

Article

Technical Infrastructure as an Element of Sustainable Development of Rural Regions in Małopolskie Voivodeship in Poland and Trnava Region in Slovakia

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Abstract: The work discusses issues of the infrastructure, its instruments, and specifics of infrastructure in Polish and Slovak rural areas. The aim of this article is to analyze the level of technical infrastructure development in rural regions of the Małopolskie Voivodeship in Poland and the west part of Slovakia—Trnava self-governing region (Trnava region) as two regions with a similar position regarding regional competitiveness index. Following the topic, after identification of strengths and weaknesses of mentioned regions, the opportunities, and threats of sustainable development of infrastructure in rural areas have been analyzed using the SWOT method. The development of sustainable, reliable, and functional infrastructure does not only refer to the chosen regions of Poland and Slovakia but also other regions in the European Union. Sustainable infrastructure is a factor stimulating social and economic progress as one of the most important determinants of sustainable development and regional competitiveness. The authors notice a particular lack in the sustainable development of infrastructure in the field of water and sewerage management together with the supply of water. Therefore, this article tries to complete the gap in research focusing on the concept of a more systematic approach to technical infrastructure improvement in the context of sustainable development, and strategy of cooperation.

Keywords: rural development; local development; infrastructure; sustainable development goals; regions



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1. Introduction

Sustainable development is an essential element of building a coherent future that will be resistant to the risks and challenges. The term “sustainability” is used in a very broad sense as the overall strategic aspiration, common purpose, or mission [1,2]. The official definition in the 1987 Brundtland Commission Report, ‘Our Common Future’ states: Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs [3]. To be able to reach sustainable development goals, it is necessary to integrate three elements: economic growth, social inclusion, and environmental protection. All these elements are interconnected and are essential to achieve the prosperity of the whole society. These elements are vital from the point of view of inhabitants of the studied areas. Improvement of the quality of life through the development of technical infrastructure cannot be linked with the loss of profits for future generations.

Acceptance of policies will increase the number of productive capacities, productivity, and productive employment; financial inclusion; sustainable agriculture, pastoralist,

and fisheries development; sustainable industrial development; universal access to affordable, reliable, sustainable, and modern energy services; sustainable transport systems; and quality and resilient infrastructure [4].

The number of sustainability definitions and connected terms continues to increase along with the rapid increase in awareness of the importance of sustainability [5,6]. The development of infrastructure is defined as one of the sustainable development goals in the 2030 Agenda for Sustainable Development [4], which enhances the importance of the balance between new investments in infrastructure and sustainable development. Sustainable development, following the Sustainable Development Goals (SDGs) framework, ought to be considered as the main reference to means to achieve this strategic mission. It is a clear global mandate for greater integrated policymaking [7].

The new model of qualities of sustainable infrastructure consistent with the SDGs, oriented towards meeting the needs of “people-first” and defined by the World Economic Forum in June 2020, has five desirable outcomes: access, resilience, effectiveness, replicability, and engagement [8].

It is essential to understand the goals of sustainable development as a collective global strategy for development are not only global but must be taken especially on a regional level. It is the regions that are understood as an important element in the ecosystem of change. Regions of sustainable development and rural areas are considered especially as a spatial diversity, which can either take the direction towards the diversity or towards various levels of development. It is assumed that the direction towards various levels of development has got a multifunctional and multisectoral character, whereas the direction towards diversity results from different development factors. The basic motivation for this study was to recognize the need to find an effective solution for a more sustainable and efficient regional development considering the improvement of infrastructure.

Factors causing failure regarding infrastructure development, and environmental protection are as follows [9–12]: violation of the perfect competition conditions by monopolies, the limitations in improving public goods, existence of incomplete and imperfect information, existence of uncertainty and risk in economic decisions, the existence of external effects, insufficiencies resulting from individual and collective property right. Due to societal and technological changes, these should be the changes in activities regarding the environment [13–15].

The municipalities (communes) which implement the policy of regional development try to make use of their diverse features, resources, and predispositions as the factors of economic growth and improvement of competitiveness. To achieve it, different types of instruments are used which can be divided into four elementary groups according to the classification applied in the European Union: programming regional development, financial instruments, development of technical infrastructure, immaterial ways of supporting regional development [16].

Balážová, Papcunová and Jarábková [17] state that in each region it is possible to find a unique combination of factors for its differentiated development.

Economic success in today’s Europe often depends on the region’s ability to develop cooperation with other regions. The European Union began to implement cohesion policy, based on the principle of helping less developed countries and their regions through financial assistance, to result in the convergence and levelling of regional disparities on an equal footing [18]. Cohesion policy is influenced by existing basic development trends, especially accelerating structural changes in national economies (also conditioned by globalization, economic and institutional integration), the growing importance of mobilizing internal resources of the economic economy, changes in regional policy but also changes in public administration.

Although most of these investments are motivated by the desire to increase economic productivity and employment, they have an impact on the sustainability of the regions and environment.

Investments in infrastructure either directly or indirectly influence the attainment of all of the Sustainable Development Goals (SDGs), including 72% of the defined targets [19].

Cooperation and exchange of experiences between regions can be a key trigger in stimulating a dynamic and promising process of regional development [20,21]. The international co-operation of regions with a similar profile especially in areas with rural regions, (similar strengths and weaknesses) for sharing their experiences and knowledge can play an important role to address the regional differences and to raise their competitiveness. A synergistic effect can be achieved by cooperation on analysis and creation of solutions for rural areas. In particular, it is an attractive strategy of cooperation for neighbouring countries with a similar history, geography and social ties of the population. The importance of research into competitiveness and the importance of rural areas are also confirmed [22].

The aim of this article is to analyze the level of technical infrastructure development in rural regions/municipalities of the Małopolskie Voivodeship in Poland and the Trnava region in Slovakia in the context of sustainable development. Both mentioned countries and regions can be defined as rural according to the Eurostat methodology defining a rural region as an administrative unit structured according to the level of rurality by the rate of the number of people living in rural villages and the total number of inhabitants in the region.

The above-mentioned regions were selected for further analysis based on detailed knowledge and personal experience of the authors and because of their similarity, which was found objectively identified by analyzing the competitiveness of regions by the regional competitiveness index.

First, a systematic review of the literature has been introduced to generate a conceptual framework to identify a gap in research (with focus on open access articles in WOS by searching for topics sustainable development goals SDGs, infrastructure, technical infrastructure, and sustainable, regional/rural). Then the following methods were applied: description, analogy, deduction, induction, statistical data analysis, presentation, and conducting results. Subsequently, the strengths and weaknesses of the rural areas in the Malopolska region and the Trnava region were identified, and threats and opportunities for future sustainable development were discussed. By comparing the current regional competitiveness of the given regions, their similarities, the possibilities of cooperation were discussed, as well as future challenges and the need for regional cooperation. The discussion considers future research ideas concerning the economic and social importance of the technical infrastructure of the regions.

2. Materials and Methods

The scope and content of the analysis have been defined considering the goals of sustainable development, including the selection of regions according to their similarities, to identify their development potential.

First, a systematic review of the literature has been carried out by searching for topics and terms related to the research problem (infrastructure, its division, technical infrastructure, sustainable, region, rural).

The aim of the theoretical analysis is to identify current trends and identify a gap in research. The search is focused on scientific articles and articles published in the Web of Science (WOS) database. Within search focused on the term “infrastructure” are found 251,156 articles in journals, proceedings, and chapters, while reviews are excluded from the search. Regarding the focus on current trends, the search was limited to the period of the last 10 years (2010–2020). During this period 187,948 contributions were found. To find the most relevant sources, the search process was narrowed by the term “technical infrastructure” to 9803 articles. and by a combination of the terms “technical infrastructure” and “sustainable”, to 995 results, including 368 papers with open access. Our most relevant selection is the combination of the terms “technical infrastructure” + “sustainable” + “region” or “rural” with 201 results, including 73 articles with open access.

