Realization of a Geographic Information System for aid decision-making for forest management

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Article Info

ABSTRACT

This work aims to create a decision support and geographic information system aimed at optimizing the management of forest capital in the Adrar region. Through this awareness, we question the place of geographic information in the dialogue process and the approach to sustainable development. Cadastral data, satellite images, cartographic and photographic data will be presented. Data processing and data integration will be discussed. The expected results must provide knowledge beyond reach without these tools. They clarify the importance of satellite images and the spatial component of geographic information. In the current context of sustainable development, geographic information appears necessary for decision-making

I.   Introduction

The definition of the term forest for its classification is variable because it refers to thresholds, the nature and importance of which vary from country to country: minimum forest cover, minimum stand area and others. Internationally, the Food and Agriculture Organization of the United Nations defines forests as land covering an area of more than 0.5 hectares (5000 m^2) with trees reaching heights greater than 5 meters and a forest cover of more than 10%. This definition excludes lands whose predominant vocation is agricultural or urban. Moreover, the observation of the evolution of continuous chronological series requires a stability of the nomenclatures [1]. Knowing how to study, monitor and manage this wealth inherited from nature is not to be taken lightly, bad consequences will affect virtually all areas, this management by new techniques and tools which are not by conventional slow methods. Geographical Information Systems (GIS) are becoming an increasingly important component of the management of natural resources and in particular, forests around the world [2]. Geographic information systems are likely to be a valuable tool to assist forest management decision-makers, and are already being used extensively for these purposes in specific locations in Algeria and around the world in general [3].

Better monitoring and management is generally preceded by better presentation and planning, thus providing decision support, on load measurements, in order to avoid any anomaly, loss or malfunction.
Geographic information systems bring together different computer methods and techniques, making it possible to model, enter in digital form, store, manage, consult, analyze, represent objects or collections of geographic objects, with the essential particularity of taking take into account the spatial characteristics of these objects in the same way as the descriptive attributes attached to them. In fact, the name "GIS" covers a wide variety of software implementations built according to different technical choices, with very diverse functionalities and performances [4-6].

The objective is to develop a GIS to manage forest resources of the Adrar region based on UML formalism and speaking in natural language, so that the user can quickly and adequately determine references to objects unique which provide the coordinates required to position places on a map and in the GIS. The ultimate goal of the system is to increase the quality of locations in terms of precision and accuracy.

II.   Study site

The wilaya of Adrar is located in the southwest of Algeria; it extends between the geographic coordinates [8]:
- ✓ Longitudes between 0 ° 30`E and 0 ° 30` West
- ✓ Latitudes between 26 ° 30` and 28 ° 30` in the North
- ✓ With an average altitude of 220 m

The wilaya covers a total area of 443.782 km², i.e. 17.97% of the total area of Algeria, occupied by a population of 432.193 inhabitants spread over 11 daïra and 28 municipalities. It is bordered to the north by the wilayas of El-Bayedh and Ghardaïa, to the west by the wilayas of Béchar and Tindouf, to the east by the wilaya of Tamanrasset, and to the south by Mauritania and Mali.

• To the north by the large Erg Occidental.

• To the south by the Tanezrouft plateau.

• East by the Tademaït plateau.

• To the west by the Erg Chèche.

Divided into four natural Saharan regions represented by [9]:

• Gourara: Its administrative center is the daïra of Timimoun, this region brings together all the palm trees and ksars of this daïra and extends from Tinerkouk to Aougrout and Talmine.

• Touat: It extends from Brinkane to Reggane; it is the largest of the regions.

• Tidikelt: This region extends from Aoulef to Ain-Salah which is the center of the region

• Tanezrouft: Bordj-Badji-Mokhtar region.

Figure 1. Location of the study implementation area

III. Method and functionality of G.I.S:

Our geographic information system dedicated to forests must be able to perform the following efficiency operations [7]:

1- Data acquisition:

This is the step that ensures the entry and coding of spatial and descriptive data, error checking and preprocessing.

2- Data management:

The fundamental functions of a GIS are fundamentally that of a DBMS. They include storing, editing, updating and extracting data.

3- Spatial analysis and data manipulation:

The main specificity of a GIS compared to traditional DBMS is the wide range of possibilities for manipulating and analyzing spatial data offered by GIS.

4-Data return:

It is the operation of representing the results of the extraction or analysis, in a form that is understandable by the user or by another computer system

The GIS project requires bringing together three components which are:

1-Geovisualization:

Have the maps that represent the area of study.

2-The geodatabase:

Design the spatial (geographic) database which will contain both the spatial attribute data of the geographic entities represented on the map.

3-Geoprocessing:

Which corresponds to the application (type of analysis) that our geographic information system must provide.

