Forests monitoring for environmental protection

Maria - Roberta GRIDAN[1], Alina Corina BĂLĂ[2], Floarea Maria BREBU[3]

***Abstract*— In recent decades Geographic Information Systems (GIS) had a rapid development in our country, practical applications impacting all areas of society, becoming an indispensable element in phenomena management strategy policies, simulations and analysis.**

GIS technology finds its applications in several areas from the forest sector, contributing to the development of growing stock mapping, Among the most important sectors of sylviculture, geographic systems have a very important applicability in forest management, forest cadastre, protected areas management, of forest ecosystems (habitats) mapping, trees and tree stands biometric measurements, torrent basins management, emergency situations management (forest fires), forest roads and wood mass exploitation, shelter-belt forests design and management.

In this paper we study the applicability of a GIS in forest management, for Targu-Jiu Forest Range from Gorj County. Its practical result is an interactive system of spatial data.

***Keywords*—** Forest Management, GIS, Spatial Data, Monitoring, Cadastre, Digital Map

I. INTRODUCTION

GEOGRAPHIC Information System (GIS) usually aims to producing maps and plans, managing network utilities (water-supply, sewerage system, mains, district heating, roads and railway system etc.), identifying the optimal location for an investment, the study of the impact of a certain objective upon the environment complying with the general policy of sustainable development.

The consequence of the sustainable development implementation is a necessity of spatial system designing. This means that ensuring sustainable development presumes different Geographic Information Systems (GIS) because they give quick access of updating and analyzing spatial databases. [1].

For a society that has undergone many social, economic and political radical transformations, its future depends on innovation and the skills to exploit the resources of existing socio-economic and cultural of all actors involved in the evolution of urban society.

The development dynamics (both its advantages and constraints) require a series of strategic redefinition, flexible and creative administrative levels and their operating mechanisms. One of the most important of these function mechanisms - urban management - is an activity that involves multi- and transdisciplinary approaches of urban problems.

In this context, the local administration level, this type of management, is applied in two main areas:

- Localities land managing and monitoring;
- Urban development planning.

The sheer volume of information contained in existing plans and documentation to the local administration level, perishability and difficult handling, interpretation and analysis troubles, determine public institutions to allocate significant financial resources in order to achieve urban GIS applications.

Accurate cartographic feature extraction, map updating, digital city models and 3D city models in urban areas are essential for many applications, such as mapping of buildings and their heights, simulation of new buildings, military operations, disaster management, updating and keeping cadastral databases current, and virtual reality. [1]

The application design and development should follow certain goals which suit the porpoise and after that, to choose a GIS for the territory which can be exploited by its base characteristics (spatial analysis and modeling and also spatial-temporal modeling). It represents a system aimed to deliver supplementary data to both traditional cadastre (which includes the landowning cadastre and special cadastres), to the so-called multipurpose cadastre, and also to the other related scientific and technical domains as: Geography, Geotechnical Engineering, Civil Engineering (for objectives rehabilitation, for localities General Urban Plan and Zoning Plan), etc., a reason for using it as an administrative – economical decisional support for central and local administrations. [2]

II. GEOGRAPHIC INFORMATION SYSTEM

Geographic Information System (abbr. GIS) can be defined as a computer system used for collecting, storing, querying, transforming and displaying spatial data (Borough 1985). Basically a geographic information system encompasses various data about the environment. Spatial data are information about the shape, location and Geographic relationships between entities and their attributes. This data are

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stored in different formats depending on the type of information (figure 1):

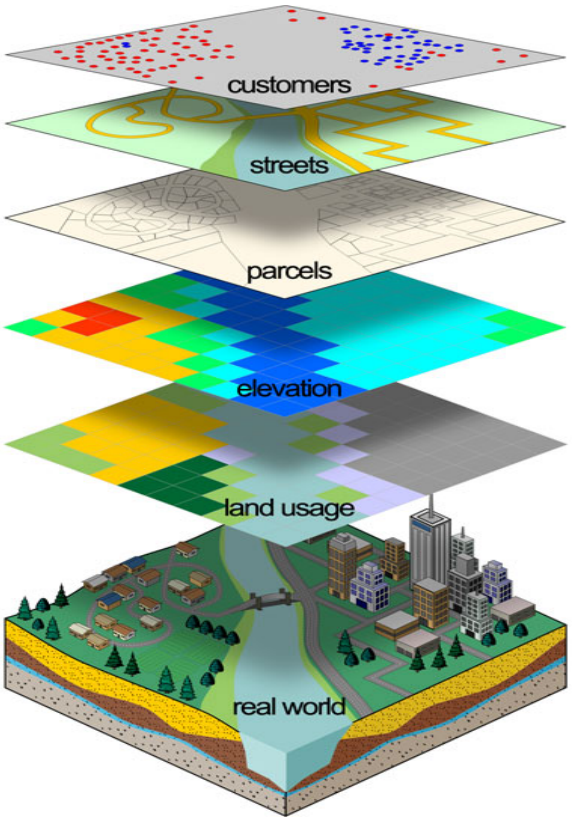

Fig.1 Information stratification

• Raster - map in the form of photos or scanned images;

