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THE USE OF TOPO-GEODESIC METHODS AND GIS MEANS FOR THE REALISATION OF THE GREEN CADASTRE FOR THE CITY OF TARGU SECUIESC

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Abstract

The aim of this paper is to highlight the facilities that geographic information systems make available to users for the inventory and management of green spaces. The Beginning of this study was pointed by the topographical measurements being done across the city of Targu Secuiesc targeting all the green areas of the city (trees, shrubs, hedges, parks, squares, street alignments, green spaces within public institutions, green spaces between condominium areas, playgrounds, monuments, statues and so on.). After obtaining the topographic data, they were processed and compensated by various methods in order to obtain the basic map. The basic map once obtained was entered into a GIS application through which data was gathered from the field.There were taken informations from the field about trees, shrubs and hedges such as species, diameter, viability, coronation, height, protection, but also the use of the areas within each zone: roads, green areas, floral arrangements, buildings, parking lots. These data were entered into the GIS application where the corresponding database was created. The areas on the map were encoded according to the use and the attributes of each zone were added, such as: name, postal number, address, area. The final result is a GIS database in the form of an interactive map that contains all the information required for an evidence of green spaces and beyond, which also highlights the current situation of green fields in the city of Tg. Secuiesc. Finally, a series of GIS analyzes have been made to highlight both the characteristics of green spaces in this city (size, distribution, status, distribution per inhabitant etc.), parking lots and the potential of GIS to clarify organizational, management and administration problems.

Key words*: topo-geodesig measurements, green cadaster, GIS, Romania, green spaces register.*

INTRODUCTION

The authorities of the local public administration have the obligation to keep records of the green areas in the localities, by setting up the local registers of the green spaces, which they update whenever modifications occur (Art.1. The technical norm for the elaboration of the local register of the green spaces).

The purpose of greenfield records is to organize their rational use, effective regeneration and protection, to exercise systematic control of qualitative and quantitative changes, and to provide information on green spaces. (Law 24 of 2007 updated and republished). The local register of the green areas in the localities within incorporated area is constituted as a component of an information system of systematically evidence and inventory of the lands in the urban area of the localities, defined as green spaces according to the law (Art. 7. Technical Norm for the elaboration of the Local Register of Green Areas). GIS stands for Geographic Information System and it is a computer software designed to store, process and make available geographic data. The main purpose of such a system is in addition to the input, storage and editing information of geographic, demographic, environmental etc. nature (Dimitriu, 2007). The information system for green spaces is carried out as a result of the identification, measurement, inventory and mapping of the defined green areas, as well as the collection of specific data on the tree species and the existing vegetation, with the determination of the qualitative and quantitative indices (Welch et al., 2002). The information system of green fields represents a

set of graphical and textual databases, designed in a unitary way, independently maintained and exploited together (Art.14. The technical norm for the elaboration of the Local Register of Green Areas).
Under the administrative, economical, social and technical-scientific aspect, the urban green spaces are a component of the public works system designed to serve the urban population, providing the city with the most suitable facilities for recreation and comfort. An essential element of the human habitat, green space exploits the biological and aesthetic potential of vegetation, harmonizes architectural ensembles, hygienises and freshens the urban environment, reducing its aggression on the inhabitants of the city (Adams and Muja, 1994). At the same time, cities, as they grow more, adding a larger number of inhabitants and building a visible polluting industry, exert more pressure on the surrounding vegetation, which it gradually degrades (Adams and Muja, 1994). So, with the development of cities and implicitly of industry, green spaces have become less and less important, being neglected or even used for purposes other than those for which they were created (Figure 1). With the drop in interest in green spaces, problems have arisen in terms of air quality, citizens' quality of life, and landscaping issues.

Dinamica suprafeței spațiilor verzi urbane în România (1980–2006)

	Anul									
	1980	1990	1995	1997	2000	2002	2003	2004	2005	2006
Spații verzi (km^2)	169,62	220,81	212,50	208,58	201,24	201,84	205,97	201,22	200,98	202,69

Sursa: Anuarul Statistic al României (1980–2006), INS, București.

Figure 1. The dynamics of green urban space in Romania

In this way, Romania's accession to the European Union had to take into account the standards given by the European Union regarding the green spaces of 26mp green space per inhabitant. In this way, there have been a series of regulations regarding the protection and creation of green spaces for the alignment of Romania with the standards. More specifically, OUG no. 114/2007 amending and supplementing OUG no. 195/2005 on Environmental Protection and Law no.24 / 2007 on the Regulation and Management of green areas in urban areas with related norms, MDTR Order no. 1466/2010 - The local register of green spaces within the built-up areas, which regulates the preparation of the green space register for each locality in order to obtain a clear evidence of the green spaces.

