THE VALOURISATION AND PARTICIPATORY MANAGEMENT OF WATER LANDSCAPES:

The project 'Tourist itineraries to discover the waters of Italy' (Rieti, Lazio Region, Italy)[1]

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ABSTRACT: The project 'Tourist itineraries to discover the waters of Italy.' designed and promoted by the Interuniversity Research Group Association GECOAGRI-LANDITALY, brings together scholars from diverse disciplinary backgrounds based on the belief that the water resource must be interpreted in its various components, functions, and potential. The project is characterised by three core features: immersion, inclusion and implementation of content. The continuous collaboration among scholars, local institutions and stakeholders has led to the development of an innovative research methodology and tools for enhancing the tourism experience. The result not only provides tourists with access to fascinating yet lesser-known sites but also empowers local operators to rediscover, enhance, and promote their territory and economic activities.

KEYWORDS: water itineraries, slow tourism, participatory water management, Lazio region

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1. Introduction: The strategic role of open access resources and applications for risk assessment, monitoring and water resource exploitation

Water is a strategic resource and central theme in the international debate on sustainable development. Specifically, Goal 6 of the 2030 Agenda (UN, 2015) aims to ensure the availability and sustainable management of water and sanitation for all, acting as common element in the development of societies, for international cooperation and various aspects related to management, monitoring and planning (UNESCO, 2015). This has led to the need for more up-to-date and comprehensive data and tools for studying, analysing, and monitoring water resources, and to the launch of specific programmes aimed at achieving greater standardisation, integration, and accessibility of information sources at global level. Indeed, in the age of digitisation, the need to carry out increasingly complex analyses, involving different factors, requires the availability and use of a large number of spatial and temporal variables, which are increasingly detailed and often associated with a specific geographical location (Balla et al., 2022). For these reasons and because of its characteristics, the GIS (Geographical Information System) is considered the most suitable tool in the management, monitoring and planning of available water resources. It allows the integration and processing of spatial and temporal information from different sources and fields, facilitating real-time monitoring of phenomena of interest as well as the development of long-term scenarios (Calera Belmonte et al., 1999).

Since the 1970s, many studies have focused on the development of methodological approaches and indicators for water quality control and monitoring purposes associated with the development of geotechnologies. From the late 1980s GIS was used to represent and, subsequently, support control and management of operations for the development of improvement programmes, operational and maintenance plans, and from the mid-1990s, it has been used in studies on water for civil uses with particular emphasis on accessibility and sustainability (Balla et al., 2022). Later, GIS was extended to study global problems, involving the management of scarce resources and the safety of people, institutions and economies at different regional scales (Shamsi, 2005). In recent decades, the development of GIS based on geoinformatics technology has been associated with the web, thus spreading the development and dissemination of increasingly rich and customisable spatial information, where each information object is related to all the others, at international level. This information may present varying complexity, be adapted to specific purposes, and be customisable with interfaces. The latter are made increasingly accessible to a growing number of users who are no longer necessarily professionals. In these senses, online GIS services act through at least three mechanisms:

1) Significantly increasing cartographic applications, thanks to greater accessibility and variety of tools and data;
2) Integrating non-spatial maps and information technologies to produce new forms and modes of representation to address major challenges for society;
3) Creating new virtual 'worlds', resembling the physical world, which are studied, analysed and used, but also exploited (MacEachren, 1998).

The latest web-based GIS services, powered by dynamic mapping research, provide access to a wide range of georeferenced, spatially and temporally dynamic, linking modules and objects (MacEachren, 1998). Research on geographical representation in the web has focused on symbolisation and, recently, on 3D representation integrated with virtual/augmented reality. All this has greatly increased the potential of representations and through animations

that can be viewed directly by the user, with the possibility of customising the various information layers and specific parameters according to the relative virtual position.

At the international level, various programs and initiatives funded by major institutions are trying to address all these characteristics and needs, including knowledge acquisition, monitoring, planning prevention of emergencies etc. These efforts are characterised by collaboration among different partners and institutions, the use of advanced and user-friendly geotechnologies and the availability of open data and resources that are easily accessible to a wide range of users. Various stakeholders, including the global scientific community, citizens, policy makers and businesses, can benefit greatly from them.

One of the most notable programs is the European Union's Earth observation program *Copernicus*,[2] which is managed by the European Commission. It focuses on studying the planet and its environment to enhance the quality of life for European citizens and beyond. The program provides information services that rely on Earth satellite observation and in-situ data. Given the complexity of interconnected topics and tasks (agriculture, blue economy, climate change and environment, development and cooperation, energy and natural resources, forestry, health, insurance and disaster management, security and defence, tourism, transport, urban planning), a systemic and integrative approach is adopted to foster partnerships among diverse organisations. The program supports a wide array of applications across several non-space domains that can substantially impact the day-to-day activities and operations of various organisations and businesses. Specifically, the *Copernicus* Marine Environment Monitoring Service offers an interesting example of providing valuable information about the ocean. This service delivers free, regular, systematic and authoritative data categorised into three areas: Blue (physical), White (sea ice), and Green (biogeochemical). The information is accessible through an interactive viewer and catalogue and raises public awareness about ocean-related issues and promotes the Blue Economy. The data and information, including research reports, contribute to various fields, such as marine protection, safety and routing, sustainable use of ocean resources, development of renewable marine energy, blue growth, and climate monitoring and forecasting.

Complementing *Copernicus*, the European Commission Joint Research Centre, UN Environment and Google aim to empower citizens and governments in assessing the status of the world's natural resources–particularly the extent of freshwater ecosystems, a key environmental concern – through a dedicated platform called the *Freshwater Ecosystems Explorer*[3]. In line with Sustainable Development Goal 6.6, this platform utilises the best available knowledge to track and monitor the health of freshwater ecosystems. The *Freshwater Ecosystems Explorer* offers free, accurate, up-to-date, and high-resolution geospatial data that illustrates changes in freshwater ecosystems over time. This innovation allows users to track (via the "explore your freshwater ecosystem" section) and narrate (via "analysis and stories") the dynamic changes of ecosystems across different levels and scales, including national, subnational, and basin levels. It addresses permanent and seasonal surface waters, reservoirs, wetlands, mangroves and water quality.

