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Analysis and assessment of the impact of transport corridor construction on the regional economic development of mountainous areas in southern Bulgaria: A case study

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ABSTRACT

In the Balkan region of Southeastern Europe, many rural, mountainous, and cross-border areas are situated. These areas are isolated from central regions, have low connectivity, and are socioeconomically underdeveloped. At the same time, there is a notable lack of research in the scientific literature on accessibility and regional policies. This article examines the potential for developing a parallel transport corridor in southern Bulgaria, situated in the cross-border region that encompasses Bulgaria, Greece, and Turkey. The authors consider the new transport route as a means of enhancing regional connectivity, thereby promoting economic and social integration within the area. The authors study the region's potential trajectory and assess the capacity of infrastructural elements for promoting regional development. A research approach is proposed to demonstrate the direct correlation between road network density and regional economic development. The authors employ an interdisciplinary approach to assess and analyze the impact of road infrastructure on the development of mountain areas in Bulgaria. Infrastructure has a significant effect on improving the connectivity and accessibility of Bulgaria's mountainous regions, thereby stimulating regional development. The study examines the relationship between the development of the road network in Bulgaria and regional economic development.

Contribution/Originality: This study makes a significant contribution to the literature by analyzing and demonstrating a direct correlation between road network density and regional economic development. The research contributes as the authors offer proposals for the regional development of the mountainous (rural) areas in Bulgaria. The study assesses the potential of the transport artery and its impact on regional development and the retention of human capital within the examined regions.

1. INTRODUCTION

In spatial terms, some mountainous regions on the Balkan Peninsula experience problems with their transport connectivity and accessibility, which leads to a slowdown in their regional economic development. Therefore, we will examine the possibilities for constructing a road connecting European Corridor № 9 along the Haskovo-Kardzhali-Makaza-Alexandroupolis route and European Corridor № 4, entirely within southern Bulgaria, passing through the Rhodope, Pirin, Slavyanka, and Belasitsa mountains. This geo-economic corridor would be of significant importance for cities in Southern Bulgaria, including Petrich, Sandanski, Gotse Delev, Dospat, Rudozem, Madan, Smolyan, Ardino, and Kardzhali. Our objective is to assess the extent to which this transport corridor might enhance the regional development potential of this mountainous part of Bulgaria, which suffers from low levels of transport accessibility. It is essential to note that similar regions with comparable issues are prevalent in other Balkan countries.

This comparison will help determine the necessary experience and practices for implementing projects aimed at improving the regional economy. Additionally, there is a notable lack of research on regions facing similar challenges, particularly regarding the impact of constructing transport connections on their economic development. Moreover, rail transport in these regions remains inaccessible. This is evident in the section between Sandanski and Kardzhali, where there are no railway lines or first-class roads. The analysis indicates that there are no alternative connections with larger interior cities such as Pazardzhik, Krichim, Asenovgrad, Plovdiv, and Sofia.

The peripheral location of towns in south Bulgaria (Petrich, Sandanski, Gotse Delchev, Dospat, Rudozem, Madan, Smolyan, Ardino, and Kardzhali) has their potential for regional development. Still, those towns suffer from low levels of transport accessibility. In this part of the country, there are no railway lines and no first-class roads. The analysis shows that there are also no alternative connections to the larger cities located in the central part of the country (Pazardzhik, Krichim, Asenovgrad, Plovdiv, and Sofia). Additionally, these towns continue to experience depopulation, leading to a decline in their population. Therefore, the construction of an expressway in the southern region of Bulgaria (between the towns of Petrich, Sandanski, Gotse Delchev, Dospat, Smolyan, and Kardzhali) will not only improve transportation connectivity but also encourage economic activity. The existence of an expressway will also have a positive demographic impact. The development of the transport system and the construction of new routes to the larger towns bordering the main border areas, such as the administrative districts of Blagoevgrad, Smolyan, and Kardzhali, will create conditions for an inflow of new investments. This means that this region can enhance its socio-economic development and play a more significant role in the national economy by building road connectivity and establishing common markets. The expected result would be an enhanced regional and economic development. The construction of an expressway in the southern region of Bulgaria (between the cities of Petrich, Sandanski, Gotse Delchev, Dospat, Smolyan, and Kardzhali) would have a positive demographic effect, as the region has the potential to accommodate nearly 500,000 people. In comparison, it is now inhabited by no more than 220,000 people. Additionally, the region has untapped tourism potential, as well as opportunities for the development of alternative agriculture and animal husbandry, making it a territory with considerable growth potential. Further development of the transport system and the construction of new routes to larger cities, particularly those bordering the central border regions, such as the administrative districts of Blagoevgrad, Smolyan, and Kardzhali, will create conditions for the influx of new investments. This means that this region can enhance its socio-economic development and play a more significant role in the national economy by building connectivity and fostering common markets. This leads to regional and economic development. Secondly, this region is both mountainous and a cross-border area, and it is, therefore, subject to specific regional policy instruments. This means that the municipalities in the region have their own demographic and economic deficits. It is essential to note that, in terms of economic development, Bulgarian municipalities and regions can be broadly categorized into three main groups: economically developed (central locations), depressed, and peripheral (backward) regions. In terms of altitude, we divide the territorial units into plain areas (fields, maritime, and Danube), semi-mountainous areas (basin and back Balkan, pre-Balkan), and mountainous areas (low-mountain and high-mountain). While examining the individual territories against socio-economic indicators, it is obvious that the mountainous regions are in a significantly depressed or economically underdeveloped condition. In practice, it is evident that these peripheral and underdeveloped territories need targeted regional development policies.

