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Resilience path.

The regeneration of fragile territories between the Mediterranean coast and the inner areas

Chiara Ravagnan*, Domenico D'Uva**, Chiara Amato*, Giulia Bevilacqua*, Ozgun Gunaydin*

Keywords: resilience paths, inner areas, Mediterranean coast, urban regeneration.

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Abstract:

The paper illustrates a research path deepened within the participation in the Cluster “Medways” promoted by the University of Trento and the Accademia dei Lincei. The research represents a joint path that integrates the project of the PDTA Department (Sapienza) “Resilience paths. The relaunch and reuse of minor railways lines for the regeneration in fragile territories” and the project “Territori Fragili” of the DASTU (Politecnico di Milano). The activity focuses on the abandoned minor railway lines connecting inner areas to the Mediterranean coast, investigating, with an interdisciplinary perspective and methodology, the opportunities that emerge from a possible strengthening of the bicycle/pedestrian system and proposes a sustainable urban project for Lanciano, along the Ferrovia Adriatica Sangritana.

The Mediterranean territories between fragility and polarization. Research paths

The processes of polarization that feed the gap between coastal and inner areas are particularly evident in the countries of Mediterranean and Northern Europe (Espon, 2017; 2018) and place accessibility at the center of the theme of territorial regeneration in coherence with the needs of socio-economic rebalancing and landscape enhancement.

The research “Resilience paths. Regeneration of fragile territories from the Mediterranean coast to inner areas”, deepened within the participation in the Cluster “le Vie del Mediterraneo/Medways” promoted by the University of Trento and the Accademia dei Lincei (coord. Mosè Ricci) is the joint path that integrates some national and international research paths promoted by the Sapienza University of Rome and the Politecnico of Milan: the project of the PDTA Department “Resilience paths. The relaunch and reuse of minor railways line for the regeneration of fragile territories. Practices in Italy and Spain”¹ (Ravagnan, Amato, 2020) and the project “Territori Fragili” of the DASTU of the Politecnico di Milano. This joint research path focuses on the divested (disused and with suspended service) minor railway lines connecting inner areas to the Mediterranean coast, investigating, with an interdisciplinary perspective, the opportunities that emerge from a possible strengthening of the bicycle/pedestrian system within the framework of an intermodal and multi-scalar mobility system (Ravagnan, D'Uva, Amato, Bevilacqua, 2020a, 2020b).

The realization of greenways connecting the Mediterranean coast to inner areas is a scenario of sustainable development (Lille Declaration, 2000) and a proactive strategy of resilience (Pike & al., 2010) for fragile territories from the environmental, social, and economic point of view. The complexity and richness of these territories, crossed by stratified systems of territorial networks, require the deployment of an integrated and multi-scalar approach, through inter-municipal strategic planning and urban projects.

In this framework, the joint path is aimed at harmonizing traditional urban planning approaches, with other data analysis to improve the sustainability of urban design. To this end, the study also involves an experimentation on a specific scope, regarding the reuse of the Ferrovia Adriatica Sangritana (FAS) in Abruzzo Region, which is affected by phenomena of divestment and suggests regeneration

processes, developed in an interdisciplinary Master Degree Thesis (Gunaydin, 2021). The analysis and the proposal have been held by combining the morphological, environmental-landscape and functional analysis of the territory, traditional within the urban planning discipline (Ravagnan, Amato, 2020) with innovative quantitative methodologies by resorting to the use of GIS in parallel with NURBS modelers, interfaced with parametric digital tools (D'Uva, Eugeni, 2021) such as Python and Tableau. The multidisciplinary analysis held on the territory configures the reuse of the decommissioned FAS line in the section San Vito Marina - Lanciano as a reference structure for strategic planning and the sustainable urban project for Lanciano (fig. 1).

Resilience paths in Abruzzo, through infrastructural, environmental and historical-cultural networks. Paths of resilience.

Research objectives and results

The research "Resilience paths. The relaunch and reuse of minor railways for the regeneration of fragile territories" has placed the theme of tangible and intangible networks at the center of a reflection on the decline and revitalization of inner areas, as keys to deepen the territorial fragility and to identify intervention strategies (Ravagnan, Amato, 2020).

The concept of "resilience" (Pike & al., 2010), is the bearer of some lines of action shared at European level and increasingly related to the theme of fragility, vulnerability and marginalization of territories outside the basin of large urban centers (Battisti, 2020). In particular it is understood as the ability of a territorial system to respond to changes in the context and to rearrange itself in a state of equilibrium :

- in relation to the scarcity of resources, a decreasing population and constant aging, developing new forms of planning and management of material and intangible networks connected to ICT, inclusive and "on demand" mobility, with the support of forms of institutional partnership and associated management of services (Battisti, 2020);
- through the promotion of development and mobility models based on territorial specificities and endogenous resources as well as on the diversification of design solutions in an anti-fragile perspective (Blecic, Cecchini, 2016) to manage the conditions of uncertainty and the variability of seasonal flows;
- through proactive sustainable development actions linked to the circular, green and low-carbon economy by experimenting with models of non-polluting housing, activities and transport, enhancing spaces capable of providing ecosystem services (UN, 2005), through a participatory approach, linked to dissemination, awareness, empowerment.