Considering the countries (regions) of a before-mentioned selection of papers, it has been found that only 4 articles out of 73 are from Poland and none of them from Slovakia. This finding also indicates a need to focus on the technical infrastructure of the regions in Slovakia and Poland in the context of sustainable development, as a new promising future scope.

Second, data from Eurostat measuring 70 indicators of regional competitiveness from the year 2019 were used for comparing the indices of regional development in a European context and then a radar diagram is applied for visualizing the partial findings. The article deals with two selected regions in Poland and Slovakia with equal competitive positions and many similarities: the Małopolska region and the Trnava region.

Third, using a systematic approach for analysis of strengths, weaknesses, opportunities, and threats (SWOT analysis) based on the strategic documents of national and regional level the strengths and weaknesses, threats, and opportunities in the above-mentioned regions were identified. Application of descriptive statistics (measures of central tendency, absolute frequency, relative frequency, sums) identifies a level of technical infrastructure in the Małopolska region and the Trnava region. The visualization of data bar charts, radar graph are used.

This article seeks to provide added value in the identification and development of measures for these regions that are below the European average. Besides, some of the findings can be used for the European Union funding and projects in line with the European Union's commitment to strengthening the unity of economies and ensuring harmonious development by reducing disparities between different regions and the backwardness of disadvantaged regions [23].

Małopolskie Voivodeship and Trnava Region

This part deals with the similarities between selected regions in terms of the main factors of competitiveness over the last ten years. The selected factors are applied to all regions at the level of the Nomenclature of Territorial Units for Statistics II (NUTS II) throughout the European Union. Data are obtained from Eurostat. This analysis is based on data on NUTS II regions for the last 10 years (2010–2020), while selected regions in Poland and Slovakia have common features such as being predominantly rural and have a similar level of indicators of regional competitiveness. The Regional Competitiveness Index (RCI), measuring using more than 70 comparable indicators the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work, has been used for conducting the level of regional competitiveness of the regions in Poland and Slovakia in comparison with the European Union average of 2019. RCI indicates sustainable strategic advantage [24]. Based on analysis of regions in Poland and Slovakia the similarity of two regions Małopolskie Voivodeship and West Slovakia has been detected as follows: RCI for the year 2019 is 46 (European average is 60); the value for infrastructure is 23 whereby European average value is 50.

A radar map of regional competitiveness determines that both above-mentioned regions, Małopolskie Voivodeship (green color) and West Slovakia -Trnava region (red color), have similar areas for improvement as follows: the lack of innovation, less market support, and slight institution's stability and accountability, insufficient technical readiness, and insufficient infrastructure (Figure 1).

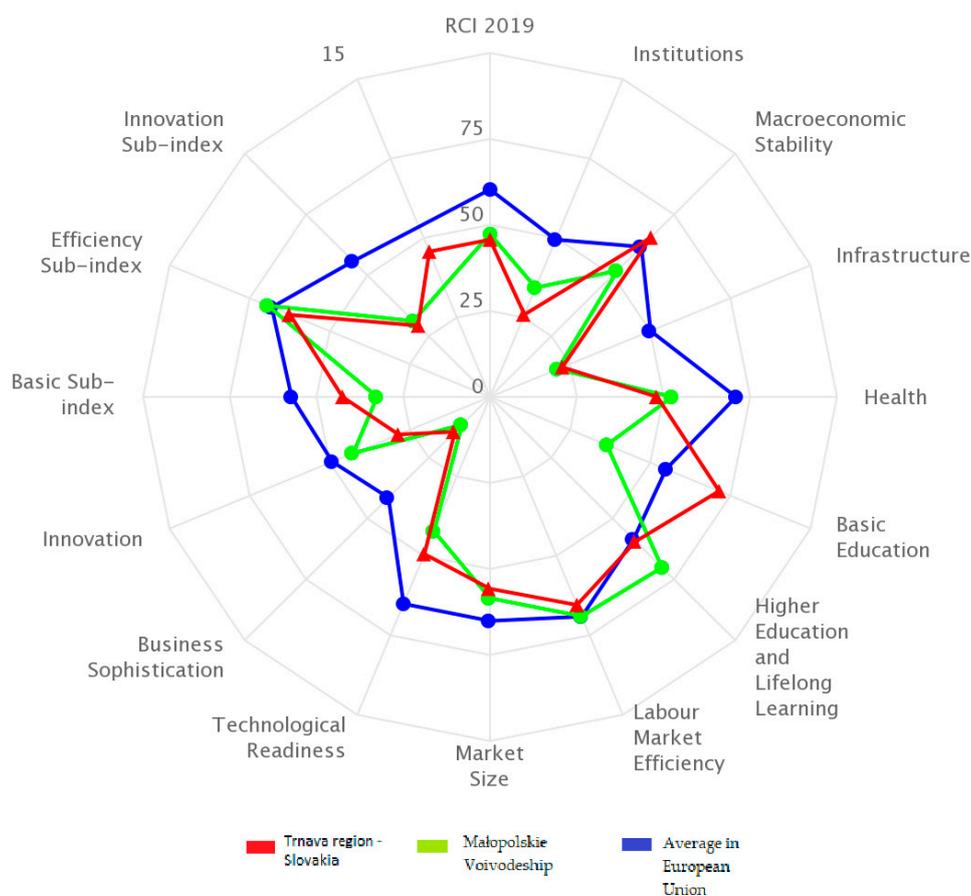


Figure 1. The comparison of the indicators of regional competitiveness index for Małopolska and the Trnava regions with the average in the European Union based on data from [24].

Challenges connected with infrastructure development are presented in the next part of the article with the focus on technical infrastructure in rural communes of the Małopolskie Voivodeship and Trnava region. The presented challenges are analyzed.

It is important to mention that a municipality (commune), as an essential part of the local government in Poland, is discussed in the first part of the paper. For this paper was categorized that the Małopolskie Voivodeship is a region. The Małopolska Region is very diverse in rural areas. There are both industrial areas, focused mainly on the mining industry (in the west) and areas with great natural values (for instance, the Tatra National Park), which are used for the rural tourism development (in the south). It is the region where the rural areas, in comparison with other regions of Poland and the EU, obtain a lot of financial resources for the development of rural areas and entities situated there. The level of infrastructure in this voivodeship (Polish term for this region), in comparison with other regions of Poland and Europe, is above the average. However, a part of the municipalities has an insufficiently developed infrastructure network and do not use the resources for this purpose efficiently (for example, the level of maximum indebtedness for local government units is a limitation for obtaining state or EU resources).

The territory in Slovakia, chosen for the identification of the potential and the comparison of the situation, is west Slovakia, more precisely Trnava Self-Governing Region, with an area of 4148 km². This region has 551,441 inhabitants, consists of cadastral areas of towns and villages of today's districts Skalica, Senica, Piešťany, Hlohovec, Trnava, Galanta and Dunajská Streda. This self-governing region is in the southwestern part of Slovakia. The area consists mainly of parts of the Záhorská lowland, the Little Carpathians, the Trnava Uplands, and the Danubian Lowland. The level of infrastructure in this region is significantly above the average compared to other regions of Slovakia. Nevertheless,

some municipalities have an insufficiently developed infrastructure network and do not use available resources intended for this purpose, similarly to Małopolska Region. The almost exclusive orientation of the industry towards car production is significant, which affects all other areas of the population's life e.g., fewer investments in agriculture, most people are employed in the industry [25]. However, the level of infrastructure, in these regions in comparison with other regions of Poland or Slovakia is above the average in the mentioned countries.

