MAPPING PUBLIC FOUNTAINS AS CULTURAL AND NATURAL RESOURCES

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Abstract
This paper explores the potential of cartography for documenting and analyzing public fountains as natural and cultural heritage features. In Bulgaria, public water fountains have significant social, historical, and symbolic value beyond their role as water supply points. The study focuses on the territory of the Municipality of Satovcha, Bulgaria, an area characterized by an exceptionally high concentration of spring-fed public fountains and internationally recognized for holding a Guinness World Record for the highest number of such fountains per capita. The objective is to develop a web-based thematic map showing the spatial distribution of fountains and supporting analyses of accessibility, technical condition, and relationships with the road network and natural environment. The methodology includes data collection, GIS database development, attribute design, classification, and cartographic visualization. The resulting web map provides a tool for sustainable water resource management, maintenance planning, and public access to information about the fountains.

Keywords: *web-based cartography, cultural and natural heritage, water fountains, GIS*

INTRODUCTION

Fountains are a specific type of public water source that combines natural, technical, and cultural characteristics. As elements of the anthropogenic environment, they serve not only the practical function related to the provision of drinking water but also play a significant social and cultural role in the lives of local communities.

Natural springs and fountains represent a distinct type of natural resource that combines hydrogeological, ecological, and socio-cultural characteristics. In addition to their cultural and historical significance, fountains are closely associated with natural springs, which are locations where groundwater naturally emerges at the Earth's surface as a result of the aquifer reaching saturation (USGS, 2019). Consequently, springs are regarded as a strategic freshwater resource. They function as ecological refuges by enhancing ecosystem resilience during periods of drought, providing water for flora and fauna when other surface water sources have dried up (Jung et al., 2024). In Bulgaria, these sites support unique ecosystems and protected species, making them areas of exceptional biodiversity. As such, they contribute to biodiversity conservation by serving as watering sites for birds and wildlife, playing a crucial role in maintaining ecological balance (Jandaghian & Colombo, 2024). Furthermore, in the context of global climate change and frequent drought events, natural springs are increasingly recognized as an alternative and independent source of drinking water, ensuring access to this vital resource during emergencies (International Association of Hydrogeologists, 2019). Modern spring water fountains are constructed through a combination of engineering solutions and sanitary measures that consider both the natural conditions of the site and safety requirements. According to the World Health Organization (2024), protecting a natural spring requires structures that prevent contamination and ensure safe water use.

Beyond their ecological importance, public water fountains also represent cultural features that reflect the interaction between natural resources and human adaptation. The architecture of fountains is characterized by considerable regional diversity, reflecting local construction traditions, available materials, and the functional needs of communities. In rural areas, they are distinguished by simple forms, the use of natural stone, and traditional decorative elements that

contribute to their cultural and historical value and identity. In mountainous regions, architectural solutions are primarily oriented toward functionality and sustainability, with structures adapted to local environmental conditions and the needs of mountain pastoralism.

In contemporary initiatives focused on sustainable development, environmental conservation, and the preservation of water resources, such traditional structures are often regarded as important elements of local ecosystems, everyday culture, and collective memory (Roman Fountains, 2025; Bulgarian Biodiversity Foundation, 2025).

In this context, the application of modern cartographic methods and GIS plays a key role in the documentation, analysis, and preservation of fountains as cultural and natural resources. GIS tools enable the systematization of data related to their location, characteristics, technical condition, and cultural-historical value. This makes it possible to analyze their spatial distribution and identify areas with a high concentration of such sites. Cartographic visualization, in turn, can support the development of strategies for their preservation, sustainable management, and promotion.

STUDY AREA AND DATA SOURCES

Satovcha Municipality as the Case Study Area

The study area of the present research is Satovcha Municipality, located in the Western Rhodope Mountains, where water holds a central place in local life, culture, and traditions. According to the officially recognized information provided by Guinness World Records, 424 spring-fed public water fountains have been registered within the municipality, representing the highest number of fountains per capita in the world (Guinness World Records, 2026). This phenomenon results from both the favorable natural conditions of the Rhodope Mountains and deeply rooted local traditions of donation, community support, and reverence for water. In this way, Satovcha Municipality represents an example of a community that successfully preserves and promotes its cultural heritage.

