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TRANSPORT EXCLUSION AND QUALITY OF LIFE IN NORTHERN PROVINCES: DIAGNOSIS AND MONITORING

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Purpose: The paper investigates the impact of transport exclusion on the quality of life for residents in the northern provinces of Poland, aiming to diagnose the problem, analyze leading causes, and present proposals for countermeasures. Improving quality of life through sustainable development and enhanced transport accessibility is a central focus for local government units.
Design/methodology/approach: The study employs an interdisciplinary approach, integrating economic, sociological, psychological, and ecological perspectives. It utilizes both subjective and objective quality of life indicators, with a standardized total and partial utility analysis applied to statistical data from public transport, infrastructure, and demographic sources. Four northern Polish voivodeships are compared using multidimensional indicator systems to measure transport development and exclusion.
Findings: Results reveal significant disparities in transport infrastructure and exclusion across the selected regions. The Pomeranian Voivodeship demonstrates the highest utility values (up to 6.83 in 2021), indicating superior transport infrastructure and accessibility, while Warmian-Masurian consistently records the lowest utility scores (as low as 1.99), reflecting higher transport exclusion. Key factors identified include road network density, railway lines, cycling infrastructure, and public transport services, which all contribute to regional differences in quality of life.
Research limitations/implications: Limitations include the availability and granularity of statistical data, and the challenge of integrating diverse indicator systems. Future research could expand the analysis to other regions or further refine the utility methodology for improved comparability and actionability.
Practical implications: The research suggests the need for targeted infrastructure investments, modernization of district and municipal road networks, expansion of public and alternative transport modes (rail, bicycle), and development of Park & Ride systems. Regions with inadequate infrastructure require interventions to reduce transport exclusion and improve mobility, impacting both local economies and residents' everyday lives.

Social implications: Enhanced transport infrastructure and accessibility support social inclusion, increase public safety, and improve access to education, employment, and services. The research informs public policy and strategic planning, potentially improving quality of life and supporting sustainable social development.
Originality/value: The paper introduces a repeatable, utility-based methodology for regional diagnosis of transport exclusion, providing actionable insights for policymakers, urban planners, and researchers to optimize regional development.
Keywords: quality of life, transport, sustainable development, usability.
Category of the paper: Research paper.

1. Introduction

The primary goal of local government development is to improve the quality of life of society, but this quality must be considered in close connection with the principles of sustainable development. Quality of life is a multidimensional area of scientific research, encompassing both objective aspects, such as economic, infrastructural, and environmental conditions, as well as subjective aspects related to individual well-being and life satisfaction. Therefore, analyzing quality of life requires an interdisciplinary approach, integrating economic, sociological, psychological, and ecological perspectives. The use of appropriate indicators and analytical methods is crucial for the accurate interpretation of research results. However, the large number of indicators, as well as the complexity and limited availability of some data, remain challenges. To address this challenge, approaches such as total and partial utility analysis are used, which enable a transparent and comprehensive presentation of sustainable development research results. This enables the effective use of data to formulate public policies and development strategies at the local and regional levels.

Implementing strategic national and international policy goals determines regional development at the voivodeship level. Sustainable development priorities should be aligned with strategic documents such as the Europe 2020 Strategy, the Poland Sustainable Development Strategy until 2025, the Poland 2030 Strategy, and the National Environmental Policy. Another key factor affecting quality of life is transportation exclusion (Pucher, Buehler, 2012), which limits social and economic mobility and hinders access to education, the labor market, and public services. Therefore, eliminating transportation barriers should be a priority for local government policy, thus supporting sustainable socioeconomic development and improving residents' quality of life.

2. Quality of life and communication exclusion

The issue of quality of life is widely discussed in the scientific literature and is the subject of analysis in various research contexts. This topic has been approached, among others, from an economic perspective, examining the impact of income, employment, and living standards on the well-being of individuals and communities. Psychology has focused on subjective indicators such as life satisfaction, happiness, and fulfillment. Meanwhile, sociology and the social sciences have emphasized the role of interpersonal relationships, social capital, and demographic structures as significant determinants of quality of life (Komornicki, 2020). Reflections on the existential dimension of well-being have also been undertaken in theology, philosophy, and the humanities. Meanwhile, mathematical, medical, and technical sciences have provided tools for quantifying and modeling changes in quality of life.

