4th and 5th centuries AD, only the remains of the baths are preserved today<sup>(21)</sup>.



**Fig 21:** Remains of the Roman Baths

## 4. The Use of Geographic Information Systems (GIS) to Highlight and Teach Archaeological Sites:

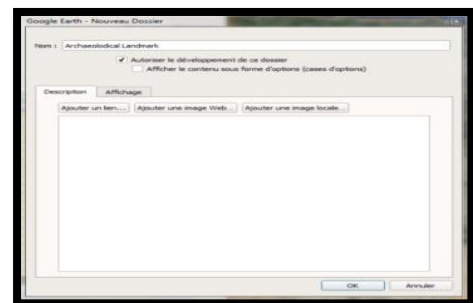
### 4.1 Using Google Earth Pro:

**Step 1:** The first step involves searching for the archaeological sites by name using the search icon, and verifying the site's location through the images provided by the program to introduce these sites.



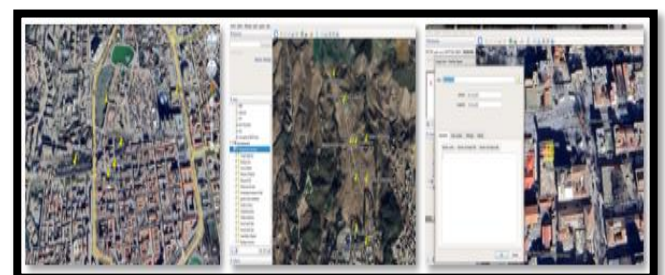
**Fig 22:** Searching for Archaeological Sites by Name Using the Search Icon and Verifying the Location Through Images

**Step 2:** Create a New Folder to Save Files Related to Archaeological Sites in Google Earth



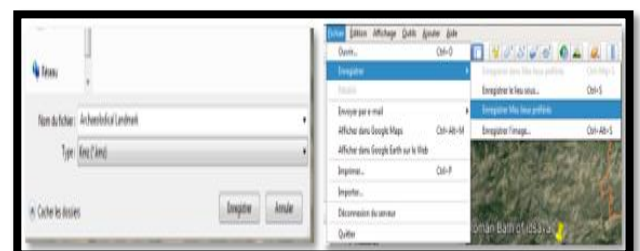
**Fig 23:** Creating a Folder to Save Files

**Step 3:** Define and Name the Locations of the Archaeological Sites



**Fig 24:** Defining and Naming Archaeological Site Locations

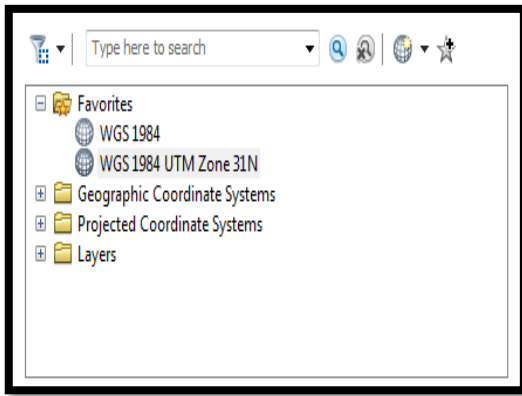
**Step 4:** Save the File on the Computer as a KML or KMZ File



**Fig 25:** Saving the File

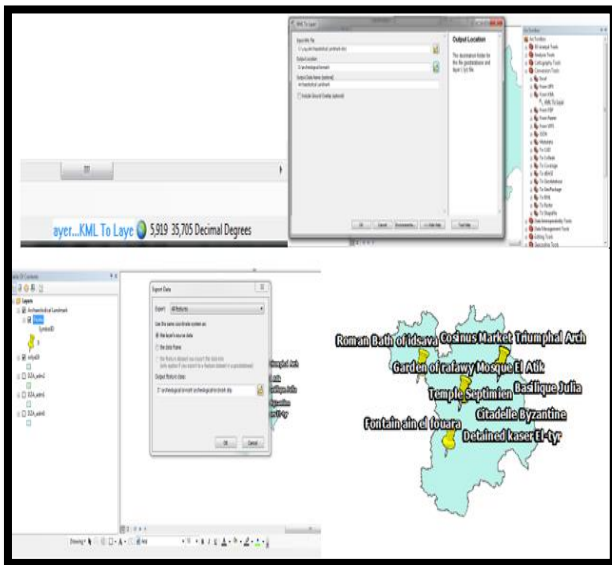
### 4.2 Using ARC GIS 10.8:

