POLITECNICO DI TORINO
Repository ISTITUZIONALE

GIS as an Information and Decision-Support Tool for Sustainable Rural Heritage Management: The Case of Ankara

Original
GIS as an Information and Decision-Support Tool for Sustainable Rural Heritage Management: The Case of Ankara / Çidem Asrav, E., Bilgin Altnöz, A.G., Rinaudo, F.. - In: INTERNATIONAL ARCHIVES OF THE PHOTOGRAMMETRY, REMOTE SENSING AND SPATIAL INFORMATION SCIENCES. - ISSN 2194-9034. - ELETTRONICO. - X-M-2-2025:(2025), pp. 21-27. [10.5194/isprs-annals-X-M-2-2025-21-2025]

Availability:
This version is available at: 11583/3003731 since: 2025-10-07T10:30:01Z

Publisher:
Copernicus Publications

Published
DOI:10.5194/isprs-annals-X-M-2-2025-21-2025

Terms of use:

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

(Article begins on next page)

29 November 2026

GIS as an Information and Decision-Support Tool for Sustainable Rural Heritage Management: The Case of Ankara

Emine Çiğdem Asrav [1], A. Güliz Bilgin Altınöz [2], Fulvio Rinaudo [3]

[1] Assist. Prof., Department of Architecture, Bilkent University, 06800 Çankaya/Ankara, Turkey – emineasrav@bilkent.edu.tr
[2] Prof. Dr., Department of Architecture, Graduate Program in Conservation of Cultural Heritage, Middle East Technical University, 06800 Çankaya/Ankara, Turkey – bilging@metu.edu.tr
[3] Prof. Dr., Department of Architecture and Design, Politecnico di Torino, Corso Duca degli Abruzzi, 24 | 10129 Torino, Italy – fulvio.rinaudo@polito.it

Keywords: Rural Heritage, Spatial Documentation, Spatial Analysis, Heritage Management, Decision-Support System, GIS.

Abstract

Rural heritage places embody dynamic interactions between people and nature, shaped by traditional practices and adaptive responses over time. Despite their significance, rural areas are often overlooked in conservation and policy frameworks. This paper develops a GIS-based information and decision-support system for the comprehensive identification and assessment of rural heritage values, using Ankara's rural landscapes as a case study.

The study integrates extensive literature and archival research, detailed field surveys, and qualitative investigations to collect multi-scalar, multi-disciplinary data. The RURANKARA•GIS database systematically organizes and analyses this data to identify the social, cultural, economic, and environmental resources vital for sustainable heritage management. A spatio-temporal analysis at the territorial scale mapped settlement patterns, land use changes, and socio-economic practices, while the town-scale application in Çamlıdere provided detailed assessments of character and risk areas.

GIS technologies proved essential for managing heterogeneous data, enabling dynamic updates, spatial analyses, and clear visualizations, although limitations such as data gaps and the challenge of representing intangible heritage were acknowledged. The developed system not only supports academic research but also offers a strategic, operational tool for local governments and policymakers to guide sustainable rural development.

Ultimately, this study highlights the importance of adopting holistic, multi-dimensional approaches in rural heritage management and provides a transparent, participatory model that bridges research, practice, and policy. The RURANKARA·GIS database contributes a replicable methodology for informing heritage-led rural development both within Ankara and in broader contexts.

1. Introduction

Rural heritage places embody intricate and dynamic interactions between people and nature at various scales in their landscape. They are challenged by natural and social processes, ecological and environmental factors, and characterized by traditional practices and local solutions developed over the years. They are part of a network of relations with socio-economic activities, cultural practices, and intangible relations that shape the physical environment at various scales. Rural areas are dynamic, continuing, adaptive, and cultural, social, environmental, and economic living systems holding traditional knowledge and experiences. With these features, rural areas provide resources as essential inputs for sustainable heritage management. To identify these resources comprehensively, it is crucial to adopt a multidimensional approach for the identification, analysis, and assessment of the values, challenges, and potentials over the *longue durée*. Such a holistic perspective is crucial for developing informed conservation strategies and sustainable heritage management practices.