Despite the extensive research on quality of life, a clear and universally accepted definition of this concept has yet to be developed. Differences in interpretation stem from the adopted theoretical frameworks – some concepts emphasize hedonistic aspects and happiness, others emphasize the availability of resources and material conditions, and others emphasize the fulfillment of basic human needs (Lucas, 2012). However, a common element of these approaches is the belief in universal methods and tools enabling quantitative and qualitative assessment of the quality of life. This analysis most often utilizes sustainable development indicators, which, when monitored over time, allow for assessing the dynamics of socio-economic and environmental changes. Transport exclusion is a social phenomenon that can significantly impact the quality of life of individuals and social groups. Quality of life refers to the subjective assessment of an individual's life, considering health, financial conditions, access to education, work, social services, and the ability to participate in social life (Kowalski, 2021). On the other hand, transport exclusion refers to difficulties in fully and effectively participating in communication processes, including a lack of access to technology and problems with understanding or communicating information.

Transport exclusion in the context of transport refers to difficulties in accessing means of transport, both public and private, which affect the mobility of people and goods. This phenomenon particularly affects people in rural areas, less developed regions, or so-called transport "dead zones" (Zielińska, 2021), whose infrastructure is insufficient or underdeveloped.

Transport infrastructure in the context of sustainable development in selected cities in the northern voivodeships.

Podlaskie Voivodeship, one of Poland's 16 voivodeships, is located in the northeastern part of the country and borders Belarus and Lithuania. This region is critical regarding nature, sustainable development, and ecological and economic integration. Podlaskie Voivodeship has an area of 20,187 km², constituting approximately 6.5% of Poland's total area. The voivodeship

is inhabited by approximately 1.2 million people (as of 2021), making it one of the least populated voivodeships in Poland (Słupik, 2016). Podlaskie Voivodeship is well connected to other regions of Poland thanks to a network of national and voivodeship roads, the A2 motorway, and the S8 expressway. Further infrastructure investments are planned to improve transport in the region. The voivodeship is well connected by rail, with significant connections to Warsaw, Gdańsk, Olsztyn, and neighboring countries (Belarus, Lithuania). Air transport: The airport in Białystok (Kryniewice airport) serves domestic and international connections, although air traffic in the region is less intense than in other parts of Poland (Kopeć, 2014).

The Pomeranian Voivodeship is located in the northern part of the country, on the Baltic Sea. It is a region of significant economic, tourist, and cultural importance, with a well-developed transport infrastructure and a strong economy based on services, industry, tourism, and agriculture (Bąk, M., 2019). It borders the Kuyavian-Pomeranian Voivodeship, the West Pomeranian Voivodeship, and the Warmian-Masurian Voivodeship. It has access to the Baltic Sea to the north and west. The Pomeranian Voivodeship has a population of approximately 2.4 million (as of 2023), making it one of the most populous voivodeships in Poland. The Pomeranian Voivodeship has a well-developed road network, including the A1 and A6 motorways and the S6 and S7 expressways. The A1 connects Gdańsk with Łódź and southern Poland, enabling efficient communication with other regions of the country. Pomerania has a well-developed railway network, with main connections between Gdańsk, Gdynia, Sopot, and other large cities in Poland. The Gdańsk-Warsaw railway line is one of the key connections (Letkiewicz, Szulc, 2022). Gdańsk Lech Wałęsa Airport is one of the largest airports in Poland, serving domestic and international connections. Gdynia also has an airport, although of lesser importance. The ports in Gdańsk and Gdynia are crucial for transporting goods in the region and global trade. Gdynia is also a center for passenger shipping.

The Warmian-Masurian Voivodeship, located in the northeastern part of Poland, is one of the most beautiful regions of the country, known for its natural wealth, numerous lakes, and green areas (Nowak and Wiśniewska, 2022). This region combines agricultural, industrial, and tourist traditions, emphasizing sustainable development and environmental protection. The Warmian-Masurian Voivodeship has an area of 24,192 km², making it one of the largest voivodeships in Poland (approximately 7.7% of the country's area). It borders the following voivodeships: Pomerania, Masovia, Podlaskie, and the Kaliningrad Oblast of the Russian Federation. The Warmian-Masurian Voivodeship is inhabited by approximately 1.4 million people (as of 2023), making the region relatively less densely populated than other voivodeships in Poland.