The public water fountains in the municipality are distinguished by the characteristic architectural style of the Rhodope Mountains, primarily featuring massive stone walls and carefully crafted stone basins. Some of them bear donor inscriptions, while others are decorated with traditional Rhodope ornaments that emphasize their cultural and historical significance. Their role extends beyond providing drinking water. Their construction reflects a long-standing tradition of philanthropy, rooted in the belief that deeds benefiting the community beyond the donor’s lifetime bring spiritual reward. This tradition is one of the main factors explaining the exceptionally high number of public water fountains in the municipality and its recognition by Guinness World Records (2026). As a result, these fountains are perceived not only as functional infrastructure but also as symbols of local identity, cultural memory, and social solidarity.

Data Sources

Within the framework of the present study, Satovcha Municipality provided primary data used for the development of the geospatial database of public water fountains. The dataset includes the geographic coordinates of the registered sites, their names, and the settlements to which the sites belong administratively. Additionally, photos and video materials were provided and used for visual verification, object identification, and the enhancement of attribute information.

The obtained data were further processed, structured, and organized within a GIS environment, where they served as the basis for the creation of a spatial database and the implementation of subsequent spatial analyses. Following the preparation and verification stage, the data were integrated into GIS, providing the base for mapping and analysis of public water fountains in Satovcha Municipality.

DEVELOPMENT OF A WEB MAP OF PUBLIC WATER FOUNTAINS AS CULTURAL AND NATURAL RESOURCES

Concept and Objectives

Given the significance of fountains as elements of natural and cultural heritage, their spatial documentation and visualization through modern GIS technologies represent an important step in their documentation, management, and promotion. In this context, a web map of the public fountains located within the territory of Satovcha Municipality has been developed. Its main purpose is to present the spatial distribution of these sites and to provide an integrated environment for analysis and visualization of the related information.

The map supports the organization of information about public water fountains and supports activities related to their inventory, maintenance, management, decision-making processes, and preservation as elements of the local heritage. It

is a thematic cartographic product in which each fountain is represented as an individual feature. Covering the administrative territory of Satovcha Municipality, it enables the analysis of the spatial distribution of the documented sites in relation to key landscape and infrastructural elements, including the road network and settlements.

Main Stages of the Workflow

The cartographic product was developed in a GIS environment. The workflow consisted of a series of key stages: preparation and verification of the input data, creation and organization of a geospatial database, editing and standardization of the attribute information, and implementation of a map symbol system for cartographic visualization (Fig. 1).

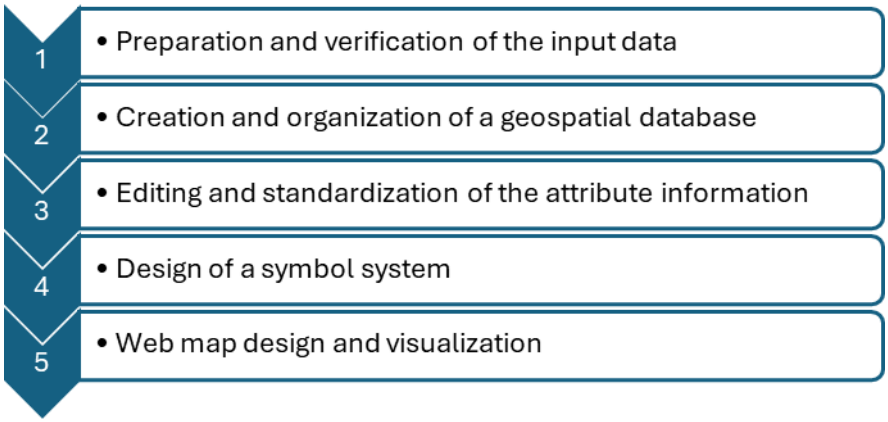


Figure 1. Main stages of the workflow

Each stage of the workflow is aimed at ensuring the effective representation of the final cartographic product. Particular attention has been paid to the structure and organization of the attribute table, which serves as the basis for spatial analyses and supports the future development of the map in a web environment. The attributes have been standardized, and additional descriptive information has been included for each fountain.

Classification of Public Water Fountains

The classification and associated attribute information play a key role in the process of map development, as they enable spatial features to be structured, systematized, and differentiated according to their characteristics, functional properties, and affiliation with specific thematic categories.

The classification of fountains was based on the available photographic and video materials, with visible characteristics of the objects and their surrounding infrastructure being analyzed. The defined categories reflect the functional features of the fountains, including the presence of rest areas, additional facilities, and other elements of their immediate surroundings. The resulting classification provides a consistent framework for describing the studied objects and can serve as a basis for further database updates through additional field surveys and the inclusion of new attributes.

The fountains within the study area were classified according to five criteria, each of which was recorded in the attribute table.

