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IMPACT OF GEODETIC STUDIES AND MEASUREMENTS ON THE PRESERVATION AND REABILITATION OF FORESTRY HERITAGE

Alina Corina BĂLĂ[1], Floarea-Maria BREBU[2], Carmen Grecea[1]

[1]"Politehnica" University of Timişoara,
[2]Banat's University of Agricultural Sciences and Veterinary Medicine, Timisoara, Aradului Street, no. 119, RO-300645, Romania,
Corresponding author: Alina Corina Bălă, e-mail:alina.bala@ct.upt.ro

***Abstract**: The policy regarding the environment preservation, as a relationship of mankind with nature, has changed in time, due to the anthropic activities, mainly with irreversible effects and, sometimes dramatic consequences. The limit between the agricultural lands and the forestry zones will be modified on the benefit of the agricultural lands and grazing lands, firstly, because of the demographic pressure. Another cause of national and global modifications represents the abusive use of forest lands. Topographic and cadastral measurements have a special importance in the environmental protection research, especially for monitoring the effects of nature's geometrical modifications. There are also evaluated the effects of anthropic modifications on the environment. All forest sectors related directly to field data cannot operate without detailed maps of the specific area. Currently, most forest plans which were made in Romania over 15 years old and no longer correspond to any reality from the field. Evolution and rapid development of surveying technology has led to these graphical products and other data necessary for a complete forest planning and its efficient management. In the paper it is presented a study case related to Săvârşin forest area, Arad county, as a boundary project using GPS technology and also satellite photograms for future 3D modelling of forested territories. The large use of the automatically tools of measurement and processing, the elaboration of digital plans and maps lead to modern a land management system which can face the present request from this field of activity. The applicability of the informational systems will last a long period of time, both categories of classic and digital materials will operate. During all this period, the technical equipment for data collection, processing, storage and overview will continue to develop, in order to accelerate the achievement of a complex project of informational systems.*

***Key words**: surveying, GPS, satellite photogram, detailed map, environment, 3D modelling*

INTRODUCTION

Before the development of the human society the planetary forests occupied an area of around 8 billion hectares, i.e. approximately a quarter of the land surface. Forests made up 8 big zonal binomials- the binomial of the equatorial forests, two binomials for the tropical forests, the subtropical forests and the temperate forests, as well as the binomial for the boreal forests. By continuous deforestation, which has not been stopped yet, the forest surface has reached nowadays 3.869 billion hectares, having a decrease of over 50%. There is a significant decrease of the tropical, subtropical and temperate forests. The equatorial and the boreal forests are still kept on large surfaces there, but these areas have climates less favorable for human activities. Most of the forests were kept in Asia, Africa, North America, Central America and South America. Europe, without Siberia, has just around 330 million hectares. On the European continent the highest number of forests is in Russia (140 mil. ha.) followed by Sweden (27 mil. ha.), and Finland (22 mil. ha.).

The Romanian forests occupy according to statistics 6.7 million hectares, which represents 26.3% of the country territory. According to this percent Romania is placed on the 11th place in Europe and is below the average percent of 31- represented by forests out of the total surface of Europe. So the majority of the countries in Europe have a much higher percentage than Romania in what forests are concerned. Among these, we would like to mention: Bulgaria with 30 %, Czech Republic with 33 %, Slovakia with 38 %, former Yugoslavia with 39.9 %, and Poland with 38 %. Romania with 0.28 ha of forest per inhabitant is placed below the average of 0.32 ha of the countries in Europe. In the last 75 years the surface of our forests has decreased from 35-40% in 1921 to 26.7% in 1990, i.e. with approximately 10-15%. By deforestation of an approximate 200 000 ha forest and the thinning of young trees by forestry crimes of hundred of thousand of hectares, the forest surface has decreased significantly in the last five years. In what the degradation state of the forest is concerned we are placed among the last countries in Europe. In fact, in the surface of 6.7 million hectares, there are also included the degraded fields with or without totally degraded forests.

