Invisible Infrastructure
Rethinking Mobility Services for Rural Accessibility in Prespa Lake Region

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Abstract - *In recent years, Albania has experienced significant demographic shifts, particularly affecting rural areas due to population decline driven by emigration, progressively, this trend has intensified accessibility challenges, affecting well-being and mobility. Sparse populations and long travel distances hamper effective public transportation, worsening inequalities, and isolation, particularly for vulnerable groups. Urgent action is required to implement sustainable and inclusive rural mobility solutions, especially amidst the pressing climate crisis. Through the examination of current international policies and a brief comparative analysis of successful European case studies, this contribution focuses on the case study of the Prespa Lake Region in Albania, aiming to outline potential mobility services to enhance the territorial accessibility of this region. Albania's ongoing accession negotiations with the European Union and alignment with global development priorities underscore the importance of combating climate change and promoting sustainable transport. While urban areas typically receive more attention, addressing mobility in rural and remote areas is essential for inclusive growth and territorial accessibility. However, challenges persist, including the cultural reliance on private cars and limited transportation services for vulnerable populations. Collaborative efforts within communities of practice are vital for addressing accessibility needs and fostering inclusion. Embracing sustainable mobility practices and the sharing economy can further mitigate environmental impacts and enhance accessibility. Efforts to improve rural mobility should prioritise local contexts, such as the Prespa Lake Region, to address unique challenges and leverage innovative solutions to enhance quality of life and economic opportunities.*

Keywords - Infrastructure, Transport Justice, Accessibility, Mobility Services

Introduction

Prespa Lake, situated on the borders of Albania, North Macedonia, and Greece, stands as an untouched oasis of nature and traditional livelihoods at the margin of the European Corridors infrastructure. Today, Corridor VIII is under construction and these investments are crucial, yet a comprehensive strategy is essential, integrating both transport and social justice to safeguard the well-being of the region's inhabitants and unlock the potential of rural area's landscapes. The purpose of this paper is to explore the socio-spatial "Invisible Infrastructure" composed of capillary transport services tailored for rural areas essential for economic activities, mobility, and social cohesion, diverging from conventional narratives on traditional transportation systems and in contrast with the monopole of heavy infrastructure, which capture all the investments and support the private car paradigm reinforcing social disparity to understand if and what alternative solutions respond better to rural accessibility needs of this region.

In recent years, Albania's demographic landscape has undergone significant changes, particularly impacting rural areas. The country has witnessed a population decline, driven by emigration trends. As rural areas make up a substantial portion of Albania's territory, they are particularly vulnerable to the impacts of depopulation. Rural areas face numerous accessibility obstacles, impacting both objective and subjective well-being [1][2][3]. Contrary to stereotypical notions of rural tranquillity [Figure 1], many residents lead hypermobile lifestyles, spending considerable time travelling to access activities [4]. Rural areas, typically dependent on private transportation, encounter difficulties due to long travel distances, sparse local populations, and the fluctuating presence of temporary residents. These factors impede the establishment of efficient public transportation services as viable substitutes for private vehicles. Consequently, rural residents experience longer travel durations in comparison to urban counterparts, leading to isolation and service inadequacies for those unable to travel. The

combination of limited access to essential services, a heavy reliance on cars for mobility, and ineffective traditional public transport exacerbates inequality, disproportionately impacting vulnerable groups [5]. Despite these obstacles, urgent action is needed to identify and implement sustainable, socially inclusive, and economically viable rural mobility solutions in response to the pressing climate crisis [6]. The ongoing Albanian accession negotiations with the European Union initiated in 2003, and now in the screening report phase, are expected to raise standards for combating climate change, aligning with global development priorities. By 2030, crucial decarbonisation goals are targeted, driven by technological advancements and widespread adoption of green technologies. Sustainable transport is fundamental to achieving multiple Sustainable Development Goals related to food security, health, energy, economic growth, infrastructure, and urban development. The transport sector plays a significant role in climate action, with a quarter of energy-related global greenhouse gas emissions originating from transportation, projected to rise substantially [7]. The European Union aims to become the first climate-neutral continent by 2050 [8], proposing the "Fit for 55" package to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. While urban areas receive considerable attention, the future of mobility lies in peripheral and remote regions, where technological efficiency and sustainability are paramount. Enhancing territorial accessibility and promoting inclusive growth in these areas is crucial to prevent exclusion and ensure sustainable mobility solutions. Accessibility needs are fulfilled not only through independent individual mobility but also through people's interdependence [9]. This is organised within "communities of practice" [10] i.e., interactive networks of people sharing concerns for accessibility-related needs and activating collaborative forms and services based on relational proximity networks inscribed within wider networks of opportunities [11]. The nature and characteristics of communities of practices influence how rural/inner areas dwellers can meet their accessibility needs, a relational and interdependent dimension that is usually overlooked but essential for their well-being and inclusion.

Although private car ownership remains a status symbol in Albania due to historical reasons, there is hope that younger generations will embrace more sustainable mobility lifestyles. The sharing economy, driven by advancements in technology, is transforming various sectors including transportation. This model emphasizes sharing, renting, and borrowing goods and services rather than ownership. Enabled by social networking and location-based services, the sharing economy offers diverse options for travel and resource access, reshaping traditional trip generation patterns. Prespa Lake Region represents an example of this very remote area, at the margin of the infrastructure, almost left out from the investments, a rare gem suck between three countries where the population suffers from the lack of services. Where villages are constantly ageing and depopulating this land needs to be addressed concerning their traditions but also with innovative solutions that can boost the quality of life and the economy of the region.

Literature review

The Albanian test base for the EU goals

Albania in 2017 reported a total population of 2,876,591 million people. In 2018, Albania's elderly population accounted for 11.9%, while children and adolescents covered 18.5%. The country has experienced significant demographic changes over the past two decades, marked by a declining population as Albanians continue to emigrate. Birth rates have also decreased, with a 2.3% decline in births recorded in 2017 compared to the previous year [12]. Albania covers an area of 28,748 km² and the rural areas represent the largest part of the national territory. Of the total area, 42.8% is agricultural land while forests cover 28.16 % and arable land is 22.4%. Over 46.5% of the total population lives in rural areas, but at the same time rural depopulation is an increasing problem in Albania and regions are increasingly facing the negative effects of this development [13].

