

Application of GIS in the Forest Management in Romania

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Abstract: *The general trends of development of the information technologies during the last decade are characterized by wider application of GIS in the forestry sector in Romania. Until recently, GIS were used mostly in the mapping of forest stands but currently their possibilities are more and more recognized as a powerful modern tool for visualization, analysis and management of the forest territories and resources. The multifunctional forest management is applied by various silvicultural treatments, maintaining a balance among all forest functions on a given territory, considering the interests of all the stakeholders within the framework of the existing legislative background. A GIS could fulfill the necessity for obtaining of information about the geographic situation of the object, its characteristics, status, analysis of the trends in its development, evaluation and modeling.*

Key words: *GIS, forest management planning, multifunctional management.*

1. The need for GIS

Since time immemorial human being have always resorted to geographical information in one way or the other in survival practices such as identifying fertile productive fields, relocating the good hunting grounds, navigating in the forests and seas, migrating, etc. Since then the need and use of geo information has gone up many folds as a consequence of civilization and modernization. Conventional approaches to spatial data handling are being replaced by digital spatial data managements systems. Today systems have evolved that can use geo information in a many of applications never imagined before. GIS is associated with disciplines such as management of resources, facilities and infrastructure, maintaining land ownership, analyzing population data, monitoring environment, health care, mineral exploration, hazard mapping, location based activates such as monitoring of endangered animals, etc. GIS integrates data from different sources to derive intelligent and informed basis for planning and decision-making. Today Geo information application technologies are becoming more and more significant in the country as they are increasingly gaining recognition within many organizations dealing with spatial data. However, reliable and accurate databases have to be built up to be able to draw upon the potentials of GIS. Therefore fundamental geo information infrastructure has to be put in place, which will include organizational changes, resource mobilization, policy frameworks, and investments in data and data creation. GIS will simply not function otherwise.

2. The main tasks of GIS in the development of multifunctional forest management plans

All the activities and stages of the development and implementation of the forest management plans and multifunctional forest management plans are more effective when appropriate graphic and attributive database is established in GIS environment.

The Geographic Information Systems (GIS) are a powerful modern tool supporting the development and presentation of the forest management plans and MFMP at all the stages

(inventory, mapping, planning of the activities) and in the process of planning of the activities of the State Forestry Enterprises (SFE), municipal and non-state structures in the forestry.

3. Presenting of precise, detailed and multiple information in a form of thematic maps, charts, general tables, analyses and visualization.

During the development of *multifunctional forest management plans (MFMP)* and public discussions, workshops and other meetings the information about the territory and forests in a given object is presented. Usually the maps and data are readable and understandable for a limited number of specialists, aware with the peculiarities of the forest cadastre.

The presenting the data about the object in a GIS environment allows easy understanding of the information by the different participants in the process. During the discussions this results in a shortening of the time necessary for identification of the conflict points, identification of future ones and delineation of current and future problems. Also this facilitates the adequate and fruitful participation of the potential stakeholders, interested in the multifunctional forest management. Maximum transparency is achieved and the forest policy implemented by the responsible administration is well understood and the confidence of the participants to it increases.

Integration of data of different type and from different sources

During the multifunctional forest management appears a necessity of additional specialized information about the forest territories and the adjacent zones. In the starting period of MFMP it is still unclear what information will be necessary. Therefore all the data available about the territory is collected and is integrated in common models and databases.

Performing of spatial analyses and revealing of relationships and trends

One of the most important tasks of GIS technology is to answer the questions, to help delineation and revealing of the trends in the forest development and to obtain new types and quality information about the territory.

Using the options of GIS for simulating of a "virtual forest"

The three-dimensional presentation of the information the visual interest is attracted and different processes are being stimulated in a real time. The capacities of GIS are used for forecasting and projecting of different objects and activities (routes, cuttings, engineering infrastructure). The forest is a complex of resources and factors, which are dynamic in the course of time and are interrelated. The correct preliminary assessment of potential disasters in the forest status (forest fires, snow breaks, windfalls) and predicting of "scenarios" as responses to different crisis situations, could provide a realism of the activities planned in MFMP. Otherwise, some of them would be inadequate.

4. Technical tools and data

Hardware and software

For development of GIS of MFMP, an appropriate hardware with peripheral devices and a software are necessary. Recommendable is the operation system Microsoft Windows (98,2000,NT,XP), with a minimum of 256MB RAM , 60MB HD, Pentium processor, CD-ROM and specialized software (ArcGIS, MapInfo, Autodesk Map, Intergraph Geomedia Pro).