• Vector - data are stored in a Cartesian system, each entity has an identifier and each entity element has Cartesian coordinates;

• Database - store the attributes for an entity or vector. Maps used in geographic information systems (GIS) are recommended to be predominantly as spatial databases, which must respect the topological and geometric integrity restrictions, respective the traditional restrictions on databases.

The data base structure contains two modules: graphical database (which contains the drawing files processed with specific soft-wares, interactive assisted by their own mathematical and graphical entities storage devices) and the textual database (which manages the economical and juridical technical attributes), both being correlated by link identifiers as: SIRUTA code (a unique code from The Territorial - Administrative Register), the immovable cadastral number and the intra-urban and extra-urban code.

The realized GIS aimed that this two databases, the graphical and textual, to be structured so that to offer quick access and retrieval amenities. [2]

Geographic Information System data and especially functions are an indispensable tool in urban management, both in terms of authority, issue but rather act as a decision support system.

Processing and synthesizing information from the database provides urban indices and pointers necessary to understand the existing situation, which offer support on short, medium and long term urban planning.

III. GIS USE IN FOREST MANAGEMENT

For a sustainable forest management is necessary knowing both quantitatively and geospatial expanding aspects, and also from qualitative aspect, as structure and condition.

The forest is a complex system, whose knowledge from these two aspects was realized from early management which was achieved by conventional means, involving travel and measurements, often under a very rough and inaccessible terrain.

The purpose of creating a GIS application, for forest monitoring for Targu-Jiu Forest Range, is to help the organizations responsible for forest protecting management in the area. Targu Jiu city is located at 195-212 m altitude, at the intersection of 45^0 02', parallel - north latitude, and $23^0$17', meridian - east longitude, in the middle of temperate zone, in the middle of temperate zone, in Targu-Jiu - Campu Mare Depression. The north part of the county is dominated by Vâlcan and Parang Mountains and the south one by Jiului mountain plain (figure 2).

Fig.2 Targu Jiu city Satellite images

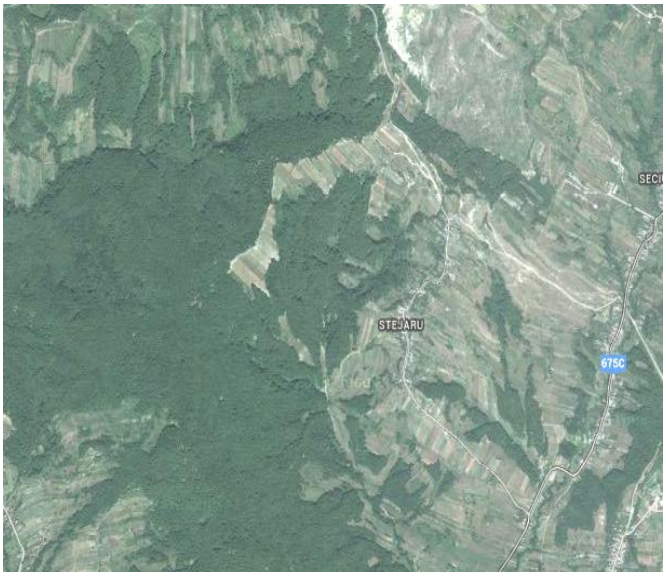

Fig.3 The agriculture expansion over forested areas

The forest GIS monitoring application presented in this paper has the porpoise of monitoring the reforestation areas affected by mining and agricultural exploitations (figure 3 and figure 4).

Fig.4 Surface mining exploitation carried out after partial deforestations

IV. Results and Discussions

Until recently, collecting and using information in the field was a paper-based process with multiple points of data entry without accessing to real-time information. [3]

This database consists of documents, technical data and spatial information, which provides Targu-Jiu Forest Range with the following major information:

- ***Tree stand maps*** - is an essential tool in forest management, providing detailed information on the stand distribution, expansion and structure. (figure 5).

