THE USE OF THE GEOGRAPHIC INFORMATION SYSTEMS FOR INVENTORING AND MONITORING THE GREEN AREAS IN CARANSEBEȘ

TENCHE-CONSTANTINESCU ALINA-MARIA [1]
HERBEI MIHAI [2]
BORLEA GHEORGHE FLORIAN [3]

[1] *Banat's University of Agricultural Sciences and Veterinary Medicine „King Michael I of Romania" from Timisoara, Faculty of Horticulture and Forestry, Department of Horticulture, consta_alina@yahoo.com*
[2] *Banat's University of Agricultural Sciences and Veterinary Medicine „King Michael I of Romania" from Timisoara, Faculty of Agriculture, Department of Sustainable Development and Environmental Engineering, mihai_herbei@yahoo.com*
[3] *Banat's University of Agricultural Sciences and Veterinary Medicine „King Michael I of Romania" from Timisoara, Faculty of Agriculture, Department of Sustainable Development and Environmental Engineering, fborlea@yahoo.com*

**Corresponding author email: fborlea@yahoo.com*

Keywords: GIS, spatial analyses, databases, Caransebeş, Green cadaster

ABSTRACT

The purpose of this paper is to present a modern approach used to establish the Local Registry of Green Cadastre of the public administrative territory of Caransebeş Municipality. Topographic measurements of green areas and the tree inventory database have been performed with the latest generation GIS and GNSS instruments. More than 7,000 trees were identified taxonomically and their geographical coordinates and biometric data were determined. All the field data was loaded into an updatable database and processed using the ArcGIS v.10.3 software. A GIS map with all the Green Cadastre information was realized as a useful instrument for the Municipality in order to easily monitor and permanently have an actual image of their green areas situation. Additionally, 48 hectares of green areas have been identified and measured as future potential objects for new projects to be financed in order to improve their citizen's welfare.

INTRODUCTION

Caransebeş, the second town in size in Caraş-Severin County, Romania, is an important cultural centre of the Banat region, with a fascinating history, being mentioned for the first time in documents in the year 1289 (Magina, A., 2008) having a population of approximately 24689 inhabitants and an area of 1220 ha (INSSE, 2012). An important advantage is the location near the highway and the railway that connect Europe with the Southern part of Romania as well as its special geographical position at a point where high mountains, hills and meadows meet at the confluence of the Timiş and Sebeș Rivers (Rusu, R., 2007; Tenche-Constantinescu A.-M., Szekely G., Borlea Gh. F., 2016). Caransebeş presents a remarkable unity of structure and urban function. The areas that compose the town create a very interesting mixture of industrial areas and green spaces (Szekely G., Tenche-Constantinescu A.-M., 2016).

The local register of green areas is a documentation that is compiled with a GIS system in order to provide the evidence of green spaces throughout the urban area: the inventory of land occupied by green areas, highlighting the type of property and the way in which these lands are managed and the description of the quantitative and qualitative characteristics of the existing wood vegetation.

MATERIAL AND METHOD

Geographic Information System (GIS) has been used to create, store, analyze and process the spatial data through a computerized process (Herbei, M.V., 2015).

Topographic measurements of green areas and the tree inventory database have been performed with the latest generation GIS and GNSS technology (Herbei, M.V., Sala, F., 2016). In order to acquire GIS data from the field it was used the GIS Leica Zeno 20 instrument, a highly precision GNSS receiver, based on Android operating system (Fig.1).

The field data was collected using the ESRI Collector Software on Android systems, loaded into an updatable database, processed using the ArcGIS v.10.3 software and stored in a geodatabase. The GIS Map of Green Cadastre was realized based on green areas and tree measurements and their coordinates using ArcGIS V.10.3 software.

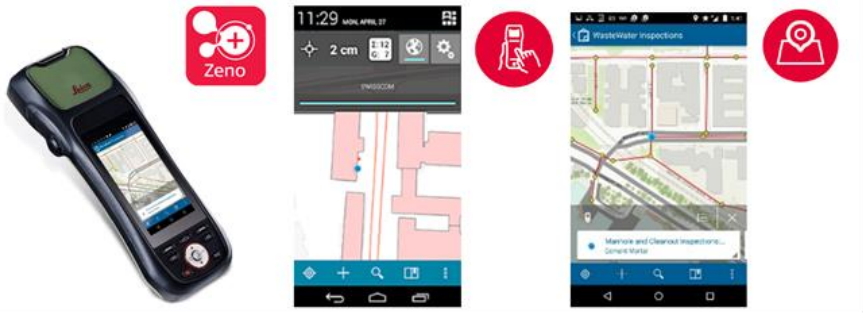

Fig. 1 Zeno Collector

RESULTS AND DISCUSSIONS

The resulting GIS map with all the Green Cadastre information is a useful instrument for the Municipality in order to easily monitor and permanently have an actual image of the detailed green areas situation (Fig. 2, Fig. 3).

