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Archaeological data and reliability criteria. A GIS measurement proposal for the study of the Mignone Valley.

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***Abstract* – The contribution focusing on a solution developed in a GIS environment for the definition of "reliability criteria" for archaeological evidence information from historical sources, ancient cartography, published studies, excavations, and surface surveys. The PhD research conducted in the context of the Marta and Mignone Valleys, aimed to reconstructing the forms of peopling and development of the geographical area between the fall of the empire and the alum's rediscovery highlighted the criticalities inherent in archaeological information that was not entirely reliable because it came from previous studies or confused mentions, sometimes not totally sufficient to constitute a solid data base on which to anchor the final reflections. The simple solution identified by exploiting the attribute tables linked to each vector could be a useful tool for the critical evaluation of the input data exploited for the GIS analysis on an archaeological landscape.**

I. INTRODUCTION

The contribution proposed here is the result of a PhD research in Post-classical Archaeology conducted at the Sapienza University of Rome on the upper Latium territory between the valleys of the Marta and Mignone rivers, aimed to reconstruct the settlement dynamics in this coastal area between the 4th and 15th centuries AD. The investigation, conducted according to the methodologies usually used to Landscape Archaeology, involved a substantial phase of collecting archaeological data, typologically diversified, from historical, cartographic, archaeological, and bibliographical sources, sometimes the result of recent investigations, but often coming from more dated research conducted before the use of GPS and in the absence of more systematic research. The management of this mass of data required the creation of a GIS system not only for the usual archiving information, but also for the creation of a functional vector base for more specific territorial analyses. From the outset, the risk of basing the final reflection on archaeological scenarios consisting of data that were not completely certain was understood. Numerous indications of the presence of human settlements were considered in our work, even though some of these were based on data so vague as to make their total consideration difficult. Regardless of the origin of the information surveyed, all the data collected presented criticalities either on the topographical or chronological level. Numerous in fact, were the dates provided only based on a quick autopsy examination of sporadic fragments of pottery or the cases of the mention of settlements with only a vague topographical indication. Despite the variable level of uncertainty, every piece of information found was included in the GIS dataset, as it was felt that even the most uncertain piece of information could take on importance if observed in the more general framework. The solution adopted to avoid is to consider with the same "weight" all the information collected in the final reflection, re-proposed a long-standing archaeological problem related to the difficulty of classifying and enclosing the multiform archaeological reality within well-defined tables and numerical codes. In a completely 'fuzzy' working logic [1], wishing to avoid flattening the indeterminateness inherent in archaeological data, an objective criterion was identified to measure and classify the degree of reliability, both topographical and chronological, of the known information on each archaeological context surveyed within the scope of the work [2].

II. THEORY AND METHODS

The valleys lapped by the Marta and Mignone rivers have always been the subject of lively studies on the area. The numerous historical events that have affected the entire region under investigation have led to a conspicuous study and research activity on the area, resulting in numerous contributions. Many of these have dealt in detail with the varied human presence in the area, focusing on the careful analysis of its conspicuous