Albania is establishing a formal definition of rural areas in collaboration with the Ministry of the Interior and INSTAT, basing eligibility for rural development support on beneficiary characteristics

Fig 1 / Beato Angelico, Tebaide, 1420 ca., Galleria degli Uffizi, Florence, Italy.

rather than just residential location. These areas are identified by population density, with fewer than 150 people per km² according to the standard OECD definition. However, rural areas face challenges with unsustainable mobility solutions due to high individual motorization rates. Public transport is primarily used for essential services such as schooling, healthcare, work, and leisure activities. The rural and mountainous regions, significantly distant from urban centres, require a shift in perspective to address accessibility issues exacerbated by depopulation and ageing, which have led to the closure of local services and increased dependence on urban centres, perpetuating a cycle of further depopulation and underdevelopment [14] [6].

Bus lines are under local Government and Municipalities are responsible for city transport and licensing processes for inter-city transport within and between circuits, whereas the private transport operators are contracted by municipalities to provide public transport services. In Albania, the organization of the transport services is delegated to each Municipality [13]. However, it is no longer sufficient to suggest solutions at the municipal level; instead, it is necessary to study territorial network systems. This is particularly true for local and metropolitan public transportation, considering the territorial scale. For instance, the complexity of the Prespa Region lies in the strong political borders that separate the hall natural environment, the territory and the villages are united around Lake Prespa but at the same time, they are divided between different states. The passage between one state and another is controlled by trade, which slows down flows and discourages transit, and the lack of basic infrastructure, such as between Greece and Albania, makes circumnavigation difficult, if not impossible.

Albania's commitment to improving rural infrastructure and mobility services is evident through a range of financial support mechanisms at various government levels. Municipalities annually allocate funds for the transport sector, supplemented by unconditional transfers from the central government. These funds are utilized for local infrastructure interventions, primarily road projects, with larger investments relying on transfers from the central budget or external funds like the Albanian Development Fund. The government plays a crucial role in maintaining and constructing local roads, often collaborating with entities like the Albanian Road Authority and the Albanian Development Fund. In addition, Albania's Inter-Sectoral Rural Development Strategy (ISRDSA) [17] aims to enhance rural socio-economic conditions by boosting agricultural productivity, preserving the environment, and eradicating poverty.

Additionally, Albania has embraced joint declarations with the European Commission and actively participates in regional initiatives like the Western Balkans and the Vienna Summit, demonstrating its commitment to improving public transport infrastructure. Several aspects of the Agenda 2030 align with the theme of sustainable transportation, notably Goal 9, which emphasizes the need to build resilient infrastructure, promote sustainable industrialization, and foster innovation. Investments in infrastructure and sustainable industrial development are crucial for economic growth, social development, and climate action. Furthermore, Goal 11 focuses on creating inclusive, safe, resilient, and sustainable cities and human settlements, highlighting the importance of universal access to safe, green, and public spaces, especially for vulnerable groups such as women, children, older persons, and individuals with disabilities [7]. Moreover, the United Nations Framework Convention on Climate Change (UNFCCC) recognizes the significant role of the transport sector in addressing climate change, as a quarter of energy-related greenhouse gas emissions originate from transportation activities. Therefore, sustainable transportation practices are essential for achieving the goals outlined in Agenda 2030 and mitigating the impacts of climate change. Overall, there is he need to shift from the current mentality of slight changes towards a radical transformation. The scenarios underlying the strategy, common to those supporting the plan for the 2030 climate objective, demonstrate that, with the right level of ambition, the combination of policy measures outlined in this strategy can lead to a 90% reduction in transport sector emissions to enable the EU to become a climate-neutral economy by 2050, while simultaneously working

source/ Open Source, Wikimedia Foundation

towards zero pollution [7]. To achieve this systemic change, we must: make all modes of transportation more sustainable, make sustainable alternatives widely available in a multimodal transportation system, and put in place the right incentives to drive the transition. The landscape of sustainable transport planning changes completely when it comes to urban peripheries, rural areas, and remote regions. Mobility in such areas is still predominantly supported by motorized private vehicles, whereas the existent supply of public transport and New Mobility Services are not sufficient to cover present and future travel demand. Travel distances tend to be longer compared to urban areas, and this makes the context of active modes as a means for door-to-door travel different [15]. Transport decisions have been typically made based on traditional economic approaches, including monetary cost and efficiency. However, the primary consideration of economic aspects tends to neglect the social, environmental, and health issues of transport services. Only in recent years, social and environmental considerations have become a key factor in transport-related decision-making, at least in urban areas.

Nevertheless, most European countries have not yet developed relevant policies or set clear targets for sustainable rural mobility. It is paramount to adapt and broaden the concept of infrastructure to enhance accessibility in rural and remote areas, where the population is ageing, youth are leaving, resources are scarce, and communities are at the margins of the infrastructure itself. Transport justice stipulates that everyone should have the right to move freely to access services and work [16]. However, some areas are poorly equipped in this regard due to their peripheral location. The weak and scattered mobility demand in these areas makes traditional public transport inadequate and inefficient. As a result, many areas have seen cost-cutting measures that have led to reduced efficiency and service levels. This has worsened social inequality, especially for vulnerable groups who lack access to private transportation due to physical limitations, age, or financial constraints. Improving connectivity between urban and rural areas is essential for ensuring equal access to services and opportunities and promoting social justice. While digital services can reduce isolation, physical access to major centres remains crucial for territorial development. Physical accessibility can help stimulate local economies and improve the quality of life for people with limited access to services and opportunities [14].