Another international thematic project focused on water resources is the *Global Surface Water Explorer*, characterised by a multifunction interface that is simple and intuitive within

[2] These include member states, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Océan.

[3] The innovative functionalities of the initiative can be explored here: https://www.sdg661.app/

a dedicated Web-GIS platform, documenting the position and seasonality of surface waters and measuring long-term changes at high resolution.[4] Developed by the Joint Research Centre of the European Commission, this dynamic thematic database features an advanced interface, seamless source integration and a high degree of user-platform interaction. The project relies on specifically produced global datasets that document the location and seasonality of surface waters. These data are derived from national inventories and descriptions through statistical extrapolation of regional data and satellite images. By leveraging high-resolution measurements, the project enables users to visualise long-term changes in surface water distribution. Due to its ability to map the location and dynamic changes of water surfaces, its website specifies it as a "virtual time machine that maps the location and temporal distribution of water surfaces at the global scale over the past 3.8 decades." The dataset is produced from Landsat images with contributions from USGS and NASA and supports a range of applications including water management, climate modelling, biodiversity conservation and food safety. Consistent with Goal 5 of the 2030 Agenda, it enables monitoring changes in different water-related ecosystems over time and space, providing an important knowledge support for various users and, in particular, for public decision-makers. Among the most significant innovations of the platform is the possibility of obtaining a dynamic narrative of the main changes and phenomena observed, which can be explored through story maps featuring selected case studies (currently numbering 23).

Considering these recent innovations and advancements in the field of geotechnologies applied to water resources [5] with regard to their progressive narrative, dynamic and experiential capacity, the following section will describe the project developed by the GECOAGRI-LANDITALY Interuniversity Association (Grillotti Di Giacomo and De Felice, 2022).

2. 'Tourist itineraries to discover the waters of Italy': objectives, tools, results

2.1 Origins and Purpose of the Project

The project was developed within a rich programme of activities (scientific, educational and promotional), conceived and largely already realised by the Italian Interuniversity Research Group GECOAGRI-LANDITALY.[6] "The world of water, water for the world" (cf. Figure 1) is the motto of the project *Itinerari turistici alla scoperta delle acque d'Italia* (Tourist itineraries to discover the waters of Italy), which produced ten multimedia totem stations in 2022 (Grillotti Di Giacomo & De Felice, 2022). It received immediate and substantial financial support from the ACEA S.p.A. Group which operates water, environment and energy businesses in Italy. This support came after ACEA recognised and appreciated the results from the research conducted by the Research Group, notably highlighted in a publication

[4] The innovative functionalities of the initiative can be explored here: https://global-surface-water.appspot.com/

[5] Also see Hohenthal et al. (2024), Liu et al. (2021), Silva et al.(2020).

[6] The Interuniversity Research Group GECOAGRI-LANDITALY (Comparative Geography of European and Extra-European Agricultural Areas) is an Italian research group within the Association of Italian Geographers (A.Ge.I.) composed by professors, researchers from various Italian universities, as well as experts from different disciplinary backgrounds. The group aims to promote scientific activities to enhance historic rural landscapes, typical quality products, and supporting local development. See further information about the Research Group athttps://www.gecoagrilanditaly.it/ and https://www.ageiweb.it/gruppi-di-lavoro/gecoagri-landitaly/

released in 2018 to celebrate the 80th anniversary of the Peschiera-Capore aqueduct complex (Grillotti Di Giacomo, 2018).

The interest in knowing and valourising the territory arose from ACEA's plan to construct the upper section of the Peschiera-Capore aqueduct (the main aqueduct serving Rome). This initiative undoubtedly facilitated the full acceptance of the project in which lecturers and university researchers from various disciplinary backgrounds, as well as scholars and experts in the territory, cartographers, and young technical graduates[7] collaborated. The young graduates involved in the project were selected through a widely publicised call for applications in the local media and, after being trained and motivated, brought new perspectives for research and comparisons both on the methodological interdisciplinary discussions and the final application.

The innovation of this immersive, inclusive, user-centered project, compared to others[8], involves multiple levels:

a. *Scientific* – it is highly multidisciplinary because other projects have used similar tools to examine mainly physical-natural aspects;

b. *Methodological* – the hydrographic and territorial reality is presented as a dynamic, visual and systemic narration obtained with the use of different documentary sources, beginning with historical cartography;

c. *Multilevel and participatory* – because it has actively involved public and private actors, experts from various disciplinary backgrounds, institutions, stakeholders operating in the territory, local community;

d. *Slow, sustainable, inclusive, phygital tourist amenities*–because the stations scattered in strategic hydrographic points chosen on the territory allow maximum accessibility to all, in fact even though they are physically present in specific places they allow you to visit even inaccessible spaces and to draw information in the form of video and audio (Kaur et al. 2023, Silva and Mattos 2020).

The aim of the itineraries is to promote the participatory management of water resources and facilitate forms of partnership among local communities, economic enterprises and scientific institutions interested in stimulating processes of integral and sustainable management of the water resource, together with tourist activities in marginal territories, thereby interpreting and valuing it in its natural, economic and cultural dimension.

[7] With different backgrounds and expertise from various Italian universities and research centres: University of Insubria, University of Perugia, University of Rome La Sapienza, University of Cassino and Southern Lazio, University of Salerno, University of Bari, University of Foggia, University of Sassari, CNR and ENEA.

