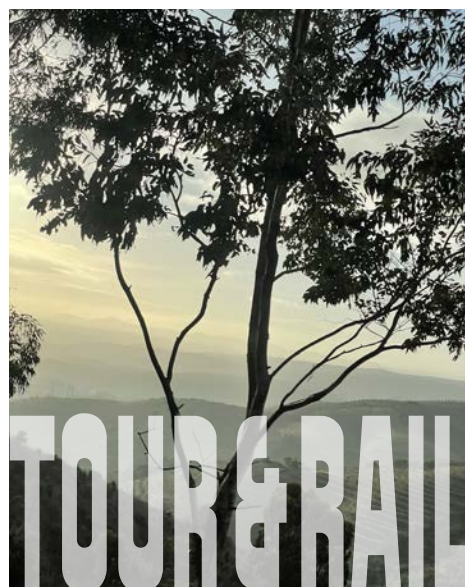




TOUR&RAIL

TOURISM REACTIVATION OF LOW-TRAFFIC RAILWAY LINES

A COMPARATIVE STUDY OF THE DOURO AND LUCCA-AULLA LINES



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Project

TOUR&RAIL

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CHAPTER 1:

INTRODUCTION TO THE TOUR&RAIL PROJECT

1.1. THE DECLINE OF THE CONVENTIONAL RAILWAY NETWORK AND THE RISE OF HIGH-SPEED RAIL

This report constitutes one of the outcomes of an ambitious European project entitled *Tour&Rail. Collaborative ecosystem for ecological transition in rural areas through a sustainable tourism model applied to low-traffic railway lines in Europe*. Funded under Erasmus+ KA220-HED, this three-year project reflects on the fundamental role of conventional railways in fostering territorial cohesion across rural Europe.

Over the past two decades, railway infrastructure in Europe has undergone a contraction of approximately 6% (Rudolph et al., 2023). This decline has resulted in the closure of nearly 14,000 kilometres of track, primarily affecting low-demand conventional lines connecting rural or sparsely populated areas. This dismantling stems from a gradual process of abandonment, beginning with declining passenger numbers – driven by factors such as demographic ageing, rural depopulation and competition from other transport modes – followed by reductions in public funding for maintenance, and culminating in irreversible deterioration that renders continued operation economically and socially unviable.

Conversely, European Union policies aiming to decarbonise the transport sector – supported by strategic frameworks such as the *European Green Deal and the Sustainable and Smart Mobility Strategy* – position rail as the backbone of a clean, intermodal mobility system (European Commission, 2019, 2020). It is noteworthy that rail transport generates the lowest volume of greenhouse gas emissions per user, provided that occupancy rates are optimal. Under this premise, investment over the past decade has focused on expanding high-speed rail, a system designed to connect major urban centres through high-capacity services with minimal intermediate stops.

1.2. TERRITORIAL DISPARITIES AND THE VALUE OF THE CONVENTIONAL NETWORK

Since 2008, the European high-speed rail network has expanded by more than 80%, growing from 5,800 kilometres to over 8,500 kilometres (European Commission, 2025). Despite this progress, this centralised model marginalises rural areas, which account for approximately 45% of the continent's land area and are home to around 25% of the EU's population (World Bank, 2024).

In contrast to this exclusion, the conventional railway network – with its mesh-like structure and extensive territorial coverage – emerges as a key solution for ensuring safe and environmentally sustainable mobility in outer regions. As an already amortised infrastructure, its basic maintenance requires significantly lower investment than the construction of new alternatives. Its positive impact extends beyond its functional utility:

- It acts as a driver of social cohesion and territorial balance in structurally disadvantaged areas.
- It provides an affordable, universal service that promotes social equity.
- It contributes directly to population retention in vulnerable, low-income regions.

Abandoning these lines entails relinquishing a public asset of considerable value, the recovery of which would subsequently involve almost prohibitive financial, legal and technical costs. Moreover, dismantling this infrastructure prevents the exploitation of strategic opportunities, such as diverting trains in the event of emergencies on main lines, strengthening freight transport, or reconfiguring regional routes in coordination with other transport systems.

In this context, tourism initiatives on low-traffic lines threatened with closure may serve as a catalyst by increasing passenger numbers and enhancing the value of railway heritage and the territorial capital of the regions they cross (Ferrerol, 2006; Carter, 2008). While not a comprehensive solution for the future of low-demand conventional railways, such initiatives can act as a lever for reversing current trends of decline.

This hypothesis underpins the TOUR&RAIL project, which is structured into four work packages addressing the key questions required to tackle this complex and compelling challenge from a holistic perspective.

1.3. HIGH VALUE OF LOW-TRAFFIC RAILWAY LINES AND THEIR REGIONS

The success of a tourism service operating on a low-traffic railway line, as a disruptive element in its ongoing degradation, initially depends on several factors. Firstly, the condition of the line and its stations is critical. If infrastructure is completely abandoned or in an advanced state of deterioration, the investment required for rehabilitation may render the project unfeasible.

In this context, the TOUR&RAIL project defined and analysed low-traffic conventional lines in its first work package, establishing a methodology applicable across European countries and implemented in Spain as a case study. The results for Spain are particularly informative. A total of 40 sections belonging to 38 different lines were identified, amounting to 4,319 kilometres – approximately 25% of the national rail network and around 35% of the conventional network – as well as 666 stations or halts (Berrocal et al., 2026).

An assessment of their condition and suitability for potential tourism development led to the identification of 53 homogeneous sections. Of these, well-maintained lines suitable for tourism account for 77% of the total (34% electrified and 43% non-electrified), while 11% correspond to lines requiring improvement, all of which are non-electrified.

The remaining 12% comprise out-of-service lines, with 8% either severely deteriorated or dismantled (Berrocal & Zamorano, 2026).

This analysis enables the identification of the technical, political and economic feasibility of tourism-based revitalisation projects. However, infrastructure condition alone is not sufficient. The appeal of the surrounding region is equally important. Tangible territorial assets – such as cultural heritage, natural spaces and landscape quality – constitute the territorial capital of these lines. In the Spanish case study, these attributes have been carefully mapped and assessed, resulting in the identification of lines with significant potential for promotion.

Nevertheless, while necessary, these factors are not sufficient. Experience shows that some public investments fail not due to a lack of necessity or technical justification, but because local communities have neither been adequately informed nor empowered – institutionally or socially – to take ownership of them (Babaei et al., 2023; UIC, 2024). Consequently, these assets fail to integrate into local socio-economic dynamics, a phenomenon widely recognised in transport planning when social cohesion indicators are overlooked.

The project therefore incorporates local perceptions through the participation of Local Action Groups (LAGs) in regions affected by low-traffic lines. These non-profit associations represent both public and private stakeholders and are responsible for implementing rural development programmes through the LEADER methodology of the European Agricultural Fund for Rural Development (EAFRD).

Participation is organised through in-person discussion workshops conducted at the line-section level. The objective is to assess local perceptions of the railway as an economic asset, as well as the robustness of the social fabric in terms of entrepreneurship, civic engagement and leadership. Results reveal considerable variation in attitudes, ranging from enthusiastic support for tourism-driven revitalisation to indifference, reflected in low participation levels.

This qualitative research is complemented by a complex statistical analysis of socio-ecological coupling, which evaluates coherence between territorial configuration and economic activities using multivariate analysis of land-use and socio-economic variables. The findings highlight a range of regional configurations between urban and rural contexts, with varying levels of functional integration.

Finally, an online survey distributed through LAGs broadens the sample to include additional stakeholders such as municipalities, educational institutions, hospitality businesses, rural accommodation providers and associations.

Together, these results offer a nuanced understanding of the social realities of regions affected by low-traffic lines and provide a valuable decision-support tool.

Furthermore, the project includes a compendium of successful cases in which low-traffic conventional lines have been revitalised through tourism services.

This output demonstrates the feasibility of the project's approach and allows for the evaluation of key sustainability factors, including infrastructure condition, *territorial capital*, *social cohesion* and community self-perception.

The compendium serves multiple purposes: as a dissemination tool for travellers, a reference guide for promoters of new tourism services, and a rigorous technical document for policymakers involved in railway planning and rural development.

The project concludes with the development of a handbook of governance models for promoting tourism-based railway revitalisation in rural areas. This integrates lessons learned and proposes best practices in partnership models, multi-level institutional collaboration and stakeholder engagement. Governance is indeed a critical factor in ensuring the viability and sustainability of such projects.

1.4. COMPARISON OF TWO SUCCESSFUL LINES

Building on the compendium, this study compares two European railway lines: Ermesinde–Pocinho (Portugal) and Lucca–Aulla (Italy). Both represent exemplary cases of best practice in the revitalisation of declining lines through railway tourism.

The comparison uses many of the same indicators applied in the Spanish case study, complemented by additional analyses to assess socio-economic impacts. The aim is to identify both common and distinct mechanisms contributing to their success, including the role of territorial capital, stakeholder perceptions, governance models and implementation challenges.

This report ultimately seeks to contribute, modestly yet meaningfully, to the revitalisation of low-traffic conventional railway lines across Europe, thereby supporting the economic dynamism of rural regions.

© CP / Miradouro regional train, Douro Line



CHAPTER 2:

METHODOLOGICAL FRAMEWORK

This research adopted a mixed-methods approach, combining case study selection, spatial analysis, statistical analysis and qualitative investigation. The methodological framework was structured around three successive stages.

Stage 1. Case study selection

A Europe-wide survey and evaluation process involving railway operators and project partners was conducted to identify and select successful cases of tourism-related reactivation of low-traffic railway lines.

Stage 2. Tourism potential assessment

The tourism potential of the selected railway corridors was assessed through an adapted version of the analytical framework developed in Work Package 3 (WP3) of the Tour&Rail project, combining Geographic Information Systems (GIS), territorial analysis, multivariate statistics and stakeholder workshops.

Stage 3. Field evaluation

Field visits were carried out to evaluate infrastructure conditions and to contextualise the results through direct observations of the railway corridors and the regions they serve. The combination of these complementary methods made it possible to analyse tourism-led railway revitalisation from both territorial and operational perspectives, while triangulating quantitative, spatial and qualitative sources of evidence.



2.1. IDENTIFICATION AND SELECTION OF SUCCESSFUL CASES OF TOURISM REACTIVATION OF LOW-TRAFFIC RAILWAY LINES

The first stage of the research consisted in identifying and selecting relevant case studies of tourism-related reactivation of low-traffic railway lines across Europe. Rather than relying on a predefined list of cases, the research adopted an iterative and exploratory approach, combining the expertise of railway operators and academic partners.

Phase 1. Preliminary survey

The work to select the two lines began in April 2024 with the launch of a preliminary survey addressed to members of the UIC **Commuter and Regional Transport Services (CRTS)** and **TopRail** (Tourism Opportunities for Railways) groups. The survey served two complementary purposes.

OBJECTIVE	DESCRIPTION
Defining the scope of the study	To explore how railway stakeholders define and identify low-traffic railway lines across different national contexts.
Identifying potential case studies	To invite railway operators to identify railway lines within their networks that could potentially meet the objectives of the Tour&Rail project.

Phase 2. Defining the analytical scope

The survey revealed the absence of a harmonised European definition of low-traffic railway lines. Responses showed considerable variation in the existence and formulation of formal definitions across national contexts. Rather than establishing a uniform definition ex ante, the project adopted a pragmatic approach, simply assuming that the lines identified by railway stakeholders themselves corresponded to the notion of low-traffic railway services in their respective contexts.

A first preliminary survey round led to the identification of an initial set of candidate lines. This exploratory phase was complemented by coordination meetings among consortium partners, which aimed to establish a common analytical framework and refine the scope of the investigation. It was collectively agreed that the work package would focus on successful cases in which tourism had contributed to the reactivation, maintenance or strengthening of regional low-traffic railway lines. Consequently, lines exclusively dedicated to tourism, high-speed rail services, industrial railways and very short lines (less than two kilometres in length) were excluded from the scope of the study. Furthermore, selected cases were expected to demonstrate tangible proof of success, notably through increased ridership and/or improved economic performance.

Phase 3. Development of the analytical framework

To ensure comparability across a range of national contexts, the consortium developed a standardised analytical framework in the form of technical fact sheets (Appendix A). These fact sheets were designed to document a broad range of information, including infrastructure characteristics, service supply and demand, tourism resources along the corridor, stakeholder configurations, and the historical trajectory of each line. In addition, four guiding questions were introduced to assess the relevance of each case: whether the line could be considered a low-traffic railway line; the extent of its tourism potential; the influence of tourism on funding mechanisms; and the degree to which tourism contributed to the continued operation of the line.

Phase 4. Data collection and approval

A second survey was conducted in November 2025 to complement the initial results and broaden the geographical scope of the study. In parallel, consortium partners contributed additional examples through documentary research and expert knowledge, allowing the construction of a wider corpus of potential cases.

The analytical framework was subsequently applied to document approximately one hundred railway lines. Following completion, the fact sheets were submitted to railway operators for verification, completion and approval. This approval process played a crucial role in strengthening the reliability of the dataset by combining academic research with the operational expertise of railway practitioners.

Phase 5. Final case study selection

The final selection of case studies was based on a comparative assessment of the documented lines using the common analytical framework and guiding questions. Particular attention was paid to the extent to which tourism contributed not only to attracting visitors but also to supporting the long-term viability of the railway service. This process ultimately led to the selection of two contrasting yet emblematic cases:

- the Douro line in Portugal
- the Lucca–Aulla line in Italy

Both lines represent situations in which tourism has become an important component of the territorial and operational sustainability of regional low-traffic railway services, while being embedded in distinct geographical, institutional and socio-economic contexts.

2.2. TOURISM POTENTIAL ASSESSMENT

Following the selection of the Douro line and the Lucca–Aulla line as case studies, the tourism potential of the regions served by these railway corridors was assessed through an adapted version of the methodological framework developed within Work Package 3 (WP3) of the Tour&Rail project. The original WP3 methodology was conceived as a comparative tool enabling the evaluation and ranking of low-traffic railway lines according to their tourism development potential. It combined two major analytical dimensions – *territorial capital* and *social cohesion* – which were subsequently aggregated into composite indicators.

The objective of the present research differs from that of the original WP3 framework. Rather than comparing a large number of railway lines or producing a synthetic score, the aim was to characterise and better understand the tourism potential of two selected cases previously identified as successful examples of tourism-related railway revitalisation. Consequently, the analytical dimensions and indicators developed within WP3 were retained, while the procedures designed for benchmarking purposes – such as indicator classification, weighting systems and the calculation of a final composite index – were not implemented. Instead, the methodology was used as an exploratory and interpretative framework to identify the territorial resources, socio-economic characteristics and local dynamics associated with the two case studies.

A central component of the methodology was the use of Geographic Information Systems (GIS) to analyse the spatial relationship between railway infrastructure and territorial resources. All spatial analyses were conducted in QGIS using exclusively open-access datasets. Cartographic methods were employed not only to represent territorial resources but also to assess their accessibility and visibility from the railway corridors, thereby providing a spatial characterisation of tourism potential.

2.2.1. TERRITORIAL CAPITAL

The first analytical dimension focused on *territorial capital*, understood as the set of regional resources that may contribute to the tourism appeal of a railway corridor. Following the WP3 framework, three complementary categories of resources were considered: cultural heritage, landscapes and protected natural areas.

2.2.1.1. CULTURAL HERITAGE SITES

The cultural heritage component included nationally, regionally and internationally protected sites. The analysis sought to evaluate both the accessibility of these resources from railway stations and how visible they were from the railway line itself.

Unlike the original WP3 methodology, which relied on fixed-distance buffers around stations, accessibility was assessed through network-based isochrones generated using

the ORS Tools extension in QGIS, based on OpenRouteService routing data. Walking accessibility was considered in order to provide a more realistic representation of the tourism resources effectively reachable from railway stations in 5, 10 and 15 minutes (Figure 1). This adaptation was considered particularly relevant in the study areas, where mountainous topography and complex transport networks limit the explanatory power of Euclidean distance measures.



Figure 1: Example of GIS Isochrone obtained with ORS tool.
Source: Authors

The perception dimension aimed to capture the heritage assets visible or potentially perceptible during the railway journey. Visibility analyses were conducted using a 30-m resolution Digital Elevation Model (DEM). Observation points were generated every 500 metres along the railway corridors, and viewsheds were calculated within a one-kilometre perimeter on either side of the railway line (Figure 2). This approach reflects the assumption that railway tourism is influenced not only by the destinations

served but also by the visual experience offered during the journey itself. For extensive heritage sites represented by large polygon geometries, the original methodology was adapted by measuring the surface area included within the visibility zone rather than recording their simple presence or absence. This provided a more accurate representation of the importance of large-scale heritage resources within the railway landscape.

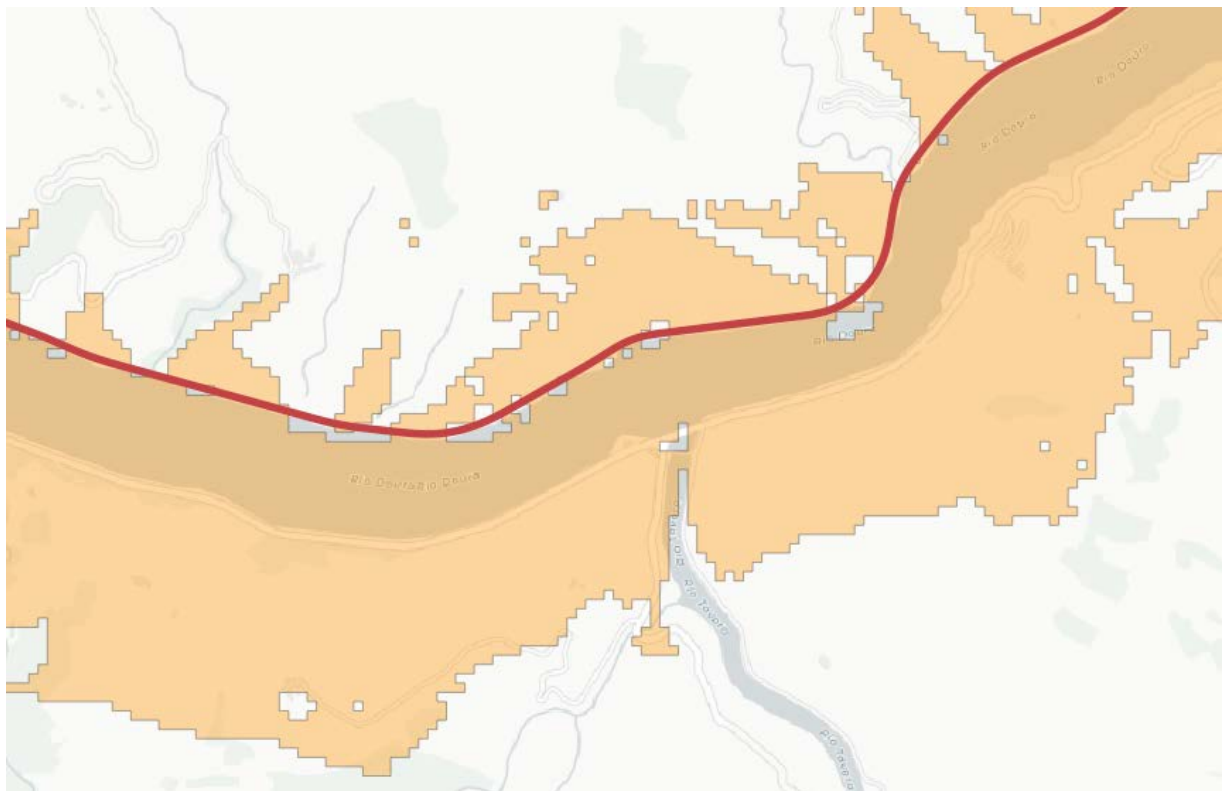


Figure 2: Example of a perception buffer made on QGIS.
Source: Authors

2.2.1.2. LANDSCAPES

The landscape component examined the scenic qualities of the railway corridors through three complementary indicators: landscape richness, landscape diversity and landscape uniqueness. Landscape richness was assessed by calculating the number of distinct landscape units crossed by each railway corridor, thereby capturing the variety of landscape environments encountered during the journey. Landscape diversity was evaluated using the *Shannon Diversity Index*, which considers both the number of landscape units and their relative proportions along the corridor, providing a more nuanced measure of landscape heterogeneity. Finally, landscape singularity aimed to identify particularly remarkable landscape features through the presence of sites designated as Natural Monuments or Protected Landscapes.

As with heritage resources, visibility constituted a central analytical dimension. In addition to the one-kilometre viewshed used for most analyses, a broader ten-kilometre visibility buffer was introduced to account for distant landscape features visible on the horizon. This adaptation was intended to better capture the visual experience associated with railway travel in mountainous environments, where distant valleys, mountain ranges and prominent landforms often contribute significantly to the perceived appeal of the journey.

2.2.1.3. PROTECTED NATURAL AREAS

The natural assets component focused on protected natural areas located along the railway corridors. National, regional and international protection schemes were considered, including Natura 2000 sites. Accessibility was assessed through the same isochrone-based approach used for

cultural heritage resources, while visibility was evaluated using the viewshed analyses described above. As with heritage assets, the analysis of large protected areas relied on surface measurements within the visibility zones rather than simple presence indicators, allowing for a more nuanced appreciation of the relationship between the railway line and its surrounding natural environment.

The objective of this first analytical dimension was not to quantify tourism activity itself, but rather to identify and characterise the cultural, landscape and environmental resources that could potentially support tourism development along the selected railway corridors.

2.2.2. SOCIAL COHESION

The second analytical dimension focused on *social cohesion*. In the original WP3 framework, this dimension sought to evaluate the relationships between territorial structures, socio-economic characteristics and local perceptions. It was composed of two complementary components: *socio-ecological connectivity* and *perceived value of the territory*.

2.2.2.1. SOCIO-ECOLOGICAL CONNECTIVITY

The first component, *socio-ecological connectivity*, combined land-use information derived from the CORINE Land Cover database with socio-economic indicators describing the municipalities crossed by the railway lines. Because statistical classifications and socio-economic categories differ between Portugal and Italy, the indicators were adapted in order to identify the most comparable variables available in each national context while preserving the analytical logic of the original framework.

Using these datasets, a Canonical Correlation Analysis (CCA) was conducted to explore the relationships between land-use patterns and socio-economic characteristics. Land-use variables constituted the first set of variables, while socio-economic descriptors formed the second set. The objective was to identify the principal gradients structuring the regions crossed by the railway corridors and to examine how environmental and socio-economic characteristics interact.

Unlike the original WP3 methodology, however, the purpose of the CCA was not to derive a synthetic measure of social cohesion. Instead, it was employed as an exploratory statistical tool to produce a typology of the regions crossed by the railway lines. The resulting canonical space was classified into three groups using a Natural Breaks (Jenks) classification procedure. The robustness of the classification was subsequently assessed using Mahalanobis distance tests, which measure the statistical separation between groups within the multivariate space.

The resulting territorial clusters were then interpreted according to the variables that most strongly characterised each group. This made it possible to identify and map distinct territorial dynamics, such as tourism-oriented areas, agricultural regions, zones experiencing demographic decline and more urbanised environments. The results were subsequently projected and mapped in ArcGIS Pro to facilitate their geographical interpretation and to visualise the spatial distribution of the identified territorial profiles along the railway corridors.

2.2.2.2. PERCEIVED VALUE OF THE TERRITORY: STAKEHOLDER WORKSHOPS

The second component of the *social cohesion* dimension, *perceived value of the territory*, was established by means of stakeholder workshops conducted during the field visits. The objective of these workshops was to complement the spatial and statistical analyses with the perspectives of actors directly involved in the management, operation, promotion and development of the railway lines and the regions they serve.

Participants included representatives of public institutions, railway operators, tourism organisations, local authorities, associations and other stakeholders engaged in territorial development. Participation was voluntary and informed consent was obtained from all participants prior to the discussions. Workshops were audio-recorded and documented for research purposes in accordance with the ethical procedures established within the Tour&Rail project.

The workshops followed a semi-structured discussion guide organised around several thematic blocks (Appendix B).

Main themes addressed during the stakeholder workshops:

THEMATIC BLOCK	MAIN TOPICS DISCUSSED
Territorial context	Local identity, demographic and socio-economic trends, governance arrangements, mobility patterns, territorial strengths and weaknesses, and the main challenges affecting local communities.
Tourism dynamics	Visitor profiles, travel motivations, mobility patterns, interactions with local communities, impacts of tourism on local development, and the relationship between tourism and regional governance.
Territorial resources	Cultural heritage, natural and landscape assets, tourism infrastructure and services, accessibility, conservation, and locally valued resources that may not be identified through conventional tourism analyses.
Governance and future perspectives	Recent investments, governance arrangements, examples of good practice, the role of the railway within territorial development strategies, and future opportunities and constraints for both the railway service and the surrounding area.

The workshops were not intended to produce a quantitative measure of regional perception. Instead, they provided a qualitative understanding of how local stakeholders perceive the territory, its resources, its development trajectories and the role played by the railway line. This component of the analysis made it possible to contextualise the results obtained through the *territorial capital* and *socio-ecological connectivity* analyses, while identifying dimensions that cannot easily be captured through spatial or statistical indicators alone, such as local narratives, perceptions of territorial identity, governance dynamics and stakeholder expectations regarding tourism-led railway development.

By combining GIS-based spatial analysis, multivariate statistical techniques and qualitative stakeholder perspectives, the adapted WP3 framework provided a multi-dimensional assessment of tourism potential. Rather than producing a synthetic score, the methodology aimed to characterise the resources, territorial configurations and local dynamics that may contribute to the long-term appeal and sustainability of tourism-related railway services. From this perspective, tourism potential is understood as a relational property emerging from the interaction between railway infrastructure, territorial resources, socio-economic contexts and stakeholder perceptions.

2.3. FIELD VISITS AND INFRASTRUCTURE ASSESSMENT

To complement the spatial, statistical and qualitative analyses, field visits were conducted along both railway corridors. These visits pursued two complementary objectives: assessing the physical condition of railway infrastructure; and developing a contextual understanding of the territorial environments crossed by the lines.

The assessment of infrastructure condition relied on a standardised survey instrument developed within Work Package 2 (WP2) of the Tour&Rail project. The methodology combined quantitative and qualitative evaluations of both railway tracks and stations.

For railway infrastructure, the assessment considered four main aspects: superstructure, infrastructure, electrification and signalling systems, and safety. For stations, the evaluation focused on accessibility and safety, multimodal connections, services and facilities, and architectural condition (Figure 3). The collected observations were transformed into standardised scores and qualitative categories (Figure 4), allowing for a systematic appraisal of infrastructure quality along the railway corridors. Rather than focusing solely on average conditions, particular attention was paid to the degree of homogeneity or heterogeneity observed along the lines, enabling the identification of well-maintained sections as well as areas requiring rehabilitation or modernisation.

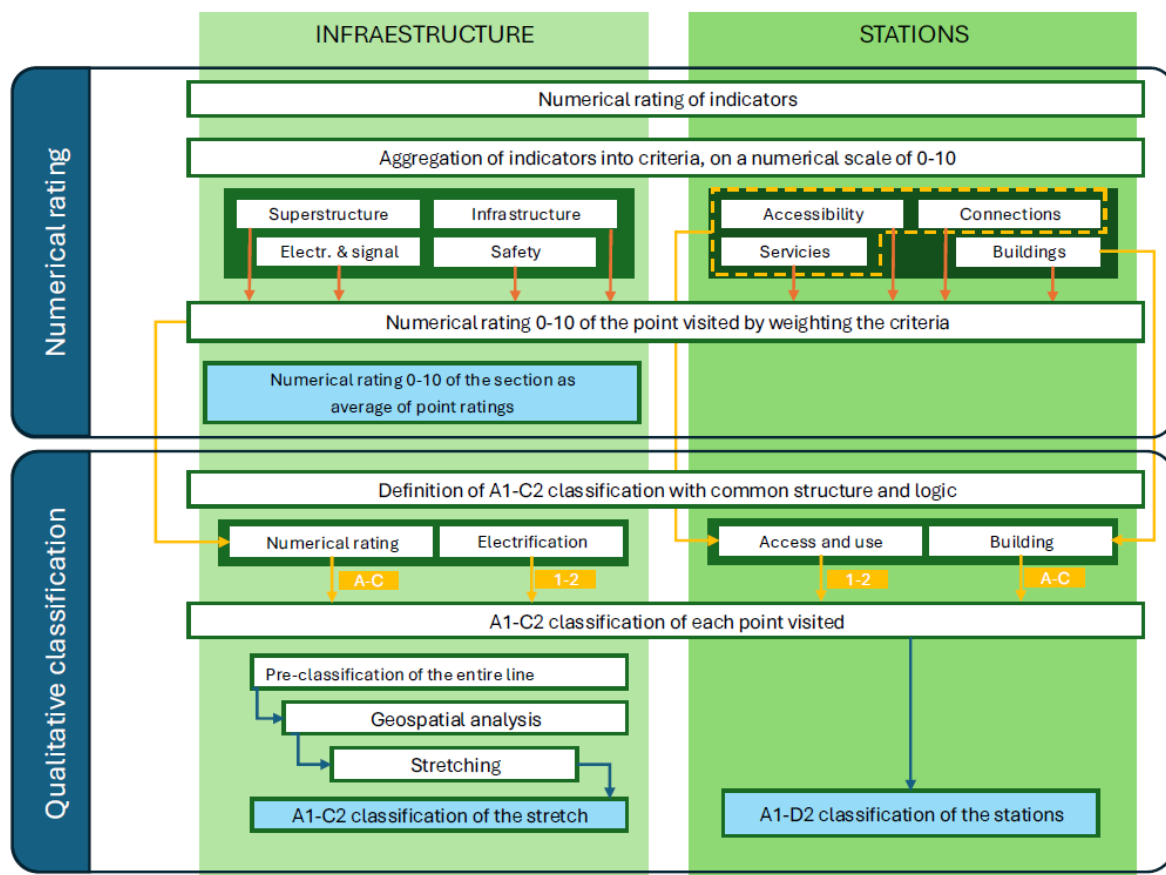


Figure 3: Methodological framework assessment of the state of conservation. Source: Authors

A1	Tracks with good state of conservation and electrified
A2	Tracks with good state of conservation and non-electrified
B1	Tracks in state that can be improved , electrified
B2	Tracks in state that can be improved , non-electrified
C1	Railway tracks not in regular use , maintained
C2	Railway tracks not in regular use , non maintained

Figure 4: Classification scheme for railway track condition. Source: Authors

Beyond infrastructure assessment, field visits also served as an important source of qualitative information. Direct observations were used to better understand how the railway lines operate within their territorial contexts, their integration into local mobility systems, the relationship between stations and surrounding settlements, and the accessibility of the tourism resources identified by the GIS analysis. Particular attention was paid to landscape quality, visual continuity along the corridor, and the experiential dimensions of railway travel.

Field observations further enabled elements that are difficult to capture through spatial or statistical analyses alone to be identified, such as the overall atmosphere of stations, the condition of public spaces surrounding railway facilities, the visibility of heritage and landscape assets from the train, and practical barriers affecting access to tourism resources. In this respect, the field visits played a crucial role in contextualising and evaluating the results obtained through the *territorial capital* and *social cohesion* analyses, while providing a more comprehensive understanding of the opportunities and constraints associated with tourism-led railway development.

CHAPTER 3:

THE DOURO LINE – REACTIVATING A TOURISM- LED LOW-TRAFFIC REGIONAL LINE

INTRODUCTION

This chapter provides an overview of the Douro railway line in Portugal and examines its relationship with the regions it serves, paying particular attention to the role of tourism in the restructuring, revitalisation and renewed use of the railway corridor.

The Douro line was selected from more than one hundred cases identified in the *Compendium of Successful Cases of Tourism Reactivation of Low-Traffic Lines Across Europe* (Work Package 4), developed as part of the Tour&Rail project. It constitutes one of the two cases examined in depth in this comparative analysis, aiming to identify the factors which underlie successful tourism-led railway revitalisation. Over the past decade, the line has experienced growing tourism demand, accompanied by a significant expansion of rail services and substantial investment in infrastructure renewal, reflecting a revived commitment from rail and local stakeholders, as well as a broader recognition of the line's strategic role for tourism, mobility and regional development.