In particular, the research was aimed at defining lines of intervention for:

- the relaunch of the ordinary railway service, in the framework of a functional approach that sees mobility as a fundamental right of citizenship;
- the reactivation of abandoned railway lines for tourist services, through the use of historic trains for the setting up of routes to rediscover historic territories, landscapes and villages;
- the reuse of abandoned railway lines for the design of cycling networks represents an opportunity for the construction of new green networks (EC, 2013) that innervate the territory in urban and extra-urban areas, a form of slow tourism that enhances the landscape and natural environments.

Medways. From the Adriatic coast to the inner areas of Abruzzo

As part of the participation in the *Medways* research cluster, the presence of a system of minor railways connecting the Mediterranean coast and inner areas emerged as a possible structure for a cycling system capable of decongesting coastal mobility in the summer seasons and enhancing the territory of the coastal regions for sustainable tourism (fig. 2).

Among the fields of study addressed, the Abruzzo territory is an emblematic case for a reflection on the strategic role of the abandoned railways for the purposes of territorial rebalancing, landscape and environmental enhancement as well as urban regeneration of the minor centers and widespread heritage. In this context, the area constituted by the Provinces of Chieti and L'Aquila is characterized, on one hand, by a scarce presence of the railway network system mainly caused by its orography which has inhabited centers that are difficult to connect to each other, with related problems of accessibility; on the other hand by a complex system of ecological, historical and infrastructural

networks that connect the Adriatic coast to the internal areas of the Apennine ridge through paths dotted with historic centers.

In particular, among the many disused or underused lines in Abruzzo, the line from San Vito Marina to Castel di Sangro, which is part of the FAS lines and not currently active, plays a strategic role. As it crosses the region, this line encounters many valuable minor historical centres (San Vito Chietino, Lanciano, Castel Frentano, Castel di Sangro), areas of high naturalistic value (from the "Grotta delle Farfalle" Regional Nature Reserve on the coast to the Maiella National Park), signs of the stratification of the territory (such as the network of sheep tracks) and widespread historical elements (**fig. 3**); the FAS connects the Basso Sangro-Trigno inner area with the Adriatic infrastructure system and the coast near Ortona, known for its very rugged and inaccessible urban landscape and for beaches and cliffs whose icon is the famous "trabucco", immortalised as a "fishing machine" by Gabriele d'Annunzio. Along this stretch of coastline, the FAS was connected to the Adriatic railway line that, in this section from Ortona to Vasto, is now divested and reused as the "Via dei Trabucchi" greenway² (Ravagnan, Amato, 2020).

The Ferrovia Adriatico Sangritana, a secondary railway, was inaugurated in 1912 after a long and troubled gestation period of more than half a century. In the early years of its construction, the FAS constituted the only direct link between the Frentane and Sangro areas. However, the Second World War caused extensive damage to the railway, leading to the first suspension of service in 1943. The line was reactivated in 1945 by a "Cooperativa di Lavoro" (Work Cooperative) for the voluntary reconstruction of the railway, and continued to perform its function until the 1980s when the Ministry of Transport undertook extensive renovation works. Despite this, the Sangritana's traffic declined due to the growing proliferation of road transport. This led to the idea of exploiting the railway line for tourism in 1987: the "Il Treno della Valle" ("The Valley Train").

The 1990s marked a period of profound technological and infrastructural changes for the FAS, and in 2005, it was definitely suspended between Lanciano and Castel di Sangro. Finally, with the opening of the track-doubling between Ortona and Casalbordino by RFI, the FAS trains also abandoned the historic station of San Vito Marina and the old route to stop, via a new connection, in the new RFI station of San Vito - Lanciano.

The old railway route up the San Vito Chietino ridge, which once guaranteed accessibility to the historic centres of San Vito (**fig. 4**) and Lanciano, is now replaced in the first section by the new railway network, and abandoned. Its closure, in addition to causing a state of abandonment of the territory, has interrupted a network of material and immaterial cultural values between the coast and the inland areas.

The reuse of railway lines and soft mobility systems. Methodological references for data analysis

Fragile Territories. Research objectives and methodologies

Politecnico di Milano's DASTU, within the project Territori Fragili, has been carrying out since 2018 a research project on "Territorial Fragilities" in Italy (Dezio et al., 2020). Within the framework of the interdisciplinary research in progress at the time of writing this paper, an in-depth study on the experimental mapping of the coastal and hilly territory refers to the Costa dei Trabucchi. This territory has an orographic configuration characterized by deep river valleys transversal to the coastline, interspersed with hilly ridges, where the most populous towns are located. On the contrary, those located directly on the coast suffer from a seasonal variation of the population, making it problematic to define mobility policies compatible with both the winter and the more complex summer structure. The undertaken research work aims to improve intermodal connections using soft mobility strategies to connect the hill towns with the coast. The case study of this work investigated a disused section of the railway line between Lanciano and San Vito Chietino. The networks in the area follow the constraints imposed by the orography; the fast networks: road, highway, and rail - which connect over long distances are located along the coast; the slow ones: rail and road - are transversal. The intermodal nodes that link these two types of connections belong to the railway network and are the stations of San Vito Chietino and Lanciano, the subject of a more in-depth analysis.

