REALIZATION OF A GEOGRAPHICAL INFORMATIC SYSTEM FOR INACCESSIBLE FOREST FUND

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Abstract

Modern geomatic technologies, which are currently used, offer the possibility for various users to propose and adopt efficient technical solutions in the fields of activity related to the activities carried out.

The various activities within the forestry sector involve the use of cartographic products, such as landscaping maps (forestry), in analog and / or digital format, as appropriate, depending on the available logistics.

The use of specialized computer programs for the exploitation of cartographic products related to the forestry sector, in analog and / or digital format, contributes considerably to the adoption of technical solutions related to current activities: regeneration and management of stands, recovery of forest products, monitoring the health of trees , forest fund guarding, forest management certification, etc.

The development and use of a computer system and the database of accessible stands, using the program MapSys 10.0, offers the possibility to specialists in the forestry sector, to opt for the variety that ensures a superior technical and economic efficiency.

Key words: geomatic technologies, geographic information system, accessible stands, database, digital forest map, forest thematic map.

INTRODUCTION

The Geographic Information System (GIS) is a technical and organizational set of people, equipment, rules, regulations, methods and working algorithms, with the main objectives of collecting, verifying, validating, storing, displaying and processing geographic data (Chrisman, Nicholas, 1998).

GIS is the computer system that connects a database that operates with geometric-spatial elements, with another database that operates with attributes of information, which is contained in the first database (Clarke, Keith, 1997).

The first database refers to graphical representations of the terrain, coordinate systems, the position of the characteristic points in relation to different reference systems, etc.

The second database is an alphanumeric, textual database, which contains tables in which the attributes of the graphic elements registered in the first database are stored.

The main objectives of GIS are the analysis and study of these data, of the relationships that are established between them, in order to obtain new information to substantiate the decision-making process.

Geographic information systems are represented by a set of programs, which process the spatial information contained in the maps, under spatial (technical, positioning), economic, legal aspects (Chezan et. al. 2006).

The valorization of wood products represents for a series of forestry units the predominant (basic) activity, as a result for the forest management of the objectives related to this activity, it is necessary to meet a series of conditions regarding the infrastructure (Iovan, 2020) - respectively the accessibility of the forest stands (Irimie, 2021).

MATERIAL AND METHOD

The case study was carried out within the Production Unit (P.U.) III Galbena, Sudrigiu Forest District (F.D.), Bihor Forest Administration (F.A.), in the stands 44A, 44B, 44C, 45A, 45B, 46A, 46B, 47A, 47B, 47C, 47D, 48A, 48B, 48C, 49A, with a total area of 174.48 ha.

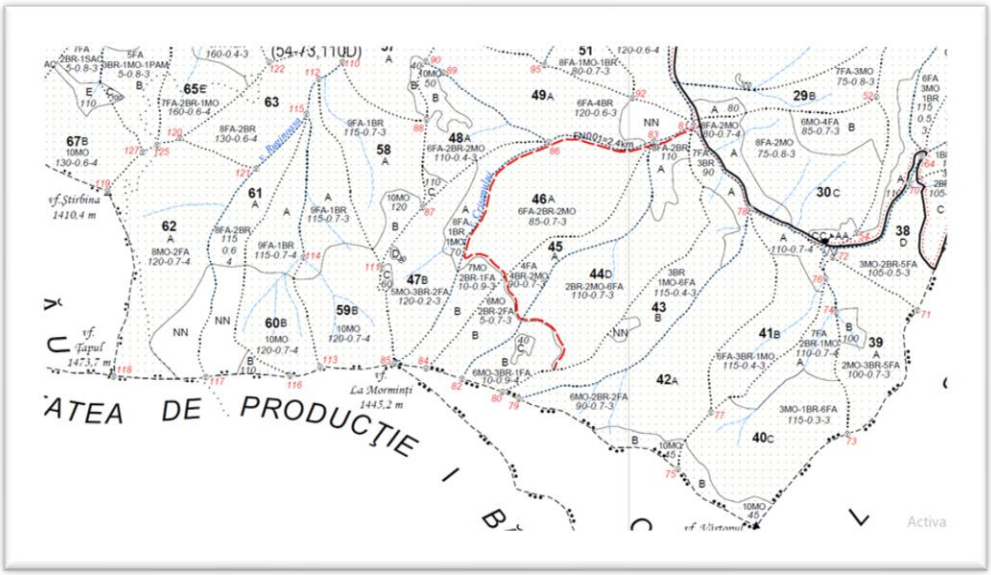


Photo.1 - Location of the case study (extract from the forest map at a scale of 1: 20000, of the Production Unit III Galbena, Sudrigiu F.D., Bihor F.A.