The chapter draws on a range of materials. Fact sheets completed and approved by UIC

member operators provide an initial empirical basis, including data on infrastructure, services and tourist attractions. The analysis also builds on the methodology developed in Work Package 3 (WP3) to assess the tourism potential of the line. In addition, a technical field visit provided a more concrete understanding of the railway corridor through in-situ observations, an assessment of the state of conservation of the infrastructure, and a group discussion involving a wide range of stakeholders involved in the management and transformation of the line. These materials were complemented by meetings with *Comboios de Portugal (CP)*, the operator of the line, which helped to further clarify its functioning and current challenges.

The chapter begins with a presentation of the line's geography, historical development and operational characteristics. The second part presents the results of the methodology developed in WP3. The third part focuses on observations and assessments carried out during the field visit. Finally, the chapter concludes by examining the interactions between tourism and the railway line, as well as prospects for the corridor.

3.1. GEOGRAPHICAL, HISTORICAL AND OPERATIONAL CONTEXT

3.1.1. GEOGRAPHICAL CONTEXT

The Douro railway line (Linha do Douro) is located in northern Portugal and runs east–west across the region, connecting Ermesinde (a suburb of Porto) on the Atlantic coast, to Pocinho, a small village in the municipality of Vila Nova de Foz Côa, near the Spanish border (see Figure 5).



Figure 5: Map of the Douro railway line. Source: Authors

The line crosses several districts – Porto, Aveiro, Viseu, Vila Real and Bragança – thereby linking regions with highly contrasting profiles. It connects the country’s second most populous city to some of the most rural and remote areas of Portugal. This link between metropolitan areas and rural areas is one of the line’s structuring features together with the Douro River. Beyond its transport function, the railway plays an important regional role, providing continuity across different topographical constraints and relatively limited connections.

The line follows the Douro Valley, a landscape which has steep slopes and deeply carved out hillsides shaped by the Douro River. According to UNESCO, the region is distinguished by dramatic elevation contrasts and terraced vineyards supported by dry-stone walls, which have been constructed over centuries to enable viticulture on the valley’s rugged slopes. This terrain has strongly influenced the construction of the Douro line, which runs close to the river and follows its winding course, and has more broadly contributed to both the outstanding scenic value of the Alto Douro Wine Region and to the technical constraints associated with the development and operation of transport infrastructure.

Another distinctive characteristic of the corridor is the close relationship between the river and the railway. For much of the route, both infrastructures follow the same valley floor, creating a strong visual and functional connection. Historically, the river played a central role in the transport of wine and goods, while the railway improved accessibility between Porto and the heart of the valley. Together, they contributed to opening up the region and continue to shape its configuration.

From a territorial perspective, the corridor links three broad geographical entities:

- Porto, a major metropolitan area and the principal gateway to the region
- The wine-producing Douro Valley, with its terraced vineyards, historical wine estates, and a dense concentration of cultural and landscape resources
- The Upper Douro, extending eastwards towards Pocinho and the Côa Valley, where lower population densities, stronger rural characteristics and internationally recognised archaeological heritage create a distinct landscape

While the analysis focuses on the section between Marco de Canaveses and Pocinho, the line cannot be separated from its relationship with Porto. Beyond serving as the most western stop on the line, the city constitutes the main point of entry to the Douro region and plays an important role in shaping transport and visitor flows. Nevertheless, the Marco de Canaveses–Pocinho section lies outside the Porto metropolitan area and its urban rail services and therefore constitutes the core of the study area.

3.1.2. HISTORY OF THE LINE

The construction of the Douro railway line began in 1875 with a dual objective: to transport passengers and goods and to open up the Douro region, which was then difficult to access, with road transport remaining the main but highly precarious mode of connection. The line was built within a region with an economy already strongly based in viticulture and reliant on the Douro River, which had long served as a major transport corridor for wine and agricultural products destined for Porto and international markets.

The line was opened progressively. It first reached Peso da Régua in 1879, the main urban centre of the Douro region, then extended to Pinhão in 1880, Tua in 1883, and finally Barca d'Alva in 1887. The last extension enabled one of Portugal's earliest international rail connections to be established, providing a direct link to Salamanca and Madrid. At its peak, the line extended over nearly 200 kilometres, shaping both regional and export-oriented transport, particularly those associated with the wine trade.

This reflects a classic example of nineteenth-century railway expansion, combining economic integration, territorial cohesion and international connectivity. The Douro line thus played a key role in connecting a more minor, production-oriented region with national and international markets, while simultaneously supporting the emergence of urban centres along the corridor. Together with the river, it became one of the principal infrastructures which helped shape the Douro Valley.

However, during the 1980s, Portuguese transport policies increasingly prioritised road infrastructure development, particularly following the country's accession to the

European Economic Community in 1986. While major investments were directed towards improving road accessibility, several secondary railway lines experienced declining levels of investment and service provision.

In 1988, the section between Pocinho and Barca d'Alva was closed, part of a broader process of railway streamlining at the Iberian scale. At that time, the Spanish government decided to discontinue several low-traffic lines, including the section between La Fuente de San Esteban and Barca d'Alva. Consequently, Portuguese authorities also closed the Pocinho–Barca d'Alva segment, effectively severing the cross-border continuity of the line and transforming Pocinho into an end stop. This closure therefore highlighted a transition from expansion and integration to contraction and selective withdrawal, in which more regional and low-demand sections were progressively marginalised.

While the line was not directly threatened with closure, it nevertheless became gradually weakened, typical of many rural railways in Europe: a loss of strategic function and a period of underinvestment. From the 1990s onwards, however, the Douro Valley's growing appeal as a tourist destination progressively created new opportunities for the railway. The development of wine tourism, river cruises and heritage-based tourism, together with the incorporation of the Alto Douro Wine Region into the UNESCO World Heritage List in 2001, contributed to increasing the region's visibility and creating favourable conditions for the subsequent development of tourism-oriented railway services.

3.1.3. INFRASTRUCTURE CHARACTERISTICS

The section aims to characterise the technical profile of the line and its operating conditions. Data relating to the infrastructure can be found in the *Network Statement 2026* (2024) published by the infrastructure manager, *Infraestruturas de Portugal (IP)*.

From a technical perspective, the Douro line extends over 164.4 km, running from Ermesinde station to Pocinho. This corresponds to the section of the network officially designated by the infrastructure manager as the Douro line. On this section, 44 stations and stops exist according to the GTFS database provided by CP.

The line is not yet fully electrified. Electrification began in the 1990s on the Porto–Caíde section and was extended to Marco de Canaveses in 2019. Although services between Marco de Canaveses and Régua resumed on 2 April 2026 following five months of infrastructure works, electrification has not yet reached Régua and is expected to be completed by 2028. The electrical system operates at 25 kV / 50 Hz AC.

The line is double-track from Porto São Bento to Caíde (except for a 2.4 km multi-track section between Porto-Campanhã and Contumil), and single-track from there to Pocinho. The line uses the Iberian gauge (1668 mm).

Signalling systems also vary along the route, consisting of automatic block signalling (RCAP) up to Caíde, intermediate automatic block (RCI) up to Marco de Canaveses, and telephone block (RCT) from there to Pocinho.

These characteristics match the profile of a low-traffic line on the Marco de Canaveses–Pocinho section, typical of rural rail infrastructure: single track, incomplete electrification (albeit recently extended), and relatively low-performance signalling systems.

3.1.4. SERVICE CHARACTERISTICS

The aspects presented here aim to characterise the level of service, through the types of operation, their frequency and the associated demand.

From a functional perspective, considering the service-based passenger connections, the line extends over 178 km, from Porto São Bento station to Pocinho. Travel time is approximately 3 hours and 20 minutes, reflecting relatively low operating speeds, ranging between 50 km/h and 90 km/h from Pocinho to Ermesinde.

The line accommodates three types of traffic: regular passenger services, tourist services and freight. This section will focus on the first two.

3.1.4.1. RAILWAY PASSENGER SERVICES

The line is served by three types of passenger services: urban, regional and interregional (see Figure 7). According to the 2026 timetable, current services are:

- For the Porto–Marco de Canaveses urban service: 4 trains per day
- For regional services, primarily serving the Régua–Marco de Canaveses section: 5 trains per day
- For interregional services, running from Porto to Pocinho: 5 trains per day (with three additional services terminating at Régua)

Introduced by CP in 2017, the *MiraDouro* service was designed with two objectives in mind: to reinforce passenger services on the Douro line and to enhance the tourism experience along one of Portugal’s most scenic railway corridors. Initially operating only at weekends, it was integrated into the Douro line’s InterRegional services in 2020, operating daily during peak tourist seasons. While no official ridership figures were available for this study, the extension of the service beyond weekends, together with the continued growth of tourism in the Douro Valley, suggests that passenger numbers have increased in recent years. All InterRegional services are operated by locomotive-hauled trains using refurbished rolling stock that returned to service after several years of inactivity, comprising CP Class 1400 diesel locomotives from the 1960s together with Schindler coaches from the 1940s and Sorefame coaches from the 1970s. Fares are 10.85€ between Porto and Régua and 14.80€ between Porto and Pocinho.

3.1.4.2. RAILWAY TOURIST SERVICES

The line also provides several dedicated tourist services.

The Douro Historical Train (see Figure 6) runs between Tua and Régua (30 km), a section widely regarded as the most scenic section of the route. This seasonal service runs every Saturday from June to October, as well as on selected Wednesdays between July and September. Over the 2023–2025 period, it carried an average of 11,000 passengers per year. The historic rolling stock has been restored with the support of European funding.

The service occupies a distinctive position within the Douro Valley's tourism. Beyond the railway journey itself, it is frequently integrated into broader tourist packages combining visits to wineries, cultural attractions, local gastronomy and river-based activities. As a result, the train contributes not only to railway conservation but also to the wider tourism economy of the valley, interacting with a range of tourism stakeholders.

The success of the service has also played an important role in uncovering the line's potential and demonstrating the appeal of railway-based tourism experiences in the Douro Valley. In this respect, the Douro Historical Train can be regarded not only as a tourism product, but also as an important catalyst for the subsequent development and diversification of tourism-oriented railway services along the corridor.



Figure 6: Douro Historical Train rolling stock. Source: Authors

In addition to the Douro Historical Train, the line hosts several seasonal tourists programmes:

- **Almond and Blossom Circuit (March):** a tourist itinerary showcasing the spring landscapes of the Douro, including a visit to the Côa Museum; approximately 650 and 640 passengers in 2024 and 2025, respectively.
- **Grape Harvest Festival by Train (Porto–Pinhão):** a service operated over two weekends in September with a wine-related theme; around 400 passengers annually over the past three years.

- **Presidential Train (since 2023):** a high-end tourist service operated by CP between Porto and Ferradosa in partnership with the chef Chakall, combining rail travel with a culinary and wine tourism experience. The partnership ended in 2026, and although the service is currently suspended, it is expected to resume operations in 2027.

These services illustrate the diversification of the line's uses, combining everyday transport with the promotion of railway and landscape heritage.

3.1.5. TOURISM AS A DRIVING FORCE

The Douro line is seeing growing tourism-oriented promotion. The development and diversification of rail services, whether regular (such as the *MiraDouro*), heritage-based (the Douro Historical Train), or high-end (the Presidential Train) provide useful indicators of this trend. This variety of services appears to respond to a broad range of tourist profiles and expectations, encompassing local and regional visitors, international tourists seeking to discover the Douro Valley, and high-end clientele looking for exclusive travel experiences. The progressive expansion of these services reflects a broader requalification of the line, in which its transport function increasingly coexists with explicit tourism-oriented uses.

The Douro Historical Train occupies a particularly important place within this tourism ecosystem. Beyond the train journey itself, a range of tourism activities and packages have progressively developed around the service, with travel agencies integrating the train into wider visitor itineraries and tourism experiences. More generally, railway-based tourism contributes to extending visitors' stays and encourages the exploration of different parts of the valley.

A distinctive feature of the Douro tourism model lies in the close relationship between rail and river tourism, frequently being integrated into combined tourism products. Boat-and-train excursions have become a characteristic component of the destination, enabling visitors to experience the valley through complementary perspectives. This intermodality contributes significantly to the appeal of the region and reinforces rail's role within the broader tourism economy of the Douro Valley.

Another advantage for the railway is its exceptionally favourable location. It connects or provides access to three UNESCO World Heritage sites, the Historic Centre of Porto, the Alto Douro Wine Region and the Prehistoric Rock Art Sites of the Côa Valley, while crossing one of Europe's most internationally recognised wine landscapes. It therefore links different components of regional tourism, including vineyards, wineries, museums, cultural heritage sites, accommodation facilities and river cruises.

This dynamic has been reinforced by recent investments in infrastructure, rolling stock and service quality, which have improved both the appeal and the operational conditions of the line. Tourism is therefore not merely a complementary activity but one of the principal factors underpinning the contemporary development of the Douro line. The railway provides an example of a broader process observed on several low-traffic railway lines across Europe, whereby tourism is contributing not only to the diversification of services but also to the renewal of infrastructure whose traditional transport functions have progressively weakened.

This subsection has given context on the Douro line from both an infrastructural and a service-based perspective, while retracing the main events in its history in relation to broader developments in European rail. This long-term perspective makes it possible to identify moments when the line's continuity was called into question, as well as the more recent role of tourism as a driving force of its reactivation and functional reconfiguration. The next section will provide a more detailed examination of the line's connections with the regions it serves.



Figure 7: Portuguese railway network. Source: CP

3.2. TOURISM POTENTIAL OF THE REGION

The methodology developed within the *Tour&Rail* project in previous work packages aims to identify the tourism potential of the line. It is based on two main pillars – *territorial capital* and *social cohesion* – which are presented in detail in the methodology section. These two pillars, along with their associated indicators, have been applied to the Douro line.

3.2.1. TERRITORIAL CAPITAL

The *territorial capital* pillar is composed of three main indicators: *cultural heritage assets*, *landscapes* and *protected natural areas*.

Note: The methodology not only concerns the identification of the sites but also their accessibility from the stations and their *perception* from the line.

3.2.1.1. CULTURAL HERITAGE ASSETS: AN EXCEPTIONAL CONCENTRATION OF UNESCO SITES

The analysis of the Douro Line's cultural heritage assets highlights a significant aspect of its tourist appeal. The distinction between regional, national and international levels has been made in line with the specific characteristics of Portugal's heritage protection framework.

Local level of protection

The analysis found a relatively limited presence of sites with the lowest protection levels. According to the *Sistema de Informação para o Património Arquitectónico*

(SIPA) database¹, only one heritage asset of “municipal interest” (*Interesse Municipal*) was identified: the *Quinta de Santo António*. This site is theoretically visible from the railway line between Ferrão and Pinhão stations, but remains inaccessible on foot or by bicycle, based on isochrone analysis conducted in QGIS using ORS tools.

National level of protection

At the national level of protection, two categories exist in Portugal: Monument of Public Interest (*Monumento de Interesse Público*) and National Monument (*Monumento Nacional*), the latter providing a higher and more stringent level of protection. For the Monument of Public Interest designation, the SIPA database made it possible to identify several relevant sites along the Douro line. Four of these are theoretically visible from the railway line:

- *Casa dos Arcos*, near Marco de Canaveses station
- *Casa da Soenga*, including its gardens, statues, and the Chapel of *Nossa Senhora do Carmo*, near Porto de Rei station
- *Pelourinho de Barqueiros*
- Boundary markers of the Douro demarcated wine region (*Marcos de Demarcação da Zona de Produção de Vinhos Generosos do Douro*) in Mesão Frio

From a pedestrian accessibility perspective, only the Casa dos Arcos site falls within a 15-minute walking radius from a railway station; it is in fact less than 5 minutes from Marco de Canaveses station.

1. *Sistema de Informação para o Património Arquitectónico* (SIPA) is a national information system that provides comprehensive, georeferenced data on architectural and cultural heritage sites in Portugal and was used here to identify and locate heritage assets along the Douro line.

However, when considering cycling accessibility, five additional sites are reachable within 15 minutes:

- *Igreja de Santa Maria de Fornos*, within 5 minutes from Marco de Canaveses station
- *Pelourinho de Barqueiros*, within 15 minutes from Barqueiros or Porto de Rei stations
- Boundary markers of the Douro demarcated wine region in Mesão Frio, also within 15 minutes from Barqueiros or Porto de Rei stations
- *Pelourinho de Mesão Frio*, within 15 minutes from Barqueiros or Rede stations
- *Solar da Família Vaz Osório / Casa Vaz*, within 5 minutes from Rede station

Regarding the National Monument level of protection, two sites were identified. Both are theoretically visible from the railway line:

- *Igreja Paroquial de Barrô*, a parish church of significant historical and architectural value, representative of religious heritage in the Douro region
- *Gravuras rupestres do Cachão da Rapa / Fraga Pintada do Cachão da Rapa*, a set of prehistoric rock engravings and painted rock art, testifying to early human occupation of the Douro Valley and forming part of a broader culturally important archaeological landscape

However, isochrone analysis indicates that neither of these sites is accessible within a 15-minute walking radius from the line. The Cachão da Rapa rock art site is, nevertheless, theoretically accessible by bicycle within 15 minutes.

International level of protection

From a *cultural heritage assets* perspective, the Douro line's importance largely rests on the presence of outstanding sites protected at international level. The line serves a remarkably high number of such sites for a railway corridor, with no fewer than three UNESCO listed sites:

- *The Historic Centre of Porto*
- *The Douro Wine Region (Alto Douro Wine Region)*
- *The Prehistoric Rock Art Sites of the Côa Valley*

Although the historic centre of Porto is not included in the study area (Marco de Canaveses–Pocinho) and was not analysed as part of the methodological application, it cannot be entirely excluded from analysis, as it is directly connected to this segment and contributes to its tourism appeal.

At the other end of the line are the *Prehistoric Rock Art Sites of the Côa Valley*, the northern part of which is directly served by Pocinho station. UNESCO describes the site as follows:

The two Prehistoric Rock Art Sites in the Côa Valley (Portugal) and Siega Verde (Spain) are located on the banks of the rivers Agueda and Côa, tributaries of the river Douro, documenting continuous human occupation from the end of the Palaeolithic Age. Hundreds of panels with thousands of animal figures (5,000 in Foz Côa and around 440 in Siega Verde) were carved over several millennia, representing the most remarkable open-air ensemble of Palaeolithic art on the Iberian Peninsula. Côa Valley and Siega Verde provide the best illustration of the

iconographic themes and organisation of Palaeolithic rock art, using the same modes of expression in caves and in the open air, thus contributing to a greater understanding of this artistic phenomenon. Together they form a unique site of the prehistoric era, rich in material evidence of Upper Palaeolithic occupation.

The site extends across a wide and relatively remote area, with several archaeological nuclei and facilities such as the Côa Museum.

However, the most influential asset is undoubtedly the *Alto Douro Wine Region* which has the railway line running at its core along this entire section (Figure 8), with stations from Rede to Pocinho. UNESCO describes the site as follows:

Wine has been produced by traditional landholders in the Alto Douro region for some 2,000 years. Since the 18th century, its main product, port wine, has been world famous for its quality. This long tradition of viticulture has produced a cultural landscape of outstanding beauty that reflects its technological, social and economic evolution.

Of the 23 stations included in the study segment, 14 provide direct access to this area. In terms of visibility from the railway, the methodology had to be adapted to account for the exceptional nature of the relationship between the line and this UNESCO site. The railway offers extended views of the terraced vineyards along a significant portion of the journey, which constitutes a major component of its tourism appeal.

Considering the site as a single, undifferentiated entity would have led to an underestimation of the line's territorial capital. No UNESCO site of comparable scale had been identified in the previously analysed Spanish cases in WP3. It was therefore deemed relevant to calculate the surface area of the site within a 1 km perception buffer along the railway line, amounting to 129.6 km². This approach offers a more accurate account of the extent of the landscape visible from the railway during a train journey.

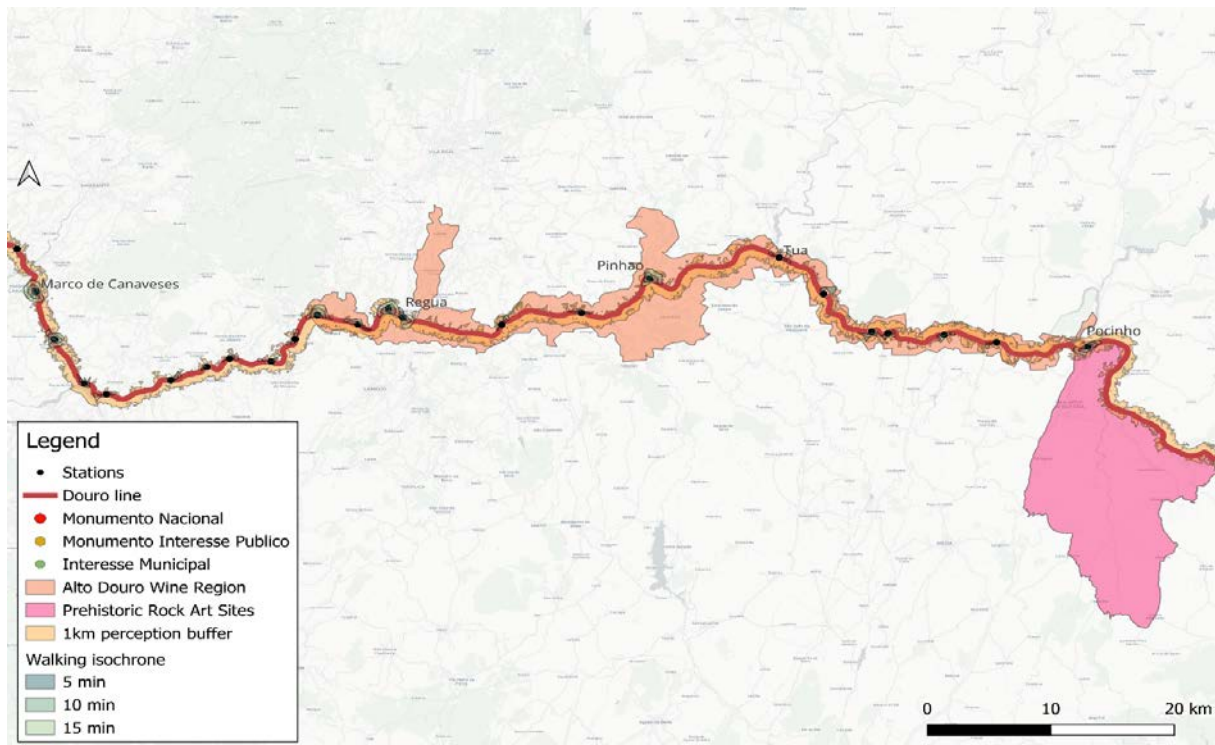


Figure 8: Heritages sites along the Douro line.
Source: Authors

3.2.1.2. LANDSCAPE

The methodology developed within the project provides three indicators related to landscape quality: *landscape richness* (the number of landscape units crossed), *landscape diversity* (the proportion of each of these units along the route), and *landscape uniqueness* (characterised by their level of protection, particularly as natural monuments or protected landscapes).

Landscape richness

For the landscape richness indicator, a map of landscape units of Portugal was used, produced by the *Department of Landscape and Biophysical Planning* of the *University of Evora* for the *General Directorate for Spatial Planning and Urban Development* (DGOT-DU), within the *Ministry of Environment and Spatial Planning* (Pinto-Correia et al., 2002).

A total of 128 landscape units had been identified across mainland Portugal alone (Figure 9).

According to Pinto-Correia et al. (2002), the methodology is based on a holistic approach combining spatial analysis and qualitative expertise in order to identify landscape units with internal coherence and a specific character. It relies on the cross-referencing of biophysical and anthropogenic variables (geography, soils, land use, etc.) derived from cartographic and image-based data integrated into a Geographic Information System. This is then refined through field observations and expert evaluation of landscape “character”. The overall approach is iterative, combining objective analysis with subjective assessment.

Overlaying this mapping with the Douro railway line reveals that six units are crossed: Units 35, 34 and 33 in Zone E; Units 8 and 12 in Zone A; and Unit 30 in Zone D. The rural segment under study (Marco de Canaveses–Pocinho) crosses four units, with most of its length located within Units 33 to 35 in Zone E, and a smaller portion within Unit 12 in Zone A, near the stations of Juncal and Marco de Canaveses.

According to the *Direção-Geral do Território* (2004), in *Identificação e caracterização da paisagem em Portugal Continental*, the units are described as follows:

- Unit 12 – *Baixo Tâmega e Sousa*: A humid and densely populated landscape characterised by a patchwork of agricultural land uses, including mixed farming, vineyards and pasture, interspersed with hedgerows and woodland. Although the terrain is uneven, it has been extensively shaped by human activity, with dispersed urban development and significant peri-urban pressure from Porto. The resulting landscape has a hybrid rural-suburban character and displays a degree of spatial fragmentation.
- Unit 33 – *Riba-Douro*: A deeply incised valley dominated by the river, with steep slopes adapted into a variety of agricultural terraces. Greener and more humid than the sections upriver, the landscape is strongly influenced by the presence of water and intensive human activity. It combines productive agricultural land, diverse land uses and a relatively coherent relationship between human practices and environmental constraints.
- Unit 34 – *Douro Vinhateiro*: An iconic landscape defined by terraced vineyards (*socalcos*) carved into schist slopes at the heart of the Port wine region. The result of centuries of large-scale human intervention, it constitutes an exceptional cultural landscape of considerable identity and heritage value. Its spatial organisation is dominated by vineyards and quintas, demonstrating a highly refined adaptation to the area's natural constraints.
- Unit 35 – *Alto Douro*: A more arid and rugged section of the valley, characterised by a Mediterranean agricultural mosaic of olive groves, almond orchards and vineyards, alongside a stronger presence of natural environments. Human settlement is more dispersed and less specialised than in the Douro Vinhateiro. The landscape is distinguished by its pronounced natural character, visual coherence and significant ecological richness.

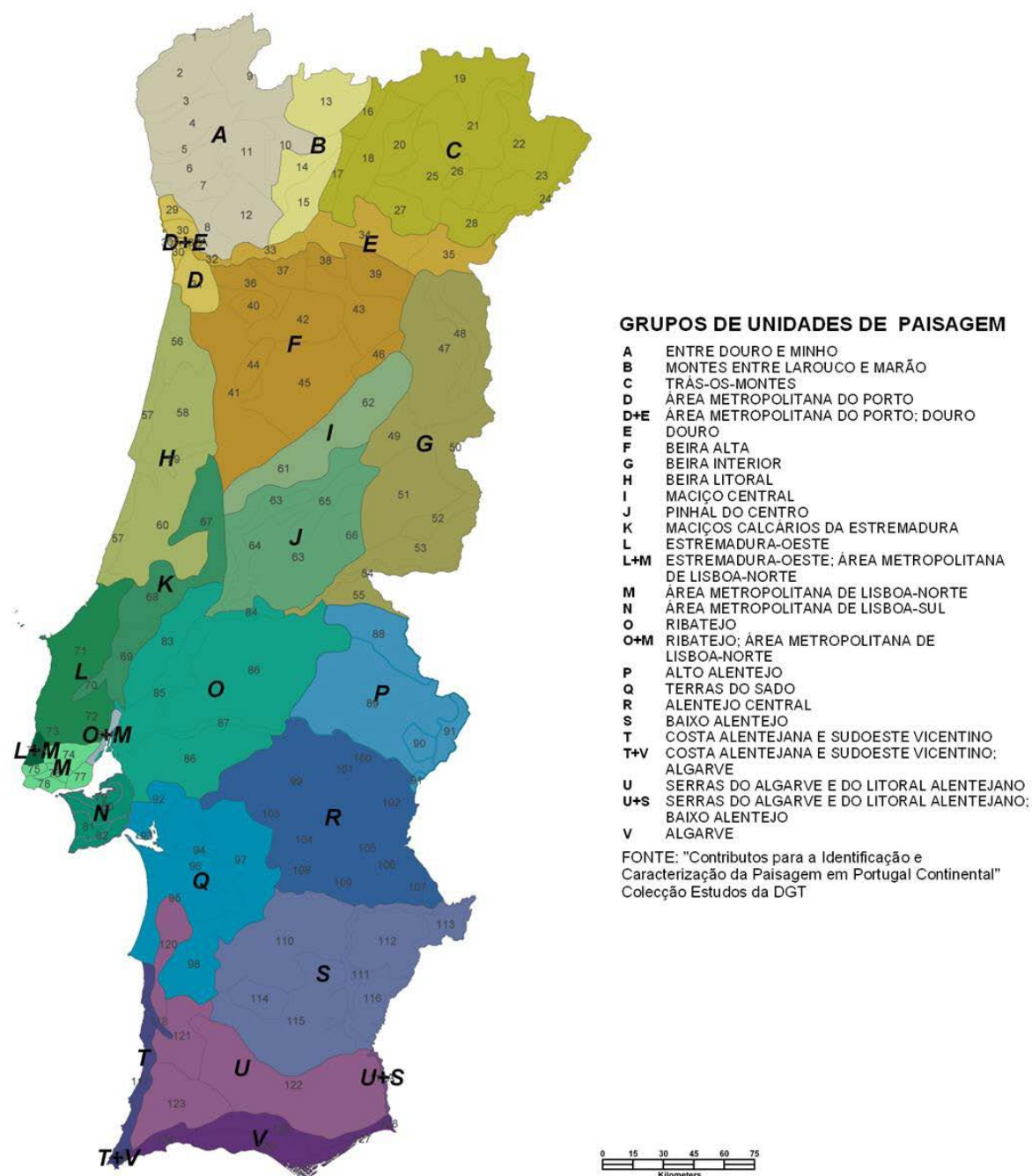


Figure 9: Map of landscape units in Portugal. Source: Ministry of Environment and Spatial Planning (DGOT-DU)

Landscape diversity

To assess landscape diversity, the *Shannon index*, as defined in the methodology section, was used. An intersection was performed between the railway line and each landscape unit in order to determine the share of the line length for each, using QGIS.

The line thus crosses Unit 35 over 32.44 km, Unit 34 over 74.27 km, Unit 33 over nearly 25 km, and Unit 12 over slightly more than 8 km. The absolute values produced by this operation appear to be overestimated. However, as the relative proportions remain unchanged, the calculation of the index is unaffected. The calculation of the index yields a value of . The calculation of the index yields a value of $H' = 1.10$. This result indicates a high level of diversity, characterised by the high level of presence of all categories, despite one of them technically dominating.

Landscape uniqueness

For this, no landscape protection – apart from the UNESCO site – was identified within the national network of protected areas (*Rede Nacional de Áreas Protegidas* – RNAP), which lists protected natural areas at the national level and includes categories such as *natural monument* and *protected landscape*, corresponding to those targeted by this indicator. No classified landscape of this type was identified within the study area, nor within the accessibility and perception buffers defined by the methodology.

3.2.1.3. PROTECTED NATURAL AREAS

To conclude this section on territorial capital, the indicator relating to protected natural areas will be discussed, again distinguishing between regional, national and international levels of protection.

Three protected natural areas have been identified within the accessibility and/or perception buffers along the railway line (Figure 10):

- *Alvão/Marão*: A Natura 2000 site with mountain ranges, forest habitats, deeply incised valleys and high levels of biodiversity. Part of this area is visible from the railway line near Régua station.
- *Serra de Montemuro*: A Natura 2000 site featuring a high-altitude mountain massif, heathlands, grasslands and traditional agro-pastoral systems. It is theoretically visible on the left bank of the river between Pala and Barqueiros stations, while a small section can be reached by bicycle within 15 minutes from Mosteirô station.
- *Tua Regional Park*: A protected area centred on the Tua Valley, distinguished by its steep terrain, diverse agricultural landscapes and variety of natural habitats. Only a very small part of the park is visible from the railway line, although it can also be accessed by bicycle.

Nevertheless, it should be highlighted that only a very limited surface area of these protected natural areas falls within the visibility and accessibility buffers defined in the project.