The analysis of statistical data reveals that the peripheral and mountainous territories in the southern mountainous parts of Bulgaria, specifically those covering the districts of Blagoevgrad, Smolyan, and Kardzhali, are experiencing economic decline, demographic depopulation, and regression in spatial and urban development. This logically leads to the opening of financial gaps [1]. These processes are creating conditions that are exacerbating regional and territorial inequalities considerably. The observed disparities are confirmed by several analyses conducted by Bulgarian experts [2]. The imbalances that have accumulated in Bulgaria's regional development are not unique to the years of transition, although they have been exacerbated significantly over the last three decades.

These regional problems stem from long-standing accumulations, unbalanced growth of demographic and economic potential, and inadequate infrastructure in various parts of a given territory [3]. It is essential to recognize that the challenges of regional development are closely tied to the accessibility and connectivity of the territories under consideration. In other words, there is a direct correlation between the implementation of an effective regional policy and the improvement of connectivity in the context of increased mobility. Therefore, the regional policy should be supported by building transport infrastructure with a higher density of the transport network, as well as by constructing alternative access roads to the municipalities that are part of the studied spatial area.

2. LITERATURE REVIEW

The central thesis of the authors is that the region of Southern Bulgaria, due to its location and geographical specifics as a mountainous region, is difficult to access and lacks good transport connectivity between the municipalities in the three districts of Southern Bulgaria, through which the future expressway will pass. The construction of the expressway in this region will overcome geographical barriers to transport connectivity and create conditions for regional economic and territorial development. The region under consideration is characterized by significant strategic importance due to its unique status as a cross-border region, providing connectivity with Greece, Turkey, and the Mediterranean. At the same time, this region is characterized by its mountainous terrain. Therefore, for the needs of the study, it is necessary to define basic concepts such as cross-border and mountainous regions. In practice, there is no uniform definition of a mountainous region in Europe [4]. The analysis of existing definitions reveals that each country employs a distinct methodological approach to mountain areas [5]. According to some authors, mountain areas should be perceived in terms of their geographical, economic, and social criteria [6] while other authors argue that the leading criteria are physico-geographical [7, 8]. According to the third group of experts, the leading criterion is the population. That is, mountainous areas are those where more than 50% of the population resides [9]. At the same time, as it has become clear, Southern Bulgaria can be perceived as a border region or part of a cross-border region. The definitions associated with this concept have been interpreted through the lens of politics, regional geography, geopolitics, and others. All definitions point to the proximity of this region to the border and another region that is part of a neighboring country [9]. In developing and analyzing the new Southern Expressway, the authors apply the principles of strategic planning, viewed through the lens of the concept of endogenous growth [10, 11]. The authors believe that by building strategic road infrastructure, the conditions for regional development will be improved. Endogenous growth relies mainly on the internal or local resources of the region [12]. In this case, the authors suggest stimulating regional businesses by increasing infrastructure coverage and thus improving accessibility. The relationship between the development of road networks and economic growth (i.e., economic and regional development) has been the focus of extensive research in the economic literature for various economies and regions. The analyses of researchers on this issue show that road infrastructure plays a crucial role in promoting and stimulating economic development [13, 14]. The analysis of the literature reveals several aspects of this relationship that have been explored [15]. In their studies, the authors assess the extent to which the construction of the expressway will create conditions for increased factor mobility, economic linkages, freight, and trade, thereby stimulating regional economic development [16, 17]. Of course, the state plays a vital role in this process through regional policy implementation, and municipalities play a crucial role in constructing a utility system to retain the workforce [18].

3. RESEARCH FRAMEWORK

The focus of our study encompasses parts of the districts in southern Bulgaria (Blagoevgrad, Smolyan, and Kardzhali), through which the expressway (road) from Petrich to Gotse Delchev, Dospat, Smolyan, and Kardzhali is planned to pass. Forty-one municipalities of the three mentioned districts are located in the examined area.

For the research, the authors employ methods such as regional analysis and synthesis, as well as synchronous and asynchronous analysis, chronological and spatial development, among others. A range of documentary research methods (including analysis of legal acts and strategic documents), statistical analyses, transport accessibility modeling, and cartographic methods were used to produce the spatial analysis. Particular attention was paid to research methods of comparative analysis, the demand method, and the application of the scenario method.

The study aims to analyze and evaluate the effects of constructing an expressway that passes through southern Bulgaria, and to assess the extent to which the region's economic development will be stimulated as a result of the new transport connectivity. The central thesis of the authors is that the construction of the Southern Rhodope expressway will significantly improve the accessibility and connectivity of the region (the three NUTS III level districts through which it passes), and thus create conditions for increasing the gross domestic product and regional development of the municipalities in Southern Bulgaria.

The authors' main idea is to assess the potential impact of constructing a southern expressway through the Rhodope, Rila, and Pirin mountain ranges, which are located in southern Bulgaria. The expressway passes through three NUTS III regions. To evaluate the potential effects of the expressway construction, the authors combine economic, socio-economic, and regional statistical data analysis. The leading indicators analyzed are population in the three regions, length of the road network, domestic freight transport with the final destination being the three regions, proximity to a major administrative center, and increased accessibility in the three areas based on improved connectivity and reduced time between different municipalities and major administrative centers in the three regions.