The stands in the analyzed and studied plots have a reduced accessibility, as a result, the extraction (capitalization) of the possibility of main products (Irimie, 2021), established by the forest management in

force, cannot be realized at present, due to the lack of an adequate infrastructure - forest roads (Iovan, 2020).

In order to carry out the case study, an appropriate bibliographic documentation was made, using in this context specialized treatises and elaborations (forest management and forest map of the production unit elaborated in 2014), scientific articles and specialized software.

In the field, observations were made on the itinerary and in the stationary one, respectively, and the recording on digital support of the images from the field (Crainic, et. al., 2018).

The main elements used to create the computer system and the database are represented by the forest management and forest map related to the Production Unit III Galbena, at a scale of 1: 20000 (which were developed in 2014) and the MapSys 10.0 program.

In order to be able to use the forest map properly, it was georeferenced (associating a system of relative coordinates) with the MapSys 10.0 program, using the Helmert transformation method - with common points (Marton, 2007).

The transformation method used involves the use of common points (in the two coordinate systems - the map and the spreadsheet, respectively), which have known coordinates (Crainic, 2021, Crainic et. al. 2018, Sabău, 2010, Sabău, Crainic, 2006).

The sequence of work steps (technological flow) corresponding to the creation of the database is as follows:

-scanning the map;
-obtaining the raster;
-vectorization of the raster;
-obtaining the related vectors and polygons;
-completion of topology;
-collection of attributes;
-creating thematic layers;
-creating the database;

The block diagram for obtaining vectors, polygons, thematic maps and the database using the corresponding raster is shown in Figure 1.

To build the geographic information system with MapSys 10.0, several steps are required, which are as follows:

-opening the work schedule;
-setting the working parameters;
-saving the initial elements in a new work;
-import of the raster (landscaping map);
-implementation of the coordinates of the known points for the four transformation points;