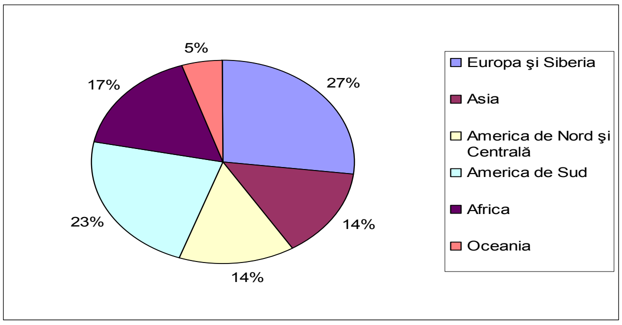

Figure 1. Forest distribution on continents

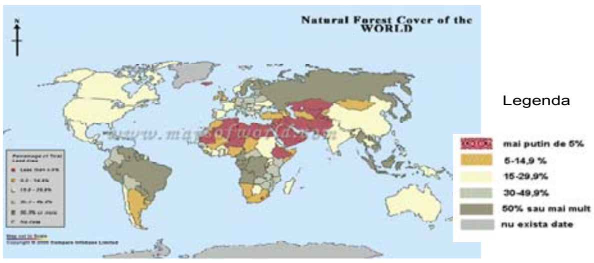

Figure 2. World wide natural forests distribution [www.mapsofworld.com]

The transition from the centralized economy to the market economy, started in 1990, led to many other alterations in the property regime and forest management. Over 400000 ha of forests have been reverted to their former owners or to their inheritors, their number could reach 1 million; thus leading to a huge division of the forests.

The Romanian forest patrimony has a surface of 6.382 million hectares, out of which 6.223 million hectares is covered with forests, and the rest of 159 thousand hectares is represented by lands designated for agriculture, production and forest management. Forests occupy 26.7% out of the country territory, with an uneven distribution within the territory.

Approximately 53% of the forests are located within the Carpathian Arch, 37% in the pre-Carpathian hills and 10% in the fields. The forest distribution according to the relief is graphically presented in Figure 3.

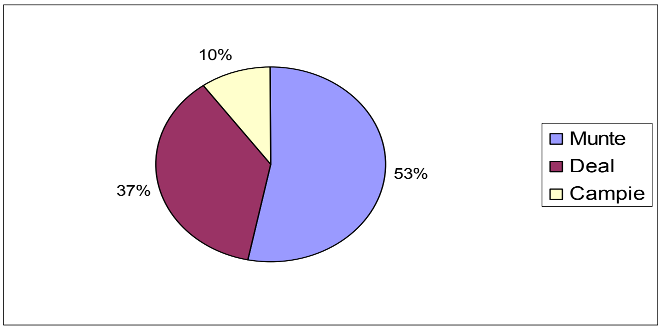

Figure 3. Forest distribution in Romania related to relief

It is mandatory, especially by using forest arrangement, to find solutions for their durable management by making periodical measurements and topo-geodesic evaluations. All the forest units in charge of administering land information have to have a real situation, updated for the territory and to have access to detailed maps.

The reduction of the land surface represents a danger for the hydrologic equilibrium, for the protection of the soil and of the environment, as well as for the forest protection basis.

THE USE OF SATELLITE MEASUREMENTS IN FOREST AREAS

The current paper presents a case study for the Savârşin area, Arad county. The project refers to the forest area delimitation with the help of the GPS technology and the satellite photograms useful for future 3D land modelling.