material remains. However, these studies have focused on specific evidence, such as the road system [3], religious settlements [4], and demic centres [5], or have limited the analysis to a specific chronological phase, such as the Etruscan period [6], the Roman period [7] or the medieval period [8]. Even in cases where the settlement logic has been investigated in a diachronic sense, data and information have been concentrated on single sites or territorial districts of however small dimensions. This activity has undoubtedly led to an advancement of research in this field, although also considering archaeological evidence of dubious provenance. We have noticed how even the most serious and accurate territorial studies have been based on data whose reliability of the information reported has not been objectively declared, thus using vast masses of data that in part suffer from a lack of topographical or chronological precision due to the necessary consideration of all known information on the context under investigation. This criticality, although inherent in archaeological research, still seems to be an issue that is as much debated as it is unresolved, at least in the academic sphere. The most effective solutions, in fact, come from preventive archaeology through the development of GIS solutions for the creation of objective systems based on scales of mathematical values that are useful in the process of choosing which data to use and/or discard when drawing up archaeological risk maps [9]. Such an analysis, being aimed at a realistic territorial reconstruction in the various historical periods in which to make the relative subsistence forecasts, requires an accurate recording of the archaeological data within the broader panorama of ancient and modern sources that offer information about the type of archaeological presence found in the project area (see also the effort to "normalise" the archaeological data implemented for the National Archaeology Geoportal, in [10]. As in the case of preventive investigations, so in the census data aimed at a plausible reconstruction of the territorial and settlement development in the Marta and Mignone Valleys, the problem was how to make the 'choices', which had to be made outside of personal logics or those linked to specific chronological sensitivities. Considering the poor amount of known data for the area under investigation, it was deemed fruitless to 'discard' upstream the less verified data, choosing instead the identification of an objective criterion based on a scale of mathematical values that would allow each piece of data to be considered within the overall assessment for its reliability value. It was considered important that each piece of data regarded, could be "re-assessed" by the readers to make the elements of deductive reflection demonstrable and the criticalities inherent in each piece of data known. For a territorial-based work such as the one carried out in this upper Lazio context, several elements may be noteworthy in assessing the quality of a piece of data (chronology, topography, provenance, geographical context, etc.), but the dating attributed to the find by the source and the location reported seemed to us to be the most diriment elements within a study that attempted to delineate the change of a territory mainly on the basis of 'where' and 'when' each settlement was born or moved. The data collected was also exploited for the realisation of a reconstructive proposal of ancient land use, as well as to understand the extent to which the mining basins in the area influenced the locational choices made in the territory [2]. The method applied to make the level of reliability of the topographical and chronological information of each datum objectively assessable involved the insertion of two specific numeric fields, one for the level of chronological reliability and another for that of topographical reliability, already in the attributes table of the 'site' shapefile (Table 1).

Table 1. Parameters for attributing topographical and chronological reliability values.

Values	Topographical reliability	Chronological reliability
0	Information about a highly generic positioning.	nformation about an attribution to macro-periods (e.g., the medieval age).
1	Documented information indicating toponymic coincidence with a place or building still existing, but of uncertain topographical coincidence.	Information of materials within closer chronological ranges (e.g., early medieval age).
2	Information from archaeological reconnaissance before the use of GPS.	Information from surveys or archaeological investigations dated by means of comparisons.
3	Information from archaeological reconnaissance or investigations carried out with modern topographic tools	Materials from reconnaissance or archaeological investigations dated by radiocarbon analysis or from documentary sources written in a specific year

Each piece of information has been associated with a value from 0 to 3, where in the case of chronological reliability the value 0 indicates data for which there is only a generic chronological attribution expressed in terms of macro-chronologies (e.g. Roman age, medieval age, etc.), while the value 3 has been associated with all those pieces of information about archaeological

evidence from systematic investigations which, following the well-known stratigraphic method, have allowed a more specific chronological attribution. In the case of topographic reliability, on the other hand, the value 0 was associated with all those pieces of information with a very generic positioning. This category, for example, included all mentions of settlements or sporadic archaeological discoveries having as their only topographical references districts, roads, and elements of the territory definable not with specific points but with wide-ranging buffer areas. Value 3, on the contrary, was assigned to archaeological evidence recorded with modern topographical instruments (GPS, RTK, Total Station, etc.) and therefore having such precise positioning that it can be defined with a pair of coordinates (Table 2). The value resulting from the sum of the chronological reliability with that of the topographical reliability gave a numerical series of values between 1 and 6 representing the degree of importance with which to consider each datum within the analyses for final consideration, bearing in mind that 1 represents the minimum reliability value and 6 the maximum value.

Table 2. Table of total reliability parameters for input data.

Values	Corresponding data types for each value
1	Near-zero degree of reliability > cannot be considered within the final analysis sample.
2	Low degree of reliability > partially considered within the final analysis sample.
3	Discrete degree of reliability > can be considered within the final analysis sample with large chronological and topographical buffers.
4	Degree of reliability good > can be considered within the final analysis sample with tight chronological and topographical buffers.
5	Degree of reliability very good > can be considered within the final analysis sample with verified dates and placements.
6	Excellent degree of reliability > considered within the analysis sample with chemical dating and topographic positioning deduced with topographic tools.