**Step 1:** Open the Program and Select the Appropriate Projection System for the Region and Project Objectives.



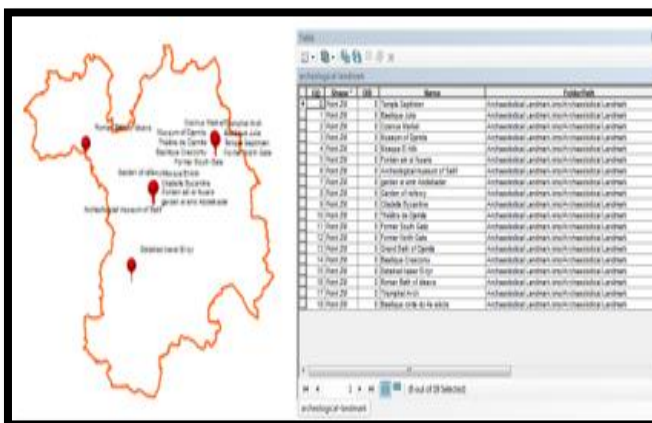
**Fig 26:** Selecting the Projection System

**Step 2:** Import KML or KMZ Files and Convert Them to Shapefiles.



**Fig 27:** Importing Files and Converting Formats

**Step 3:** The Result is a Shapefile Containing Various Information Such as the Name of the Archaeological Site and Its Actual Location, Represented in a Table.



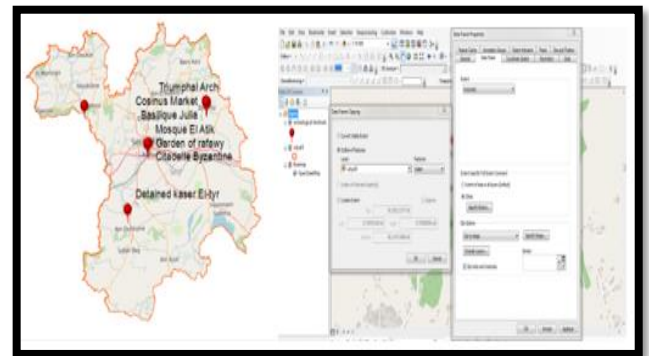
**Fig 28:** Shapefile Containing Various Information

**Step 4:** Use the Online ArcGIS Feature to Add the OSM Map Layer.



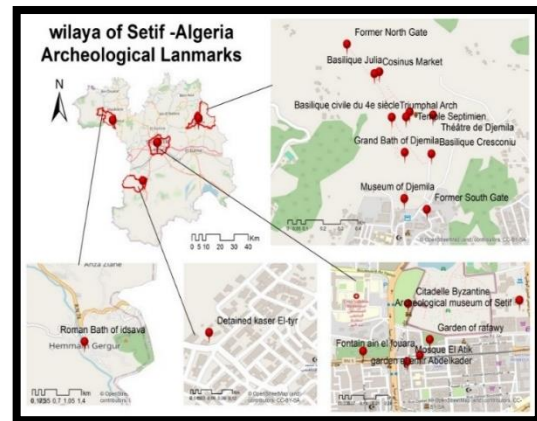
**Fig 29:** Using Online ArcGIS Feature and Adding the OSM Map Layer