The Abruzzi territory. Territorial features and digital ecosystem

In this area, the disused railway line, which connects the coast with the built-up area of Lanciano, overcomes the considerable height difference with an ingenious series of viaducts (**fig. 4**) and helical tunnels. It was precisely from this stretch that the need arose to tackle the analysis of the connections, bearing in mind the orography as a critical element for the management of soft mobility. This analysis was carried out using the tools of territorial analysis such as GIS in parallel with NURBS modelers, interfaced with parametric digital tools (D'Uva, Eugeni, 2019). The choice to operate with NURBS technology instead of the usual Mesh (D'Uva, Eugeni, 2021) was driven by the accuracy and effectiveness of multiscalar manipulation, made possible only by the mathematical nature of NURBS elements. In order to create the parametric 3D model of the study area, at first, Digital Terrain model (DTM), roads and buildings were retrieved by selecting them from the Open Data cartographic database of the Abruzzo Region.

Thanks to this digital ecosystem, it was possible to model the landscape both at the Lanciano and San Vito by analyzing the two head stations in detail, which required further in-depth analysis. The three-dimensional modeling of the territory, including rail, road, and built-up areas, was beneficial for undertaking a quantitative analysis. For soft mobility, it has been necessary to analyze the road slope, developed globally for all the roads of the territory, identifying those with a value lower than 10%. This analysis was carried out by applying an ad hoc algorithm to the network of roads that highlighted the smoothest route for cycling.

The analysis was applied to the area of San Vito Chietino, (**fig. 5**) where the disused station is a connection node with the Costa dei Trabucchi bike path, on which GPS mapping was performed. From this node, the connection with the current FS San Vito-Lanciano station has been reported through the decommissioned section, and the already-explained slope algorithm has been applied to identify on the road network which is the most straightforward connection with the decommissioned helical section.

A slope analysis algorithm has been applied to the Lanciano node, where the station currently in operation has a moderate difference in height for the center of the town instead of the decommissioned station, which is easier to access.

The algorithm applied for the San Vito node uses the benefits of parametric design, with which a more restrictive selection of controlled gradient routes was made. An alternative proposal for this area is to connect the working station node with the decommissioned line and proceed along the line to the downtown station. This methodology allows a fluid elaboration of the three-dimensional model starting from the DTM, although with all the limits imposed by the computation time of the single steps. In order to achieve this fluidity, it was necessary to set compensating parameters that could optimize the accuracy of the model with the real possibility of processing it. The first involved the DTM produced by the Abruzzo region, which had a 10-meter spacing; the one used was interpolated and transformed into a raster with a 40-meter spacing.

This selection was indispensable not only for the already stated computational reasons but also for optimizing the representation.

A sustainable urban project for Lanciano. Regeneration scenarios

An urban regeneration project in Lanciano between mobility and historic Networks

The characteristic of Lanciano as a crossroad is the starting point of the proposal of an Urban project in the framework of the topic and approaches of the joint research path "Resilience paths. The regeneration of fragile territories between the Mediterranean coast and inland areas". For these reasons, this thesis aims to bring a new perception on the regeneration of Lanciano historic centre and especially the disused Sangritana Railway Line between mobility and historic networks, harmonizing traditional urban planning approach with GIS and data analysis tools such as Python and Tableau.

In particular, the research developed in the thesis "*An urban regeneration project in Lanciano: The Disused Sangritana Railway Line Between Mobility and Historic Networks*" (Gunaydin, 2021) starts with an integrated approach analysing the territorial context of Chieti Province and census data which also brings demographic and social aspects into the study as inputs (**fig. 6**).

Territorial analysis combines traditional environmental, historical, morphological and functional systems with the spatial data analyses and real user data including Strava pedestrian and bike heat maps as well as real-time traffic data using HERE Maps API and Python, with a special focus on the urban area of Lanciano (**fig. 7**). Besides, on two selected parts of the proposed cycle paths next to the main stations, an elevation and slope research has been conducted with three different methods including a number of spatial calculations on QGIS together with elevation data retrieval through Google Maps API and Python. During the research, PyQGIS and file handling in Windows workflows using Python were experienced, which made managing a big number of geographical data from Abruzzo Open Data Platform easier.

All the analyses lead to the evaluation and definition of goals resulting with a master plan proposal for the sustainable Urban Project (**fig. 8-9-10**) which takes into account a model of public space based on a "green infrastructure" (EC, 2015) and a 15 minutes walking distance accessibility of the local centralities (Moreno, 2020).