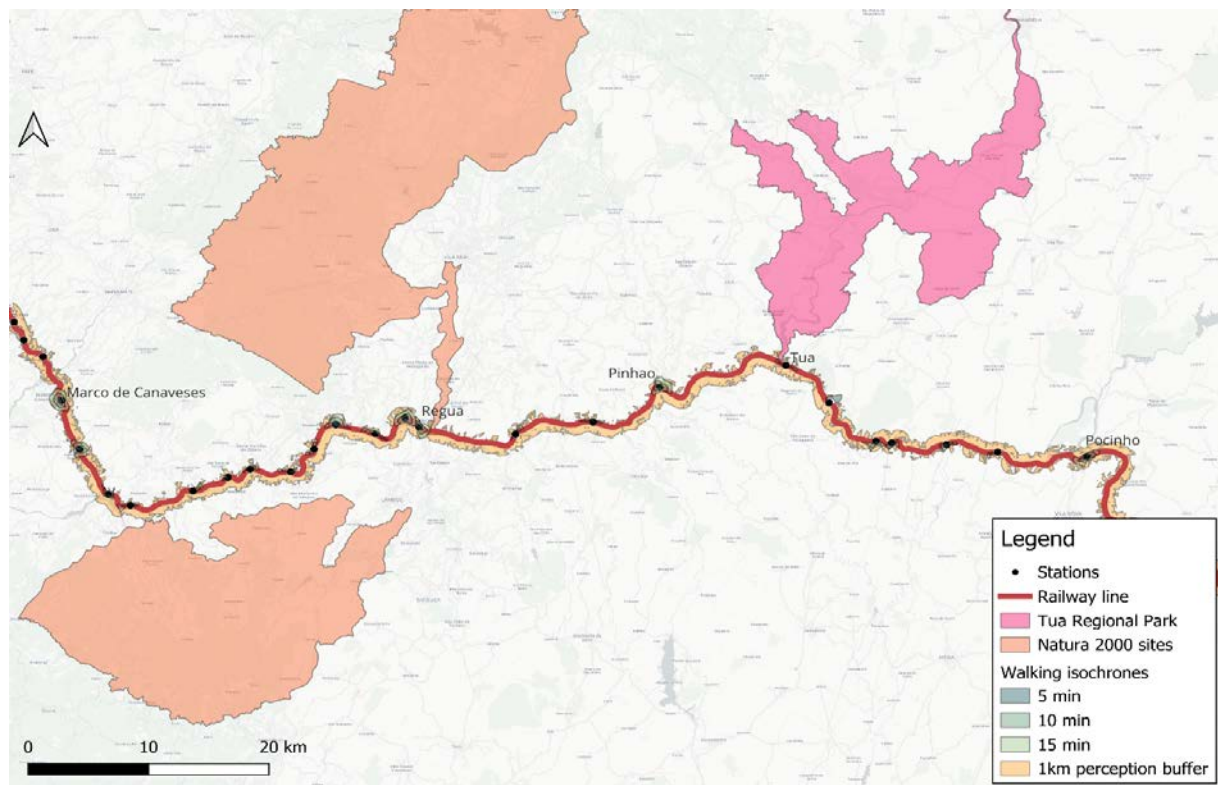


Figure 10: Protected natural areas along the Douro line.
Source: Authors

3.2.2. SOCIAL COHESION

Following the methodology developed in WP3, social cohesion was analysed using two indicators: socio-ecological connectivity and perceived territorial value. This analysis seeks to assess each region's level of social cohesion and socio-economic vitality, based on the premise that the strength of the local social fabric plays a crucial role in determining its capacity to support the tourism-led revitalisation of low-traffic railway lines.

3.2.2.1. SOCIO-ECOLOGICAL CONNECTIVITY

The social-ecological connectivity indicator is used in this case study primarily to better understand the socio-economic dynamics of the area surrounding the line. While the indicator provides valuable insight into the characteristics and vitality of the local social

fabric, it does not in itself allow for social cohesion to be directly assessed. Such an evaluation would require a comparative approach involving several low-traffic rural railway lines with the same national or regional background, as was undertaken for the Spanish case studies in WP3.

In this context, the indicator is therefore mainly used as a tool for identifying regional dynamics and socio-economic characteristics that may influence the capacity of the area to support tourism-led revitalisation processes.

For the socio-ecological connectivity analysis, the municipalities crossed by the Douro line between Marco de Canaveses and Pocinho stations were identified.

The area considered is composed of 15 municipalities.

Three complementary datasets were used in the analysis:

- **Socio-economic indicators:** A set of socio-economic variables was compiled for each municipality (Appendix C.1). This data was obtained from PORDATA, a statistical database maintained by the Fundação Francisco Manuel dos Santos, which compiles official data from national and international statistical sources, including Statistics Portugal.
- **Land-use data:** Land-use information was obtained from the CORINE Land Cover (CLC) 2018 database provided by the European Commission. The original land-cover classes were collated into an

intermediate classification comprising 15 categories, of which 12 are represented within the study area (Appendix D.1)

- **Statistical analysis:** The relationships between land-use variables and socio-economic characteristics were explored using Canonical Correlation Analysis (CCA).

Approximately one-third (33.7%) of the study area is covered by scrub and/or herbaceous vegetation, followed by permanent crops (27%), and heterogeneous agricultural areas (approx. 25%). Urbanisation accounts for only 1.1%.

Figure 11 shows the results of the CCA, which examined the relationships between land-use variables and socio-economic characteristics.

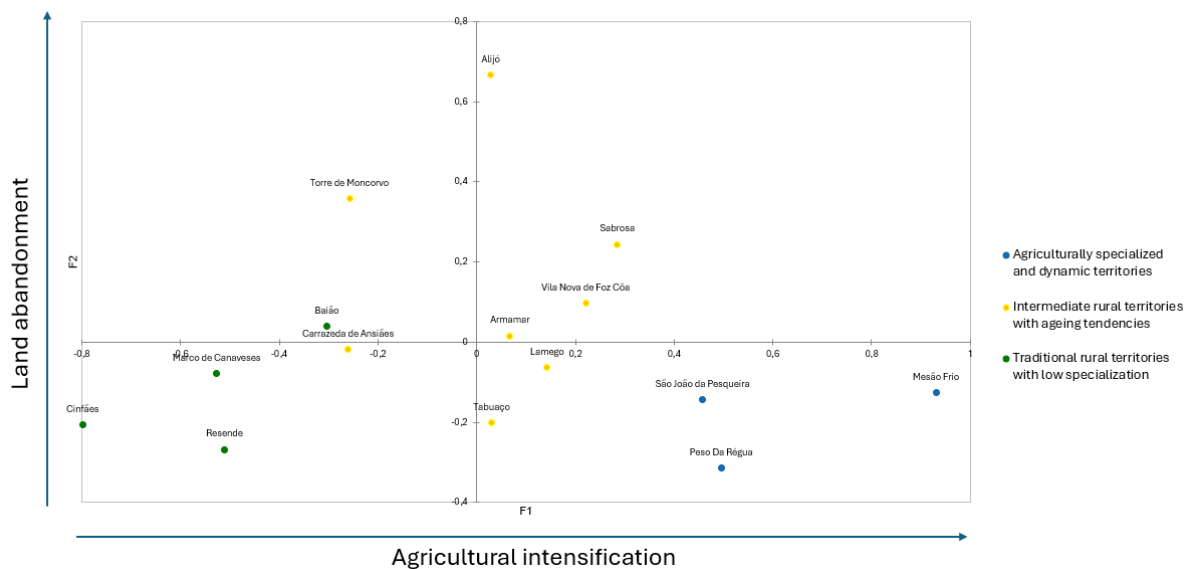


Figure 11: Socio-ecological groups provided by CCA.
Source: UCM

Three distinct typologies were identified and are given below, reflecting different models of spatial organisation and socio-economic dynamics. Figure 12 is a cartographic representation of this spatial distribution.

Agriculturally specialised and dynamic regions

This group is clearly situated at the positive end of the first axis and at low second axis values, indicating a strong specialisation in intensive agricultural systems, particularly those associated with permanent crops. Its position on the gradient reflects regions with greater economic dynamism, relatively high-income levels, and some connection to complementary activities such as tourism. The low second axis score also suggests a stable territorial structure, with lower marginalisation or abandonment. Overall, these areas represent the most consolidated and economically resilient rural profile, with comparatively higher levels of tourism development than the other typologies.

Intermediate rural regions with ageing populations

These regions are centrally positioned along the F1 axis and show slightly positive values on F2, indicating an intermediate profile in both productive and demographic terms. Their position along F1 reflects a mixed agricultural structure, with no dominant specialisation, while their location along F2 points to emerging demographic ageing and growing territorial fragility.

This typology has relatively low population density, combined with moderate levels of agricultural unemployment and evidence of land-use extensification or partial abandonment, such as the presence of sparsely vegetated open spaces.

However, as these regions do not occupy extreme positions on the marginality gradient, they cannot be regarded as fully declining areas.

Overall, these characteristics suggest a transitional profile typical of rural areas undergoing structural change, where elements of vulnerability coexist with remaining productive capacity and potential for adaptation.

Traditional low-specialisation rural regions

These regions are situated at the negative end of the F1 axis and exhibit moderate to low values on F2, reflecting low levels of agricultural specialisation and a predominance of more extensive or diversified farming systems. Their position along F1 indicates a less pronounced productive orientation than that observed in more specialised regions, while their relatively neutral position on F2 suggests an absence of acute marginalisation or advanced processes of abandonment.

Unlike more dynamic or transitional areas, these regions show limited evidence of industrial transformation or urban development pressures. Instead, they retain a traditional rural structure, within which agricultural activities remain relatively extensive and economic diversification is limited. Although economic dynamism is comparatively weak, these regions are not necessarily associated with severe socio-economic decline.

Overall, this group represents a model of traditional rurality, marked by lower productive intensity and a weaker integration into advanced economic processes, while nevertheless maintaining a degree of territorial stability.

Among the different groups, consolidated productive rural areas exhibit the highest levels of tourism development, followed, at some distance, by transitional regions with a mixed structure. By contrast, ageing and declining rural regions record the lowest levels of tourism development.

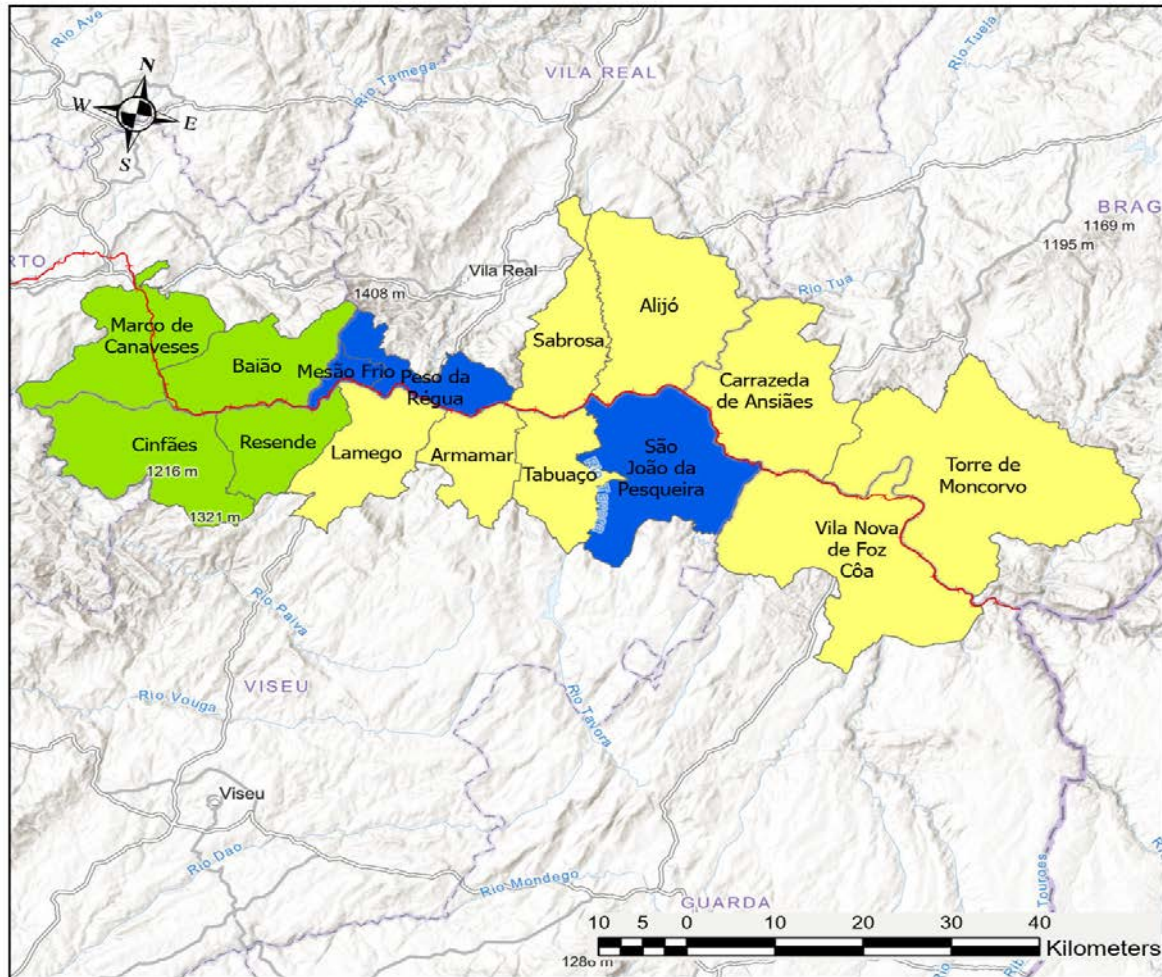


Figure 12: Cartographic representation of the regional typology. Source: UCM

3.2.2.2. KEY LESSONS FROM THE GROUP DISCUSSION

The group discussion held in Régua on 22 January 2026 provided interesting insights into the local situation, enabling a more grounded understanding to be gained of the line’s evolution, the projects currently under discussion, and the areas of consensus and disagreement among the key stakeholders involved in its day-to-day management and development. Table 1 below presents the participants who took part in the group discussion, highlighting the wide range of stakeholders and organisations represented.

STAKEHOLDER	REPRESENTATIVE	ROLE
Valongo Municipality	Catarina Paiva	Head of the Culture, Cultural Activities and Tourism Division
CCDR Norte	Ricardo de Sousa	Senior Officer, Regional Development Services Department
Infraestruturas de Portugal (IP)	Alberto Aroso	Transport Engineer
CP	André Pires	Representative Marketing Department
	Pedro Banhudo	Chief Inspector, Commercial Services
Turismo do Porto e Norte de Portugal	Paula Reis	Representative
Museu do Douro	Maria Joao Fonseca	Representative
CONSORTIUM PARTNERS		
EVORA University	Paola Hernandez	Researcher
UIC	Vanessa Pérez	Senior advisor
	Fernanda Bach	Intern

Table 1: Participants in the group discussion. Source: Authors.

Stakeholders involved

The Douro line is supported by a broad, multi-layered network of public authorities, railway operators, tourism organisations, cultural institutions, municipalities, private businesses and civil society stakeholders.

Key institutional stakeholders include *Infraestruturas de Portugal* (IP), who is responsible for the physical infrastructure and long-term planning; *Comboios de Portugal* (CP), the national railway undertaking, represented by departments for both tourism products and regional service management; and the Northern Regional Coordination and Development Commission (CCDR Norte), which coordinates sectoral public policies across the region. Porto and Northern Portugal Tourism, encompassing eighty-six municipalities, promotes the area and the integration of rail into broader tourism strategies. The Douro Museum serves as a cultural gateway for the valley’s heritage. Municipalities along the line contribute to local infrastructure and, in some cases, partner directly with CP on tourist services.

The private sector – including river cruise operators, wineries, hospitality providers and tourism agencies – plays a significant role in packaging and marketing experiences that combine rail, river and wine tourism. Civil society organisations, notably the League of Friends of the Douro World Heritage and the Vale d'Ouro Association, have historically acted as advocates in this manner.

Configuration

The Douro line functions as a territorial development platform where railway services, tourism products, heritage conservation and regional development policies intersect, yet governance is distributed rather than centralised. Coordination was historically facilitated through SPI-Douro and other public-private partnerships created to support the UNESCO World Heritage nomination and the Douro Valley Tourism Development Plan. As these structures no longer exist in their original form, coordination now takes place through project-based partnerships, bilateral contacts between CP and IP, and informal personal networks. The Douro Intermunicipal Community (CIM), which groups all municipalities in the valley, represents a key formal governance structure, though it was absent from the workshop discussions. The line operates on single-track infrastructure, largely with manual signalling, creating operational constraints that further complicate coordination between IP, which controls infrastructure capacity, and CP, which manages timetabling and rolling stock deployment.

Roles and responsibilities

IP bears responsibility for infrastructure investment, including the ongoing electrification between Marco de Canaveses and Régua, bridge reinforcement works and the long-term modernisation project up to Barca d'Alva. CP manages four distinct tourism products – the Historic Douro Train, the Almond Blossom Route, the Grape Harvest service and the Presidential Train – as well as regular interregional services including the *MiraDouro*. CCDR Norte coordinates regional development plans and manages EU-funded programmes. Porto and Northern Portugal Tourism lead destination marketing, and the connection of multimodal tourist options, including the integration of river cruises with rail itineraries. The Douro Museum contributes to heritage interpretation and regional branding. Private cruise operators and tourism agencies package combined rail-river experiences, purchasing ticket blocks from CP and distributing them through international channels. Municipal governments support local tourism infrastructure and partner with CP on specific service programmes.

Power dynamics

Formal decision-making authority over infrastructure investment and operational planning rests with IP and CP, who are both state entities headquartered in Lisbon, with priorities that do not always align with regional needs.

During the discussion, local stakeholders expressed frustration at rolling stock allocation that systematically favours other lines and at electrification timelines subject to unresolved ministerial approvals. Regional and local stakeholders – CCDR Norte, the

tourism board and municipalities – occupy largely consultative roles with limited formal leverage over railway decisions. Nevertheless, civil society has repeatedly shaped the line’s development trajectory, acting ahead of political institutions: citizen-led campaigns and regional associations were instrumental in securing a unanimous parliamentary resolution for the reopening of the line to Barca d’Alva, while the European Commission’s identification of the Douro corridor as a high-potential “missing link” has lent further external legitimacy to regional advocacy. Tourism demand therefore is increasingly having an indirect influence over service decisions, giving private operators and the visitor economy a growing stake in strategic planning.

Relationships

Stakeholder relationships are largely collaborative and built on a shared understanding of the railway as the backbone connecting tourism, heritage, transport and regional development.

The complementarity between train and river cruise is particularly significant: many tourism packages combine both modes, with cruise operators purchasing CP ticket blocks and coordinating itineraries between Barca d’Alva and Porto.

Cooperation between CP and IP is operationally necessary but periodically strained by differing institutional priorities, and coordination between CP’s tourism and scheduling departments and regional entities remains person-dependent rather than institutionalised.

On their side, the municipalities partner with CP on specific products – the Historic Train, for instance, operates in collaboration

with the municipalities of Régua, Alijó and Carrazeda de Ansiães – without being formally embedded in broader service planning. Nevertheless, a recurring tension exists regarding how the benefits from tourism are concentrated: participants noted that visitors frequently remain within enclosed circuits, generating limited economic spillover for smaller communities along the route.

Expectations and demands

Stakeholder expectations meet on increased investment, greater service frequency, diversification of tourism flows, and restored cross-border connectivity (there is strong support for reopening sections of the line toward the Spanish border). The reopening of the Pocinho–Barca d’Alva section is seen as transformative, with economic projections suggesting regional growth of approximately eight percent over thirty years. CP envisions integrating the line into multimodal European itineraries, particularly if a future high-speed link through Porto Airport reduces access times. The tourism board and cultural institutions call for extending visitor flows beyond the Régua–Pinhão corridor, to address the issue of concentrated tourism that bypasses smaller communities. Local residents and municipalities expect the railway to function as a genuine transport backbone – enabling access to employment, services and cultural events year-round.

Across sectors, there is strong and consistent demand for a reconstituted governance body equivalent to the former SPI-Douro: a dedicated, multi-stakeholder structure capable of coordinating tourism development, transport planning and regional promotion in a sustained and systematic manner.

3.3. TECHNICAL FIELD VISIT TO THE DOURO LINE

3.3.1. OBJECTIVES AND METHODOLOGICAL FRAMEWORK

The technical visit was created as an empirical evaluation tool for the research activities conducted as part of *Work Package 4* (WP4). The field visit had two main objectives:

- Assess the railway infrastructure: evaluate the railway infrastructure and station buildings' state of conservation by applying the methodology developed in WP2, with the aim of determining whether the condition of the assets was homogeneous or heterogeneous along the entire line.
- Assess the regional and tourism context: use in-situ observation to better understand the line's functional dynamics, its integration into the surrounding urban environment, and its interactions with tourism-related activities, with particular attention being paid to tourist accessibility, the quality of services provided to users and the effectiveness of interchange nodes.

The field inspection was expected to generate qualitative data that could not be obtained through documentary analysis alone. The visit also provided an opportunity to organise a group discussion with local stakeholders, following the methodology developed in WP3, to document the *perceived value* aspect of the *social cohesion* component.

3.3.2. DESCRIPTION OF THE FIELD VISIT

The technical visit dedicated to the exploration of the Douro line took place on 22 January 2026. For logistical reasons, the visit was conducted by car. The temporary closure of the railway line between Marco de Canaveses and Régua due to engineering works, combined with limited train frequencies and long travel times, prevented some of the consortium partners from travelling from Porto to Pocinho by rail within the available timeframe.

Travelling by car also offered several advantages. It provided an opportunity to better understand the conditions when using the main alternative to rail transport, explore areas beyond the immediate surroundings of the railway stations, and benefit from greater flexibility when visiting the different locations along the corridor.

Following the methodology described in Section 2.2, the WP2 field assessment questionnaire was applied to the Douro line. Before the visit, a series of observation points was selected to provide a representative overview of the condition of the railway corridor, taking the fact that the section between Marco de Canaveses and Régua was closed for modernisation work into account. In total, four railway stations and four additional observation points along the line were assessed.

Pocinho station

The first stop of the field visit was Pocinho station (see Figure 13). Located on the outskirts of the village of Pocinho, in the municipality of Vila Nova de Foz Côa, the station functions as eastern-most stop of the Douro line. Its integration into the surrounding village is limited, owing to its peripheral location in relation to the centre, the absence of dedicated pedestrian connections, and a station environment largely dominated by railway infrastructure, open spaces and freight-related facilities.

The station building appeared well maintained, with recently refreshed paintwork and functional lighting, retaining much of its historical character through its decorated *azulejos* (Portuguese tiles) (see Figure 14) and the preservation of period furniture in the waiting room. Accessible toilets were available, and a recently installed reception point was present, although it was closed during the visit.



Figure 14: Protected azulejos at Pocinho station. Source: Authors

From an operational perspective, the station infrastructure was generally in good condition. The ballast showed no visible signs of deterioration, and the wooden sleepers were well maintained. Although access to the station building was possible for people with reduced mobility thanks to ramps, it would have been difficult to board a train due to a lack of level platforms.

The main observations recorded during the field visit were:

- Non-central location with limited integration into the surrounding urban fabric
- Well-preserved historic station building with *azulejos* and original furniture
- Railway infrastructure in good overall condition
- Partial accessibility for people with reduced mobility, although level boarding is not available
- Limited multimodal connectivity, with car parking and a taxi stop but no bicycle parking or nearby bus services



Figure 13: Pocinho station and its protected tiles. Source: Authors

The journey from Pocinho station continued along the winding roads of the Douro Valley, through the vineyard terraces that define the region's iconic landscape. This provided an opportunity to directly appreciate the outstanding scenery of this UNESCO World Heritage Site (Figure 15).

The visit then proceeded to the vicinity of the Mós do Douro railway bridge (see Figure 16).

A viewpoint overlooking the valley offered a striking panorama combining the renowned vineyard terraces, the Douro River and the region's railway heritage.

From this vantage point, a partial assessment of the railway infrastructure was also able to be made. The ballast appeared to have been renewed recently, as indicated by its light colour and the absence of vegetation, while the track was equipped with bi-block concrete sleepers.



Figure 15: UNESCO protected vineyard terraces.
Source: Authors

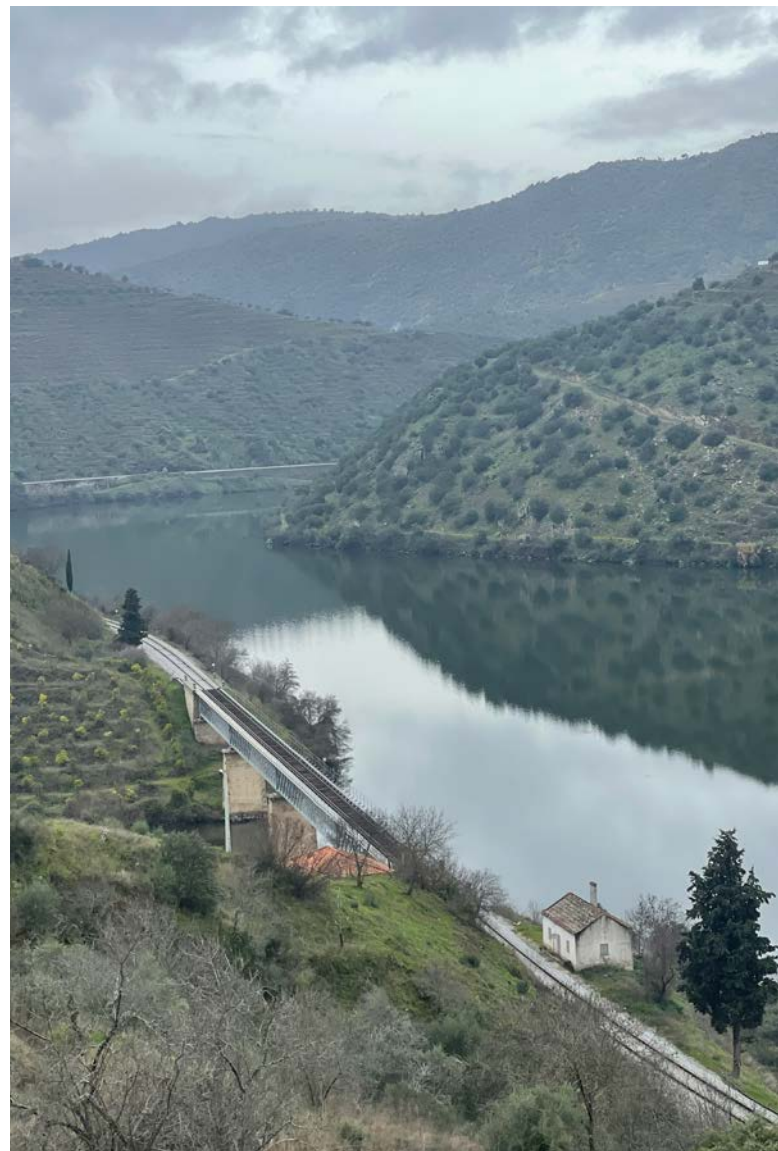


Figure 16: Mós do Douro railway bridge. Source: Authors

Tua station and its surroundings

The third stop was the Tua Station (see Figure 17). Situated at the confluence of the Tua and Douro valleys, within the municipality of Carrazeda de Ansiães, Tua is a junction station occupying a distinctive geographical setting. Unlike Pocinho, its integration into the surrounding urban fabric is less a matter of isolation than of physical constraints imposed by the terrain and fragmented spatial organisation. The station lies within a narrow valley and is separated from nearby built-up areas by steep slopes, transport infrastructure and water bodies associated with the Tua dam. Consequently, access to the surrounding area depends on a limited road network and discontinuous pedestrian routes, creating a strong sense of enclosure

The station has food service points, and the *Centro Interpretativo do Vale do Tua*, contributing to a livelier and less isolated atmosphere than that observed at Pocinho.

As at Pocinho station, Tua's building appeared to be well maintained, with recently refreshed paintwork, functional lighting and decorated *azulejos*. Accessible toilets are also available.

From an operational perspective, the station infrastructure was generally in good condition. The ballast showed no visible signs of deterioration, and the wooden sleepers were well maintained. Although access to the station building was possible for people with reduced mobility thanks to ramps, it would have been difficult to board a train due to a lack of level platforms.

A formal, well-designed car park was available in the immediate vicinity. However, beyond car access, multimodal connections remained very limited: there were no bicycle facilities or nearby bus services, and few alternative transport options.



Figure 17: Tua station. Source: Authors

In addition, the level crossing located near the station provided an opportunity to assess the railway infrastructure beyond the immediate station area. The observations made there contrasted with the conditions within the station itself: both the ballast and the wooden sleepers exhibited visible signs of wear and deterioration, suggesting a lower level of maintenance outside the core station perimeter (see Figure 18).



Figure 18: Infrastructure site assessed near Tua station.
Source: Authors

Pinhão

The fourth stop was Pinhão station (see Figure 19). Like the others, it was in good overall condition, with a station building that appeared to have been recently renovated and well maintained. However, it was clear that it had a higher level of services and activity.

Restaurant spaces were located within the building, and dedicated offices offered bookings for combined river cruise and train excursions, reflecting the site's strong tourism focus. The presence of staff further reinforced its role as an active and managed station.



Figure 19: Pinhão station and its famous tiles.
Source: Authors



Architecturally, it is possible the most impressive station along the line, thanks to its exceptionally detailed *azulejos*. Unlike Pocinho and Tua, the station is located within a clearly tourist-oriented village, where the railway is fully rooted in the local area.

This can be seen by its much stronger urban integration: the station is directly connected to the village, with immediate proximity to services, public spaces and pedestrians. It offers more multimodal transport options, including bus connections and links with river transport and not just car access. Altogether, this makes Pinhão a genuine intermodal and tourist hub, in contrast with the more isolated and infrastructure-dominated stations observed upriver.

In Pinhão, the group split into two. While some participants continued the technical visit by road, another group travelled by train (Figure 20) through the spectacular landscape of the Douro Valley. Experiencing the line as passengers allowed the group to better understand the customer perspective and to complement the technical observations made during the rest of the car-conducted visit.

Régua

The fifth stop was the Peso da Régua railway station, located in the heart of Peso da Régua, standing out as an important intermediate hub along the Douro line, with a much stronger level of urban integration than other stations further upriver. The station was directly connected to surrounding streets, services and the riverfront, making it a central node for local transport and tourism. As with the other stations, the building was in good condition, well maintained and functionally equipped, but here it is complemented by a wider range of services and a more continuous presence of staff.



Figure 20: The MiraDouro entering Pinhão station.
Source: Authors

The station benefitted from developed multimodal connections, including bus services and proximity to river cruise activities, reinforcing its role as a gateway to the Douro valley. Its architectural character, while more functional than Pinhão, still reflects the line's historical identity. Overall, Régua is a true urban and intermodal anchor, contrasting with the more isolated or spatially constrained stations such as Pocinho and Tua.

Marco de Canaveses

The last stop was at Marco de Canaveses station (Figure 21), which marks a clear transition along the Douro line toward a more urbanised and car-oriented environment.

Compared to stations further upriver, the surroundings were characterised by a higher density of built-up areas and a strong presence of road infrastructure. This was reflected in the significant volume of car traffic observed around the station, as well as in the prominence of parking and road access in its immediate environment.

The station itself was functionally maintained, in line with others on the line, but its role was more clearly within everyday urban transport patterns rather than primarily tourism-oriented flows.

In terms of integration, it benefited from direct connections to the surrounding town, with closer proximity to housing, services and local activities. However, this stronger urban integration was also accompanied by a greater car dominance, shaping both access conditions and the overall atmosphere of the station area.



Figure 21: Marco de Canaveses station. Source: Authors

3.3.3. MAIN FINDINGS FROM THE VISIT

3.3.3.1. URBAN, FUNCTIONAL AND TOURISM INTEGRATION OF THE DOURO LINE

The technical visit of the Douro line, carried out on 22 January 2026, provided a set of key findings regarding infrastructure conditions, station functions and their integration into surrounding regions.

The technical visit highlighted a significant contrast in the degree of urban and functional integration of the stations along the Douro line. Overall, a clear gradient from upriver to downriver was observed, reflecting differences in settlement patterns, accessibility conditions and the role played by the railway within local mobility and tourism.

Stations upriver such as Pocinho and Tua had relatively weak integration into their surrounding regions. In Pocinho, the station was located on the outskirts of a small settlement and within an environment dominated by railway land and freight-related activities. In Tua, integration was constrained less by the station's location than by the steep terrain and fragmented spatial configuration of the valley. In both cases, multimodal connections remained limited and were largely restricted to private car access, contributing to a sense of relative isolation. These characteristics tended to reduce the stations' capacity to function as major tourism gateways, despite the high scenic value of their surroundings.

Further downriver, Pinhão and Peso da Régua exhibited a markedly stronger level of urban and functional integration. Both stations were directly embedded within the urban fabric and were located in areas where tourism plays a significant economic role.