MATERIALS AND METHODS

In order to achieve a real and accurate record of the green spaces in the locality, both topo-geodetic means and GIS tools (mobile devices / applications / books) were used, as well as analyzes, to highlight the results of the paper. The areas concerned were only the areas of the public utility: the town hall, hospitals, schools, churches, condominiums, cemeteries, parks, boulevards etc.
The first method used is the topographical survey method which involved making topographical measurements with the help of GPS technology and a total station in order to obtain the basic plan of the city. The measurements were made by combined polygnometric traverse and the framing into the national geodesic network was done using the GPS technology.
The second method used was the method of data processing. In this method data compensation was done both by the classical method and by the smallest square method specific to Topsys program. The precision of the measurements was within the limit prescribed by the law so it was possible to proceed to the next step.
Another method used was the method of observing and collecting field data. This method involved stepping up the land and taking over details about tree/shrub with a mobile device and a dedicated application. The data taken were: species, height, diameter, crown, protection, viability. Correct identification of the species has been done with guidance catalogs for determining the species. Besides this, information on area use has been identified and was taken over. In addition to the green areas, the following uses were targeted: alleys, floral lots, playgrounds, waters, monuments, buildings, yards, parking lots, sports ground, fitness area etc.
In addition to the above-mentioned methods, specific GIS methods have also been used:

georeferencing of cadastral plans, vectoring of useful data, and GIS specific analyses (Tereşneu, 2006, 2008).
These methods are necessary to highlight the results of the work in order to identify any gaps and to act where it is needed.

RESULTS AND DISCUSSIONS

After carrying out the green space assessment work, we have a GIS database with precise information on both green spaces and other categories, as well as trees, constituting the green space register. This register consists of 54 maps (400x720 mm), which comprehend the entire surface evaluated at a scale of 1:1000 (Figure2).

Figure 2. The map no. 20 from the Green Zones Register

The GIS database allows us to carry out various analyzes in viewing and managing the items of interest. Thus, we can determine, for example, the areas for each category of use that we are interested in, especially for green spaces (Figure 3).

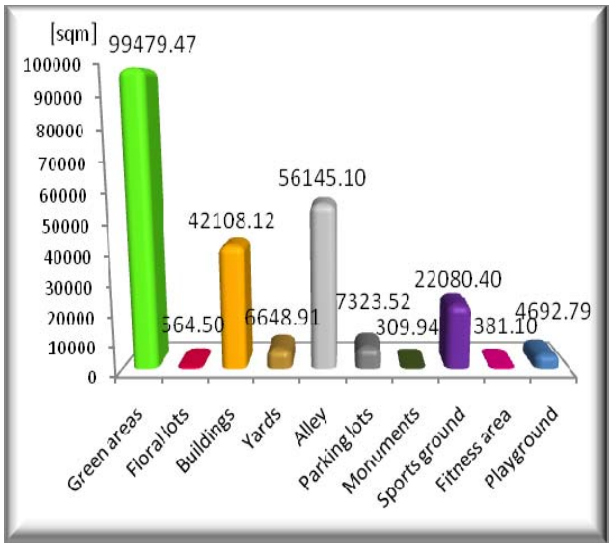

Figure 3. Classification by type of use

This graph shows the clear situation of the surfaces in the field depending on the type of use. The classification did not take into account the roads but only the alleys, which is why the green areas with a total area of 99479 sqm. The second place in the classification is taken by the alleys with a total area of 56145 sqm. This category includes alleys within parks and pedestrian areas within condominiums and along roads. The third place in the ranking is held by the buildings with an area of 42108 sqm , which includes public buildings (town hall, hospital, school, library, church, etc.) as well as apartment blocks or other constructions of public interest. The classification continues with the sports grounds (22080 sqm), parking lots (7324 mp), yards (6649 mp), playgrounds (4693 mp), floral arrangements (564 mp), fitness facilities (381 mp), and lastly monuments and statues (310 mp).
In addition to the areas of use, the GIS database also has records of trees and shrubs, each of which is characterized by different attributes such as: order number, species, diameter, height, crown, protection, viability. So there has been a classification of the most common 10 trees and shrubs (Figure 4.).
It is easy to note that the most common tree on the surface of the studied locality is Acacia (Salcam) (Robiniapseudacacia) being present in 1096 specimens, followed by Molid (Picea Albies) and Tuia (Thuja occidentalis). We notice that we have a "TAIAT" element in a total of 349 copies. These are trees that existed

at the time of the measurements, but were cut off until the data was taken from the field, or are just points that show that the tree has not been completely eliminated from the ground (show root existence).