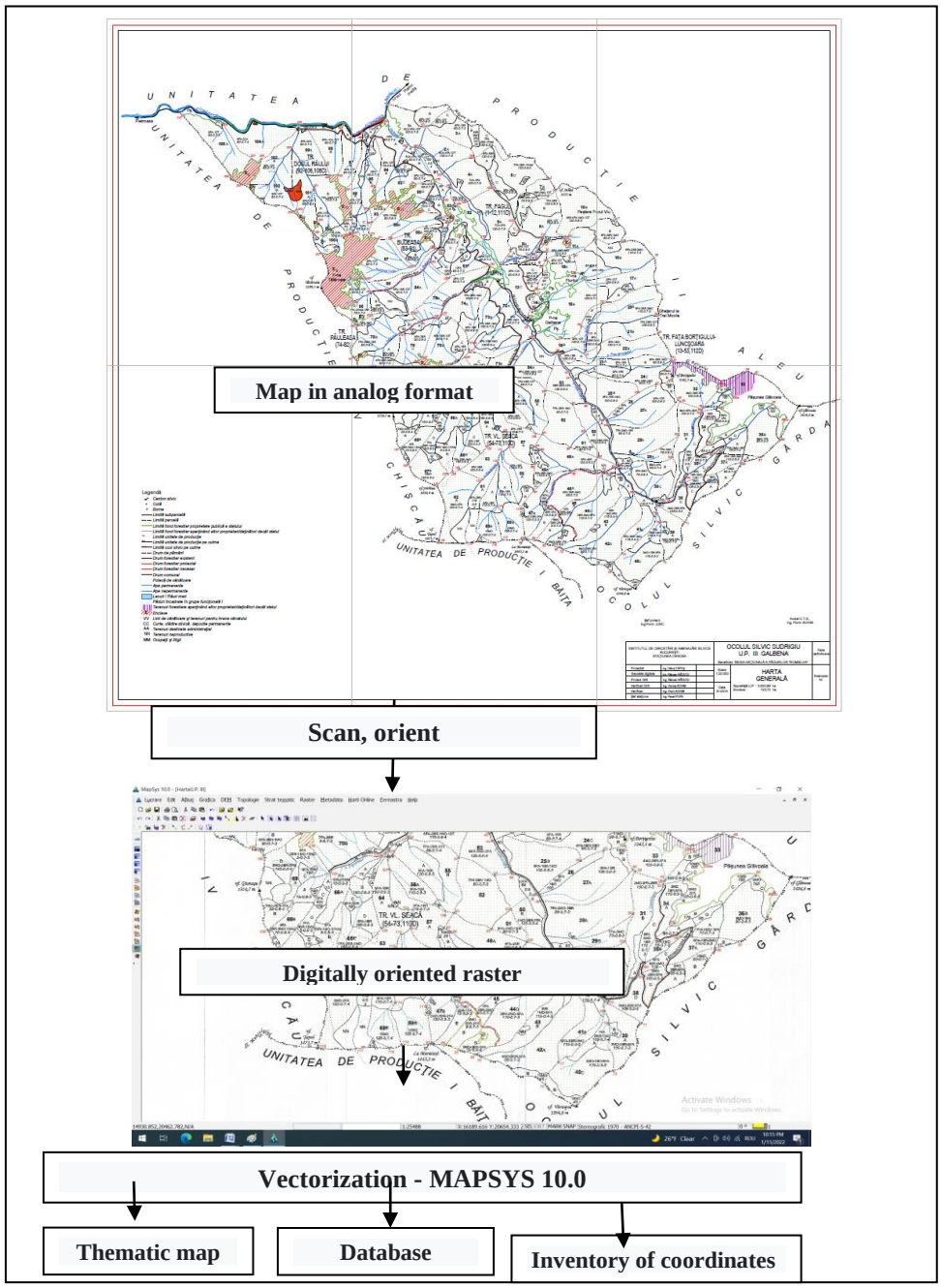


Fig.1 - Block diagram of obtaining GIS products by using raster data - respectively the layout map of the Production Unit III Galbena, Sudrigiu F. D., Bihor F. A.

-initialization of the raster orientation on four common points of known coordinates;

-realization of orientation (raster georeferencing);

-verification of the oriented raster;
-setting the thematic layers (layers);
-realizing the vectorization of the desired raster;
-obtaining the vector;
-completion of topology;
-solving non-closing errors;
-referring the topology;
-implementation of identifiers from layer 2;
-referring the topology;
-collection of attributes;
-initializing the construction of the database;
-adaptation of the database to the collected attributes;
-implementing attributes in the database;
-verifying the elements in the database;
-making thematic maps;
-verification of thematic maps;

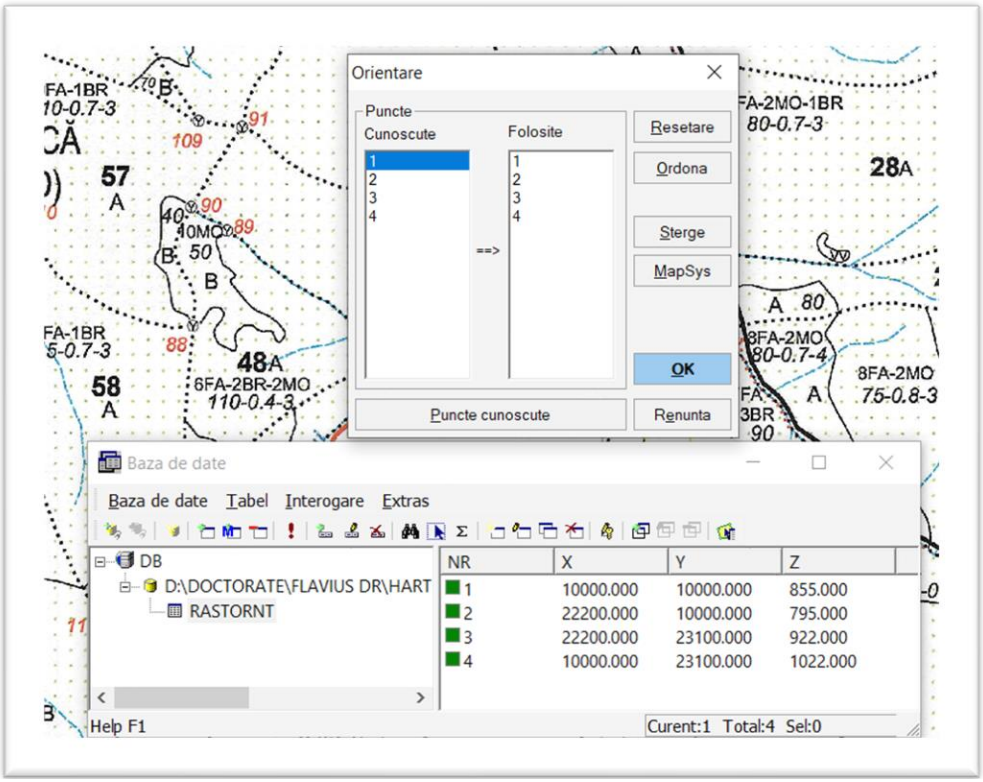


Photo. 2 - Georeferencing the raster on four common points, with the program MapSys 10.0

-archiving thematic maps using the pdf extension.

The functions in the Raster menu of the MAPSYS 10.0 program allow the efficient use of scanned maps and plans or orthophoto images, for

the purpose of vectorizing them or for viewing them in combination with existing graphic or topological elements (Marton H., 2007).