They have a broader range of services, including restaurants, ticket offices and tourist booking facilities, as well as more diversified transport connections such as buses and river cruises. These stations therefore function as genuine intermodal and tourism hubs, linking rail with other forms of transport and with local visitor activities.

Marco de Canaveses station was distinct, marking the transition toward a more densely urbanised environment closer to the Porto metropolitan area. The station was well integrated into the surrounding town and close to housing, services and everyday activities. However, this stronger urban integration was also accompanied by a pronounced dominance of road infrastructure and private car use, which shaped both access conditions and the overall character of the station area. Its role was therefore more closely associated with daily transport than with tourism-oriented functions.

The visit also provided broader insights into the regional and economic geography of tourism in the Douro Valley. Outside the peak tourist season, tourism activity appears to be concentrated primarily on the Peso da Régua–Pinhão section, where hospitality services, river cruises and tourism-related businesses are most visible. Beyond this core area, tourism infrastructure becomes less apparent, despite the exceptional landscape quality of the valley.

At the same time, the visit underscored both the outstanding scenic value of the Douro Valley – particularly as experienced from the railway – and the accessibility challenges created by its steep and fragmented terrain. In this context, the rail line appears to play a strategic role not only as a transport infrastructure but also as a means of

accessing, experiencing and enhancing the region. The differentiated levels of urban and functional integration observed therefore help explain the unequal development of tourism and highlight the importance of rail in structuring visitor flows within the valley.

3.3.3.2. STATE OF CONSERVATION

The state of conservation assessment was developed to provide an indication of the quality of the railway infrastructure regarding its potential for supporting the development of tourist rail services. The methodology therefore focused primarily on the condition of the line infrastructure itself, while the evaluation of stations provided an additional indication of the extent to which attention and investment have been devoted to the image and appeal of the line. To find potential variations in condition along the route, several observation points were assessed in order to determine whether the line displays a homogeneous or heterogeneous state of conservation. The classification system used for this assessment is presented in detail in the methodology section.

All visited sites were assessed using a structured questionnaire designed to evaluate the condition of both the infrastructure and station facilities. However, this work was significantly constrained by adverse weather conditions. Heavy rainfall prior to the visit caused landslides and made several access paths impracticable, limiting in situ observations. Some locations, such as *Ferradosa* railway station, could not be evaluated due to restricted access. As a result, parts of the line were assessed using Google Street View, although this tool proved of limited relevance because the available imagery (April 2015) does not reflect recent upgrades, such as the replacement of

wooden sleepers with concrete bi-block sleepers, as observed during the field visit.

Using the methodology developed in Work Package 2 (WP2), the results suggest an overall conservation rating of B2, corresponding to a non-electrified line with an intermediate level of preservation. This rating appears to be broadly representative of the line as a whole.

Nevertheless, this assessment should be interpreted with caution considering the methodological limitations described above. If the section between Marco de Canaveses and Régua were electrified and the track fully renewed, this segment would have likely received a rating of A1, where “1” denotes electrification and “A” indicates a high level of conservation. In practice, the line is composed of segments with varying levels of conservation. Moreover, observations conducted outside station perimeters occasionally revealed uneven maintenance conditions, with visible signs of wear on ballast and sleepers in certain sections.

Particular attention appears to have been paid to the maintenance of built elements in stations, including paintwork, furniture, roof tiles and sanitary facilities. Architectural heritage – particularly the presence of *azulejos* – also contributed significantly to the identity and appeal of several stations, most notably Pinhão railway station. The main shortcoming observed was the absence of real-time passenger information displays. Overall, the stations achieved a conservation rating between A2 and A1 denoting a high-level of preservation.



© CP / Douro Historical Train

CONCLUSIONS AND PERSPECTIVES

This chapter represents the culmination of the work carried out throughout the Tour&Rail project: the identification of the Douro line as a successful case through the Compendium developed in Work Package 4, the assessment of its state of conservation using the methodology from Work Package 2, and the evaluation of its tourism potential through the framework developed in Work Package 3. Together, these complementary approaches demonstrate the relevance of the overall methodology, both in highlighting the factors underpinning the line's success and in identifying critical issues and future challenges that remain to be addressed.

The Douro line represents a particularly successful example of tourism-based reactivation of a low-traffic railway line. Its success does not rely on a single factor, but rather on the combination of an exceptional landscape, strong railway heritage, diversified tourist services and sustained investment in infrastructure and station quality.

Tourism now plays a significant role in the contemporary function of the line. The railway does not merely provide access to the Douro Valley; it has become one of the main ways of experiencing it. This is particularly visible through the Douro Historical Train, around which a range of tourism activities has developed.

Travel agencies reserve seats, combine the train journey with local visits, wine-related experiences or river cruises, and promote integrated boat-and-train products. In this sense, the line functions not only as a transport infrastructure, but also as an influential part of the tourism economy of the valley.

By following the Douro River and crossing the UNESCO-listed Alto Douro Wine Region, the train offers continuous views over terraced vineyards, steep slopes, river landscapes, historic stations and wine-producing estates. The tourism value is therefore not only at destinations or around stations but in the act of travelling through the landscape. More broadly, the line contributes to connecting a remarkable concentration of heritage and tourism resources, including the Historic Centre of Porto, the Alto Douro Wine Region and the Prehistoric Rock Art Sites of the Côa Valley, all recognised as UNESCO World Heritage sites.

However, the most structurally important service remains the *MiraDouro*. Unlike the heritage and seasonal products, it operates as a regular passenger service while simultaneously offering a tourism experience using historic Schindler carriages and panoramic views over the valley. In this respect, the *MiraDouro* embodies the dual identity of the Douro line, combining everyday transport functions with tourism. Its success demonstrates that tourism-oriented improvements can reinforce regular railway services rather than replace them. The Douro case therefore illustrates not only how tourism can revitalise a railway line, but also how it can strengthen the legitimacy and viability of public transport services serving local populations.

The Douro line also demonstrates how tourism can contribute to the functional requalification of a railway without fully replacing its transport role. Heritage services such as the Douro Historical Train, seasonal products and high-end offers such as the *Presidential Train* address different tourist profiles, from local and regional visitors to international tourists and premium wine-tourism clientele. Together with the *MiraDouro*, these services strengthen the visibility and legitimacy of the line, while maintaining its dual identity as both a transport infrastructure and a tourism asset.

At the same time, the case highlights the importance of sustained investment. Beyond the recent electrification of the Marco de Canaveses–Régua section, the line has undergone continuous modernisation works for nearly a decade, including work on engineering structures, signalling systems and track superstructures. These investments have improved reliability, comfort and operational performance, while progressively reducing the technical constraints that historically affected the line. The planned extension of electrification to Pocinho would represent a further step in this process. More broadly, electrification forms part of a national railway strategy aligned with European sustainability objectives, aiming to progressively electrify the Portuguese rail network. In this regard, the Douro line is benefiting from a policy that is currently favourable to rail investment and decarbonised mobility.

This also forms part of a larger strategy of renewed railway development in northern Portugal. Alongside upgrading existing lines, several strategic projects seek to improve the accessibility of the interior regions.

Among them, the proposed Trás-os-Montes high-speed corridor would establish a direct rail connection between Porto Airport and the Douro region, potentially transforming accessibility conditions for both residents and visitors. Although still at the project stage, such developments illustrate a broader reconfiguration of regional accessibility that could reinforce the role of rail transport within the tourism and transport systems of northern Portugal.

Nevertheless, despite these improvements, the principal operational constraint of the Douro line remains the predominance of single-track infrastructure beyond Caíde. While recent work has enhanced the condition of the line, capacity remains limited by the number of crossings and by more basic signalling systems than those found on more intensively used corridors. Future growth in passenger and tourist services would therefore likely require additional investments in signalling, traffic management and operational flexibility. Another possibility would be to increase the number of locations where trains can terminate, cross, or reverse direction. Such improvements could facilitate the development of new service patterns and potentially enable tourist services to be extended beyond their current operating limits. In the case of the Douro Historical Train, for example, additional operational flexibility could create opportunities to extend tourist activities further east, thereby extending the benefits of tourism to sections of the line that currently receive relatively limited visitor flows.

The case also reveals some of the limitations commonly associated with tourism-led development strategies. While visitor numbers have increased substantially over

recent decades, tourism growth does not automatically translate into widespread local economic benefits. A significant share of tourism activity is organised through integrated packages combining transport, accommodation, cruises and guided visits, often managed by specialised operators. As a result, visitors frequently remain within relatively closed circuits, spending limited time in the villages served by the railway and generating only modest direct benefit for local businesses. The predominance of day-trip tourism reinforces this tendency, with many visitors travelling to the Douro Valley and returning to Porto on the same day.

In this context, the importance of future railway projects may extend beyond transport considerations alone. Improved accessibility, enhanced services and the development of new destinations along the corridor could contribute to diversifying tourism practices and encouraging longer stays within the region. Such developments would not only increase visitor numbers but could also strengthen local economic spillovers, helping tourism to contribute more effectively to the region's development, especially as its economy remains relatively fragile with demographic trends marked by ageing and population decline.

Stations remain crucial interfaces between railway, territory and tourism. Pinhão and Peso da Régua are the most successful examples, combining strong urban integration, tourist services, intermodal connections and heritage value. By contrast, Pocinho and Tua have more fragile integration, due to their location, topographical constraints, and limited multimodal connections. This contrast suggests that future success will depend not only on



© CP / *Miradouro regional train, Douro Line*

infrastructure upgrades, but also on the capacity of stations to function as effective gateways to surrounding regions.

From a broader perspective, the Douro line also raises the question of territorial extension and cross-border reconnection. At the European scale, the European Commission's 2018 report on cross-border rail connections and missing links identifies the Pocinho–Salamanca connection as a gap in the European railway network. At the same time, the report underlines that substantial challenges are associated with the project, including high investment costs, limited traffic potential and insufficient political commitment. The full restoration of the former international connection therefore remains uncertain.

Nevertheless, the shorter Pocinho–Barca d'Alva section, extending over approximately 26 km near the Spanish border, is currently the subject of feasibility studies being conducted by Infraestruturas de Portugal, with the support of local stakeholders. More broadly, the modernisation and reopening projects affecting the Douro corridor are strongly supported by municipalities, tourism organisations, regional institutions and civil society groups, which increasingly view the railway as a strategic tool for territorial development. Although considerably more modest in scope than a full cross-border reopening, the Barca d'Alva project could represent an important step in reactivating the upper Douro, extending the scenic and heritage experience of the line, reconnecting Pocinho to part of its historical corridor, and potentially improving access to the Douro International Natural Park. If combined with appropriate last-mile services, interpretation tools and coordinated tourism products, this extension could help spread tourism further upriver, beyond the current Régua–Pinhão core, while reinforcing the appeal of the eastern section of the line.

The current trajectory of the Douro line therefore reflects a broader convergence between tourism development, infrastructure modernisation, accessibility projects and local engagement. The challenge for the future will not only be to maintain the appeal of the line, but also to ensure that the benefits generated by tourism, infrastructure investment and improved accessibility are distributed more evenly across the region. In this respect, the Douro line provides valuable lessons for other low-traffic railway lines across Europe seeking to reconcile tourism development, territorial cohesion and sustainable mobility.

CHAPTER 4:

THE LUCCA–AULLA LINE – A SUCCESSFUL CASE OF TOURISM REACTIVATION THROUGH REGIONAL MOBILITY SYSTEMS

INTRODUCTION

This chapter provides an overview of the Lucca–Aulla railway line in Italy and examines its relationship with the regions it serves, particularly focusing on the role that tourism played in the restructuring, revitalisation and renewed use of the railway corridor.

The Lucca–Aulla line was selected from more than one hundred cases identified in the *Compendium of Successful Cases of Tourism Reactivation of Low-Traffic Lines Across Europe* (WP4), developed as part of the Tour&Rail project. It constitutes one of the two cases examined in depth in this comparative analysis, which aims to identify the factors underlying successful tourism-led railway revitalisation. In recent years, the line has been the object of a growing number of tourism-oriented initiatives while continuing to provide regular passenger services for local and regional mobility. This combination of tourism development and everyday transport functions makes it a particularly relevant case for examining the relationship between tourism and railway service provision.

The chapter draws on a range of materials. Fact sheets completed and approved by UIC member operators provided an initial empirical

basis, including data on infrastructure, services and tourist attractions. The analysis also builds on the methodology developed in Work Package 3 to assess the tourism potential of the line. In addition, a technical field visit provided a more concrete understanding of the railway corridor through in situ observations, an assessment of the infrastructure's state of conservation, and a group discussion involving a wide range of stakeholders involved in the management and transformation of the line. These materials were complemented by meetings with Trenitalia, the operator of the line, and RFI, the infrastructure manager, which helped to further clarify its functioning and current dynamics.

The chapter begins with a geographical presentation of the line and its regional context. The second part is dedicated to outlining the infrastructure and operational characteristics of the line. The third part presents the results of the methodology developed in WP3 being applied. The fourth part focuses on observations and assessments conducted during the field visit. Finally, the chapter concludes by examining the interactions between tourism and the railway line, as well as prospects for the corridor.

4.1. GEOGRAPHICAL, HISTORICAL AND OPERATIONAL CONTEXT

4.1.1. GEOGRAPHICAL CONTEXT

The Lucca–Aulla line is located in Italy, in the north of the Tuscany Region connecting the historical city of Lucca at its south to the town of Aulla at its north (see Figure 22), not far from the Mediterranean coast.



Figure 22: Geographical overview of the Lucca–Aulla railway line. Source: Authors

The Lucca–Aulla railway, historically and colloquially referred to as the “Ferrovia della Garfagnana”, constitutes a vital infrastructure spanning approximately 88 kilometres through one of Italy’s most complex and evocative mountain ranges. Located entirely within the Tuscany region, the line acts as a backbone for the provinces of Lucca and Massa-Carrara, traversing three distinct sub-regions: the Serchio Valley (Valle del Serchio), the Garfagnana and the Lunigiana. The route is defined by its transition from the historic plains of Lucca to the rugged mountain passes of the Apuan Alps and the Tuscan-Emilian Apennines.

The region possesses narrow valleys, dense chestnut forests and rivers that have carved deep canyons over millennia, such as the *Solco di Equi*. This dramatic landscape led to significant engineering challenges during construction, resulting in a line characterised by steep gradients and a high density of remarkable engineering structures. The railway is interspersed with viaducts and tunnels, most notably the *Lupacino Tunnel*, which have become integral parts of the local heritage. This unique location not only makes the Lucca–Aulla a transport corridor but a “landscape observatory”, offering passengers views of medieval mountain villages, prehistoric caves and the white marble peaks of the Apuan Alps.

4.1.2. HISTORY OF THE LINE

The history of the Lucca–Aulla is a testament to the persistence of mountain communities. Construction began in the late 19th century, with the first sections opening in 1892, but due to the technical difficulties of the terrain, a full connection to Aulla Lunigiana was not completed until 1911. The line played a crucial role in the early 20th century in breaking the isolation of rural Garfagnana. However, it suffered devastating damage during World War II, particularly between 1944 and 1945, when much of the infrastructure was sabotaged. The subsequent reconstruction in the 1950s was then vital for the valley’s post-war socio-economic recovery.

A pivotal moment in the line’s recent history occurred in the late 1990s and early 2000s. During this period, the Lucca–Aulla line was classified among Italy’s *rami secchi* (“dry branches”), a category used for railway lines considered economically weak. In response, a progressive requalification programme was launched through a succession of agreements and service contracts. An initial agreement in 1997 established a framework for reorganising public transport and consolidating rail services. This was followed in 1998 by service contracts between Ferrovie dello Stato (FSI) and the Provinces of Lucca and Massa-Carrara to finance additional services, together with a complementary agreement involving the *Comunità Montana della Lunigiana* to strengthen the line’s tourism and environmental role. These arrangements were renewed in 2000, before responsibility for regional rail services was transferred in 2001 to the Region of Tuscany through a service contract with Trenitalia.

The survival and ongoing modernisation of the Lucca–Aulla line are the results of a coordinated effort among several key stakeholders:

- **Rete Ferroviaria Italiana (RFI):** As the national infrastructure manager, RFI is responsible for the maintenance of the single-track line, its tunnels (including the 7.5-km long Lupacino Tunnel), and the technological upgrading of its signalling systems.
- **Trenitalia (regional management):** The operator of the regional rail service, it manages the rolling stock and coordinates with the Region of Tuscany to align service supply with local demand.
- **Region of Tuscany:** The primary funding body and planning authority, which holds the PSO contract and dictates the strategic goals for regional mobility.
- **Province of Lucca:** The Province rallied other institutions to prevent the line's closure in the 1990s and continue to oversee the integration between rail and local bus feeder services.

4.1.3. INFRASTRUCTURE CHARACTERISTICS

This section aims to characterise the technical profile of the Lucca–Aulla railway and its operating conditions. The information is based on a technical fact sheet reviewed and approved by the operator.

The Lucca–Aulla is a single-track, standard-gauge (1,435 mm), non-electrified railway line extending for approximately 88 km between Lucca and Aulla Lunigiana. It is operated under a centralised traffic control system (Dirigente Centrale Operativo – DCO) located in Pisa.

Train operations are managed through an axle-counter block signalling system (Blocco Conta Assi – BCA), and the line is equipped with the Sistema Controllo Marcia Treno (SCMT) train protection system, which was progressively deployed along the entire route between 2021 and 2022.

From a technical perspective, the line has several characteristics which are commonly associated with secondary regional railways in Italy. These include single-track infrastructure, the absence of electrification and relatively simple signalling arrangements in relation to those found on the main national network. While these features reflect the historical development of the route and its traffic levels, recent investment has focused on improving operational safety and reliability by upgrading signalling equipment and implementing the SCMT system across the line.

4.1.4. SERVICE CHARACTERISTICS

The aspects presented here aim to characterise the level of service, through the types of operation, their frequency and the associated demand. The line accommodates three types of traffic: regular passenger services, tourist services and freight. This section will focus on the first two.

4.1.4.1. PASSENGER SERVICES

The Lucca–Aulla line is primarily served by regional passenger trains operated by Trenitalia. According to the current timetable, the service is structured around an approximately hourly frequency on weekdays, with additional services during peak periods, while trains generally operate every two hours on Sundays and public holidays. In total, around 31 passenger trains run on the line each day.

The line uses a mixed fleet that includes ATR 220 “Swing” diesel multiple units (see Figure 23) and more recently introduced “Blues” hybrid trains. The Swing trains, introduced in Tuscany from 2015 onwards, offer improved accessibility for passengers with reduced mobility as well as dedicated bicycle spaces. The Blues trains combine diesel and electric traction technologies and are increasingly used on regional services.



Figure 23: Swing diesel train on the line. Source: Authors

Operating speeds vary according to the route's features, which traverses the mountainous landscapes of Garfagnana and Lunigiana. Despite its single-track and non-electrified configuration, the line provides regular connections between the inland valleys and the wider Tuscan railway network.

A distinctive feature of the Lucca–Aulla service is its long-standing integration with local bus networks. Since the late 1990s, the requalification programme developed for the line has included the reorganisation of feeder bus services and the introduction of integrated rail-bus ticketing schemes. Several stations, including Bagni di Lucca, Borgo a Mozzano, Castelnuovo Garfagnana, Piazza al Serchio and Aulla Lunigiana, function as local interchange points where rail services connect with bus routes serving surrounding villages, mountain communities and local activity centres. This intermodal organisation was conceived as a means of extending the catchment area of the railway and improving accessibility in areas with dispersed settlements and mountainous terrain.

Consequently, the line has seen a positive change in passenger trends, with annual tourist-related ridership estimated at approximately 65000 passengers. This ridership appears stable (growing since the post-pandemic recovery) and reflects a burgeoning interest in “Slow Tourism” initiatives within the “Green Tuscany” region, positioning the railway as a central pillar for the area's socio-economic and environmental resilience.

4.1.4.2. TOURIST SERVICES

Tourism-oriented railway services have become an increasingly visible component of the Lucca–Aulla line. In addition to its regular passenger services, the railway is occasionally used by heritage and special trains organised by Fondazione FS Italiane and local stakeholders. These include:

- The *Treno del Presepe* serving the Christmas nativity event at Equi Terme,
- The *Treno dei Saperi* promoting local food products
- The *Treno dei Parchi* highlighting the natural heritage of the region, and steam-hauled excursion trains operating at selected occasions
- The *Treno a vapore* on Easter Monday and 1 May on the Viareggio/La Spezia–Lunigiana–Garfagnana route

Beyond these dedicated services, promoting tourism has increasingly been integrated into broader regional tourism strategies. Trenitalia has included destinations along the line in its digital *Travelbook* guides, notably promoting Equi Terme and the surrounding areas of the Apuan Alps. The railway is also incorporated into tourism products developed by local operators, such as the *Garfagnana Experience*, which offers multi-day itineraries combining rail travel with visits to historic villages, natural sites and cultural attractions located along the route.

4.1.5. TOURISM AS A DRIVING FORCE

Although regional passenger transport remains the primary function of the Lucca–Aulla railway, the regions served by the line have increasingly been promoted through tourism-related initiatives. The railway provides access to a range of cultural, historical and natural attractions, including the Ponte della Maddalena (Devil’s Bridge) in Borgo a Mozzano, the thermal baths of Bagni di Lucca and Equi Terme, the historic centre of Castelnuovo Garfagnana, and the landscapes of the Apuan Alps.

Beyond simple destination marketing, tourism development strategies in Garfagnana and Lunigiana increasingly emphasise outdoor recreation, local gastronomy and cultural heritage. For example, products such as Protected Geographical Indication (PGI)-certified farro and chestnuts, hiking and cycling activities, and the region’s migratory heritage are regularly highlighted when promoting tourism. The area is also included in the national Italian programme dedicated to roots tourism, which seeks to reconnect descendants of Italian emigrants with their places of origin.

While these initiatives are not centred on the railway itself, they contribute to a broader context in which tourism has become an increasingly important component of regional development and promoting the areas served by the Lucca–Aulla line.

4.2. TOURISM POTENTIAL OF THE REGION

The methodology developed within the *Tour&Rail* project in previous work packages aims to identify the tourism potential of the line. It is based on two main pillars: *territorial capital* and *social cohesion*, which are presented in detail in the methodology section. These two pillars, along with their associated indicators, have been applied to the Lucca–Aulla line.

4.2.1. TERRITORIAL CAPITAL

The *territorial capital* pillar is composed of three main indicators: *cultural heritage assets*, *landscapes* and *protected natural areas*.

Note: The methodology not only concerns the identification of the sites but also how accessible they are from the stations and their *perception* from the line.

4.2.1.1. CULTURAL HERITAGE ASSETS

Analysis of cultural heritage assets along the Lucca–Aulla line show that these represent a significant share of the line’s tourism potential. However, unlike the Douro line in Portugal, the methodological distinction between regional, national and international levels of heritage protection could not be applied. The Italian heritage protection system does not formally differentiate between regional and national levels of legal protection in the same way as the Portuguese framework. In Italy, heritage assets are generally classified according to whether they are legally protected or not, without an intermediate hierarchy based on regional scale. The analysis has therefore been adapted to reflect the specificities of the Italian heritage protection framework.

National level of protection

The Italian heritage protection system is based in part on a form of presumptive heritage designation, whereby publicly owned properties (and certain properties owned by non-profit entities) that are more than seventy years old and created by a now-deceased person are presumed to be of cultural interest and are therefore subject to interim protective measures even before a full assessment of their historical, architectural, or artistic significance has been carried out. This presumption does not constitute an automatic definitive designation, but rather a provisional legal protection that remains in force until the competent authorities complete the formal verification procedure (*verifica dell’interesse culturale*) provided for in Articles 10 and 12 of Legislative Decree No. 42/2004 (*Codice dei beni culturali e del paesaggio*).

In terms of cultural heritage, the number of protected sites located within the buffer zones defined in the methodology is particularly substantial.

For the accessibility indicator, the OpenRouteService (ORS) plugin in the QGIS software was used to generate walking isochrones of 5, 10 and 15 minutes around each station. Protected heritage sites were then identified using the *Beni architettonici tutelati ai sensi della Parte II del D.Lgs. 42/2004* database, which constitutes the official inventory of architectural assets protected under Part II of Italian Legislative Decree No. 42/2004.

By applying the intersection tool in QGIS, 164 protected heritage sites were identified within a 15-minute walking distance of the 23 stations along the line. Of these, 128 are located in the vicinity of Lucca station, highlighting the central role of Lucca’s

historic centre in the cultural heritage assets served by the railway. When accessibility was assessed using a 15-minute cycling isochrone, the number of accessible protected sites increased substantially.

For the perception indicator, an additional 40 nationally protected heritage sites were identified within the 1-kilometre visibility buffer along the railway corridor. Overall, nearly 200 protected heritage sites are either

directly visible from the railway or accessible within a short distance from its stations (see Figure 24). Only a small number of sites are accessible from stations but fall outside this visibility zone.

International level of protection

No heritage sites protected at the international level (UNESCO, Natura 2000, etc.) were identified in the accessibility or perception assessments.

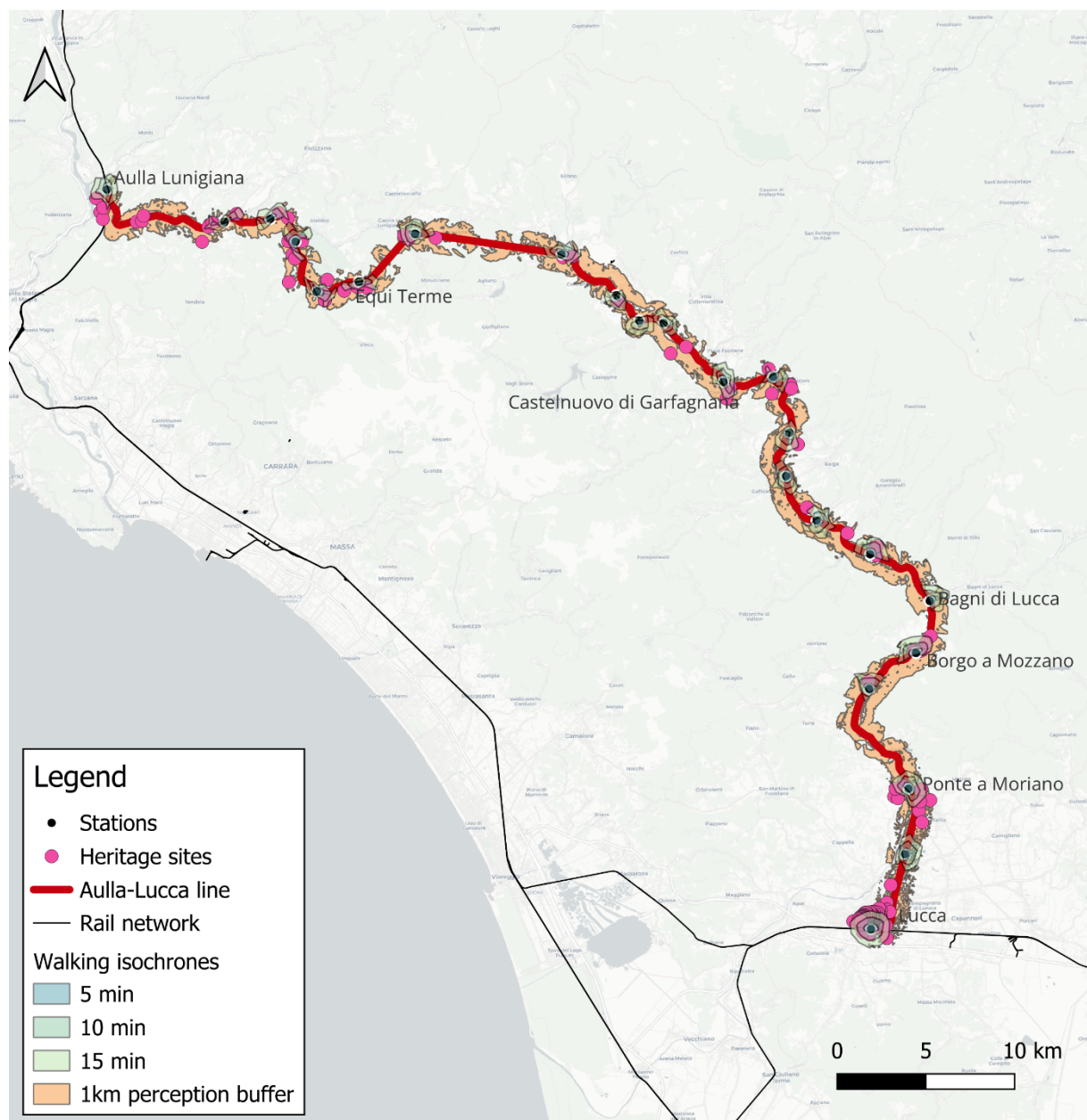


Figure 24: Accessible and perceptible heritage sites from Lucca–Aulla line. Source: Authors

4.2.1.2. LANDSCAPE

Here again, the methodology developed within the project provides three indicators related to landscape quality: landscape richness (the number of landscape units crossed), landscape diversity (the proportion of each of these units along the route) and landscape uniqueness (characterised by their level of protection, particularly as natural monuments or protected landscapes).

Landscape richness

For the landscape richness indicator, the landscape units (*ambiti di paesaggio*) defined in the Tuscan Regional Territorial Plan with Landscape Value (*Piano di Indirizzo Territoriale con valenza di Piano Paesaggistico*, PIT-PPR) (Figure 25) were used. These units are the result of a structural and interpretive regionalisation of the area rather than a simple aggregation of existing protected areas or administrative boundaries. Their delineation is based on the concept of territorial heritage (*patrimonio territoriale*), understood as the long-term parallel evolution between natural systems and human settlement patterns that gives each portion of the region its distinctive identity.

Methodologically, delimiting the landscape units relies on the integrated analysis of three major regional structures:

- **Hydro-geomorphological structure**, which includes geography, geology, soils, river basins and drainage systems.
- **Ecosystem structure**, which encompasses ecological networks, forest systems, habitats and biodiversity patterns.
- **Settlement structure**, which covers urban systems, rural landscapes, transport infrastructure and the historical arrangement of human occupation.

These three structures are treated as the fundamental components of the regional territorial heritage and are mapped and analysed at the scale of the entire region.

The boundaries of the landscape units are established through an interpretive overlay of these regional structures in order to identify areas characterised by a high degree of internal homogeneity. This homogeneity is assessed in terms of geomorphological continuity, ecological functioning, historical land use trends and the spatial organisation of settlements and infrastructure. The resulting units generally correspond to large areas such as mountain valleys, coastal plains, hill systems, or historically integrated urban-rural regions. Their limits therefore reflect functional and historical relationships rather than purely visual criteria or strict administrative divisions.

This regionalisation process is informed by identifying structural invariants (*invarianti strutturali*), that is, features considered sufficiently stable over time to constitute the enduring framework of the landscape. These invariants include mountain systems, hydrographic networks, traditional agricultural patterns, settlement hierarchies and wildlife corridors. They are used to distinguish landscape units with common development trends, environmental characteristics and planning challenges.

Each landscape unit is subsequently described in a dedicated analytical report that documents its defining features, historical evolution, current dynamics, critical issues and objectives for landscape quality. In this way, the landscape units function as operational planning units designed to support the formulation of context-specific conservation and development policies.

Figure 25 shows the cartographic results of the Tuscan PIT-PPR.