Conventional rural public transport systems face challenges in meeting diverse traveller needs due to their inflexibility. Limited exploration of tailored mobility solutions for rural areas has hindered efforts to enhance sustainability and inclusivity. Additionally, the economic viability of such solutions remains underexplored. Addressing social inclusiveness requires recognition of diverse user needs, including both permanent and temporary residents. Innovative solutions like demand-responsive transport (DRT) and shared mobility are gaining momentum, offering sustainable alternatives to private cars, and improving transport accessibility. However, it is crucial to identify the true beneficiaries and prioritize individualized services to ensure maximum freedom of movement according to user needs, even in digitally advanced scenarios.

The Hard Infrastructure

In the most common sense, the term "infrastructure" refers to socio-technical systems capable of supporting various productive activities. Roads, railways, power lines, water pipelines, and sewage systems, form the complex network of infrastructure that decisively shapes urban life in cities and territories [18]. Transport plays a critical role in facilitating economic activities and ensuring social well-being and cohesion among populations. It enables people to move about daily and is essential for the production and distribution of goods. These infrastructures transform nature, make resources and places available, and commodify them. Designed to provide efficient and universal services and follow advanced engineering models, the techno-scientific apparatus of infrastructure impacts territories by often imposing standardized solutions that simplify or obscure contexts, and sometimes generate conflicts and exclusion. Decision-makers at governmental and international levels face various challenges in their efforts to improve transportation. These challenges include physical barriers like inadequate infrastructure, bottlenecks, missing links, and financial constraints

hindering their removal. Addressing these issues requires coordinated action among governments, both domestically and internationally, to implement effective solutions. Massive infrastructure investments from Europe are currently transforming the Albanian landscape through the construction of an extensive transportation network that will span the entire country. Corridor VIII [Figure 2], which is part of the Pan-European Transport Corridors, was identified and defined in various Pan-European Transport Conferences, including Prague (1991), Crete (1994), and Helsinki (1997) [19]. It was designed as a multimodal transport system that would link Southern Italy to the Black Sea, incorporating maritime and river ports, airports, multimodal ports, roads, and railways. It covers a total of 1,270 km of railways and 960 km of roads, running from the southern Italian ports of Bari and Brindisi to the Albanian ports of Durres and Vlora, passing through the capitals of Tirana, Skopje, and Sofia, and extending through Plovdiv to the Bulgarian ports of Burgas and Varna on the Black Sea. Heavy infrastructure like highways and motorways may only reach a few cities, leaving others excluded from the system. Moreover, it is not enough to simply improve transportation infrastructure and promote more flexible transportation services. It is also important to enhance the local territorial capital by bringing services, knowledge, social interactions, and other resources to these areas [20]. To be effective, the infrastructure must be widespread, enabling people to access services and move freely across the territory. For instance, the European Corridor VIII, which is important for trade and industry, cannot be the only infrastructural investment for the Albanian territory, as it does not meet the needs of most of the territory, which is remote and rural, such as the Prespa Lake Region.

The current transportation infrastructures and services are insufficient to meet the demands of these remote regions. Due to the dispersed nature of their populations, providing transportation is economically challenging and hardly justifiable in terms of expenses. Furthermore, optimizing transportation solutions becomes even more challenging due to the seasonal flows that are associated with tourism [14]. The towns and hamlets of Prespa Region are dispersed over a wide mountain territory, some of them being far from the main road axis of the valley. Most trips are made by car, and the current public transport system fails to meet the needs of the few who rely on it.

The responsibility for accessibility planning has been assigned to the local authorities, which implies that accessibility goals are not a concern of national transportation planning. This further suggests that significant investments in transportation infrastructure and services, which have a long-term impact on accessibility patterns and contribute to persistent accessibility injustices at the local level, are not considered part of national accessibility planning. Usually, transportation planners and engineers follow a set of professional procedures to analyze the transportation system's current state and determine solutions to address issues like traffic congestion, air pollution, rising costs, and low service levels. However, the actual impact of these solutions on different people and the systematic way in which they affect people's lives are often disregarded in the field of transport planning [16]. The investment in infrastructure should not accentuate the disparity between rich and poor [21].

Conventionally, the infrastructures discussed are the result of large, centralized projects. However, a

Fig 2 / The Hard Infrastructure, Corridor VIII construction in the Shkumbin River.

closer look reveals something else: the existence of micro-infrastructure processes and self-produced infrastructures. Considering social innovation and its evolutionary trajectories, it is observed that, before reaching maturity and the realization of dedicated infrastructures, there is a phase of self-infrastructure, in which groups of creative and enterprising individuals modify the meaning and use of what they find in the infrastructure necessary for what they propose to do. Thus, an abandoned plot of land can become a garden, a busy street a bike path, a parking lot a space for tables, a residential building a cohousing, and so on. This happens before the decisions necessary to transform the self-generated infrastructures into fully legitimate and consolidated infrastructures are made [11].

The Invisible Infrastructure

Traditionally, private transport has historically been the primary mode of mobility in regions with low population density. The mobility requirements of rural populations are diverse. Permanent residents usually travel for work, education, healthcare, socialization, and leisure, with working-age adults travelling independently [Figure 3]. Additionally, temporary rural residents, including second-home owners and tourists, travel in rural areas for leisure, maintenance, and socialization, and often rely on private transport during holiday periods to travel within their destination and the surrounding area. However, certain demographic groups such as younger children and older adults may require assistance with travel due to limited mobility or rights to independent travel. These individuals contribute to the diverse mobility needs within rural communities, necessitating flexible and inclusive transportation solutions [6]. The preference for private cars is driven by convenience, limited alternative options, emotional attachments, and the perception of car ownership as a symbol of freedom and status. However, private transport fails to align with sustainable mobility principles, posing environmental and equity concerns. The economic shock underscores the need for affordable and

source/ Photo by the Author. Mirakë, Albania (November, 2023)

equitable mobility. Despite increased connectivity in the transportation sector, mobility remains costly for low-income individuals and inaccessible for people with disabilities or limited digital literacy. Ensuring free access to mobility for all is essential, especially in rural, peripheral, and remote areas.