In order to associate a coordinate system to the raster related to the landscaping map used, its georeferencing was performed, by Helmert transformation, using for this purpose four common coordinate points in the two coordinate systems - table 1.

Table 1

The inventory of the coordinates of the common points used for the georeferencing of the arrangement map at a scale of 1:20 000, related to the Production Unit III Galbena, Sudrigiu F.D, Bihor F.A.

Nr. crt.	X(m)	Y(m)	Z(m)	Observaţii
1	10 000,000	10 000,000	855,000	puncte comune
2	22 200,000	10 000,000	795,000	puncte comune
3	22 200,000	23 100,000	922,000	puncte comune
4	10 000,000	23 100,000	1022,000	puncte comune

The coordinates of the common points used for georeferencing were determined graphically, from the landscaping map at a scale of 1:20 000, adopting for this purpose a local system of rectangular coordinates.

RESULTS AND DISCUSSION

The realization of the geographical information system related to the forest fodder from the presented location, supposes the opening of a new work in the MAPSYS 10.0 program and the completion of the previously presented stages, within the methods and the way of work, which were proposed - figure 1.

As a result, the vector related to the analyzed and studied plots was obtained, using for this purpose the raster (scanned landscaping map, in digital format) relatively oriented (georeferenced) - photo. 3.

It is found that there is a correlation between the surface of the plots in the plot description and the one calculated analytically from the vector obtained, for the forest fund analyzed and studied.

In the present case study, the main attributes are represented by the number of the plot (planning unit) and their accessibility, aspects that are analyzed and studied.

The plots that are not properly accessed will be marked separately on the generated thematic map, in order to be able to analyze and study carefully, with an optimal efficiency, in order to establish appropriate technical solutions.

The establishment of the location related to the transport installations from the studied inaccessible exploitable stands is made on the obtained vector, and the length of the routes will be determined analytically,

adding the lengths of the alignments materialized by the characteristic points of detail.