IV.   Results and discussion

The geographical object represents a more or less complex entity of the real world such as a road, a building or even an urban area and others. Nowadays, geographic information is an essential resource in a decision-making context and digital spatial data are more and more frequently used as a support and decision aid by many organizations [10].

Our GIS develop allows to perform some common functions such as the selection of the desired data, the creation of thematic maps and in addition the standard functionality provided by any GIS such as Zoom In Out, map control (movement) , display by layer, forest add and update, statistics and others.

Since we used MapInfo version 10 for map processing, we also chose it for the display of our maps in our application and this thanks to a connection between it and Delphi7, indeed our programming in Delphi7 is based on calls to procedures and functions proposed in MapBasic [11].
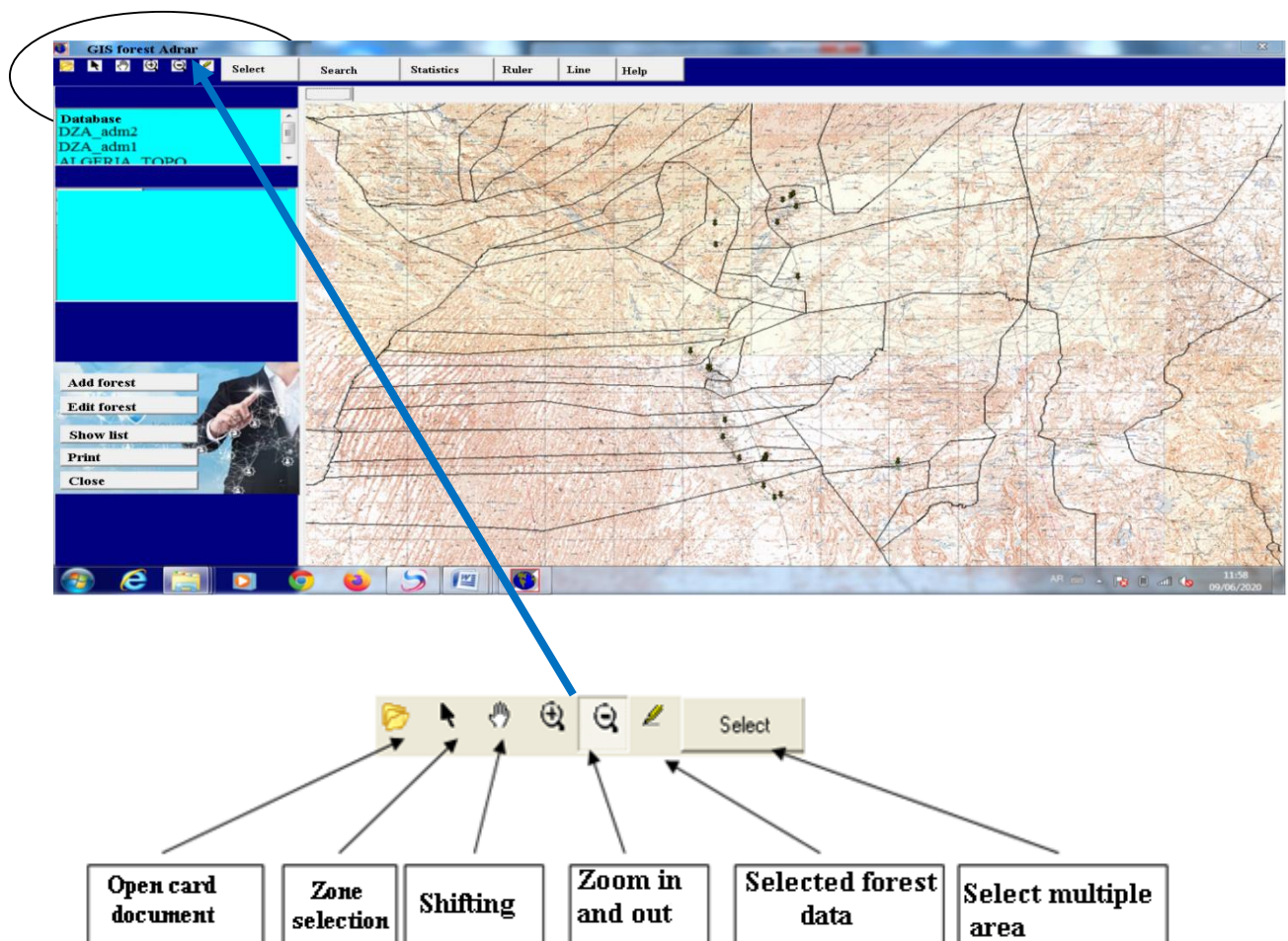