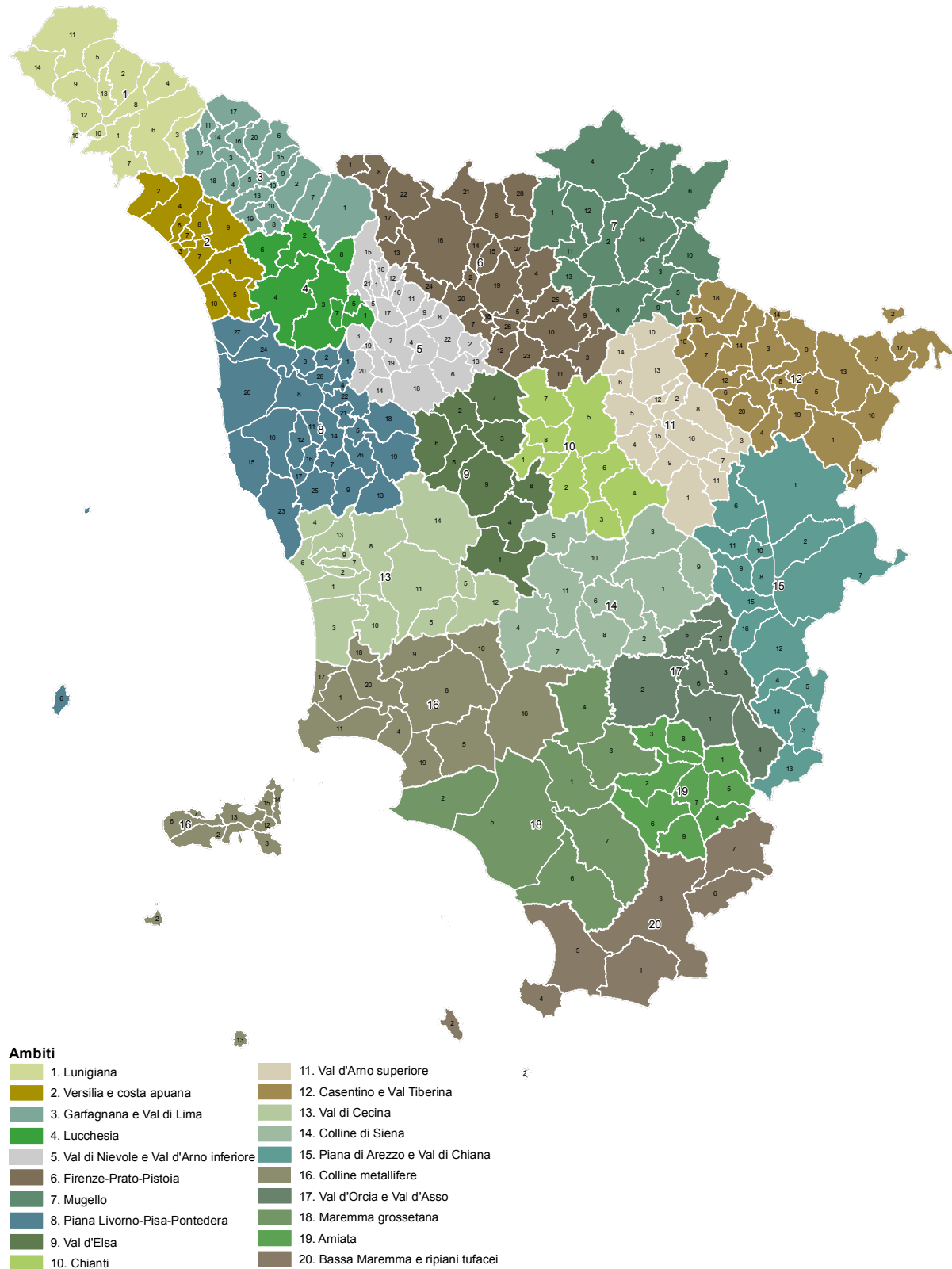


Figure 25: Landscape unit division resulting from the Piano di Indirizzo Territoriale (PIT)

Overlaying this mapping with the Lucca–Aulla line makes it possible to identify the landscape units crossed. In this case, there are three: Lunigiana; Garfagnana, Serchio Valley and Lima Valley; and Lucchesia (Figure 26).

According to Tuscany Region documentation, these units are described as follows:

- **The Lunigiana landscape unit** corresponds to the Magra River valley, a border region between Tuscany, Liguria and Emilia-Romagna shaped by a long-standing agro-silvo-pastoral economy. Its landscape is characterised by a mosaic of forests, chestnut groves, cultivated clearings, mountain pastures and numerous fortified villages and castles linked to the historic Via Francigena. The southern part of the area includes the Apuan Alps, where marble quarrying has contributed to a distinct landscape shaped by the interaction between natural features and human activity. Today, the region is affected by the progressive abandonment of upland areas and by the concentration of residential and economic development in the valley floor of the Magra River.
- **The Garfagnana, Serchio Valley and Lima Valley landscape unit** is a mountainous region structured around the Serchio River, located between the Apuan Alps and the Apennines. It is characterised by abundant water resources, karst springs, thermal water and a rich mosaic of forests, chestnut groves, mountain pastures and historic hilltop villages with a long agro-silvo-pastoral tradition and by the Lombard process of fortification. On the valley floor, fields for agriculture have progressively led to settlements, industries and transport infrastructure, including the railway, being

more concentrated while many upland areas have experienced depopulation and land abandonment. The Apuan sector also has marble quarries, which have shaped the landscape and contributed to a distinctive cultural identity at the interface between nature and human activity.

- **The Lucchesia landscape unit** is organised around the broad plain of Lucca, a former marshland progressively reclaimed and transformed into one of Tuscany's most productive agricultural areas, now heavily urbanised. This plain is located along the Serchio River, and an extensive hydraulic system of canals, wetlands and drainage works, including the Nottolini aqueduct, are structured around it. It is encircled by a varied ring of hills and mountains – the Pizzorne plateau, the southern Apuan Alps, the Monti Pisani, and the Montecarlo and Cerbaie hills – characterised by forests, olive groves, chestnut stands, vineyards and a remarkable concentration of historic villas and parks. At the centre, the city of Lucca has long dominated and led to the surrounding countryside being organised into a dense network of farmsteads (“corti lucchesi”), roads and irrigation channels, creating a highly ordered agricultural landscape often described as a vast garden.

Nowadays, this historical rural structure has been increasingly fragmented by residential expansion, industrial development (notably the paper industry) and transport infrastructure, nevertheless maintaining a strong cultural identity rooted in the close relationship between city, plain and surrounding geography.



Figure 26: Landscape units crossed by the Lucca–Aulla line. Source: Authors

Landscape diversity

To assess landscape diversity, the Shannon index, as defined in the methodology section, was used. An intersection was performed between the railway line and each landscape unit in order to determine the share of the line length for each, using QGIS.

The line has 23.96 km in the Lunigiana unit, 43.64 km in the Garfagnana unit and 23.09 km in the Lucchesia unit. The calculation of the index yields a value of . This result indicates a high level of diversity, characterised by the high level of presence of all categories, despite one of them technically dominating (48% within the Garfagnana unit).

Landscape uniqueness

For this, no landscape protection – apart from the UNESCO site – is identified within the World Database on protected areas (WDPA) which lists protected natural areas at the international, national and regional levels and includes categories such as *natural monument* and *protected landscape*, corresponding to those targeted by this indicator. No classified landscape of this type was identified within the study area, nor within the accessibility and perception buffers defined by the methodology.

However, outside of this database, which allows a comparison with other national contexts, the Italian landscape policy framework is structured around the *Codice dei beni culturali e del paesaggio* (Legislative Decree No. 42/2004), which establishes two complementary categories of legally protected landscapes (*beni paesaggistici*):

- The first category includes landscapes designated through specific administrative acts because of their outstanding public interest (*immobili e aree di notevole interesse pubblico*, Articles 136–141), such as historic villas and gardens, monumental complexes and panoramically significant areas.
- The second category comprises areas protected automatically by law under Article 142 (*aree tutelate per legge*), including coastal zones, river corridors, lakeshores, mountains above 1,200 metres in height, glaciers, national and regional parks, forests, areas subject to civic-use rights, wetlands and archaeological sites. This dual system combines discretionary designation with statutory protection, creating a comprehensive framework in which landscape conservation extends well beyond conventional protected areas to encompass a wide range of natural, cultural and historical features. These legally protected areas form the core spatial reference for regional landscape planning, notably through the *Piano Paesaggistico*, which integrates heritage protection into broader regional governance. Any alteration affecting these protected landscapes is subject to prior landscape authorisation (*autorizzazione paesaggistica*), ensuring that development projects are assessed for their compatibility with the landscape values recognised by law.

Under this legal framework, the entire railway line is subject to landscape protection constraints, as it crosses, provides access to, or offers views of legally protected landscape features, including archaeological sites, rivers and watercourses, forests, mountain areas, glacial landforms and lakes.

4.2.1.3. PROTECTED NATURAL AREAS

Analysis of the perception and accessibility of protected natural areas, based on the World Database on Protected Areas (WDPA), reveals limited tourism potential for the Lucca–Aulla railway line (Figure 27). Following the methodology, heritage sites are examined across multiple scales, from the international to the regional level.

From an international protection perspective, no heritage sites seem to be protected in the immediate vicinity of the line.

The railway follows the Serchio River, alongside the Regional Natural Park of the Apuan Alps (Parco Naturale Regionale delle Alpi Apuane), a nationally recognised protected area in Italy. However, the park lies mostly beyond the 1 km accessibility and visibility buffers used in the methodology. Only a very small section appears to be theoretically visible from Equi Terme station. Near Aulla station, a small portion of the Area Naturale Protetta di Interesse Locale (ANPIL) Fiume Magra in Lunigiana is also marginally visible.

At the regional level, only the Valli glaciali di Orto di Donna e Solco d’Equi is partially visible and accessible from Equi Terme station. This site largely overlaps with the Regional Natural Park of the Apuan Alps.

Overall, the protected natural areas indicators suggest a limited tourism interest in this respect along the Lucca–Aulla line, based on the databases and methodological parameters used in this study.

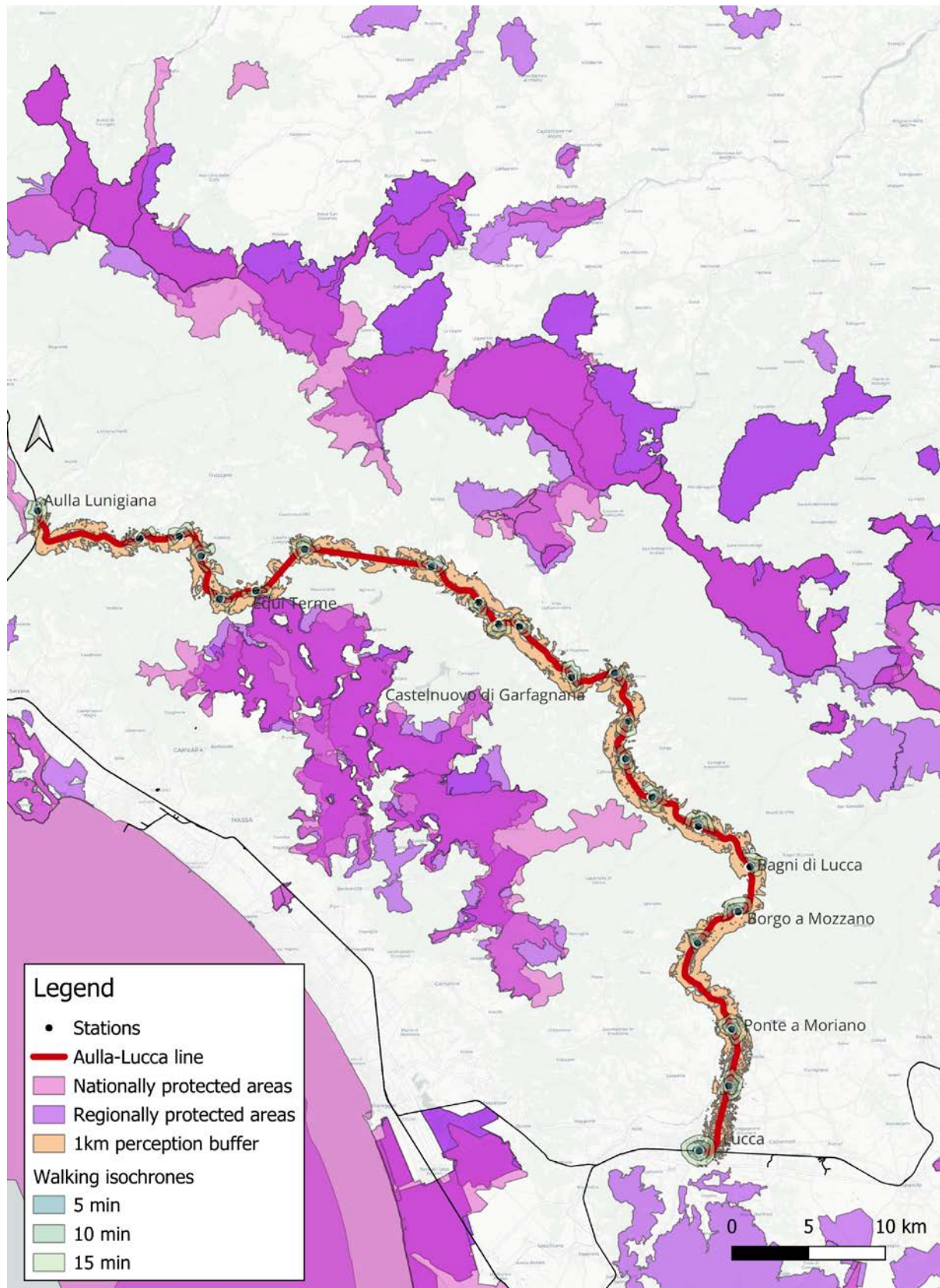


Figure 27: Protected natural areas according to the World Database on Protected Areas (WDPA). Source: Authors

4.2.2. SOCIAL COHESION

Following the methodology developed in WP3, social cohesion was analysed using two indicators: socio-ecological connectivity and perceived territorial value. This analysis seeks to assess each region's level of social cohesion and socio-economic vitality, based on the premise that the strength of the local social fabric plays a crucial role in determining its capacity to support the tourism-led revitalisation of low-traffic railway lines.

4.2.2.1. SOCIO-ECOLOGICAL CONNECTIVITY

The social-ecological connectivity indicator is used in this case study primarily to better understand the socio-economic dynamics of the area surrounding the line. While the indicator provides valuable insight into the characteristics and vitality of the local social fabric, it does not in itself allow the level of social cohesion to be directly assessed. Such an evaluation would require a comparative approach involving several low-traffic rural railway lines with the same national or regional background, as was undertaken for the Spanish case studies in WP3.

In this context, the indicator is therefore mainly used as a tool for identifying regional dynamics and socio-economic characteristics that may influence the capacity of the area to support tourism-led revitalisation processes. For the first step of the socio-ecological connectivity analysis, the municipality crossed by Lucca – Aulla line.

The area considered is composed of 18 municipalities.

For each of these municipalities, a set of socio-economic descriptors (Appendix C.2) was documented. The CORINE Land Use Land Cover (LULC) 2018 database provided by the European Commission was also used, with the LULC data being used with an intermediary level of 15 categories. 12 categories were present in the area in question (Appendix D.2)

More than two thirds (68%) of the area is covered by *Forests*, followed by 16% of *Heterogeneous agricultural areas*. *Urban fabric* comes in third on the list only with 3.47%.

The Lucca–Aulla railway serves as a fundamental socio-economic counterweight for the Serchio Valley, providing a stable alternative to road travel, which is frequently compromised by the region's complex terrain and weather-related disruptions. However, the infrastructure's socio-economic impact is not constant across the line. To evaluate the range of regional dynamics influenced by the railway, a multivariate statistical approach was applied. A Principal Component Analysis (PCA) was performed based on land-use data to identify the underlying gradients of territorial differentiation. Socio-economic variables for each municipality were included as supplementary variables, allowing for a post-hoc interpretation of the factorial space without influencing its construction.

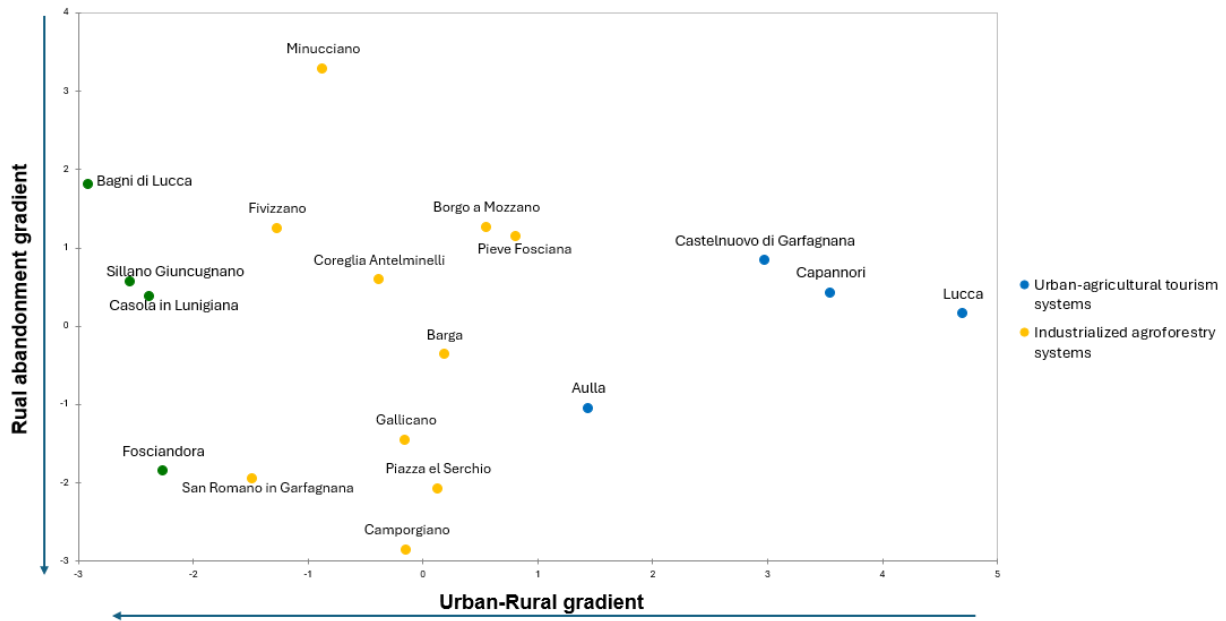


Figure 28: Multi-dimensional analysis of the region: differentiation of the Lucca–Aulla line municipalities based on land use and socio-economic dynamics. Source: UCM

As Figure 28 shows, the first principal component (F1) represents a clear urban–rural gradient, organising the municipalities according to their level of socio-economic centrality and degree of urbanisation. At the positive end, municipalities such as Lucca, Capannori and Castelnuovo di Garfagnana are characterised by higher population density, stronger economic dynamism, greater functional variation and a pronounced presence of urban and service-oriented activities. At the negative end, municipalities such as Bagni di Lucca, Sillano Giuncugnano and Casola in Lunigiana are associated with low population density, limited accessibility and reduced functional complexity, reflecting more outlying and more deeply rural situations.

The second principal component (F2) expresses a gradient of rurality towards socio-ecological abandonment, distinguishing rural regions with a higher relative functional vitality from those experiencing progressive decline and a loss of dynamism. Minucciano, Fivizzano and Borgo a Mozzano, for example, have positive values, retaining a certain level of land-use diversification and some activities such as nature-based tourism or local services. In contrast, negative values are associated with municipalities such as Camporgiano, San Romano in Garfagnana and Fosciandora, characterised by stronger rural monofunctionality, weaker integration into economic and tourism networks, and more evident signs of socio-economic decline and structural abandonment. Figure 29 provides a cartographic representation of this analysis.

Urban-agricultural-tourism systems

These regions are characterised by a marked socio-ecological multi-functionality, where urban, agricultural and tourism-related land use coexists within a highly anthropized environment. They have a high population density and a well-established urban fabric, combined with still-significant agricultural activity, particularly in heterogeneous agricultural mosaics. From a socio-economic perspective, they stand out for having higher income levels, lower demographic ageing and a diversified production structure.

In terms of tourism, they concentrate the highest supply and accommodation capacity, suggesting a strong integration into tourism dynamics, likely linked to both urban tourism and nearby rural tourism. Overall, this model reflects dynamic regions that are nonetheless subject to increasing pressure on land and natural resources.

Industrialised agroforestry systems

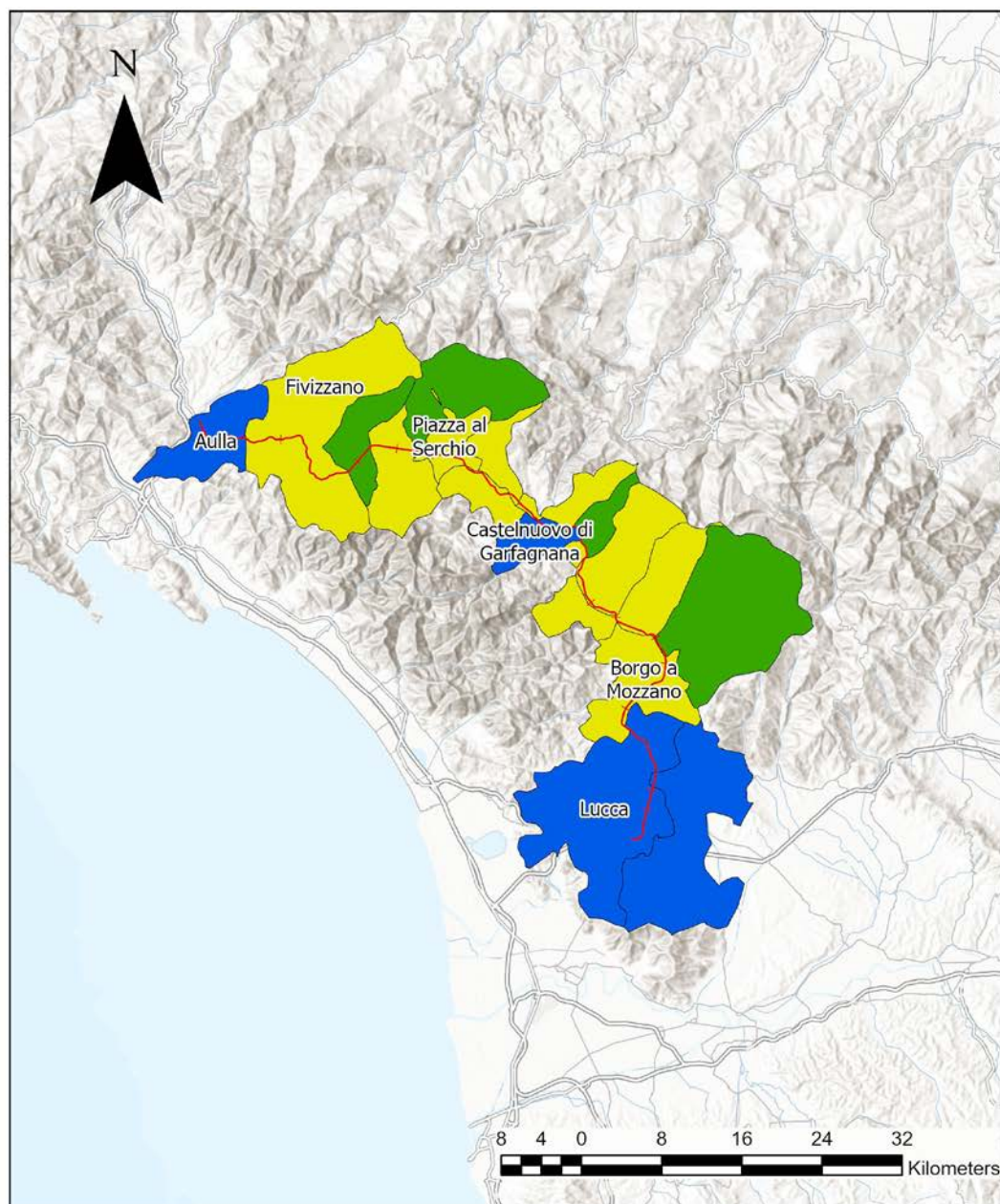
These regions constitute socio-ecological transition spaces, where forest cover predominates alongside agricultural use and a significant industrial presence. Population density is intermediate and the level of urbanisation is moderate, resulting in a less intensive territorial structure than Class 1. From a socio-economic perspective, income levels are intermediate and the demographic is increasingly ageing, with a clear specialisation in the industrial sector as the main economic driver.

From a tourism perspective, they have moderate capacity and development, likely associated with natural and landscape resources, although without reaching a high degree of tourism specialisation. Overall, they represent regions in relative balance, but with a risk of population decline and structural changes in land use.

Ageing rural forest systems

This group are regions with forest ecosystems and extensive land use being clearly dominant, with very low population density and limited land artificialisation. From a socio-ecological perspective, they exhibit dynamics of agricultural abandonment and landscape naturalisation, accompanied by pronounced demographic ageing and lower income levels. The economic structure is weak, with higher unemployment rates and limited sectoral diversification.

Tourism is low, indicating low integration into tourism circuits despite their environmental potential. These regions reflect processes of rural depopulation and functional marginality, although they may also offer opportunities linked to conservation and nature-based tourism.



—+— Lucca-Aulla Line

Social-ecological connectivity

- Aging rural forest systems
- Industrialized agroforestry systems
- Urban-agricultural tourism systems

Figure 29: Cartographic representation of the socio-ecological connectivity. Source: UCM

4.2.2.2. KEY LESSONS FROM THE GROUP DISCUSSION

A group discussion held in the Province of Lucca Headquarters on 11 March 2026 provided interesting insights into the local situation, enabling a more grounded understanding to be gained of the line's evolution, the projects currently under discussion, and the areas of consensus and disagreement among the key stakeholders involved in its day-to-day management and development. Table 2 below presents the participants who took part in the group discussion, highlighting the wide range of stakeholders and organisations represented.

PAST (PLAYERS DURING THE LINE DEVELOPMENT)			
Stakeholder	Representative	Role	Notes
Tuscany Region	Saverio Montella	Director	
Lucca Province	Francesco Pifferi	Transport Advisor	Current Major of Camporgiano
Lucca Province	Cecilia Carmassi	Transport Advisor	
Lucca Province	Vittorio Torre	Official	
Trenitalia, Tuscany Region	Paolo Cozzi	Timetable manager	
Trenitalia	Federica Follesa	Manager	
TPL CLAP Company	Luigi Filippi	Director	
CURRENT PLAYERS			
Stakeholder	Representative	Role	Notes
Tuscany Region	Laura Castellani	Manager	
Tuscany Region	Angela Dondoli	Official	Official in the development phase
Lucca Province	Francesco Raspini	Chief of Staff	
Trenitalia, Tuscany Region	Natalia Giannelli	Director	
Trenitalia, Tuscany Region	Cristina Bruno	Timetable manager	
Rete Ferroviaria Italiana (RFI)	Angela D'eboli	Representative	
Migra (freight transportation)	Nicola Poli	Representative	Current Major of Minucciano
TPL Company (Autolinee Toscane)	Sandro Bartolucci		
Castelnuovo Garfagnana	Andrea Tagliasacchi	Major	former Lucca President relevant in development phase
Bagni di Lucca	Paolo Michelini	Major	
San Romano in Garfagnana	Raffaella Mariani	Major	
Association "Presepe Vivente di Equi Terme"	Fabio Furia	Representative	
FLA Ferrovia Lucca Aulla (tourism organization)	Roberto Pasquali	Representative	
Provincial Observatory on the Condition of Persons with Disabilities - Coordinator	Giacomo Perfigli	Coordinator	Soliera (comune di Fivizzano MS)

Table 2: Participants in the group discussion. Source: Authors

Stakeholders involved

The Lucca–Aulla railway is supported by a multi-level network of public authorities, railway operators, municipalities, civil society organisations and educational institutions. At the national level, Rete Ferroviaria Italiana (RFI) manages infrastructure and oversees train traffic through control centres in Florence and Pisa, while Trenitalia operates the thirty-one daily passenger trains and two freight services via its Tuscany Regional Office. The Tuscany Region holds strategic and contractual responsibility for regional rail service planning – a competency transferred from the national level in 2000 – and is a key source of funding for infrastructure and rolling stock. The Provincial Administration of Lucca served as the institutional catalyst for rail-bus integration in the late 1990s. The Union of Municipalities of Garfagnana, representing fifteen municipalities across the Serchio Valley, represents collective local interests, while the Provincial Paraplegics Association of Massa Carrara has led a comprehensive accessibility improvement programme since 2015. Secondary school students and daily commuters constitute the primary user groups and have substantially shaped service planning priorities.

Configuration

The current governance model emerged in response to the threat of closure in the 1990s, when the corporatisation of Ferrovie dello Stato introduced profitability criteria that rendered the line economically unviable. The Province of Lucca convened a formal multi-party agreement bringing together municipal governments, the Region, Trenitalia and RFI, resulting in an integrated rail-bus ticketing and timetabling system – later being made formal as the regional Pegaso scheme – that

aligned connections with school schedules and cut journey times significantly. The line itself operates as a secondary, single-track route with few crossing points, connecting two main arteries (the Florence–Viareggio–Pisa line and the Pontremolese), meaning that there are strict operational constraints. The model was reinforced by two subsequent milestones: recovery funds in response to the 2013 Garfagnana earthquake were used to reinforce over thirty tunnels and bridges, and the introduction of the Swing trains in 2015 improved accessibility and prompted stations to be modernised across nearly all stops on the line. Alongside institutional arrangements, both lines have also benefited from the commitment of key individuals who drove cooperation and sustained the revitalisation process. This highlights both the importance of individual leadership and the need to progressively embed these dynamics within permanent coordination structures to ensure their long-term continuity.

Roles and responsibilities

RFI maintains and upgrades physical infrastructure and manages annual summer maintenance disruptions for safety work. Trenitalia schedules services and coordinates with RFI on passing-loop and timetabling logistics. The Tuscany Region provides strategic direction, finances rolling stock procurement, and harmonises rail and road services. The Province of Lucca coordinates bus feeder services to stations, while the Union of Municipalities advocates for service continuity, park-and-ride development and expanded intermodal connectivity. The Paraplegics Association monitors station accessibility through joint inspections with RFI and engages municipalities in providing adapted parking.

Disability organisations contribute expertise that has extended modernisation efforts well beyond rolling stock to encompass stations and public spaces. Educational institutions also help determine service design through their scheduling requirements.

Power dynamics

Substantive decision-making authority rests with RFI and Trenitalia, whose efficiency priorities have not always aligned with regional needs. Regional and local stakeholders have consistently countered this imbalance through financial joint investment, political negotiation and demonstrated social value rather than formal jurisdictional challenge. The Tuscany Region has assumed a brokering role, funding service contracts and purchasing rolling stock to maintain leverage over operational decisions. Accessibility advocates have similarly expanded their influence by anchoring improvements in broader quality-of-life and tourism arguments. The overall balance between economic and regional interests has remained stable, but institutional continuity is at risk: the coordination model has relied on a small number of committed individuals, and their eventual departure – without a permanent successor body – represents a recognised and unresolved vulnerability.

Relationships

Stakeholder relationships combine formal contractual arrangements with long-accumulated personal trust. The Province of Lucca's collaboration with the state railways proved unexpectedly constructive from the outset, with Trenitalia actively supporting the integration initiative rather than defending its operational boundaries. RFI's cooperative stance has been sustained

throughout the post-earthquake investment programme, underpinned by the Region's political backing. Joint station inspections between the Paraplegics Association and RFI have yielded concrete improvement to accessibility, while municipal governments support strong collective ownership of the line, as it is a critical regional resource. The success of this model stands in sharp contrast to other Tuscan corridors – such as the Siena–Buonconvento line – where bus and train operators ran competing services and ridership continued to decline, underscoring the exceptional and, as participants acknowledge, fragile nature of the achievements on the Lucca–Aulla line.

Expectations and demands

Stakeholders expect the line to remain a vital transport corridor while adapting to evolving demographic, environmental and regional conditions. Given the area's exposure to landslides, seismic risk and an ageing population, the railway is viewed as essential infrastructure for resilience, with road routes frequently being blocked by natural events and ambulance travel times by road reaching up to two hours.

Future aspirations include increased service frequency toward a light-rail model, using hybrid or hydrogen-powered trains, a streamlining of the twenty-four stations into larger intermodal hubs, and full accessibility compliance across all stops. Participants also stressed the need to reconvene the multi-stakeholder roundtable that produced the original integration agreement, updating its analysis to reflect changed school schedules, worker mobility patterns, hospital access demands and freight potential – ensuring the line remains relevant across future social and regional contexts.

4.3. TECHNICAL FIELD VISIT TO THE LUCCA-AULLA LINE

4.3.1. OBJECTIVES AND METHODOLOGICAL FRAMEWORK

The technical visit was created as an empirical evaluation tool for the research activities conducted as part of Work Package 4 (WP4). The field visit had two main objectives:

- **Assess the railway infrastructure:** evaluate the railway infrastructure and station buildings' state of conservation by applying the methodology developed in WP2, with the aim of determining whether the condition of the assets was homogeneous or heterogeneous along the entire line.
- **Assess the regional and tourism context:** use in-situ observation to better understand the line's functional dynamics, its integration into the surrounding urban environment, and its interactions with tourism-related activities, with particular attention being paid to tourist accessibility, the quality of services provided to users and the effectiveness of interchange nodes.

