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TANGIBLE AND INTANGIBLE: DIGITAL SYSTEMS AND METHODOLOGICAL ANALYSIS FOR UNDERSTANDING AND ACCESSING THE CULTURAL HERITAGE OF FRAGILE TERRITORIES

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Abstract

This research examines the town of Lama dei Peligni as an emblematic example of a fragile territory in the Abruzzo hinterland, characterized by the loss of cultural identity, yet set within an orographic context distinguished by significant landscape qualities. The study employed a scientific, multidisciplinary, and integrated methodological approach, aimed at objectively and informatively understanding the territory's historical-environmental -tangible and intangible- values. Analyses were structured within a unified system that enabled objective comparisons with the current configuration of places, facilitating the updating and iteration of various analyses by establishing a GIS-based geodatabase. The heterogeneous data collected were synthesized through the language and methodologies of graphic representation, employed as a tool for analysis and scientific cognitive mediation, to valorise and disseminate the findings, ultimately guiding informed design decisions.

Keywords

Fragile territory, cultural identity, GIS, graphic representation, heritage enhancement

1. *Introduction and aims of the research*

The district of Lama dei Peligni in the Upper Aventino Valley, serves as an emblematic case within the discourse of fragile territories of the Abruzzo region, specifically regarding the loss of cultural identity linked to environmental hazards and depopulation phenomena. These issues affect many historic centres in the Abruzzo hinterland (Caffio, 2022) that exhibit a progressive regression of their architectural, urban, and socioeconomic features due to recurring destructive events of natural or anthropogenic origin.

The concurrence of events determined the progressive abandonment of the historic towns, triggering the subsequent sociocultural decay caused by the lack of a young and active population capable of exploiting resources from the territory.

The recent seismic events in L'Aquila (2009) and Amatrice (2017) reignited the debate on the theme of environmental fragilities inherent in the very nature of many smaller towns in the central Apennines. The choice of the district of Lama dei Peligni is instrumental in analysing and understanding the irreversible effects that the loss of the historic built environment can have on the cultural identity of a place. Although the town has ancient origins, the current urban nucleus of Lama dei Peligni, lacking elements of interest capable of generating cultural attractiveness, reflects the consequences of this decay process. Furthermore, the lack of architectural quality in the historic centre coincides with the denial of the signs of its historical memory (Renzoni & Eramo, 2020). Conversely, it is profoundly meaningful regarding both the natural vulnerability of its territory and the destructive events that marked it in the first half of the twentieth century. It is important to note that the municipalities of the Upper Aventino Valley unfortunately lay along the route of the German defensive line, known as the "Gustav Line", during the Second World War. This had a devastating impact on the urban areas, determining their almost total destruction and leading to an inadequate post-war reconstruction. Despite the aforementioned vulnerabilities, the historic centre of Lama dei Peligni occupies a compact area between the southern slopes of the Majella Massif and the western bank of the Aventino River. In the same area lie the neighbouring centres of Lettopalena, Gessopalena, Taranta Peligna, Fara San Martino, and Torricella Peligna. Although

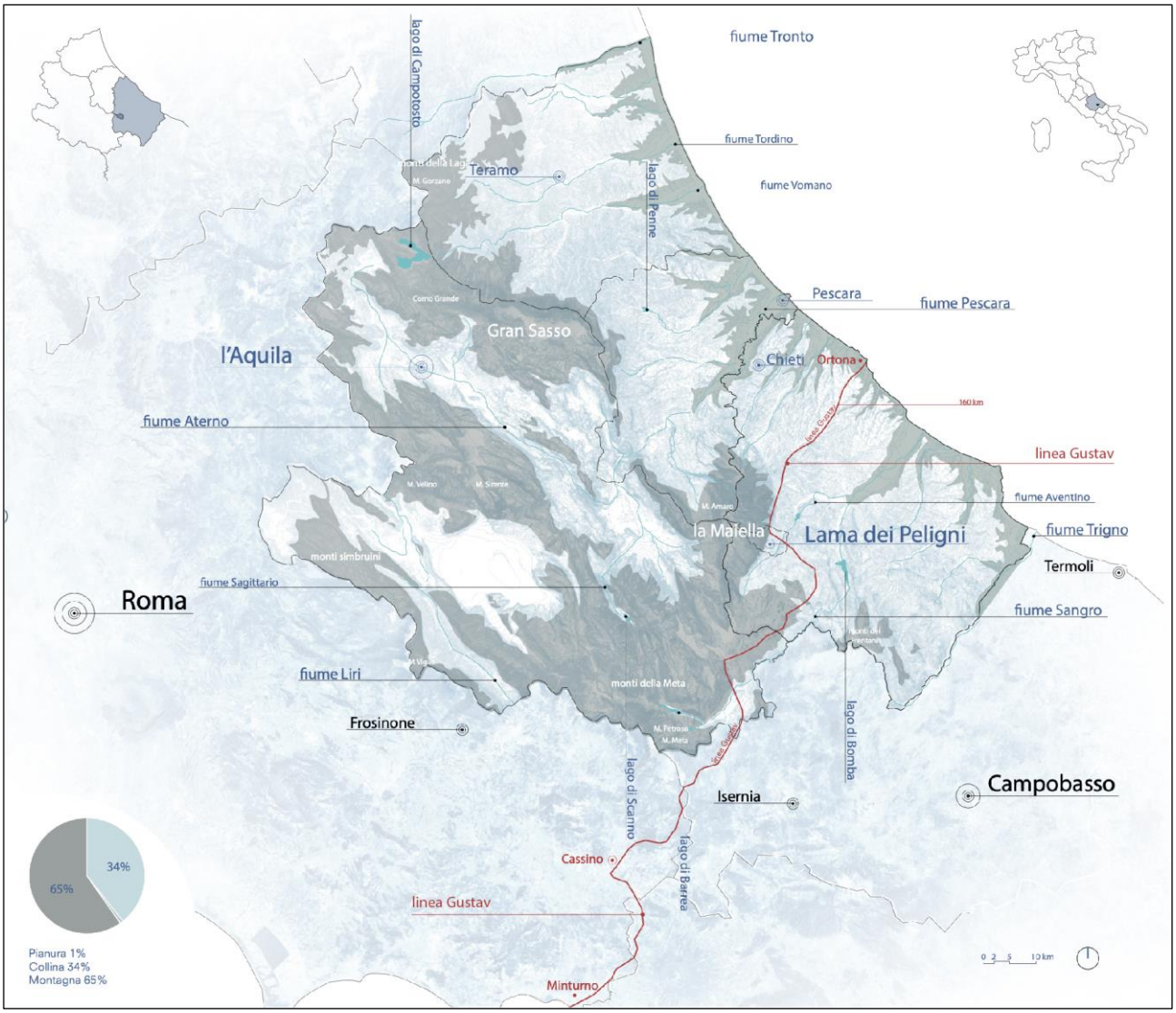

Fig. 1: Territorial overview of Lama dei Peligni within the context of the Upper Aventino Valley. The Gustav Line, historically traced along the mountain ridge, emphasising the strategic role of the area during the Second World War, is highlighted in red.

the distinctive orography inadvertently created favourable conditions for the establishment of the Gustav Line -that is, the defensive trenches of the German army that exploited the natural roughness of the land- these very features could now foster the regeneration of the towns, as they represent their most significant landscape assets.