The reuse of the line constitutes the reference for the regeneration of a system of abandoned or underused open spaces, to build a network of new green squares, public gardens or urban gardens, and for the construction of a secondary system of cycle and pedestrian paths. The dense and regular urban zones are configured as pedestrian areas or limited traffic zones in consistency with the model of the Spanish "superillas" (Rueda, 2016). The reuse project also represents the "fil rouge" of regeneration operations of the railway and architectural-urban heritage such as the old Lanciano station, the main churches and the built fronts.

Research paths for the Mediterranean and new scenarios for sustainable and multi-actor urban projects

The multidisciplinary analyses and assessments carried out in the area represent the basis for the knowledge and the interpretation to configure a multiscale and integrated urban project that considers the reuse of the disused FAS line as a spatial backbone. The different scales are coordinated in a project of environmental regeneration, infrastructural mending, and landscape fruition. The project takes its strength, at territorial scale, from the presence of the new railway line, to which it is connected with intermodal nodes, and from the connection with important natural and historical routes such as the Greenway dei Trabucchi along the coast and the Tratturo l'Aquila-Foggia. The cycle network in this area of the province could represent a system of rediscovered functional and cultural relations, which are also indispensable to overcome scenarios of depopulation in inner areas and to rebalance tourism and road pressures on the coast. This new network can create opportunities for synergic and sustainable interactions between the inner areas and the coastline that are based on the enhancement of places and on development objectives defined at national and international level (National Strategy for Inner Areas, 2013; National Strategy for Sustainable Development, 2017).

The proposed approach, that combine research and design practice, suggests a holistic approach that face the design of a intermodal rail-bike system, taking into account the main problems (environmental vulnerability, accentuated slopes, disused structures, intersections with major infrastructures) and at the same time the significant opportunities (regional and national accessibility nodes, cultural routes, historical urban landscape) of fragile territories.

The intervention on railways as new axes of sustainable mobility is therefore configured as an interdisciplinary field of experimentation for the regeneration of fragile territories capable of guaranteeing a resilience based on adaptation to socio-economic changes and demographic flows, the enhancement of endogenous resources, stimulating a transition to green and circular economies. In this scenario related to the arising attention on climate and health issues, the role of soft mobility, especially if supported by electric recharging stations, constitutes a priority line of intervention to build resilience paths for cities and territories and is important not only for the purpose of landscape enhancement for sustainable tourism needs but also as an alternative to private mobility and public transport, affected by social distancing rules.

The implementation of these projects, as it emerges from the project proposals financed in the framework of the SNAI and by European funds (ERDF fund in particular), as well as in the "Missions" of the Italian PNRR, assumes however a long-term horizon, beyond the covid and post-covid phase, for the regeneration of inner peripheries (Espon, 2017) based on the different forms of infrastructural

and technological reconnection as well as on the physical and functional regeneration of the architectural and urban heritage.

In this direction, interdisciplinary research represents a fertile methodology to bring together research and experimentation programmes that can make non-sectoral contributions to complex issues such as those of the Mediterranean territories.

Notes

1. Website: <https://sites.google.com/uniroma1.it/percorsidiresilienza>.
2. <https://www.relive.cc/view/v8qkk5kAxKq>.

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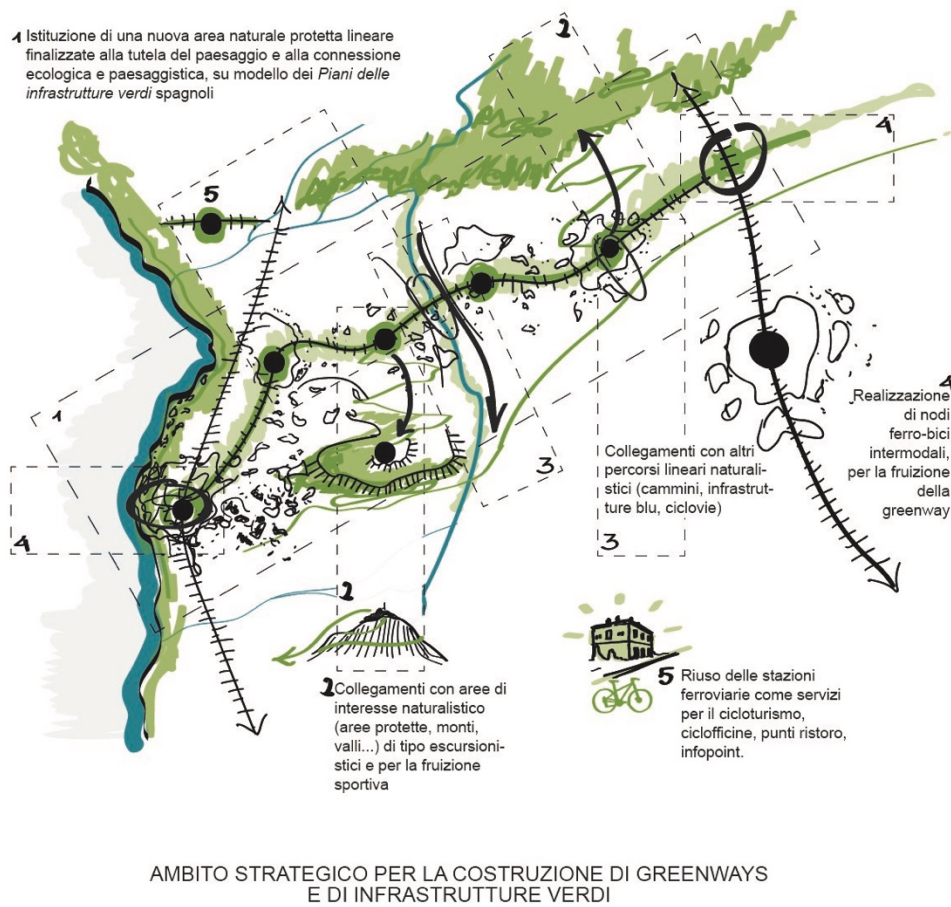
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Attributions