The study's second phase involves calculating the density of the road network in the three areas before and after the construction of the speed road. The following formula is used to calculate the road network density:

$$\text{Road Network Density} = \frac{\text{Total road length (km)}}{\text{Area (sq. km)}}$$

At the final stage of the study, the authors analyze the correlation between road network density and gross domestic product per capita (GDP per capita). In this stage, the authors apply correlation analysis [19].

4. ANALYSIS OF THE RESEARCH RESULTS

4.1. Territorial and Regional Characteristics of the Region

In Bulgaria, there is a lack of planning and coherence regarding investments in transport infrastructure in the country's mountainous regions. Therefore, developing a sound strategic framework in the transport sector and implementing corresponding projects are necessary for effectively implementing quality regional policies. These policies aim to respond adequately and efficiently to the needs of the population and regional businesses in municipalities with predominantly mountainous territories [20]. Sectoral strategic approaches reflect European thinking to establish different levels of importance within transport networks, and they are particularly relevant for the mountainous areas of the regions of Kardzhali, Smolyan, Plovdiv, Pazardzhik, and Blagoevgrad [21]. A retrospective analysis reveals that, at various times, efforts have been made to address regional disparities through targeted regional policies. However, no sustainable, successful model for developing these territories has yet been found. The analysis reveals that while roads are being built, railway construction projects are being frozen, helicopter air transport sites are being neglected, and no new alternative routes are being designed. The economic development of these territories is hindered because the infrastructure built between the 1960s and 1980s has deteriorated, and it is inadequate for the needs of businesses and people in the twenty-first century. For example, the attempted renaissance of mining, spas, logging, and other industries in this region requires additional transportation accessibility and connectivity. Difficult access hinders investors from developing their businesses in these regions. Moreover, the new economy entails the development of new industrial centers and the optimization of spatial planning to achieve a more effective regional development policy [22]. In this direction, the development of the

regions also requires the formation of sustainable regional markets, which create conditions for centrifugal growth, as well as the establishment of specific industries in individual municipalities of the mountainous regions.

The approach to guiding the strategy for developing mountain transport infrastructure should be adapted to the available European funding sources and their specific characteristics. This is the time for the state to step up its support for these areas by creating the conditions for preparing several projects to be financed by European funds; the current policy of waiting has proven ineffective. Other countries have oriented their transport infrastructure development policy towards the establishment of a set of very well-founded national priorities. The policy directs all available resources exclusively towards implementing these priorities and has produced national projects that are at the level of readiness for planning permission within a few years. In this way, the state is attempting to create the conditions for regional businesses to participate in the construction of several infrastructure projects, because they may not have the potential to manufacture and design them. This implies that the focus of programming should be prioritized towards mountain and frontier settlement systems of functional types IV and V [23]. This approach aims to maximize the capacity of the public sector and businesses to prepare a range of projects and activities to accelerate the socio-economic development of the regions. Regional multi-year investment strategies need to be developed to support these regional development policies. These regional development policies for mountain regions should be presented alongside the annual national reform programs as a means of identifying and coordinating priority investment projects to be supported by national or European Union (EU) funding, or both.

The Bulgarian settlements in the Rilo-Rodopa massif and the Sandanski-Petrich valley originated and developed in close connection with the geographical features, which also imposed certain restrictions on their development and expansion. The barriers to growth are due to the direct influence of altitude and the degree of topographic variation. Initially, the predominant activity of the population was agriculture. However, as social evolution progressed, activities in these regions became increasingly diversified. The range of economic activities expanded to include the extraction and processing of wood, coal extraction, and the mining of various ores of ferrous and non-ferrous metals, as well as non-metallic resources. This fact led to the development of a transport network in the mountainous area, spanning from the Rhodope and Pirin Mountains through the Belasitsa Mountains, which was implemented along hydrographic arteries, depression corridors, and other routes. In this direction, the peculiar parallel from the village of Parvomaj (within Petrich Municipality) to the town of Petrich, Gotse Delchev, Smolyan, and Kardzhali could create the necessary vector of sustainable regional connectivity, leading to more comprehensive regional development of these parts of the territory (Figure 1).

Figure 1. Location of Blagoevgrad, Smolyan, and Kardzhali districts, along with their spatial coordinates. Art. Ozone.bg.

It is essential to note that, due to global warming, populations must gradually shift their habitats to higher altitudes. This means that the areas mentioned are suitable for regional economic development, and efforts can be made to strengthen and invest in their development. In this direction, one of the key elements in developing a regional spatial development scenario is the functionality of the urban settlement network, which bridges the gap between settlements in the mountainous parts of Southern Bulgaria. The development trend of the settlement system at the regional level is influenced by several factors, among which the most important are: the configuration of the transport network (accessibility), the position of the cities in the urban hierarchy at the national and European levels (the response to the phenomenon of globalization, the ability to attract economic activities), and last but not least, the geographical features (the geographical potential of the territory), including the proximity to agglomeration areas (Figure 2) [8]. This implies building new expressways to meet the needs of road transport, and in the future, exploring opportunities to develop railways or cableways for transporting goods and services in these mountainous and plain regions.