The municipality of Lama dei Peligni rests in an environment of significant cultural, contemplative, and natural interest. It is, in fact, included in the protected area of the Majella National Park, one of the three major national parks in the Abruzzo territory (Pratesi, 1996). Specifically, this part of the mountainous Abruzzo hosts spiritual landmarks such as the prestigious Convent of Sant'Antonio da Padova and the remains of the Hermitage of Sant'Angelo, built by the Blessed Roberto da Salle, a follower of Celestino V (Burri & Latini, 2002; Campanelli, 2010). The area is also home to the scenic natural site of the Grotta del Cavallone, which inspired D'Annunzio's work *La figlia di Jorio*. The cave, one of the highest in Europe, can be reached via a cable car that ascends to an altitude of 1388 meters, surrounded by the local wildlife.

These motivations led to conducting the research with a scientific, multidisciplinary, and integrated methodological approach, aimed at gaining an objective and divulgative understanding of the historical and environmental values, both tangible and intangible, of the territory in question. The organisational structure is fundamentally based on multidisciplinary investigations: historical and iconographic research, and digital surveys at different scales with differentiated levels of depth,

supported by Geographic Information Systems (GIS). Similar integrated approaches have been adopted for the study of historical urban transformations (Baratin, Bertozzi, & Moretti, 2015), cultural heritage in fragile territorial contexts (Pirinu, Mocci, & Sanna, 2024), and urban transformations following catastrophic events (Continenza & Trizio, 2012).

The adopted methodology enabled structuring information from multiple sources, integrated into the data translation process using the languages and methodologies of graphic representation (Palestini, 2017; Salerno, 2018). This approach allowed for the investigation of the urban characteristics of the historic centre of Lama dei Peligni in relation to its surrounding landscape, aiming to restore the identity of the places by valorising the material and immaterial values of the settlement, inseparable from the unique and significant habitat that surrounds it (Palestini, 2018).

2. *The environmental and landscape context*

The Abruzzo territory is characterised by an orographic system dividing it into two distinct areas: mountainous and coastal. The central Apennines define the backbone of the region, intersecting it longitudinally with the high massifs of the Majella and Gran Sasso, located in its central part, which occupy much of the inland area. The remaining areas feature a hilly system gradually sloping towards the vast, flat, sandy coastal strip. Hydrographically (Fig. 1), the watercourses flow west-east towards the Adriatic Sea, the largest being the Aterno-Pescara River. The major lakes are artificial, except for Lake Scanno, which has a natural origin.

Abruzzo ranks first in Italy for the percentage of protected land, accounting for 36% of the regional territory (Ministero dell'Ambiente e della Sicurezza Energetica, 2024). Regional parks and Natural Reserves are numerous, while there are three national parks: the Abruzzo National Park, the Gran Sasso and Monti della Laga National Park, and the Majella National Park (Fig. 2). Within this regional context lies the area of the Upper Aventino Valley (Fig. 3), a stretch of territory extending between the upper course of the namesake river and the southern slopes of the imposing Majella Massif. Its landscape is profoundly shaped by the orography of the 'mother' mountain, which is also defined as 'sacred' in the collective imagination. As previously introduced, the distinctive geomorphological characteristics of this territory influenced both the settlement dynamics and the historical events that have shaped its evolution. The mountain massif and the river have dictated the settlement system in the valley. The municipalities located there, particularly those on the western side of the river—Palena, Lettopalena, Taranta Peligna, Lama dei Peligni, Civitella Messer Raimondo, and Fara San Martino—are arranged at close distances along a primary route, built during the Bourbon period, roughly parallel to the river (Fig. 5).

These urban centres exhibit recurring features that define their landscape significance and share common challenges related to environmental fragility, natural hazards, and depopulation.

Indeed, they are characterised by compact and spatially constrained development, clustered around the state road and close to the mountain slopes, which are furrowed by a dense minor hydrographic network. Furthermore, they are largely included within the Majella National Park, which encompasses a significant portion of their administrative boundaries. At the same time, their ground is affected by significant hydrogeological hazards, particularly landslides, and falls entirely within the highest seismic hazard classification (Presidenza del Consiglio dei Ministri, Dipartimento della Protezione Civile, 2024), outlining a context highly prone to natural disasters. This fragility is further aggravated by a deficient infrastructure system, lacking railway connections and consisting primarily of the state road, from which only a few urban and local branches extend. Within this district, the case study of Lama dei Peligni was extracted as a representative example due to its historical and developmental trajectory. Its natural vulnerabilities and the destructions it suffered provide a paradigm for understanding dynamics common to the other towns in the area.

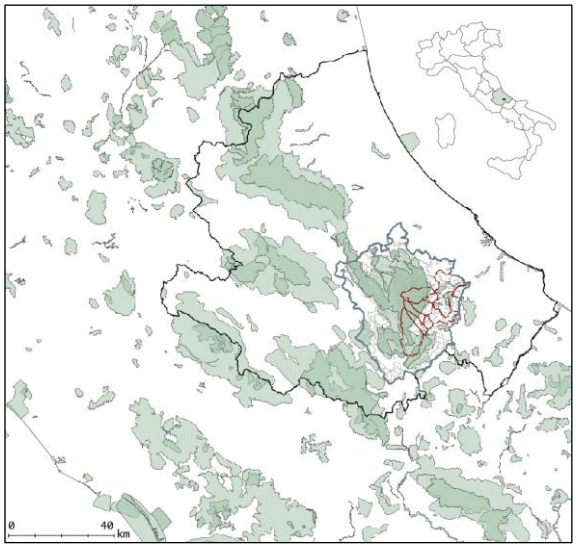

Fig. 2: The thematic cartography highlights the perimeters of the municipalities of the Upper Aventino Valley (in red) and the distribution of regional protected areas (in green).