It's worth noting that the voivodeship is connected to other parts of Poland via a network of national roads, including the S7 expressway (Warsaw-Gdańsk). The region also boasts a network of regional roads connecting smaller towns with larger cities. The Warmian-Masurian Voivodeship has a railway network connecting Olsztyn with other Polish cities,

including Warsaw, Gdańsk, Bydgoszcz, and Poland's eastern border. Olsztyn-Mazury Airport is the main airport in the region, serving both domestic and international connections. It is also a major passenger transport hub for tourists.

The West Pomeranian Voivodeship is located in the country's northwestern part, on the Baltic Sea. This region is strategically vital to Poland economically, touristically, and culturally. It is characterized by an extensive transport infrastructure, a strong maritime sector, and a dynamically developing economy. The West Pomeranian Voivodeship has an area of 22,892 km², constituting approximately 7.4% of Poland's total area. It borders Germany to the west, the Pomeranian Voivodeship to the east, and the Lubusz and Lower Silesian Voivodeships to the south. In the north, the region has access to the Baltic Sea. The West Pomeranian Voivodeship has a population of approximately 1.7 million (as of 2023). The West Pomeranian Voivodeship has a well-developed road network. The A6 motorway and expressways (S3) connect the voivodeship with other parts of Poland and Germany. West Pomerania also has a well-developed railway network, connecting Szczecin with other Polish cities, including Warsaw, Wrocław, and Poznań. There are also international connections with Germany (Kogut-Jaworska, Wankiewicz, 2018). Air transport: Szczecin-Goleniów Airport is the main airport in the region, offering domestic and global connections.

Additionally, the airport in Świnoujście serves smaller regional connections. The ports in Szczecin, Świnoujście, and Kołobrzeg are crucial for the maritime transport of goods and passengers. The primary tool for defining detailed goals and actions, aimed primarily at achieving fully sustainable development, but also helping to develop appropriate patterns, is development strategies. All of the surveyed voivodeships have adopted development strategies:

- Podlaskie Voivodeship Development Strategy 2030,
- Pomeranian Voivodeship Development Strategy 2030,
- Warmian-Masurian Voivodeship 2030. Socio-economic Strategy,
- West Pomeranian Voivodeship Development Strategy 2030.

This defines the concept of the voivodeships' functioning over several to a dozen or so years (Chen, 2021). The overarching development goal at every level of local government is a high quality of life, and the implementation tool is a strategy that forms the basis for regional development policy. Quality of life can be considered the result of actions undertaken by local government authorities (Augustyn, 2020). The Podlaskie, Pomeranian, Warmian-Masurian, and West Pomeranian voivodeships were selected for analysis because they represent diverse infrastructural, geographic, and socio-economic conditions in northern Poland. These regions encompass highly urbanized and economically well-developed areas (e.g., Pomerania, West Pomerania) and areas with lower population density and limited transport services (e.g., Warmian-Masurian, Podlaskie). This allows for identifying differences in the level of transport exclusion and assessing the impact of transport infrastructure on residents' quality of life in the context of sustainable development.

3. Sustainable development indicators as a tool for examining the quality of life in the aspect of communication exclusion

The concept of sustainable development is associated with constant challenges, activities, and constantly changing processes. Achieving this goal requires effective management and monitoring of ongoing activities. Implementing strategies, development plans, and programs allows for achieving sustainable development goals.

Indicators are a key tool in assessing progress, enabling the monitoring and analyzing ongoing tasks. Concepts such as indicator, measure, variable, characteristic, or category describe, estimate, and define selected phenomena. There is no accepted definition of an indicator in the literature – it is often used interchangeably with a measure (Andrews, Caldera, Johansson, 2013). Furthermore, there are inconsistencies in distinguishing the concepts of an indicator and an index. An indicator, expressed as an absolute or relative number (e.g., the percentage ratio of the analyzed values to the adopted base), describes the level of a given phenomenon and is an essential element of statistical analysis.