Figure 2. The software interface

IV.1. Forest information

To see the information (characteristic) of the Forest just click on the "Information" or "forest data" button, then click on the forest point, a dialog box contains the information for this selected forest, see Fig. 3
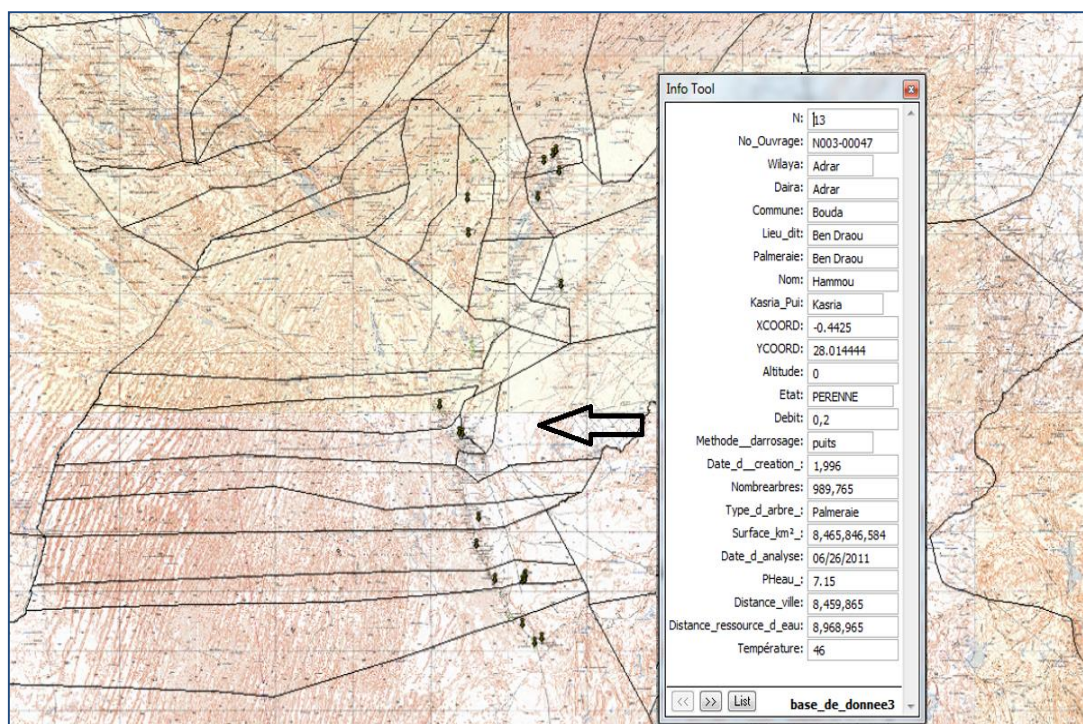

Figure 3. The information of the selected forest

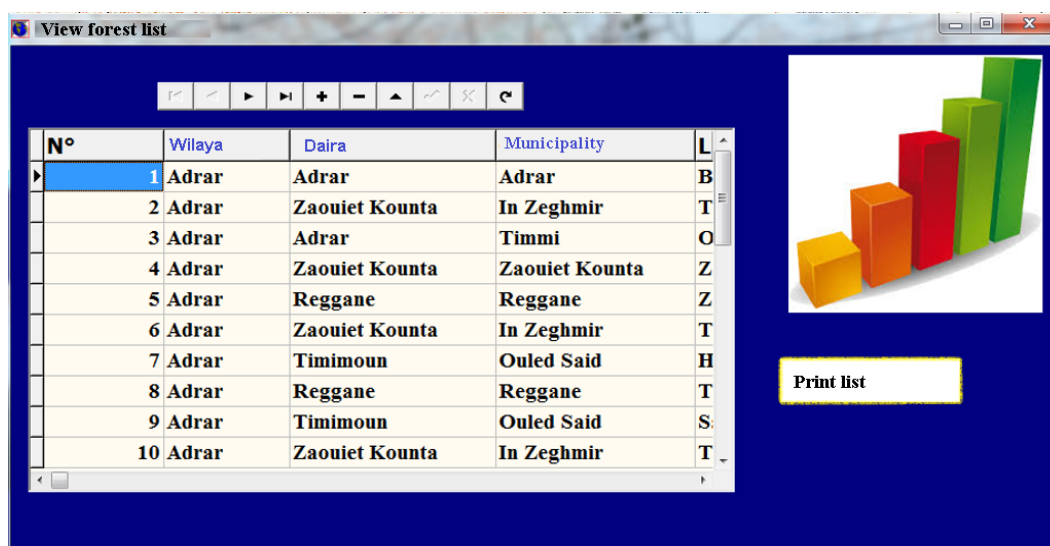To enlarge the map, select the 'Zoom in' button see Fig. 1

The search for a forest can also be carried out while determining the scope of the search: by means of the name of the Municipality or Daïra, or by limiting the number of trees as shown in the figure below.