III. RESULTS

The first result obtained thanks to the use of a mathematical classification of the topographical and chronological reliability of each piece of data considered in the census, made it possible to have a first Archaeological Map of the territory between the Marta and Mignone Valleys of the settlements existing between the 6th and 15th centuries A.D. (Fig. 1).

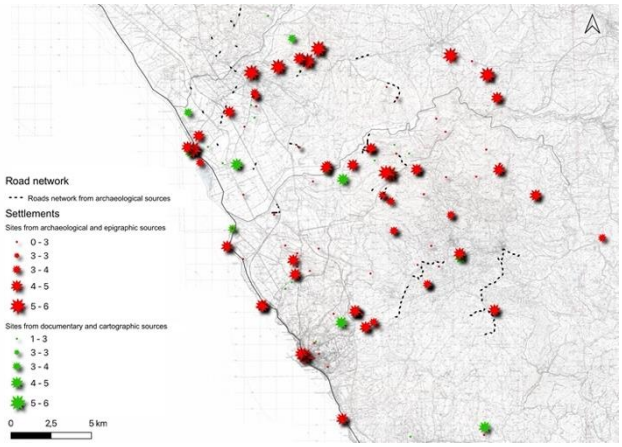

Fig. 1. Map showing input data based on the level of reliability obtained.

From the graph representing the percentages of reliability, it is evident that only 3% of the total input data considered for the GIS analyses have a very low reliability, coming from smoky or totally silent information on the topographical or chronological profile, while the majority of the data, equal to 26% of the total data considered (143), present an intermediate reliability value of 3, in 25% of the cases equal to 5 and in 16% equal to 6, the highest level of reliability calculated (Fig. 2).

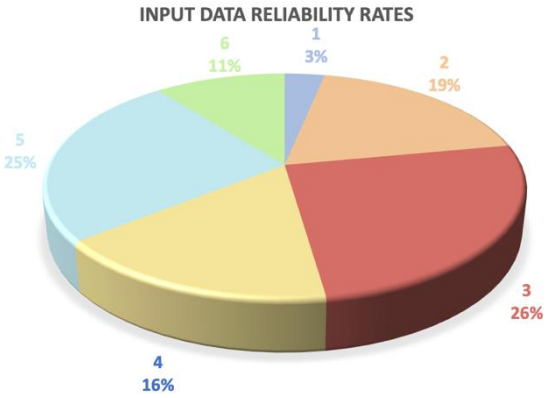

Fig. 1. Graph illustrating the percentages of sites in relation to the total reliability value.

The deduced values made it possible to extrapolate from the total number of surveyed contexts only the most certain settlements, all attestations between 3 and 6, which were used as input data for specific analyses. In fact, the study conducted focused on understanding the economic-political and social reasons that may have underpinned the settlement dynamics in which the

investigated area was articulated between the 6th and 15th centuries AD. This reading was carried out using two different tools, namely the use of ancient soils and the exploitation of mineral resources. We have assumed, in fact, that both elements played a prominent role from the pre-Roman era onwards in this territory, as pivots within a larger and more complex economic system [11]. In view of this, both elements were considered plausible 'keys' for an overall understanding of the anthropized territory. In this way, it was possible to draw circumstantial maps of the use of ancient soils, relying on the greater level of reliability of the input data, and likewise to verify how much the mining factor also played a certain role in the choice of settlement sites [2].