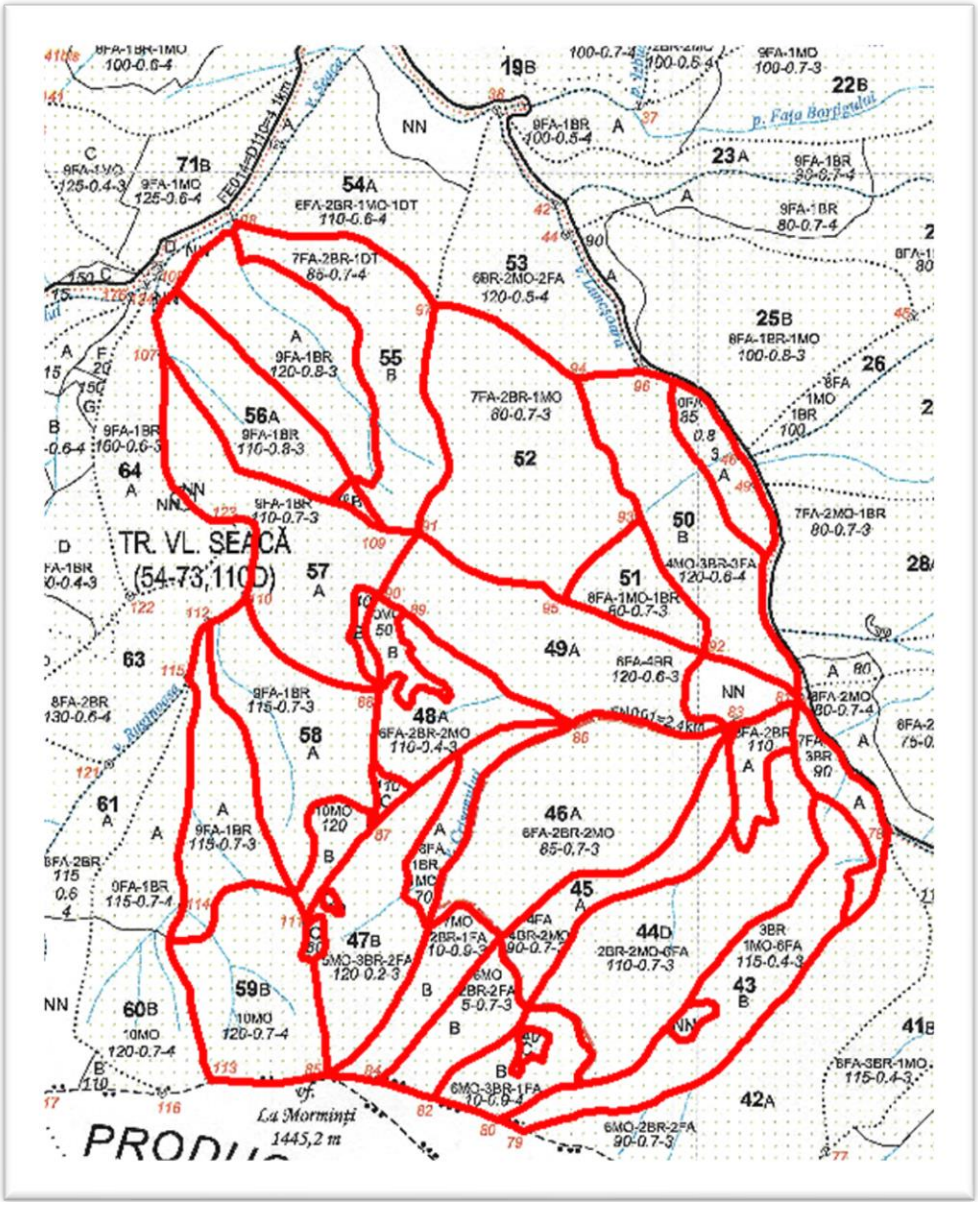


Photo. 3 - The vector related to the analyzed and studied plots

Obtaining optimal solutions involves the analysis of several possible scenarios (variants), analyzing (combining) in this sense the field data with the planimetric elements identified on the raster used and implicitly on the vector generated by the vectorization process.

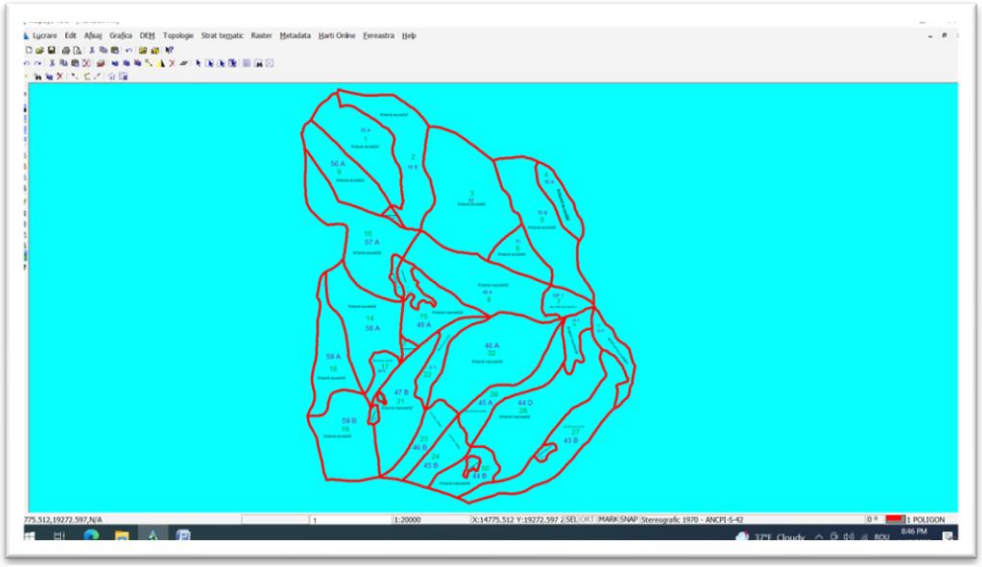
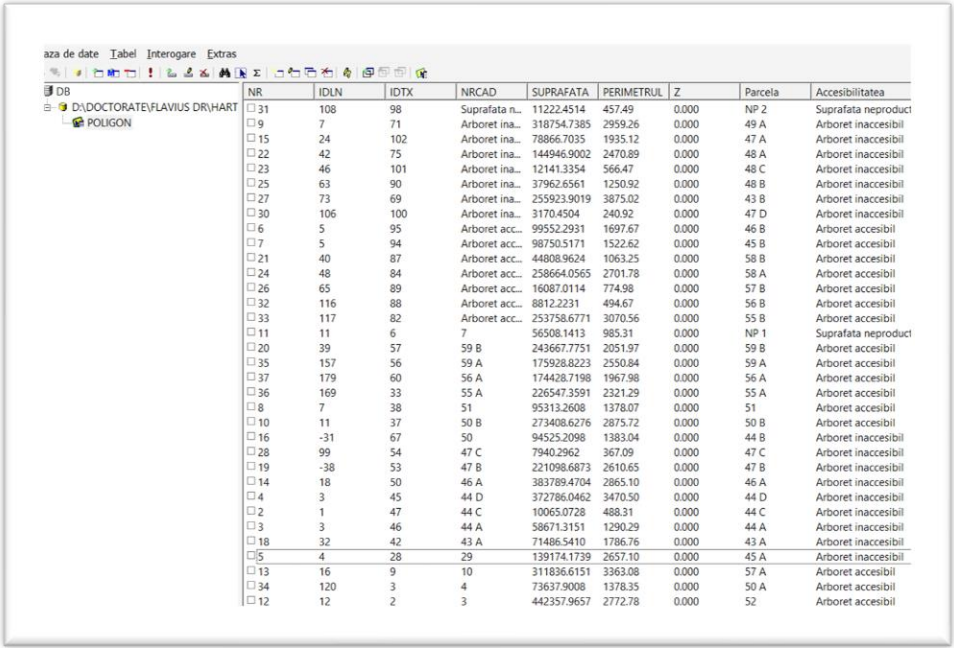