Despite the importance of the sustainable development goals focused on the infrastructure of rural areas, this topic has been studied and described to a very limited extent in the literature concerning this subject (case studies most often refer to single municipalities/communes) or several publications in the scope of the infrastructural gap [26,27].

3. Region as a Basic Local Government Unit in Poland and Slovakia

First, the region and regional government will be discussed in Poland and Slovakia, then strengths and weaknesses focused on the geographical, natural division, demographic development, and the general economic state and characteristics of the region will be analyzed.

3.1. Region as a Basic Local Government Unit in Poland

A region is a basic local government unit in Poland. The most important entities of the local authority in Poland are local communities living in the areas which create local self-government associations. The basic administrative unit in Poland is a commune (gmina), group of communes form a district (powiat), and a group of districts—a voivodship (województwo). This decides on belonging to a local group, which gathers inhabitants of a given local government unit. The main objective of creating a local government in Poland, apart from managing public administration [27], was an opportunity for inhabitants to decide on settling cases and problems [28]. By this organization, inhabitants refer their cases and ideas directly to competent representatives, give suggestions for solutions, which simplifies and speeds up the whole process. The achievement of this objective requires full self-reliance and independence of self-governmental bodies [29].

The Constitution of the Republic of Poland and the European Charter of Local Self-Government should be considered as the basic legal acts regulating the functioning of local self-government. Other essential legal acts defining the scope of functioning local self-government in Poland are especially the act of 17 March 2016 on commune self-government, the act of 19 May 2016 on a poviats self-government, the act of 1 April 2016 on voivodeship self-government, the act of 13 November 2003 on incomes of local government units [30,31,31–34].

The new administrative division was introduced in Poland on 1 January 1999. Then the two-level administrative division having been in force since 1975 was substituted with the three-level division, which consists of voivodeships, poviats, and communes. The territory of a poviats includes several communes, and the area of a voivodeship consists of several poviats. It is essential that there are no dependencies between the levels of self-government authorities.

The changes of borders of the local government units in Poland are made under the regulation of the Council of Ministers. The local government units have a right of association and a right to join international and regional associations of local communities as well as they may initiate cooperation with local and regional societies from other countries.

The elementary local government unit in Poland is a commune, which performs all the tasks of local self-government unreserved for other units. In justified cases, the legislator may order the local government units, including the communes, other public tasks. To carry out the tasks, the commune may create organizational units and conclude agreements with other entities, including non-governmental organizations. Fulfilment of the public tasks may be organized by cooperation between the local government units.

The scope of the commune actions includes all the public matters of local importance, which are vital from the point of view of satisfying local needs. Meeting the needs of the community is the own task of a commune. Especially, the own tasks include matters relating to:

- spatial order, real estate management, environmental protection, and protection of nature as well as water economy,
- communal roads, streets, bridges, squares, and organization of road traffic,
- water mains and water supply, a sewerage system, communal wastewater removal and treatment, maintaining cleanliness and order as well as sanitation facilities, waste dumps and communal waste disposal, a supply of electrical energy and thermal energy as well as gas,
- human health and social work activities (including care centres and facilities), public education; pro-family policy (including the provision of social, medical, and legal care for pregnant women),
- communal housing; maintaining communal buildings and public facilities and administrative buildings, open-air markets, and market halls as well as communal cemeteries and local public transport,
- culture, including communal libraries and other cultural institutions as well as protection of monuments and care about monuments,
- physical culture and tourism, including recreational areas and sports equipment,
- public order and safety of citizens as well as fire and flood protection, including equipment and maintenance of a communal flood storehouse,
- support for and propagation of self-governmental ideas (including the creation of conditions for action and development of auxiliary units and implementation of impulse programs for active citizenship), and promotion of a commune and cooperation with non-governmental organizations and local societies and regional ones from other states [30]. The responsibility framework of communes in the scope of technical infrastructure is in Poland regulated by art. 7 item 1 of the act on self-government which reads that satisfying collective needs of a community belongs to own tasks of a commune.

3.2. Region as a Basic Local Government Unit in Slovakia

In terms of territorial organization, the Slovak Republic is divided into self-governing territorial units, which are municipalities and higher territorial units, also referred to as self-governing regions. The territorial district of a higher territorial unit is identical to the territorial district of the region. The regions were determined by the Act of the National Council of the Slovak Republic of 1996 “On the Territorial and Administrative Organization of the Slovak Republic” (Act No. 221/1996). namely: Bratislavský, Trnavský, Trenčiansky, Nitriansky, Žilinský, Banskobystrický, Prešovský, Košický [35].

3.3. SWOT Analysis for Małopolskie Voivodeship and Trnava Region

The partial analysis of strengths and weaknesses is focused on the geographical, natural division, demographic development, and the general economic state and characteristics of each region (Figure 2 for Małopolskie Voivodeship, Figure 3 for Trnava region).

| Strengths of the Małopolskie voivodeship | Weaknesses the Małopolskie voivodeship |
|---|--|
| <p>Strong academic center, the Krakow Technology Park Existence of research and development units Efficiently operating technology transfer centers High share of the population with higher education Regional Contact Point for EU Framework Programs; Innovation Relay Center (IRC). Establishment of the Regional Information Center for Foreign Scientists. Orientation on consulting and training for SMEs. Developed technological offer regarding financing from EU financial instruments. Relatively low unemployment. Good level of IT infrastructure development. Developed construction industry Developed processing industry in the field of agricultural and fruit production. Diversified economic profile.</p> | <p>Lower quality of technical infrastructure in smaller municipalities. Insufficient support for applied research in research Limiting research units to contacts with entrepreneurs Lack of information and promotion activities about the part of research units addressed to entrepreneurs Absence of contact point for entrepreneurs looking for partners among research units. Lack of a national and regional system of financing innovative enterprises. Insufficient number of innovative small and middle enterprises (SMEs) Low usage of the patent protection for innovative solutions. Large disproportions in economic development within the region. Insufficient number of SMEs in Małopolska. Large disproportions in the economic activity</p> |
| Opportunities the Małopolskie voivodeship | Threats the Małopolskie voivodeship |
| <p>International cooperation within EU programs. Creation of regional cooperation networks of enterprises and scientific institutions. Promoting a culture of innovation Promotion of the region as a place of study and work for foreign scientists and students. Development of the capital market, supporting the financing of new technologies for SMEs. Investments in high technologies. Greater use for tourist service, new ecological farms Development of pro-ecological enterprises Decentralization of public finances Information and knowledge-based economy. Dynamic development of education, including adults Increased inflow of EU structural funds. Acceleration of rural restructuring processes. Increased cooperation with other EU regions. Large reserve in the service sector in rural areas. Entering the labor market of the baby boom.</p> | <p>Superficial treatment of innovation Unresolved issue of restructuring R&D units, after dispersion and ineffective use of bank funds. Poor development of resources Lack of financial opportunities for cooperation of enterprises with the science sector. A social approach to privatization and restructuring of enterprises. Competing with cheap labor and the ability to fill a niche rather than product innovation as a strategy. Treating innovation, and technology transfer, not as a business strategy. Lack of a network of SMEs that combine to carry out research and implementation projects to technology transfer, capable of cooperation with large companies. Still difficult transport accessibility of Małopolska. Slow pace of transformation into a rural farm ("open-air museum" of the countryside).</p> |

Figure 2. SWOT analysis: characteristics of the Małopolskie voivodeship. Source: drawn by authors based on data from [36–39].