[8] Among the notable national projects are the GeoVires Lab, within the Department of Earth and Environmental Sciences at the University of Milano-Bicocca, and the ARGO3D project, developed through a collaboration between the University of Milano-Bicocca and the Cometa Consortium. Both initiatives were established within a Virtual Reality Laboratory that integrates expertise from earth sciences and computer science. These projects aim to innovate the teaching, learning, and dissemination of earth sciences by leveraging advanced visual rendering and graphic computing techniques. Through these technologies, users can actively engage with and explore geological environments reconstructed in virtual reality. For further details, see: https://geovires.unimib.it; https://argo3d.unimib.it.

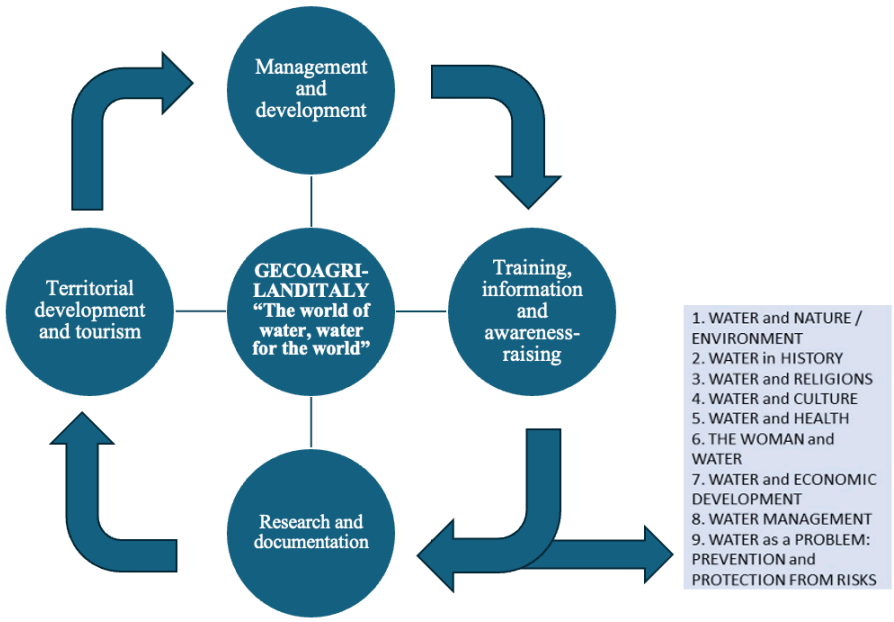

Figure 1 - Fields of interest and intervention of the Association "Interuniversity Research Group GECOAGRI-LANDITALY". (Source: Documentary Fund Interuniversity Research Group GECOAGRI-LANDITALY.)

2.2 Framework and tools for the development and implementation of interactive stations

During 2022, ten multimedia totem stations were completed and installed in various locations, allowing individuals to 'travel' while sitting on the benches located at the various sites and practice slow tourism by using the QR Codes connected to the ACEA Immersive Museum (MIA). The digital portal can be accessed by framing the QR Code with a smartphone, or remotely by connecting to the GECOAGRI-LANDITALY Association website. Once entered, it is possible to observe inaccessible sites by browsing in a virtual environment with texts, videos, audio and a photo gallery and access the history and geography of the territories that water has created both through its erosive action and through the stimuli collected by humans for cultivating, breeding, generating clean energy, developing tourist and cultural activities, from thermal to artistic ones (Wu et al., 2024).

Every station, except the first one that is connected directly to the internet, consists of a wooden structure with a wave-shaped base (which allows adults and children to sit on it) and a two-sided headboard (cf. Figure 2). On the first side, dominated by a particular photo of the site chosen for the installation, there is the QR Code that allows smartphone access to the various contents of the places presented in the totem (audio, video, photo gallery, in-depth maps, graphics, augmented reality reproductions, cartographic representations of both thematic and historical sites). The QR code also allows users to enjoy a tourist itinerary that connects the various sites illustrated and the legend of the different symbols is used to

navigate within the digital portal. This gives drone access to the place, landing, time travel in a virtual (phygital) journey through which – thanks to high-resolution immersive aerial photography – it is possible to fly over springs, lakes, rivers, waterfalls, cities, valleys and intermontane basins, choosing to 'land' from time to time in one of the many tourist attractions.

Figure 2 – Totem station 2 located in *Ponte romano novo*. (Source: Documentary Fund Inter-university Research Group GECOAGRI-LANDITALY.)

The second side of the board contains the map of the middle and lower valley of the river Velino (Lazio region), that is the complete route with the location of the 10 stations[9] and the

[9] The 10 stations installed are: *il mondo dell'acqua, l'acqua per il mondo* (the world of water, water for the world, with 12 places and 26 detailed information sheets); *Rieti vetrina del pianeta acqua. Una straordinaria ricchezza idrografica nel cuore d'Italia* (Rieti: a showcase of the planet water. An extraordinary hydrographic wealth in the heart of Italy, with 10 places, 19 landings, 78 information sheets, 11 audio, 4 time travel, 5 photo gallery); *Il Velino a Ponte romano novo. Il fiume e la città: un rapport simbiotico tra opportunità e minacce* (The Velino river at new Roman bridge. The river and the city: a symbiotic relationship between opportunities and threats, with 8 places, 5 landings, 20 detailed information sheets, 5 audio, 4 time travel, 9 photo gallery); *Fonte Cottorella Terme oligominerali "acqua fresca, ligerissima e gradita": attrazione terapeutica e ludica* (Cottorella oligomineral thermal baths "fresh water, very light and pleasant": therapeutic and tourist attraction, with 11 places, 1 landing, 24 information sheets, 6 audio, 1 photo gallery); *Le Cutiliae aquae: culti, terme e testimonianze storiche* (The Cutiliae aquae: cults, thermal baths and historical testimonies, with 9 places, 1 landing, 20 information sheets, 12 audio, 4 photo gallery); *Umbilicus Italiae il lago di Paterno tra natura e cultura* (Umbilicus Italiae the Paterno lake between nature and culture with, 3 landings, 17 tabs, 8 audio, 5 time trips, 3 photo gallery); *Il laghetto sorgivo di Canetra: un potenziale turistico e idroelettrico* (The Canetra spring lake: a tourist and hydroelectric potential, with 9 places, 5 landings, 16 tabs, 7 audio, 3 time trips, 2 photo gallery); *Greccio, Fonte Lupetta e la Valle del primo presepe* (Greccio, Lupetta spring and the Valley of the first nativity with 9 places, 3 landings, 24 tabs, 12 audio, 11 time travel, 1 photo gallery); *La Riserva dei*

