Archeologia e Calcolatori
36.2, 2025, 141-146
doi 10.19282/ac.36.2.2025.12

THE IN.RES.AGRI FINAL CONFERENCE. FROM PROJECT RESULTS TO FUTURE STEPS

This section brings together the papers from *An integrated and open IT approach for archaeological topography of centuriation. Final conference of the PRIN 2022 project In.Res.Agri* (Naples, 20th-21st November 2025), organised within the project 'Investigating Resilient Roman Agricultural Landscapes in Southern Italy' (In.Res.Agri). Funded by the Italian Government (PRIN 2022, project code 2022SMJCHX), the project examines the long-term persistence and discontinuities of Roman rural topography in order to understand how its components have endured over centuries within the contemporary landscapes of southern Italy. The rational organisation of space – above all through land reclamation intended to improve agricultural yields – is likely a principal reason for the survival of centuriated layouts; yet this is not the only factor, especially in areas that have retained a predominantly rural vocation, such as *Apulia*, or undergone intense urbanisation, such as the suburbs of Naples. The Archaeological Mapping Lab of the University of Naples, together with the laboratories of the Institute of Heritage Science at the National Research Council (CNR-ISPC) and of the University of Salento, advances a holistic approach that integrates topographical, archaeological, environmental and textual data. The resilience of Roman agrarian landscapes is investigated across multiple dimensions, including centuriation, route networks and settlement systems (Castagnoli 1958; Settis 1993). The project has focused – and will continue to focus – on the systematic collection of legacy (topographical, archaeological and textual) data and new field evidence in selected case-study areas of southern Italy, in the Campanian Plain, Irpinia and *Apulia* (Brancato *et al.* 2024, fig. 1).

The conference provided an opportunity to bring the project's research units into dialogue, to report on the results of the planned activities, and to share reflections on methods, documentation workflows and data management, as well as on the interpretation of the evidence integrated into our analyses. These open-access proceedings present the key outputs of the In.Res.Agri project as to November 2025. At the same time, the conference allowed to outline future steps particularly with regard to data integration, methodological innovation and future applications of the digital platform of the project (Brancato *et al.* 2024, fig. 6).

The three topographic case studies considered in the In.Res.Agri project were selected on the basis of the characteristics of the territories of southern Italy, namely Campania and Puglia: (1) evidence for centuriation emerging from previous archaeological research; (2) textual, topographical and – where

available – stratigraphic documentation; (3) environmental data from ongoing projects and investigations; (4) representativeness of different environments in southern Italy in relation to centuriation and its transformations over time. The researches accordingly range from field investigations to archival research and to the integration of archaeo-topographical data within GIS for the diachronic reconstruction of the morphostratigraphy of agrarian landscapes. Their shared objective is the historical reconstruction of these landscapes and a clearer understanding of the cultural, political and technical logics that shaped them. Ancient topography, as an archaeological discipline, is not confined to the *disiecta membra* of the past revealed by digital tools, yesterday GIS and remote sensing, today machine learning and artificial intelligence. Rather, it interrogates the technologies, the ancient technical competences and cartographic knowledge that enabled the planning and organisation of space in both urban and rural contexts (Brancato 2025). In this perspective, the archaeological map is conceived as a dynamic and complex information system, crucial not only for answering questions on 'resilient' landscapes but also for their valorisation, protection and informed planning.

Within this framework, In.Res.Agri aims to refine our understanding of the resilience of Roman agrarian landscapes in southern Italy, beginning with a renewed reading of *limitatio*. As widely discussed by historians and archaeologists, *limitatio* should not be reduced to centuriation alone but understood as a broad repertoire of practices for orienting, measuring and managing land in relation to geomorphology, infrastructures and agricultural uses over the long term. The rational management of space, particularly the reclamation of 'difficult' areas such as alluvial plains and their conversion to cultivation, is probably a principal reason why the morphology of Roman *limitatio* has survived within the contemporary landscape (cf. Quilici Gigli 2025). This holds both for deeply urbanised areas, such as the Campanian Plain, now partly encompassed within the wider metropolitan area of Naples, as well as for contexts that retain a strong rural vocation, such as Irpinia.