| Strengths of Trnava region | Weaknesses of Trnava region |
|--|--|
| A well-developed network of transport Quality soil, mineral wealth Favorable climatic conditions Preserved biodiversity Significant watercourses, geothermal water springs Lowly polluted air Protected landscape area Research and development units Technology transfer centers in the region Low unemployment rate compared to the average rate in Slovakia Regional Contact Point for EU Framework Programs | Low quality of technical infrastructure, especially in smaller municipalities Small number of protected areas, high level of deforestation Sparse protected areas with life/living conditions in the countryside. Insufficient use of natural conditions and beauties for tourism (hunting, fishing tourism) Population aging Insufficient legislative solution to producers Insufficient effective education arousing citizens' interest in improving the quality of the environment Insufficient promotion of natural and cultural wealth Low level of education in rural areas compared to the average |
| Opportunities of Trnava region | Threats of Trnava region |
| Improving the protection of natural heritage Better protection of the soil Creation of an area with stabilized development in settlement structure Continuous improvement of economic and service infrastructure More effective influencing of qualification structure on the level of population importance adequate to specifics of the region Decentralization of public finances. Strengthening innovation in regions. Development of the information society and a knowledge-based economy. Enhancement of education, including adult education. Increased cooperation with other EU regions. Increased inflow of EU structural funds. | Environmental pollution Improper and unprofessional deforestation Decreasing quality of the water reservoir on Žitný ostrov Insufficient diversification of industry, focused only at the automotive industry, without research and development Insufficient expenditures and investment in infrastructure and innovation Lack of networking of SMEs that combine research and implementation projects related to technology transfer. Unattractiveness of rural areas/outflow of young people/aging population Continuing outflow of staff capacity from rural areas Low recycling rate Biowaste not treated as a source Increasing age index |

Figure 3. SWOT analysis: characteristics of the Trnava region (Trnava self-governing region). Source: drawn by authors based on data from [40–42].

Sources used for the analysis of the Małopolskie voivodeship are authors [36] and strategic regional documents: Regional integrated territorial strategy; National Strategy for Regional Development on the principles of supporting regional development; Assumptions of the regional development strategy in Poland; Task Force for Regional Development in Poland [37–39]. Sources used for the analysis of the Trnava region are strategic regional documents: Regional integrated territorial strategy of the Trnava self-governing region for the years 2014–2020; Rural development strategy in the Trnava self-governing region; Program of economic development and social development of the Trnava self-governing region [40–42].

4. Technical Infrastructure as an Element Essential to a Functional Society

The citizens' life quality both in big agglomerations and small rural areas significantly depends on the existence of technical, economic, social infrastructure. The word infrastructure derives from Latin. It consists of two parts and it means infra—under, below, lower,

down, and structure—building, construction, organization, system. Having joined these two parts, a term was formed: a substructure. Barteczek (1982) defines infrastructure as a set of local facilities, which make up standard equipment of spatial units of a given size, which are on a certain level of social and economic development and have their population and economic potential. These facilities meet collectively defined social and economic needs, whereas their provision does not obey the activity of market laws [43]. Another definition of infrastructure is presented by Piskozub (1997), who defines infrastructure as permanently situated linear and point public facilities created by a man, which make up a foundation of social and economic life due to their function of the movement of persons and loads (transport), news (communications), electricity (the power industry) and water (water management) [44]. Next, *Wielka Encyklopedia PWN* (Polish Scientific Publisher's Encyclopaedia) defines infrastructure as basic facilities and institutions which are necessary for the proper functioning of the economy and society [45].

The wide section of infrastructure consists of elements that include economic, social, and technical infrastructure. The technical infrastructure includes all transmission networks and facilities connected with them, providing necessary services for a given spatial and economic unit in respect of power engineering, heat and water supply, communal wastewater and waste removal, transport, telecommunication, and others [46]. The economic infrastructure significantly refers to services in the scope of transport, communications, power engineering, and environmental protection and development. The second group comprises the social infrastructure which includes services in respect of law, safety, education and science, culture, social care, and health care, etc. (for instance, schools, hospitals, courts, prisons, state administration institutions) [47]. The authors consider the analysis of the technical infrastructure. The economic and social infrastructure, owing to the length of this article, will not be discussed in detail in the paper.

Infrastructure, including technical infrastructure, is important in achieving sustainable development goals for three main reasons. We agree that infrastructures have to be sustainable [48] and need to facilitate local needs in a sustainable and environmentally friendly manner [49]. Reasons are as follows: First, sustainable development focuses attention on the creation or maintenance of areas of wildlife-rich natural or semi-natural habitat in heavily developed, developing, or urbanized landscapes. Second, it involves the creation of added value between different areas, potentially allowing collaboration and experience sharing among otherwise isolated areas. Third, it introduces an idea about the importance of rural areas so that it can be understood by planners and private businesses that control decisions about land development and investments. Technical infrastructure has been considered the main instrument for the implementation of sustainable development strategy.

Numerous definitions of technical infrastructure can be found in the literature concerning this subject. The first definition referred to is presented by Borcz (2000) who describes the technical infrastructure as a group of elementary buildings, equipment, and installations, which include: bridges, roads, telecommunication networks, and energy networks, which are necessary for the proper functioning of society and productive branches of the national economy [50]. The infrastructure is defined by Góralski and Lazarek (2009) as any equipment and installations necessary to provide the proper functioning of the national economy and life of society [51].

The literature concerning this subject distinguishes a division of technical infrastructure into underground, ground, and overground. The following types of infrastructure make up the underground technical infrastructure: heating, power, gas, sewerage, telecommunication, and water. The ground technical infrastructure includes the following types of infrastructure: heating and gas. The overground technical infrastructure comprises, first, power infrastructure and telecommunication one [52].

The technical infrastructure has a major influence on inhabitants' quality of life and the development of rural areas. The principal barrier to this development is mainly a lack of financial resources. Since Poland joined the European Union, rural communes have

had a chance to make use of international financial resources and more and more often benefit from support programs for these areas. However, the development of the technical infrastructure is still insufficient or improves too slowly in many regions.

4.1. The Technical Infrastructure in the Rural Regions of Małopolskie Voivodeship

According to Aschauer (1990), the existence of technical infrastructure is the key to profitability and effectiveness of production, as well as the distribution of goods and activities of each entity [53]. The named benefits are also the reason for which the technical infrastructure development is a priority in the EU policy towards the states on the low level of development. On the other hand, in the countries that are currently the most developed, various financial instruments are leading. In the Polish conditions, especially in the context of challenges posed by the 21st century, the use of elements of infrastructure as an incentive to locate economic functions, and simultaneously to stimulate economic development, is becoming a priority. This problem can be discussed from different perspectives and often are presented partial solution. e.g., optimization of water treatment processes [54].

In Poland, as of 1 January 2020, there are 16 voivodeships, 380 poviats, and 2477 communes, but 1533 communes are rural ones, 642 are urban-rural communes and 302 are urban communes. The number of communes which are towns with poviat rights is 66 [55].

The Małopolska region is one of 16 voivodeships situated in Poland. The number of inhabitants is almost 3.4 million and although it is one of the smallest voivodeships, it is characterized by the second-highest population density in Poland. The administrative situation in the Małopolskie Voivodeship as of 1 January 2020 is presented in Table 1.

Table 1. Administrative division of the Małopolskie Voivodeship.

| | |
|--------------------------|-----|
| towns with poviat rights | 3 |
| poviats | 19 |
| urban communes | 14 |
| urban-rural communes | 48 |
| rural communes | 120 |
| total of communes | 182 |
| towns/cities | 62 |

Source: own work based on data from Poland statistics office. Datacube [56].

The Małopolskie Voivodeship is an administrative centre developing dynamically. Apart from the big cities such as Kraków, Nowy Sącz, or Tarnów, rural communes are significant. Often, these areas are chosen as an alternative for living in the noise of the city. The proximity of big scientific centres and business centres allows people to commute to work, school or cultural centres in an easy and fast way.