path connecting them all (cf. Figure 3B). The fourth totem, entitled *Sorgenti del Peschiera: un sistema acquedottistico unico al mondo* ('The Peschiera Springs: A water system unique in the world'), has not yet been implemented due to restricted access to the Peschiera Springs as they are a sensitive site (given that the water collected there serves three quarters of the city of Rome). Nonetheless, it is documented with photos and proposed itineraries. From all the other locations, video images and historical reconstructions in 3D allow viewers to explore reality in every corner, in every aspect and from different points of view. The visitor can immerse themselves in both the current reality and that of the past, also documented in the territorial transformations that occurred in the different historical phases reconstructed as augmented reality (metaverse).

Using the QR Code of each totem and following the suggestions of the itinerary map attached to each station, it is possible to choose places, virtual tours, time travel, detailed information sheets, audio, film and photo gallery. The complexity and breadth of so many items explains the reason why it was necessary to refine an operational methodology prior to the project's commencement that was subsequently adopted by all those who collaborated. This is due to different reasons, such as the collection and selection of the documentation needed to enhance the various contents (environmental, historical and cultural); the introduction of different information and documentary sources into an organic structure that is usable and functional for users and also for the operators and the technicians that materially assembled and built the computer and physical bases of the totems (cf. Figure 3 A and B).

2.3 Results: perspectives for social inclusion and territorial valourisation

So far, 100 sites and 47 virtual tours illustrated by 263 information sheets have been included in the stations already installed; 91 audio files; 37 time travel sequences; 33 photo galleries. In this first phase of the project, the tourist offering allows users to explore entirely new paths, leading to the discovery of the largest concentration of spring waters in Europe, as well as the ancient, fruitful relationship that unites the water to the organisation of the territory, the economy, the art, health and religion as a means of therapy and spiritual purification.

The totem station *Cuore blu: il mondo dell'acqua, l'acqua per il mondo* is different from others because it directly connects to the internet and has an accessible touch screen. The station, as well as illustrating missions, programs and projects of the National Interuniversity Research Group GECOAGRI-LANDITALY and the various activities undertaken in the Cuore Blu Center (summer schools, competitions for schools, freshwater aperitifs, exhibitions), represents the water resource of the entire national territory in Italy, seen from different aspects: naturalistic-environmental; historical-cultural; economic-managemental; hydrogeological risk, and the protection and conservation of water resources. The other 9 totems allow users to discover unexpected hydrographic features and emblematic cases that justify why the territory of Rieti, with its extraordinary wealth of aquatic resources, can be considered a showcase of the 'water planet', that exemplifies of the fertile, complex

Laghi Lungo e Ripasottile. Le Septem aquae tra mulini, santuari e "giardini di marzo" (The Reserve of the Lungo and Ripasottile Lakes. The Septem aquae among mills, sanctuaries and "gardens of march" with 10 places, 10 landings, 23 information sheets, 15 audio, 10 time travel, 7 photo gallery); *La cascata delle Marmore, Piediluco e il sistema Nera-Velino* (The Marmore waterfall, Piediluco and the system Nera-Velino with 13 places, 30 information sheets, 15 audio, 1 photo gallery).

relationship between water and human communities.

Figure 3A (left) - the rear side common to the 10 totem-stations, each of which allows, through a different QR code, to know the history, environment, culture and economy of the surrounding area. Figure 3B (right) the front of the totem-station 2. In each station, the front contains not only essential information (title, emblematic image, legend) but also the QR Code that allows to embark on the digital journey, choosing the itinerary thanks to the icons represented in the navigation legend. (Source: Documentary Fund Interuniversity Research Group GECOAGRI-LANDITALY.)

Rieti, which might be considered to be 'the beating heart' of the national water resource, is a precious treasure trove of waters, derived from more than 400 hydrographic points, including sources, springs, fountains, troughs and thermal baths (cf. Figure 5). There are 123 precious springs that are sites of considerable hydrographic, economic and tourist interest. In the Velino valley they provide 49,620 litres per second (l/s) of drinking water. The biggest concentration is in the San Vittorino plain in just 8 square kilometres in the short stretch between Canetra and Caporìo. Here 85 springs generate to the largest spring area on the entire European continent, bringing more than 32,000 l/s of this precious resource to the surface. On the other side of the Terminillo and Corno massifs, spring waters are also of significant importance. First of all, the *Septem aquae ciceroniane* that bring 5,000 l/ s to the surface and Le Capore from the River Farfa, which produces more than 5,000 l/s. If the abundance of spring waters leads the area of Rieti to claim the record in Europe, just as extraordinary is the quality and variety of their mineral salts and micronutrients. Experts speak of a real concentration of water diversity, from the trace minerals to the sulphurous and ferruginous ones.

Rieti, with its wealth, has always been at the forefront not only in terms of control, but also in the management of water resources. The millenary attempts of reclamation of the prehistoric *Lacus Velinus* (discussed in section 3) could be mentioned, in addition to the construction of two imposing artificial reservoirs on the Salto and the Turano at the end of the 1930s, along with the realisation of the Peschiera-Capore aqueduct in the same decade, a unique project in the world for the energy and civil use of water resources and the numerous hydroelectric power plants that exploit its kinetic force. This has also paved the way for careful choices of suitable hydrophilic crops, such as *guado* (sugar beet), that led to the construction of the first sugar factory in Italy in Rieti in 1863, or for the cultivation of the wheat that Nazareno Strampelli genetically modified to make it resistant to the moisture of the Reatin Basin that was then exported internationally.[10] History and geography fully justify the title "showcase of the water planet".