This paper proposes a GIS-based information and decision-support system designed for the comprehensive identification and assessment of rural heritage values, contributing to sustainable heritage management. The rural landscape of Ankara was selected as a case study due to its diverse natural and cultural features and the increasing vulnerability of its rural areas, which, despite their significance, have not yet been studied holistically.

The study first presents a spatio-temporal identification and analysis of Ankara's rural landscape within a GIS environment to reveal its multi-layered heritage values and challenges in a historical perspective. This approach enables the identification of character and risk areas across different scales and the mapping of critical social, cultural, economic, and environmental resources. Subsequently, the paper introduces the assessment criteria, and the database developed to facilitate the systematic assessment of these landscapes. Finally, the application of this system is demonstrated through the case of Çamlıdere, a rural town where character and risk areas overlap since it shows diverse traditional practices and fabric persist, but which simultaneously faces significant risks of loss and degradation.

Through this study, the paper highlights the importance of adopting holistic approaches to the identification and assessment of rural heritage places, which are often overlooked in policymaking and conservation legislation. A comprehensive understanding of these places is essential for developing appropriate policies and strategies that ensure their effective and sustainable management.

This contribution has been peer-reviewed. The double-blind peer-review was conducted on the basis of the full paper.
https://doi.org/10.5194/isprs-annals-X-M-2-2025-21-2025 | © Author(s) 2025. CC BY 4.0 License.

2. Methodology

A multilayered study was conducted for the purpose of this paper. The research process included extensive literature and archival surveys, followed by fieldwork to understand both the physical and social environments of the study area. Ultimately, Geographic Information Systems (GIS) were integrated into the study to systematically store, document, analyse, and spatially assess the collected data.

2.1 Literature and Archival Surveys

The project started with data collection of historical and contemporary sources. For this, libraries and archives of research centres, online archives, and archives of public bodies were searched. In the end, a great amount of primary and secondary sources, visual and textual documents such as state records, historical cartography (Figure 1, Figure 2), aerial photos, maps, old photos and illustrations, cadastral maps, master plans, map of designated areas, inventories, registered buildings and structures, maps showing topography, road network, and water system were collected.

After initial analysis of these data, they are organized systematically and incorporated into GIS environment (Figure 3).



Figure 1: 1908 map by Richard Kiepert, Karte von Kleinasien, B3. Angora, https://digitalcollections.nypl.org/collections/maps-of-asia#

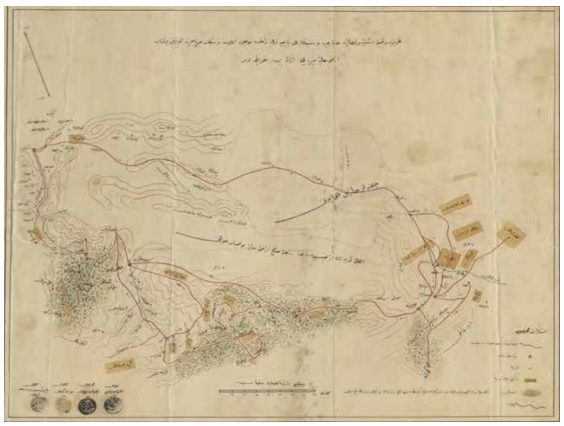

Figure 2: Resettlement areas on the south of Ankara (Y..PRK.KOM. 00008_00014_001, Document Date: H-20-05-1309; M: 1891/1892)

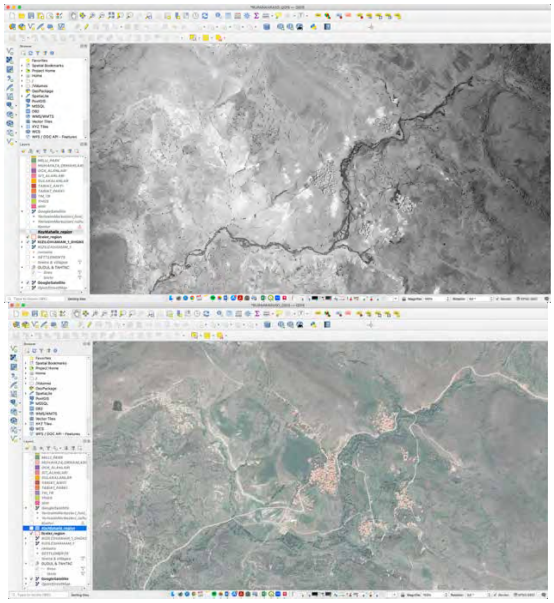

Figure 3: The overlap of 1972 orthophoto and current Google Maps image of the same area

