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USING GIS IN LANDSCAPING: A CASE STUDY IN CRAIOVA

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Abstract

The arrangement and management of urban green spaces require interdisciplinary approaches that combine ecological knowledge with modern spatial technologies. This study evaluates the applicability of Geographic Information Systems (GIS) for landscaping management through a case study conducted in Craiova, Romania. A database containing tree species, spatial coordinates, age categories, and health status was created using GPS-based field observations and processed in QGIS 3.40.1. Spatial analysis enabled the classification and visualization of dendrological material according to species type, age, and phytosanitary status. The results identified 69 deciduous trees and 11 conifers, as well as 10 trees that were simultaneously old and diseased, representing priority intervention areas. GIS-based mapping and buffer analysis improved the identification of maintenance zones and optimized decision-making regarding pruning, treatment, and replacement operations. The study demonstrates that GIS technologies can support more efficient and sustainable landscape management practices in urban areas.

Key words*: Craiova, GIS, landscaping, study*

INTRODUCTION

Since the beginning of civilization, humans have been concerned with beauty and the arrangement of the space in which they lived.
The use of topographic knowledge for navigation is among the best early illustrations of GIS applications, albeit without the "digital" aspect.
A GIS is a computer-based system to aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information (Figure 1).

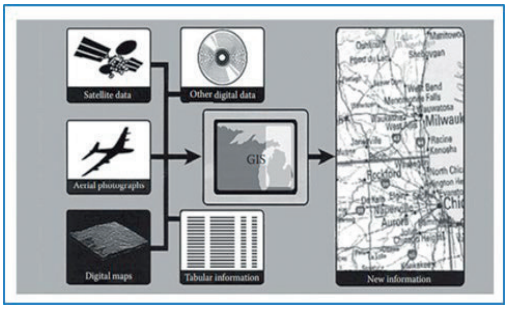

Figure 1. GIS system

Every GIS database must be referenced to a base map or base data layer. Ideally, the database should be referenced to a large scale, very accurate base map (Yousefi and Razdari, 2015).

The key element, or building block, of GIS is the geo-referenced, digital map. This element is the backbone to which we can integrate any data that we can collect or even imagine, as long as it has a spatial identifier. A variety of technical issues are tied to the digital map: map projection, a geo-rectification process to develop the digital map, and related issues that are nominally discussed in the metadata, which are data that thoroughly define/describe the aforementioned data. Another relevant background piece of knowledge is the nature of the data that comprise a GIS; these data can be points (e.g., well locations), lines (e.g., stream networks), and/or polygons (e.g., soil map units). Two distinct choices for the GIS data structures are raster (pixel based or rows and columns) or vector (coordinate based or lines that join to define a map unit).
Remote sensing technology linked with a GIS has been usefully implemented in the identification of multiple environmental characteristics, i.e., vegetation cover, urban sprawls, transitions in forests, and particularly variations in LULC changes for certain time periods (Helmer et al., 2000). It has been observed that remote sensing and GIS techniques offer more accurate and cost-efficient data evaluation in comparison to other traditional approaches and surveys (Jat et al., 2008).

GIS are regarded as essential for identifying the changes in remotely sensed images (Vibhute et al., 2013). It offers the ability to integrate data from multiple resources for the identification of change. The combined effect of the hydrological maps, soil and topographic maps, and classified images obtained through GIS may provide helpful information in extracting land use for a given area. In addition, it may show the tendencies of land use changes because of its ability to develop the model by using provided statistics and datasets. Moreover, GIS and remotely sensed images are widely utilized to recognize LULC changes (Rahman et al., 2012; Attri et al., 2015; Jiang et al., 2018). For tracking land cover changes, the combined use of GIS and remote sensing has been demonstrated to be a reliable and profitable technique (Hazarika et al., 2015; Lopez-Granados et al., 2013; Lambin et al., 2003; Serra et al., 2008).

In modern urban research, spatial data can be obtained from various sources, including satellite remote sensing data, geographic surveying and mapping data, traffic network data, census data, etc. (Zafar, 2024). GIS-based spatial analysis tools provide a new idea that can visually present massive urban data and evaluate landscape accessibility by analyzing the spatial relationship between urban elements (Chen et al., 2020).