Overall, the tourist offer produced was innovative because it allows the traveler to know each territory beyond the historical and geographical limits imposed by the categories of time and space in which they live. These aspects that make the project innovative, useful and interesting, are therefore linked to at least three of its characteristics: immersion, inclusion and implementation of content. The interactive digital technology, used to build each totem station, overcomes barriers and sensory and motor difficulties, because, on the one hand, it gives information associating audio and video and, on the other hand, it offers video-shots made by drones, allowing everyone, regardless of their level of mobility and agility, to move virtually and observe landscapes and sites – including from above - that are difficult to reach or hidden.

Therefore, the immersive and inclusive capacity of the stations derives from the offer of access to digital contents that allow, everyone access to the different hiking experiences and to participate, together with all other tourists, in discovering the extraordinary water resources present - and often hidden - in the territories crossed by the various routes. Along with the inclusion and immersion functions, it is equally important to implement the content present in the project. It is equally significant that the digital offer constitutes a shared participation provided to local operators (stakeholders, entrepreneurs, administrators), who may ask to implement its contents, adding useful information for

[10] See Tauger (2023) for his discussion of Nazareno Strampelli's wheat breeding activities and their role in 'the first Green Revolution.'

extending tourist routes and/or advertising information, catering accommodation services on the various sites. For this reason, each totem station includes an itinerary map that provides all the necessary information (cf. Figure 4).

Figure 4 - Example of an itinerary map (from totem-station IX) inserted in each totem-station; the representations are useful to request and plan guided visits and surveys on the territory. (Source: Documentary Fund Inter-university Research Group GECOAGRI-LANDITALY).

Figure 5 - The hydrographic wealth of Rieti. (Source: Documentary Fund Interuniversity Research Group GECOAGRI-LANDITALY.)

3. Geo-historical research and augmented reality: the land of the ancient *Lacus Velinus*

In the project *Itinerari Turistici alla scoperta delle acque d'Italia* ('Tourist itineraries to discover the waters of Italy'), geohistorical research using cartographic and documentary sources has proved crucial to reconstruct the hydrographic base of the Reatin basin and to bring out the systemic dimension of the ambivalent relationship between water resources and human communities, characterised by conflict and complementarity (Azzari, 2019; Vallerani, 2019).

Lacus Velinus (Velino Lake)[11] is a significant case for understanding how geohistorical research and augmented reality can be employed to reconstruct hydrographic systems that have been altered over time by reclamation and other territorial transformations. In ancient times, *Lacus Velinus* covered much of the Rieti plain and, thanks to modifications made by the Romans, its waters flowed into the River Nera (Cammerini, 2006, Lorenzetti, 2021). The historical geography of the *Lacus Velinus* thus tells of a complex relationship between natural elements and cultural instances, an articulated relationship between resources and populations. Cicero, writing to Attico, tells that he was called to Rieti, host of Quinto Assio, to settle a case concerning the management of water resources.

According to tradition, following the cutting of the Marmore by Manio Curio Dentato, the waters of the *Lacus Velinus* were channeled into the River Nera. The Ternans then summoned the Reatini to court, holding them accountable for the increased river floods that occurred after the implementation of hydraulic works. This important work of reclamation marks a transition in the territorial history of the Reatin Basin which, after being drained, became an agricultural and also a place of experimentation and innovation where, in the following centuries, repeated attempts to manage and control water resources would be made. The territorial history of this piece of land exemplifies the relationship between the human community and natural resources, clearly showing how human ingenuity has sought, according to the geomorphological nature and the *milieu*, to find a systemic balance by assuming different roles in response to the various territorial functions.

In prehistoric times, when the maximum extension of *Lacus Velinus* was recorded, reconstructed from the contour lines of 380 and 400 m etres(see respectively Dupré Theseider, 1939 and Grillotti Di Giacomo, 2008, 2018) the lake, to the south, surrounded Montecchio and Colle Aluffi (Figure 6). Proceeding northwards, it surrounded San Balduino hill and Montisola, whose toponym records the perception that the community had of the mountain, which appeared as an island. The waters widened, then, occupying the entire Canal Plan and encompassing Ventina and Piediluco lakes, reaching the Marmore. To the east, it extended to the springs of Santa Susanna (*Septem aquae*[12]),encompassing the lakes of Ripa Sottile and Lungo, which are now considered remnants of the prehistoric lake.

[11] Regarding the extension of the lake from prehistoric times, we refer to the essays by Dupré Theseider (1939) and Grillotti Di Giacomo (2008).

[12]The name *Septem aquae,* reported by Dionysius of Halicarnassus and Cicero, confirms the copiousness of the water resource in this territory. The suffix *sette* (seven), quite common in Italian toponymy, indicates the quantity that can be, for some scholars, exact, or indeterminate, for others, referring to an indefinite plurality of natural elements, such as water, or human-made structures, like bridges (Setteponti is a name found in the Reatin basin) and chimneys. The latter represent a synthesis that is part of the whole, to indicate houses and settlements (Settecamini is also found in the local toponym of Reatin). Sette Acque, Setteponti, Settecamini refer to a landscape characterised by a notable presence of