Photo. 4 - The vector equipped with the corresponding attributes, in the MAPSYS 10.0 program



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DB
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POLIGON

NR	IDLN	IDTX	NRCAD	SUPRAFATA	PERIMETRUL	Z	Parcela	Accesibilitatea
31	108	98	Suprafata n...	11222.4514	457.49	0.000	NP 2	Suprafata neproduct
9	7	71	Arboret ina...	318754.7385	2959.26	0.000	49 A	Arboret inaccesibil
15	24	102	Arboret ina...	78866.7035	1935.12	0.000	47 A	Arboret inaccesibil
22	42	75	Arboret ina...	144946.9002	2470.89	0.000	48 A	Arboret inaccesibil
23	46	101	Arboret ina...	12141.3354	566.47	0.000	48 C	Arboret inaccesibil
25	63	90	Arboret ina...	37962.6561	1250.92	0.000	48 B	Arboret inaccesibil
27	73	69	Arboret ina...	255923.9019	3875.02	0.000	43 B	Arboret inaccesibil
30	106	100	Arboret ina...	3170.4504	240.92	0.000	47 D	Arboret inaccesibil
6	5	95	Arboret acc...	99552.2931	1697.67	0.000	46 B	Arboret accesibil
7	5	94	Arboret acc...	98750.5171	1522.62	0.000	45 B	Arboret accesibil
21	40	87	Arboret acc...	44808.9624	1063.25	0.000	58 B	Arboret accesibil
24	48	84	Arboret acc...	258664.0565	2701.78	0.000	58 A	Arboret accesibil
26	65	89	Arboret acc...	16087.0114	774.98	0.000	57 B	Arboret accesibil
32	116	88	Arboret acc...	8812.2231	494.67	0.000	56 B	Arboret accesibil
33	117	82	Arboret acc...	253758.6771	3070.56	0.000	55 B	Arboret accesibil
11	11	6	7	56508.1413	985.31	0.000	NP 1	Suprafata neproduct
20	39	57	59 B	243667.7751	2051.97	0.000	59 B	Arboret accesibil
35	157	56	59 A	175928.8223	2550.84	0.000	59 A	Arboret accesibil
37	179	60	56 A	174428.7198	1967.98	0.000	56 A	Arboret accesibil
36	169	33	55 A	226547.3591	2321.29	0.000	55 A	Arboret accesibil
8	7	38	51	95313.2608	1378.07	0.000	51	Arboret accesibil
10	11	37	50 B	273408.6276	2875.72	0.000	50 B	Arboret accesibil
16	-31	67	50	94525.2098	1383.04	0.000	44 B	Arboret inaccesibil
28	99	54	47 C	7940.2962	367.09	0.000	47 C	Arboret inaccesibil
19	-38	53	47 B	221098.6873	2610.65	0.000	47 B	Arboret inaccesibil
14	18	50	46 A	383789.4704	2865.10	0.000	46 A	Arboret inaccesibil
4	3	45	44 D	372786.0462	3470.50	0.000	44 D	Arboret inaccesibil
2	1	47	44 C	10065.0728	488.31	0.000	44 C	Arboret inaccesibil
3	3	46	44 A	58671.3151	1290.29	0.000	44 A	Arboret inaccesibil
18	32	42	43 A	71486.5410	1786.76	0.000	43 A	Arboret inaccesibil
5	4	28	29	139174.1739	2657.10	0.000	45 A	Arboret inaccesibil
13	16	9	10	311836.6151	3363.08	0.000	57 A	Arboret accesibil
34	120	3	4	73637.9008	1378.35	0.000	50 A	Arboret accesibil
12	12	2	3	442357.9657	2772.78	0.000	52	Arboret accesibil

Photo. 5 - The database created in the MapSys 10.0 program, for the analyzed plots

The attributes collected from the georeferenced site, for the analyzed and studied plots, were automatically implemented in the textual database - photo. 5, which can be interrogated as needed.