**Step 5:** Clip the Map Layer to the Boundary of the Province.



**Fig 30:** Clipping the Map Layer

**Step 6:** Style the Map and Export It.



**Map 2:** Archaeological Sites in the Province of Sétif

**5. Highlighting the Archaeological Tourism Route in the Province of Sétif:**

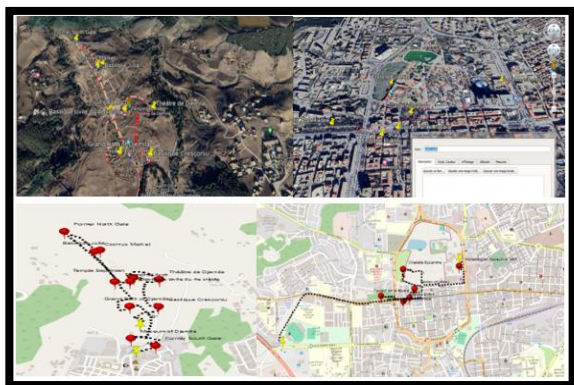
Archaeological tourism sites are located in four municipalities: Hammam Gurgour, Ain Oulmene, Sétif, and Djemila. Due to the distances between these municipalities and the fact that most archaeological sites are found in Sétif and Djemila, two small routes were developed: the Sytifis Tourist Loop, which allows visitors to access all the aforementioned archaeological sites, and the Cucol Tourist Loop for the ancient city of Djemila. Both sites lack direct public transportation to



some points, requiring walking. However, in Setif, tramway services can be utilized. These routes are part of the archaeological tourism circuit connecting the four municipalities.

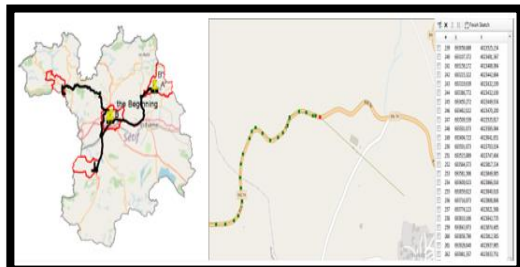
### 5.1 Method for Creating and Highlighting the Archaeological Tourism Route for the Province of Setif:

In this phase, Google Earth Pro can be used to draw the route and save the file as KMZ or KML, then imported into ArcGIS and converted to a shapefile to simplify the extraction of the route.



**Fig 31:** Creating the Route on Google Earth Pro

Alternatively, a shapefile can be created in ArcGIS to draw the route using the OSM map layer.

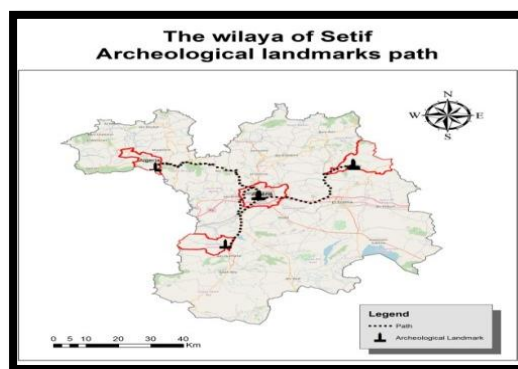


**Fig 32:** Creating a Shapefile to Draw the Route

Finally, style the maps and export them.



**Fig 33:** Styling and Exporting the Maps



**Map 3:** The Archaeological Tourism Route of the Province of Setif

### 6. Recommendations for Various Authorities and Entities in the Wilaya of Setif Regarding Geographic Information Systems:

- Rely on digital mapping and the use of Geographic Information Systems (GIS) for various sectors.
- Produce site maps, highlight road networks, and update them regularly.
- Create a catalog to showcase archaeological and tourist sites of the Wilaya and develop routes to facilitate access.
- Utilize remote sensing to support various studies.
- Establish a Geographic Data Base (BDG) for different sectors including education, housing, tourism, and commerce.

### Conclusion:

Archaeological sites attract various types of tourists, and the Wilaya of Setif boasts a vast array of these sites. This study emphasizes the importance of using Geographic Information Systems (GIS) to highlight and teach about the archaeological sites in this Province. By defining their locations, we make it easier for visitors and researchers to access these sites. To further facilitate this, we developed maps to showcase the sites and the road network connecting them, creating an archaeological tourism route featuring two main circuits: the Sytfis Loop and the Cucol Loop. This example demonstrates how GIS technology can be utilized in the tourism sector and applied to other sectors for digital transformation and database creation, which should be embraced by local authorities due to its significant contemporary relevance.

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