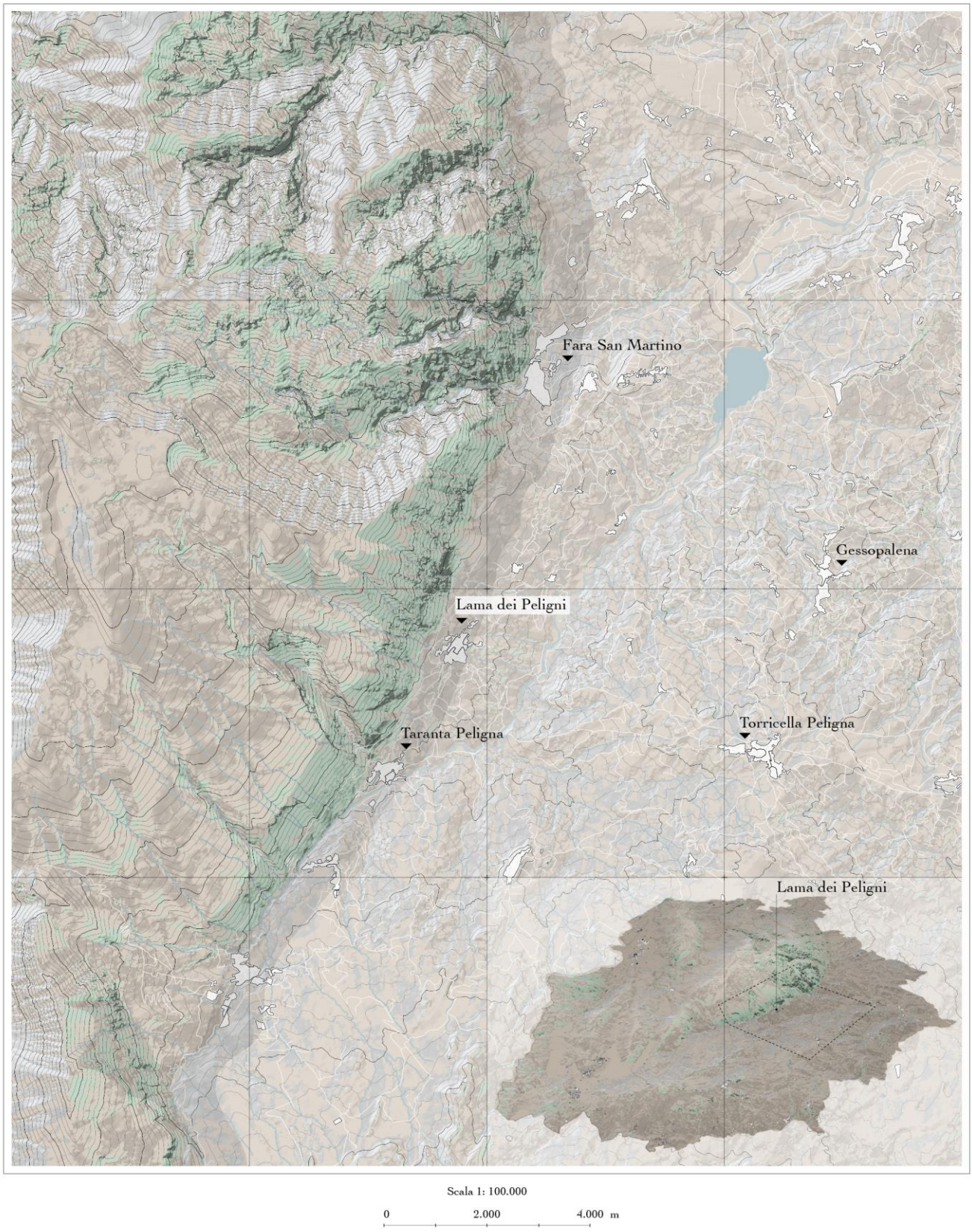

Fig. 3: Digital model of the Upper Aventino Valley area. The cartography shows the orographic and hydrographic layout, with particular reference to the territory of Lama dei Peligni and its neighbouring villages. The representation highlights the relationship between morphology, settlement distribution and areas of environmental interest within the landscape context of the southern slope of the Majella. The locator map at the bottom right situates the mapped area within the broader study area.

3. *Transformations and destructions of the urban area of Lama dei Peligni*

The settlement of Lama dei Peligni has ancient origins, as evidenced by the remains of Neolithic villages near the present-day town (Rellini, 1914; Manzi & Macchiarelli 1989; Geniola 1989-1990). Little information is available regarding the development of the settlement in later periods, except for the discovery of ruins dating back to the Imperial Age (De Nino, 1891). However, remnants of medieval structures, part of the town's original core, are still visible along the eastern edge of the urban fabric. This original nucleus was relocated due to landslides that occurred from the Renaissance period onwards, causing part of the old village to slide downhill.

The first expansion of the built-up area towards the south-west resulted from the relocation of the medieval settlement, primarily due to the aforementioned landslide and reconstruction works implemented in the aftermath of the seismic events of 1627 and 1706. In the second half of the nineteenth century, a second phase of urban expansion occurred, fueled by the economic and social boost from the construction of the new Bourbon road, which provided the vital transport link to Naples (Notarbartolo, 1842). The First World War triggered the first major disruption of the local economy, marked by massive emigration of its inhabitants.

The socioeconomic crisis worsened further just a few years later with the devastating 1933 earthquake, with its epicentre in Lama. Perhaps due to the media coverage following the seismic event, the Fascist regime promptly addressed the housing emergency, resolving the issue in less than two years by constructing a cluster of buildings west of the historic centre, accommodating the families left homeless (Ridolfi, 2005).

The decisive blow came ten years later when the town suffered one of the most brutal devastations of the Second World War, which virtually annihilated the settlement. At that time, Lama dei Peligni and the neighbouring municipalities of the Upper Aventino Valley found themselves, tragically, along the Gustav Line, the German defensive belt—a circumstance that, as previously mentioned, resulted in the near-total destruction of the historic centre in December 1943. In a desperate attempt to halt the Allied advance, the town was mined using the ruthless

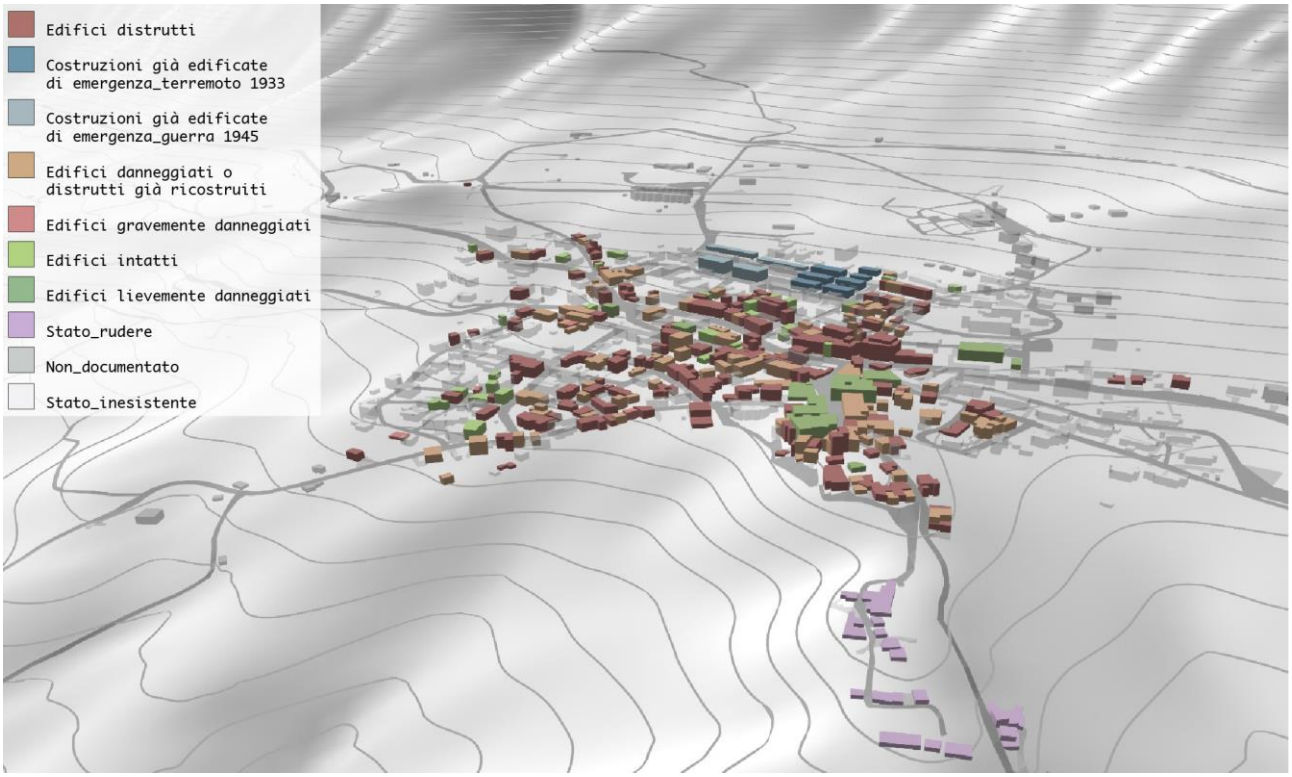

Fig. 4: Georeferenced 3D reconstruction of Lama dei Peligni's state, based on engineer De Petra's 1947 documentary analysis. It shows the preservation, damage, and reconstruction status of buildings after the 1933 earthquake and 1943 war operations, including related emergency constructions. The representation visualizes the intervention layering and urban fabric transformation's extent in relation to the territory's morphology.

'room-to-room' tactic, leaving no escape and reducing the town to ruins.

The post-war years followed, during which, without planning, similar constructions were added to the few surviving buildings to reconstruct the destroyed street frontages. In this regard, in 1947, a local technician, the engineer De Petra, was appointed to draw up the Reconstruction Plan, which was approved by the Ministry of Public Works in 1949 (Renzoni & Eramo, 2020). Although inadequate, the plan constituted the indispensable instrument to guide the urban redevelopment initiatives, which had, in fact, already been arbitrarily undertaken by private individuals using salvaged materials from the rubble.