2.2 Fields Surveys

Field surveys were carried out to identify and assess the natural and built environment, along with the socio-economic and cultural practices, social dynamics, and intangible relations shaping the rural areas. Additionally, the perspectives, expectations, and willingness of local stakeholders to engage in sustainable heritage management activities were explored.

This process involved systematic observations and analytical investigations of the physical environment, complemented by qualitative research methods—including structured and semi-structured in-depth interviews, guided walks, and focus group meetings—to understand and interpret the social environment.

Ethics approvals were obtained prior to fieldwork. All participants were fully informed about the study, and their voluntary participation was ensured through the signing of a Voluntary Participation Form during the field surveys (Figure 4).



Figure 4: Avşar, Kalecik (author, 2024)

2.3 Geographical Information System (GIS)

A great amount of data was collected through literature, archival, and field surveys. This data was systematically organized and integrated into QGIS Software. Geographical Information Systems (GIS) played a crucial role in this process by enabling the storage, analysis, and assessment of multi-scale and heterogenous data within a single platform. GIS also provided a flexible and continuously evolving environment that allowed for the gradual development of RURANKARA·GIS database, supporting the incorporation of new information over time.

The organized data was then classified and categorized according to two primary purposes: first, to analyse the values, problems and potentials of rural Ankara across different scales; and second, to establish a data-driven base for decision making processes aimed at sustainable heritage management.

3. RURANKARA·GIS as An Information and Decision-Support System for Sustainable Management of Ankara’s Rural Landscapes

RURANKARA·GIS database was developed for data collection, spatial analysis and assessment. It enabled a holistic understanding of Ankara’s rural landscapes, as well as assessment of social, cultural, economic, and environmental resources for sustainable heritage management.

3.1 Building the Database

The diverse and multi-layered data provided information on the natural context, transportation network, political and administrative structure, settlement history, architectural features, socio-economic and cultural practices, as well as their transformations and spatial correspondences. This comprehensive dataset enabled the holistic identification of Ankara’s rural landscapes from a historical perspective.

To utilize this data effectively for the purpose of assessment aimed at sustainable heritage management, it was necessary to systematically classify and evaluate it.

The analysis and assessment were conducted based on several key criteria: the presence, authenticity-integrity, continuity-relationality, and life-production-usage of each component of Ankara’s rural landscape. These criteria enabled the development of an assessment scale ranging from the most favourable to the least favourable conditions, which in turn facilitated the identification of character and risk areas.

In this structure, multi-layered data used for the holistic identification of Ankara’s rural landscapes formed the features classes and features of RURANKARA·GIS database (Figure 5), while the assessment scale based on predefined criteria constituted the attributes of the GIS system.

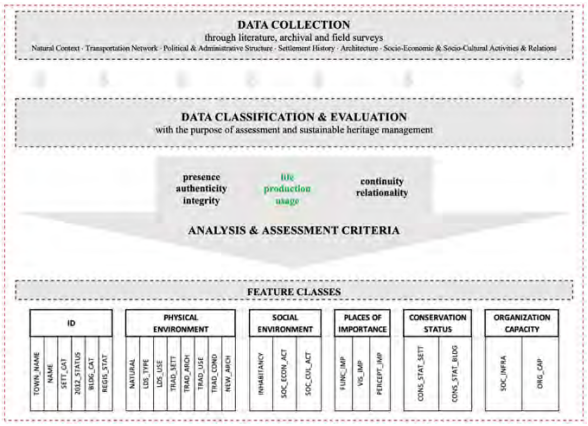

Figure 5: Mental Model of RURANKARA·GIS Database

3.2 Data Analysis and Assessment for Understanding Ankara’s Rural Landscapes

The comprehensive dataset gathered through previous studies was entered into QGIS, and data analysis was carried out across multiple scales.