Criterion "Zone"

The purpose of this criterion is to clearly distinguish between fountains located within urbanized areas and those situated outside them, in suburban or natural environments.

Based on this criterion, the fountains were classified as follows:

- Fountains within settlements – fountains located within the built-up areas of settlements;
- Fountains outside settlements – fountains located outside settlement boundaries, in mountainous, forested, or inter-settlement areas.

The "Zone" attribute is essential for analyses, as it enables the assessment of relationships between the spatial distribution of fountains and other characteristics, such as accessibility, the presence of rest areas, and overall condition.

Criterion "Accessibility"

The "Accessibility" indicator reflects the possibilities for reaching each object by different types of transport. Its purpose is to provide a more realistic assessment of the usability of the fountains, as well as the level of difficulty involved in reaching them by local residents, visitors, and the services responsible for their maintenance.

According to this indicator, the classification is as follows:

- On foot – for fountains that can be reached only or primarily by walking, via forest trails or steep terrain;
- By passenger car – for fountains located near paved or well-maintained roads, allowing access by a standard motor vehicle;
- By off-road vehicle – for fountains located in hard-to-reach areas where access is possible only by an off-road vehicle, via unpaved or roads in poor condition.

Combining information on the road network, terrain, and elevation enables a more objective and well-supported assessment of accessibility, even in the absence of complete field observations for each site. In this way, the classification is not based on subjective judgment, but rather on a comparison of several spatial indicators. The "Accessibility" attribute expands the analytical potential of the map and creates opportunities for its practical application in maintenance planning, improving access, and developing tourist routes.

Criterion "Material"

The "Material" attribute reflects the main construction materials used in the development of the water fountains. Its purpose is to present the structural characteristics of the fountains, their durability over time, and their visual appearance in the context of the surrounding environment.

The following material categories have been used:

- Stone – for fountains built entirely or predominantly from natural stone, characteristic of traditional local architecture;
- Concrete – for fountains constructed mainly from concrete, without additional stone cladding;
- Concrete and stone – for fountains with a concrete supporting structure additionally covered with stone, combining modern construction techniques with a traditional external appearance;
- Other material – for fountains where atypical or contemporary finishing solutions have been used, such as tiles, decorative panels, or other combined materials that do not fall into the previous categories.

The classification of materials was based on a visual analysis of the available photographic and video materials, as well as field inspections of some of the fountains. The categorization considered the dominant construction material, as it defines both the durability and the overall appearance of the structure. This approach enables the standardization of information and avoids overly detailed or incomparable descriptions.

The "Material" attribute complements the overall characterization of public fountains and enables further analyses related to the relationship between the materials used, the current condition of the structures, and the need for maintenance or rehabilitation.

Criterion "Condition"

This criterion provides a qualitative assessment of the current physical and functional condition of public water fountains. The assigned values are based on an analysis of photos and videos provided by the municipal administration. The assessment is interpretative and based primarily on visual information. To ensure clarity and comparability, the condition of the fountains has been classified into the following categories:

- Good – fountains in very good or excellent physical and functional condition, with no visible structural damage, well-preserved basins and spouts, and no immediate maintenance required;
- Fair – functional fountains showing minor defects or signs of wear and deterioration, such as damaged or detached cladding, small cracks, corrosion of metal elements, and a partially neglected surrounding environment;
- Requires maintenance – fountains in poor condition with evident structural or functional deficiencies, including damaged structural elements, overgrown vegetation, making them difficult to use or non-functional.

Criterion "Rest Area"

The classification scheme includes the attribute "Rest area", along with "Rest area type", which describe the presence and characteristics of rest areas located near public water fountains.

The following categories of "Rest area" are used:

- Fountains with a rest area – assigned to fountains where the available photographs or video recordings clearly indicate the presence of a designated space intended for rest or recreation;
- Fountains without a rest area – assigned to fountains where no features associated with resting or short-term stay are identified near the fountain.

The "Rest area type" field provides additional information about rest areas by specifying the type of facility or feature present, where applicable. In cases where no designated rest area is available, this is also recorded in the field to ensure data completeness and consistency. The following values are used:

- Bench – used when a standalone bench is present;
- Gazebo – used when a covered structure intended for rest and shelter is present;
- Shelter – used when a simple roofed structure without enclosed sides is present;
- Shelter with barbecue – used when a combined facility for resting and food preparation is present;
- Mountain shelter – used when a more substantial protective structure, typically found in mountainous areas, is present;
- No rest area – used when no designated rest area has been identified at or near the fountain.

