FOREST MAPPING IN LITHUANIA: THE ROLE OF GEOGRAPHIC INFORMATION S's (*Science, Systems and Studies*)

Introduction

There is quite common opinion in a GIS community that mapping is less important than the geographic analysis and that professional GIS users manipulate the numbers but not the nice pictures. Contrary, the cartographer who needs GIS as a tool for map production does not use it for sophisticated analysis and modelling. And this is quite obvious – the cartographer is not a forester, urban planner or biologist and he or she does not necessarily need GIS for sophisticated and rather specific analysis. The aim of this presentation is to discuss the role of GIS as a set of tools or solutions (i) within the frames of forest inventory and management planning, resulting in forest resource information and detailed management prescriptions for some period (**S**ystems), (ii) some fundamental issues raised by the use of GIS and related technologies, such as spatial analysis, map projections, accuracy issues and scientific representation (**S**cience). And, (iii) both systems and science are impossible without systematic study of the use of geographic information (**S**tudies).

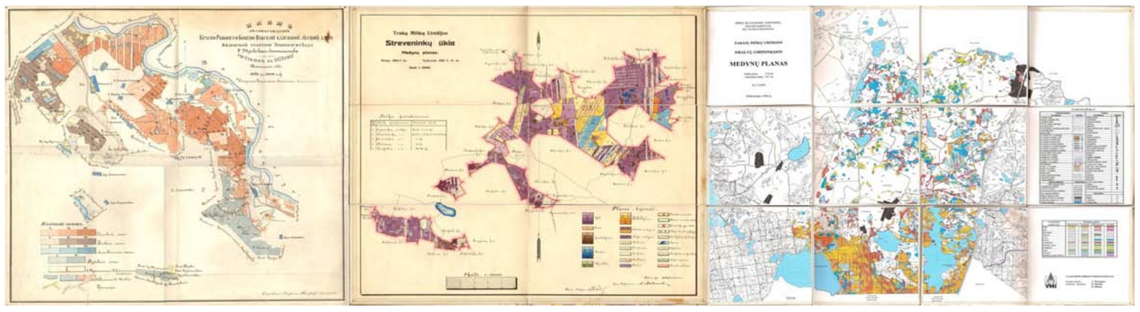


Fig. 1. Forest stand maps developed for three different generations: years 1879, 1930 and 1998

Forest mapping in Lithuania is based nowadays on the database-driven cartography approach (Fig. 2). Such approach means that the development of databases of the forest resource databases takes place first. Database-oriented approach simplifies and facilitates the generation and maintenance of the product and ensures the data consistency. The database can be used later for multiple cartographic products by employing different symbol schemas. The lists of digital maps and charts produced are easy to modify. Main advantage of such approach is flexibility in choosing the content and structure of hard- and softcopy outputs, which is difficult to clearly define in advance.