The initial analyses were conducted at the territorial scale, focusing on the spatio-temporal development of Ankara’s rural landscapes. The development of settlement patterns from prehistoric times to the present within the rural territory of Ankara was mapped (Figure 6, Figure 7, Figure 8). Additionally, the variations in land use patterns, architectural characteristics, and socio-economic practices (Figure 9) were also analyzed and spatially represented.

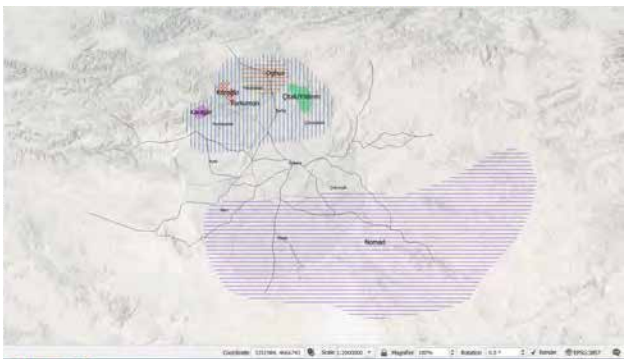
Figure 6: Settlement pattern of Ankara's rural landscape in the 15th century

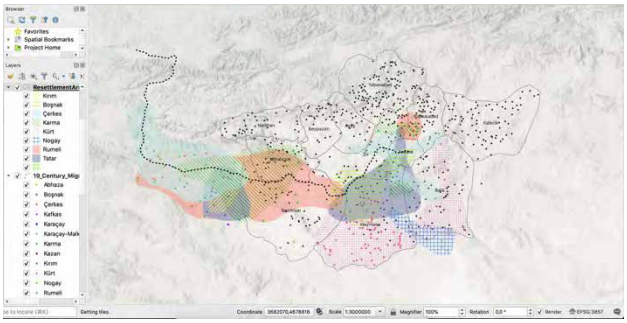
Figure 7: Resettlement of migrants to the south of Ankara at the end of the 19th century

This contribution has been peer-reviewed. The double-blind peer-review was conducted on the basis of the full paper.
https://doi.org/10.5194/isprs-annals-X-M-2-2025-21-2025 | © Author(s) 2025. CC BY 4.0 License.

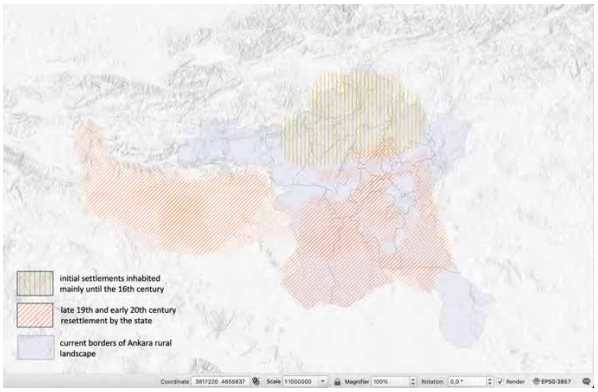

Figure 8: Spatio-Temporal Development of the Settlement Pattern

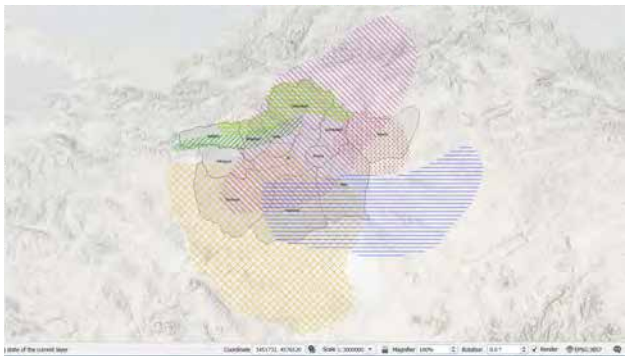
Figure 9: Local economic activities around the rural territory of Ankara

Through this process, the values and characteristic features of Ankara’s rural landscapes were identified and mapped at territorial scale. This information facilitated the categorization of data based on their potential contributions as social, cultural, economic, and environmental resources, serving as essential inputs for sustainable heritage management.