The field inspection was expected to generate qualitative data that could not be obtained through documentary analysis alone. The visit also provided an opportunity to organise a group discussion with local stakeholders, following the methodology developed in WP3, to document the *perceived value* attribute of the *social cohesion* component.

4.3.2. DESCRIPTION OF THE FIELD VISIT

The fieldwork was carried out in two phases to fully address the project's objectives. A first site visit was conducted on 12 February 2026 by the University of Florence (UNIFI) partners. This visit assessed the railway line and its stations' state of conservation. Following the methodology developed in Work Package 2 (WP2) presented in the methodology section, the survey questionnaire was applied to the Lucca–Aulla line. Three stations and infrastructure points were assessed to provide a representation of the physical condition of the line and its associated facilities. This initial visit also served to prepare the second field visit, which took place on 18 March 2026 and involved all project partners as well as students participating in the Student Week event organised as part of Work Package 5 (WP5).

For the second field visit, the morning programme was conducted by bus in order to visit several key locations along the line that could not easily be reached given the relatively low frequency of train services. This allowed the group to stop at the Devil's Bridge, Bagni di Lucca station and Castelnuovo di Garfagnana station. The return journey was made by train, so that the participants were able to experience the railway service directly and to observe the landscapes and settlements visible along the route.

Lucca station

The field visit began at the Lucca railway station (Figure 30), recognised as the major gateway and the “nodal filter” of the line. In this location, the analysis examined the station’s capacity to manage the transition from the high-frequency regional corridors (Florence-Pisa-Viareggio) to the single-track mountain line. The inspection highlighted that Lucca is not merely a transit point but a vital hub where digital signage, multi-

language information and high-standard refreshment areas determine the first impression of the inland region for tourists. From a geographic perspective, this station represents the threshold between the plain and valley, making its role as an intermodal exchange centre (rail-to-bus and rail-to-bike) essential for reducing private car reliance in the sensitive mountain ecosystems located further north.



Figure 30: Lucca station and tracks. Source: Authors

Mid-valley infrastructure

Continuing the itinerary northward, the monitoring activity involved the stations of Ponte a Moriano and Borgo a Mozzano (Figure 31). These sites were identified as *territorial outposts* that serve the industrial and residential outskirts of Lucca. The observation focused on the quality of the infrastructure's management, assessing how these smaller stations maintain safety and accessibility in rural contexts.

A significant portion of the inspection was dedicated to the Ponte della Maddalena (Devil's Bridge, Figure 32). This 11th-century architectural masterpiece serves as a primary case study for the line's tourist potential. Geographically, the bridge is the narrowest point of the valley, and the station's proximity to this landmark demonstrates how rail can act as a "scenic balcony". The visit underlined that without the railway stop, access to the monument would be entirely dependent on the congested valley road (SS12), thereby proving that the station is a strategic asset for the environmental sustainability of local tourism.



Figure 31: Borgo a Mozzano station platform.
Source: Authors



Figure 32: Devil's bridge. Source: Authors

The itinerary included a dedicated stop at the station of Bagni di Lucca (Figure 33), a site of immense historical value. Historically renowned as one of Europe's premier thermal complexes, the town's relationship with the railway is emblematic of the "Belle Époque" travel tradition. The station acts as a time-portal, connecting the modern rail service to the historical wellness retreats and the architectural heritage of the valley.

The analysis highlighted that the station is not just a transport stop but a "cultural gateway" that is helping to facilitate the revitalisation of health-and-wellness tourism, which is currently a growing segment for the Mid-Valley's long-term development.



Figure 33: Bagni di Lucca station. Source: Authors



Figure 34: Bus & rail intermodality at Bagni di Lucca station. Source: Authors

The Castelnuovo Garfagnana area

The inspection continued at the station of Castelnuovo di Garfagnana (Figure 35), the undisputed central hub for the upper valley. Geographically, Castelnuovo represents the point where the valley opens up towards the Apuan Alps and the Apennines. In this node, the railway is configured as a fully integrated service centre.

The visit permitted the “hub-and-spoke” model to be assessed, whereby the bus system branches out from the station to reach remote mountain hamlets. This station is vital for the local economy’s resilience; it is the primary access point for trekking and outdoor tourism, and its operational efficiency directly correlates with preventing social and economic marginalisation of the Garfagnana highlands.



Figure 35: Castelnuovo de Garfagnana station. Source: Authors

4.3.3. MAIN FINDINGS FROM THE TECHNICAL VISIT

The technical visit was conceived as an empirical evaluation tool for *Work Package 4* (WP4), aiming to directly assess the integration between the railway infrastructure and the territorial mobility system. The route began at Lucca station (the major gateway), continuing to Ponte a Moriano and Borgo a Mozzano (studying the iconic “Devil’s Bridge”), then Bagni di Lucca (a major European thermal complex) and Castelnuovo di Garfagnana (the central hub). The day concluded with an institutional meeting at the Province of Lucca headquarters, involving transport planners and tourism stakeholders.

The primary objective was to acquire qualitative data on tourist accessibility, intermodal nodes, station preservation and future development strategies. The field visit to the Lucca–Aulla railway line confirmed that the infrastructure cannot be interpreted solely through its technical or operational characteristics. Instead, it must be understood as a regional system in which mobility, socio-economic dynamics and landscape values are deeply intertwined. The empirical observations collected during the visit, combined with stakeholder interviews, a set of structural findings, that explain both the persistence and the transformation of the line over time, to be identified. These are presented below.

4.3.3.1. TECHNICAL CAPITAL AND INFRASTRUCTURE

A primary finding concerns the structural role of the railway as the region’s backbone within a geomorphologically constrained environment. The Serchio Valley and Garfagnana have limited road accessibility, high hydrogeological vulnerability and dispersed settlement patterns. Therefore, the railway provides a stable and predictable mobility system, reduced travel times compared to road transport, and resilience in adverse environmental conditions. From a territorial perspective, the railway acts as linear infrastructure for cohesion, mitigating the risk of spatial fragmentation and socio-economic isolation.

A central finding emerging from the field analysis is the progressive diversification of the functions performed by the railway over time. Originally conceived as a form of transport infrastructure aiming to ensure local accessibility and supporting economic connectivity, the line has gradually evolved into a multi-functional system that accommodates a broader range of uses. In its current configuration, it simultaneously serves daily commuting needs – particularly for pupils and workers – supports freight transport activities, especially those related to regional industries such as marble extraction, and facilitates tourism-related mobility. This functional diversification has played a crucial role in enhancing the resilience of the system, as it reduces dependence on a single demand segment and enables the railway to respond more flexibly to changing socio-economic conditions. In this sense, the line has transitioned from being mono-functional infrastructure to a multi-purpose territorial asset.

Despite its structural relevance and functional adaptability, the Lucca–Aulla railway remains subject to a series of technical constraints that significantly affect its operational performance and long-term development potential. The single-track configuration of the line, combined with the limited number of crossing points, imposes a high dependency on timetable precision and reduces operational flexibility. Under such conditions, even minor delays can affect the entire line, with cumulative disruptions that affect overall service reliability. These constraints are further intensified by the complex topographical context in which the railway is embedded. The presence of steep gradients, numerous tunnels and bridges not only increases maintenance requirements but also limits the feasibility of infrastructural upgrades or capacity expansion. Consequently, the system can be considered operationally efficient under stable conditions, yet structurally vulnerable when exposed to external disruptions or fluctuations in service demand.

The findings must be framed within the broader context of *territorial heterogeneity* identified through the PCA analysis. The interaction between the railway and region is not uniform but varies significantly depending on local socio-economic and spatial conditions. In areas with *urban-agricultural-tourism* systems, the level of integration is relatively high, supported by stronger economic structures, diversified land use and a more developed tourism sector.

In contrast, a more intermediate level of integration exists for areas in industrial transition, reflecting a balance between productive activities and emerging service functions.

Finally, in ageing rural forest systems, the rail line plays a more limited role, as these regions are marked by low population density, reduced accessibility and structural socio-economic marginality. This differentiation highlights the importance of considering spatial variability when assessing the impacts and potential of the railway.

4.3.3.2. OBSERVED INFRASTRUCTURE CONDITION

The technical assessment was complemented by the survey results collected during the field visit. These provide additional information regarding the physical condition of the railway infrastructure. This, in particular, includes the state of the ballast, the type and condition of the sleepers, the visible condition of the track components, the quality of drainage, the presence of vegetation close to the track, and the general maintenance level of the observed sections. These elements are important because they allow the technical capital of the line to be assessed not only in terms of network configuration and service performance, but also in terms of the actual state of the infrastructure.

The line survey confirmed that all of the inspected points were in service at the time of the assessment, and were all on a single-track, non-electrified railway with conventional ballasted track. The ballast was evaluated as being in a good visible condition, according to the scoring framework. The track is equipped with wooden sleepers and rigid fasteners, with no slab track being observed present. The survey also reported no apparent rail defects in the inspected sections, indicating that the rail components were visually serviceable at the time of the inspection.

The infrastructure-related indicators highlighted the specific challenges associated with the corridor's mountainous terrain. Drainage was generally assessed positively, with no major visible issues reported at the inspected points. The earthworks, however, were more varied, suggesting a need for localised maintenance along the line, especially given the exposure of the corridor to hydrogeological risks and the importance of slope stability and water management for the operational resilience of mountain railways.

The electrification and signalling indicators confirmed that the line is not electrified. Nevertheless, this should be interpreted as a structural feature of the railway rather than as a defect. Speed limit signs and beacons were generally observed and assessed as being in acceptable or good condition, although some local variability was recorded. Safety-related components, including fencing, easements and nearby level-crossing protection, performed more moderately. This suggests that, while the line remains operationally functional, safety-related peripheral components may require targeted monitoring or improvement.

Overall, the line survey resulted in a B2 score. B indicates an intermediate level of preservation while 2 indicates the absence of electrification. This evidence supports the interpretation of the Lucca–Aulla line as being resilient but technically constrained infrastructure, whose long-term performance depends on continuous maintenance, targeted upgrades and the careful management of local vulnerabilities.

The station survey results provided a complementary perspective. The inspected stations are in service and generally provide

a basic level of accessibility, passenger information and regional connection. However, it also highlighted differences between the main nodes and smaller intermediate stops. Larger stations and central nodes tend to perform better in terms of accessibility, user information and intermodal connections, while smaller stations have more limited services and facilities. This confirms that the station system has already undergone partial upgrading and can support intermodal and tourism-related functions, but further improvements would be necessary to consolidate the line as an accessible and tourism-oriented transport corridor.

4.3.3.3. INTERMODALITY AND GOVERNANCE

One of the most significant findings emerging from the field analysis is the central role of intermodal integration in ensuring the long-term viability of the Lucca–Aulla railway line. Empirical evidence clearly indicates that neither the rail nor the bus system, when considered independently, would be capable of fulfilling both the necessary economic and regional functions. While the railway alone would struggle to be financially sustainable due to limited demand, the road-based system would be unable to guarantee adequate coverage across a dispersed and geographically complex area. The solution adopted over time has therefore been based on a functional integration model, in which the railway operates as the primary transport axis, while bus services are reorganised as feeder systems connecting peripheral settlements to the main line. Within this configuration, stations have a strategic role as multimodal interchange nodes, facilitating the transfer between modes of transport and enhancing overall system efficiency.

This reorganisation has enabled a more logical allocation of transport resources, reduced service duplication and improved accessibility to remote areas. From a systemic perspective, the Lucca–Aulla line can thus be interpreted not as an isolated railway, but as the core component of a broader multimodal mobility network.

At the same time, the field visit highlighted that the effectiveness of this integrated system is strongly dependent on the quality of its institutional coordination. The line's relative success is closely linked to the active involvement of multiple governance levels, including the Region of Tuscany, the Province of Lucca, local municipalities and railway operators, whose cooperation has been essential in aligning transport planning, funding mechanisms and service provision. However, the analysis also revealed that significant regional asymmetries exist in the implementation of this governance model. In particular, integration appears to be more advanced and consistent within the Lucca area, where coordination mechanisms are well established, whereas other sections of the line exhibit weaker institutional alignment and less effective integration between transport modes. These disparities have direct implications for service quality, accessibility conditions and the capacity to support local development processes. In this context, governance is not merely as a complementary factor, but a critical enabling condition for the performance and sustainability of low-demand railway systems.

4.3.3.4. TOURISM, ACCESSIBILITY AND SYSTEM ADAPTATION

The empirical evidence collected during the field visit indicates that tourism represents an increasingly relevant, yet still secondary,

function of the railway. Tourism along the line appears to have developed primarily after the service was stabilised, rather than initially driving it. It is closely linked to local events and seasonal trends and also strongly depends on its integration with other mobility systems to ensure effective accessibility to destinations. The railway supports both inbound tourism from coastal areas towards inland destinations and local mobility within the valley, contributing to the movement of visitors across the region. However, tourism demand remains spatially concentrated and is temporally discontinuous, with peaks during specific periods and at certain locations. As a result, although the potential for tourism development is significant, it is not yet fully structured and remains partially underexploited, requiring further strategic coordination and promotion.

Recent investments have led to substantial improvements in physical accessibility along the line, representing a significant step towards a more inclusive mobility system. The introduction of modern rolling stock, combined with station platforms being upgraded and station layouts being improved, has enhanced overall usability for a wider range of users. These interventions have particularly benefited people with reduced mobility, elderly people and occasional users such as tourists and families, contributing to a more equitable access to transport services. Beyond their immediate functional impact, these improvements also have strategic implications, as they create the necessary conditions for the development of accessible tourism. This segment, although still emerging, represents a potential area of growth that aligns with broader European objectives related to inclusivity and sustainable mobility.

The Lucca–Aulla railway can be interpreted as a hybrid system in which structural constraints coexist with a significant capacity for functional adaptation. Its persistence over time is not the result of economic efficiency alone, but rather of sustained institutional coordination and the ability to integrate multiple functions within a single infrastructure. In this context, tourism does not replace rail's traditional mobility role, but rather complements it, contributing to its overall viability. The analysis demonstrates that the relative success of the line is grounded in the interaction between intermodal integration, governance mechanisms, functional diversification and a strong degree of regional embeddedness. Together, these factors provide a comprehensive explanation of how a low-demand railway can continue to be useful and evolve within a changing socio-economic and spatial environment.



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CONCLUSION AND PERSPECTIVES

This chapter represents the culmination of the work carried out throughout the Tour&Rail project: the identification of the Lucca–Aulla line as a successful case through the Compendium developed in WP4, the assessment of its state of conservation using the methodology developed in WP2, and the evaluation of its tourism potential through the framework developed in WP3. These complementary approaches together demonstrate the relevance of the overall methodology, both in highlighting the factors underpinning the success of the line and in identifying critical issues and future challenges that remain to be addressed.

It provided a synthesised interpretation of the main evolutionary phases of the Lucca–Aulla railway, aiming to clarify how the line's role has changed over time, moving from a basic connection for isolated mountain communities to a multi-functional infrastructure combining local mobility, freight, intermodality and tourism-related uses.

Originally, its main role was to reduce the isolation of the Serchio Valley, Garfagnana and Lunigiana, supporting access to regional centres and enabling people and goods to move in a geographically constrained environment. During the second half of the twentieth century, however, this role was progressively challenged by structural changes, including the growth of road-based transport, industrial restructuring and demographic decline in rural areas. These processes weakened the demand base of the line and contributed to its classification as a low-traffic railway at risk of marginalisation.

The turning point occurred when local and regional institutions decided not to treat the line as isolated and economically weak, but as the core component of a wider regional mobility system. Through successive service agreements involving FSI, RFI, the Provinces of Lucca and Massa-Carrara, the Comunità Montana della Lunigiana and, subsequently, the Region of Tuscany, a comprehensive requalification programme was implemented. This programme combined an increase in rail services with the reorganisation of feeder bus routes, the introduction of integrated rail-bus ticketing schemes, the refurbishment of station buildings and the development of tourism-oriented initiatives. Rather than focusing solely on the railway itself, the objective was to strengthen its integration within the wider regional mobility system of Garfagnana and Lunigiana.

At present, the Lucca–Aulla railway continues to provide regular passenger services and remains an important component for fulfilling daily mobility needs in the regions it serves. Its current role extends beyond the operation of train services alone, relying on connections with local bus networks and on the accessibility functions performed by stations located throughout the valley. Alongside this, tourism-related activities have grown. Heritage and special trains, destination marketing initiatives, rail-based tourism products and the promotion of local cultural and natural attractions have expanded the range of uses associated with the line, while remaining complementary to its primary transport function.

Looking forward, the future of the line will depend on its capacity to maintain this combination of mobility, accessibility and regional functions.

Continued infrastructure maintenance, targeted modernisation measures and effective coordination between transport authorities and local stakeholders will remain essential. At the same time, recent initiatives suggest that tourism will continue to play a growing role in the promotion of the railway. This is illustrated by the proposed Lunigiana Express project, developed as an alternative to the planned closure of the Castelnuovo Garfagnana–Minucciano section during summer 2026. Conceived as a seasonal service linking Pisa, the Tuscan coast and Lunigiana, the project combines direct tourist access with local rail services on the remaining operational section of the line. Whether implemented as a temporary measure or as the basis for future developments, it demonstrates the continued capacity of local stakeholders to use the railway to support broader regional objectives.

Overall, the Lucca–Aulla line’s development can be understood as a process of successive adaptations. Initially conceived as a tool for regional integration and reducing geographical isolation, the line later experienced a period of decline and marginalisation. The requalification programme launched at the turn of the twenty-first century subsequently redefined its role through institutional coordination, intermodal integration and service enhancement. Today, the railway combines regional mobility functions with a growing range of tourism-related activities, illustrating how a secondary railway can be continuously adapted to changing needs while remaining embedded within a broader system of regional accessibility.

CHAPTER 5:

UNDERSTANDING SUCCESSFUL TOURISM REACTIVATION: A COMPARATIVE ANALYSIS OF THE LUCCA–AULLA & DOURO LINES

INTRODUCTION

This chapter develops a systematic comparison based on data and knowledge gathered from two railway lines previously selected from among approximately one hundred low-traffic railway lines across Europe. The comparison focuses on the Porto–Pocinho section of the Douro line in Portugal and the Lucca–Aulla line in Italy. Together, they provide the basis for a particularly instructive comparison for two main reasons.

The first reason is that both lines are emblematic cases. They have already been identified by national and international institutions as successful examples of the integration of three complementary aspects:

- The maintenance and continuous modernisation of low-traffic regional railway lines.
- The protection and enhancement of environmental, cultural and landscape heritage in rural areas facing various socio-economic challenges.
- Territorial development strategies that increasingly incorporate tourism while preserving the railway's role as a public transport service.

The second reason is that the first-hand research conducted on each of these lines as part of the Tour&Rail project provides an opportunity to develop an in-depth understanding of the factors underpinning their success. Rather than seeking to identify a single best practice, the comparison explores how different combinations of railway features, regional resources and governance arrangements have enabled these two railway lines to become recognised examples of successful revitalisation.

Consequently, the objective is not just to identify the elements common to both cases, but also to understand how different regional and institutional configurations can lead to successful outcomes.

However, comparison is a challenging evaluative exercise. The geographical, institutional and technical aspects of the two case studies are markedly different, and they follow distinct trends in terms of rail service regulation, the organisation of tourism activities, and the protection and enhancement of heritage resources. Comparison and evaluation are therefore delicate processes. They require, among other things, the collection of a substantial amount of information. Yet it would be a mistake to assume that a comparative exercise is necessarily more rigorous and reliable from a scientific perspective, or more useful from an evaluative perspective, simply because it incorporates a large volume of raw data. In practice, the comparative strategy must first be defined according to the specific objectives pursued and the means available. It is therefore essential to conduct the evaluation with a clear awareness of its potential contributions and limitations, as well as relying on a rich and precise body of knowledge.

Methodologically, this chapter combines a structured empirical comparison with an interpretative analysis. It begins by organising the evidence collected from the two case studies within a common framework, before examining the factors that underpin the success of each railway line. The transparency, consistency and robustness of the comparative approach is ensured, while the unique aspects of each case are maintained.

The chapter is structured as follows:

- **Section 1** defines the principles of comparison and the overall research strategy.
- **Section 2** describes the methodological framework adopted for the comparative analysis.
- **Section 3** presents the empirical comparison through a series of thematic tables organised around three complementary categories: stakeholders and railway services, railway infrastructure and state of conservation, and territorial capital and socio-economic context.
- **Section 4** develops the comparative interpretation by identifying the features shared by the two successful cases, examining the different combinations of factors underpinning their success, and analysing the governance arrangements through which these configurations have emerged.

The concluding section discusses the strengths and limitations of the comparative approach.

5.1. OBJECTIVES AND CHALLENGES OF A COMPARATIVE STRATEGY

5.1.1. CONDITIONS FOR COMPARABILITY

The Tour&Rail project is based on an inventory of more than one hundred low-traffic railway lines across Europe. One possible approach would have been to undertake a large-scale comparative analysis of this corpus. Indeed, the emergence and consolidation of rural rail tourism across Europe reflects a broader dynamic in which railway operators, public authorities and tourism stakeholders increasingly observe, adapt and emulate

successful initiatives developed elsewhere. Various professional networks already facilitate the exchange of experiences and good practices, although there is currently no integrated European platform for this.

However, conducting a comparative analysis of this large number of railway lines was not the approach adopted within the Tour&Rail research programme. Mobilising such a large volume of highly heterogeneous information would have risked reducing both the robustness of the comparison and the interpretative value of the results. Moreover, such an exercise would likely identify a very large number of explanatory variables without providing sufficient understanding of how they interact within specific regional contexts.

Instead, the comparison focuses on two case studies for which extensive empirical investigations were conducted by the international research teams involved in the Tour&Rail project. The comparison therefore constitutes a second analytical step, building upon the in-depth case studies presented in Chapters 3 and 4. The Porto–Pocinho and Lucca–Aulla railway lines were first analysed independently by means of documentary research, GIS analyses, field observations and stakeholder interviews before being brought together within a common comparative framework.

5.1.2. CHALLENGES OF THE COMPARATIVE APPROACH

Restricting the comparison to two cases fundamentally changes the objectives of the analysis compared with large-scale benchmarking exercises. Rather than identifying average tendencies across a large sample, the objective is instead to explain how two railway lines, both widely regarded

as successful examples of revitalisation, have achieved this outcome through different combinations of territorial, railway and institutional factors. This strategy raises three main methodological challenges.

➤ Moving beyond description to identify the factors that underpin successful railway revitalisation.

The objective is to move beyond the descriptive analyses developed in the two case-study chapters and to identify the factors that contribute to the contemporary success of these railway lines. This requires combining the perceptions of local stakeholders with the empirical evidence collected in order to distinguish between common explanatory mechanisms and case-specific features.

➤ Assessing whether the two cases reflect a common process or different models of development.

Comparing only two cases makes it possible to examine the complexity of each situation while testing an important hypothesis. Either both cases belong to the same general process of railway revitalisation, characterised by recurring mechanisms despite contextual differences, or they represent distinct development models shaped by different regional, institutional and socio-economic conditions. This direct comparison therefore contributes to the broader question of whether the revitalisation of low-traffic railway lines follows a single pathway or whether multiple trajectories can coexist depending on local contexts.

► **Integrating evidence from a variety of sources within a common analytical framework.**

The two case studies encompass highly diverse realities, combining geographical and environmental characteristics, long-term infrastructure trends, socio-economic dynamics, tourism resources and multi-level governance arrangements. The challenge is therefore not to combine these aspects into a single performance score, but to organise them within a coherent analytical framework that allows meaningful comparison while preserving the complexity of each case. The comparative tables developed in this chapter provide this common structure by aligning information derived from documentary sources, spatial analyses, field observations and stakeholder interviews. Rather than ranking the two railway lines, this approach makes it possible to identify different configurations of railway services, regional resources and governance arrangements that underpin their successful revitalisation.

5.2. METHODOLOGICAL FRAMEWORK

The objective of the selected methodology is to work within a variation-finding framework. The aim is to identify common principles across situations that are never exactly identical, while acknowledging the uniqueness of each case. Rather than seeking to establish rankings or identify a single model of success, the comparison aims to understand how similar historical trends may lead to different territorial configurations. By identifying both shared characteristics and meaningful variations, the analysis seeks to explain how different combinations of railway, territorial and institutional factors contribute

to the contemporary development of low-traffic railway lines.

The approach follows the workflow presented below.

The first step consists of identifying a common set of analytical criteria that allows existing knowledge to be systematically aligned for both railway lines. The available information originates from a wide variety of sources and methods, including direct field observations, stakeholder interviews, archival records, public planning documents, GIS analyses and socio-economic indicators. The comparison therefore requires the integration of quantitative measurements, qualitative observations and institutional processes relating to infrastructure management, heritage protection, tourism development and territorial planning. Particular attention is paid to distinguishing observed facts from their interpretation, while ensuring that all information is described according to a common analytical framework.

A particular challenge concerns the scale of comparison. Each railway line constitutes both a single corridor and a variety of sections, stations and territorial contexts. Some stations are better equipped than others, infrastructure conditions vary along the route, and tourism resources are unevenly distributed. Rather than comparing these sub-units individually, the information was synthesised into comparative tables that summarise the main features of each railway line while preserving the variety observed during fieldwork.

The second step consists of organising these empirical observations into a coherent comparative framework. Instead of aggregating indicators into composite scores,

the comparison is structured around three complementary categories:

- stakeholders and railway services
- railway infrastructure and its state of conservation
- territorial capital and socio-economic context

Each category brings together evidence derived from multiple sources and methods in order to provide a consistent description of the two railway systems and the regions they serve.

The final step consists of interpreting these empirical results by means of the comparative analysis. Rather than evaluating the relative performance of the two lines, the objective is to identify shared histories, highlight the different regional development models that have emerged, and examine the governance arrangements through which these developments have been shaped. This interpretative approach makes it possible to relate the empirical observations to broader processes of railway revitalisation, while remaining aware of the specific institutional, territorial and historical background to each case.

Ultimately, the comparison aims to explain how similar railway infrastructures can become embedded within different regional development projects. By analysing the interaction between railway services, regional resources and governance arrangements, the methodology aims to identify complementary rather than competing models of revitalisation, thereby contributing to a more contextual understanding of the long-term sustainability of European secondary railway lines.

5.3. EMPIRICAL COMPARISON

This section presents the empirical comparison of the Douro and Lucca–Aulla railway lines based on the analytical framework explained above. The results are organised into three complementary categories:

- stakeholders and railway services
- railway infrastructure and its state of conservation
- territorial capital and socio-economic context

The following tables provide the empirical basis for the comparative interpretation developed in the next section.

5.3.1. COMPARATIVE CHARACTERISTICS OF THE RAILWAY SYSTEMS

5.3.1.1. STAKEHOLDERS AND RAILWAY SERVICES

Both railway lines rely on a broadly similar institutional structure, with a national infrastructure manager and a national railway undertaking responsible for passenger services. However, responsibilities are distributed differently. While the Douro line remains largely managed and financed by the Portuguese State, the Lucca–Aulla line operates within Italy’s regionalised railway system, whereby the Tuscany Region acts as the transport authority and finances passenger services through a Public Service Obligation contract with Trenitalia. Local authorities also play a much stronger role in Tuscany than in Portugal.

STAKEHOLDERS	DOURO LINE	LUCCA-AULLA LINE
Infrastructure manager	Infraestruturas de Portugal	Rete Ferroviaria Italiana
Transport authority	National government	Regional government (Tuscany)
Train operator	CP (national railway operator)	Trenitalia (national railway operator)
Funding of passenger services	Primarily financed by the Portuguese State	Financed through a public service contract between the Tuscany Region and the operator
Role of local authorities	Limited influence on railway planning	Strong involvement of the region, provinces, municipalities and mountain communities

Table 3: Main stakeholders. Source: Authors

Both railway lines provide regular regional passenger services as their primary function, but they differ in the way tourism is integrated into their railway operations. On the Douro line, CP operates several dedicated tourist trains, including seasonal heritage and thematic services, while the *MiraDouro* panoramic train complements the regional offer. In contrast, the Lucca–Aulla line relies almost exclusively on conventional regional services, with tourist trains operated only occasionally by private organisations or heritage associations. Both lines also host limited freight traffic.

TYPE OF SERVICE	DOURO LINE	LUCCA-AULLA LINE
Regular passenger service	Regional trains including <i>MiraDouro</i> panoramic trains	Regional trains
Tourist services	• <i>Comboio Histórico do Douro</i> (seasonal historical train) • <i>Rota das Amendoeiras</i> (almond train) • <i>Festa das Vindimas de Comboio</i> (Grape Harvest Festival by Train) • The Presidential trains	• <i>Treno del Presepe</i> serving the Christmas nativity event at Equi Terme • <i>Treno dei Sapori</i> promoting local food products • The <i>Treno dei Parchi</i> highlighting the natural heritage of the region • Steam-hauled excursion trains operated on selected occasions
Freight	Limited	14 trains/week

Table 4: Types of railway services. Source: Authors

Both lines operate modern regional rolling stock but with different operational profiles. The Douro line combines diesel multiple units with the heritage *MiraDouro* service, whereas the Lucca–Aulla line operates both diesel and hybrid trains. End-to-end travel time is approximately 200 minutes on the Douro line and 120 minutes on the Lucca–Aulla line. Service frequency is also more uneven in Portugal than in Tuscany, while fares remain distance-based in both cases.

PASSENGER SERVICE	DOURO LINE	LUCCA-AULLA LINE
Rolling stock	Regular passenger service: CP Class 0450 diesel multiple units <i>MiraDouro</i> : CP 1400 series diesel locomotive with Schindler and Sorefame carriages	ATR 220 “Swing” (diesel DMU) HTR.312 “Blues” (hybrid tri-modes)
Travel time	200 min (from Porto São Bento)	120 min
Frequency	• 6 daily trains from Marco de Canaveses to Porto São Bento (Urbanos do Porto) • 6 daily trains from Porto to Marco de Canaveses (Regional and InterRegional service) • 4 daily trains from Régua to Pocinho (Regional service)	10/12 round trips
Fares	€14.80 from Porto Sao Bento to Pocinho. The fare varies depending on the distance.	€10 from Lucca to Aulla. The fare varies depending on the distance.

Table 5: Characteristics of the passenger service. Source: Authors

5.3.1.2. RAILWAY INFRASTRUCTURE AND STATE OF CONSERVATION

Although the two lines differ in length and geographical context, they share several characteristics typical of European secondary railways. Both are predominantly single-track and largely non-electrified, although the western section of the Douro line is electrified. They also differ in gauge and signalling systems, reflecting their respective national standards. Finally, both cross demanding terrains requiring numerous bridges and tunnels and have experienced periods during which their long-term future was questioned.

TECHNICAL CHARACTERISTICS	DOURO LINE	LUCCA-AULLA LINE
Territorial location	Metropolitan area (from Porto to Marco de Canaveses) and rural areas as far as Pocinho	Mountain hinterlands between two mid-size cities
Construction date	1875 – 1887	1892 – 1959
Length	164 km (from Ermesinde to Pocinho)	90 km
Electrification	Not electrified from Régua to Pocinho	Not electrified
Gauge	Iberian gauge (1,668 mm)	Standard gauge (1,435 mm)

TECHNICAL CHARACTERISTICS	DOURO LINE	LUCCA-AULLA LINE
Signalling system	• From Ermesinde to Caíde: Automatic Block (RCAP) ¹ • From Caíde to Marco de Canaveses: Interposed Automatic Block (RCI) ¹ • From Marco de Canaveses to Pocinho: Telephonic Block (RCT)	Axle-counter block system
Number of tracks	Single-track from Caide to Pocinho	Single-track
Civil engineering	35 bridges and numerous short tunnels	33 bridges and numerous tunnels including the 7.5-km long Lupacino Tunnel
Number of stations	44	23
Closure/risk of closure	1988: Closure of the Pocinho – Barca d’Alva section after the closure of the Spanish section between Barca d’Alva and Salamanca	Early 2000s: Widely regarded as a <i>ramo secco</i> within the Italian debate on railway streamlining

Table 6: Infrastructure characteristics. Source: Authors

Field observations indicate that both railway lines are relatively well maintained. Although local variations exists, particularly on the Douro line, both were classified as B2 according to the Tour&Rail methodology, reflecting an intermediate level of maintenance on largely non-electrified secondary railways. Both also face similar long-term challenges associated with single-track operation and increasing exposure to climate-related hazards.