Fig. 2 GIS map with all the Green Cadastre Caransebeș

	A	B	C	D	F	J	K	L	M	N
1	Unique Identifier	X[m]	Y[m]	Z[m]	Location	Species	Native / Non native	Diameter(cm)	Heigh (m)	Vitality (1-Dry, 10 Healthy)
138	137	443559,38	280191,90	186,74	Str. Principala	PRUNUS DOMESTICA		16	4	8
139	138	443562,39	280192,03	186,92	Str. Principala	PRUNUS DOMESTICA		13	4	4
140	139	443565,90	280191,22	186,67	Str. Principala	PRUNUS DOMESTICA		16	6	8
141	140	443568,85	280190,60	186,64	Str. Principala	PRUNUS DOMESTICA		14	5	8
142	141	443572,24	280189,86	186,75	Str. Principala	PRUNUS DOMESTICA		18	5	7
143	142	443577,60	280188,47	187,05	Str. Principala	PRUNUS DOMESTICA		17	5	7
144	143	443580,83	280188,32	186,70	Str. Principala	PRUNUS DOMESTICA		13	5	7
145	144	443583,85	280187,19	186,75	Str. Principala	PRUNUS DOMESTICA		16	4	7
146	145	443586,90	280186,94	186,76	Str. Principala	PRUNUS DOMESTICA		16	4	7
147	146	443590,35	280186,11	186,76	Str. Principala	PRUNUS DOMESTICA		10	4	7
148	147	443594,47	280185,51	186,74	Str. Principala	PRUNUS DOMESTICA		11	4	6
149	148	443593,75	280181,45	186,83	Str. Principala	TILIA PLATYPHYLLOS		80	18	6
150	149	443602,24	280183,66	186,64	Str. Principala	PRUNUS DOMESTICA		12	5	7
151	150	443606,81	280182,32	186,62	Str. Principala	PRUNUS DOMESTICA		12	4	7
152	151	443628,16	280177,12	186,68	Str. Principala	PRUNUS DOMESTICA		14	6	7
153	152	443636,49	280175,42	186,34	Str. Principala	PRUNUS DOMESTICA		11	5	8
154	153	443640,67	280174,33	186,40	Str. Principala	PRUNUS DOMESTICA		16	6	8
155	154	443645,39	280173,34	186,53	Str. Principala	PRUNUS DOMESTICA		18	7	9
156	155	443660,72	280170,39	186,49	Str. Principala	PRUNUS DOMESTICA		20	9	9
157	156	443660,50	280166,34	186,52	Str. Principala	JUGLANS REGIA		7	5	9
158	157	443665,65	280165,10	186,73	Str. Principala	JUGLANS REGIA		38	14	8
159	158	443666,50	280169,01	186,59	Str. Principala	PRUNUS DOMESTICA		26	11	9
160	159	443671,10	280169,47	187,12	Str. Principala	PRUNUS DOMESTICA		14	6	5
161	160	443671,51	280168,54	184,49	Str. Principala	PRUNUS DOMESTICA		14	4	5
7022	7082	438433,937	282329,992	206,31	Vasile Alecsandri	THUJA ORIENTALIS	EXOTICA	11	7	7
7023	7083	438453,804	282326,701	206,9	Vasile Alecsandri	CUPRESSOCYPARIS LEYLANDII	EXOTICA	34	15	8
7024	7084	438455,393	282320,371	206,9	Vasile Alecsandri	PINUS NIGRA	EXOTICA	36	13	9
7025	7085	438450,474	282315,87	206,9	Vasile Alecsandri	PINUS NIGRA	EXOTICA	26	9	9
7026	7086	438445,094	282311,813	206,9	Vasile Alecsandri	PINUS NIGRA	EXOTICA	23	8	9
7027	7087	438477,966	282224,712	205,35	Vasile Alecsandri	CUPRESSOCYPARIS LEYLANDII	EXOTICA	30	6	7
7028	7088	438478,832	282219,022	205,35	Vasile Alecsandri	CUPRESSOCYPARIS LEYLANDII	EXOTICA	26	7	8
7029	7089	438481,043	282202,87	205,36	Vasile Alecsandri	CUPRESSOCYPARIS LEYLANDII	EXOTICA	24	8	7
7030	7090	438485,361	282191,979	205,01	Vasile Alecsandri	THUJA OCCIDENTALIS	EXOTICA	11	7	8
7031	7091	438482,351	282188,022	205,11	Vasile Alecsandri	CUPRESSOCYPARIS LEYLANDII	EXOTICA	28	17	9
7032	7092	438482,661	282182,598	205,08	Vasile Alecsandri	CUPRESSOCYPARIS LEYLANDII	EXOTICA	26	6	7
7033	7093	438482,997	282176,311	205,01	Vasile Alecsandri	THUJA ORIENTALIS	EXOTICA	1	1	7
7034	7094	438483,307	282175,929	205,01	Vasile Alecsandri	CUPRESSOCYPARIS LEYLANDII	EXOTICA	25	17	8
7035	7095	438483,335	282170,153	204,96	Vasile Alecsandri	CUPRESSOCYPARIS LEYLANDII	EXOTICA	23	15	7
7036	7096	438620,537	282162,238	206,34	Episcopiei	TILIA CORDATA	INDIGENA	28	10	9
7037	7097	438617,061	282198,416	206,12	Episcopiei	TILIA CORDATA	INDIGENA	27	9	9
7038	7098	438522,125	282337,989	205,98	Episcopiei	LIGUSTRUM VULGARE	INDIGENA	4	3	9
7039	7099	438516,111	282345,83	205,98	Episcopiei	FORSYTHIA SUSPENSA	EXOTICA	2	2	8
7040	7100	438512,524	282349,036	205,98	Episcopiei	SPIRAEA VANHOUTTEI	EXOTICA	2	2	9