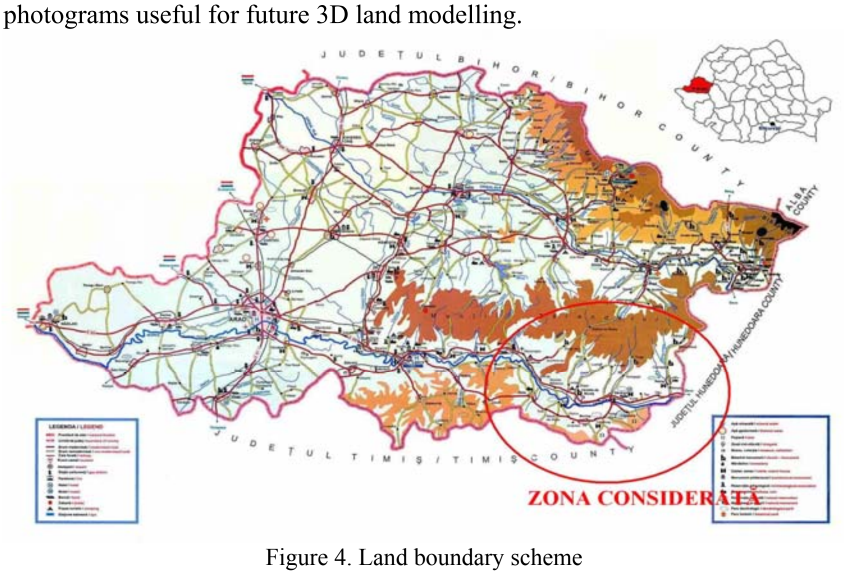

Figure 4. Land boundary scheme

The topo-geodesic measurements were made at the request of Ocolul Silvic Arad. The method used for the land measurements was based on the use of GPS technology with dual frequency receivers L1/L2 ,"TRIMBLE" in static regime. The existent geodesic network existent in the working area and used for determination with the GPS measurements, part of the State Geodesic Network, comprises 4 triangulation points, as follows: 5 COLINE , DEALUL FETEI , INEU and HEREDIA (Figure 5) .

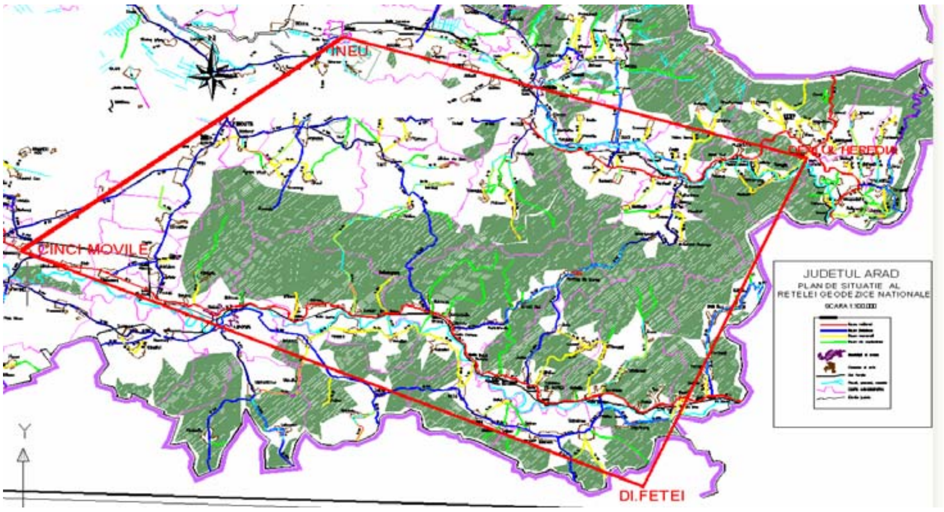

Figure 5. Points of the geodetic state network

More than this 58 points were designed for the raising network: B206 , B208 , B213 , B216 , B217, B218 , B220 , B221 , B222 , B226 , B227 , B229 , B231 , B232 , B233 , B234 , B235 , B236 , B237 , B239 , B242 , B243 , B245 , B247 , B249 , B251 , B253 , B254 , B255 , B256 , B257 , B259 , B260 , B264 , B265 , B266 , B267 , B26 , B272 , B274 , B275 , B276 , B278 , B281 , B282 , B285 , B287 , B290 , B292 , B295 , B296 , B299 , B31 , B67 , B69 , B77 , BPD205 şi B216 . Out of these, four points were selected, i.e. B251 , B253 , B67 and B216 to thicken the state geodesic network which served as a basis for the exact determination of the other points of the raising network.

Next, we are going to present the processing of the satellite measurements and the tridimensional transformation of the points in the Stereographic Projection 1970 System.