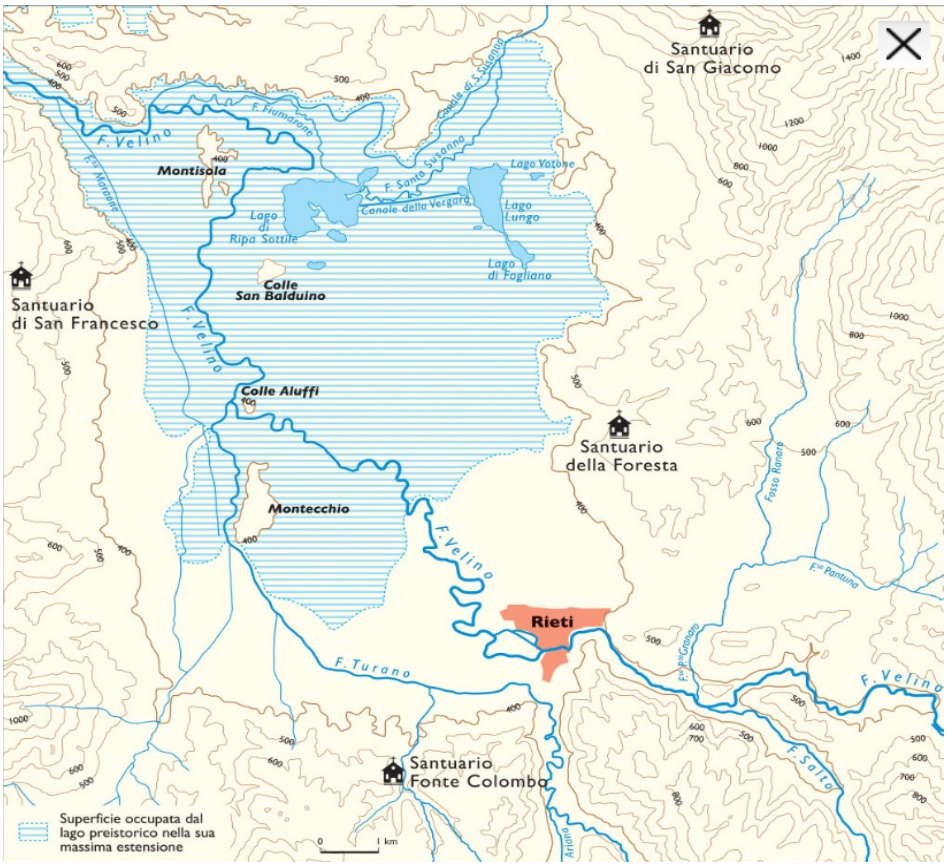

Figure 6 - The extension of the ancient *Lacus Velinus*, which occupied much of the current Reatin Basin. (Revised version of Grillotti Di Giacomo, 2008, p. 584.)

The intervention of the Romans marks a territorial transformation that affects the geography and economy of this territory. Once the excess water was drained, fishermen transitioned to farming. The lake landscape transformed into a rural environment, altering its resources, economy, and infrastructure. This new status records, therefore, a different physical geography, which is well highlighted by the historical cartography in the following centuries (fig. 7, 8 and 9), marking the passage from the *Lacus Velinus* to the remnants of Lake Velino (Plinio, *Historiarum Mundi*, III), as well as a new relationship between the environmental and cultural dimensions, characterised by vulnerability and constant maintenance work to preserve a fragile balance.

water. This abundance of water likely necessitated the construction of bridges and shaped the lives of the local population, who would have relied on these structures in their daily activities, including heating their homes with numerous chimneys. The natural element of water becomes in this area an iconema of the landscape, It is a feature that has drawn the attention of visitors over centuries, including Cicero, who recorded the name.

During medieval times, marshes were documented in the Reatin Basin. This development compelled the Cistercian monks, who had already settled there, to reclaim the land in order to create a safer and more comfortable place. They relocated from the Abbey of Saint Matthew, in the plain, to a higher site, where they established the Abbey of San Pastore. [13]

Figure 7 - Giovanni Antonio Magini, *Umbria, overo Ducato di Spoleto*. Detail of the region of the Reatin lakes, 17th century.

Figure 8 - Claudio Martigny, *Lago di Ripasottile*, 1721.

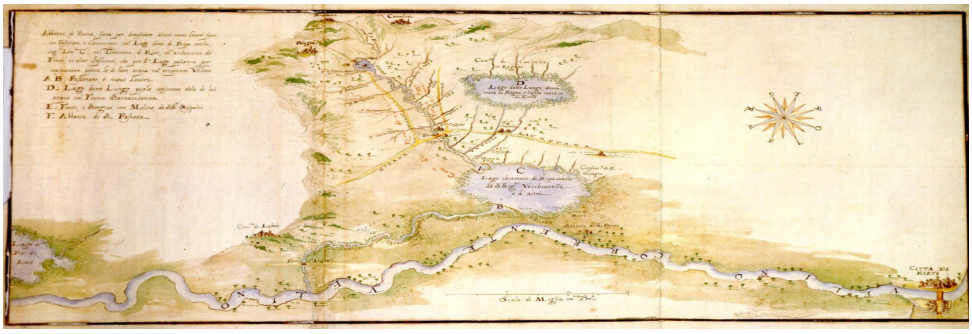

Figure 9 – Unknown cartographer, draft of *Pianta, fatta per dimostrare alcuni nuovi lavori fatti con Passonate, e Cannucciate nel Lago detto di Ripa Sottile*, XVII-XVIII.

[13] Another factor that lends weight to accounts that the Reatin Basin was again submerged by water in the Middle Ages is the religious tradition that Saint Francis used a boat to travel between the convents of Greccio, Poggio Bustone, Fonte Colombo and La Foresta, in what would later be known as the Holy Valley.