Urban datasets often reflect socio-economic inequities, potentially introducing bias into the model's predictions (Aslam et al., 2024). For example, affluent areas may be overrepresented in datasets due to better data availability, while marginalized communities might be underrepresented (Boadi et al., 2025).

Practice has proved that the parametric design method of landscape architecture can take the basic spatial data provided by the field of surveying and mapping as the basic design input, and at the same time use ArcGIS software to complete the corresponding data analysis and processing, so as to accurately grasp the elements of landscape architecture and dynamically optimize the design scheme, which provides a brand-new design idea and technical path for the field of landscape architecture design (Ni Xiao, 2025).

Recent applications of integrating remote sensing-derived indices with machine learning algorithms have demonstrated improved accuracy and efficiency (Mykola et al., 2025).

Therefore, the main objective of this study is to demonstrate how GIS-based spatial analysis can support urban landscape management in Craiova by identifying tree distribution patterns, health conditions, and priority intervention areas. The research also evaluates the practical role of QGIS in improving maintenance efficiency and decision-making in urban green spaces.

MATERIALS AND METHODS

This study was conducted in the Craiova area, located in Southwest Romania (44°20′N, 23°49′E). The methodological approach combined field data collection with GIS-based spatial analysis. The study did not aim only to inventory trees, but also to evaluate how GIS techniques can support decision-making in landscape management.

The following variables were recorded for each tree: species, latitude, longitude, age category (young/old), and health status (healthy/sick). Spatial coordinates were collected using the GPS Coordinates mobile application, while age and health status were determined through visual assessment based on trunk condition, canopy structure, and visible phytosanitary symptoms.

The collected data were organized in Microsoft Excel and converted into CSV format for processing in QGIS version 3.40.1 "Bratislava" (QGIS Association, 2025). Spatial analysis included thematic mapping, attribute classification, and buffer-zone generation around diseased trees to identify priority management areas. Additionally, spatial clustering of old and unhealthy trees was analyzed in order to optimize intervention routes and maintenance operations.

The study method does not aim to repeat previous documentation, but rather to synthesize existing elements and relate them to the concept of landscape, interpreting data to identify the distinctive competencies of the land in question through both objective - quantitative and subjective - perceptual analyses. The synthesis elements will be interpreted to structure recommendations and development directions that have as their main purpose the improvement

of landscape quality as an indicator of quality of life.

The following characteristics were chosen as variables:

• Species;
• Latitude;
• Longitude;
• Age with 2 graduations: young and old;
• Health status with 2 graduations: healthy and sick.

The spatial coordinates of the trees were determined using a mobile phone application (GPS coordinates). Age and health status were determined visually.

Tree age category was determined through non-invasive visual indicators commonly used in rapid dendrological assessments. Trees with small trunk diameters, smoother bark, and compact, symmetrical crowns were classified as young, while individuals with visibly thicker trunks, coarse or fissured bark, and expanded or irregular crowns were classified as old. These criteria ensured consistent categorization without requiring destructive sampling.

Health status was evaluated using visible phytosanitary indicators. Trees showing uniform foliage, intact bark, and no signs of pests or fungal infections were classified as healthy. Trees exhibiting canopy thinning, leaf discoloration, bark lesions, fungal bodies, or pest damage were classified as sick. These indicators follow standard urban tree assessment practices and allow rapid identification of risk trees.

The raw data were recorded in an Excel file. After converting it to a CSV file, it was imported and processed using the QGIS program. All mapping operations were performed in QGIS version 3.40.1 “Bratislava” (QGIS Association, 2025).

RESULTS AND DISCUSSIONS

Using the QGIS program, the data were processed to create presentation maps. In these maps, the program allows the introduction of all identification elements (north, scale, legend, etc.).

The classification of trees according to their type led to: 69 deciduous trees (86.25%) and 11 conifers (13.75%). Going further, trees can also be classified according to botanical family to determine their degree of spread (Figure 2).

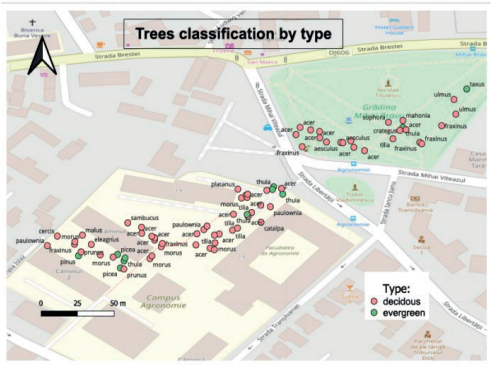

Figure 2. Trees classification by type

The age of the plants, another criterion taken into account, is very important because it provides information regarding future work and interventions on the plants in the near future. By classifying dendrological material by age, we can determine which trees require immediate intervention and we can create corridors to protect visitors from falling branches.