Efforts to reduce car usage often prioritize initiatives that cater to car owners, perpetuating inequalities in mobility and accessibility. Sustainable transport planning can unconsciously reinforce these disparities by prioritizing travel demand and allocating new transport infrastructure, exacerbating differences in travel patterns among various population groups [16]. We need to shift away from traditional models of unlimited expansion and adopt mindful approaches that recognize the finite nature of natural resources and the importance of ecological balance. Additionally, integrating ethical considerations and social equity into all aspects of territorial planning is crucial, promoting social inclusion, fair access to resources, and equitable distribution of benefits from planning and management efforts. Transport and mobility planning has been going through a fundamental paradigm change, from conventional approaches focusing on physical and economic dimensions to minimizing the generalized cost of travel towards more sustainable approaches also incorporating social dimensions [22]. An approach focused on sustainable practices profoundly influences how we perceive and design our environment. This requires a collective commitment to adopting policies that prioritize social equity, environmental sustainability, and community well-being. Socially, extending public transport services ensures access to essential functions for all citizens. Economically, balancing community resources and service costs is crucial for long-term viability. Environmentally, efforts to minimize pollutant emissions include fleet modernization, alternative fuel usage, and electrification where feasible. Integrating public transport within an intermodal framework promotes a modal shift and reduces overall environmental impact. The invisible infrastructure comprises multiple complex layers, not all of which are physical, including person accessibility, landscape potential opportunities, and new public mobility systems. Infrastructure, including roads and public spaces, becomes more than just functional elements but also fosters social interaction and community engagement. These spaces serve as vital nodes for cultural exchange and economic activity, contributing to the vibrancy of both urban and rural areas. Recognizing the multifaceted nature of these spaces emphasizes their role in promoting inclusivity, creativity, and resilience within communities [11]. Identifying the needs, aspirations, and challenges of rural and inner areas dwellers is essential for developing effective strategies to overcome barriers to accessibility-related well-being [Figure 4]. By implementing innovative approaches such as improving transportation infrastructure, introducing shared mobility solutions, and enhancing digital connectivity, it is possible to address these challenges and improve personal accessibility for residents. Person accessibility is a characteristic attributed to individuals, indicating whether they have access to specific locations whereas place accessibility pertains to activity locations, indicating whether they are accessible to certain individuals or from specific other locations. A justice-oriented approach to transportation planning should prioritize individuals, as justice demands equitable treatment for people rather than locations [16] [Figure 5]. In rural areas, social infrastructure often compensates for the lack of formal services by fostering dense networks of relationships. This sense of community leads to the creation of a genuine sharing economy, where informal practices address structural deficiencies in the transportation system. For instance, initiatives like carpooling and volunteer rides enable citizens to assist vulnerable community members, such as the elderly, by offering transportation to medical facilities or delivering goods. In the context of the

Prespa Region, Lake Prespa stands out as a prominent yet often overlooked feature. Despite its significance, it has the potential to function as the invisible infrastructure that connects all the surrounding areas [Figure 6] [Figure 7].

The perception of the untouched water basin in the Prespa region is widespread. However, water itself can serve as infrastructure. Lake transportation offers an opportunity to improve connectivity, given its prominent presence in the landscape [Figure 8]. Establishing easy and efficient linkages across the water basin can facilitate the movement of people and goods between lake cities. However, leveraging this potential poses challenges, including balancing transportation needs with preserving the landscape's beauty and safeguarding the lake ecosystem from human activities.

Sparking from the existing lifeline that already connects people in remote areas, new public transport can be envisioned [Figure 9]. In the next paragraph, there is an outline of different possibilities to be implemented in rural areas that are now spreading all over Europe and that suggest how new mobility services are changing and evolving to provide as much accessibility as possible. This evolution must prioritize inclusivity, ensuring universal access to mobility, improved connectivity in rural and remote regions, accessibility for individuals with disabilities, and the provision of favourable social conditions, opportunities for skill development, and attractive employment prospects within the

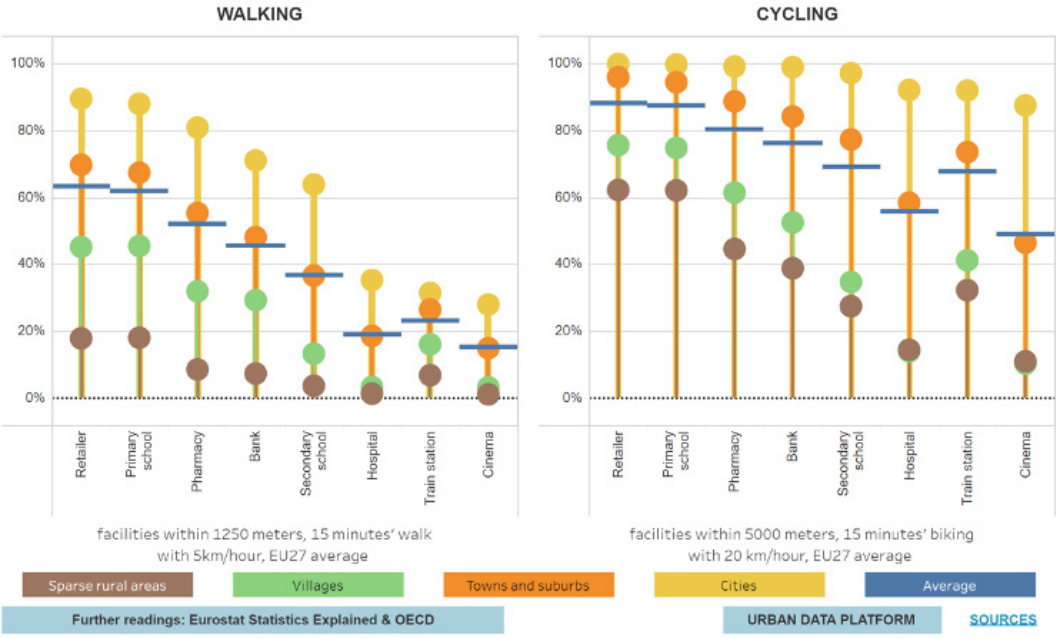

Fig 3 / Share of EU population within 15 min from service area *source/ KCMD Data Portal (2021)*

sector [16].