Fig. 3 GIS database for Green Cadastre (extract)

The most important feature of a GIS is its ability to perform spatial analysis, to process spatial data (geographic) in order to obtain information (reports), in due time, on the studied area (Fig. 4).

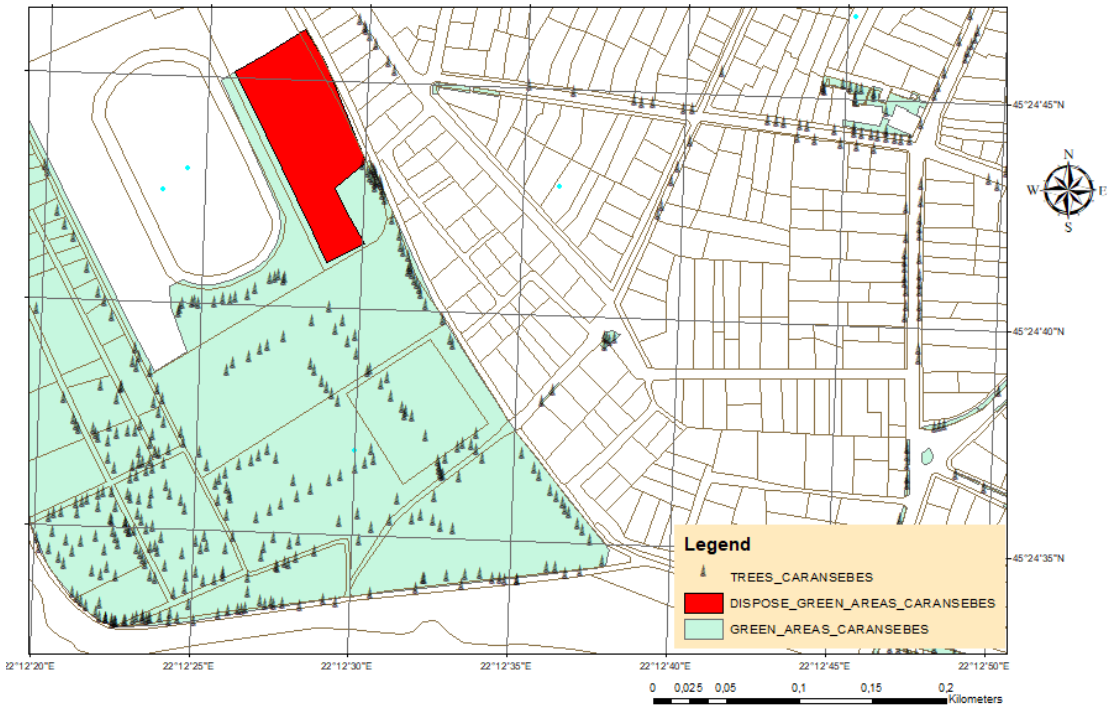

Fig. 4 Extract from GIS Map for Caransebes

The spatial database information can be analyzed in various ways, considering multiple criteria. Fig. 5 and Fig. 6 show answers (examples) for 2 types of queries from Pivot Table, for example: *"Viewing all trees from Teius Park"* and respectively *"Viewing trees with a vitality ranging between 1 and 5, from Teius Park"*.