The program allows trees to be grouped so that any pruning interventions can be carried out as efficiently as possible, with minimal disruption to pedestrian traffic.

For example, in our study we found 35 old trees (43.75%) and 45 young trees (56.25%) (Figure 3).

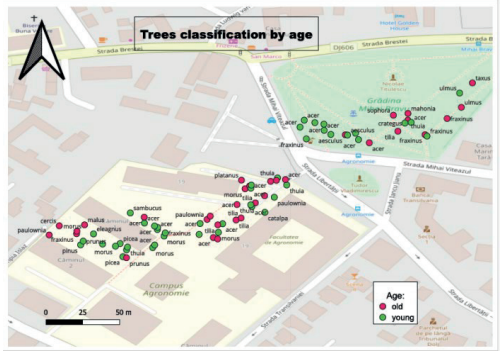

Figure 3. Trees classification by age

Classifying the dendrological material by health status, we have: 60 (75%) healthy and 20 (25%) diseased trees. The program allows the creation

of protective buffer zones around each diseased tree, depending on the type of disease or pest.
This buffer zone helps us save time, labour and materials (substances) for the treatment of sick trees (Figure 4).

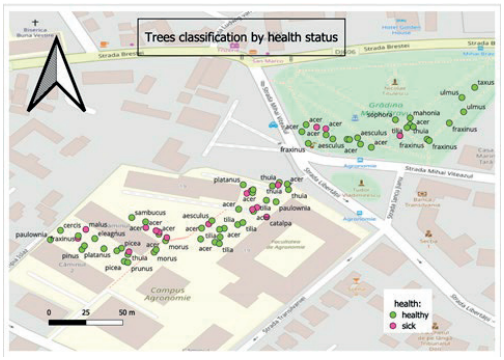

Figure 4. Trees classification by health status

Combining this information, we found a number of 10 (12.5%) old and diseased trees, grouped by action areas so that their replacement/treatment activity would be as efficient as possible.
Beyond the descriptive classification of trees, GIS analysis highlighted several important spatial patterns. Diseased trees were concentrated in specific sectors of the study area, indicating the possibility of localized environmental stress factors or pest propagation. Buffer zones created around affected trees allowed the identification of risk areas where monitoring and phytosanitary interventions should be prioritized.
Spatial clustering analysis also revealed that old trees were frequently located along the main pedestrian circulation corridors. This finding is important because it allows landscape managers to prioritize pruning and replacement works in areas with high public exposure. By integrating age and health status into the GIS database, intervention priorities could be established more efficiently.
The identification of 10 trees (12%) classified as both old and diseased demonstrates the practical utility of GIS for urban green-space management. These trees formed distinct intervention clusters that can reduce maintenance costs and improve work planning efficiency. In addition, the GIS-based approach facilitates future updates of the database and long-term monitoring of vegetation dynamics.

CONCLUSIONS

The present study demonstrates that GIS technologies represent an effective tool for urban landscape management and the monitoring of green spaces. By integrating field observations with spatial analysis in QGIS, it was possible to identify tree distribution patterns, health-risk areas, and priority intervention zones.
The results showed that GIS-based analysis can improve maintenance efficiency by supporting targeted pruning, treatment, and replacement operations. The creation of buffer zones around diseased trees and the identification of clusters of old and unhealthy trees provide practical decision-support tools for landscape managers.
Furthermore, the methodology used in this study can be replicated in other urban areas with similar environmental and landscape conditions. Future research may include advanced GIS techniques, remote sensing data, and machine-learning models to improve the monitoring and sustainable management of urban vegetation.
These technologies provide essential tools for monitoring, managing, and adapting practices to ensure sustainability and resilience against climatic variations.
Continued advancements in remote sensing and GIS will enhance their effectiveness in addressing the challenges posed by climate change in the future.
QGIS helps us be more efficient and save materials in our daily work.
While this study focuses on Craiova city, its methodology and findings could be adapted to other regions with similar landscape, geographical, and agricultural features.

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