After identifying the resources contributing to sustainability, they were mapped (Figure 10). This mapping revealed areas within Ankara where the components of sustainable heritage management are present and most strongly intersect, as well as areas where components are absent. The spatial analysis thus highlights both the strenghts and weaknesses across the region and identifies the priority intervention areas and the resources available to support sustainable heritage management.

The Çamlıdere district (marked by a black outline on the map), one of the areas where resources overlap the most and which also carries risk at the regional scale, was selected for more detailed studies focused on sustainable development.

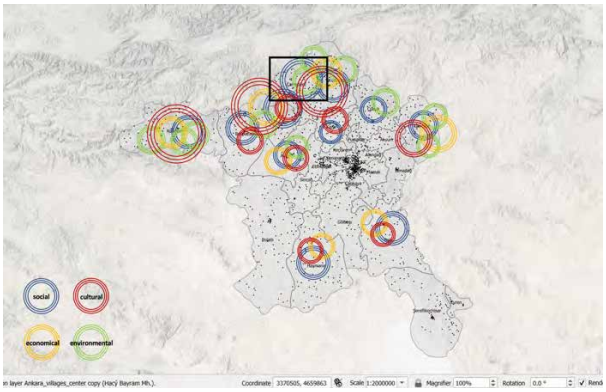

Figure 10: Resources for Sustainability at Territorial Scale

3.3 Assessment of Çamlıdere’s Rural Landscape for Sustainable Heritage Management

To carry out analyses at the town scale, the RURANKARA·GIS database was further refined for both analysis and assessment purposes. At this scale, the analysis continued to follow the predefined feature classess, and assessment were conducted based on the established criteria.

After structuring the attribute table of the RURANKARA·GIS database, data entries were initiated for each rural settlement (Figure 11).

Each rural settlement was initially represented as a point within the RURANKARA·GIS platform. To better visualize the spatial distribution of the various attributes associated with each settlement, points sharing similar characteristics were reinterpreted and redrawn as areas. This method clarified the intra-district distribution patterns and revealed spatial relationships, overlaps, and divergences between areas with different characteristics.

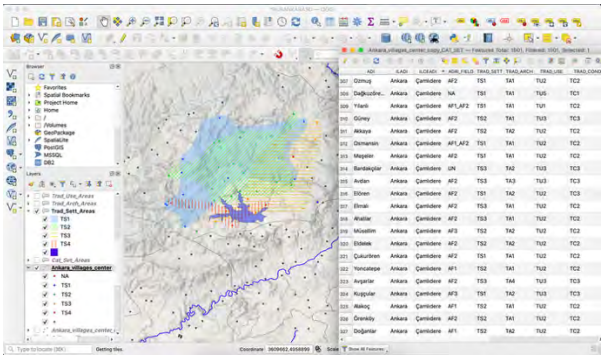
Figure 11: Data entry with the attribute table

A series of thematic maps were then prepared to analyse and assess the rural areas in Çamlıdere town (Figure 12).

Firstly, the different rural settlement categories mapped so that their spatial relations among each other can be visualized. Then, homogeneity of traditional settlements, authenticity and integrity of traditional settlements and architecture, the use and condition of traditional buildings, continuity of traditional socio-economic and cultural practices, as well as the density and harmony of the new buildings with the traditional fabric were analysed from the best condition to the worst.

This contribution has been peer-reviewed. The double-blind peer-review was conducted on the basis of the full paper.
https://doi.org/10.5194/isprs-annals-X-M-2-2025-21-2025 | © Author(s) 2025. CC BY 4.0 License.