The primary database

The primary database for GIS development is used the information about the object in the current forest management and game management plans; digital models and data from the

municipal services; plans of the territorial development of the object of interest; available cartographic materials, texts and numerical data; results of field measurements; aerial photographs and photo-charts, ortho-photo-plans and satellite images; digital models of the relief.

The forest thematic maps are themselves situation maps in a scale of 1:10 000, 1:25 000 and smaller. Their elaboration is based on topographic maps in a scale M 1:5 000 and M 1:10 000, on the digital models of land division plan, and on the maps of the restored property on forest lands, geodesic field measurements and other sources. They are updated every ten years by a new forest management planning of the territory.

5. Information from the State Forest enterprises (SFE), Regional Forestry Directorates (RFD) and the National Forestry Agency (NFA)

The main forest-related information, necessary for the development of MFMP is taken from the digital models of the forest management plan and game management plan of the object and its attributive database developed in the adopted standard formats. The information supplied by the state forestry institution is a source for:

- obtaining of information about the spatial distribution of the forest complexes, the borders among the properties of different owners and users;
- determining of the forest fund area and its subdivisions from the point of view of forest and game management planning;
- linking the activities planned in the MFMP to the area and planning of forestry and engineering activities;
- identifying of the territories with limitation regimes of forest use (protected and protection territories, water supply zones, water catchments, protected localities, natural sights, zones restricted for grazing, zones restricted for collection of medicinal plants, mushrooms etc.);
- marking of areas according to fire risk, access to water basins, platforms for aviation techniques, observation towers, tourist fireplaces;
- determining the hunting area, game habitats; zones for game breeding, zones with restricted access; hunting routes, equipment, activities.

Data from the municipal administration

An important part of development of the general model of the object is identification of the properties in the forest territory based on the files presented by MSAF in a standard DEM format:

- digital models of maps of the restored property (MRP) of the land in the object;
- digital models of the land division plans (LDP) of the land in the object.

Data from aerial photographs and images

- new or available in archive aerial photographs and ortho-photo-plans of the forest fund;
- new or available in archive satellite images (resolution 5-30 m).

Supporting data and materials

Additional information concerning the object during the development of GIS of MFMP is provided by different services and subdivisions of the local authorities, unions and NGOs:

- Municipal administration - data about municipal objects and areas of responsibility (forests, waste deposits, single constructions out of regulation etc.), data from the municipality service "Ecology" concerning the state of water, air and soil;
- Mayors and mayor representatives - information about the objects of local importance, pastures;
- Regional service for fire control and public safety - data about fire control activities and objects;

- Regional service for environmental protection (RSEP) - data about environmental pollution and ecological problems, data about the monitoring of environment;
- Hunting unions - data about the areas managed by the hunting unions;
- Tourist clubs - tourist routes, paths and sights around; recreation places, camps, caves, rock-climbing objects, bicycle tracks, ski-tracks etc.
- Regional road service;
- Water service - water network and sewerage out of regulation, canals, water power stations (WPS), dams, springs;
- National Energy Company (NEC) – power lines, power distribution stations, zones of responsibility of NEC.
- Union of hoteliers and tour-operators - objects (hotels, country houses, guest houses), services and sightseeing;
- Other stakeholders - private forest owners, timber harvesting companies, owners of WPS.
- During the process of MFMP development, the huge in volume, diversity and complexity information is being discussed, updated, and integrated until the achievement of the final variant.

6. Development of GIS of MFMP

GIS could respond to the necessity to have data and information about the situation of the object, its characteristics and status. Later on, after the analysis of developmental trends, assessment and modeling, a new level of knowledge about the object is achieved.

Table 1. Proposed stages of development of GIS of MFMP

Stage	Activities	Results
Preliminary investigations and analysis	Analysis of the potential for ideas, information available, particular topics	Data in different formats
Presenting of GIS technologies	Popularizing among the participants in MFMP and increasing their awareness with the capacity of GIS technologies.	Demonstration of GIS software products
Elaboration of a task for GIS development		Defining the parameters of GIS - objectives, extent and contents
Preliminary concept for GIS	1. Development of a common model of the territory - data conversion in a unified format	Common model and database
2. Presenting the list of the necessary information for the GIS developing		List with the necessities
3. Development of the matrix with the requirements of MFMP		Matrix of the requirements
4. Identification and mapping of the conflicts		Detailed and general maps and information
Dynamic implementation of GIS	1. Presentation of GIS at public discussion - information tables	Thematic maps, tables, charts, analyses
2. Logistic support to the workshops		
3. Defining of zones of "agreement" and conflict zones		