Tools and methodology

Rethinking Rural Mobility: MOD, TOD, DTR and MaaS

The past few centuries have seen significant trends in urbanization, with cities being the focus of social and economic development. However, we must not overlook the fact that Europe remains a predominantly rural territory. Approximately 75% of Europe's physical area comprises open countryside, rural and mountain villages, and smaller towns that exhibit low to moderate population density. Even in what is regarded as predominantly "urban" areas, the built-up areas are relatively small, surrounded by peri-urban and rural hinterlands of moderate population density. Rural areas are home to 28% of Europe's entire population, which amounts to 146.322.571 million people [23] [Figure 10]. Europe's rural areas, though individually small, collectively hold significant spatial and population sizes, impacting food production, ecology, culture, and social cohesion. Ensuring their health and effectiveness is crucial for Europe's overall well-being. Policies and objectives across Europe must acknowledge the diversity of rural areas and integrate them to achieve broader goals fully.

Resources for public transport in rural areas vary considerably by state. Although rural areas typically offer the most affordable housing, they provide the greatest accessibility challenges with few or no transportation services available to youth, seniors, and people with disabilities. Automobile ownership is an economic necessity, creating a serious strain on low-income household budgets. The combination of social capital and mobility presents a potent force in rural communities, fostering cohesion, connectivity, and prosperity. Ridesharing and neighbourly assistance already form the backbone of transportation in areas lacking public transit. Mobility-on-demand (MOD) enhances this grassroots system by offering diverse resources, improving communication, and providing technology training. MOD offers flexible, shared transport tailored to users' needs, expanding service coverage, and enhancing convenience and cost-effectiveness through micro-transit options like shared rides in smaller vehicles. Integrating structured and on-demand transport creates a sustainable mobility ecosystem adaptable to local needs and constraints. Public transport authorities can partner with private firms to develop customized MOD models tailored to the unique needs of rural areas. Comprehensive research is crucial to understanding the feasibility and benefits of MOD solutions, particularly in enhancing access to job opportunities and essential services like healthcare. MOD services can also streamline goods delivery and agricultural product transport, fostering economic growth in rural communities. Traditional MOD methods, such as carpooling, can mitigate digital poverty and limited internet access in rural regions. Transportation solutions for rural areas should also consider Transportation-On-Demand (TOD) service, which includes semi-flexible demand-responsive transport as well as flexible door-to-door demand-responsive transport. TOD is a transportation service that is tailored to areas where the demand for mobility is scattered, such as business zones, suburban areas, rural communities, or even night services. Traditional public transportation, such as buses, light rail, and metros, works best in dense city centres and inner suburbs. On-demand transport provides a solution to these challenges by offering a flexible and efficient alternative to serve low-density areas or to complement regular routes in periods of lower traffic. On-demand transportation solutions are designed to promote social cohesion and expand territories, covering the first and last mile to/from regular routes, providing more mobility to people living in suburban areas, and addressing the unmet needs of specific groups of people, such as seniors or people with disabilities. Other emerging adaptive mobility solutions are Demand-Responsive Transport (DRT), as well as shared mobility solutions or shared transport. DRT services provide a flexible option between regular public transport and personalized taxi services. These services come with flexibility in route choice, trip scheduling, and on-demand stops. In contrast, shared mobility encompasses various models within the sharing economy, such as bike-sharing, car-sharing, car-pooling, or ridesharing, typically initiated by private

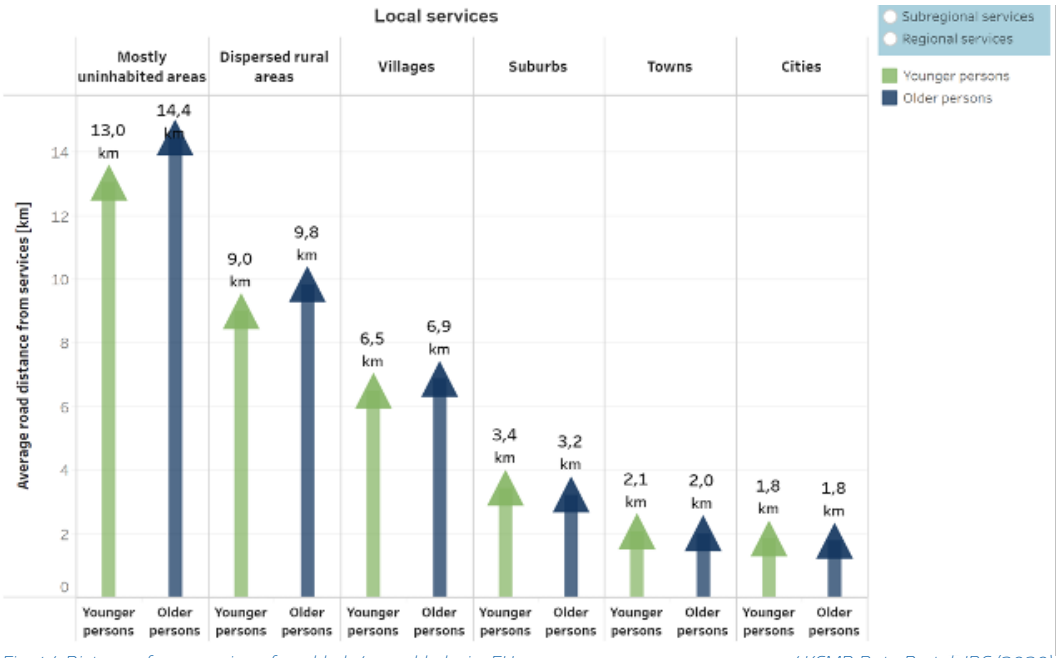

Fig 4/ Distance from services for elderly/non-elderly in EU areas with different degree of urbanisation *source/ KCMD Data Portal, JRC (2020)*

entities. While DRT is considered a primary solution for contemporary rural mobility challenges, shared mobility is seen as complementary to conventional public transport [6]. The integration of technology to enhance the transportation system is becoming more prevalent. As the demand for passenger transportation rises, new and innovative solutions are being developed to integrate various transport services into a single, on-demand and accessible service model known as Mobility as a Service (MaaS). MaaS operators streamline costs, enhance safety, and ensure regulatory compliance. They offer diverse reservation channels like mobile apps, websites, or telephone services to meet customer needs. MaaS integrates various transport options into a single service accessible on demand, including public transport, ridesharing, car-sharing, taxi services, and more [24]. This approach simplifies payments and provides real-time information on available options. The rapid growth of MaaS suggests a potential revolution in mobility, evolving from previous unimodal and multimodal systems [25].