Drawing on personal recollections, De Petra attempted to reconstruct the memory of what had been lost by drafting two 1:1000 scale plans—one depicting the existing conditions of the time and the other outlining proposals for the Reconstruction Plan. These documents hold significant value as graphic records, as they are the only drawings that document both the pre-existing structures and the destruction of the village. As often happened with reconstruction plans drafted for the Abruzzo territory, this planning effort could not address the housing emergency promptly, partly due to the absence of effective documentation on the original architectural heritage (Fig. 4). It is important to acknowledge the resilience of the population, which, in the face of each destructive event, has attempted to counteract it with a determined reorganisation of the settlement. However, the inability to implement adequate building control measures, combined with the economic impossibility of reconstructing the buildings and restoring their specific stylistic and architectural values—buried along with the rubble—ultimately resulted in an urban fabric characterised by anonymous constructions, detached from architectural language and lacking elements that could be linked to a local cultural identity.

4. Methodology and operational layers

The graphical readings and syntheses of the data emanate from the analysis of the urban evolution of Lama dei Peligni and its relations with the context (Fig. 6). As previously mentioned, the data are derived in the first place from the historical investigations supported by the digital surveys, including drone-based photogrammetric capture aimed at documenting the current state of the town, and multi-scale spatial observations.

A unified system was set up to support data aggregation, organisation, and contextual updating with a heterogeneous nature, aiming at gathering and systematising the investigation.

This enabled the comparison with the current objective conformation of the places, allowing the updating and iteration of the different analyses by creating a geo-database in a GIS environment.

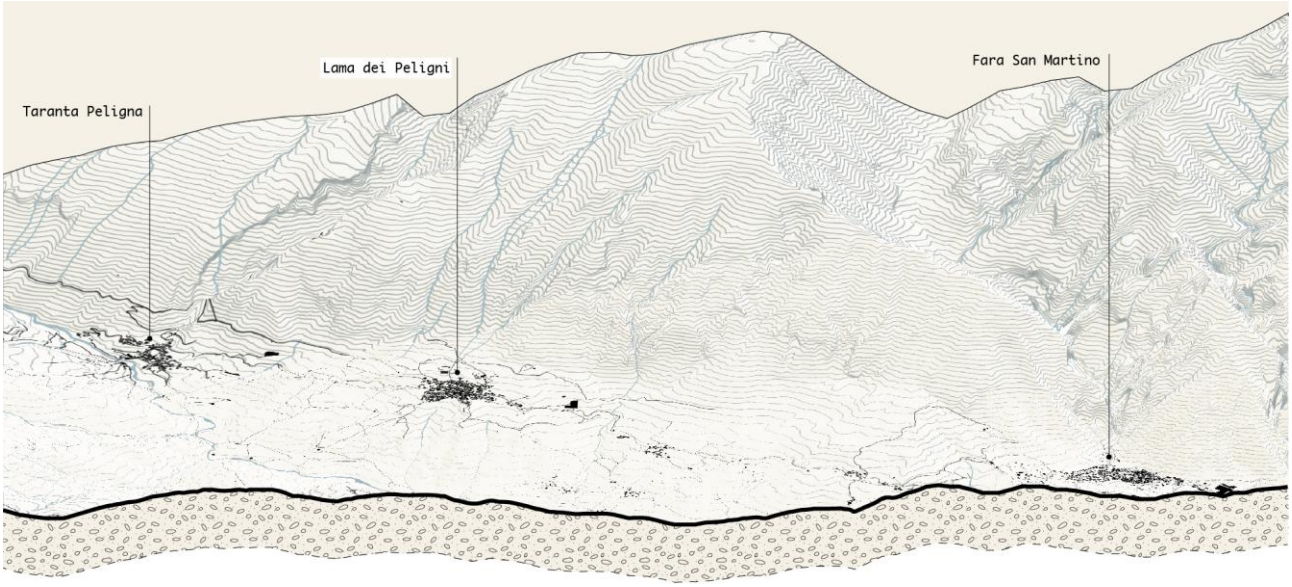

Fig. 5: Digital model: the cross-sectional profile of the Upper Aventino Valley provides an integrated interpretation of the eastern Majella slope's morphology and the settlement arrangement in relation to elevation and the river valley system.

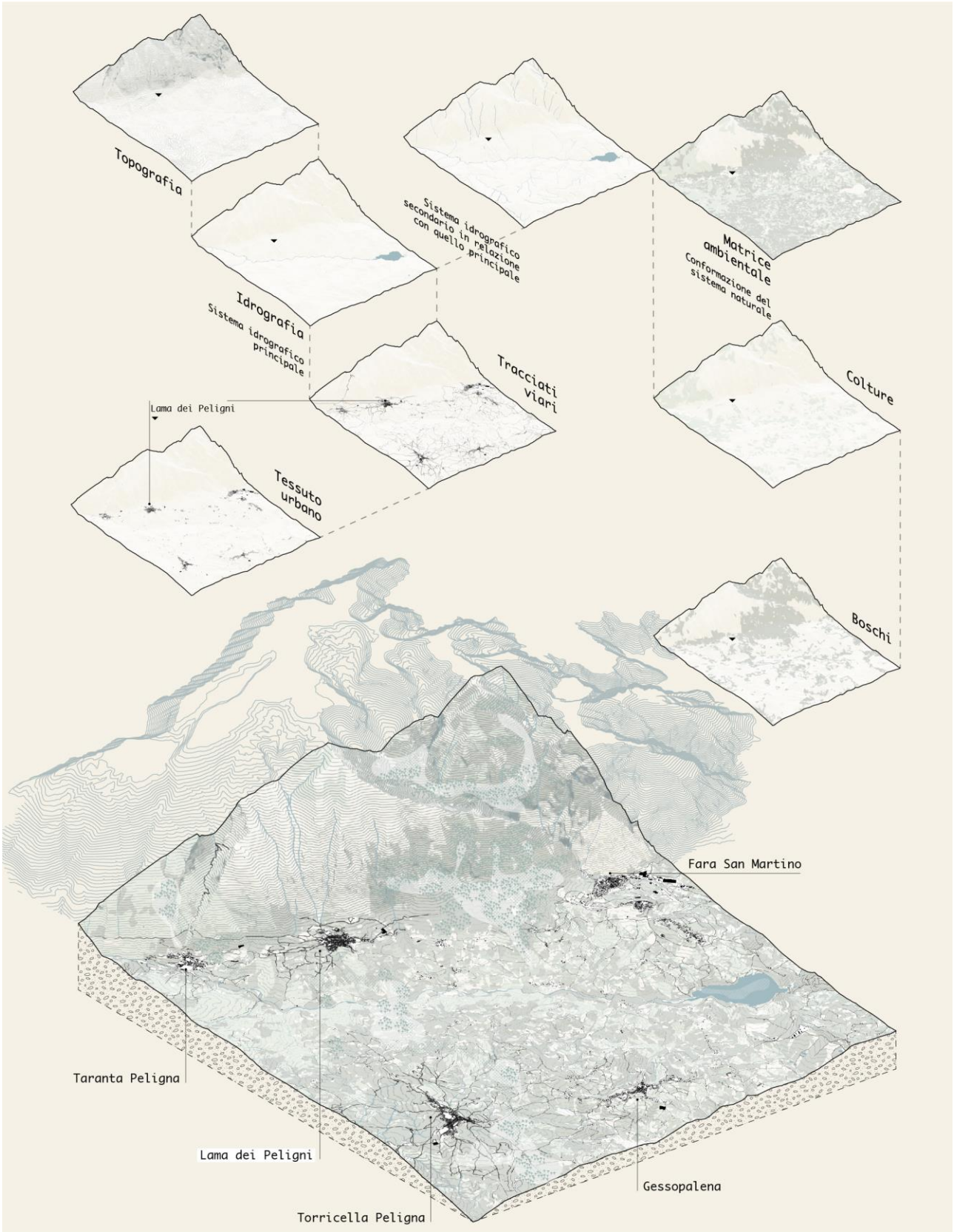

Fig. 6: Digital model: the representation shows the analytical layering of the territory, identifying and decomposing some fundamental components of the landscape. The layers allow for a thematic reading of the single analyses and comprehensive overview that emphasizes the relationships between natural and anthropized landscapes.