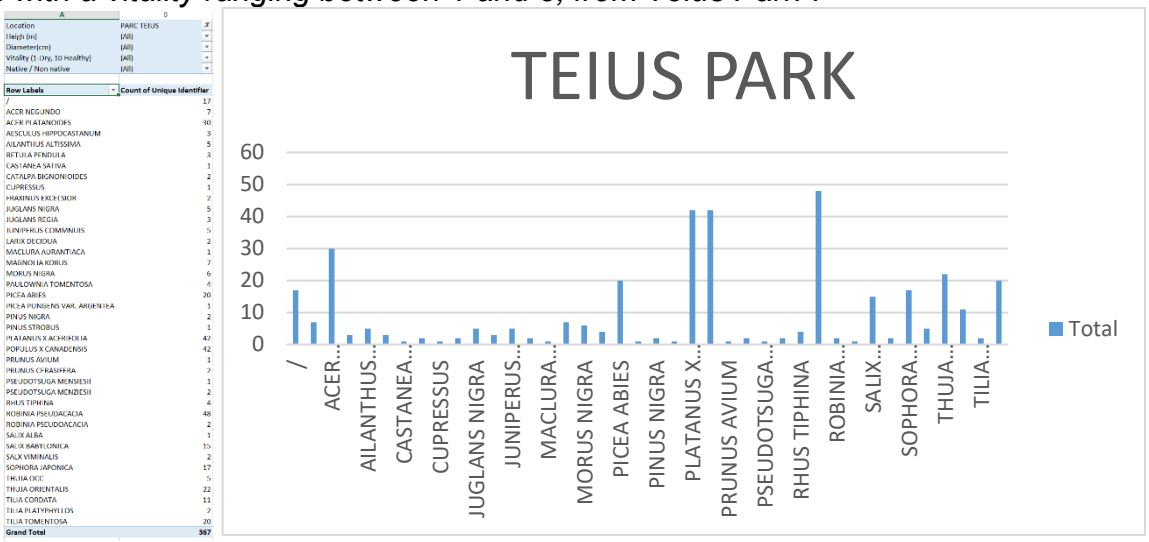

Fig. 5 Pivot Table and chart for Teius Park

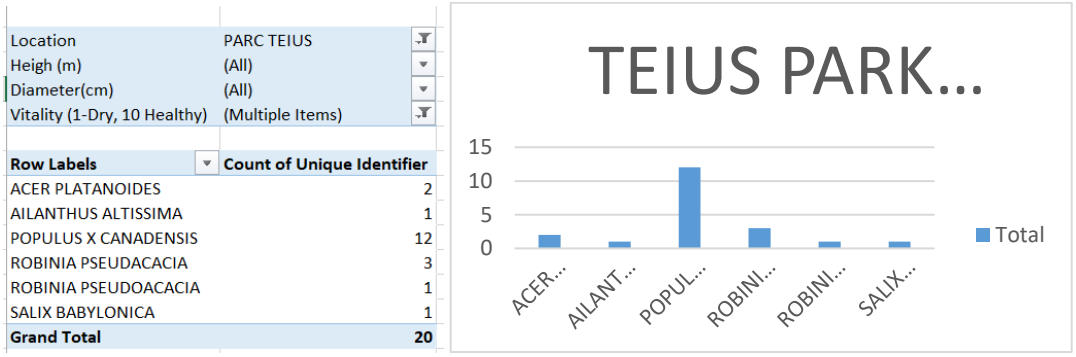

Fig. 6 Pivot Table for trees with low vitality from Teius Park

The data can be better valued by publishing a WEB service, for example ArcGIS Online, so a WEB map with the data collected from the field has been created to be easily used by citizens or other interested stakeholders. An example is presented in Fig. 7: a public WEB Map with the Green Area Register in Caransebes.