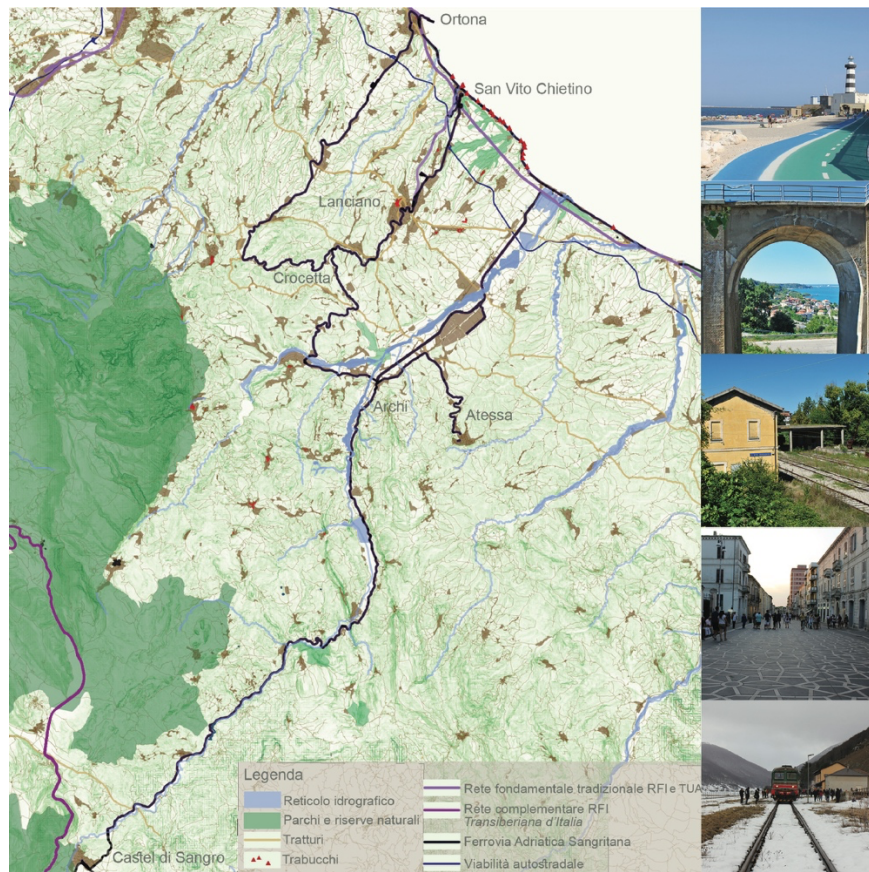
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(Fig. 1) Territorial framework of Chieti Province, Abruzzo, Italy. Source: Gunaydin 2021.