Figure 4. Search for forests in the commune of "Adrar"

IV.2. List of Forest

If we click on the button "Show list" of Fig.1 a box of the list of all the forests of the region of Adrar is displayed (see Fig.5)

Figure 5. Displaying the list of forests

We can make statistics such as for example the number of trees compared to the surfaces of the zone (see Fig. 6)
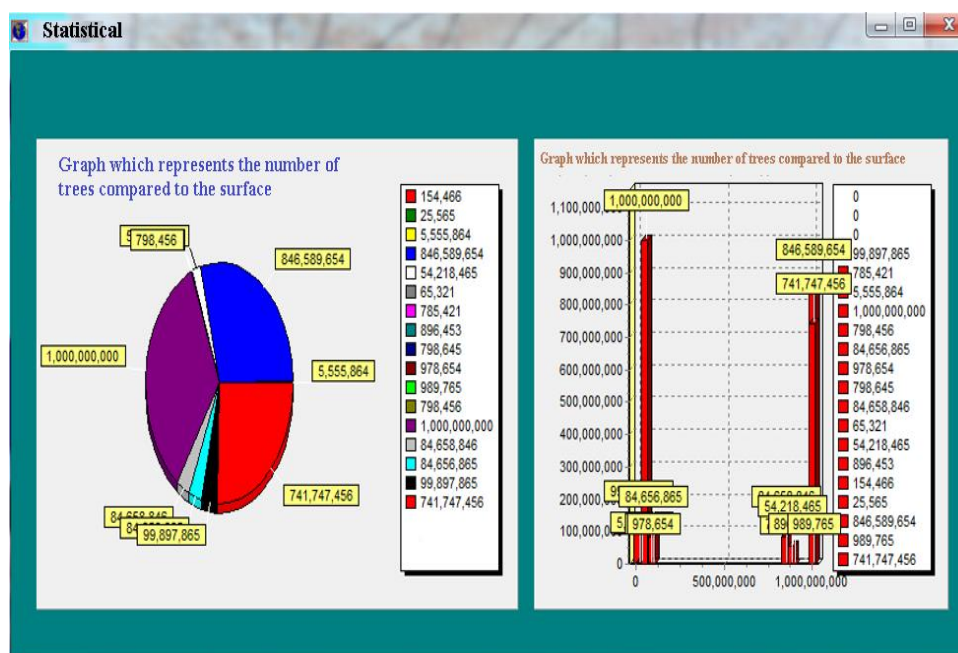

Figure 6. Statistics of the number of trees in relation to the areas

IV.3. Add and updating a forest

To add a forest, all you have to do is click on the 'Add forest' button then click on a point on the map and enter the characteristics of the forest, see Fig. 7.
To delete a forest, just click on the forest then press the Delete key on the keyboard.
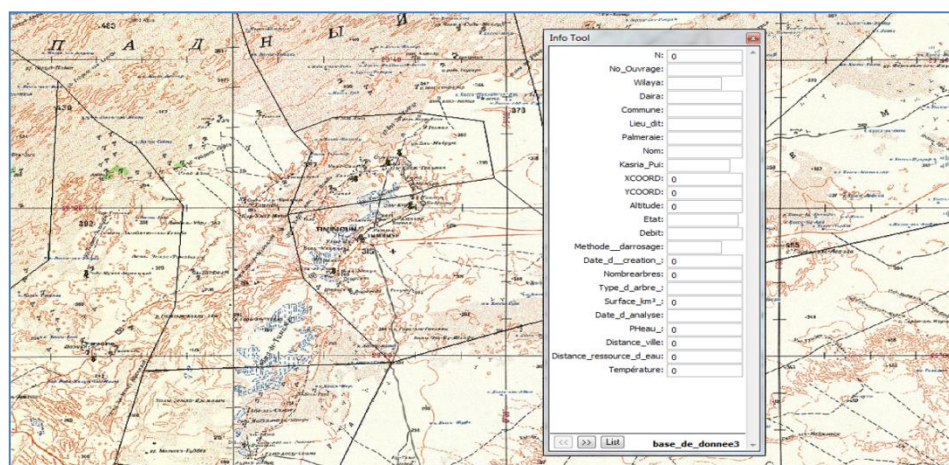
Figure 7. Adding a Forest

V. Conclusion

In this paper, we carried out a detailed analysis of the needs of our application as well as a design that should meet the needs of users of our software in the management of forest resources in the region. We can, through a study of tools and methods, choose those that seemed to us the most suitable to design and build our system. Our completed forest estate GIS contributes to improving management and decision-making as it provides recent information on the characteristics of forests for each city through satellite images. It is a source of information that quickly provides up-to-date information within a shorter timeframe. It can be said that information is an essential element in the forestry sector. In addition to the work approach adapted throughout the development was based on modularity to allow enrich the work with many modules for example:

- ✓ Extend the application to support other types such as (irrigation, agriculture, industry, energy).
- ✓ Develop the application on the web to make it available to everyone.

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