In what the GPS measurements are concerned, the quality control refers to those procedures or indicators through which it can be ensured a certain degree of quality (precision and reliability) of a GPS measurement. That is why the quality control has to deal both with error detection and with the interpretation of primary and secondary corrections , obtained by the method of least squares, specific to the GPS technology.

There is a number of quality indicators which can be monitored by the program for the processing of the GPS Trimble Measurements, which include:

- *mean square error of the observations –for the case in question it is within the acceptable tolerance = (±3mm/1ppm);*
- *number of observations rejected – none was rejected;*
- *statistic tests regarding parameters or residual errors;*
- *final standard deviation - final standard deviation is 0.800mm;*
- *value of the optimum solution;*
- *unfavorable solution;*
- selective ambiguity parameters.

RESULTS AND DISCUSSION

As it can be seen the points: B206 , B208 , B213 , B216 , B217, B218 , B220 , B221 , B222 , B226 , B227 , B229 , B231 , B232 , B233 , B234 , B235 , B236 , B237 , B239 , B242 , B243 , B245 , B247 , B249 , B251 , B253 , B254 , B255 , B256 , B257 , B259 , B260 , B264 , B265 , B266 , B267 , B26 , B272 , B274 , B275 , B276 , B278 , B281 , B282 , B285 , B287 , B290 , B292 , B295 , B296 , B299 , B31 , B67 , B69 , B77 , BPD205 and B216 were determined by three 3 vectors, using B251, B253 , B67 and B216.as reference points for processing the identification marks (figure 6 and figure 7)

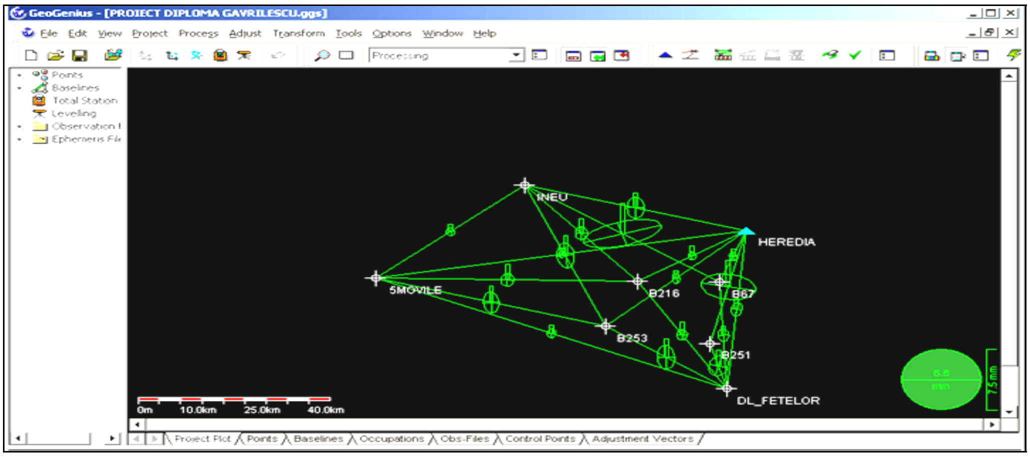

Figure 6. Geodetic state network Sketch (Processing stage)