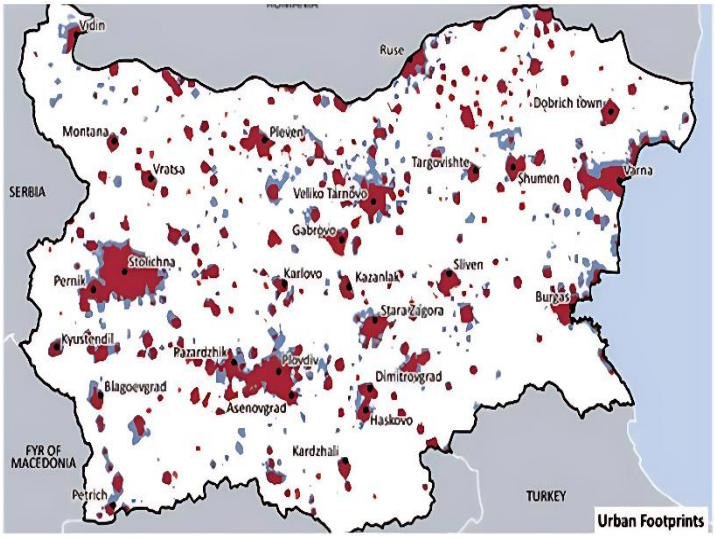

Figure 2. Agglomeration areas in Bulgaria. World Bank.
Note: Ex. National Centre for territorial development.

The development of transport infrastructure ensures sustainable economic development through investments made in this sector, acting as a driver for the development of other sectors of the national economy (Figure 3). Investments, innovative policies, and solutions will not add value without basic transport infrastructure. Infrastructure deficits at the national level are reflected in particular through reduced mobility, insufficient connectivity in certain regions, high transit traffic in numerous localities, and long waiting times at border crossings, among other issues. Despite efforts and recent progress, Bulgaria's transport infrastructure remains insufficient in terms of meeting development needs. Improving transport connectivity is influenced by infrastructure development, which is determined by regional planning and zoning of the Bulgarian state [23]. The new EU targets are not necessarily calibrated to the development needs of all EU Member States, given the identified disparities in west-east connectivity. Given the importance of infrastructure for Bulgaria's development, there is a need to coordinate national efforts for the period 2025-2045 to secure the financial resources to kick-start the investment targets needed to implement the two projects of European importance at the level of the TEN-T network that crosses the national territory, as well as national priorities regarding regional interconnection routes.

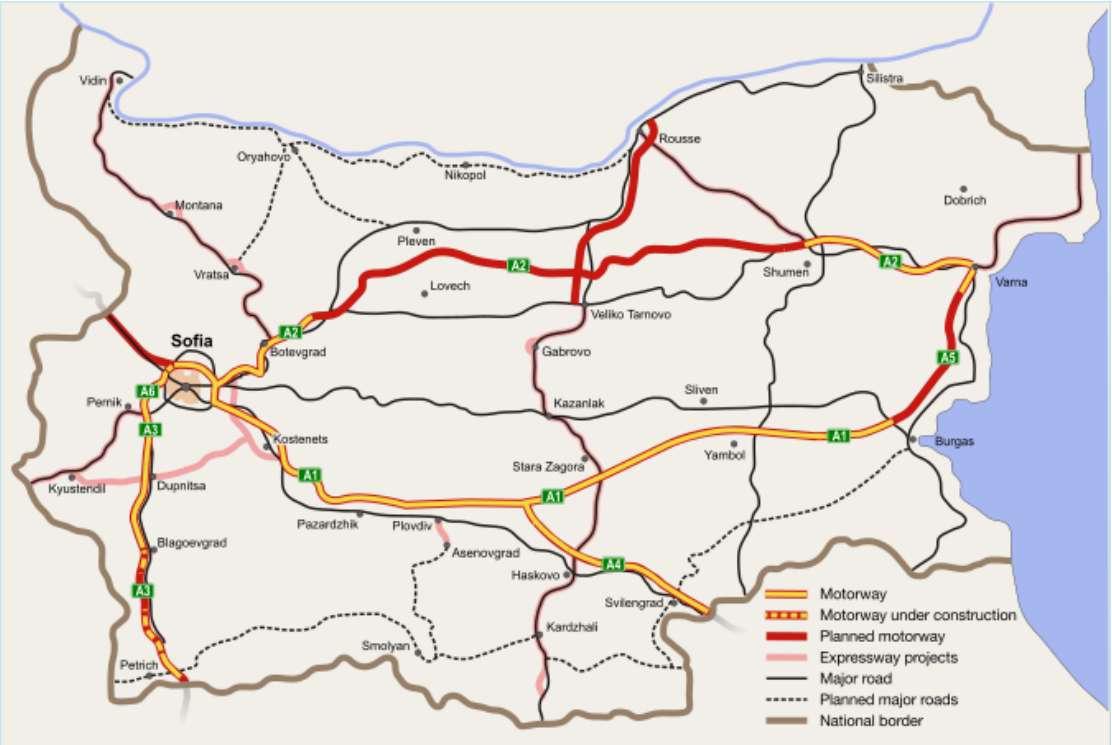

Figure 3. Spatial model for transport infrastructure. Ministry of Transport and Information Technology, Republic of Bulgaria.
Note: Ex. National Spatial Development Concept, 2013–2025.