IV. CONCLUSION

The land-use pattern observed with the reconstructive proposal deduced from the input data to map the existing land uses between the 8th and 18th centuries showed how in this area the change understood in political-social and climatic terms also influenced land use [12]. The landscape examined, which has always been sparsely urbanized, at first glance seemed to have undergone little or no change. However, a closer reading of the archaeological indicators with the highest levels of reliability deduced showed how the entire valley was affected by moments of transformation. The lengthy analysis of soil exploitation has shown that if its use in agricultural terms should not have conditioned settlement choices, mineral deposits and particular eco pedological conditions may, on the contrary, have contributed to the continued presence of some settlements over others. A type of exploitation that must be contextualized in the context of a local production where the use of the resources offered by a given environment is employed to satisfy self-consumption and not for more structured commercial forms such as the later alluniferous activity. Therefore, in the medieval view of a productive self-sufficiency intended to satisfy the primary needs of medium-sized human groups, these kinds of peculiarities were certainly considered. The distribution of the population and the settlement forms that developed in this region between the 6th and 15th centuries depended, to a greater or lesser extent, on a combination of multiple factors that conditioned each other. Assigning a specific level of reliability to the findings that can be traced back to the presence of a quarry and a mine has made it possible to understand how this type of natural resource, too, played an important role in the dynamics of settlement in this territory well before the 'rediscovery' of alum, even in the absence of specific methodologies functional to the investigation of quarry signs in the Middle Ages.

REFERENCES

[1] F. Nicolucci – S. Hermon, “La logica Fuzzy e le sue applicazioni alla ricerca archeologica”, on Archeologia e Calcolatori, No.14, 2003, pp. 97-110.

[2] F. Vacatello, “Una terra protesa verso il mare. L’analisi territoriale dell’area tra Civitavecchia e Tarquinia (Lazio) tra VI e XV secolo”, on PaST. Strumenti E temi di Archeologia,No.13, 2023, in print.

[3] F. Vallelonga, S. Del Ferro, L. De Lellis, “La via Aurelia e la viabilità minore tra Roma e Civitavecchia nel Medioevo, on “Entre la terre et la mer. La via Aurelia et la topografie du litoral du Latium et de la Toscane”, International Colloquium, Juin 2014, 2018, pp. 131-171.

[4] V. Fiocchi Nicolai, “Scavi e scoperte di archeologia cristiana nel Lazio dal 1983 al 1993: dieci anni di archeologia cristiana in Italia”, on Atti del VII Congresso Nazionale di Archeologia Cristiana, September 1993, 2003, pp. 309-310.

[5] C. Corsi, “Tra Tuscia e Maremma: territorio, insediamento e comunicazioni nell’Alto Lazio in età Longobarda”, on Una terra di mezzo. I Longobardi e la nascita della Toscana, C. Valdambrini (ed.), Grosseto, 2022, pp. 63-76.

[6] L. Pulcinelli, “Le fortificazioni di confine: organizzazione del territorio tarquiniese al tempo della conquista romana”, on Aristonothos, “Il ruolo degli oppida e la difesa del territorio in Etruria: casi studio e prospettive di ricerca”, F. Cambi (ed.), No.5, 2012, pp. 69-120.

[7] G. Gazzetti, A. Zifferero, “Progetto Monti della Tolfa – Valle del Mignone: secondo rapporto di attività. (1985-1989)”, On Archeologia Medievale, No.17, 1990, pp. 435-440.

[8] G. Maggiore, “Medioevo altolaziale: la valle del Marta”, on PaST. Strumenti E temi di Archeologia, No.11, 2022.

[9] D. Calaon, C. Pizzinato, “L’analisi archeologica nei processi di valutazione ambientale. Proposta metodologica in ambiente GIS”, on Archeologia e Calcolatori, No.22, 2011, pp. 413-439.

[10] V. Acconcia, V. Boi, A. Falcone, “Il ruolo dell’Istituto Centrale per l’Archeologia (ICA) e del Servizio II della DG-ABAP nel supporto e coordinamento delle attività di scavo sul territorio nazionale: la normalizzazione del flusso procedimentale”, on Bollettino dell’Archeologia On Line, X, 2019, pp. 219-237.

[11] L. Dallai, G. Bianchi, F.R. Stasolla, “I paesaggi dell’allume. Archeologia della produzione ed economia di rete”, On Archeologia Medievale, No.29, 2020.

[12] F. Vacatello, G. Previti, “Dalla terra alla cucina! Un’indagine multidisciplinare sull’uso dei suoli antichi nel territorio di Cencelle (VT) tra X e XVI secolo d.C., on Spolia Journal of Medieval Studies, XIX, No.10, 2023, in print.