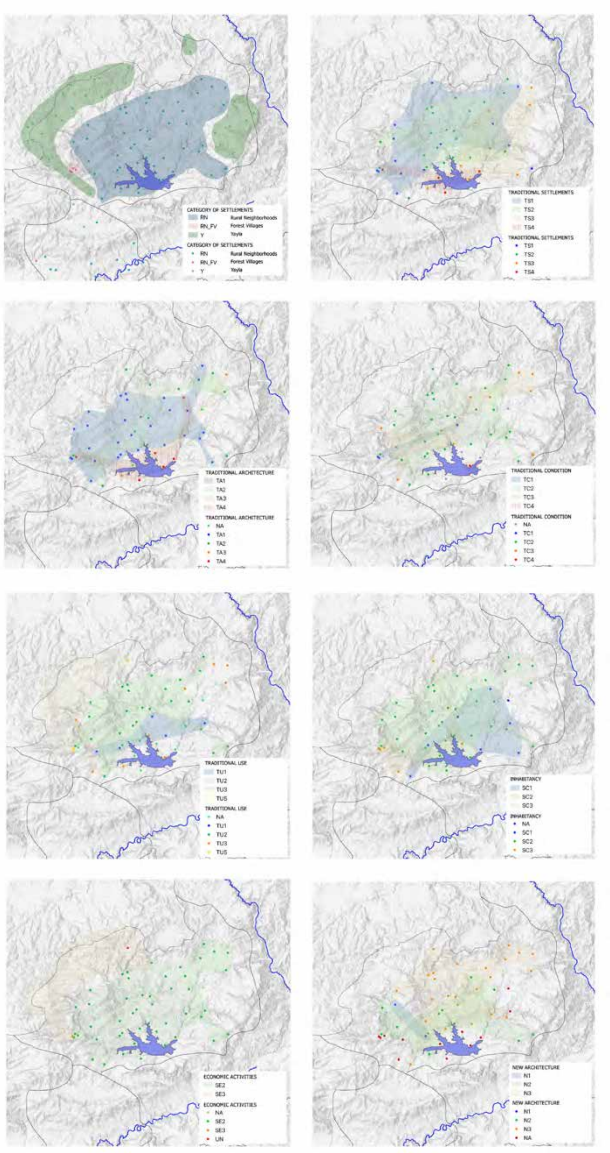

Figure 12: Data Analysis Maps

Rural areas in Çamlıdere town were then assessed based on the criteria of authenticity, integrity, continuity, and relationality. Areas where the traditional physical fabric, production practices, lifestyles, and spatial usage patterns are maintained, at risk, or completely lost were identified. This assessment revealed, through different layers, the living and abandoned areas, regions where production activities continue or have nearly ceased, and settlements that have either preserved or lost their character. It also concretely mapped the points where social, cultural, economic, and environmental resources are concentrated, overlap, or are lacking.

By overlapping these maps, character and risk areas at the town scale were identified, following the same approach applied at regional scale. Subsequently, the social, cultural, economic, and environmental resources that could contribute to sustainability were determined and mapped (Figure 13).

This spatial information highlighted the strong and weak areas within Çamlıdere town, providing a foundation for developing strategies and actions for sustainable heritage management. It offers a clear framework for identifying priority areas for intervention, leveraging social, cultural, economic, and environmental resources, and facilitating knowledge transfer from existing good practices.

This analyses distinguished strong areas that maintain their identity and originality from weaker areas where these qualities are deteriorating. Consequently, priority intervention zones for the local development of rural Ankara were determined, and key elements to be considered in these interventions were defined. Additionally, the documentation of traditional knowledge systems and local production practices provided a solid foundation for developing strategies centered on cultural sustainability.