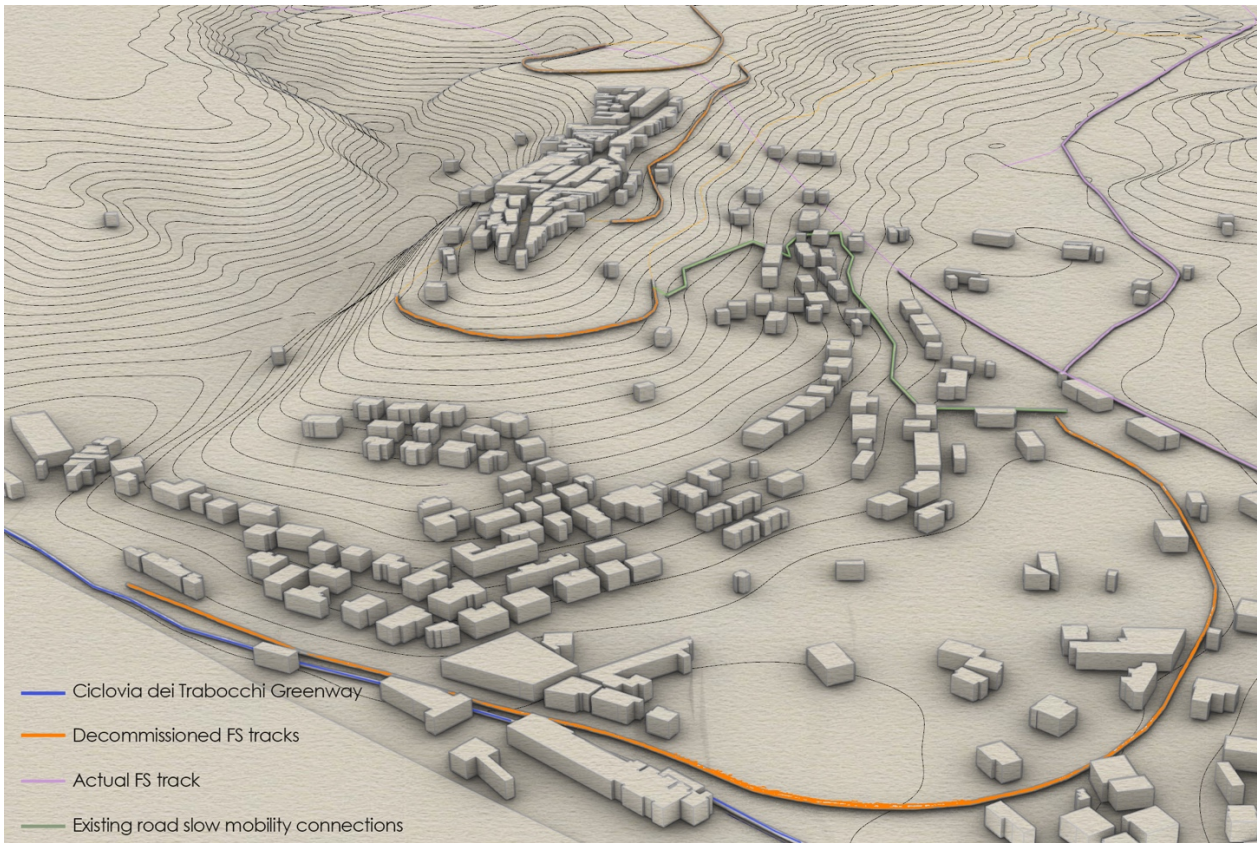
(Fig. 2) Scheme of the lines of intervention for the construction of strategic areas aimed at greenways and green infrastructure projects along disused railways. Source: C. Ravagnan, C. Amato, 2020 (Author: C. Amato).



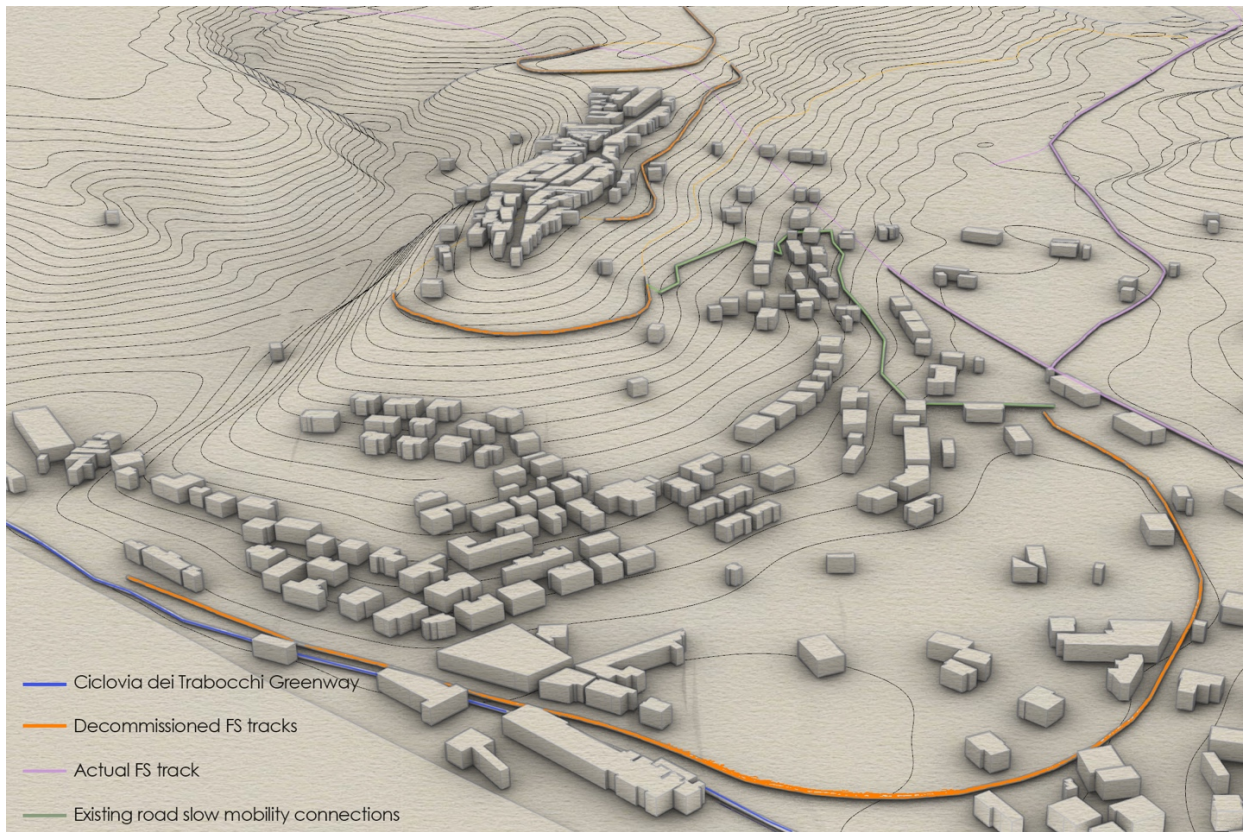
(Fig. 3) The former Ferrovia Adriatico Sangritana from the Adriatic coast to inner areas. In the images on the side: The Trabocchi Greenway, the FAS, the San Vito - Trasbordo station, Lanciano, the "Trans-Siberian of Italy". Author: chiara Ravagnan, 2021.