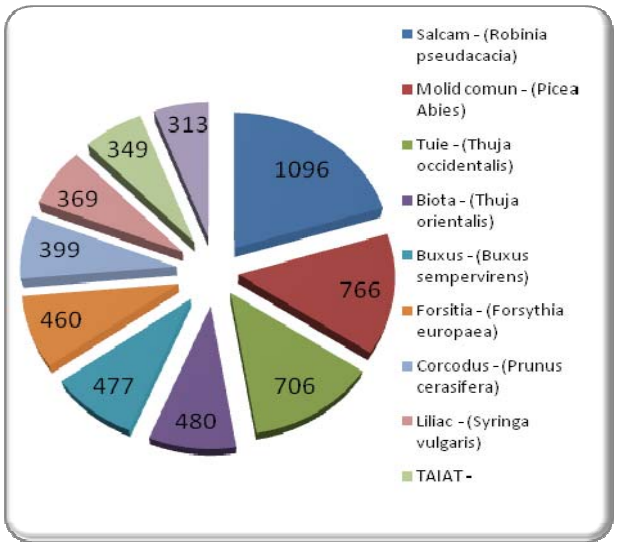

Figure 4. The most common 10 species of trees/shrubs by number

These classifications were made taking into account the observations from the entire area of the locality, but such classifications can also be made for certain areas or individually for different buildings, depending on the point of interest (Figure 5, Figure 6).

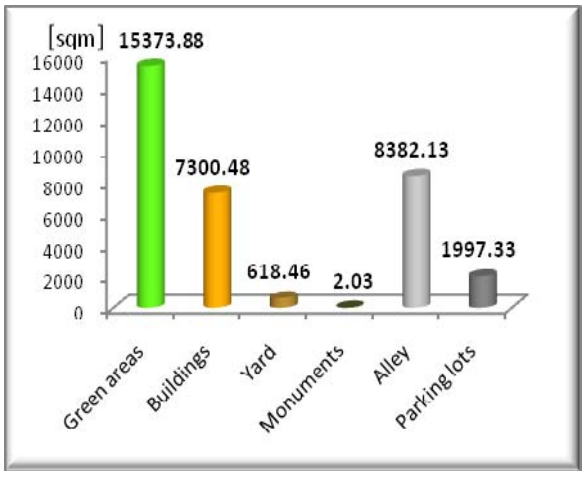

Figure 5.Municipal hospital of Tg.Secuiesc - Classification by type of use

In this case, it is obvious that we will no longer meet all categories of use and a very large number of trees. These individual building classifications are of great use because it is possible to analyze a point of interest, eliminating unnecessary data and shortening working time.

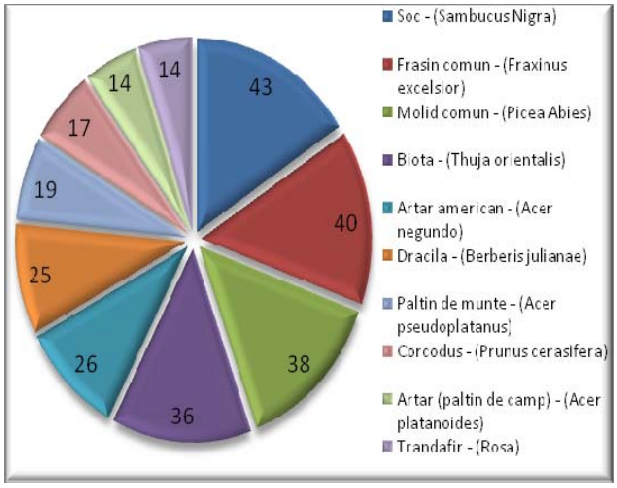

Figure 6. Municipal hospital of Targu Secuiesc - The most common 10 species of trees/shrubs by number

Following the realization of the green spaces in the public domain, a total area of green areas of about 26 hectares was built up in the intravilan of Targu Secuiesc.