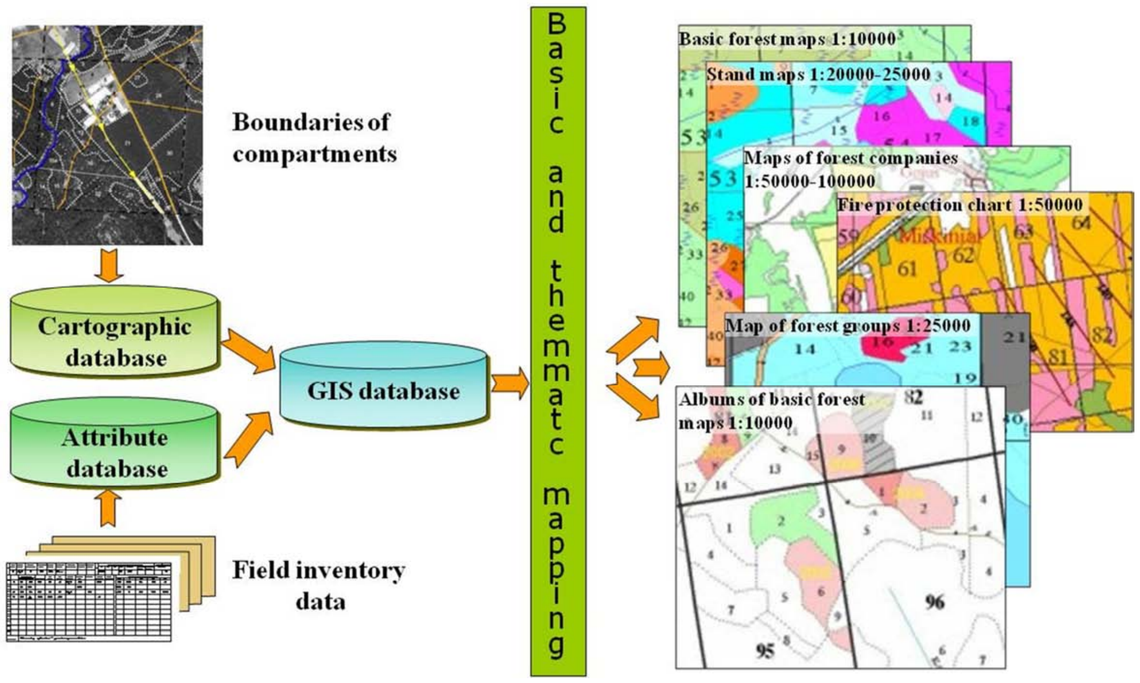


Fig. 2. The database-driven cartography approach in Lithuanian forest mapping

2. "How is it made"?

Lithuanian forest inventory and management planning, including the forest mapping, is based on a combination of interpretation of aerial photos and conventional field work since 1950s. GIS is used since 1995. Main features of forest inventory, putting out the database of forest resources, are the following (Fig. 3): techniques.

1. Collection of all available information to be used for possibly objective singling-out of the forest inventory units – forest stands (old forest maps, remote sensing data (e.g. CIR orthophotos), general GIS databases (e.g. GDB10LT) and maps, field measurements, etc).
2. Digitizing and integration of all collected information (e.g. scanning and geo-referencing of paper maps).
3. On-screen interpretation of new boundaries of forest compartments by forest inventory engineers. The same person is checking the interpretation in the field and finalizes the compartment level GIS database later.
4. Development of initial version of forest compartment GIS database and printing-out of sketch maps for field surveys.
5. Conventional field survey, utilising some modern GIS related tools, like GPS, web based inspection of inventory results.
6. Finalization of forest compartment GIS database, development of cartographic elements, and calculation of some specific attributes (e.g. area, unique IDs), mapping, etc. using conventional techniques.

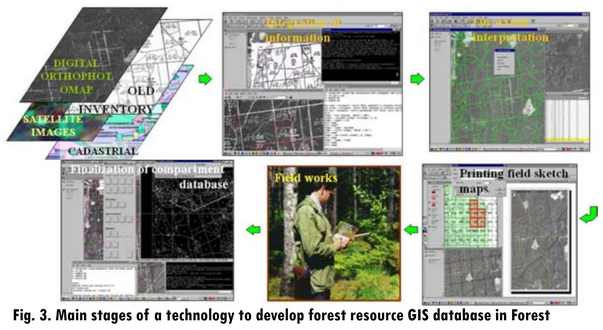


Fig. 3. Main stages of a technology to develop forest resource GIS database in Forest Inventory and Management Planning Institute

Current GIS system is based on ESRI ArcGIS, ArcSDE and MS SQL Server. It manages more than 1,3 Mil. of polygon (just forest compartments), around 4 Mil. of linear and around 1,5 Mil. of annotation features.

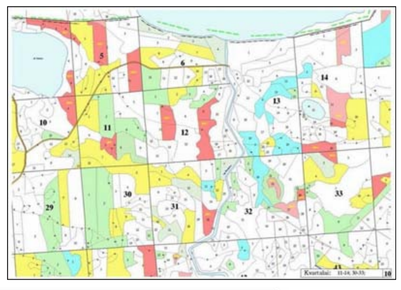
3. What does it contain?

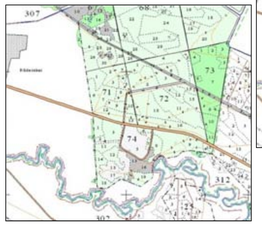
There are two types of maps that are output from a GIS in Lithuania:

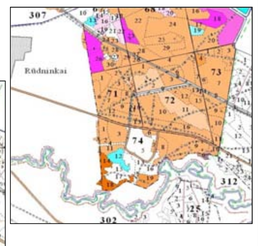
- Formal maps for a mass user developed following some cartographic conventions.
- Informal maps or charts to visualize and analyze geographic forest related data.