The characteristics and configuration of the topography have a significant influence on Bulgarian regional development. In practice, the relief is an essential element influencing land, rail, and road transport networks, with areas in the mountains of the Rhodope massif being more isolated and lacking access to the rail transport network. The quality of municipal roads is fair or poor, especially in the Rhodope and Pirin mountains in the Blagoevgrad district. There is a lack of multimodal, road-rail, and bicycle centers for bicycle tourism, although some settlements are attempting to develop this type of tourism. Public transport is underdeveloped, with private transport being the predominant mode of transport, especially on road networks in and near urban areas. In towns and municipalities in the mountain region, there are no natural gas supply networks, and there are partially unelectrified areas where, as in the case of natural gas supply, the dispersion of towns and households in mountain towns causes very high specific initial investment costs. The mountainous areas in the Kardzhali, Smolyan, and Blagoevgrad regions are poorly covered by mobile phone signals and have poor internet quality. Labor resources in these three districts have been steadily declining over the past decade, primarily due to internal and external migration of the working-age population, as well as a healthy population, but also due to aging demographics. In recent years, the city of Blagoevgrad has established itself as a key economic center, but for several reasons, it has also experienced a significant slowdown in its development. This is mainly due to a lack of innovative development in all three districts, including science and technology transfer parks and other new industries.

The construction of an expressway in southern Bulgaria, starting from the village of Parvomay and passing through the towns of Petrich, Sandanski, Gotse Delchev, Smolyan, and finally to Kardzhali, or a total of 292 kilometers, will undoubtedly give a boost to the regional development of this part of the country. From a regionalist perspective, achieving this breakthrough will bring new efficiency to the transport system, leading to cost reductions for both industry and the general public. In terms of industry, this translates to lower costs, increased productivity, reduced resource requirements, more competitive products, and larger markets for these products. For transport operators, superior transport means lower costs and better use of vehicles and staff. For people, more efficient transportation means saving time, increasing job opportunities, and diversifying the supply of consumer goods and leisure options.

Transport infrastructure is a significant factor in the overall development of an area. In this context, the transport strand aims to develop the potential for economic growth in all areas of the urban regions mentioned, which require well-provided transport infrastructure [19].

The construction of the expressway will not only provide good transport connectivity to the three southern districts in Bulgaria, but also create conditions for better economic links between the municipalities it passes through. The three districts cover 525,746 people, or approximately 8.3% of the Bulgarian population (6,445,481) (Figure 4). The active part of the population in the three districts will increase their mobility, the geography of markets, and logistical links.

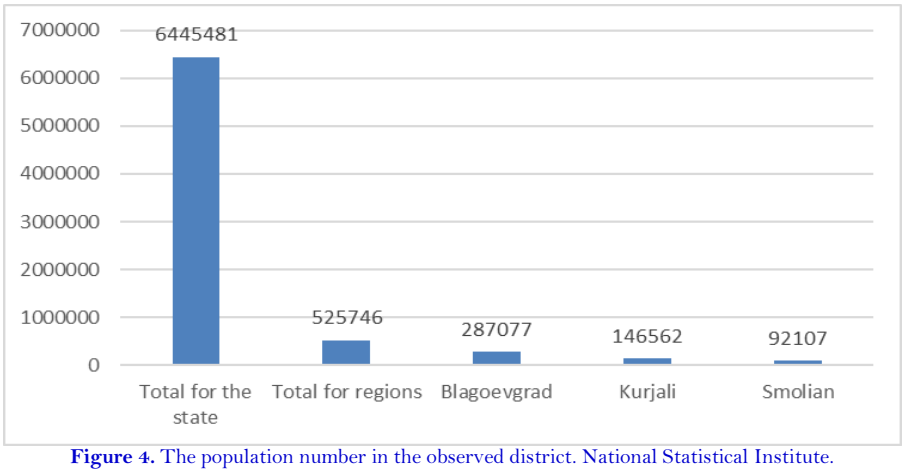

Figure 4. The population number in the observed district. National Statistical Institute.

There are 236,877 people registered in the municipalities through which the expressway passes (Figure 5). This is half of the population in the three districts considered. The construction of the new route will provide better accessibility to individual municipalities as well as to the main administrative and economic centers in Bulgaria, which are located parallel to the path. The largest cities in Bulgaria are Sofia, the regional town of Pazardzhik, the second-largest, Plovdiv, and another regional city in Central Bulgaria, Stara Zagora.

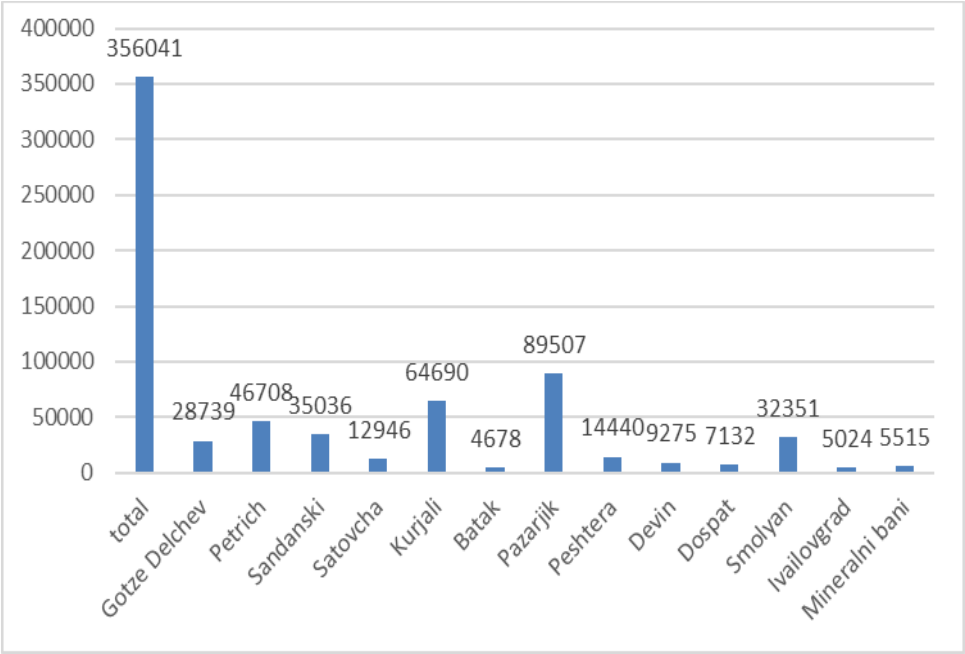

Figure 5. The population of the cities located on the new speed road. National Statistical Institute.