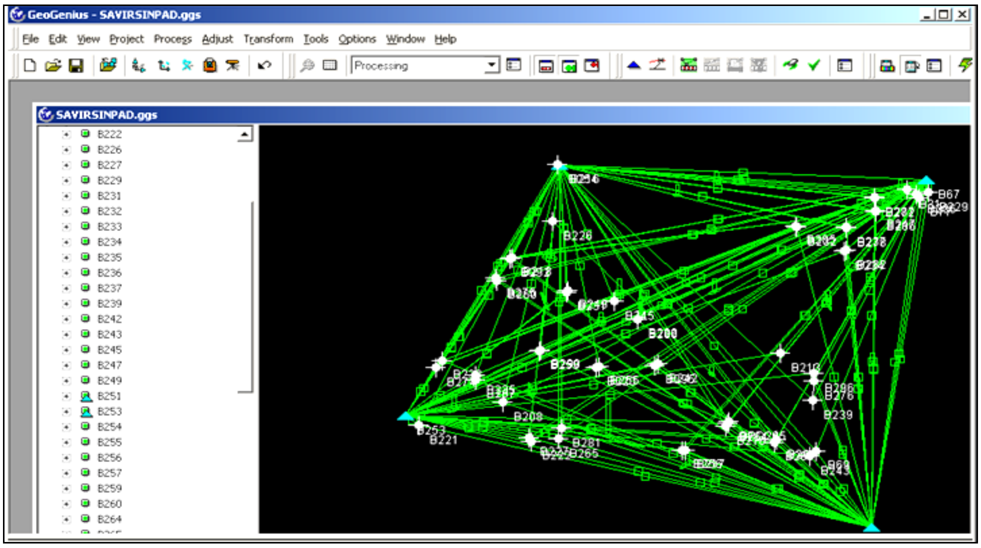

Figure 7. Lifting network Sketch (Processing stage)

The transformation of the points from the positioning system WGS`84 into the projection system 1970 was made tridimentionally on the basis of common points (e.g.: DEALUL FETEI, HEREDIA, INEU, 5 COLINE).

Table 1

Transformation Parameters WGS84 -> National

Adjusted Transformation Parameters WGS84 -> National	
Scale	0.999995710 +- 0.000000426
Rotation X	4.0013 arcsec +- 0.1168 arcsec
Rotation Y	2.9844 arcsec +- 0.1284 arcsec
Rotation Z	-5.8840 arcsec +- 0.1172 arcsec
Translation X	20.8499 m +- 3.6512 m
Translation Y	-117.4890 m +- 4.1739 m
Translation Z	-29.5829 m +- 3.3221 m

3. Points transformed to National Plan Coordinates System example

Point	N [m]	E [m]	ell.H [m]	orth.H [m]
INEU	552022.1582	259438.4121	112.3812	112.3812
DL.HEREDIA	536154.4706	310682.2804	309.5810	309.5810
CINCI MOVILE	524010.3860	223764.6282	120.7401	120.7401
DL.FETEI	487256.7169	304549.3450	509.6559	509.6559
B10	536503.4956	282289.8709	200.2910	200.2910
B104	565454.8125	270797.6741	147.8287	147.8287
B105	537802.7599	312803.8890	344.1457	344.1457
B11	550851.3716	285726.6122	245.6498	245.6498
B112	531984.4714	284836.8860	264.4630	264.4630
B114	563858.6584	270277.1469	146.7639	146.7639
B115	576979.5063	272698.9636	265.9807	265.9807
B158	565963.3908	268390.2341	161.8897	161.8897
B116	560980.5666	271394.5232	134.6160	134.6160
B12	545902.1413	281153.2151	151.4098	151.4098
B122	565218.1815	268459.5634	160.6862	160.6862
B127	556755.6267	270474.8846	123.7869	123.7869
B128	550008.7374	279329.2220	152.6242	152.6242
B13	537473.2978	281493.2129	151.3882	151.3882
B135	554081.3147	274888.9215	135.2913	135.2913
B137	567531.1523	268003.3395	148.5435	148.5435
B136	537990.8470	280811.8775	147.7513	147.7513

Residuals of Control Points (National Plan Coordinates System)

Point	N [m]	E [m]	ell.H [m]
INEU	0.0028	-0.0241	-0.0002
DL.HEREDIA	-0.0816	-0.0724	0.0000
CINCI MOVILE	-0.0000	-0.0002	-0.0001
DL.FETELOR	0.0311	0.0710	0.0001

It can be seen from the geocentric coordinate transformation WGS84 into stereographic coordinates 1970 that the raising network can enter into the precision degree of +/- 10 cm being able to be used at the raising of the details specific to forester cadastre.

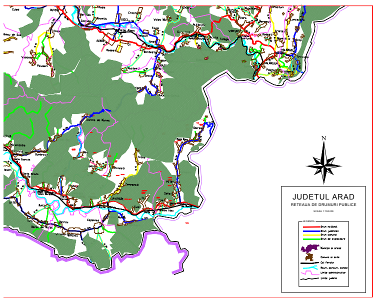

Figure 8. Situation plan of the raising network 1:100.000

By using the GPS satellite measurements, the forest arrangement plans and the satellite photograms we can make 3D land modelling.