In addition to the descriptive and thematic attributes, the attribute table also includes fields related to the terrain, which further expand the analytical potential of the map.

Cartographic visualization

For this study, the web map (Fig. 2) was developed featuring three levels of thematic visualization, each utilizing a set of map symbols (Fig. 3) designed to achieve specific informational objectives:

1. General visualization: presents all public water fountains using a unified symbol, providing an overall overview of the density and spatial distribution of water resources within the region.
2. Functional visualization: classifies the public water fountains according to the presence of associated infrastructure, clearly distinguishing between "fountains with a rest area" and "fountains without a rest area." This enables users to quickly identify locations suitable for short-term recreation.
3. Accessibility-based visualization: focuses on logistical aspects by using specific symbols to indicate the accessibility level of each public water fountain (e.g., accessible by passenger car, accessible only by off-road vehicles, or reachable via hiking trails).

In all three visualization approaches, when a user selects a specific public water fountain, detailed information about the selected site is displayed in a pop-up window according to the defined classification criteria. Furthermore, the information panel also includes photographs provided by the municipal administration, serving as visual evidence of the condition, construction characteristics, and immediate surroundings of the fountains. Additional information is provided through the elevation of each site, derived from a digital elevation model (DEM), which supports a more comprehensive analysis of the spatial distribution of fountains by enabling the investigation of relationships between elevation, accessibility, condition, and the presence of rest areas. The integration of descriptive, visual, and environmental data enhances the developed GIS database, extending its application beyond visualization and enabling more detailed spatial analyses and planning activities.

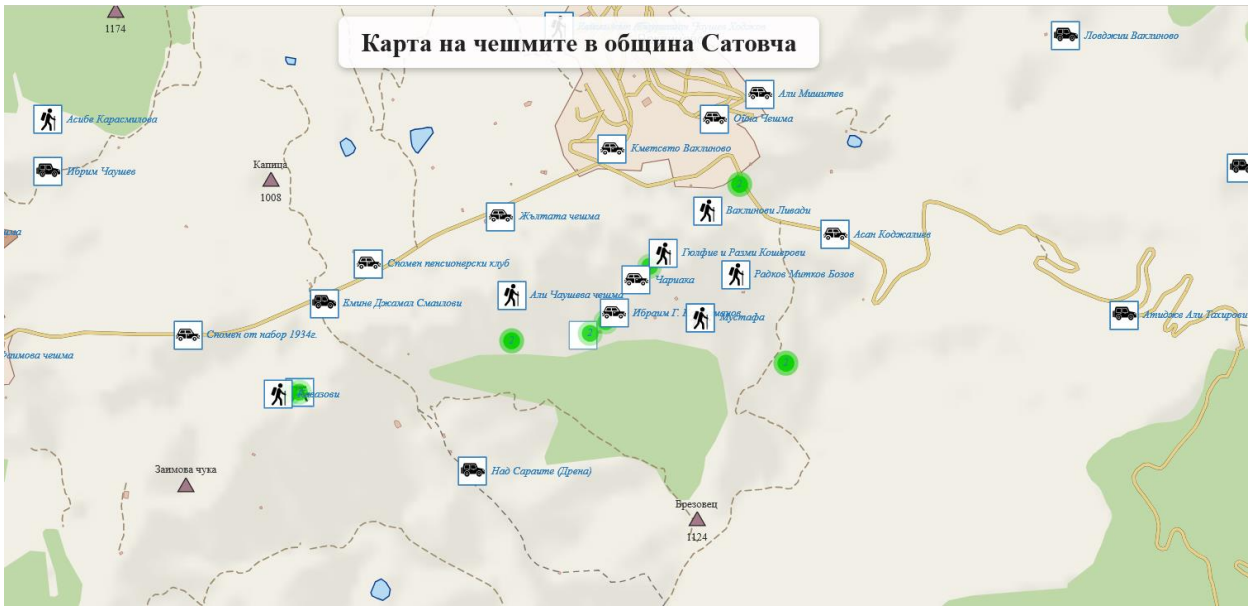


Figure 2. Web map fragment showing the accessibility-based visualization of public water fountains