Initially, available geographical data in open format were surveyed from the main national and European catalogues. These data were then used to develop the base layers of the information system, employing the open-source software QGis.

Specifically, vector data from the Database Territoriale Regionale of Regione Abruzzo (Regione Abruzzo, 2007), hydrogeological hazard maps from the Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA, 2005), seismic hazard maps from the Istituto Nazionale di Geofisica e Vulcanologia (Meletti, Montaldo, Stucchi, & Martinelli, 2006), and data from the "Shared Knowledge System" (Regione Abruzzo, 2018) concerning cultural and landscape resources, protected natural zones, and protection constraints, were employed and systematised. Digital Terrain Models (DTM) were derived from two sets of 10m resolution raster datasets (Regione Abruzzo, 2015; Tarquini, Isola, Favalli, Battistini, & Dotta, 2023).

At the current state of research, no open data is available from LIDAR surveys or satellite imagery, which could help to model elevated surfaces. This lack confirms the marginality of the territory under examination and the need for scientific studies on it.

Three investigation areas of decreasing size and varying levels of detail were identified to structure the analytical interpretation of the places (Fig. 7). The first, at the wider scale, covers the territorial extent of the municipalities within the Majella Park; the second pertains to the municipalities of the Upper Aventino Valley, and the third examines the built area of the municipality of Lama dei Peligni at an urban scale. Each area involved selecting diverse thematic analyses and setting corresponding visualisations, defining input data resolution -the inherent detail level of the raw data- and output representation scale based on the investigation scale and study theme.

At the first level, data relating to orography, main hydrography, the position of inhabited centres, and protected areas were investigated. The infrastructural and hydrographic networks, as well as land use and hazard characteristics were analysed at the second level (Fig. 8). Finally, urban-scale analyses of the data relating to the historic centre of Lama dei Peligni were introduced. At the urban scale, data on the current state of buildings, including public spaces and internal roads in relation to the regional infrastructure network, were derived.

Subsequently, a detailed DTM (0.5m resolution) was generated through terrain elevation data interpolation, followed by an initial, highly simplified volume modelling based on available roof eaves height data.

Data acquired through the investigations were integrated in parallel, focusing on two priority aspects: optimising the knowledge of the urban

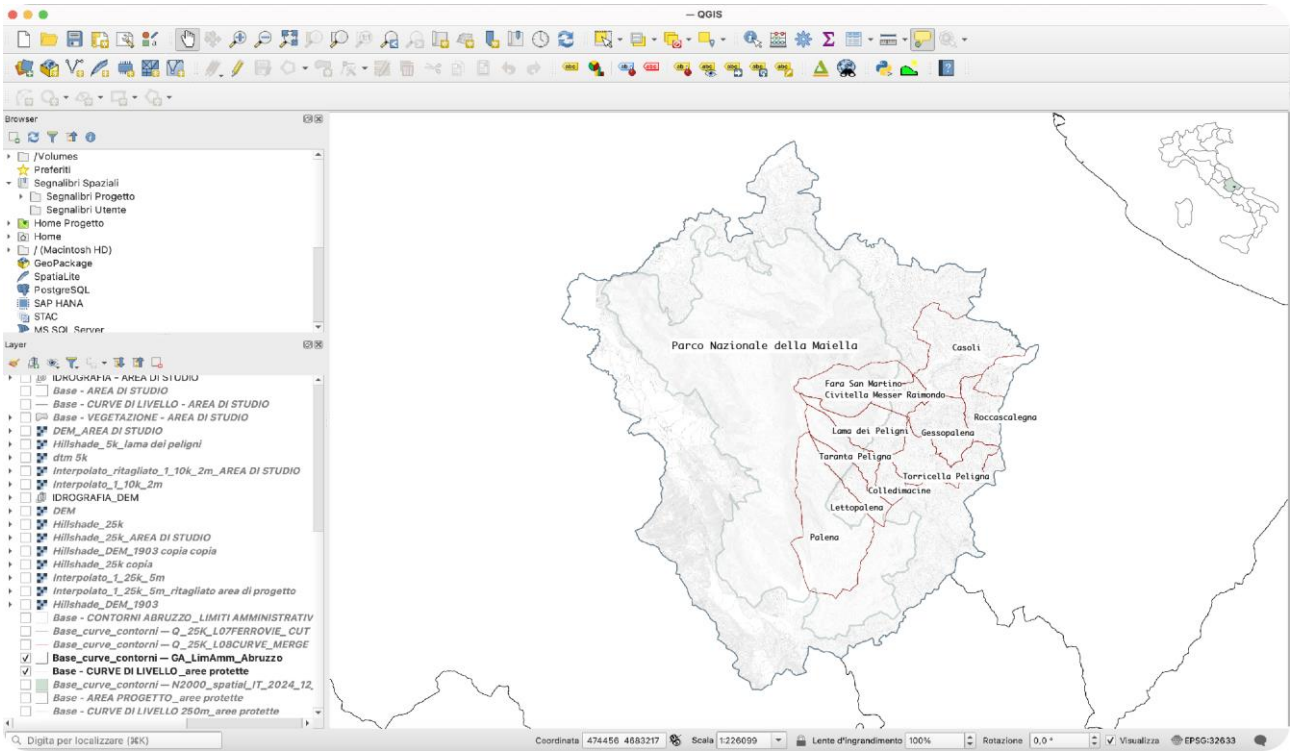

Fig. 7: Territorial and administrative context of the study area, documenting the organization of territorial data in the GIS.