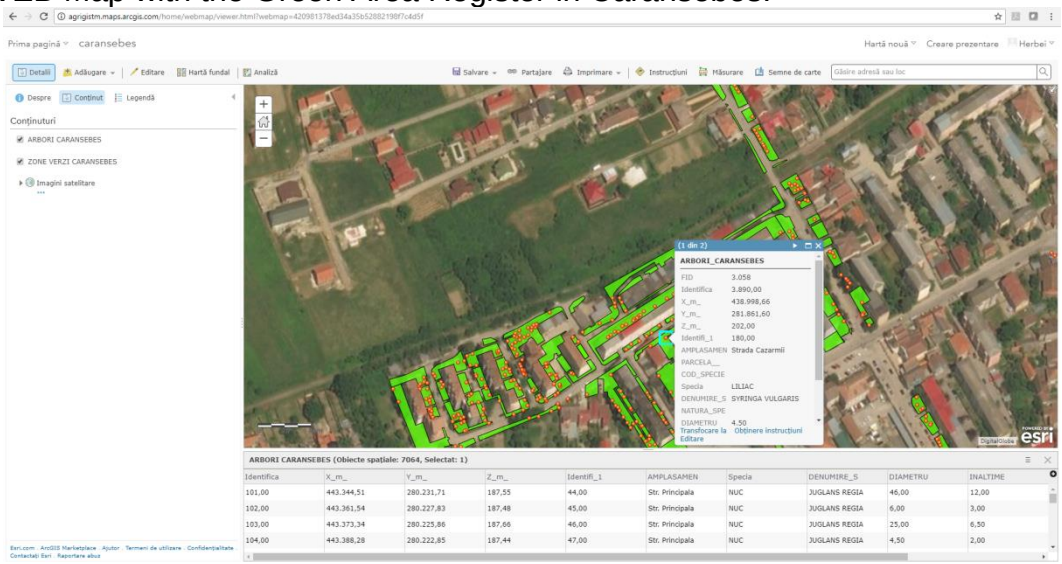

Fig. 7 Interactive WEB service for Green Area Register GIS data

Currently, the Local Green Area Register includes all data (projects, plans, maps, land use types, etc.) related to the green areas system of Caransebeş. This is a set of information gathered by specific methods and procedures, subsequently processed appropriately by programs and stored as a database (GIS). This spatial database is an open system in which real-time changes of the actual existing situation of green spaces and vegetation in Caransebeş municipality can be registered. Thus, any change (setting up a new green space, planting trees, grubbing up sick trees) can be recorded and monitored online. The use of a Green Area Register will facilitate many aspects of urban green space management: maintaining and developing existing green area protection functions; designing and applying a set of appropriate maintenance measures based on outstanding events (storms, diseases or pest attacks, fires etc.); conserving and increasing biodiversity in green spaces. This GIS system can also be used for monitoring green areas and degraded lands that can be redeveloped as green spaces in order to ensure an adequate qualitative level of environmental factors and a high level of the population health.

CONCLUSIONS

The local register of green areas in Caransebeş Municipality was established using modern methods of area measurements, mapping and planning based on a GIS system. The latest generation methods and programs ensuring high precision and accuracy were used, as all the necessary elements in this respect were well determined and analyzed in detail. The Local Registry of Green Spaces in Caransebeş Municipality reflects the situation of the green spaces existing within the limits of the urban area in accordance with the current legal framework. The use of GIS in Green Cadastre lead to a better management of the local green areas potential in Caransebes with direct and important positive implications for the people's safety and quality of life. Also, the urban green areas system can be expanded more easily by identifying new areas with ecological or socio-cultural potential to be established as green areas with specific present-day requirements in order to serve the citizen's welfare.

ACKNOWLEDGEMENTS

The financial assistance for this article from the part of research project „Study regarding development strategy of green infrastructure of Caransebeș Municipality" (no. 9450/30.12.2013) is gratefully acknowledged.

BIBLIOGRAPHY

1. **Herbei, M.V.,** 2015 - *GIS şi Modelare cartografică,* Universitas, p.151-160, Petroşani;
2. **Herbei, M.V., Sala, F.,** 2016 - *Biomass prediction model in maize based on satellite images*. In AIP Conference Proceedings, Vol. 1738, No. 1, 350009, AIP Publishing;
3. **INSSE**, 2012 - *Rezultatele provizorii ale Recensământul Populației și Locuințelor - 2011*;
4. **Magina, A.,** 2008 - *Confesiune şi societate în Banatul Montan la graniţa dintre Evul Mediu şi modernitatea timpurie,* în Crisia, nr. XXXVIII, Oradea;
5. **Rusu, R.,** 2007 - *Organizarea spaţiului geografic în Banat*, Editura Mirton, Timişoara;
6. **Szekely, G., Tenche-Constantinescu, A.-M.,** 2016 - *The analysis of the urbanistic and ecological potential for regional development in Caransebeș,* SGEM 2016, Albena;
7. **Tenche-Constantinescu, A.-M., Szekely, G., Borlea, Gh. F.,** 2016 - *Improving the urban image of the town of Caransebeş by the extension of green spaces and pedestrian areas in the city centre,* Journal of Horticulture, Forestry and Biotechnology, Volume 20(2), p. 100-111, Timişoara.