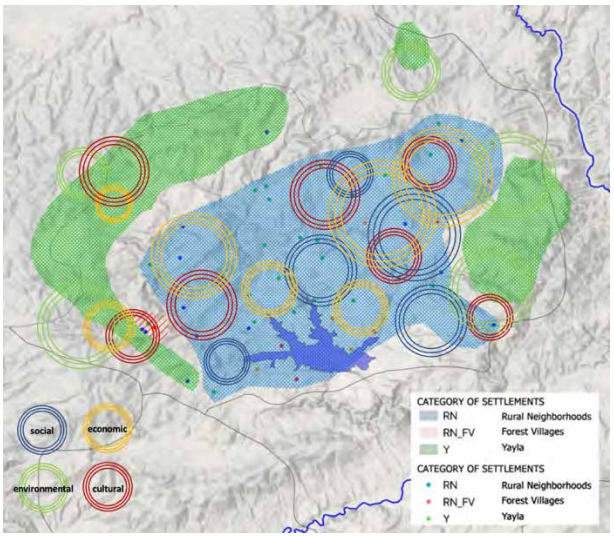

Figure 13: Resources for Sustainability at Town Scale

4. Results & Discussion

This multi-layered study was carried out through a systematic process of data collection, analysis, and assessment. The RURANKARA•GIS database, developed throughout the study, integrates diverse forms of visual and textual data from various disciplines, along with multi-scale and multi-detail information concerning rural Ankara. Throughout this process, QGIS played a critical role by consolidating heterogeneous data within a single platform and enabling a range of operations—from identification to spatio-temporal analysis and assessment—toward sustainable heritage management goals.

At the territorial scale, spatio-temporal analyses revealed the evolution of rural landscapes, the historical development of settlement patterns, and the changes in land use, socio-economic practices, and architectural characteristics. These analyses facilitated the identification of character areas where traditional features are well-preserved and risk areas where degradation or transformation processes are accelerating. Furthermore, the mapping of social, cultural, economic, and environmental resources across the region highlighted the spatial distribution of sustainability potentials and vulnerabilities.

The application of the system at the town scale, through a detailed study of the Çamlıdere district, demonstrated the flexibility and effectiveness of the developed approach. Thematic mapping and the classification of rural settlements enabled the visualization of traditional features, levels of authenticity and integrity, socio-economic continuity, and the degree of harmony between new developments and historical

fabric. By overlapping these layers, a nuanced understanding of character and risk areas was achieved, providing critical spatial intelligence for future interventions.

The use of GIS technologies in this research offered several advantages. GIS enabled the integration of multi-source and multi-disciplinary data into a unified spatial framework, facilitating holistic analyses that would be difficult to achieve otherwise. The ability to manage data dynamically, update information easily, and perform multi-scalar analyses enhanced the robustness of the study. Moreover, GIS provided powerful visualization tools, allowing the spatial distribution of heritage values, risks, and resources to be communicated clearly to both technical and non-technical audiences. This significantly strengthens the potential for informed decision-making and stakeholder engagement in heritage management processes.

However, the use of GIS in heritage studies also presents certain limitations. The quality and completeness of GIS analyses are heavily dependent on the availability, accuracy, and granularity of the input data, which can be especially challenging in rural contexts where archival and contemporary information may be fragmented or inconsistent. Additionally, while GIS excels in spatial representation, it can sometimes oversimplify the dynamic and intangible aspects of rural heritage, such as community knowledge systems, practices, and memories that do not always have direct spatial references. Therefore, while GIS serves as a powerful tool for supporting sustainable heritage management, it must be complemented by qualitative methods and participatory approaches to ensure a truly holistic understanding of rural landscapes.

Overall, the study demonstrated that holistic and multidimensional analyses of rural areas are vital for understanding the complex interplay of heritage values, risks, and sustainability potentials. The RURANKARA•GIS system enables evidence-based decision-making and strategic planning for the sustainable management of rural heritage landscapes, addressing both preservation needs and opportunities for revitalization and development.

5. Concluding Remarks

Rural heritage areas represent complex systems shaped by a multiscalar network of relationships, values, challenges, and a wide range of actors embedded within the landscape. Integrating and managing the diverse data required for their holistic identification, conservation, and sustainable development is inherently difficult. This research demonstrates how GIS technology can effectively address this challenge by consolidating and organizing varied data types within a single platform, enabling multi-dimensional analysis. For the first time, Ankara’s rural areas have been identified and evaluated in such a comprehensive manner. A key outcome of this study is the development of the RURANKARA•GIS database, which offers an integrated framework for understanding the rural landscape, assessing its values and issues, and supporting informed decision-making for future actions by multiple stakeholders.