However, in rural areas, the success of new mobility solutions hinges on reliable internet access and digital literacy. Variations in mobile network availability and internet quality, compounded by sparse population density, pose challenges for digitally facilitated transport services. Additionally, accessing and utilizing these services necessitates internet-connected devices and proficiency in operating corresponding applications, presenting barriers for certain user groups and impeding progress toward sustainable mobility solutions [26]. Service solutions for passengers should be designed to be physically accessible but also technologically accessible, by offering booking choices that work for everyone without the necessity of a smartphone.

Over the last decade, several EU-driven initiatives, such as SMARTA [27], have been undertaken. Despite a lack of extensive academic discourse, reports and insights from relevant transport operators provide valuable information on sustainable rural mobility solutions. The following paragraph presents case studies highlighting innovative mobility solutions and successful operational practices implemented in Albania and rural areas across Europe.

Good practices from Albania

Albania has undertaken several projects aimed at promoting accessibility and sustainable mobility [28]. Notably, three proposals have been put forth, with a focus on improving the urban fabric of Tirana, the capital city with a population of 475,577 inhabitants as of 2017 [12]. The Tirana Municipality is taking action to reduce private car usage and enhance cycling infrastructure to combat traffic congestion and air pollution caused by around 140,000 motor vehicles in the city. Through extensive stakeholder engagement, the initiative prioritizes bicycle lanes and parking facilities to encourage cycling and alleviate road traffic, leading to better public health outcomes. Ecovolis [29], a bike-sharing initiative in Albania, is promoting healthy living and improving air quality by making cycling accessible, enjoyable, and environmentally friendly for the community. Tirana has also taken a significant leap forward in its fight against pollution by introducing electric buses, marking a milestone in Albania's pursuit of sustainable transportation. This initiative follows the municipality's approval of Albania's first electric taxi company license, demonstrating a concerted effort to combat pollution in a city burdened by high population density and vehicular traffic. Additionally, the Tirana Ime mobile application represents a significant step towards enhancing citizen engagement and addressing urban issues in Tirana. This innovative app not only provides access to essential information on transportation and traffic but also empowers citizens to report neighbourhood issues in real time, facilitating prompt municipal responses. With its user-friendly interface and comprehensive categories covering traffic, pollution, and tourism, Tirana Ime fosters a sense of community participation in the city's improvement [28]. While successful transportation projects have been implemented, expanding such initiatives to remote rural areas is crucial. These regions hold transformative potential for economic, social, and tourist development. Securing funding for these areas should be a priority for policymakers and transportation stakeholders. To address this effectively, I have selected four European case studies resembling rural settlements. These studies encompass different transportation systems, including on-demand public transportation,

demand-responsive transport, and carpooling services, providing valuable insights for improving territorial accessibility in the Prespa Region.
Case studies for a new mobility system As previously mentioned, addressing accessibility challenges in the Prespa Region requires a multidimensional approach to rural life. Exploring case studies can inspire potential strategies for these remote communities. Drawing insights from SMARTA (Smart Rural Transport Areas) [27], an EU-funded project initiated by the European Parliament, can provide valuable perspectives on sustainable rural mobility solutions. SMARTA curated Good Practice Study Cases, highlighting innovative transportation methods like ride-sharing schemes tailored for rural residents and vulnerable social groups. These cases highlight various aspects of rural mobility, including solutions for the elderly and disabled, as well as the integration of ICT to enhance transport efficiency and user information [Figure 11].
Shotl (TOD), Spain
On-demand pooled transportation services were introduced in 2017 in municipalities surrounding the Barcelona conurbation, including Sant Cugat del Vallès and Vallirana (23-34 inhabitants/ km²). Shotl [30], an IT company, revolutionized suburban mobility by integrating a pooling technology platform that replaced inefficient regular services and extended them to low-demand peripheral areas. Their hybrid system combined fixed-route-and-schedule services during peak times with flexible on-demand services for the rest of the day, facilitated by passenger and driver apps for real-time booking and optimized routes. This approach fostered efficiency, accessibility, and healthier lifestyles for residents, leading to increased user numbers, reduced public spending, and healthier exercise habits. In Sant Cugat, the average vehicle occupancy increased significantly from six passengers per trip with the former conventional line to sixteen passengers per trip with the on-demand services. The weekly average number of passengers transported slightly increased from the service's launch, from 12-14 passengers per week to about twenty. In Vallirana, the daily ridership increased from twenty passengers before the on-demand service to 28 trips per day in Week 1 post-launch and by Week 6, the ridership exceeded the 50-trip per day mark. Most trips were observed from the town centre to the residential area, reflecting passengers' preference to walk downhill to the centre but less willingness to walk uphill on their return journey or while carrying heavy shopping bags. The service's success has led to its extension to larger areas, meeting the needs of a wider population while optimizing costs and minimizing empty trips.
Connecting Communities (DRT), England
Connecting Communities [31] is a demand-responsive transport service in Suffolk County's rural areas (5,237 inhabitants in 2011, 0.3-0.4 persons per hectare). The service, offered by Suffolk County Council, caters to individuals without regular bus access, serving seven geographical areas (Suffolk, Yoxford, Badingham, Earl Soham, Parham, Great Glemham and Rendham) and accommodating diverse activities such as accessing essential services and connecting to railway and bus stations. Users can book multiple journeys up to 14 days in advance or an hour before travel by contacting their local operator or using the online form. When local public transport is unavailable, users can be connected to nearby stations or bus routes for onward travel, ensuring convenient access to their destination. The service aims to enhance daily transport access for rural communities, reduce