In Figure 6, the length of the road network in the three districts is plotted against the total length of the road network in the state. The total length is 19,668 km compared to 1,908 km for the three districts. With the new alignment construction, the length of the road network in the three districts will increase by 292 km.

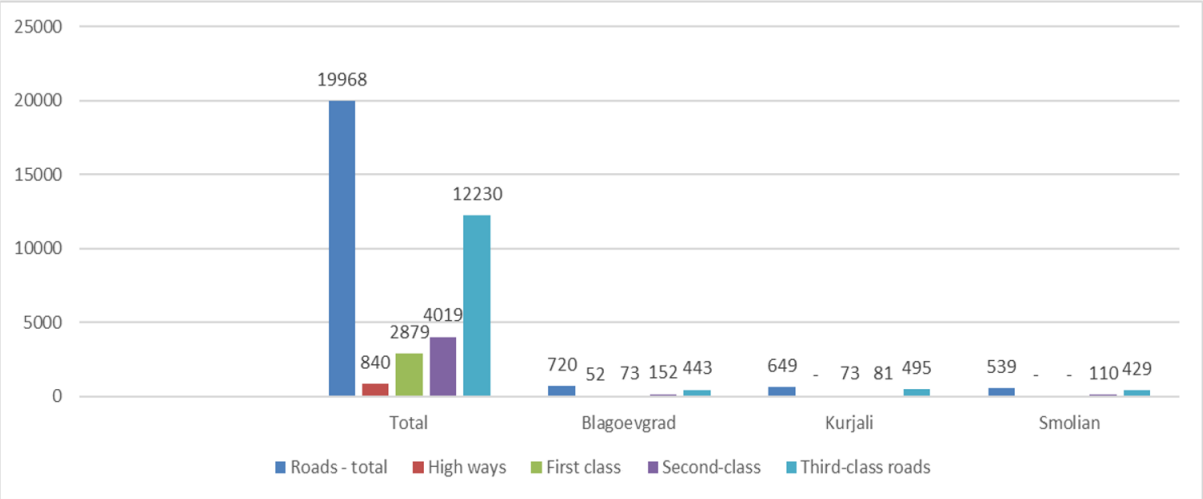

Figure 6. The road network in the observed districts through which the speed road crosses (in km). National Statistical Institute.

As illustrated in Figure 7, the domestic freight data is presented, with the final destination being the three counties and municipalities that the expressway passes through. It can be posited that the construction of the route will result in an augmentation of trade and transportation of goods between the municipalities, predicated on enhanced connectivity and accessibility.

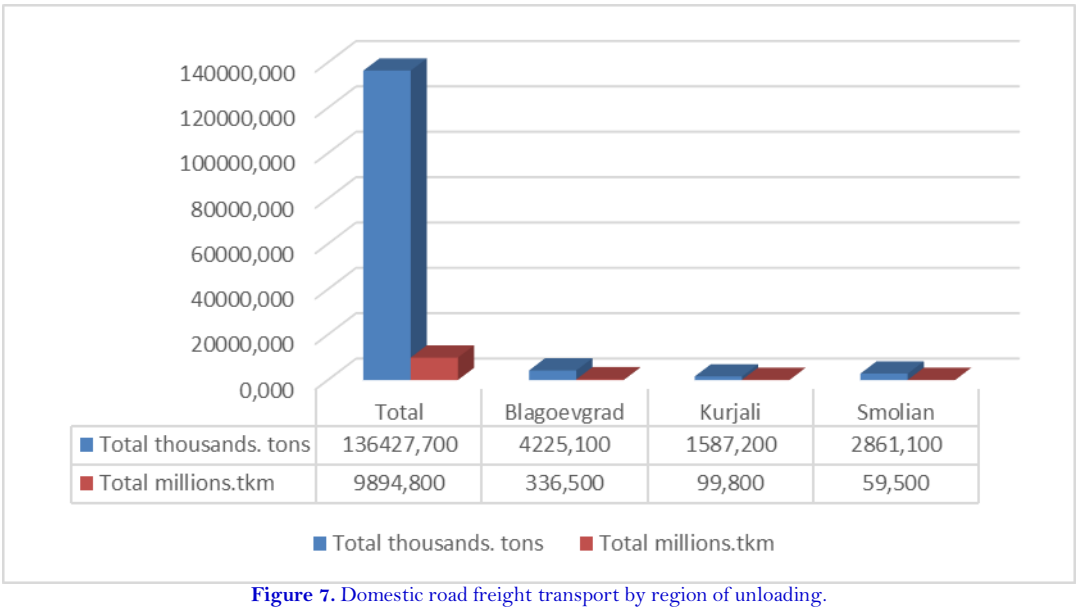

Figure 7. Domestic road freight transport by region of unloading.