The use of indicators as information carriers has become widespread due to their multidimensionality, availability, unambiguity, and the possibility of comparing data. Many indicators and their sets are used to assess the development of voivodeships in the context of sustainable development (Razmjoo et al., 2021).

However, it is worth considering the readability and ease of analysis of many indicators used to monitor the quality of life (Kaniowski et al., 2025). An overly complex analysis can pose a challenge for local government employees. Therefore, research should focus primarily on developing indicators that will find practical application in the management of local government units (Xinyi Wang et al., 2021).

2.1. Usability as a tool for measuring communication exclusion as an element of quality of life

A system for monitoring the implementation of activities defined in development strategies should be a key management tool, enabling effective planning, optimal resource allocation, systematic evaluation, and adaptation of undertaken actions to dynamically changing socio-economic conditions. This process should be based on a standardized and repeatable methodology, ensuring high-quality analysis and comparability of results (Dol, Haffner, 2010).

The total and partial utility method enables a transparent and unambiguous assessment of the degree of implementation of the analyzed activities. With a properly selected set of indicators, this method is highly readable, and the interpretation and presentation of results become more transparent and objective.

Using sustainable development indicators within this method allows for determining the total utility of the analyzed voivodeships. Precise classification of the functions of individual indicators is crucial. They can serve as:

- stimulants (an increase in their value indicates a positive phenomenon),
- destimulants (an increase in their value is unfavorable). This analysis utilizes stimulants (stimulants) and destimulants (regressors), enabling a precise assessment of the impact of individual factors on the development of the analyzed territorial units. Partial utility determines the relative value of a given sustainable development indicator for the analyzed city about the value of that indicator in other towns (Alpopi, Iacoboaea, Stănescu, 2011). Its value is calculated individually for each indicator according to a specific mathematical formula:

$$U_{ij=}\frac{\mathrm{C}ij-\mathrm{C}_j^0}{\mathrm{C}_j^1-\mathrm{C}_j^0} \quad (1)$$

where:
U ij - partial utility of city i relative to indicator j,
C ij - value of sustainable development indicator j for voivodeship i,
Cj 0 - the lowest (for a sustainable development stimulant) or the highest (for a sustainable development destimulant) value of sustainable development indicator j among the surveyed voivodeships,
Cj 1 - the highest (for a sustainable development stimulant) or the lowest (for a sustainable development destimulant) value of sustainable development indicator j among the surveyed voivodeships.

The partial utility value takes values from the range [0, 1], where zero corresponds to the lowest level achieved by the voivodeship in a given indicator, and 1 indicates the highest – i.e., the reference value among the analyzed units. Therefore, a higher partial utility value indicates a better level of implementation of a given aspect of sustainable development.

The total utility is calculated using the following formula:

$$Gi = \sum_{j=1}^{n} Uij \quad (2)$$

The value of total utility depends not only on the values of the partial utilities, but also on the Number of indicators analyzed, as the highest possible value of total utility is equal to the sum of the indicators considered.

The total utility value depends not only on the values of the individual partial utilities, but also on the Number of indicators considered. It should be noted that the maximum value of total utility equals the sum of the values of all analyzed indicators.

This study calculated total and partial utilities for five indicators related to environmental governance, which undoubtedly contribute to improving the quality of life. A detailed list of indicators and their calculated utilities is presented in the table.

Indicators that best illustrate changes in transport exclusion regarding quality of life were selected for this study. The availability of current statistical data also determined the selection of these indicators. Among the destimulating indicators are: Fatalities per 100,000 inhabitants. Vehicles [person], while the stimulants were defined as: Total public roads per 100 km^2 [km], Passenger transport per capita [person], Number of passenger cars [pcs], Total railway lines per 10,000 population [km], Share of county and municipal roads with dirt surfaces in the total length of these roads [%], Bicycle paths per 10,000 population [km], Length of public transport lines per 1000 inhabitants [km], Number of Park & Ride parking lots [pcs].