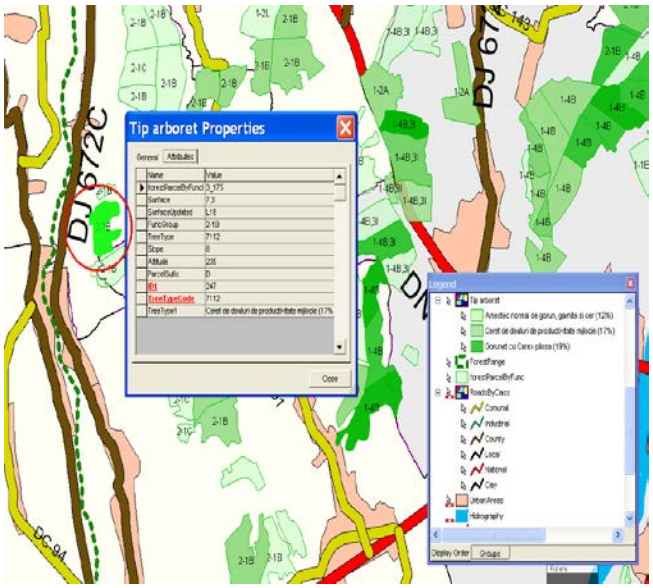

Fig.5 Example of stands map [4]

- ***The forest boundaries map overlapped on landforms*** - can be very useful for accurate altitude and soil profiles location, topo-climate elements determination, etc (figure 6).

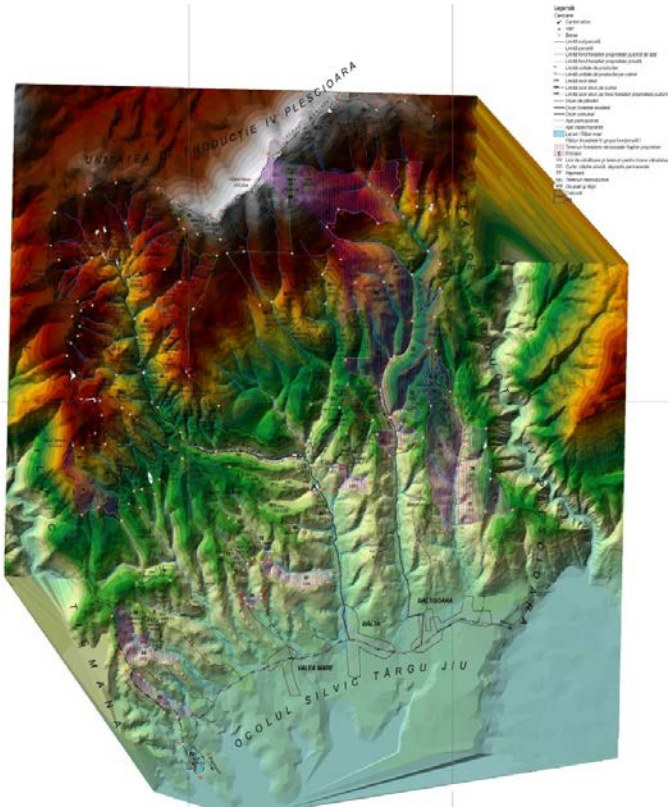

Fig.6 Example of forest boundaries map overlapped on relief landforms [4]

- ***The jurisdiction where the forest plot is located-*** Management of cadastral to an accurate identification, heritage data management and of the

public belonging to the Forest Department (figure 7).

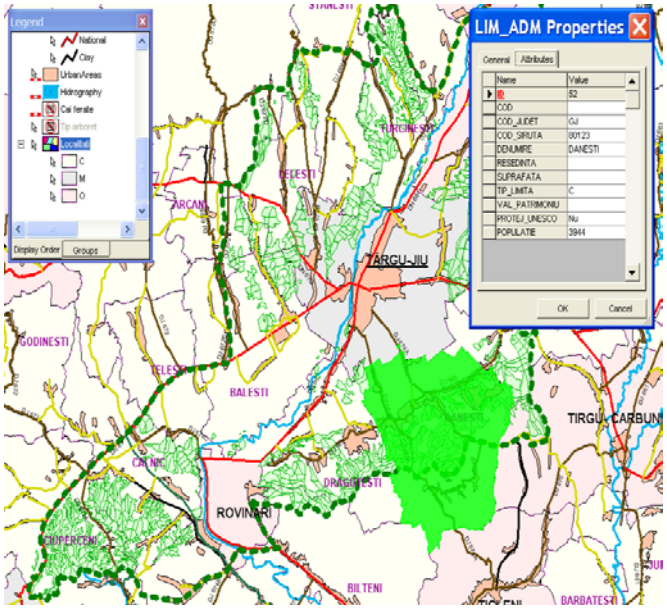

Fig.7 Example of Jurisdiction with the forest properties presentation [4]

- ***Emergency situations management*** – The application can provide the road distance to the nearest point of the plot and also the distance and altitude that the firefighters have to go through the forest to reach the intervention point (figure 8).