Methodologically, the project aims to optimise knowledge through an integrated, interdisciplinary approach combining topographical, archaeological, environmental and textual sources. In this framework, *limitatio*, articulated into centuriation, the route network and settlement systems, is adopted as a key interpretative lens for investigating long-term landscape dynamics. Since the pioneering work of Ferdinando Castagnoli (1958), interest in the forms of centuriation has grown significantly (Muzzioli 2009). In the 1980s, in Italy and France, techniques were developed for identifying regular orientations and modules referable to the Roman *actus*. It has, however, become increasingly clear that morphology alone is insufficient to distinguish ancient traces with certainty from modern or contemporary agrarian layouts. The project therefore moves beyond an exclusively topographical reading in favour of

an integrated, critical and multi-scalar analysis of landscapes. In light of this, In.Res.Agri is structured around four objectives:

1. To define an operational model for understanding Roman *limitatio* practices, through a detailed and integrated analysis of topographical, geomatic, archaeological, environmental, iconographic and textual data within a specific geographical corridor (Campania-*Hirpinia-Apulia*) and a coherent Roman-period framework.
2. To interpret diachronically the transformations of the landscape linked to agrarian rationalisation, considering how geomorphology, pre-existing road networks and reclamation works have contributed, and will continue to contribute, to making *limitatio* a highly resilient feature; archaeological maps produced in recent decades constitute a crucial evidentiary layer for relating centuriation to other structuring elements, such as the road system.
3. To experiment with hybrid methodologies integrating traditional field survey with advanced processing and dissemination workflows, including the staged deployment of machine-learning techniques for the semi-automatic detection of agrarian grids.
4. To contribute to Open Science by releasing datasets and documentation as soon as they are produced and by fostering transparency in analysis, interpretation and dissemination.

From this perspective, the project's approach can be described as an instance of 'open digital archaeogeography' (Moscati 2017), in which the integration between archaeology and geography is developed on a shared computational basis. The methodological advances also lay the groundwork for the project's future development, especially in enhancing automation, improving analytical resolution and expanding the comparative potential across wider areas of southern Italy.

For each case study the project verifies techniques adopted in previous research by consulting the photographic archives of the participating research units (Archaeological Mapping Lab, CNR-ISPC; Laboratory of Ancient Topography and Photogrammetry, University of Salento; Archaeological Mapping Digital Laboratory, DSU-University of Naples Federico II) and by acquiring additional historical and recent aerial photographs (e.g., from the Aerofototeca Nazionale, Rome). For each study area, remotely sensed imagery has been processed and georeferenced to identify axes of ancient agrarian division; each dataset has also been enriched through the systematic review of high-resolution optical satellite imagery (e.g., WorldView-3/4), orthorectified and processed for the detection of archaeological traces. Where coverage was incomplete or required further investigation, UAV (drone) survey has been undertaken, as planned, to acquire detailed imagery and produce high-resolution

digital terrain models (DTMs). As noted above, aerial and satellite imagery has also been employed in machine-learning experiments.

The increasing volume of datasets requires innovative analytical methods, such as Object-Based Image Analysis (OBIA), an AI-based framework that reduces interpretative ambiguity. In archaeological contexts, this technique operates across multiple scales – from the landscape to the individual artefact – via automatic image classification. It enables image segmentation into objects (grouping pixels with similar characteristics) and their rule-based classification, making explicit geometric, spectral, spatial and relational properties; identified objects are then assigned to categories on the basis of form, colour, texture and position. Finally, the remote-sensing outputs have been ground-truthed through surface survey and aerial reconnaissance, using sample checks in areas where detected traces appear consistent with an ancient agrarian grid.

To support the systematic collection, integration, querying and publication of the project's data, a digital platform, called Digital Groma, was developed. Its design was based on the FAIR principles, primarily aiming at interoperability with larger Italian initiatives, such as the ICCD's National Catalogue and the Geoportale Nazionale per l'Archeologia, but also at making the data freely available to reuse for the wider scientific community via an API endpoint. All research units have actively adhered to Open Science, by consciously adopting, wherever feasible, non-proprietary software and by committing to publishing the data produced during the project as open data, including a curated bibliographical dataset maintained and published via Zotero. By the end of the project, geodata and bibliography in LOD formats will be accessible from the Digital Groma platform and other websites related to the project (https://digitalgroma.cnr.it/; https://archeomaplab.it/progetti/progetto-in-res-agri-prin-2022/), also providing links to the project's open-access reports and publications.

Ultimately, advancing a diachronic understanding of how agrarian landscapes have been transformed is central to contemporary debates on territorial management. While each area retains its specific agricultural history, recurring patterns help to explain how human action has shaped the natural environment and how rural landscapes have changed, disappeared or evolved over millennia. The endurance of Roman centuriation for more than two thousand years, unlike other systems of land division, attests to a holistic and strikingly modern enterprise that anticipated today's notions of sustainable territorial design and stewardship. Building on the methodologies deployed in In.Res.Agri – from archival 'excavation' to remote sensing, OBIA/ML and on-the-ground verification – the initiative will deliver an integrated, interoperable and reusable knowledge base for a wide area of southern Italy, reducing data fragmentation across separate archives and improving research quality, while enabling wider reuse for scholarship, teaching and informed public planning.

These outcomes represent not an endpoint but the foundation for subsequent phases of research, ensuring that In.Res.Agri will continue to evolve through expanded datasets, enhanced analytical tools and deeper engagement with territorial planning.