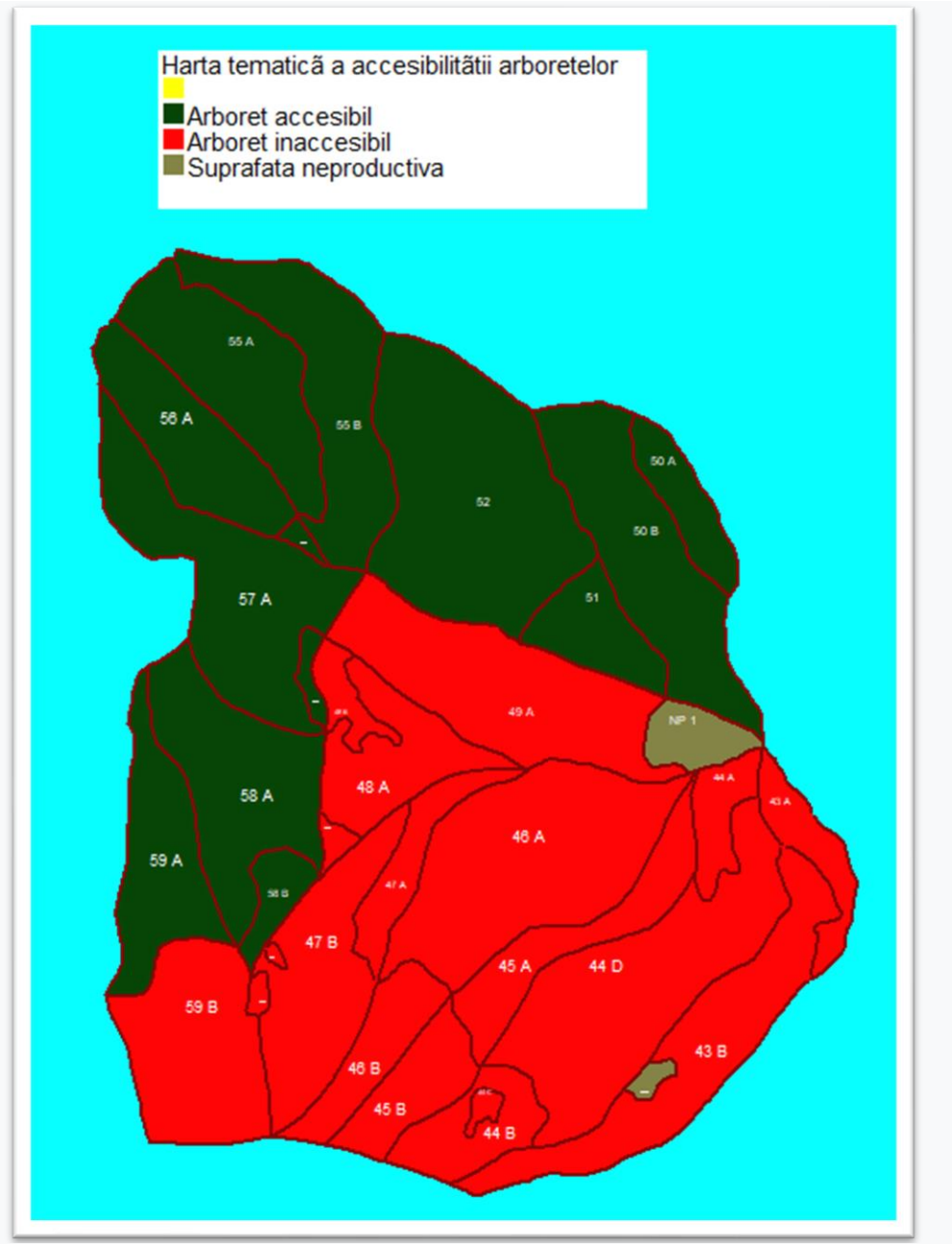

Photo. 5 - Thematic map of the accessibility of the stands, made in the MAPSYS 10.0 program, for the analyzed plots

Also, in the MapSys program, the thematic map of the accessibility of the stands in the analyzed and studied plots was generated, using for this purpose the thematic layers Polygon, Plots and Accessibility, which were activated simultaneously.

The thematic map - photo 5, thus obtained can be used in digital format at the desired scale, can be archived or as the case may be and / or can be printed in an appropriate graphic format, depending on the scale adopted.

The content elements related to the thematic map of the accessibility of the studied stands can be established, respectively implemented according to the need, taking into account the beneficiary's requests.