COMPONENT	DOURO LINE	LUCCA-AULLA LINE
Is the point in service?	Yes	Yes
Type and condition of sleepers	3 of the 4 points assessed have wooden sleepers. The other has biblock concrete sleepers	Wooden sleepers
Condition of the ballast	Ballast condition differs strongly depending on the point assessed. Ballast near the stations seems to be better maintained	Ballast condition seems to be well-maintained according to the 3 points assessed
Fasteners	Elastic to rigid depending on the point assessed	All the points assessed have rigid fasteners
Drainage works	Appear to be in good condition	Non-visible

COMPONENT	DOURO LINE	LUCCA-AULLA LINE
Earthworks	Appear to be in good condition	Non-visible
Speed limit signs and beacons	None	Appear to be in good condition
Beacons	None	Appear to be in good condition
Challenges in conservation and management	The single-track configuration and a limited number of crossing points result in high dependency on timetables and growing costs of maintenance and operation in the context of climate change	The single-track configuration and a limited number of crossing points results in high dependency on timetables and growing costs of maintenance and operation in the context of climate change
Results	Overall, the line displays intermediate to good maintenance of its infrastructure, with renovation work that seems to have been concentrated around stations. The line has been classified B2 according to the Tour&Rail methodology	Overall, the line displays intermediate to good maintenance of its infrastructure. The line has been classified B2 according to the Tour&Rail methodology

Table 7: State of conservation assessment. Source: Authors

The field survey also included an assessment of stations along both railway lines, focusing on passenger facilities, accessibility, intermodality and the visible condition of the buildings.

Overall, the stations on both lines are in good physical condition, with generally well-maintained buildings, roofs and electrical installations. However, the comparison highlights differences in the level of services and equipment provided for passengers. Stations on the Lucca–Aulla line generally offer more modern passenger information systems, with dynamic display screens, as well as more bicycle parking facilities and stronger integration with local bus services. On the Douro line, the level of equipment varies more significantly between stations, reflecting the diversity of the line and the different functions performed by individual stations.

Stations on both lines provide public toilets and car parking facilities, while commercial services and catering facilities remain unevenly distributed. Finally, the Douro stations retain a distinctive architectural identity through the widespread use of traditional *azulejos*, which constitute a characteristic element of the line's heritage.

STATION CHARACTERISTICS	DOURO LINE	LUCCA-AULLA LINE
PMR accessibility	Differs largely from one station to another	Available at all stations visited, although the condition and quality of the facilities vary
Safety passage between tracks	Low, unannounced level crossings	Low to medium level of crossings
General condition of the platform	Good	Good

STATION CHARACTERISTICS	DOURO LINE	LUCCA-AULLA LINE
Type of support for user information	Static (paper sheets)	Dynamic (screens)
Distance to the nearest town	Vary. Some are directly within the town, others can be located between 1 and 3 km away	All the stations visited are within 1 km of the town, if not within
Connection with other modes of transport	Vary. Some of them have no connection to other modes of transports	There is an integration between rail and bus modes
Car parking	Most of the stations offer car parking	All the stations offer car parking
Bicycle parking facilities	No bicycle facilities identified	All stations offer bicycle facilities
Car/bike/scooter sharing service	None	None
Public toilets	All stations offer public toilets	All stations offer public toilets
Catering service or shopping area	Vary	Vary
Ticket sales	Vary. Sometimes tickets can only be purchased from staff or machine, or from both	Tickets can be purchased from machines or staff
Apparent condition of the roof	Good	Good
Apparent condition of the structure	Good	Good
Apparent condition of the coatings and finishes	Good	Moderate to good
Apparent state of electrification and lightning	Good	Good
Station heritage	Most of the station are decorated with <i>azulejos</i> tiles that are protected.	Well-preserved historic station buildings

Table 8: Station characteristics and state of conservation assessment. Source: Authors

5.3.1.3. TERRITORIAL CAPITAL AND SOCIO-ECONOMIC CONTEXT

The comparison reveals two distinct heritage profiles. The Douro line provides access to three UNESCO World Heritage Sites, including the Historic Centre of Porto, the Alto Douro Wine Region and the Prehistoric Rock Art Sites of the Côa Valley. In contrast, the Lucca–Aulla line provides access to a much larger number of nationally protected heritage sites, reflecting the richness and density of its local cultural heritage. The landscape covered by the two cases is also different. While both lines cross a variety of landscape units, the Douro line is characterised by the continuity of its UNESCO-listed terraced vineyard landscape, whereas the Lucca–Aulla line traverses a mosaic of forested, mountainous and agricultural landscapes. Finally, according to the World Database on Protected Areas (WDPA), neither line provides significant access to protected natural areas either visible or directly accessible from the railway.

TOURISM POTENTIAL	DOURO LINE	LUCCA-AULLA LINE
Main heritage sites	3 UNESCO sites are easily accessible from the Douro stations: Porto historic city centre, Alto Douro Wine Region and the Prehistoric Rock Art Sites of the Côa Valley	164 nationally protected heritages sites are accessible within a 15-min walk from rail stations. 128 are located near Lucca station
Main landscapes characteristics	The line crosses 4 landscape units: Peri-urban agricultural mosaic; Terraced river valley; Terraced vineyard cultural landscape; and Agro-natural Mediterranean landscape	The line crosses 3 landscape units: Forested heritage landscape; Mountain agro-forestry landscape; and Historic agricultural plain
Protected natural areas indicator	Quasi-absence of protected natural areas accessible from the stations or visible from the line	Quasi-absence of protected natural areas accessible from the stations or visible from the line

Table 9: Station characteristics and state of conservation assessment. Source: Authors

The socio-economic analysis characterises the municipalities crossed by the two railway lines according to their land-use patterns, demographic dynamics and economic structures. Based on the multivariate analyses presented in the previous chapters, the comparison identifies the main territorial profiles associated with each railway corridor and examines the relationship between tourism development and local socio-economic conditions.

The results highlight distinct territorial configurations. The Douro line primarily serves productive agricultural regions dominated by permanent crops and a variety of agricultural landscapes, while the Lucca–Aulla line crosses predominantly forested regions structured around a stronger urban–rural gradient. In both cases, the analyses distinguish three main territorial profiles, ranging from the most dynamic to the most fragile municipalities. Tourism development is consistently associated with the most economically diversified regions, whereas the outermost and more ageing areas display lower levels of tourism integration. Finally, although the two railway lines cross comparable rural environments, they fulfil different territorial functions.

The Douro line primarily supports productive agricultural regions centred on viticulture and cultural landscapes, while the Lucca–Aulla line plays a stronger role in connecting isolated mountain communities with regional services.

ASPECT	DOURO LINE	LUCCA-AULLA LINE
Main territorial gradient	Agricultural specialisation and productive capacity	Urban–rural gradient combined with socio-ecological abandonment
Most dynamic regions	Productive agricultural areas specialised in permanent crops, with relatively high income and tourism development	Urban–agricultural multi-functional systems combining services, agriculture and tourism
Intermediate regions	Mixed agricultural systems undergoing demographic ageing and structural adjustment	Industrialised agro-forestry systems with moderate tourism development
Most fragile regions	Traditional rural areas with limited productive specialisation and weak economic diversification	Ageing forest regions affected by depopulation and socio-ecological abandonment
Dominant land cover	Permanent crops and heterogeneous agricultural landscapes	Forest ecosystems and heterogeneous agricultural landscapes
Relationship between tourism and territorial dynamics	Tourism is concentrated in economically productive agricultural regions	Tourism is concentrated in economically diversified regions combining urban functions, agriculture and services.

Table 10: Socio-economic profile of adjacent regions. Source: Authors

Taken together, these empirical observations provide a structured overview of the similarities and differences between the two railway lines. The following section moves beyond this descriptive comparison to examine how these observations contribute to explaining the success of each case.



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5.4. COMPARATIVE INTERPRETATION

5.4.1. SHARED TRENDS OF EUROPEAN SECONDARY RAILWAYS

Although the Douro and Lucca–Aulla railway lines operate in different national contexts, the comparison reveals remarkably similar historical trends that are characteristic of many European secondary railways. Both lines were progressively constructed during the second half of the nineteenth century and aimed to open up geographically isolated regions, support regional economic development and strengthen their integration into the national railway network. In both cases, the railway initially fulfilled a strategic transport function by connecting rural and mountainous areas to larger urban centres and facilitating the movement of both passengers and freight.

Despite these common origins, both lines experienced a similar period of decline during the second half of the twentieth century. The rapid expansion of road transport, changing mobility patterns and successive public investment priorities progressively reduced their strategic importance within their national railway systems. As on many secondary lines across Europe, declining passenger demand was accompanied by ageing infrastructure, increasing maintenance costs and a gradual deterioration of service quality. Both corridors were therefore confronted with recurring debates regarding their long-term viability. For the Douro line, this process culminated in the closure of the eastern section between Pocinho and Barca d'Alva in 1988, following the cessation of cross-border services with Spain. Regarding the Lucca–Aulla line, the railway was categorised as a *ramo secco*

during the early 2000s, as it was considered a marginal branch line within the Italian railway network.

The comparison also highlights that both railways retain many of the technical features commonly associated with European secondary lines. They are predominantly single-track railways, largely non-electrified, are operated with relatively modest service frequencies and still accommodate limited freight traffic. Their routes cross complex topography requiring numerous bridges and tunnels, which continue to represent significant maintenance and investment challenges. Nevertheless, both lines have remained in operation and have benefited from renewed investment over the past decades. Although the nature of these investments differs between the two cases, they exemplify a broader European trend whereby secondary railways are progressively modernised rather than abandoned, while still providing regular regional passenger services.

Taken together, these shared historical and technical characteristics justify the comparison developed in the following sections. They demonstrate that the Douro and Lucca–Aulla lines belong to a common category of European secondary railways and, at the same time, provide the basis for analysing the different regional trends by which their long-term sustainability has subsequently been pursued.

5.4.2. CONTEMPORARY REGIONAL FUNCTIONS AND DEVELOPMENT MODELS

Although the Douro and Lucca–Aulla railways have followed comparable historical trends, the empirical comparison reveals that they now fulfil different regional functions and rely on distinct development models.

In both cases, tourism has become an important component of the long-term sustainability of the railway. However, rather than replacing the traditional transport function, it has been integrated in different ways, according to the characteristics of the regions served and the objectives pursued by public authorities and railway stakeholders.

The Douro line is embedded within a region whose international reputation largely predates the contemporary revitalisation of the railway. The Alto Douro Wine Region, the Douro River and the UNESCO World Heritage designation constitute a highly visible regional identity, reinforced by a well-established wine tourism sector and complementary attractions such as river cruises and cultural heritage. Within this context, the railway increasingly contributes to the enhancement of an already recognised destination. This is reflected not only in the accessibility it provides to these heritage assets but also in the development of dedicated railway tourism products operated by CP, including the Historic Train, the Presidential Train, the Almond Train and the *MiraDouro* panoramic service. Tourism is therefore integrated directly into the railway offer, making the train itself part of the visitor experience while maintaining its regional passenger function.

The Lucca–Aulla line follows a different path. Rather than relying on internationally recognised heritage labels, it serves a region characterised by a dense network of nationally protected heritage sites and diverse mountain and agricultural landscapes. A large proportion of these heritage assets are concentrated around the historic centre of Lucca, while additional cultural and natural resources are distributed along the Garfagnana and Lunigiana valleys.

In this context, the railway functions primarily as a regional connector, providing access to both a major heritage destination and a broader network of smaller attractions, while continuing to support everyday regional mobility. In general, local authorities, destination management organisations and private operators develop tourist experiences, while the railway operator focuses primarily on regional passenger services. Intermodal integration between rail and bus services further illustrates this dynamic, with the railway forming one component of a broader regional accessibility strategy.

These differences are also reflected in the nature of recent public investment. Along the Douro line, major interventions have concentrated on infrastructure modernisation, particularly the progressive extension of electrification and the improvement of the railway corridor, while tourism products have been integrated into the railway offer itself. On the Lucca–Aulla line, investment has instead focused on improving the quality of regional passenger services through the introduction of new rolling stock, the modernisation of station services and the strengthening of multimodal connections. In both cases, the railway remains a public transport service, but the regional motivation underpinning investment differs substantially.

Taken together, the comparison suggests that tourism contributes to the sustainability of both railways through different regional configurations. In the Douro Valley, tourism reinforces the international attractiveness of an already established destination and is closely integrated into the railway strategy. Along the Lucca–Aulla line, tourism complements a broader regional

development model centred on regional accessibility, local heritage and the multi-functional use of the railway. Rather than revealing a single model of tourism-oriented railway development, the comparison highlights different ways of connecting railway services, regional resources and tourism activities.

5.4.3. GOVERNANCE AS THE INSTITUTIONAL EXPRESSION OF THESE DEVELOPMENT MODELS

Although both the Douro and Lucca–Aulla lines are rural railways with significant regional value, their stakeholder configuration, governance dynamics and primary development motivation differ substantially. In both cases, the railway is seen as more than a transport service – it functions as a tool for territorial cohesion, regional development and place-based identity – yet the logic underpinning each line’s survival and evolution reflects distinct institutional histories and social priorities.

The Douro case is driven predominantly by tourism and heritage. Stakeholders frame the railway as a strategic asset linking UNESCO World Heritage sites, wine tourism, cultural attractions and river cruises, with tourism demand acting as the principal catalyst for investment and innovation. Civil society organisations and private tourism operators have played a particularly influential role alongside public institutions, producing a relatively dispersed governance structure where influence is shared across railway operators, regional authorities and advocacy groups. This diffusion of power has been both a strength – enabling civic pressure to override institutional inertia, most recently through a unanimous parliamentary resolution for the

reopening of the line to Barca d’Alva – and a weakness, leaving coordination fragmented since the dissolution of SPI-Douro, the public-private partnership that once anchored the region’s development strategy.

By contrast, the Lucca–Aulla case emerged from concerns about service survival and regional accessibility. The line’s legitimacy rests primarily on its role as a public service connecting geographically isolated and seismically vulnerable communities, with high-school students and daily commuters making up the core user base. Governance is more institutionalised: a formal multi-party agreement reached in the late 1990s brought municipalities, the Province of Lucca, the Tuscany Region, Trenitalia and RFI to the same table, producing an integrated rail-bus ticketing and timetabling system that remains operational today. Power is concentrated more strongly within public institutions and transport organisations, though local authorities have expanded their influence through collective action, and accessibility advocates have secured tangible station improvements unavailable in the Douro context. Tourism is a complementary rather than a primary use case, and participants are explicit that a purely touristic vocation is not financially or regulatorily viable.

The power dynamics in both cases reveal a common structural pattern: national infrastructure managers and operators hold formal decision-making authority, while regional and local stakeholders exert influence through financial co-investment, political negotiation and the strategic use of external approval. The mechanisms of influence differ, however. In Italy, the 2013 Garfagnana earthquake served as an involuntary catalyst, unlocking

national emergency funds and attracting political attention to the line. In Portugal, the equivalent forces have been civic and cultural: the UNESCO designation of 2001, the European Commission's 'missing links' study and sustained associative mobilisation. Both cases illustrate a broader pattern in which secondary rural lines depend on extraordinary events or organised civic pressure to overcome institutional inertia, raising questions about the structural adequacy of existing governance frameworks.

Relationships among stakeholders are collaborative in both contexts but oriented towards different ends. For the Douro line, collaboration focuses on enhancing tourism experiences, expanding visitor flows beyond the Régua–Pinhão corridor, and integrating rail with river and wine itineraries. For the Lucca–Aulla line, cooperation centres on service integration, operational efficiency and regional resilience – particularly given that road routes are frequently blocked by landslides and seismic events. Both networks share a structural vulnerability: reliance on individual institutional champions, the absence of permanent coordination bodies, and the risk that accumulated goodwill and institutional memory will not survive generational transitions. This fragility is openly acknowledged by participants in both cases.

Together, the two cases illuminate complementary models of rural railway development. The Douro line demonstrates how tourism and heritage can build the political and economic case for railway revitalisation, while the Lucca–Aulla line illustrates how coordinated public governance and multimodal service integration can safeguard mobility in remote regions. Both ultimately affirm the same conclusion: that

the technical and operational conditions for viable rural railways are insufficient without the deliberate, sustained cultivation of the governance architectures – formal or informal – that hold diverse stakeholders together around a shared long-term vision.

CONCLUSION

This chapter set out to compare two railway lines widely recognised as successful examples of the revitalisation of low-traffic regional railways. Rather than evaluating their relative performance or identifying a single best practice, the objective was to understand the factors underpinning their success and to examine how these factors combine within two distinct regional and institutional contexts.

The comparison first confirms that the Douro and Lucca–Aulla lines belong to a common family of European secondary railways. Both were built during the expansion of the railway network in the nineteenth century, both experienced long periods of decline associated with the rise of road transport and changing investment priorities, and both have recently benefited from renewed public investment. These shared historical trends provide the conditions for a meaningful comparison while demonstrating that the current success of these lines cannot simply be attributed to favourable initial conditions.

The comparative analysis also shows that the success of these two railway lines cannot be explained by a single factor. In both cases, it results from the connection of complementary aspects, including the quality and continuity of railway services, the mobilisation of regional resources, the integration of tourism into broader regional development strategies, and the capacity of

public institutions and local stakeholders to sustain long-term cooperation. While these aspects are common to both cases, their respective significance and their modes of connection differ substantially. The Douro line illustrates a model in which tourism and internationally recognised heritage constitute a major driver of railway development, whereas the Lucca–Aulla line demonstrates how regional mobility, intermodality and territorial accessibility can coexist with tourism development within a broader public service framework.

At the same time, the comparison highlights that success should not be regarded as a permanent or consistent condition. Both railway lines remain characterised by internal variety in terms of infrastructure, station facilities and regional integration. They also continue to face significant challenges relating to infrastructure maintenance, climate change, demographic evolution and the long-term continuity of governance arrangements. Maintaining the conditions of successful revitalisation therefore requires continuous adaptation, rather than assuming that revitalisation has been definitively achieved.

Ultimately, the value of this comparative exercise lies not in identifying a model to be replicated, but in demonstrating that successful revitalisation may emerge from different combinations of railway, regional and institutional factors. The following chapter builds on these findings to discuss their broader implications for the future development of low-traffic railway lines in Europe.

5.4.3.1. FROM CASE STUDIES TO EUROPEAN DIALOGUE

The comparative analysis presented in this book also served as the basis for the Tour&Rail conference held in Florence on 16 June 2026. Bringing together railway operators, infrastructure managers, tourism organisations, public authorities and researchers, the conference was an opportunity to discuss the two case studies and explore their broader implications for the future of low-traffic railway lines in Europe.

Following an overview of the Tour&Rail methodology and preliminary findings, dedicated sessions examined the Douro and Lucca–Aulla lines from the perspective of railway operators, infrastructure managers, tourism organisations and regional authorities. These discussions highlighted the variety of development trends while confirming several of the comparative findings presented in this book, including the importance of governance, regional integration and stakeholder cooperation.

The conference concluded with a roundtable on the future of rural railway services in Europe, extending the discussion beyond the two case studies to address broader challenges such as governance, multimodal integration, public value and climate objectives. In this respect, the conference illustrated how the lessons drawn from the Douro and Lucca–Aulla lines can contribute to wider European debates on the revitalisation of low-traffic railway lines.



CHAPTER 6:

CONCLUSIONS

This report set out to identify the factors behind the successful revitalisation of two low-traffic railway lines through tourism and territorial development. Building on an in-depth comparison between the Douro and Lucca–Aulla lines, in Portugal and Italy respectively, it examined how railway modernisation, territorial capital, tourism strategies and governance arrangements interact to support the long-term sustainability of regional railway services. Rather than seeking to identify a single model of successful railway revitalisation,

the comparative analysis explored the different ways tourism, transport and territorial development can be carried out within distinct institutional and regional contexts.

This concluding chapter synthesises the main findings of the comparative analysis, discusses the complementary pathways to successful railway revitalisation identified in the two case studies, reflects on the methodological contributions and limitations of the research, and finally outlines implications for policy and future research.

6.1. MAIN FINDINGS

6.1.1. GOVERNANCE TRANSFORMS TERRITORIAL CAPITAL INTO DEVELOPMENT OPPORTUNITIES

A first major finding of this comparative analysis concerns governance's central role in the two railway lines' success. Both case studies have significant territorial capital, although of different nature and scale. The Douro Valley relies on internationally recognised assets, including a UNESCO World Heritage cultural landscape and a long-established wine tourism economy, whereas the Lucca–Aulla line draws on a more varied combination of landscapes, local heritage, gastronomy and outdoor activities.

The comparison nevertheless demonstrates that territorial capital does not constitute a development opportunity in itself. Its contribution to railway revitalisation depends on the stakeholders' ability to transform it into a joint development project.

This transformation is comprised of two complementary processes. First, governance's contribution to the recognition, designation and use of territorial capital. Through long-term institutional choices, political commitment and stakeholder cooperation, regional assets progressively acquire economic, cultural and institutional value. Heritage protection, landscape policies, tourism initiatives and multimodal integration should therefore be understood not simply as ways of using existing assets, but as the outcome of collaborative work.

The two case studies illustrate this first process, but through different trajectories. In the Douro Valley, the UNESCO World Heritage designation resulted from decades of protection policies and institutional work before becoming a central component of a broader strategy linking railway services, wine tourism, river cruises and regional development. Along the Lucca–Aulla line, initiatives such as the *Garfagnana Experience* similarly demonstrate how local authorities and tourism stakeholders progressively connected landscapes, gastronomy, cultural heritage, outdoor recreation and transport, and synthesised them into a singular destination. Although these initiatives differ in scale and international visibility, both demonstrate that territorial capital can only be developed through collaborative efforts which unify distinct regional assets.

The second process is the contribution of governance to the construction of regional narratives. Successful territorial development relies not only on recognising valuable resources, but also on connecting them through coherent stories that reinforce regional identity and support collaboration. Labels, tourism products, railway services and communication strategies all play a role in this process by bringing together otherwise distinct regional characteristics and making them authentic and marketable projects.

6.1.2. RAILWAY SUSTAINABILITY DEPENDS ON INTEGRATING TOURISM INTO REGIONAL DEVELOPMENT STRATEGIES

The outcome of the comparison between the two lines suggests that the long-term sustainability of low-traffic railway lines depends less on the development of

dedicated tourist railway services than on the integration of tourism into broader regional development strategies. Tourism contributes to railway sustainability when it acts as a driver of territorial development, generating demand that extends beyond the railway itself and supporting a wider regional economy. The railway becomes one component of a territorial development project rather than a tourist attraction operating in isolation.

The two case studies show the different ways this process can occur. In the Douro Valley, tourism has become the principal driver of regional development. Railway services are integrated into a broader strategy combining the UNESCO cultural landscape, wine tourism, river cruises and regional branding. Rather than solely attracting visitors through the railway, this integrated offer creates sustained demand for travel throughout the valley while reinforcing the region's international visibility and economic appeal. The objective of spreading tourism across the wider area is exemplified by the efforts to extend tourism beyond the Régua–Pinhão section.

Along the Lucca–Aulla line, tourism occupies a more complementary position within a development model centred on regional accessibility. Rather than developing dedicated tourist rail services, tourism is built into the existing public transport system. The integration of regular rail services with the regional bus network allows visitors to access heritage sites, outdoor recreation and rural communities while preserving the railway's primary public service function. The comparison suggests that stronger regional policies integrating railway services with tourism-centred development and the local economy could further reinforce the long-term sustainability of the line.

In both case studies, tourism already generates economic benefits through accommodation, restaurants, cultural activities and other visitor services. However, these benefits remain unevenly distributed and further integration between railway and tourist services, and local businesses could strengthen both territorial cohesion and the long-term sustainability of the railway. The comparison therefore suggests that successful tourism-oriented railway strategies rely not simply on attracting visitors, but on embedding the railway within a broader regional development model capable of generating sustained demand over time.

6.1.3. SUCCESS AS A DYNAMIC AND MULTI-DIMENSIONAL PROCESS

The comparison also provides a more nuanced understanding of what constitutes a successful low-traffic railway line. Rather than representing a fixed or homogeneous condition, success appears as a dynamic process resulting from the continuous interaction between railway services, territorial development, tourism strategies and stakeholder cooperation. Although case studies demonstrate significant achievements, these are not evenly distributed across all aspects of development.

In both cases, strengths coexist with persistent vulnerabilities. The Douro Valley benefits from strong international visibility and a well-established tourism economy. However, visitor flows remain highly concentrated both spatially, along the most popular sections of the line, and temporally, with season-dependant popularity. In addition, the long-term coordination of stakeholders remains dependent on

sustained institutional commitment. Along the Lucca–Aulla line, the integration of rail and bus services, the quality of regional governance and the railway's public service function are major strengths, while the tourism sector remains more modestly sized, and there is room for further integration between railway services and tourism stakeholders.

The comparison therefore suggests that success should not be understood as a final achievement, but as a continuous process requiring long-term adaptation. The sustainability of these strategies depends on maintaining stakeholder cooperation, renewing institutional commitments, adapting tourism strategies to changing regional conditions and preserving the balance between railway services and wider regional objectives. From this perspective, successful regional reactivation is not a stable outcome but an ongoing process that must be continuously maintained and renewed.

6.2. MULTIPLE PATHWAYS TO SUCCESSFUL REVITALISATION

One of the principal conclusions emerging from this comparative analysis is that there is no single model for the successful revitalisation of low-traffic railway lines. Although both case studies are recognised as successful examples, they have developed differently, reflecting distinct regional contexts, governance arrangements and development priorities. The comparison suggests that success should not be understood as the replication of a predefined model, but as the capacity to connect railway services with the specific resources, stakeholders and objectives of each region.

The Douro Valley is an example of the model in which tourism acts as the principal driver of territorial development. The railway derives its long-term legitimacy from its integration into a broader tourism economy built around the UNESCO cultural landscape, wine production and regional branding. By contrast, the Lucca–Aulla line follows a model centred primarily on territorial accessibility and public services. Tourism complements this function by strengthening the region’s appeal and diversifying the uses of the railway, without becoming its primary justification. These two pathways demonstrate that successful revitalisation may rely on different combinations of tourism, mobility and territorial development.

Despite these differences, the comparison also identifies common principles between the two. For example, the railway is viewed as more than a transport service: it is integrated into a wider regional project supported by

long-term public investment, multi-level governance and cooperation between railway undertakings, public authorities and local stakeholders. Likewise, tourism is successful not because it operates independently of the railway, but because it is embedded within broader territorial development strategies capable of generating lasting economic and social benefits.

Therefore, the main lesson of the comparison is not that the Douro or the Lucca–Aulla line should be faithfully reproduced elsewhere. The transformation of territorial capital through collaborative work, the integration of railway services into regional development strategies, and the development of governance arrangements capable of sustaining these symbiotic relationships over time are vital. The diagram below summarises the common and case-specific success factors of the two railway lines.

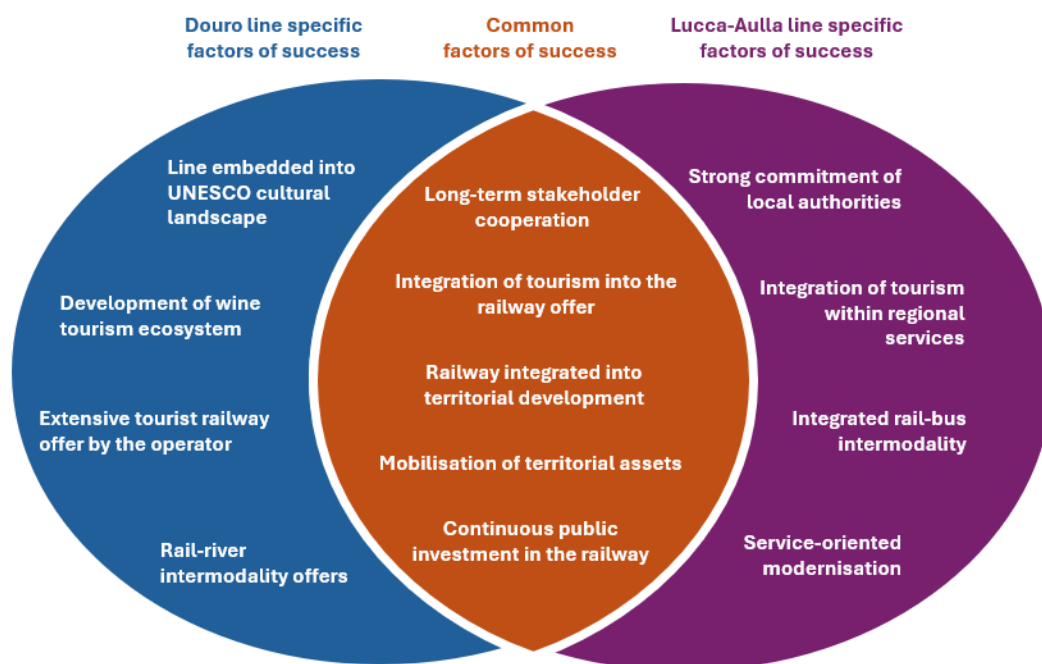


Figure 36: Comparative synthesis of the success factors of the Douro and Lucca–Aulla railway lines. Source: Authors.

6.3. METHODOLOGICAL CONTRIBUTIONS AND LIMITATIONS

6.3.1. METHODOLOGICAL CONTRIBUTIONS

Beyond empirical findings, this report also contributes to the comparative analysis of low-traffic railway lines. Rather than comparing a large number of cases through a limited set of standardised indicators, the research adopted a more in-depth comparative approach using two case studies. This strategy made it possible to capture the complexity of each regional context while identifying common principles that justify the success of the two railway lines.

A second contribution is the integration of a range of evidence within a common analytical framework. The comparison combines quantitative indicators, spatial analysis, field observations, documentary sources, stakeholder interviews and focus group discussions. Bringing these different forms of evidence together made it possible to analyse railway revitalisation as a territorial, economic and governance process, in addition to a transport issue. This multi-dimensional perspective proved particularly valuable for understanding how infrastructure, tourism, public policies and stakeholder cooperation interact over the long term.

Finally, the comparative methodology developed in this study provides a structured approach for moving from detailed case-study evidence towards more general explanatory principles. Rather than identifying a single model of successful railway revitalisation, the methodology makes it possible to distinguish context-specific characteristics from more transferable principles, such as

the importance of governance, regional integration and long-term stakeholder cooperation. In this respect, the approach offers a useful analytical framework that could be adapted and tested in future comparative studies of low-traffic railway lines across Europe.

6.3.2. METHODOLOGICAL LIMITATIONS

6.3.2.1. METHODOLOGICAL LIMITATIONS RELATED TO CROSS-COUNTRY COMPARABILITY

An important limitation of the comparative methodology concerns the comparability of regional indicators in distinct national contexts. Although a common analytical methodology was developed for both case studies, several indicators rely on location-specific legal, administrative and statistical features that are not fully the same in Portugal and Italy. This reflects a broader challenge in international comparative research, where comparison often depends on functional equivalence rather than on strictly identical features. The objective, therefore, is to compare regional features that fulfil similar functions within their respective national systems, while recognising that they are not necessarily legally or statistically equivalent.

This limitation is particularly evident in the assessment of cultural heritage. The initial methodology distinguishes heritage according to different levels of protection (international, national and regional/local). However, this hierarchy is not applied in the same way in both countries. In Italy, heritage protection operates within a national legal framework and certain categories of historic assets receive automatic protection based on their age, whereas Portugal follows different legal procedures.

Therefore, heritage protection levels cannot be interpreted as directly comparable measures of heritage significance.

A similar issue concerns landscape. The analysis relied on the *Department of Landscape and Biophysical Planning* of the *University of Evora* for the *General Directorate for Spatial Planning and Urban Development* (DGOT-DU), and the *Landscape Plan* developed by the Government of Tuscany. Although both classifications identify landscape units, they are based on different conceptual approaches and planning objectives. Therefore, the landscape characteristics are broadly comparable, rather than equivalent.

Finally, the distinction between *protected natural areas* and *protected landscapes* needs further clarification. For example, the World Database on Protected Areas (WDPA) considers *protected landscapes* as one category of protected area rather than as a separate classification. Clarifying these concepts would improve the consistency of future comparative applications of the methodology.