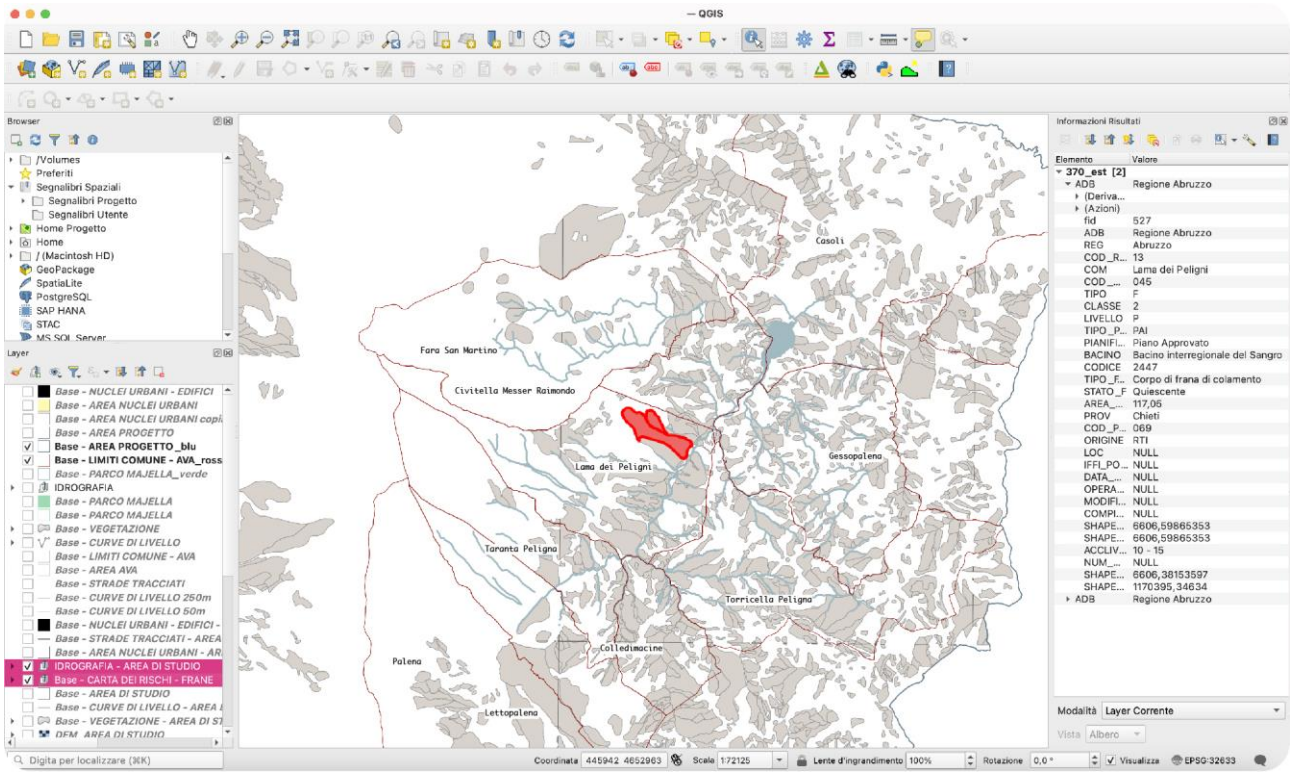

Fig. 8: The elaboration shows the integration of the official data of the Landslide Risk Map within the GIS system, allowing an integrated reading between hydrogeological hazard and the local settlement distribution, with focus on Lama dei Peligni.

fabric's current state, achieved through integrated surveys, and the systematisation within the geodatabase of the limited information on its intangible pre-war condition, for its enhancement.

The latter is derived from the research of historical memories deduced from few postcards and period photographs belonging to private collections and from the map drawn up for the reconstruction plan in 1947. As previously described, this depicts the consistency of the buildings before the war devastations.

The survey project constituted a central moment in the knowledge process, aiming to document the current state and reconstruct the past by tracing back in time.

The investigation through metric and qualitative representations constituted the essential basis for reconstructing the identity aspects of the places and for the comparison with the historical, architectural and environmental connotations of Lama dei Peligni. Consequently, Piazza Umberto I, beside San Nicola church, was chosen for in-depth studies involving surveys and three-dimensional modelling, being the core of the current historic centre, its main reference area, the ring of connection between past and present (Fig. 9-10). A survey was carried out using integrated methodologies, both aerial and terrestrial. In particular, for data acquisition with LiDAR systems, a UAV equipped with a multisensor system including LiDAR SLAM, Visual SLAM, radar, and GNSS was used to obtain accurate and complete data. The system was also equipped with a high-resolution RGB camera (9 MP). Images were acquired at variable altitudes and with mixed camera orientations, including both nadir and oblique views. This approach enhanced the 3D reconstruction of the surveyed area by improving coverage of vertical structures and ground morphology. The images were processed using Agisoft Metashape, generating orthophotos and a high-resolution Digital Surface Model (DSM) with a spatial resolution of 0.2 m. The outputs were georeferenced in the WGS84/UTM33N system and integrated into the GIS environment.

Elevation drawings were subsequently processed and integrated into the database, by linking them to planimetric vector representations. The DSM was exploited for simplified 3D modelling of the built environment within the GIS, with the support of orthophotos and spatial analysis tools. Concerning the reconstruction of pre-war consistency sources, the immediate post-war plan was integrated as a georeferenced raster layer, adapted to the

Fig. 9: The image sequence documents the drone survey stages conducted in the urban area.

reference system of current vector data. A descriptive field relating to the state of the buildings in 1947 (indicated in the legend as non-existent, destroyed, survived, reconstructed) was then introduced to be able to visualise in a synthetic representation the devastations of 1943.

Additionally, the historical photographs were dated and linked/attributed to the corresponding buildings to enable a direct comparison with current state representations. Finally, vector graphics software was employed to process the graphic analyses, creating synthetic and effective representations of investigation data for easier interpretation by a wider audience.

5. *Analysis of the transformations of the urban*

The investigation methodology used in the urban fabric analysis, integrating ground-based and drone-based digital surveys, enabled the reconstruction of its intrinsic relationships and those with the surrounding landscape. The use of digital tools to acquire three-dimensional data facilitated a comprehensive analysis of the sites, viewed as a whole from above and within the town's significant urban settings.

The building fronts constitute urban backdrops, endowed with a character of permanence that not only represents a fixation of their cultural value but an opportunity to restore new spaces of interaction with the natural dimension.

Specifically, the urban backdrop of Piazza Umberto I's southern elevation is highlighted, assuming the role of a relevant space contiguous with the buildings and providing a direct extension of the architectural space to the urban public level.

A space capable of creating a dialogue with the urban and natural surroundings that defines a privileged viewpoint recognised in the Belvedere Verlengia and the Palazzo della Cultura, contrary to that of the urban backdrop of the northern elevation, which appears dense and compact (Fig. 11).

The historical images compared with the current surveys allowed us to understand the intercurrent relationships between the simple architectures placed in relation to the urban spaces and the qualifying environmental context, thus enabling the verification of the views to be privileged. The survey activities, translated into targeted graphic representations and readings, have provided the necessary support to highlight the intangible values hidden in historical memory,

valid to direct conscious proposals for valorisation with perceptive views that assume their relevance in the moment of comparison with the iconographic analysis. The visualization and analysis of urban values through digital survey techniques are essential to disclose both tangible elements and hidden intangible layers within historic townscapes (Brusaporci, 2014).

Therefore, urban fabric transformations were analysed retrospectively from the current state, comparing the surveys with the historical images in the database. These comparisons have enabled the deduction of the main variations in the volumes and roofing of the built environment to achieve an overall understanding of its original extent and spatial layout.

Subsequently, the analysis concentrated on the area surrounding the main square, where the examination of photographic records enabled a more detailed investigation of the changes to the building facades, identifying and emphasising the original architectural and decorative features as material signs to be valorised in the process of restoring the cultural identity of the town.

The results of the investigations allow us to document, to date, the persistence of a small historic nucleus consisting of the baronial palace and the church of San Nicola with the bell tower.

The distinctive architectural character of these buildings ensured that, during reconstruction, their original features were preserved despite some alterations, such as the obliteration of two church windows.

This nucleus is bordered by buildings where original historical elements from the 15th to 19th centuries are still visible, alongside others rebuilt in the immediate post-war period, reflecting an effort to align with the local architectural traditional lexicon. Nevertheless, the overall situation is severely compromised in the immediately adjacent areas: many of the buildings damaged in 1943 have been abandoned due to insufficient economic resources for their reconstruction and supplanted, in the 1970s and 1980s, by interventions lacking any relation with the identity of the place.

Many of these have been demolished, such as the premises of the Cooperative Bank, which originally defined the western elevation of Piazza Umberto I, now replaced by an empty, unresolved space adjacent to the main road (Fig. 12).