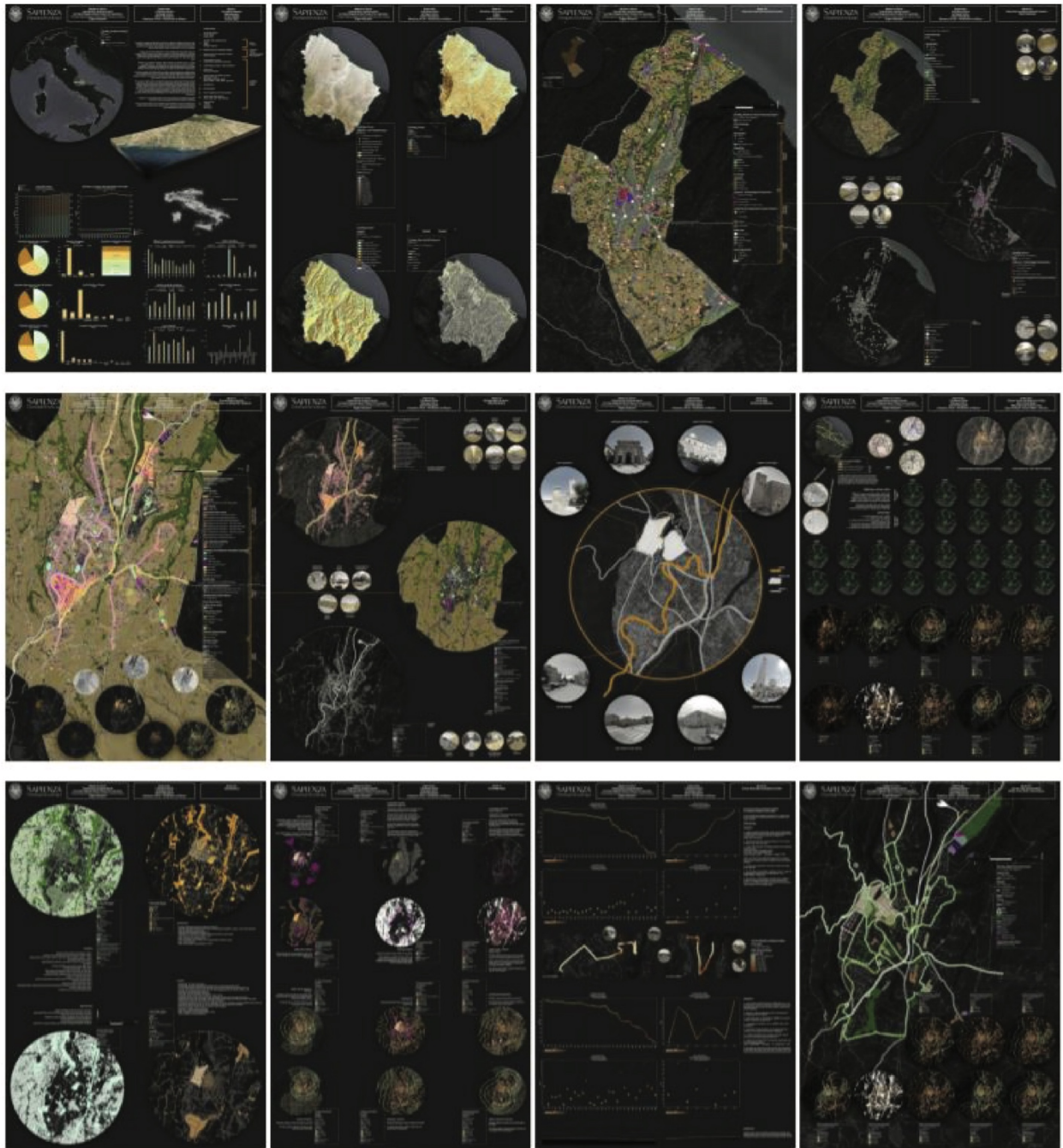
(Fig. 4) View of the Ferrovia Adriatico Sangritana and of the Adriatic coastline from San Vito Chietino (on the left). San Vito Chietino (Abruzzo, Italy; on the right). Ph. Chiara Amato, 2021.