These limitations do not invalidate the comparison, but they highlight the importance of distinguishing functional comparability from strict, legal or statistical comparability. Future applications of the methodology would also benefit from the development of correspondence frameworks capable of translating national categories into functionally equivalent analytical variables.

6.3.2.2. INTERNAL HETEROGENEITY OF THE RAILWAY LINES

A second methodological limitation concerns the level of analysis adopted for the comparison. Although each railway line is treated as a single analytical unit, both case study line have substantial internal differences. Infrastructure characteristics, station conditions, service levels and tourism resources vary considerably along the corridors. Some stations provide high-quality passenger facilities and strong intermodal connections, while others offer only basic services. Similarly, infrastructure modernisation has not progressed uniformly across all sections of either railway line.

This range raises a methodological question: should comparison focus on the best-performing sections, the weakest sections, or on the railway line as a whole? In this study, the comparison deliberately adopted the latter perspective. The objective is not to evaluate the performance of individual stations or line segments, but to understand how each railway functions as an integrated transport system. While this choice inevitably smooths certain local differences, it allows the comparison to focus on the broader themes/forces/principles at the heart of railway revitalisation.

6.3.2.3. LIMITED NUMBER OF CASE STUDIES

The comparison is also based on only two case studies. This choice made it possible to conduct in-depth empirical investigations combining field observations, interviews, documentary analysis and spatial data. However, the specificity in terms of location for the studies also limits the extent to which the findings can be generalised.

Rather than identifying universal causal relationships, the objective was to examine whether two recognised examples of successful railway revitalisation share common mechanisms despite their different national and regional contexts. The comparison therefore aimed to identify recurring processes and explanatory patterns rather than statistically representative models.

6.3.2.4. TIME CONSTRAINTS OF THE FIELDWORK

Another limitation concerns the timing of the field visits. Most of the field observations and stakeholder interviews were conducted outside the peak tourist season. Consequently, some seasonal dynamics – including temporary tourism services, cultural events, visitor flows and the full operation of certain tourism products – could only be documented through interviews and secondary sources rather than through direct observation.

Although this does not affect the overall analysis of governance arrangements or infrastructure characteristics, it may have led to only a partial representation of the seasonal intensity and diversity of tourism activities associated with both railway lines being provided.

6.3.2.5. FROM TRANSFERABILITY TO ADAPTATION

Finally, the conclusions drawn from this comparative analysis should be understood as identifying principles which can be transferred rather than prescriptive models which can be directly replicated. Instead, they provide a set of analytical principles that may inform the design of revitalisation strategies in other contexts while recognising the need for adaptation to local conditions.

6.3.3. METHODOLOGICAL PERSPECTIVES

The methodology developed in this report could be extended in several directions. First, applying the approach to a larger number of low-traffic railway lines across Europe would make it possible to assess the transferability of the mechanisms identified in the two case studies and to distinguish more clearly between context-specific factors and more general patterns of successful railway revitalisation.

Second, future applications would benefit from the development of correspondence frameworks capable of translating national, legal, administrative and statistical data into functionally equivalent analytical variables. Such harmonisation would improve the robustness of international comparisons while preserving the specificities of each territorial context.

Third, future research would benefit from following the evolution of low-traffic railway lines over time. Repeated observations would make it possible to analyse how governance arrangements, tourism strategies and railway services evolve, and how these changes influence long-term railway revitalisation.

Finally, future research could further strengthen the framework by incorporating additional indicators related to governance dynamics and climate resilience. As climate change increasingly affects railway infrastructure, tourism activities and rural regions, integrating these aspects into comparative analyses would provide a more comprehensive understanding of the long-term sustainability of low-traffic railway lines.

6.4. IMPLICATIONS FOR POLICY AND FUTURE RESEARCH

6.4.1. POLICY IMPLICATIONS

The findings of this report suggest that the successful revitalisation of low-traffic railway lines requires coordinated policies linking railway modernisation, regional mobility, tourism development and land use planning. Rather than considering these aspects separately, public authorities should promote integrated strategies capable of generating long-term economic, social and environmental benefits. Four policy priorities have emerged from the comparative analysis:

Securing long-term railway modernisation and increasing public awareness

The two case studies demonstrate the importance of maintaining long-term investment in railway infrastructure. Both lines are currently undergoing major modernisation programmes, including electrification works, while studies examining the future reopening of the cross-border connection with Spain are also underway for the Douro line. These investments demonstrate that low-traffic railway lines should be regarded as components of wider regional and national railway systems, not solely as marginal or purely tourist-oriented infrastructure.

At the same time, greater efforts should be devoted to communicating these investments to local communities. The costs and long-term benefits of railway modernisation are often poorly understood by residents, despite their implications for accessibility, territorial development and decarbonisation.

Better promotion of ongoing and planned projects, together with clearer communication of their environmental and socio-economic benefits – for example through indicators such as avoided CO₂ emissions – could strengthen local support and encourage greater rail use by residents, commuters and visitors alike.

Developing railway stations as regional multimodal mobility hubs

The comparison highlights the strategic role of railway stations in supporting both mobility and tourism. Small and medium-sized stations should increasingly be designed as multimodal hubs providing efficient first and last-mile connections while strengthening the accessibility of surrounding regions. Investment should therefore extend beyond interstation railway infrastructure to include station refurbishment, improved public spaces, bicycle facilities, pedestrian access and digital mobility services.

In the Lucca–Aulla case, further optimising rail–bus coordination could improve the passenger experience by reducing transfer times and strengthening the integration between regional rail services and feeder bus networks. More generally, railway stations could increasingly function as gateways to the surrounding area, encouraging visitors to visit heritage sites, accommodation, restaurants and outdoor recreation by sustainable modes of transport. Pilot projects and living labs could also provide opportunities to test innovative mobility solutions before wider deployment while strengthening local community involvement.

Strengthening governance, institutional learning and stakeholder coordination

The comparison demonstrates that railway revitalisation depends as much on governance as on infrastructure investment. Sustained cooperation between railway companies, public authorities, and tourism and local economic stakeholders should therefore be cemented in policy rather than relying on temporary initiatives or individual leadership.

One important challenge concerns the development of shared monitoring and evaluation tools. Collecting and sharing data on passenger demand, tourism flows and local economic impacts would provide stronger evidence for adapting railway services and regional strategies over time. Regular meetings between railway companies, local authorities and economic stakeholders could facilitate continuous adjustments to service frequencies, timetables and tourism initiatives while ensuring that railway development remains aligned with local needs. More broadly, strengthening cross-organisation learning and the circulation of good practices would reinforce governance capacities and contribute to more inclusive and resilient regional development.

Improving the accessibility and appeal of railway tourism

Although pricing does not appear to be a decisive in determining demand in either case study, fare policies remain an important tool for broadening railway use. Integrated ticketing between rail and other modes of transport, together with affordable pricing strategies for residents, young people, older adults and repeat visitors, could encourage

more frequent use of railway services throughout the year. Beyond increasing rail use, such measures would contribute to embedding railway transport more firmly within everyday travel practices while reinforcing the long-term sustainability of tourism-oriented railway development.

6.4.2. FUTURE RESEARCH

This report also highlights several directions for future research on the relationship between low-traffic railway lines, tourism and regional development.

A first priority concerns the long-term implications of railway revitalisation. The two case studies represent processes that are still ongoing. Future research would therefore benefit from following their development over time to understand how governance arrangements, public investment, tourism strategies and stakeholder partnerships evolve, and under which conditions they reinforce, or weaken, the long-term sustainability of railway services. Such approaches would also make it possible to assess how continuous railway modernisation influences wider regional dynamics, including local economic development, public investment and tourism diversification.

A second direction for research concerns the regional impact of railway revitalisation. While this report demonstrates that railway revitalisation should be understood as a regional project rather than solely as a transport intervention, further research is needed to assess its broader economic, social and environmental effects.

This includes examining how railway investment contributes to regional cohesion, local business development, demographic appeal and residents' quality of life, as well as identifying the how and where these benefits occur.

Climate change also deserves more attention. Future research should investigate how climate-related hazards (including extreme rainfall, landslides, wildfires and heatwaves) affect both railway infrastructure and tourism, and how adaptation strategies can be incorporated into long-term railway and regional planning. Understanding the relationship between climate resilience, infrastructure investment and regional development is likely to become a central challenge for the future of low-traffic railway lines.

Finally, future research should continue to investigate the role of railways as instruments of regional development. This study suggests that the revitalisation of low-traffic railway lines cannot be understood solely through transport performance or tourism indicators. Instead, it calls for broader research examining how railways interact with regional governance and development, environmental transitions, and changing mobility practices. Such an agenda would contribute to a more comprehensive understanding of the role that low-traffic railway lines can play in supporting the long-term resilience and appeal of rural regions.

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APPENDICES

APPENDIX A –

COMPENDIUM TECHNICAL FACT SHEET TEMPLATE

SUMMARY

Updated: 23/07/2026

Line name

Country

Region or canton

DESCRIPTION OF THE LINE

Origin/destination

Category

Line length (km)

Track gauge (standard, narrow, broad)

Electrification (yes/no)

- Direct Current (DC)/Alternating Current (AC)/
Special configuration
- Voltage

Signalling system

General condition of the line (bad/medium/good)

GPS coordinates of origin and destination

Route Map link

Sources

TOURISM APPEAL	
Main towns/cities on the route	
Natural features (mountains, rivers, coasts)	
Cultural sites (UNESCO, historical stations)	
Unique Selling Points	
Visitor services (hotels, tours, local crafts)	
Sources	
CURRENT OPERATION INFO	
Opening date	
Current services (freight/passenger/tourism)	
Service (frequency, speed, passengers/trains per day/week/month/year)	
Annual tourist ridership (last 5 years)	
Ridership trend (increasing/stable/declining)	
Revenue sources (ticket sales, subsidies, other)	
Ticket price (€)	
Sources	
HISTORIC OPERATION INFO (IF APPLICABLE)	
Has the line been closed in the past? (yes/no)	
Closure date	
Operating conditions before closure (frequency, speed, passengers/trains per day/week/month/year)	
Services before closure (freight/passenger/tourism)	
Reason for closure	
Reopening date	
Sources	

STAKEHOLDERS INVOLVED	
Service provider (operator)	
Infrastructure manager	
National authorities	
Regional/cantonal authorities	
Local authorities	
Community involvement level (low, medium, high)	
Impact on local economy (jobs, local business synergy)	
Sources	
OBJECTIVES AND CHALLENGES	
Works required for reopening/revitalisation	
Estimated reopening or revitalisation cost	
ASSOCIATED PROJECTS	
Local	
National	
International	
Sources	
OTHER INFORMATION	
Historic summary	
Maps/photographic documentation	
Bibliography	
Contact person	
RELEVANCE: HOW RELEVANT IS THIS LINE FOR T&R?	
Could the line be categorised as a “Low-traffic/rural line”? (yes/no)	
How important is the potential for tourism development on this line? (low/medium/high)	
Does tourism influence funding for the line? (low/medium/high)	
Is tourism a vital activity to keep the line open and active? (low/medium/high)	

APPENDIX B –

GROUP DISCUSSION INTERVIEW GUIDE

INTRODUCTORY PHASE. 30 MIN

QUESTIONS GUIDE – FOCUS GROUP

Preliminary phase: Project presentation and group dynamics. **15 min**

Attendee introductions. First of all, if you agree, you may briefly introduce yourselves to the group (maximum 3 minutes per person – approx. 15 minutes in total), explaining your role or activity within your organisation.

PRESENTATION OF ATTENDEES	SECONDARY QUESTIONS
Name and role of participant	Description of their tasks within the company, local entity or association. Age, gender, level of education, profession.
Description of organisation	Number of employees, objectives, members (for associations), scope of activity, etc.
Organisation's main topics of interest within the region	What are the main projects you are currently involved in within the area?
Relationships with participants in the group	Whether participants know each other or not.
Other	Whether everyone participates, whether someone has more influence within the group, whether any information of high relevance for the project (e.g. transport-related) emerges early on, etc.

TERRITORIAL/SOCIO-ECONOMIC AND POLITICAL CHARACTERISATION. 30 MIN

If you had to describe this area to someone who does not know it, in just a few words, what would you say or highlight about it?

If it does not emerge naturally during the discussion: **What do you think are the best and the worst aspects of living here/in this area?**

GENERAL PERCEPTION OF THE AREA	SECONDARY QUESTIONS
Atmosphere (quiet, lively, festive/cheerful, isolated, etc.)	Is there a lot of activity or is it a quiet area? Is it an attractive place to live? Does it feel healthy? Is it dangerous or unsafe in any way?
Territorial values (economic, socio-political, services, etc.)	What are the main reasons why people would want to live here? Would you say it is an area rich in economic terms or in resources? Is it a well-connected area? What issues most concern or interest people here? What types of services are generally available, and which ones are lacking?
Other	Data of high relevance for the project, perceptions of frustration or complaint in any respect, expressions of pride, etc.

Could you please tell us what people from this area are like?

LOCAL COMMUNITY PROFILE	SECONDARY QUESTIONS
Identity-related values Sense of belonging and pride in local ways of life and values considered distinctive, everyday life	What are people like around here and how do they feel? Would you say people support each other a lot? Are they strongly rooted in the region? Do you think people are happy and proud to live here? How would you describe the people who live in this area? What differentiates this region and makes it special? What do local people enjoy doing the most? What would be the first place you would take someone, or the first activity you would do with them, to help them get to know your area and its people? Do people have healthy habits such as playing sport or going for walks? Do people go to bars frequently? Are local people more home-oriented or do they prefer going out and taking part in group or family activities of a cultural or religious nature? Do people tend to shop more in local businesses, or do they prefer large shopping centres or travelling to the nearest urban centre?
Socio-demographic profile Number of inhabitants, age, gender, migration, cultural diversity	Is the population mainly older or younger? How many inhabitants are there? Are people mostly long-term residents or is there a high level of migration? Would you say there are particularly disadvantaged or vulnerable groups?

LOCAL COMMUNITY PROFILE	SECONDARY QUESTIONS
Socio-economic profile Professions, main economic activity sectors, level of education, etc.	What do people do for a living? What is the main economic activity? Is there a high level of education in the area or do people start working at a young age? Are there large landowners or is property very fragmented in this area? Do many people depend on tourism-related activities? How has the area changed over the last 10 years? How do you think it will develop over the next 10 years, and what factors are likely to drive that development?
Social cohesion	Which activities would you say bring together the greatest proportion of the local population or are of particular interest to them? For what reasons do people usually gather here? Are there many social initiatives? Are there social conflicts among residents? Do people mix across social groups or are there strong differences in activities due to economic class, age or socio-cultural issues? Are there many associations in the area? What type? Are people very religious; do they attend church regularly? Are there many local festivals or gatherings? Are migrant populations well integrated? Are there any disadvantaged groups?
Key stakeholders and governance	Who do you consider to be the most important people or organisations in the region? Which entities are most important for the local community? Do they function well? What is your perception of their work and the support they provide to local people? Are you involved in local governance? Are there participatory budgets or decision-making processes that involve the local community? How would you assess local politicians?
Local communication and transparency	Do you think people are well informed here? How do you find out about what is happening in your area? (Press, social media, word of mouth, cafés/bars, neighbourhood meetings, municipal council meetings, etc.)
Mobility	Do people travel a lot from here? For what reasons? Which means of transport are most commonly used? What are the main access routes to the area? Is there a high level of emigration?
Other	Information of high relevance for the project (e.g. contacts, involvement in tourism or transport, etc.), perceptions of frustration or complaint, expressions of pride regarding any outstanding aspect, population-related conflicts, meeting places, etc.

And what are visitors like? Is there a high level of tourism in the area?

VISITOR/TOURIST PROFILE	SECONDARY QUESTIONS
Perception of satisfaction between tourists/visitors and local residents	
Socio-demographic profile Number of visitors, age, gender, diversity of profiles, origin	How would you describe the people who visit this area? Are they mostly older or younger? How many visitors come? Do they come from far away? Do they visit as families?
Socio-economic profile Professions, main economic activity sectors, level of education, etc.	Are visitors generally wealthy or highly educated? Are they backpackers? Do they come for work or for holidays? Is it expensive to visit this area as a tourist?
Purpose of visit and interaction with local residents	Which activities would you say attract or interest visitors the most? Why do you think this area is well known and attractive for visitors? Do visitors mix with local residents or is there a clear separation from the activities of people who live here? Do they attend local festivals? Does local business benefit from their presence?
Key stakeholders and governance	Who do you consider to be the most important people or organisations for tourism in this territory? Are there tour operators or many guided tour services? Does the local population benefit from these activities? Are you involved in tourism development in the area, or do you know local people who depend on it? Are there local or regional policies that have supported tourism in the area? Are there local tourism associations or companies? Are tourism stakeholders involved in local decision-making? Do measures aimed at tourists have an impact on the local population? How and in what way – positive or negative? Is the local population's opinion taken into account in tourism-related decision-making? How?
Communication	How do you think visitors find out about places of interest or activities available in the area?
Mobility	What means of transport are most commonly used by tourists? Are there walking routes or hiking activities? Are there areas that are difficult to access for visitors or residents? How do people reach them? How often do people visit the area? Do they return? Do they come only for a meal and leave the same day? What are the main access routes to the area? Do they stay overnight? How many days do visitors usually stay?
Other	Information of high relevance for the project (e.g. contacts, involvement in tourism or transport, etc.), perceptions of frustration or complaint, expressions of pride regarding any outstanding aspect, conflicts, places to visit, spaces of interaction between tourists and local residents, etc.

TOURIST/HERITAGE VALUES AND RESOURCES OF THE AREA. 30 MIN

We would like to learn a bit more about the main attractions of your area. Please can you tell us more about the leisure and recreational activities that are of greatest interest to both local residents and visitors.

VALUES OR RESOURCES	SECONDARY QUESTIONS
Most significant values/ assets/activities	What would you highlight in your locality as the most attractive or outstanding aspects for visitors? How would you describe this area to someone who does not know it? What should not be missed when visiting this area? Is there a lot of cultural, sporting or environmental activity in the area? What are these activities and who organises them? You previously mentioned that tourists come to see XXXX – do you think these are the only resources? Are there other types of values that people tend to overlook?
Cultural values and assets	What do people value more: nature or culture? Are there many festivals or celebrations? What type? (Secular, religious, music, dance, etc.) Are there any traditional foods or recipes? Which local products are most appreciated? What about monuments, churches, archaeological sites or museums? Is there a high level of cultural activity? Who organises it and where does it usually take place? Are there local artists or craftspeople? Are there legends or anecdotes that everyone knows? Any traditional songs or dances? Are there cultural centres or exhibition/concert halls in the area? Are there squares, parks or public spaces for sitting, walking or playing sport? Are there areas with bars, terraces, pastry shops or cafés? Are there well-known local figures such as artists, writers, politicians or recognised entrepreneurs, either contemporary or from the past?
Natural or landscape values and assets	Would you say that the relationship with nature is an attraction in this area? Why? What is the local fauna and flora like? Are there good areas for walking, attractive viewpoints or landscapes worth visiting or highlighting? What would you consider the most beautiful natural area to visit here? Which wine-growing or agricultural areas are particularly attractive for visitors?
Tourism infrastructure or services	Are there good restaurants or places to eat in the area? Are there hotels or locations commonly used by visitors for overnight stays? Are there organised tourism activities such as guided tours? Is there a lot of leisure activity organised for visitors? Are there shops specialising in tourism-related products? Which shops or businesses are most attractive to visitors? How is tourism in the region promoted or how are tourism activities communicated? (Websites, brochures, tourist offices, etc.)
Seasonality and climate	What is the best time of year to visit this area? Do local residents usually travel during the summer? Are there more tourists in summer or in winter? Do the leisure activities of residents and visitors change by season? Are cold, rain or other weather conditions decisive for visits, or do visits take place throughout the year and across the whole area?

VALUES OR RESOURCES	SECONDARY QUESTIONS
Tourism potential	Among the resources identified, which do you think are the most accessible? Which ones should be strengthened or could contribute more to the local economy through tourism? (Job creation, improvement of services, etc.)
Conservation and maintenance	Which of the identified resources do you think are best preserved? Which ones would need restoration? Do you think there are abandoned resources in the area? Which ones and why? Do you consider it important to invest in improving these resources, or are there other priorities such as investment in healthcare, education, etc.?
Other	Information of high relevance for the project (e.g. contacts, involvement in tourism or transport, etc.), perceptions of frustration or complaint, expressions of pride regarding any outstanding aspect, conflicts, places to visit, points of interaction between tourists and local residents, etc.

GOOD PRACTICES, INVESTMENT AND FUTURE PERSPECTIVES. 30 MIN

We would like to learn more about how you assess, from a technical and regional perspective, the recent development of the area, the actions implemented in recent years, the investments carried out, their impact on development and connectivity, and the medium- and long-term prospects for future development.

REFLECTION ON THE RECENT AND FUTURE DEVELOPMENT OF THE REGION	SECONDARY QUESTIONS
Investment and its impact on the territory	Who have been the main investing stakeholders in the area in recent years? (Public administrations, other levels of government, private investment, etc.) In which sectors and areas has this investment mainly been concentrated? Do you consider that this investment has had a significant impact on regional development and on connectivity, both internal and external? Based on your experience, what do you think has been done particularly well in recent years in terms of local development? Can you identify any actions or projects that could be considered relevant good practice for the region? From a critical perspective, is there any aspect that you think could have been planned differently or improved?
Governance and coordination spaces	Do the main territorial stakeholders have access to common forums, technical working groups or other coordination spaces? Do you think these spaces have a real capacity to influence strategic decisions on local development?
Recent development and future prospects	From a technical point of view, how would you describe the development of the area over the last ten years? Looking ahead to the next ten years, which priorities do you consider key for balanced and sustainable regional development?

APPENDIX C.1 –

SOCIO-ECONOMIC AND SOCIO-DEMOGRAPHIC INDICATORS FOR THE SOCIO-ECOLOGICAL CONNECTIVITY ANALYSIS OF THE DOURO LINE

Socio-economic descriptors	Male population 2024	Female population 2024	Ageing index	Population density 2024	Tourist accommodation	Average monthly earnings (€)	Livestock density 2019	Agricultural unemployment - 2024 (1st economy sector)	Industrial unemployment - 2024 (2nd economy sector)	Unemployment in services - 2024 (3rd economy sector)
Alijó	48.73	51.27	396.3	34.6	0.1	1026.1	1.22	33.9	20.1	41
Armamar	47.67	52.33	360.3	48.1	0.15	1007	0.44	25.2	14.7	56.1
Baião	48.11	51.89	251.6	97.9	0.12	997.1	2.56	16.1	29.6	47.5
Carrazeda de Ansiães	48.31	51.69	471.4	19.2	0.02	955.9	0.41	77.1	3.4	15.9
Cinfães	49.09	50.91	256.7	72.3	0.08	988.4	6.19	12	34.1	47.9
Lamego	47.83	52.17	292.6	145.3	0.2	1037.7	1.47	12.3	18.3	64.5
Marco de Canaveses	48.37	51.63	174.8	245.2	0.11	989.4	1.65	5.1	44.8	42.7
Mesão Frio	47.35	52.65	335.7	129.4	0.33	1086.4	0	34.5	13.5	46
Peso Da Régua	47.08	52.92	282.8	150.5	0.21	1095.9	0.01	23	17	54.2
Resende	48.99	51.01	265.1	78.1	0.12	915.9	3.62	27.3	17.3	50.8
Sabrosa	48.38	51.62	381.9	35.9	0.12	1107.9	2.01	26.2	15.1	53.1
São João da Pesqueira	49.44	50.56	298.5	25.3	0.03	1049.6	0.09	27.9	10.9	48.9
Tabuaço	47.66	52.34	388.2	37.6	0.05	1074.4	0.2	26.3	15.7	52.2
Torre de Moncorvo	47.69	52.31	503.7	12.5	0.026	960.2	0.07	64.1	4.3	27.1
Vila Nova de Foz Côa	48.15	51.85	436.2	16	0.025	1033.4	0.05	65.9	4.4	26.1

APPENDIX C.2 –

SOCIO-ECONOMIC AND SOCIO-DEMOGRAPHIC INDICATORS FOR THE SOCIO-ECOLOGICAL CONNECTIVITY ANALYSIS OF THE LUCCA-AULLA LINE

Socio-economic descriptors	Agriculture area	Male population 2025	Female population 2025	Ageing index	Population density	Tourist accommodation	Tourist accommodation capacity	Average gross income per person by	Total employment	Agricultural employment	Industrial employment	Trade, hotels and restaurants employment	Transportation and storage, information and communication services employment	Total unemployment
Aulla	68.0113352	49.012733	50.987267	234.18	1.66894449	28	0.46674446	22337	4489	1.84896413	23.7692136	22.0316329	9.57897082	8.02
Bagni di Lucca	58.1663631	50.0359712	49.9640288	352.6	0.60716454	26	0.15786278	19197	1999	4.70235118	34.1170585	22.4612306	5.80290145	6.33
Barga	33.5037594	49.423851	50.576049	280.8	1.50375945	49	0.73684211	23325	3852	2.41433022	36.6043614	19.3146417	5.4517134	5.57
Borgo a Mozzano	8.79834254	49.085183	50.914817	275.5	1.38121547	16	0.22098448	21465	2777	2.98883687	40.5113432	19.2293842	4.93338135	5.18
Camporgiano	14.9446494	49.4969819	50.5030181	384.5	3.6900369	320	11.8081181	20856	793	37.3266078	37.3266078	16.2673392	4.9180279	6.48
Capannori	24.9553001	49.5433496	50.4566504	210.0	0.6385696	136	0.86845466	24377	19666	33.728262	33.728262	20.0701719	5.776467	5.21
Casola in Lunigiana	6.57197882	48.4649123	51.5350877	603.2	2.40731825	10	0.24073182	20331	308	5.84415584	26.6233766	22.7272727	8.11688312	10.23
Castelnuovo di Garfagnana	42.0701754	48.3283212	51.6716788	261.8	3.50877193	26	0.9122807	23475	2334	4.32733505	30.2485004	20.5655527	0.64267352	6.72
Coreglia Antefimelli	6.96969697	49.8622047	50.1377953	270.8	1.89393939	23	0.43560606	21877	2101	1.76106616	42.6463569	19.7524988	5.37839124	5.4
Fivizzano	11.3687814	49.341248	50.658752	494.6	5.05050505	50	0.27607531	21268	2611	5.24703179	26.5032555	16.6219839	6.74071237	8.24
Fosciandora	21.8686869	46.9314079	53.0685921	346.1	5.05050505	8	0.4040404	20490	214	6.54205607	28.5046729	20.5607477	8.41121495	11.02
Galliciano	9.60655738	50.683289	49.306711	266.7	3.27868852	140	4.59016383	21443	1442	2.63522885	41.2621359	20.3863495	5.47850208	5.37
Lucca	26.7493261	48.329251	51.670749	243.4	0.53908356	512	2.76010782	26671	38274	1.62251137	23.8752156	19.9822334	7.07529916	6.46
Minucciano	31.5263158	48.7194081	51.2805919	518.7	1.75438596	20	0.35087719	21146	675	4.59259259	36.1481481	17.9259259	8.2962963	8.28
Piazza al Serchio	20.6642066	48.1031128	51.8968872	499.2	3.6900369	5	0.18450185	20943	858	3.61305361	34.4988345	17.8321678	7.57575758	8.95
Pieve Fosciana	14.0277778	49.9097473	50.0902527	315.9	3.47222222	16	0.55555556	22619	937	2.98826041	34.1515475	20.8110993	4.48239061	6.16
San Romano in Garfagnana	12.6923077	49.1214668	50.8785332	267.1	3.84615385	11	0.42307692	22880	583	4.63121784	31.0463122	14.5797989	5.1457976	4.66
Sillano Giuncugnano	59.297164	48.2965932	51.7034068	497.0	1.23304562	9	0.11097411	19758	392	5.86734694	27.5510204	19.8979592	7.65306122	8.27

APPENDIX D.1 –

DISTRIBUTION OF LAND COVER CATEGORIES

ACROSS THE MUNICIPALITIES INCLUDED IN

THE STUDY AREA FOR THE SOCIO-ECOLOGICAL

CONNECTIVITY ANALYSIS OF THE DOURO LINE

	Arable land	Forests	Heterogeneous agricultural areas	Inland Waters	Open spaces with little or no vegetation	Pastures	Permanent crops	Scrub and/or herbaceous vegetation associations	Industrial, commercial, transport units and mines	Urban fabric
Alijó	0.38	6.56	19.32	1.15	14.67	0.25	30.98	24.49	1.32	0.87
Armamar	0.22	7.05	23.35	1.38	0.3	0	37.16	30.09	0.22	0.24
Baião	0.45	12.16	32.93	1.33	0.23	0.22	4.94	46.73	0	1.02
Carraceda de Ansiães	2.24	14.36	28.63	1.69	0.1	0.09	16.15	35.3	0.97	0.47
Cinfães	1.03	16.33	29.64	1.33	0.18	0	0.13	51.05	0	0.31
Lamego	1.38	6.91	23.33	1.77	0.15	0.95	32.08	31.15	0.33	1.95
Marco de Canaveses	0.28	10.18	44.43	2.62	0.37	0	2.29	33.77	1.05	5.02
Mesão Frio	0	6.44	10.62	3.01	0	0	63.82	14.64	0	1.46
Peso Da Régua	0	4	13.62	1.54	1.22	0	60.92	16.54	0.15	2.02
Resende	1.99	7.03	44.73	1.85	0	1.14	2	40.83	0	0.41
Sabrosa	0	14.24	17.28	0.8	1.92	0.25	32.16	31.32	1.06	0.98
São João da										
Pesqueira	0.77	5.19	16.03	1.24	0	0	50.83	25.46	0	0.49
Tabuaço	0.83	9.98	25.55	0.21	0	0	22.53	39.43	0.88	0.58
Torre de Moncorvo	0.96	2.51	24.79	2.96	7.63	0	15.55	45.08	0.11	0.42
Vila Nova de Foz Côa	0.21	2.39	17.5	1.87	2.7	0.14	34.97	39.2	0.32	0.7

APPENDIX D.2 –

DISTRIBUTION OF LAND COVER CATEGORIES

ACROSS THE MUNICIPALITIES INCLUDED IN

THE STUDY AREA FOR THE SOCIO-ECOLOGICAL

CONNECTIVITY ANALYSIS OF THE LUCCA-AULLA LINE

	Urban fabric	Industrial. commercial and transport units	Arable land	Permanent crops	Pastures	Heterogeneous agricultural areas	Forests	Scrub and/or herbaceous vegetation associations	Open spaces with little or no vegetation	Other Uses
Aulla	4.3	2.7	0.9	3.4	0	27.7	56	1	4	0
Bagni di Lucca	1.4	0.1	0	0	0.5	2.4	83.1	7.1	5	0.2
Barga	4.4	0.9	4.1	0	0	12.2	74.1	3.1	1.3	0
Borgo a Mozzano	2.8	1.7	0	4.2	0	10.1	76.1	3.2	0.1	1.8
Camporgiano	1.5	0	0	0	0	32.2	66.1	0	0	0.2
Capannori	8.4	3.3	18.3	12.5	0	21.9	30	5	0.2	0.4
Casola in Lunigiana	1	0	0	5	1.1	12.7	77.1	1.6	0.9	0.7
Castelnuovo di Garfagnana	7.1	2.5	2.7	0	0	17.2	61.3	6.7	0	2.5
Coreglia Antelminelli	4.6	1.1	0	0	0	7.9	81.4	4.1	0.8	0
Fivizzano	1.5	0	0.9	3.1	0.8	15	68.7	7.1	2.6	0.4
Fosciandora	0	0	0	0	0	14	85.3	0.5	0.2	0
Galliciano	4.8	0.8	0.5	0	0	15.4	76.1	0	2.5	0
Lucca	10.9	2.7	7.2	9.6	0	22.6	41.7	3.2	0	2
Minucciano	2.9	0	0.6	2.9	2.1	8.2	67.3	9.6	3.6	2.9
Piazza el Serchio	2.7	0	2.9	0	0.1	29	62.8	2.5	0	0
Pieve Fosciana	1.7	1.2	5.2	0	0	9.2	71.9	9.2	0.7	0.9
San Romano in Garfagnana	1.6	0	0	0	3.8	23.1	69.8	1.8	0	0

TOUR & RAIL