4.2. Assessing the Effects of Building an Expressway

Tables 1 and 2 present the results of the national road network density calculations for all three districts, categorized by road infrastructure type. As indicated in the methodology section, density is calculated by dividing the length of the road network by the area of the district. As can be seen, the density of the road network is increasing, indicating improved connectivity and accessibility. These conditions create opportunities for regional development in the areas through which the new expressway passes.

Table 1. The density of roads by categories and districts of the Republic of Bulgaria. Authors' calculation.

Region, NUTS 3	Density of times- states, total	The density of roads in the state, including highways	Density of times- states, Class 1	Density of times- states, Class 2	Density of times- states, Class 3
Blagoevgrad	1.116	0.081	0.122	0.235	1.542
Kardzhali	2.018	0	0.246	0.252	0.163
Smolyan	1.688	0	0	0.344	1.343

Table 2. Road density by category and region of the Republic of Bulgaria after the construction of the new route in Southern Bulgaria. Authors' calculation.

Region, NUTS 3	Density of times- states, total	The density of roads in the state, including highways	Density of times- states, Class 1	Density of times- states, Class 2	Density of times- states, Class 3
Blagoevgrad	1.310	0.551	0.024	0.050	0.146
Kardzhali	3.400	0.162	0.024	0.028	0.163
Smolyan	2.048	0.360	0	0.036	0.141

In Figures 8 and 9, the authors analyze the correlation between road network density and per capita GDP inflows in the district. In the first figure, a moderate correlation is observed between the two indicators. With the construction of the new expressway, it can be assumed that this correlation will strengthen. Infrastructure provision is expected to increase, which will have a positive impact on the regional economic development of Southern Bulgaria, particularly in the three districts under consideration.

The construction of the route from Petrich to Gotse Delchev, Smolyan, and Kardzhali is a crucial step in defining an investment transport program for the development of mountain regions, given the situation in which the identified necessary investments underscore the need for the implementation of this project. It is, therefore, essential to prioritize the projects according to a set of predefined evaluation criteria, which ensures a fair and neutral prioritization process developed on an independent scientific basis. Adding funding constraints to the list of prioritized projects will drive the implementation strategy. In this direction, it is evident from Figure 8 that there is a correlation between road network density and GDP, which shows the current state of increase in the benefits of the road transport network concerning increased traffic flows, safety, and accessibility to the primary road network. A set of measures and a series of interventions with immediate results have been proposed, in line with best practice examples from other countries in the European Union.

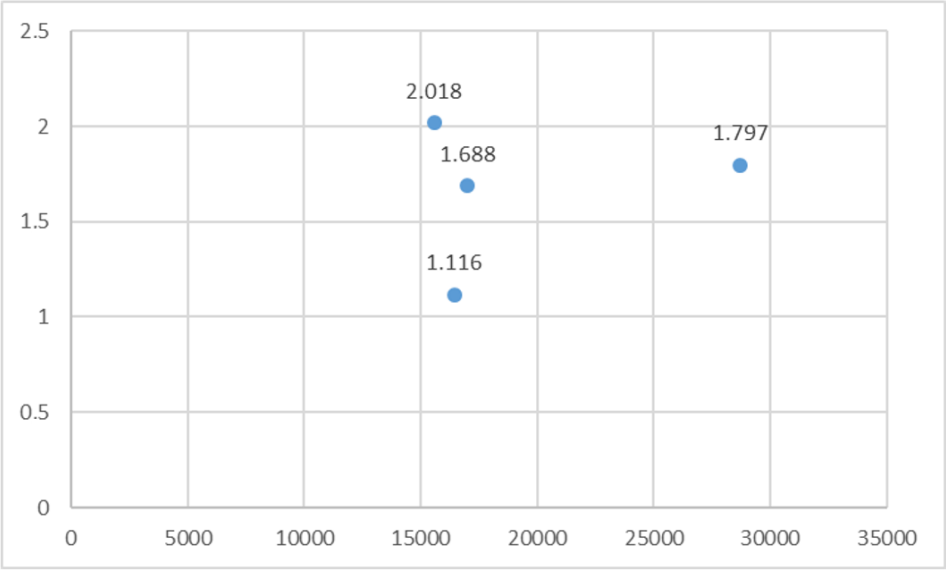

Figure 8. Correlation of road network density to GDP per capita before expressway construction.

It is essential to recognize that the state of the regional economy is influenced by the road network, which must

be achieved through integrated and unified development between the economy and transportation. This approach is analogous to the methodology used to determine transportation networks and the location of economically active entities. The development of expressway networks aims to concentrate investment and interventions for so-called corridor closures, leading to targeted investments intended to achieve local economic development. We can conclude that upgrading the primary road network or constructing new roads creates conditions for sustainable economic growth, based on the permanent mobility provided by road transport in mountainous areas. It is worth noting that external funds from the European Union currently represent the primary funding source for significant infrastructure projects in Bulgaria. This imbalance is primarily due to the insufficient funding of infrastructure investments from the state budget, as well as the favorable co-financing rate for projects funded by external non-reimbursable funds, which makes it challenging to implement such projects despite their proven effectiveness. Data indicate that, compared to other regions, the road infrastructure is not at a satisfactory level. Nonetheless, it is generally recognized that significant investments are needed in the construction of new first-class and highway roads in the country to improve the state of the regional economy [19].