The forest resource GIS database as it is can be accessed just by very limited number of potential users that have needed hardware, software and competence. The are some options to query and observe it using web based solutions, as the VMTGIS, developed by the State Forest Service. However, the set of standardized forest maps remain main solution to make the GIS information accessible for a possibly wider audience (Fig. 4). The following is some summarized list of standard forest maps developed within the frames of forest inventory and management planning:

- Basic forest map at a scale of 1:10000;
- Forest stand map at a scale of 1:20000, indicating prevailing tree species and age;
- Forest stand map at a scale of 1:20000, indicating forest sub-groups and forest protection regimes;
- Map of forest blocks at a scale of 1:10000, indicating prevailing tree species and age;
- Map of forest blocks at a scale of 1:10000, indicating planned silvicultural treatments;
- Administrative map of forest enterprise at a scale of 1:50000;
- Map of forest groups and sub-groups at a scale of 1:50000;
- Map of forest ownerships at a scale of 1:50000;
- Forest fire prevention map at a scale of 1:50000;
- Some other maps, depending on the demand.







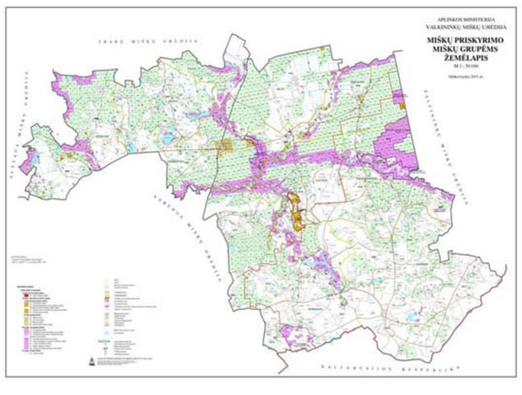


Fig. 4. Standard forest maps developed within the frames of forest inventory and management planning

Maps are the easiest way to understand and represent the geographic data. Contrary to the computer-driven GIS, paper maps are both storage and communication mechanisms. The detailed GIS information might be summarized to be output practically at any scale and any use. The user is easy to layout and print even one or several maps exactly following his needs. If paper maps are prepared for numerous users, one must follow some rules, which will depend on the peculiarities of maps prepared and geographic data available. However, large degree of flexibility is common in forest mapping, especially when creating informal maps or charts (Fig. 5). Even basic principles of cartography are followed, some of forest maps may look unacceptable for professional cartographer. So, very often if not always professional forester with some basic GIS skills is preferred to professional cartographer with even moderate abilities in forestry.