The RURANKARA•GIS database is designed to serve a multi-actor structure by offering a comprehensive, dynamic, and updatable data infrastructure. The GIS-based decision-support system facilitates the integration and assessment of multi-scalar and multi-disciplinary data, making it accessible to a wide range of stakeholders. It is structured to support both researchers conducting academic studies and decision-makers developing policies. Researchers can access, update, and enrich the database with new findings, while experts from various disciplines can utilize its outputs to approach Ankara’s rural landscapes through an informed, holistic perspective.

For decision-makers, particularly local governments, development agencies, and relevant public institutions, the system offers a tangible and operational tool to guide policy development and implementation processes. It supports strategic planning for rural sustainability by identifying character areas, highlighting risk zones, and mapping critical social, cultural, economic, and environmental resources. The system thereby facilitates data-driven, evidence-based approaches in heritage management, local development initiatives, and resource allocation.

Ultimately, the RURANKARA•GIS database advances the field of sustainable rural heritage management by providing a transparent, participatory, and adaptable model. It demonstrates that rural landscapes, often overlooked in conservation and policy frameworks, can be systematically studied, assessed, and integrated into broader sustainable development strategies. By bridging research, practice, and policy, the RURANKARASD project offers a replicable methodology that can inform heritage-based rural development both within Ankara and beyond.

Acknowledgements

This publication is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement Nº 801509 TÜBİTAK Co-Funded Brain Circulation Scheme 2, Project No: 121C166.

References

Antrop, M. (2005). Why landscapes of the past are important for the future. Landscape and Urban Planning.

Ardissone, P., Rinaudo, F. (2005). A GIS for the Management of Historical and Archaeological Data. Proceedings of 20th CIPA international Symposium, 26 September-01 October 2005, Turin, Italy.

Bilgin Altınöz et al. (2023). Utilising GIS for Documentation, Conservation, and Sustainable Management of Middle East Technical University Campus in Ankara as a Modern Period Living Heritage Place. Proceedings of 29th CIPA international Symposium “Documenting, Understanding, Preserving Cultural Heritage: Humanities and Digital Technologies for Shaping the Future”, 25–30 June 2023, Florence, Italy.

Council of Europe (2000) The European Landscape Convention (ELC), Florence.

Denyer, S. (2011) Retrospective statements of OUV for World Heritage properties: Authenticity & integrity. In workshop for the 2nd cycle of worl d heritage periodic reporting for western europe, prague.

Feilden, B. M., & Jokilehto, J. (1998). Management Guidelines for World Cultural Heritage Sites.

Halfacree, K. (2005) Rural Space: Constructing a Three-Fold Architecture. In Cloke, P.J., Marsden, T., Mooney, P.H. (eds.). Handbook for Rural Studies, SAGE, London.

Harrison, R. (2015) Beyond “natural” and “cultural” heritage: toward an ontological politics of heritage in the age of Anthropocene, Heritage & Society, vol. 8, no. 1, pp. 24-42.

Icomos (2011) The Paris Declaration on Heritage as a Driver of Development, Paris.

Şahin Güçhan, N. (2017) (ed.) Kommagene Nemrut Yönetim Planı, Pozitif Matbaa.

Taylor, K., Clair, A., & Mitchell, N. J. (2014). Introduction: cultural landscapes: Twenty-first century conservation opportunities and challenges. Conserving Cultural Landscapes, 1-25.

Unesco (2013) The Hangzhou Declaration: Placing Culture at the at the Heart of Sustainable Development Policies, http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CLT/images/FinalHangzhouDeclaration20130517.pdf

United Nations (2015) Transforming Our World: The 2030 Agenda for Sustainable Development, General Assembly on 25 September 2015, A/70/L.1, https://sdgs.un.org/2030agenda.

Unesco World Heritage Centre, (2023) The Operational Guidelines for the Implementation of the World Heritage Convention, Paris.