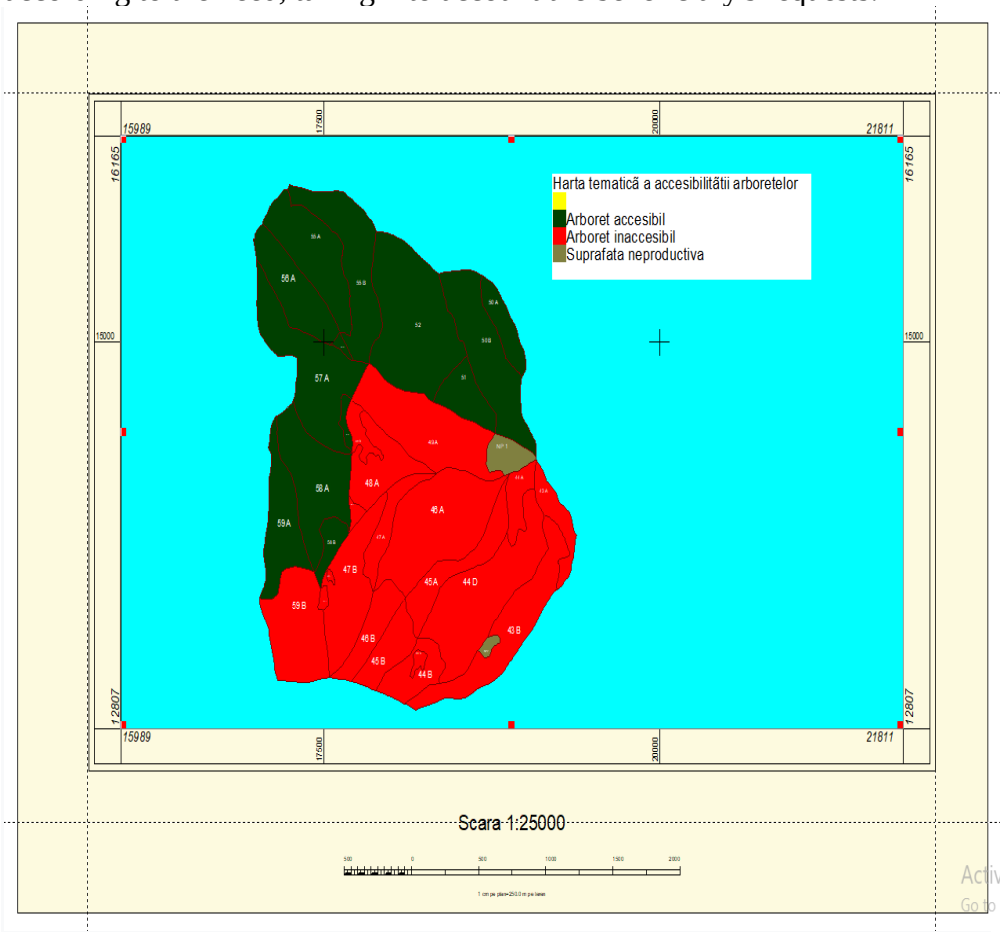

Photo. 6 - Thematic map of the accessibility of the stands, made in the MAPSYS 10.0 program, for the analyzed plots, at a scale of 1: 25000, set for printing

The surface of the plots that vectorized was determined by the analytical method, and is found in the tabular records in the textual database, and can be used in digital and/or analog format - photo 6, as appropriate, depending on the logistics used.

The small differences between the surface in the plot description and the one determined by the analytical method, following the vectorization process, are due to the working technology that was used.

Photo 5 shows the thematic map of the accessibility of the stands within the Production Unit III Galbena, Sudrigiu Forest District, Bihor Forestry Administration, where the case study was carried out. From the analysis of the thematic map it can be observed the location of the accessible stands, of the inaccessible ones and respectively of the non-productive land surfaces.

CONCLUSIONS

The implementation of geomatic technologies in the various positioning and design activities in the forestry sector, offers the guarantee of efficient, optimal technical solutions, in order to sustainably capitalize on forest resources.

The development of information systems related to the activities within the forestry sector offers the possibility for the field and office staff to adopt efficient solutions, in order to solve the various problems that involve the positioning of the details on the areas with forest vegetation.

The use of digital technologies for obtaining and / or exploiting cartographic products (in analog or digital format) facilitates the achievement of performances in establishing technical solutions related to the forest management and accessibility of the forest fund.

The use of raster data and, implicitly, vector data in geomatic technologies, ensures a high accuracy of the spatial positioning of the details in the forestry sector and the obtaining of multipurpose cartographic products.

The need to implement modern geomatic technologies for positioning and making high-accuracy digital mapping products in current activities within state and/or private forestry units is imperative, given the current trend of global digitization of all productive activities.

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