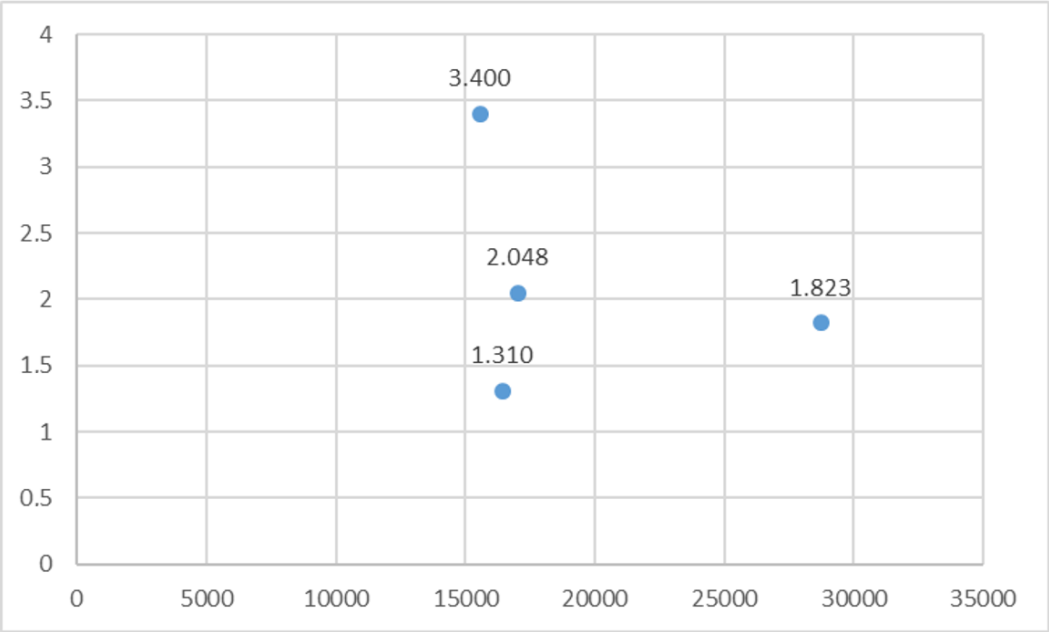

Figure 9. Correlation of road network density versus GDP per capita after new road construction.

Figure 9 shows that all three districts, Blagoevgrad, Smolyan, and Kardzhali, have deficits in their road networks, indicating a need for closer integration with the national road network. It is evident that this directly correlates with the level of GDP per region. Where we have a more developed road network, we also tend to have a higher GDP per capita. We can summarize that the development of transport infrastructure ensures sustainable economic growth through investment, acting as a driver for the development of other sectors of the national and regional economy. Investment in human settlements will not have added value without the availability of quality transport infrastructure. Infrastructure deficits at the regional level are reflected in particular by reduced mobility, insufficient connectivity in certain regions, high transit traffic in many locations, and long waiting times at logistics points.

5. CONCLUSION

The analysis of connectivity corridors at the regional level between the districts of Blagoevgrad, Smolyan, and Kardzhali in southern Bulgaria is a crucial step in identifying and justifying interventions and projects for the road sector. To develop an economically sustainable and highly efficient road network, both at the national and regional levels, analyzing this connectivity route proves necessary. It presents an opportunity to build new and complementary

infrastructure. The creation of internal connectivity corridors ensures the connection between these areas and the rest of Bulgaria (including considering the area as a border and part of a large cross-border region), but also access to routes that connect the poles of economic growth of Bulgaria and industrial centers (existing or potential). Particular attention is given in the analysis of the routes in Southern Bulgaria along the Petrich-Gotse Delchev-Smolyan-Kardzhali route to their connection to the national and regional economy, as well as to transport corridors in neighboring countries. In addition to these measures, we note that all investments in road infrastructure will comply with TEN-T standards and will incorporate, from the design phase, the requirements of the EIA (environmental impact assessment) and those regarding appropriate environmental assessment (part of the Habitats Directive - Council Directive 92/43 EEC on the conservation of natural habitats and of wild fauna and flora, adopted on 21 May 1992), as well as the new technical provisions necessary to limit pollution in the transport sector.

Within the framework of the study, the authors demonstrate the connection between the development of the road network in Bulgaria, particularly in the southern part of the country, and regional economic development. Infrastructure has a significant impact on improving the connectivity and accessibility of Bulgaria's mountainous areas, thereby stimulating regional development. On the other hand, the authors employ an interdisciplinary approach in assessing and analyzing the impact of road infrastructure on the development of mountain areas in Bulgaria.

In the current and medium-term development stage of Bulgaria, it is necessary to construct such expressways to support regional economic development. Therefore, at the district and municipal levels, it is required to review and establish standards for the design of new and first-class road networks, as well as the related functional connections with different regions and nearby areas. Design processes need to be more flexible to reduce investment costs associated with projects and to adapt standards to current technological realities. This approach of creating a network of expressways in mountainous areas implies a new development approach. This can be taken as a structural approach that includes fundamental quantitative and qualitative socio-economic and cultural values, details of population evolution, indicators of social and technical infrastructure, as well as the housing situation, the economy, the labor market, education, trade, industry, tourism, sport, administration, land use in each area of the city and the city as a whole, and the environmental situation. These facts also serve as a starting point for developing sectoral and transport concepts and visions to improve the transport system in the semi-mountainous and mountainous areas of the Republic of Bulgaria.

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