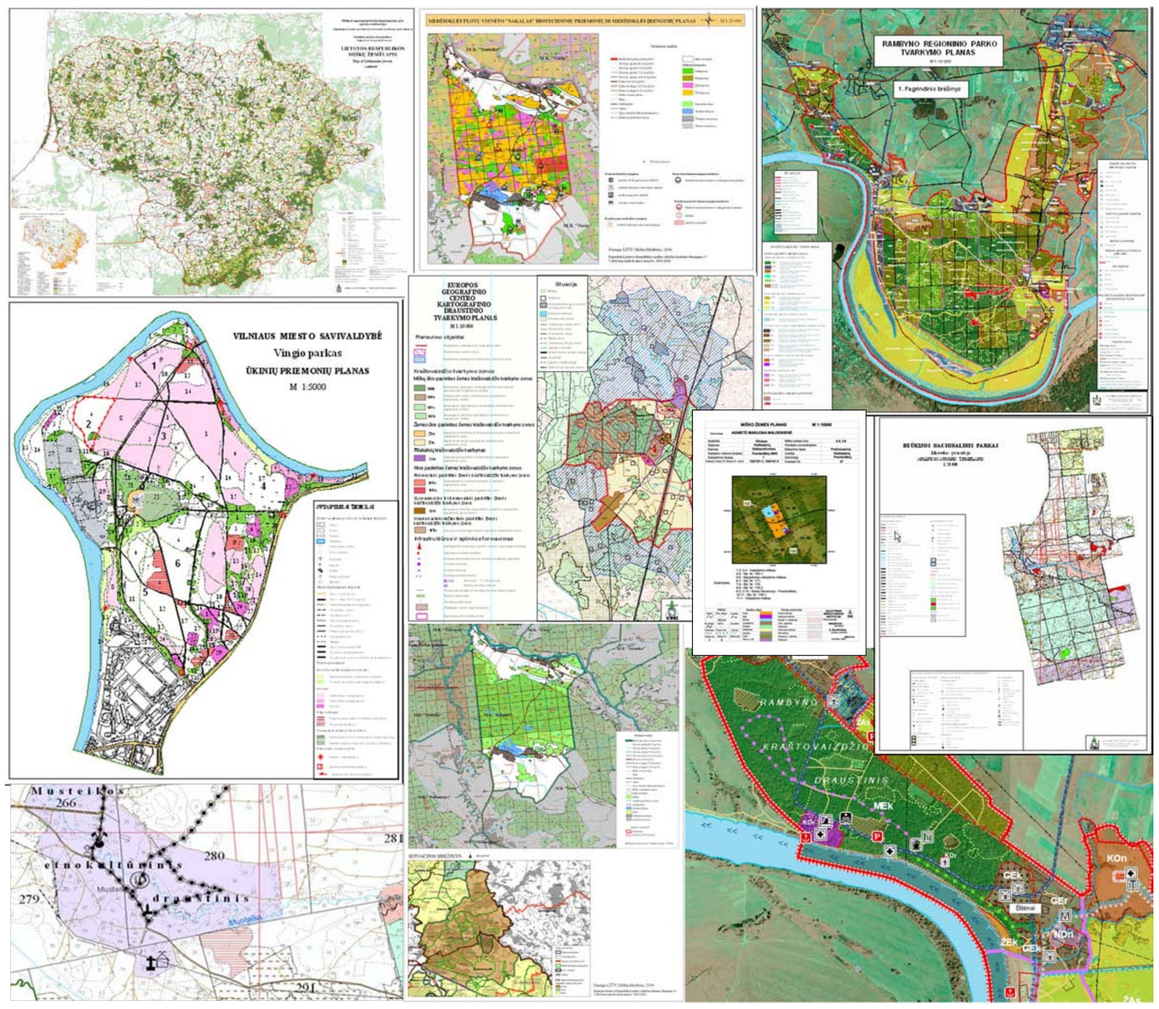


Fig. 5. Some examples of non-standard forest maps

4. GIS as Geographic Information Studies

Introduction of GIS in forest inventory and management planninghas set new requirements for the skills of forestry people, no matter they are GIS developers users or just viewers. At first glance, the overall level of GIS techniques in Lithuanian forestry is rather high. However, the progress was based on the efforts of several professionals, employed by Forest Inventory and Management Planning Institute and Forest Survey Service (today State Forest Service).Competence in GIS among professional foresters is remains rather low. Lithuanian University of Agriculture has accepted the challenge to solve this issue (Fig. 6). There are three major directions assumed for strengthening GIS related teaching/training to improve the general level in GIS competence among forestry specialists:

1. **GIS and related courses for University students** of all levels. Bachelor degree students of Forest and Ecology faculty have mandatory GIS introductory course since 2004. The 3 credit course includes lectures on GIS basics, data models, geo-referenced and thematic GIS databases, GIS analysis, as well as brief review of major GIS related projects in the field of natural resource management. ArcGIS (University Campus license) software is introduced during the practical training sessions. All basic functions as well as some forestry GIS applications are exercised. Introductory GIS course is followed by more in-depth studies during Master studies. Master degree GIS course differs slightly for the students from different departments, but, in general, the curriculum of Geographic Information Systems for Forestry/Environment includes: design and development of spatial databases, geostatistics and surface modeling, web-GIS with special focus on GIS as geo-information science. ArcGIS (ArcInfo) with its modules is used as a tool for practical training. The training itself is based on several practical exercises with the use of advanced GIS tools.And, finally, the most advanced GIS curriculum is offered for doctoral students. It is usually tuned to meet the specifics of each student, but, in general, it includes the same topics as for Master students (for doctoral students, who did not have this course before) plus a small scale research project based on the use of GIS techniques.
2. Special **training of University teachers and researchers** in order GIS to become an integral part of other courses and research projects. There are several objectives of such approach. First of all, GIS is a powerful tool to enhance the research capabilities of teachers and researchers, dealing with different aspects of natural, social, and human-made phenomenon, improve their image. Next, there are quite many other courses, which can incorporate advantages of GIS-aided solutions, thus, make the student to deal with GIS on an everyday base.
3. **Extension education**. One of the main tasks for the University is set at the moment to provide former graduates with general level competence in using GIS for possible their every-day activities, actually, to guarantee an opportunity for them to gain the same competence as current graduates. So, special courses are designed for extension students including possibilities for distance education.