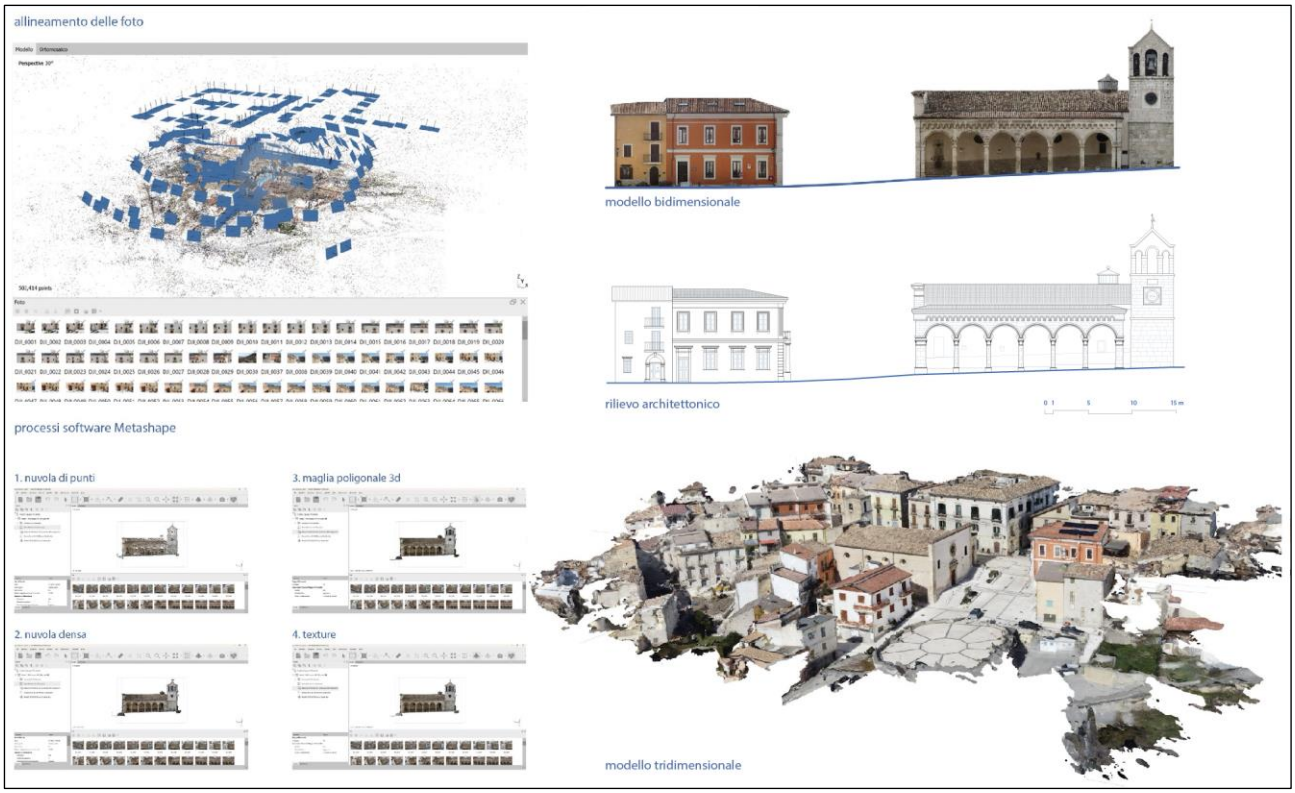

Fig. 10: The table illustrates the workflow for processing data from photogrammetric survey.

6. Results and conclusions

In summary, as outlined in the preceding sections, the research has explored the relationships between urban development, territorial features, and the historical forces that have shaped the fragile Upper Aventino Valley.

Within this framework, Lama dei Peligni was selected as a representative case study of the history and transformations of numerous central Apennine towns, affected by recurrent destructive events, unsuitable reconstructions, and abandonment.

The research methodology, integrating historical research, digital surveys, and graphic analyses, and supported by the use of GIS tools, proved effective in structuring the investigations and achieving the results: highlighting the material and immaterial traces of the persistence of the place's cultural identity, along with the significant naturalistic values that define the context.

Accordingly, the graphic representations served a dual purpose: as a tool for analysing and synthesising the collected data and as a medium for enhancing and disseminating the findings to both specialist and broader audiences. Establishing a foundation of scientific knowledge, which fosters greater collective awareness, is essential for guiding informed design decisions that can generate regenerative transformations, propose alternative visions, and re-establish a close relationship between urban public space, the community and the landscape. It is an opportunity to channel attention on punctual and minimal interventions, conveying emotional and perceptual meanings in close relation to the surrounding environment. From a future perspective, potential actions include establishing a museum of territorial memory, which could serve as a focal point for revitalising local cultural identity and landscape values. Additionally, despite the painful historical associations, the paths leading to the Gustav Line could be promoted, highlighting how it exploited the territory's rugged terrain and numerous natural hideouts, with trenches concealed in the Abruzzo mountains to hinder the

Fig. 11: Orthophoto of the building fronts defining the backdrops of Piazza Umberto I in Lama dei Peligni.

Fig. 12: Graphic elaboration of the premises of the Cooperative Bank resulting from integrated survey and comparative analysis with historical photographs.

advance of the allies in Italy suggesting itineraries designed for remembrance and historical-naturalistic exploration. Pages of history marked by sadness can be reconciled with the landscape's harshness and beauty, a landscape holding millennia of stories and values which, combined with local traditions, can provide a foundation for informed efforts to enhance the territory and its isolated towns.

In conclusion, the urban and environmental regeneration proposal looks towards the impressive natural landscape of the Majella National Park, "the mother mountain," where landscape values intertwine with immaterial, sacred, and secular meanings.

REFERENCES

Baratin, L., Bertozzi, S., & Moretti, E. (2015). The geomorphological transformations of the city of Urbino: The design of the city analysed with GIS tools. *SCIRES-IT - IT - SCIentific RESearch and Information Technology*, *5*(1), 41–60. https://doi.org/10.2423/i22394303v5n1p41

Basso, A., Palestini, C., & Marzetti, F. (2022). Historic paths of Abruzzo: Shared information networks for enhancement of the cultural heritage of the Mediterranean. In M. Ricci (Ed.). *MedWays. Open Atlas* (pp. 749-760). Siracusa: LetteraVentidue.

Bouchenaki, M. (2003). The interdependency of the tangible and intangible cultural heritage. In *Proceedings of the 14th ICOMOS General Assembly and International Symposium: Place, Memory, Meaning: Preserving Intangible Values in Monuments and Sites*. Paris: ICOMOS.

Brusaporci, S. (2014). Issues of historic town surveying: Visualizing urban values. *SCIRES-IT - IT - SCIentific RESearch and Information Technology*, *4*(2), 63–80. https://doi.org/10.2423/i22394303v4n2p63

Burri, E., & Latini, M. L. (2002). *Parco Nazionale della Majella, la montagna dei lupi, degli orsi e dei santi eremiti*. Pescara: Carsa Edizioni.

Caffio, G. (2022). *Atlante dei borghi solitari d'Abruzzo*. Siracusa: LetteraVentidue.

Campanelli, A. (2010). *La montagna di Celestino "Maiella Madre"*. Milano: Mac.

Colanzi, M., & Rossetti, A. (2014). *Memorie d'acqua. I Mulini nella valle del Sangro-Aventino*. Ortona: Menabò.

Continenza, R., & Trizio, I. (2012). Tra strumenti classici e geodatabase 3D: il piano di ricostruzione post sisma 2009 del centro storico di Bugnara (AQ). *SCIRES-IT - IT - SCIentific RESearch and Information Technology*, *2*(2), 29-40. https://doi.org/10.2423/i22394303v2n2p29

De Nino, A. (1891). Lama de' Peligni: antichità rinvenute in vari luoghi del comune : notizie degli scavi : settembre / 15 ott. 1891. *Atti della R. Accademia dei Lincei. Memorie della Classe di scienze morali, storiche e filologiche*, ser. 4, 9, 1891.