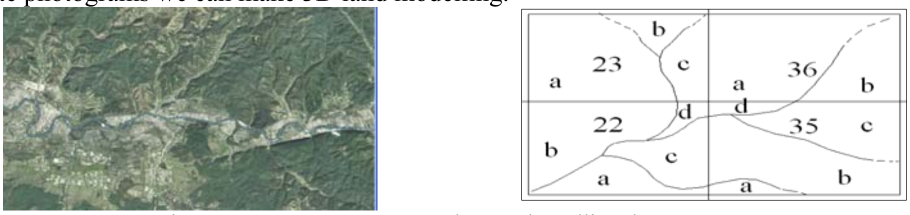

Figure 9. Forest arrangement plans and satellite photograms

The 3D modelling solutions in the area of forest arrangements help to unroll the preliminary studies for the evaluation and monitorisation of their resources, to develop feasibility studies, to research the impact of deforestation on environment, etc. .

On the basis of 3D complex modelling, of the analysis obtained, we can create data bases that can be used as a support for taking decisions in what administration, exploitation, maintenance and development of the forest patrimony are concerned. The data obtained can lead to the implementation of an efficient management system in the field of forest activities.

Figure 10. 3D land modelling

CONCLUSIONS

Nowadays, one of the most pressing global environmental challenges is balancing development and the environment. Population growth, human migration, civil strife, and pollution threaten the natural resources and ecological systems essential to our survival and well-being.

To meet these challenges, the national and local organizations have to take decisions in order to develop strategies and to provide necessary information on environment health.

An important cause of national and global modifications is represented by the abusive use of forest lands. For prevention of natural disasters, a National Cadastre System for Forestry Land is required.

This system will provide necessary information on forest reality and action taken against damage for the effective management of Romania 's forested lands. It will also provide accurate data required for land registration by incorporating Geographic Information System (GIS) technologies to provide qualitative and quantitative data and ensure compatibility with other national information systems.

Geodetic evaluation implying topographic and cadastral measurements have a special importance in the environmental protection research, especially for monitoring the effects of nature's geometrical modifications.

The new and performing technologies and methods used by geodesists help to have a better understanding of phenomenon and precise measurements in order to find solutions for a sustainable development in forested areas.

Modern GPS technology can be combined with satellite photogrammetry. This combination re-defines the way that we locate, organize, analyze and mapping the data.

Modeling 3D solution software are required, so as to organize and expand the applications of utilization services of positioning.

For a maximum efficiency is necessary to assure facilities for the user function, the potentiality to manage a huge mass of data and the potentiality of reviewing and updating the results anywhere and wherever are necessary.

The digital format allows to work at different scale without other determinations, the easiness in exploitation and the utilization in forest areas without special problems.

In adition, these can be used in periodical checking because there can be pointed out the changes in forestry heritage.

The latest research leads to the conclusion that the domain surveying engineering can offer important evaluation of the affected zone and accurate monitoring for future development.

BIBLIOGRAPHY

1. GRECEA C.– Introducere în geodezia satelitară, Editura Mirton, Timişoara, 1999;
2. NEUNER J - Sisteme de poziționare globală, Matrix Rom, Bucureşti, 2000;
3. DAVID V., HERBAN S., STURZA M., GRECEA C., BĂLĂ A., – Complemente de masuratori terestre,Vol.II, Editura politehnica 2009
4. GRECEA C. - Geodezie, Ed.Mirton, Timişoara 2005;
5. DONIȚĂ N., BORLEA F., TURCU D. – Cultura pădurilor, Editura Eurobit 2006; M. O. R. Partea I, 15,nov.2006
6. LEU I. – Măsurători terestre pentru agricultură, Ed. Ceres, Bucureşti 1990
7. www.icas.ro
8. www.mapsofworld.com
9. www.banaterra.eu