Fig 5/ The Invisible Infrastructure, Rural Dimension
source/ Author. Pustec, Albania (November, 2023)

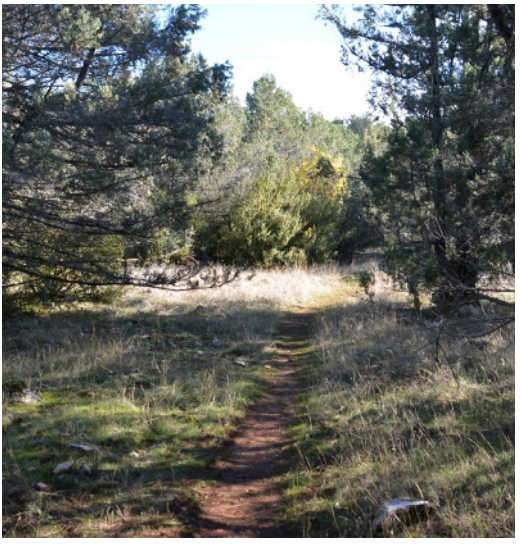

Fig 6/ The Invisible Infrastructure, Hiking Trails
source/ Author. Small Prespa, Greece (November 2023)

Fig 5/ The Invisible Infrastructure, Lake Prespa
source/ Author. Small Prespa, Greece (November 2023)

Fig 8/ The Invisible Infrastructure, Rural Dimension *source/ Photo by the Author. Pustec, Albania (November, 2023)*

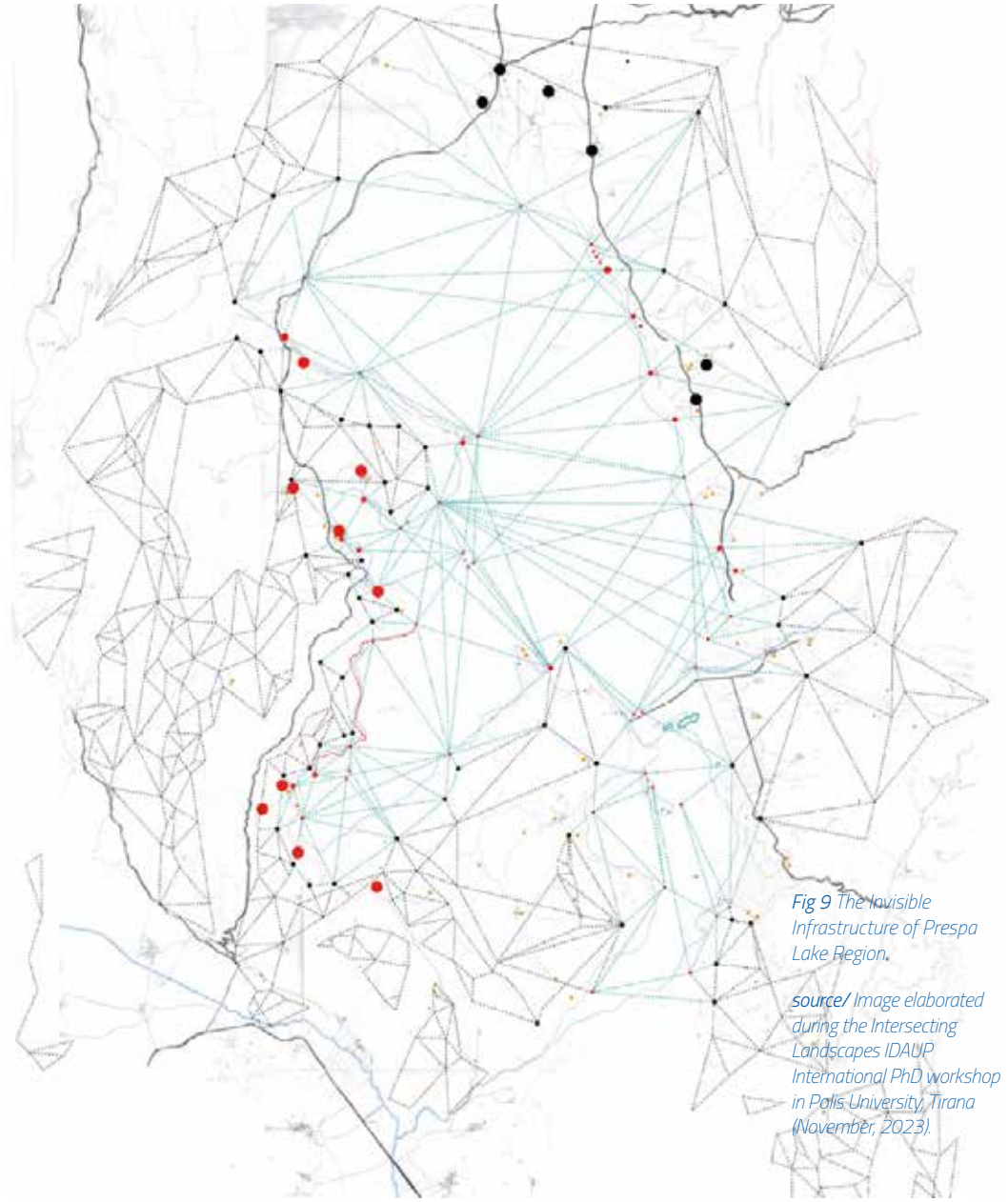

Fig 9 *The Invisible Infrastructure of Prespa Lake Region.*

source/ *Image elaborated during the Intersecting Landscapes IDAUP International PhD workshop in Polis University, Tirana (November, 2023).*