In Poland, rural areas are the territories outside the administrative borders of cities. Population density is a factor that divides the areas into urban areas or rural ones [48]. To increase the level of urbanization in their areas and simultaneously encourage people to settle within their borders, the rural communes face a necessity to erect or build up facilities of technical infrastructure used in the process of provision of services of general interest.

Infrastructure investments are related to the long period of their creation and technical indivisibility of constructions. The essential economic features of infrastructural investments include high capital intensity and a long payback period. The high capital intensity is the result of incurring high capital expenditure needed for the achievement of the expected results. The payback period is composed of a long time of creation and technical indivisibility of an enterprise [49].

The key issue concerning the competitiveness of a given region is its structure and how a given unit is equipped with technical infrastructure. Apart from roads and footpaths, fitting a commune with sanitary and technical installations is the most essential from the point of view of the present and future inhabitants. In the studied units, there has been a distinct improvement in flat equipment with elementary utilities and installations for recent years. It means that considerable financial outlays have been made and a lot of work

done in these communes. Table 2 depicts the degree of equipment of rural communes in the Małopolskie Voivodeship with individual elements of technical infrastructure.

Table 2. Degree of equipment of rural communes with the basic elements of technical infrastructure from 2010 to 2018.

| Elements of Technical Infrastructure | Flats Equipped with Installations—(in %) of the Total Number of Flats | | | |
|--------------------------------------|---|-------|-------|-------|
| | 2010 | 2015 | 2017 | 2018 |
| Water | 93.1% | 93.5% | 93.6% | 93.7% |
| Toilet | 89.2% | 89.8% | 90.1% | 90.2% |
| Bathroom | 85.6% | 86.5% | 86.9% | 87.0% |
| Gas from the gas grid | 50.3% | 50.0% | 50.2% | 51.0% |
| Central heating | 71.0% | 72.8% | 73.4% | 73.8% |

Source: Own work based on Poland statistic office, Datacube [56].

According to the data provided in Table 2, in 2018 almost 93.7% of households were equipped with water main, almost 90.2% with a toilet with running water, and over 73.8% with central heating. A little over 51% of inhabitants of the areas of the rural communes in the Małopolskie Voivodeship had access to the gas network. Figure 4 presents the numerical results of the analyses of flat equipment in rural communes in the Małopolskie Voivodeship with individual elements of technical infrastructure.

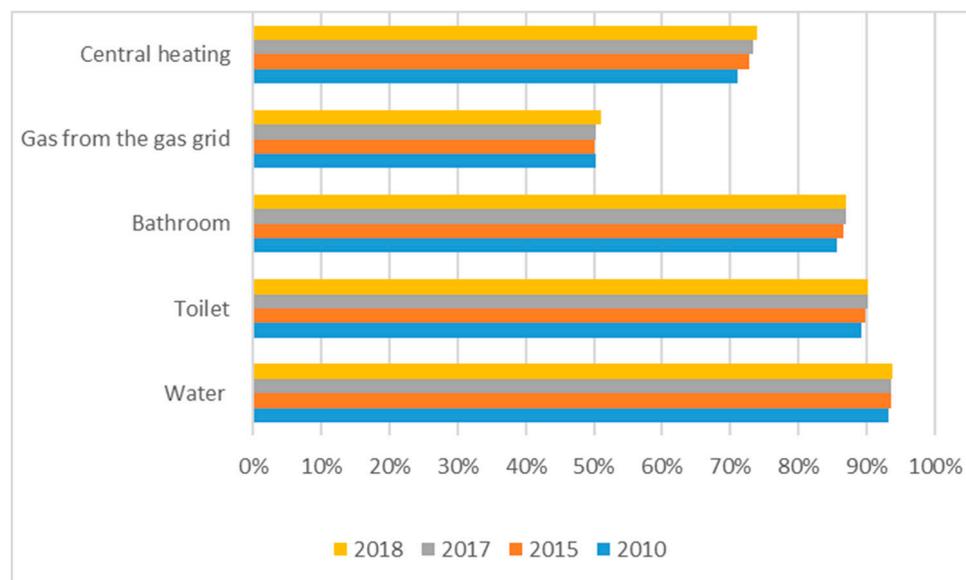


Figure 4. Population using the water main, the sewerage system, and the gas grid in rural communes of the Małopolskie Voivodeship from 2010 to 2018(%). Source: drawn by authors based on data from Poland statistic office [56].

It is worth mentioning that according to the same research, it can be stated that almost 99% of inhabitants in cities of the Małopolskie Voivodeship have access to the water main. Inhabitants of almost 98.3% of households can use a toilet with running water, but central heating is supplied to less than 87% of inhabitants of cities of this voivodeship. It should also be emphasized that the visible disproportion in household equipment between a country and a city has decreased in the analysed period.

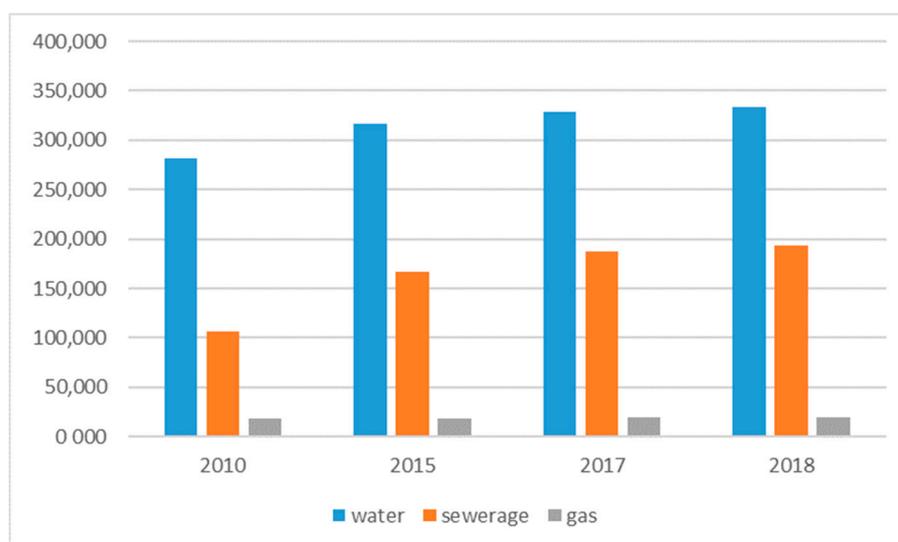
As it was mentioned, accessibility and a degree of utility infrastructure with transfer networks are the meaningful indicators for present and future inhabitants. Table 3 presents the length of individual networks in rural communes of the Małopolskie region.

Table 3. Length of industrial networks in rural communes from 2010 to 2018.

| Connections to Buildings—Distribution and Transmission Networks | Years/km | | | |
|---|----------|---------|---------|---------|
| | 2010 | 2015 | 2017 | 2018 |
| water | 282,171 | 316,456 | 329,202 | 334,049 |
| sewerage | 106,771 | 166,918 | 187,751 | 192,979 |
| gas | 17,871 | 18,596 | 18,933 | 19,095 |

Source: Own work based on Poland statistic office, Datacube [56].

According to the data presented in Table 3, the length of the distribution and transmission network is getting longer every year (Figure 5). During the analyzed years, the length of the water main in rural communes of the Małopolskie Voivodeship increased by over 51,877 km, which means a rise of almost 18%. The length of the sewage system was increased by over 86,208 km i.e., by over 80%. The length of the gas grid was also increased. From 2010 to 2018 the rise was observed from 17,871.1 km to 19,095.5 km which is by almost 7%. It is worth noticing that although the increases presented in Table 2 were not significant, the development of the transmission networks is much more important, and it shows constant work in this sector.

**Figure 5.** Length of transmission networks from 2010 to 2018 in rural communes of the Małopolskie Voivodeship in km. Source: Drawn by authors based on Poland statistic office [56].