The section starts with contributions devoted to the archaeological research carried through the integrated use of non-invasive methods application (i.e. geophysics and field survey) and digital application on remotely sensed data. The results are presented by the CNR-ISPC research unit's members: Immacolata Ditaranto and Vincenzo Giordano report on work in Eastern Irpinia, while Pasquale Merola and Francesca Di Palma examine methods of machine learning applied to the study of agrarian divisions with selected case studies from Campania. The conference proceedings bring together contributions focusing on the Campanian Plain, with particular attention to the territories of *Atella* (Brancato *et. al.*), one of the In.Res.Agri case studies, Acerra (Di Franco), and Nola (De Simone *et al.*), as well as on Southern Etruria (Fiorillo), which offers a coherent comparative framework for understanding the connections between rural landscapes and settlement systems through an integrated approach combining geoarchaeology, digital topography, and remote-sensing analysis. Within this broader context, a further comparative insight is provided by the ASH Project, whose research on the archaeology of rural landscapes across the Italian peninsula and Sicily (Pacciarelli *et al.*) investigates the relationship between volcanic soils and agricultural practices. All the papers adopt a multidisciplinary and diachronic perspective, spanning from Prehistory (Boenzi) to Late Antiquity (Tescione), with the relationship between the natural environment and human communities as a central focus (Tosolini *et al.*). The final contribution by Buono *et al.* presents the core of the IT platform, consisting of a database module able to bring to light and combine relations among diverse bodies of evidence, comprising textual and bibliographical data.

Rodolfo Brancato
Dipartimento di Studi Umanistici
Università degli Studi di Napoli Federico II
rodolfo.brancato@unina.it

Veronica Ferrari
Dipartimento di Beni Culturali
Università del Salento
veronica.ferrari@unisalento.it

Irene Rossi
Istituto di Scienze del Patrimonio Culturale - CNR
irene.rossi@cnr.it

Acknowledgements

The project 'In.Res.Agri – Investigating Resilient Roman Agricultural Landscapes in Southern Italy. An Integrated and Open IT Approach to Modelling Centuriation through Archaeology, Remotely Sensed Data, Palynology and Ancient Texts' was funded by the European Union – NextGenerationEU – Piano Nazionale di Ripresa e Resilienza (PNRR) – Missione 4 'Istruzione e Ricerca' – Componente C2 – Investimento 1.1, 'Fondo per il Programma Nazionale di Ricerca e Progetti di Rilevante Interesse Nazionale' (PRIN) – Project Code: 2022SMJCHX, CUP: B53D23001910006. Participants and collaborators: Università di Napoli Federico II (Rodolfo Brancato, PI; Marco Pacciarelli; Elda Russo Ermolli; Teresa Tescione; Antonino Bottone; Giuseppe Luongo; Marta Tosolini); Consiglio Nazionale delle Ricerche – Istituto di Scienze del Patrimonio Culturale (Irene Rossi, RU leader; Giulia Buono; Alessandra Caravale; Immacolata Ditaranto; Francesca Di Palma; Vincenzo Giordano; Pasquale Merola; Paola Moscati); Università del Salento (Veronica Ferrari, RU leader; Adriana Valchera).

REFERENCES

Brancato R. 2025, *The rural landscape from the Republic to the Empire*, «Dialogues d'histoire ancienne», 51, 1, 272-313 (https://shs.cairn.info/journal-dialogues-dhistoire-ancienne-2025-1-page-255?lang=en).

Brancato R., Ferrari V., Ditaranto I., Merola P., Rossi I. 2024, *Investigating resilient Roman agricultural landscapes in southern Italy. An integrated and open IT approach to modeling centuriation*, in R. Brancato, J. Bogdani, V. Vitale (eds.), *Linking Pasts and Sharing Knowledge. Mapping Archaeological Heritage, Legacy Data Integration and Web Technologies for Modelling Historical Landscapes (Naples, 13th-14th November 2023)*, «Archeologia e Calcolatori», 35.2, 387-400 (https://doi.org/10.19282/ac.35.2.2024.41).

Castagnoli F. 1958, *Le ricerche sui resti della centuriazione*, Roma, Edizioni di Storia e Letteratura.

Moscati P. 2017, *Archaeological computing and ancient cities: Insights from the repository of Archeologia e Calcolatori*, «Archeologia e Calcolatori», 28.2, 47-66 (https://doi.org/10.19282/AC.28.2.2017.03).

Muzzioli M.P. 2009, *Le ricerche sui resti della centuriazione cinquant'anni dopo*, «Atlante Tematico di Topografia Antica», 19, 7-50.

Quilici Gigli S. 2025, *Il difficile ordine dell'ager Campanus*, «Atlante Tematico di Topografia Antica», 35, 291-310.

Settis S. (ed.) 1993, *Misurare la terra: centuriazione e coloni nel mondo romano*, Pisa, Panini.