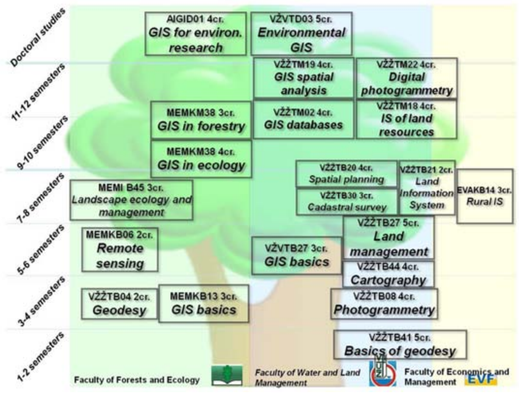
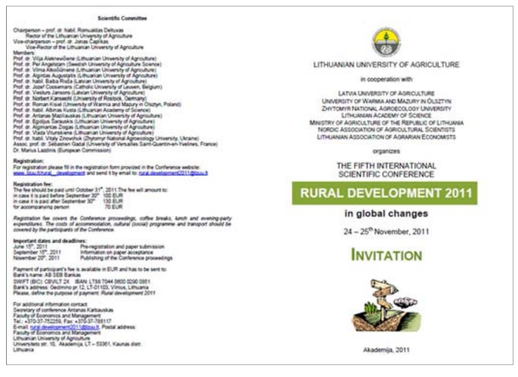
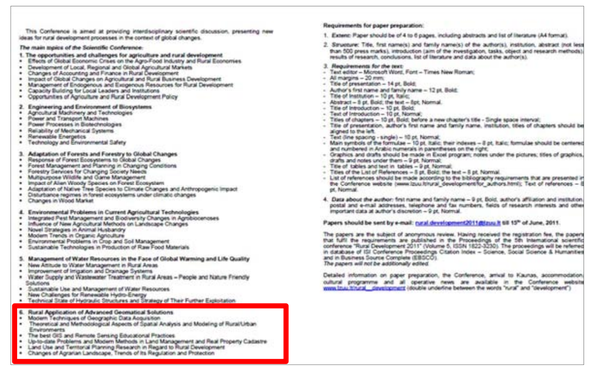


Fig. 6. GIS related courses at the Lithuanian University of Agriculture

5. GIS as geographic Information Science

GIS-aimed or GIS-based research projects, new graduate and post-graduate students specializing in the fields under discussion are expected to facilitate the promotion of general level of GIS in forestry. Forest may be considered as a geographic phenomenon, thus any research in the field of forestry finds some use of Geographic Information Science. GIS is used or even studied in Mater thesis since 1998. Today, most of Master degree research includes some aspects of GIS, even if this is scientific representation of the results in a form of map or chart. Currently, there are 4 forestry doctoral students, directly dealing with the geomatics and at least 2 times more using GIS for their own research. Biannual scientific conference "Rural Development" of Lithuanian University of Agriculture has a separate section for Geomatics, offering a forum for all scientists active in this field.





6. In conclusion

The objective of using GIS in forestry or other areas has not always been to develop a nice looking map, however the final judgments are often based on the quality of illustrations...

G.MOZGERIS*, M. PALICINAS**
*) GIS Education and Research Centre, Lithuanian Univ. of Agriculture, Studentų Str.13,
LT-53361 Akademija, Kaunas region, Lithuania, gintautas.mozgeris@lzuu.lt
**) Lithuanian Forest Management and Inventory Institute, Pramonės pr 11a, LT-51327, Kaunas, Lithuania, misa@lvmi.lt

www.giscentras.lt and www.lvmi.lt