In 2018 the communes of Lubień, Oświęcim, and Polanka Wielka had the best-developed water infrastructure. 100% of inhabitants had access to the water main in these rural communes. Among all 120 rural communes in the Małopolskie Voivodeship between 80% and 99.9% of the inhabitants of 47 communes had access to the water mains. The inhabitants of 26 communes had access to the water mains in the range from 50% to 79.9% and in 28 communes this percentage decreased to the range from 20% to 49.9%. The situation is the worst in 16 communes of rural communes of the Małopolskie Voivodeship. There the water main is available in the range from 0% to 19.9% of the inhabitants, which means that a maximum of every fifth inhabitant of the local community can use the water main.

The sewerage system is not available in the rural communes in the Małopolska region for all the inhabitants. This situation looks the best in a small commune of Muchacz. This rural commune with a little over 4 thousand inhabitants can boast about the sewerage system within 96.1% of households. In the Małopolskie Voivodeship, there are only eight rural communes in which the sewerage infrastructure amounts to a minimum of 80%.

The saturation with the sewage system reaches the range from 50% to 79.9% in 25 rural communes. Most of the communes i.e., 48 of them exceed 50%, which means that a maximum of every second inhabitant uses the sewage system. The worst situation is in 39 communes where the level of the sewage infrastructure does not exceed 20%. It should be emphasized that 8 communes found in the lowest range indicated a 0% level of the sewage infrastructure.

The last element of the technical infrastructure discussed in this elaboration is the access of the inhabitants of rural communes of the Małopolskie Voivodeship to the gas grid. Only 107 communes provided information about the gas grid in the analysed period. The rural commune of Kłaj had access to the widest range of the gas grid. 96.8% of the inhabitants were connected to the gas grid in 2018. The accessibility of the gas grid over 80% was declared in 17 of the analysed communes, and the similar result also referred to the range of 20–49.9%. This percentage fluctuated from 50% to 79.9% in the next 48 rural communes. The gas grid was available to less than every fifth inhabitant in 25 communes.

Some communes are improving the state of the technical infrastructure actively and regularly, making their area more modern and more competitive. However, distinct parts of communes are still developing their technical facilities insignificantly or selectively. The sewage infrastructure poses the greatest challenge and shortages in this scope are the most visible all over the voivodeship. The best situation is with the water mains, which is improved year by year and more percentage of the population has access to the mains in the analysed rural communes.

One of the most important elements of the functioning of a commune is planning activity in the context of sustainable development, especially in rural areas—a point of view presented by B. Piontek [57], Poplawski L., Rutkowska-Podolowska M [58], A.G. Polyakova et al. [59], and A. Zielinska [60].

4.2. *The Technical Infrastructure in the Rural Regions of Trnava Self-Governing Region*

In terms of territorial organization, the Slovak Republic is divided into self-governing territorial units, which are municipalities and higher territorial units, also referred to as self-governing regions. The regions were established by the Act No. 221/1996 of the National Council of the Slovak Republic of 1996 [58] “On the Territorial and Administrative Settlement of the Slovak Republic. The regions became self-governing within the framework of the public administration reform in 2001 when they were established as self-governing higher territorial units. The territorial district of a higher territorial unit is identical to the territorial district of the region. At present, the Slovak Republic is territorially divided into 8 higher territorial units, whose name coincides with the designation of the region, namely: Bratislavský, Trnavský, Trenčiansky, Nitriansky, Žilinský, Banskobystrický, Prešovský, Košický.

The city according to which the region or district is named is the seat of state bodies that operate in the territorial district of the region or district. The territorial zone of the region and the territorial zone of the district are territorial zones for the state bodies’ power performances, which is a decisive factor especially in determining the locally competent authority in administrative proceedings. Administrative units are also municipalities and military districts in matters in which they are entrusted with the performance of state administration.

The field of public administration represents a dynamic system, which in the era of the functioning of the Slovak Republic as an independent state manifested itself in numerous reforms, because of which it was reorganized several times. The individual stages of change were caused by changes in the political sphere, as well as efforts to reduce the costs of public administration, reducing the number of employees, or the transfer of individual competencies of the state to self-government Korec et al. [61].

The Trnava self-governing region with an area of 4148 km² (8.5% of the area of the Slovak Republic) ranks penultimate place within the regions of the Slovak Republic. The largest district of the region is Dunajská Streda with an area of 1075 km², the smallest

is the district of Hlohovec with an area of 267 km². The remaining districts have an area of Galanta—642 km², Piešťany—381 km², Senica—684 km², Skalica—357 km², and Trnava—741 km².

Of the 251 municipalities in TTSK, 16 have the status of a city (Table 4). The largest number of municipalities is in the Dunajská Streda district (67, of which 3 cities), the least in the Skalica district (21, of which 3 cities). The highest share of the urban settlement has the district of Skalica, the lowest share is in the district of Dunajská Streda.

Table 4. Administrative division of West Slovakia (Trnava region).

| | |
|-------------------|-----|
| districts | 7 |
| rural communes | 234 |
| total of communes | 251 |
| towns/cities | 16 |

Source: own work based on data from the Statistical Office of the Slovak Republic [62].

The Trnava region has a well-developed road and railway network. There is also an international airport in Piešťany, which is used mainly for character transport. Bratislava Airport operating domestic and international flights is available within one hour. The main railway lines passing through the region ensure the connection of the capital city of Bratislava with the Czech and Hungarian Republics, as well as with important centres of Slovakia—Žilina, Zvolen, and Košice. The road network consists of roads with a total length of 3309 km, of which 1900 km are state roads. Two sections of the motorway connecting Bratislava with Prague and Trenčín also pass through the region.

In terms of equipping municipalities with public water mains, the situation is relatively good in the western part of Slovakia, including the Trnava region. In the Bratislava self-governing region there are only 3 municipalities without a public water supply, in the Trnava self-governing region the situation is the most unfavorable in the Dunajská Streda district with 8 municipalities without a public water supply. For comparison, the situation is much more unfavorable in central and eastern Slovakia, where there are 106 settlements without public water supply in the Banská Bystrica self-governing region, and 57 municipalities without public water supply in the Košice self-governing region (especially in Košice-okolie and Rožňava). The state of the Prešov self-governing region has the most unfavorable situation—up to 227 municipalities have no public water supply, especially in the districts of Bardejov, Humenné, Prešov, Snina, Stropkov, Svidník, and Vranov nad Topľou. (the data year 2017).

Most of the municipality in the Trnava region (90.1%) has a public water supply system in the year 2019, it is improvement form year 2017 when 89.3% or 89.1% in the year 2015 have sufficient water supply system and 19 municipalities in the Trnava region out of 251 have to improve this part of the technical infrastructure [61].

The share of the population in the self-sufficient Trnava region supplied with drinking water from the public water supply system in 2019, has a value of 90.1% (Table 5) that is higher when compared to the average of 89.9% for Slovakia, while regional differences are evident for the rural areas of Dunajská Streda with value 83.4% in 2019 (an improvement compared to the year 2015 can be observed, where the value was 82.6%. Similarly, for rural areas in the Skalica area where the increase is from the value 87.2% to 83.4% (Figure 6).