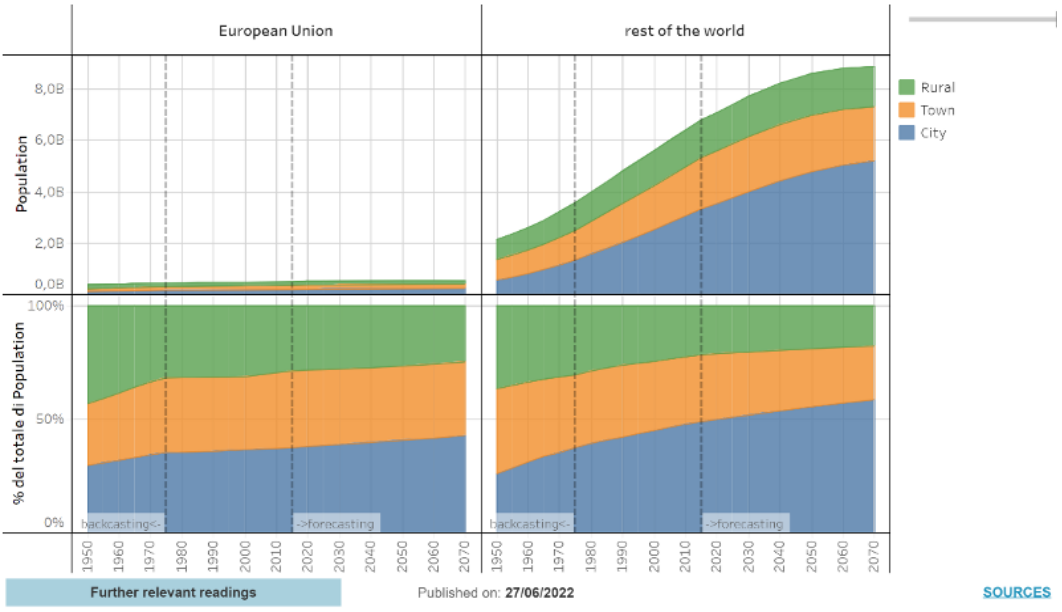

Fig 10/ : Trends in urban growth and urbanization *source/ KCMD Data Portal, Gesis repository (2022)*

carbon emissions, and provide a mobility alternative to vehicle ownership.

RezoPouce (E-Hitchhiking), France

RezoPouce [32], a hitchhiking service launched in 2010, has transformed transportation with its fast, safe, and convenient approach. As a cooperative society (SCIC), it addresses rural public transport challenges and limited mobility by utilizing modern communication technology and municipal cooperation. RezoPouce simplifies transportation, enhances rural accessibility, reduces car underutilization, and fosters community connections. With a focus on trust, ease of use, efficiency, and ecological responsibility, it contributes to a greener future while ensuring peaceful journeys. Its success lies in providing a cost-effective service through efficient communication, behavioural coaching, and technology, fostering goodwill and community spirit among drivers and users. Despite its modest budget, RezoPouce offers excellent value for public investment, with over 3,000 stops established, covering 1,305 municipalities and 2 million people in 2016. It aims to expand to 2,500 municipalities by 2024, encompassing 20% of rural France.

Texelhopper (TOD), The Netherland

In the remote Isle of Texel, located in the North of The Netherlands, there is a successful public transport project known as Texelhopper [33]. The island is home to 14,000 local inhabitants, with a population density of 85 inhabitants/ km², and half of them are concentrated in the town of Den Burg. During the summer season, the number of tourists reaches 900,000 per year. Following public transport budget cuts in 2012, many rural buses were discontinued, prompting a radical overhaul of the public transport system. Now, there is only one traditional bus line and numerous on-demand services tailored to specific target groups. By offering public transport at an affordable cost, facilitating integration between ferry, train, and minibus (with a maximum capacity of eight people), and utilizing an ICT algorithm to create optimal timetables that combine an average of five trips, ridership increased by up to 45% during the first 2 years of operation. The service has been operational since 2014 and is utilized year-round, primarily by students and pupils, with tourists being the main user group during the summer months. Additionally, the service is accessible for wheelchairs and strollers, and with 130 stops, every part of the island is easily accessible day and night for all people.

It is important to note that rural shared mobility solutions require minimal infrastructure and can be deployed rapidly, typically by local actors, using local resources. Once the framework is in place and there are obligations to act, a wide range of shared mobility services can be deployed. It is also important to appreciate that, in rural areas, social innovation may offer as much opportunity as technological innovation. The roadmap should recognize and accommodate such potential and low-/non-technology pathways, including the key role of voluntary citizen initiatives.

Conclusion and recommendations

Improving territorial accessibility in rural areas necessitates an inclusive and people-centric approach that prioritizes the diverse needs of users, particularly vulnerable categories. This involves ensuring the safety and responsiveness of mobility services while integrating various sustainable transportation modes, such as buses and shared vehicles, to promote efficiency and sustainability. Implementing a new vision and policy for rural mobility poses challenges that require addressing to meet evolving mobility needs and address existing deficits. Current frameworks and funding mechanisms are often inadequate for rural mobility outcomes, necessitating stakeholders to mobilize resources independently. Community-driven mobility solutions integrated with local activities are crucial for ensuring relevance and success. Transitioning from pilot phases to permanent operations demands long-term funding and scalability considerations. Shared mobility solutions, including flexible transport services and ridesharing, offer promising approaches, especially when coordinated with fixed-route services to improve coverage and service levels.

What emerges from these virtuous cases and good practices highlights possible mobility scenarios for the Prespa Lake Region, which integrate lightly into the physical and social system of the existing

Fig 11/ : The array of rural shared mobility services. source/ SMARTA PROJECT (2022)

landscape, safeguarding it and making it more accessible and usable for residents and tourists, but above all safe and inclusive for all vulnerable groups of people [Figure 12]. The proposals can be many, and for every budget and timeline, not all elements are yet available to evaluate which of these is the most appropriate to develop. However, given the premises, TOD could represent the most effective solution for this highly atomized territory, where flexible transport lines can comprehensively reach people who, out of necessity and leisure, move around a region where boundaries are no longer determined by politics but by the geography of the Prespa Lake basin territory.

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