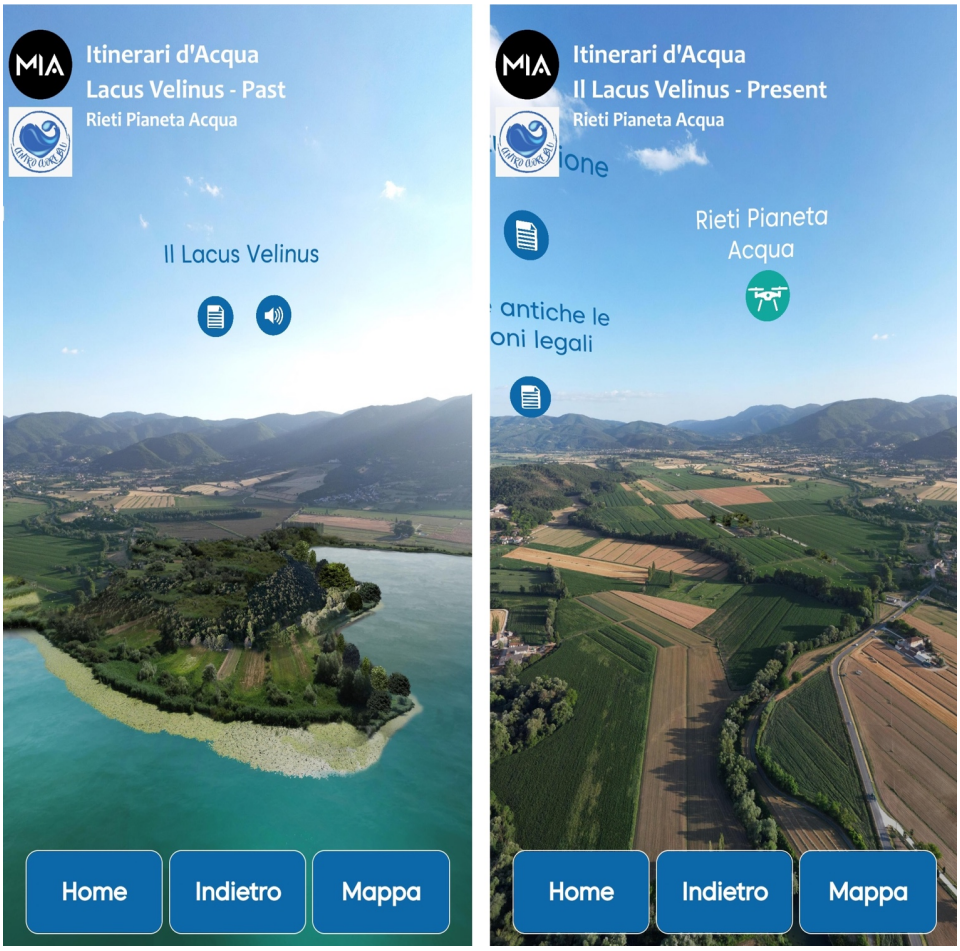

Figure 10 - The *Lacus Velinus* in three-dimensional images of the current reality (on the right) and the augmented reality (on the left). (Source: GECOAGRI-LANDITALY Inter-university Research Group Documentary Fund.)

The constant flooding of the valley has drawn important architects to Rieti over the centuries, like Bramante, Maderno, Fontana. Their water-treatment projects are a valuable testimony to the complex relationship between human communities and water resources, development initiatives and technological innovations, opportunities and threats present in a territory, that is both rich and fragile at the same time. In this project, new computer tools have made it possible to reconstruct, from these documentary sources, the lake landscape of the *Lacus Velinus* in a three-dimensional and immersive environment. It is represented by a three-dimensional map, generated from images captured by drones and enriched by augmented reality.

Through the interactive totem, using the QR code, you can start the journey in the water landscape of prehistoric *Lacus Velinus*, where the traveler is guided to observe its forms, which have disappeared and/or compromised. Immersive cartography, along with the wealth of information provided by the geohistorical sources consulted, allows us to view the water

landscapes as they once were and to trace and interpret the transformations brought about by nature and/or human activity. Specifically, users can experience the three-dimensional view of the lake before Manio Curio Dentato's intervention through the website (identified in the application with the symbol "time travel"). This feature showcases the promontories, which rose above 400 meters, and the areas accessible by small boats, likely used by fishermen who relied on the waters of the great lake for their livelihood.

To conclude this journey, partly real and partly reconstructed, a specific syntax has been developed. It is illustrated in the image from above (aerial view of the territory, marked by the drone symbol in the application) which serves as the starting point and an innovative element. The look from above, guaranteed by three-dimensional aerial images, becomes the optimal position to observe, monitor and document the water landscape of *Lacus Velinus.* A specific space is dedicated to it in the I totem and in the entire IX totem, which is reserved for the territory of the residual lakes of Ripasottile, Lungo, Fogliano and Votone, consisting of 10 virtual tours (The Springs of Santa Susanna, the Mill of Santa Susanna, Poggio Bustone, Rivodutri, The Reserve of the lakes Lungo and Ripasottile, The northern canalisations, here and there by rivers, The villa that housed Cicerone, Ponte Crispolti and Sette Ponti, Map Itinerary).By choosing the different virtual tours, the journey leads to the territory: the scale of observation changes and, consequently, the cartographic instruments change. The thematic and historical maps are preferred, since they make it easier to identify places and to gain a clearer and more detailed understanding of their evolution over time. At this level, further information can be deduced through the information sheets. The following information sheets are dedicated in the I totem to: The Lacus Velinus, the Roman reclamation, Cicero's defenses, the Cistercense's reclamations, the plains, the construction of a dam, Secular disputes, the events following the reclamation, old legal issues and Roman centuriations.[14] The IX totem consists of fifteen in-depth information sheets, eleven virtual tours, sixtime travels. The IX totem's itinerary ends with a large-scale thematic map designed to distinguish nine sites of interest which tourists can visit in order to enhance topophilia (Tuan, 1974, fig. 4).

4. Project, programme or provocation?

The itineraries proposed by the project highlight the reason why the area surrounding Rieti deserves greater media attention to its tourist attractions (Franciscan springs and oases; thermal baths and archaeological sites; beautiful lakes of various origins including the Umbilicus Italiae; rivers, canals and the highest artificial waterfalls in Europe: the Marmore waterfalls, turned after almost 2 millennia from a problem into a resource) and the reason why it should be considered a unique and extraordinary laboratory for those who want to learn about water and how to manage it.