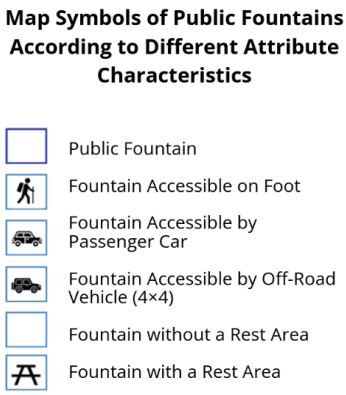


Figure 3. Symbolization of public water fountains according to thematic criteria

CONCLUSION

This study demonstrates that public water fountains can be regarded as complex objects of cartographic representation. Mapping fountains is not merely a technical task but a process of spatial documentation of both a natural resource and cultural heritage. It presents a web map of public fountains in the Municipality of Satovcha. The practical implementation in a GIS environment demonstrates that organizing the data into a structured database (including fields such as zone, accessibility, construction material, condition, availability of resting areas, and others) significantly enhances the possibilities for analysis and management. Additionally, the integration of coordinate data, visual documentation, and elevation provides a reliable basis for comparing the mapped sites and supports their effective management and future planning.

The developed web map and database can support the municipality in: planning maintenance activities and identifying fountains in poor condition; assessing logistical accessibility and the resources required for maintenance; developing tourism and ecological routes; and increasing the public visibility of the public water fountains as part of the local identity. It also provides a foundation for the further development of interactive web-based applications, as well as for the continuous monitoring and updating of spatial information.

REFERENCES

Bulgarian Biodiversity Foundation. (2025). Guide to Public Water Fountains: Restoration and Maintenance. Biodiversity.bg. https://biodiversity.bg/files/modules/4203/Cheshme-guide-1-compressed-9355.pdf, in Bulgarian (accessed: 18 November 2025)

Guinness World Records. (2026) Most drinking fountains per capita in a municipality. Guinness World Records, https://www.guinnessworldrecords.com/world-records/770750-most-drinking-fountains-in-per-capita-municipality (accessed: 8 January 2026)

International Association of Hydrogeologists. (2019). Climate Change Adaptation and Groundwater. International Association of Hydrogeologists, Strategic Overview Series, https://iah.org/wp-content/uploads/2019/07/IAH_Climate-ChangeAdaptationGdwtr.pdf (accessed: 22 November 2025)

Jandaghian, Z., Colombo, A. (2024). The Role of Water Bodies in Climate Regulation: Insights from Recent Studies on Urban Heat Island Mitigation. *Buildings*, *14*(9), 2945. https://doi.org/10.3390/buildings14092945

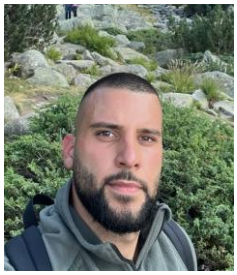
Jung M.S., Silva JAGD, Fachinetto J.M., Copetti C.M., Babeski C.M., Peter C.L. (2024) Water springs: an immeasurable resource for ensuring sustainability. An Acad Bras Cienc. 2024 Aug 19;96(3):e20231010. doi: 10.1590/0001-3765202420231010. PMID: 39166617

Roman Fountains. (2025) The History of Water Fountains: When Were They Invented? Roman Fountains, https://www.romanfountains.com/the-history-of-water-fountains-when-were-they-invented/ (accessed: 10 January 2026)

USGS (2019) Springs and the Water Cycle, https://www.usgs.gov/special-topics/water-science-school25 (accessed: 15 January 2026)

World Health Organization (2024). Guidelines for drinking-water quality: small water supplies. Geneva: World Health Organization (accessed: 10 January 2026)

BIOGRAPHY



Lazar Lyaskov is a graduate Geodetic Engineer who earned his Master's degree in Geodesy from the University of Architecture, Civil Engineering and Geodesy (UACEG), Sofia, in 2026. His master's thesis in Cartography and GIS focused on mapping small water sources as cultural and natural resources. His professional interests include cartography, GIS, spatial data management, and the application of geospatial technologies for cultural and environmental heritage documentation.



Silvia Marinova is an Associate Professor at the Department of Photogrammetry and Cartography at the University of Architecture, Civil Engineering and Geodesy in Sofia, where she also heads the Laboratory on Cartography and GIS. She has over 15 years of professional experience, including her work as a cartographer at KartGeo. Her research focuses on crisis management mapping, cartography for children, educational cartography, map symbol systems, interactive mapping, mountain cartography, toponymy, and cross-border mapping. She is the author and editor of numerous cartographic products, including tourist maps, maps for disaster management, cross-border maps, and raised relief maps.

Silvia Marinova serves as Secretary General of the Bulgarian Cartographic Association and as Chair of the ICA Commission on Cartography and Children (since 2023). She is also a member of the Chamber of Graduated Surveyors in Bulgaria. Her work combines academic research, education, and applied cartography.