Table 5. Population with elements of technical infrastructure (water main) in Trnava region.

| Elements of Technical Infrastructure-Water Main | Proportion of Population—(in %) of the Total Number | | | | |
|---|---|-------|-------|-------|-------|
| | 2015 | 2016 | 2017 | 2018 | 2019 |
| Trnava region | 89.1% | 89.2% | 89.3% | 89.7% | 90.1% |
| District Dunajská Streda | 82.6% | 82.4% | 82.1% | 82.1% | 82.1% |
| District Galanta | 96.0% | 96.1% | 96.2% | 96.3% | 96.3% |
| District Hlohovec | 93.0% | 93.3% | 93.6% | 93.4% | 94.5% |
| District Piešťany | 90.5% | 90.7% | 91.3% | 92.8% | 93.1% |
| District Senica | 88.0% | 88.9% | 89.4% | 90.0% | 94.4% |
| District Skalica | 87.2% | 87.3% | 87.6% | 87.8% | 83.4% |
| District Trnava | 89.2% | 89.1% | 89.3% | 89.8% | 90.5% |

Source: own work based on data from the Statistical Office of the Slovak republic—Datacube [62].

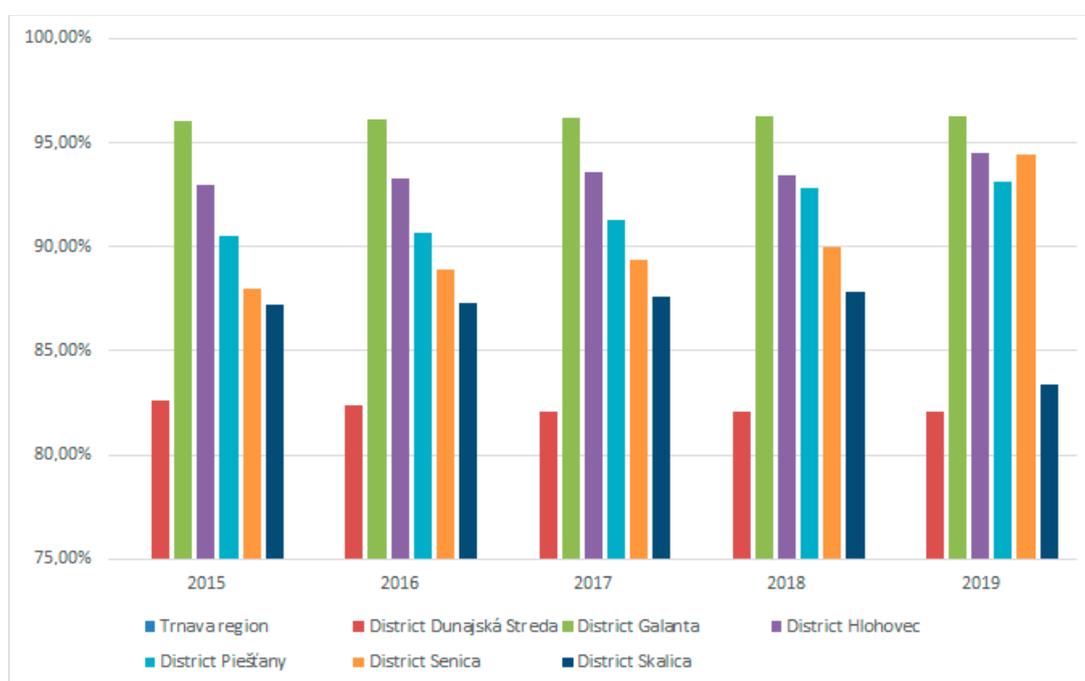


Figure 6. Proportion of population with technical infrastructure- water main—(in %) of the Total Number. Source: Own work based on data from Statistical Office of the Slovak Republic—Datacube [62].

Accessibility and a degree of utility infrastructure with transmission networks are the meaningful indicators for present and future inhabitants. According to the data presented in Table 6, the length of the distribution and transmission network in the Trnava region is getting longer every year. During the analyzed period (2010–2018) the length of the water main in rural communes of the Trnava has increased by 174 km, which means a rise of 6.7%. The length of sewage supply systems in the Trnava region was also increased by 27.3% (from 1479 km to 1883 km).

Table 6. Length of industrial networks in rural communes in the Trnava region from 2010 to 2018.

| | Connections to Buildings—Distribution and Transmission Networks | | | | | | | | |
|--------|---|------|------|------|------|------|------|------|------|
| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| water | 2593 | 2687 | 2751 | 2719 | 2725 | 2720 | 2732 | 2765 | 2767 |
| sewage | 1479 | 1596 | 1609 | 1748 | 1727 | 1780 | 1821 | 1866 | 1883 |

Source: Own work based on data from Statistical Office of the Slovak Republic—Datacube [62].

The improvement in the length of transmission networks in rural regions of the Trnava region in km are presented in Figure 7. It is important to mention that the development of the transmission networks is important for the sustainable development of the whole region. Data on gas connections cannot currently be networked by region due to the redistribution.

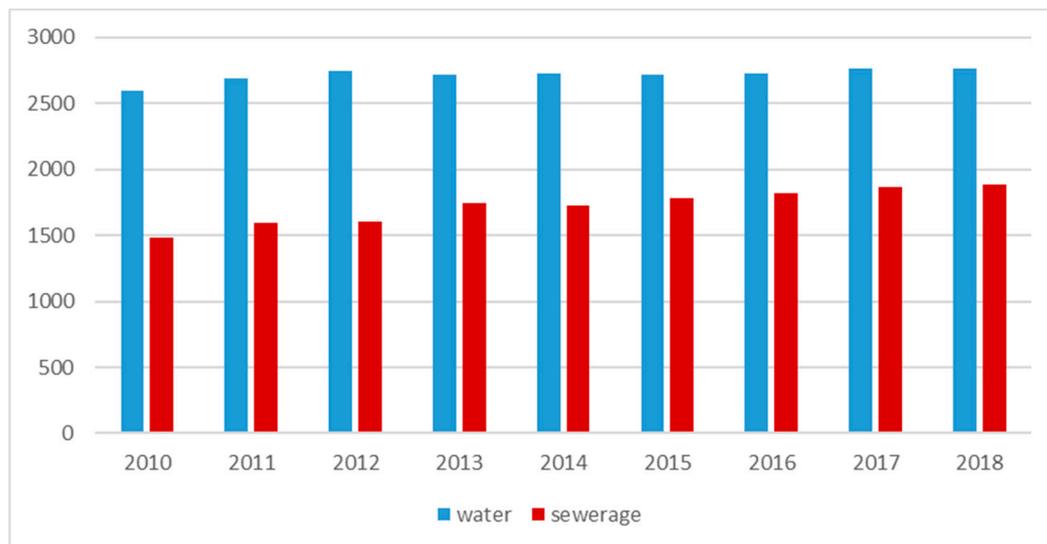


Figure 7. Length of transmission networks from 2010 to 2018 in rural regions of the Trnava region in km. Source: Own work based on data from Statistical Office of the Slovak Republic—Datacube [62].

5. Linking Technical Infrastructure, Sustainable Development, and Strategy of the Cooperation

The infrastructure is frequently a chance or a barrier to further development of the region. The sustainable infrastructure development implementation process faces several challenges [63]. Thus, the accumulation of knowledge and regional effects can be developed by competitive regional specialization [21]. The regional SWOT analysis brings improved focus, identification of opportunities of the region, finding similar threats means to choose a strategy of partnership to work with on same goals, improving together and important is also the identification of unknown aspects. The conducted SWOT analysis of Malopolskie voivodenship and Trnava region indicates the same threats of regions for further development, therefore it is necessary to focus on cooperation based on the principles of regional development of the European Union. These principles include concentration principle, partnership principle, subsidiarity, and programming principle. The principle of concentration stemmed from the need to concentrate efforts and resources to support development, especially in those regions that show lower long-term economic performance. It is based on the concentration of resources for solving fundamental socio-economic problems. It requires concentrating the European Union's structural funds in the most problematic regions. Based on the established EU criteria, NUTS II level regions are considered lagging.

(nomenclature of territorial units for statistics) whose *Gross Domestic Product* (GDP) per capita in purchasing power parity does not exceed 75% of the EU average.