Geniola, A. (1989-1990). Fonterossi (Lama dei Peligni, Prov. di Chieti). *Rivista di scienze preistoriche*, XLII(1-2), 380-381.

Istituto Superiore per la Protezione e la Ricerca Ambientale (2005). *Inventario dei fenomeni franosi in Italia.* Retrieved from: https://idrogeo.isprambiente.it

Knowles, A. K. (2008). GIS and history. In A. K. Knowles (Ed.*), Placing history: How maps, spatial data, and GIS are changing historical scholarship* (pp. 1–25). Redlands, CA: ESRI Press.

Lembo, R., Leserri, M., Pasuy Arciniegas, W., & Rossi, G. (2024). Surveying of a Cultural Landscape Through Documentation of its Tangible and Intangible Component: the Sanctuary of Las Lajas. *SCIRES-IT - SCIentific RESearch and Information Technology*, *14*(1), 187-202. http://dx.doi.org/10.2423/i22394303v14n1p187

Leserri, M., & Rossi, G. (2023). The Digital Documentation of the Cultural Heritage Between Public Interest Versus Private Property. Survey and Research on the Immacolata Square in Martina Franca (Apulia, Italy). *SCIRES-IT - SCIentific RESearch and Information Technology*, *13*(2), 27-42. http://dx.doi.org/10.2423/i22394303v13n2p27

Manzi, G., & Macchiarelli, R. (1989). L'Uomo "pre-neolitico" della Maiella (Lama dei Peligni, Abruzzo.) Datazione radiometrica dello scheletro. Rivista di Antropologia, 67, 325-328.

Meletti, C., Montaldo, V., Stucchi, M., & Martinelli, F. (2006). *Database della pericolosità sismica MPS04*. Istituto Nazionale di Geofisica e Vulcanologia (INGV). https://doi.org/10.13127/sh/mps04/db

Ministero dell'Ambiente e della Sicurezza Energetica (2024). *SIC, ZSC e ZPS in Italia*. Retrieved from https://www.mase.gov.it/portale/web/guest/sic-zsc-e-zps-in-italia

Notarbartolo, E. (1842). Descrizione della strada o dei trafori sul Monte Majella, nella Provincia di Abruzzo Citra, descritta dall'Intendente Marchese di S. Giovanni Sciara, ed eseguita sotto la sua amministrazione. *Annali civili del Regno delle due Sicilie*, 29, 114-117.

Palestini, C. (2004). Le vie degli Abruzzi. Percorsi iconografici: letture e prospettive di contesti ambientali. In C. Gambardella & S. Martusciello (Eds.), *Le Vie dei Mercanti. Da Luca Pacioli all'ecogeometria del territorio. Atti del primo forum internazionale di studi, Capri 6-7 giugno 2003* (pp. 561–573). Napoli: Edizioni Scientifiche Italiane.

Palestini, C. (2012). Paesaggi culturali: Materialità e spiritualità nelle montagne d'Abruzzo. In C. Gambardella (Ed.), *Less More. Architecture Design Landscape. Le vie dei Mercanti – X Forum Internazionale di Studi* (pp. 1288–1294). Napoli: La Scuola di Pitagora.

Palestini, C. (2017). Exploring the landscape through drawings, with historic routes and contemporary directions. In G. Amoruso (Ed.), *Putting tradition into practice: Heritage, place and design. INTBAU 2017. Lecture Notes in Civil Engineering* (Vol. 3, pp. 928–937). Springer, Cham. https://doi.org/10.1007/978-3-319-57937-5_95

Palestini, C. (2018). Time-line/Linee di lettura materiali e immateriali nella trasformazione della città. In R. Salerno (Ed.), *UID 2018 – Rappresentazione materiale/immateriale – Drawing as (in) tangible. Atti del 40° Convegno internazionale dei Docenti delle discipline della Rappresentazione / Proceedings of the 40th International Conference of Teachers of the Disciplines of the Representation* (pp. 727–734). Roma: Gangemi.

Pezzetta, A. (1994). *Casa rurale, ambiente, agricoltura e società a Lama dei Peligni dal 1700 ai giorni nostri*, Monfalcone: Savorgnan.

Pirinu, A., Mocci, S., & Sanna, G. (2024). Digital tools for the knowledge, preservation, and enhancement of 20th-century military heritage: A case study from Sardinia. *SCIRES-IT - IT - SCIentific RESearch and Information Technology*, *14*(2), 63–78. https://doi.org/10.2423/i22394303v14n2p63

Pratesi, F. (1996). *Abruzzo. Una natura da scoprire*. Pescara: Carsa Edizioni.

Presidenza del Consiglio dei Ministri, Dipartimento della Protezione Civile (2024). *Classificazione sismica aggiornata al 31 agosto 2024.* Retrieved from https://rischi.protezionecivile.gov.it/it/sismico/attivita/classificazione-sismica/

Regione Abruzzo (2007). *Database topografico regionale (DBTR), scale 1:5.000, 1:10.000, and 1:25.000 – Edizione 2007*. Retrieved from http://opendata.regione.abruzzo.it

Regione Abruzzo (2015). *Modello digitale del terreno, risoluzione 10 × 10 m*. Retrieved from http://opendata.regione.abruzzo.it/opendata/Modello_digitale_del_terreno_risoluzione_10x10_metri

Regione Abruzzo (2018). *Sistema delle Conoscenze Condivise*. Retrieved from http://opendata.regione.abruzzo.it/tema/sistema-conoscenze-condivise-0

Rellini, U. (1914). L'età della pietra sulla Maiella. *Bullettino di Paletnologia Italiana*, ser. 4, vol. 10, 30-42, 95-100.

Renzoni, C., & Eramo, E. (2020). Il rilievo della memoria/The survey of memory. In A. Arena, M. Arena, R.G. Brandolino, D. Colistra, G. Ginex, D. Mediati, S. Nucifora, & P. Raffa (Eds.). *Connettere. Un disegno per annodare e tessere. Atti del 42° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione/Connecting. Drawing for weaving relationships. Proceedings of the 42th International Conference of Representation Disciplines Teachers* (pp. 2640-2661). Milano: FrancoAngeli.

Ridolfi, N. (2005). Economia di una catastrofe: il terremoto della Majella in epoca fascista. Milano: FrancoAngeli.

Rossi, M. (2018). Learning from the past: Water heritage. Landscape patterns around Parma. In G. Amoruso (Ed.). *Putting tradition into practice: Heritage, place and design. INTBAU 2017*. *Lecture Notes in Civil Engineering* (Vol. 3, pp. 1001–1010). Cham: Springer. https://doi.org/10.1007/978-3-319-57937-5_103

Salerno, R. (Ed.). (2018). *UID 2018 – Rappresentazione materiale/immateriale – Drawing as (in) tangible. Atti del 40° Convegno internazionale dei Docenti delle discipline della Rappresentazione / Proceedings of the 40th International Conference of Teachers of the Disciplines of the Representation*. Roma: Gangemi.

Sicignano, C. (2018). Memories of Stone Among the Water Ways: The Mills Valley in Gragnano, Naples. In: Amoruso, G. (eds). *Putting Tradition into Practice: Heritage, Place and Design. INTBAU 2017. Lecture Notes in Civil Engineering*, vol 3. Cham: Springer. https://doi.org/10.1007/978-3-319-57937-5_106

Tarquini, S., Isola, I., Favalli, M., Battistini, A., & Dotta, G. (2023). *TINITALY, a digital elevation model of Italy with a 10 meters cell size (Version 1.1)*. Istituto Nazionale di Geofisica e Vulcanologia (INGV). https://doi.org/10.13127/tinitaly/1.1