A balanced, albeit provisional, assessment of the results of the project, can be advanced. For the first time, a tourist experience is accessible to all people regardless of any physical or sensory limitations. This initiative is the result of a partnership among scholars, institutions, and local businesses and stakeholder involvement is both active and ongoing, ensuring that totem stations will continue to be enriched with new content in the future. This is true in terms of both scientific contributions, benefiting the many scholars who have collaborated on the project, and in terms of the application, as the scientific and documentary materials produced provide a valuable service to local communities and their territories, which are

[14] Systems through which the Romans organised agricultural territory.

enhanced by this research. Nowadays, as 'slow tourism' is becoming more and more popular, this project offers itself as a model for accessing travel experiences and emotions by tailoring the user's commitment to their specific, individual needs. Another strength of these totem stations is that they are able to draw attention to territories that are both valuable and marginal and that have often been overlooked despite their historical, economic, and tourist potential. This goal has already been partially achieved (by about 8,200 users according to the latest data from Google Analytics). All this potential is present and is likely to deliver greater results in the future. However, what is still needed, and should not be overlooked, is a greater awareness by local institutions and stakeholders of the need for their direct involvement. Without this, every totem station, despite the richness of its content, will remain nothing more than a valuable piece of 'furniture,' meaningful only to those who have the means to engage with it. This is the real challenge we must address.

REFERENCES:

Azzari, M. (2019). Disegni d'acqua. In Berti, C. & F. Landi (Eds.), *Disegni d'acqua. Acque e trasformazioni del territorio* (pp. 13-14). Phasar edizioni.

Balla, D., Zichar, M., Kiss, E. et al. (2022). Possibilities for assessment and geovisualization of spatial and temporal water quality data using a WebGIS application. *ISPRS International Journal of Geo-Information, 11*(2), 108.

Calera Belmonte, A., Medrano González, J., Vela Mayorga, A., & Castaño Fernández, S. (1999). GIS tools applied to the sustainable management of water resources: Application to the aquifer system 08-29. *Agricultural Water Management, 40*(2–3), 207–220.

Cammerini, G. (2006). *Il fiume Velino*. Progetto Infea.

Dupré Theseider, E. (1939). *Il lago Velino. Saggio storico-geografico.* Arti Grafiche Nobili, Consorzio di Bonifica della Piana Reatina.

GECOAGRI-LANDITALY Association (2025). https://qrra.metareality.it/CuoreBlu_Demo/index.htm?media-index=0

Global Surface Water Explorer (2025). https://global-surface-water.appspot.com/

Grillotti Di Giacomo, M. G. (2008). Il Velino racconta. In M. G. Grillotti Di Giacomo (Ed.), *Atlante tematico delle acque d'Italia* (pp. 581–584). Brigati.

Grillotti Di Giacomo, M. G. & De Felice, P. (2022). Per aquam ad prospectus: Itinerari lenti nell'Umbilicus Italiae. In L. Spagnoli (Ed.), *Itinerari per la rigenerazione territoriale tra sviluppi reticolari e sostenibili* (pp. 92-100). Franco Angeli.

Hohenthal, J., Minoia, P. & Pellikka, P. (2024). Mapping meaning: Critical cartographies for participatory water management in Taita Hills, Kenya. *The Professional Geographer, 69*(3), 383–395.

Id. (2018). Dall'Umbilicus Italiae, "Cuore blu" della nostra penisola, un sistema acquedottistico unico al mondo. In A. Nicosia & M. C. Bettini (Eds.), *Acquedotto del Peschiera 80 (1938-2018)* (pp. 19–42). Gangemi Editore.

Kaur, R., Saini, A. & Singh, S. (2023). The role of digital tourism platforms in sustainable tourism development. In P. Singh, S. Daga, K. Yadav, & A. Jain (Eds.), *The need for sustainable tourism in an era of global climate change: Pathway to a greener future* (pp. 195–214). Emerald Publishing Limited.

Lindsay, W. M. (Ed.). (1913). *Sexti Pompei Festi De verborum significatione quae supersunt cum Pauli Epitome.* Stutgardiae et Lipsiae: Bibliotheca Scriptorum Graecorum et Romanorum Teubneriana.

Liu, H., Jiang, Y., Zhu, H. et al. (2021). Analysis of water resource management in tourism in China using a coupling degree model. *Water Policy, 23*(3), 765–782.

Lorenzetti, R. (2021). *Dal Velino alla cascata delle Marmore. Uomini, acque, architetti, bonifiche e grand iinteressi tra Rieti e Terni dall'epoca romana al '900.* Il Formichiere.

MacEachren, A.M. (1998). Cartography, GIS and the World Wide Web. *Progress in Human Geography, 22*(4), 575–585.

Shamsi, U.M. (2005). *GIS applications for water, wastewater, and stormwater systems.* Taylor & Francis.

Silva, K. B., & Mattos, J. B. (2020). A spatial approach for the management of groundwater quality in tourist destinations. *Tourism Management, 79*, 104082.

Tauger, M.N. (2023). Nazareno Strampelli and the first Green Revolution. *Journal of International Development, 35*(8), 2485-2512.

Tuan, Y.-F. (1974). *Topophilia: A study of environmental perceptions, attitudes and values.* Prentice-Hall.

United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*.https://sdgs.un.org

UNESCO. (2015). *Transboundary water governance and climate change adaptation: International law, policy guidelines and best practice application.* UNESCO World Water Assessment Programme.

Vallerani, F. (2019). Fiumi come corridoi di memorie culturali, saperi idraulici e rappresentazioni. *Semestrale di Studi e Ricerche di Geografia, XXXI* (1), 105–118.

Wu, W., Xu, C., Zhao, M. et al. (2024). Digital tourism and smart development: State of the art review. *Sustainability, 16*(10), 10382.