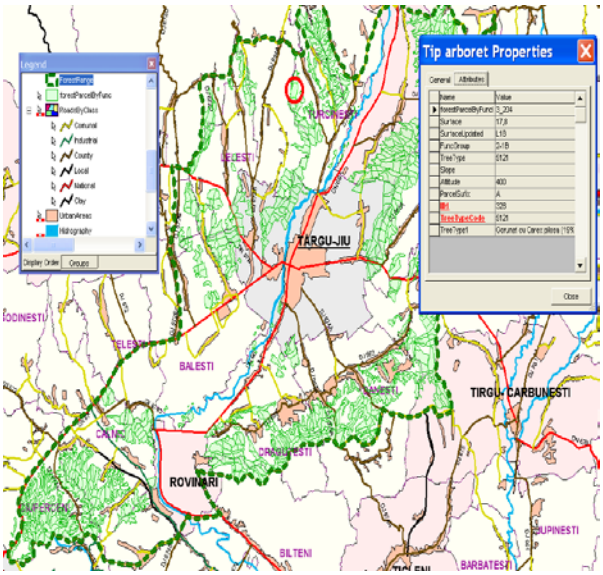

Fig.8 Intervention Preparing, in case of forest fire - Forest characteristics identification [4]

- ***Network management of shelter-belt and production forests*** - as a means of defense against: climate adversities, soil protection against erosion and landslides, economic and social objectives and also the protection of terrestrial communication ways, were and are in the attention of all countries with a developed agriculture, where the crops, land and human settlements suffer more or less harmful influences of winds, drought and surface erosion (figure 9).

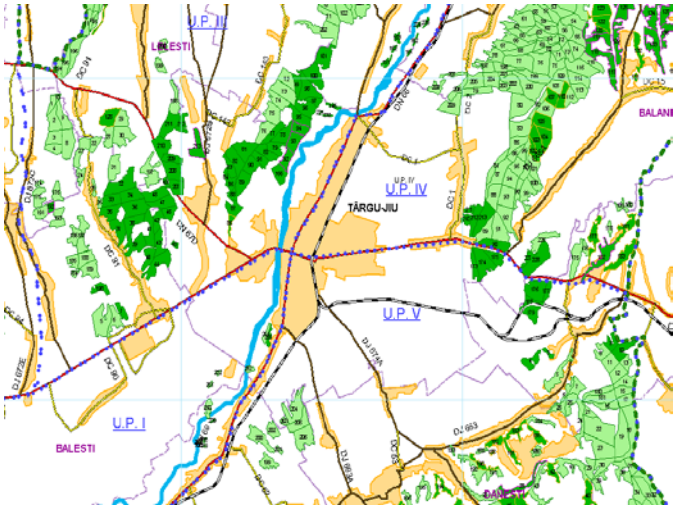

Fig.9 Example of shelter-belt or production forests [4]

This existing digital map is very helpful in the issuance of the manufacturer certificate.

GIS as modern technology of analysis and graphical-textual database processing method is very important element in environment resources management. This is a particular crucial purpose in case of multifunctional spatial system. [5]

The quality of the data in an information system depends on a series of factors regarding the system characteristics, training level of the personnel who use it, quality and the way of data acquisition, the data processing, data analysis and the upgrading of the information. [6]

The implementation and use of GIS technology in an organization represents a long process. Being a relatively new area in Europe, too, one of the main obstacles for successfully implementing and using it within the area is the lack of knowledge. [7]

Although, conceptions of cadastral systems and land administration are different among the countries, their basic function is similar, namely systematic and official recording of property rights in urban land management. [8]

V. Conclusion

In sylviculture, this GIS data type are often used from forests recognition and inventorying, land mapping, forest roads design and forest railways to the disaster areas delineation and inventorying.

GIS technology finds its application in many areas from the forest sector, contributing to the mapping development for the following sectors: forest management, forest cadastre, protected areas management, forest ecosystems (habitats) mapping , trees and stands biometrical measurements, torrential basins management, Emergency situations (windfall or forest fires) management, forest roads and wood

exploitation, shelter-belt forests design and management.

More than that, by updating and monitoring the database for dedicated GIS solutions, one can control the evolution and development of forest resources and also, could prevent major risks according to Environmental Engineering requirements.

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