The partnership principle, defined in Regulation (EU) No. 1303/2013 of the European Parliament and of the Council of 17 December 2013. Ref. [64], requires the active participation of the competent authorities of all levels in the preparation, implementation, and monitoring of the results of projects which are part of regional policy programs and are co-financed by the Structural Funds. The principle of a partnership should lead the public administration to ensure that everyone in the territorial administration focuses on tasks for which they have a natural disposition, authority, statutory competencies, and resources. The programming principle emphasizes a multi-annual integrated approach, i. planning. The principle includes strategic planning and the creation of program measures with specified goals, resources, and implementation procedures.

The principle of complementarity is based on the principle that state resources or the budget of the European Union are not a majority, but only an additional resource that contributes to the support of activities arising in the region. The principle expresses the requirement for the cooperation of resources of stakeholders implementing activities (projects) following the measures within the individual priorities and their objectives.

The principle of subsidiarity means that the responsibility for the efficient use of funds is shifted as close as possible to the implementers of the proposed project, where it is possible to take the most accurate account of the local conditions of project implementation. Individual national and regional authorities are responsible for individual projects. It represents a more detailed functional division of competencies at individual levels, supplemented by a competence system. It is defined in Article 5(3) of the Treaty on European Union (TEU) and Protocol (No 2) on the application of the principles of subsidiarity and proportionality. Ref. [65].

The change in infrastructure at the regional level means a change in the strategy of unlimited growth for the strategy for sustainability as proposed by [66].

6. Discussion

This paper investigates the elements of technical infrastructure in rural regions in the context of sustainable development goals. in the relationship with regional competitiveness measured by the regional competitiveness index (RCI).

Both analyzed regions in Poland and Slovakia as basic local government units have similar values of most indicators of competitiveness for regions compared to European average value for the last 10 years.

Results of SWOT analysis identify potential and challenges in the development of both rural regions and indicates the possibility of focusing on the same development goals.

Following the administrative division of the region, descriptive statistics about elements of technical infrastructure identifies a positive trend in development in both regions (presented in Tables 2–6).

The findings of the current research about the availability of elements of technical infrastructure are in line with the previous studies.

The significant role of infrastructure in accelerating development and improving the quality of life in rural regions is indicated by many authors [67–69], not only in the moderately developed countries but also in highly developed countries, e.g., England or Spain [70–73].

The research findings confirm that systematic improvement of the technical infrastructure, not only the state functions/more efficiently, and thus also municipalities, i.e., small local communities, regions function/work more efficiently.

Infrastructure expenditure is conducive to economic development. For many years, the European Union (EU), especially in countries like Greece, Spain, and Portugal, has been financially supporting the development of infrastructure not only from the Common Agricultural Policy but also from regional policy funds [74], therefore these countries have at present a better-developed infrastructure. Infrastructure in rural areas is subject

to continuous expansion processes over the years [75,76], especially in the field of road transport infrastructure [77–79].

Our results underline the importance of investments in technical infrastructure, confirming the view presented in the literature that subsidies for public goods positively contribute to the goal of sustainability [80]

Investments in technical infrastructure result in an increase in employment in cooperating industries, such as construction, production, trade, or tourism, which directly affects the increase in social welfare [81]. Moreover, the morale of the society is improved, thus creating an appropriate climate, encouraging investment in given regions by establishing new plants [82] or expanding housing infrastructure.

Findings from the analysis of technical infrastructure in the rural area of these selected regions (Małopolskie voivodship and Trnava region) undoubtedly have limitations in terms of different framework conditions in different regions and inconsistencies in the methodology of mapping infrastructure elements recognized during analysis as lack of detailed data in individual countries.

The fact is that infrastructure investments are the engine of the economy and it is important to link technical infrastructure with sustainable development and strategy of the regional cooperation.

Despite the differences in the level of infrastructure and entrepreneurship in the region [83,84] or in the region itself [85], also the rural communities themselves support the development of infrastructure in the countryside, this is the case not only in Poland or Slovakia but also, among others, in Latvia [86,87].

However, many issues and a lack of financial support persist in the regions of Małopolskie voivodship and the Trnava region.

A large amount of own resources and resources of the European Union (EU) is allocated to support green infrastructure, agricultural policy and rural support, which has a positive effect on rural tourism [88], in this area Poland and Slovakia, despite the later entry of both countries to the EU, can take examples from other European countries, especially from the positive development of rural areas in Spain or in England where the advantage is a know-how of the human factor after the return home from working experience gaining in these countries. The importance of the human factor is confirmed by studies by authors.

The fact is that infrastructural investments are a motor for the economy. Making outlays on the infrastructure favours economic development. The functioning of the state is more efficient through the regular improvement of the condition of the technical infrastructure, and therefore, also functioning of communes i.e., small local communities is more efficient. Investments in the technical infrastructure cause an increase in employment in the cooperating branches, and for example, with construction, production, and trade, which directly enhances social welfare. Moreover, the morale of society is improving, creating a proper climate in this way, encouraging investment in given regions through setting up new plants or expanding the housing infrastructure.

7. Conclusions

Finally, in the analyzed regions, the rural communes of the Małopolskie voivodship and Trnava region keep improving the condition of technical infrastructure. All the elements of infrastructure are gradually modernized and developed in the field of rural infrastructure or “green” infrastructure. Unfortunately, the pace of this work in some communes is still too slow. Despite new financial possibilities in the form of EU resources or public-private partnerships, some rural communes are not able to improve their infrastructure. The development of infrastructure in these communes is also a chance of development for the whole society. The well-developed rural commune attracts new residents and new investments. To conclude, reasonable actions of local government units can only demonstrate the integrated development of rural communes of the Małopolskie voivodship and Trnava region.

The challenge for the future is waste management and recycling, respecting the waste hierarchy and the goals of sustainable development. This is more and more discussed among inhabitants of rural areas and is still relevant today. This issue and problems regarding water and sewerage management will be more urgent as it is, due to climate change. It is important to consider building new infrastructural facilities concerning retention and supply of drinking water for inhabitants, but also eliminate the harmful influence of waste on the environment (for example, in the scope of contamination of groundwater or implementation of modern waste management).

Without a doubt, the present limitation on doing more detailed research is a lot of restrictions resulting from developmental determinants such as spatial differentiation of rural areas in various regions of the European Union (for instance, the existence of different determinants which are not quantified) or a lack of systematic approach for analysis of data in the field of broadly understood infrastructure.

According to the authors, this research problem is essential, and they suggest that more detailed norms regarding individual types of infrastructure should be adopted within the institutions of the European Union, and especially Eurostat, which would allow comparable research and favor a more efficient and rational use of funds while dividing them for development of infrastructure. Such a more detailed systematization would also result in a possibility of a more objective evaluation of the effectiveness of the use of EU funds with different potentials of these regions and entities located there on the objective which is also the elimination of an infrastructural gap.

In connection with future research within international projects, the prospective issue will discuss the development of infrastructure according to system principle respecting the same method for the data measurement and the evaluation and potential gas demand. The use of gas and especially wider exploitation of renewable energy sources in rural areas will undoubtedly influence the decrease in pollution resulting from the present energy production mainly from hard coal and brown coal. The development of transmission infrastructure and renewable energy sources in rural areas are vital elements of the implementation of sustainable development and contributing to the improvement of the quality of life of inhabitants. This development is also important to decrease the health problems resulting from the occurrence of smog in the Małopolskie Voivodeship (for example, this region reaches the highest existing concentrations caused by burning waste in the rural communes around Kraków).

The authors intend to continue and extend research also in other regions, especially as regards the infrastructural gap in rural areas, especially the problem of waste management and recycling is a particular case, which is more and more discussed among inhabitants of rural areas and still up to date.

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