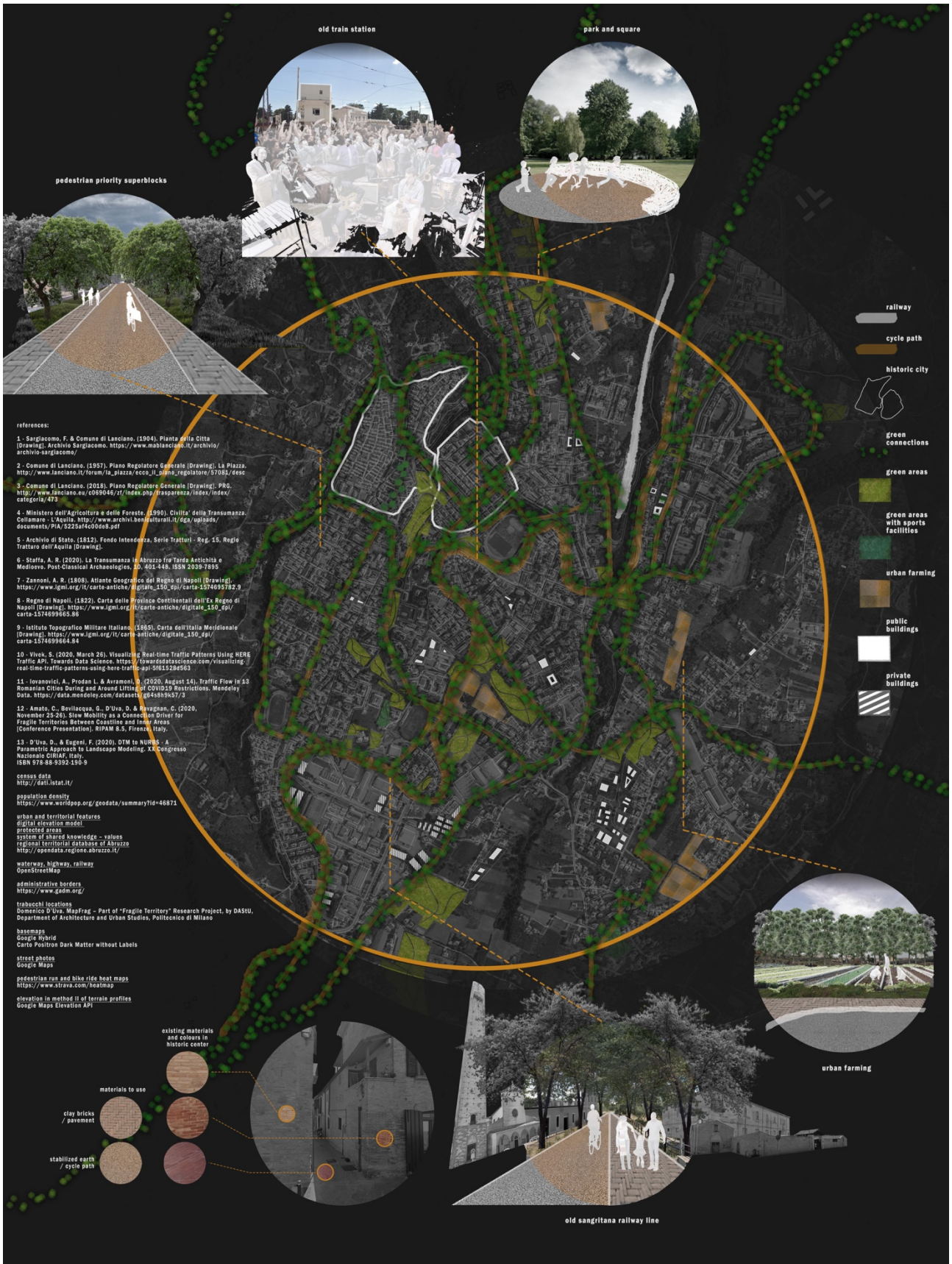
(Fig. 5) Analysis tools of local scale mobility. Connection path of slow mobility between the coast and the hilly territories - San Vito Chietino Area. Source: D'Uva 2021



(Fig. 6) Thesis maps: An urban regeneration project in Lanciano: The Disused Sangritana Railway Line Between Mobility and Historic Networks. Source: Gunaydin 2021.



(Fig. 7) Analysis of the territory of the Province of Chieti. Altimetry, Slopes, Exposure, Infrastructural Networks. Source: Gunaydin 2021.



(Fig. 10) Masterplan for the reuse of the FAS and the regeneration of Lanciano. Fonte: Gunaydin 2021.

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