By OUG no. 114/2007 amending and supplementing OUG no. 195/2005 on the Protection of the environment, stipulates the obligation of the local public administration authorities "to ensure from the intravilan land an area of green space of minimum 20 sqm / inhabitant, until 31 December 2010, and at least 26 sqm / inhabitant, until 31 December 2013 " (Article II, paragraph (1)). In order to achieve this goal, the mayoralties of some localities must identify the unproductive or damaged land to be arranged as green spaces. (Technical Standard for the elaboration of the Local Register of Green Areas). If we take into account the area of the green spaces of 261 239.089 sqm and report it the number of inhabitants of the city 18,491 (2011- Wikipedia) will determine the area of green space for each person.

Area of green spaces = 261 239.089 sqm

Population: 18,491 (2011- Wikipedia)

14.1279 sqm / inhabitant

Considering the legislative requirements regarding the area of green space for each inhabitant (min 26 sqm / inhabitant) and comparing this required by the law with the area of green space for the inhabitants of Tg. Secuiesc (about 14 sqm / person) we find that there is a difference of about 12 sqm, which determines us to say that the green area of the locality satisfies just over half of the area required by the law.

Notwithstanding this, if we compare the data on green areas in 1989 (Figure 7), we notice that the area of green spaces per person shows an increase, which prompts us to believe that the area of the green areas is constantly increasing and moving to the value required by law.

Year	*Sqm/individual*	*Area(ha)*
1989	9.7	23
2017	14	26

Figure 7. Comparison betwen the green areas in 1989 and 2017

For the creation of new green spaces, an identification of non-productive areas that can be transformed into green spaces was made in this evidence.

Four non-productive areas were identified (Figure 8) with the areas of 16947 sqm, 110345 sqm, 4139 sqm and 2242 sqm. If these surfaces will be refurbished and their use will be changed as green spaces, the area of green spaces will increase by 133,673 sqm reaching a value of approximately 40 ha, in this manner the area of green space per person will reach the value of 21.4 mp/inhabitant approaching the value imposed by law.

About 10221 trees and shrubs are evaluated within the GIS database. They are characterized by data-attributes through which a tree situation can be realized in the whole locality but also within the interest areas (parks, schools,etc.).

Thus we have a clear situation regarding the age classes (Figure 9) of the trees and their viability (Figure 10). Such situations are extremely useful for the management of green areas, trees and shrubs. There could be easily identified trees that are old or no longer fit (Figure 11) and requiring care or even cutting, so that unpleasant events can easily be avoided and the status of the trees can be under control.

Figure 8. Non-productive areas

Moreover, in the database we create trees that are protected or preserved by law. Their identification is instantaneous by assigning attribute data and coordinates to define the position of the point, which helps to manage them appropriately (Figure 12).

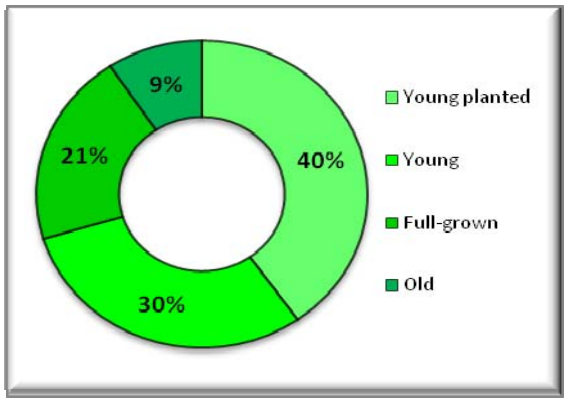

Figure 9.The classification of trees / shrubs by age

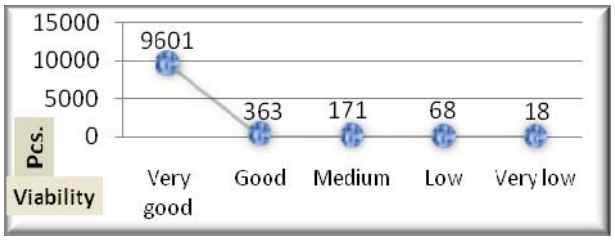

Figure 10. The classification of trees / shrubs by viability

Figure 11. The position on the map of the trees in an inappropriate condition

Species	Height	Crown	Diameter	Viavility	Age	ID no.	X North	Y East
Castanporcesc - Aesculushipo castanum	30	15	110	1	4	2756	500403.976	588361.743
Castanporcesc - Aesculushipo castanum	20	9	100	1	4	7791	500602.366	587745.156
Salcam - Robiniapseud acacia	30	10	90	1	4	2706	500414.540	588462.811

Figure 12. Data defining protected trees

CONCLUSIONS

The use of geographic information systems in the field of green space planning and management proves to be extremely useful because through a permanent and constant updating of the database, there are available useful information in real time and various analyzes and simulations can be made.

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