Table 1.
Total and partial utility values of the surveyed voivodeships in 2020-2023

Voivodeship /indicator	**Podlaskie**	**Pomorskie**	**Warmińsko-mazurskie**	**Zachodnio-pomorskie**
2020				
Total public roads 100 km^2 [km] - S	1	0,84	0,09	0
Passenger transport per capita [person]- S	0,07	0,89	0	1
Number of passenger cars [pcs] S	0	1	0,48	0,93
Total railway lines per 10 thousand population [km] - S	0,45	0	1	0,68
Fatalities per 100,000 vehicles [person] - D	0,77	0,54	0	1
Share of district and municipal roads with dirt surfaces in the total length of these roads [%] - S	1	0,34	0,45	0
Bicycle paths per 10,000 inhabitants [km] - S	1	0,96	0	0,85
Length of public transport lines per 1000 inhabitants [km] - S	0,60	1	0	0,40
Number of parking lots in the Park & Ride system [pcs.] - S	0	1	0	0,2
Total utility	4,89	6,57	2,02	5,06
2021				
Total public roads 100 km^2 [km] - S	1	0,77	0,11	0
Passenger transport per capita [person]- S	0,49	1	0	0,89
Number of passenger cars [pcs] S	0	1	0,51	0,95
Total railway lines per 10 thousand population [km] - S	0,53	0	1	0,71
Fatalities per 100,000 vehicles [person] - D	0,18	1	0	0,65
Share of district and municipal roads with dirt surfaces in the total length of these roads [%] - S	1	0,26	0,43	0
Bicycle paths per 10,000 inhabitants [km] - S	1	0,80	0	0,88
Length of public transport lines per 1000 inhabitants [km] - S	0,67	1	0	0,50
Number of parking lots in the Park & Ride system [pcs.] - S	0,04	1	0	0,18
Total utility	4,91	6,83	2,05	4,76
2022				
Total public roads 100 km^2 [km] - S	1	0,63	0,15,	0
Passenger transport per capita [person]- S	0,54	1	0	0,87
Number of passenger cars [pcs] S	0	1	0,51	0,96
Total railway lines per 10 thousand population [km] - S	,0,55	0	1	0,69
Fatalities per 100,000 vehicles [person] - D	0,19	1	0	0,84
Share of district and municipal roads with dirt surfaces in the total length of these roads [%] - S	1	0,05	0,45	0
Bicycle paths per 10,000 inhabitants [km] - S	0,79	0,61	0	1

Cont. table 1.

Length of public transport lines per 1000 inhabitants [km] - S	0	1	0	0,33
Number of parking lots in the Park & Ride system [pcs.] - S	0	1	0,03	0,17
Total utility	3,52	6,29	1,99	4,86
2023				
Total public roads 100 km^2 [km] - S	1	0,45	0,13	0
Passenger transport per capita [person]- S	0,18	1	0	0,92
Number of passenger cars [pcs] S	0	1	0,50	0,96
Total railway lines per 10 thousand population [km] - S	0,7	0	1	0,67
Fatalities per 100,000 vehicles [person] - D	0	1	0,40	0,46
Share of district and municipal roads with dirt surfaces in the total length of these roads [%] - S	1	0	0,48	0,03
Bicycle paths per 10,000 inhabitants [km] - S	0,83	0,63	0	1
Length of public transport lines per 1000 inhabitants [km] - S	0,33	0,67	0	1
Number of parking lots in the Park & Ride system [pcs.] - S	0	1	0,08	0,46
Total utility	4,04	5,75	2,59	5,5

The analysis was based on the most complete statistical data available for years. Table 1 lists nine indicators, so the hypothetical highest total utility value is 9; none of the analyzed voivodeships achieved this (maximum) value. Significant disparities exist between the analyzed cities (1.99-6.83). The highest total utility value was observed in 2021 in the Pomeranian Voivodeship (6.83). The lowest utility values were observed in the Warmian-Masurian Voivodeship in 2022, reaching 1.99. In the remaining voivodeships, utility values ranged between the Podlaskie Voivodeship (4.91-3.52) and the West Pomeranian Voivodeship (5.5-4.76).

To comprehensively analyze the obtained results, it is necessary to relate the total utility values of individual voivodeships to a reference value, referred to as the reference vector. This vector serves as a reference point, representing the highest possible rating a given voivodeship could achieve within the adopted set of criteria. Its numerical value is defined by the sum of the maximum ratings assigned to each analyzed indicator. This comparison allows for determining the degree of compliance between actual results and the ideal model and identifying areas requiring intervention to optimize the analyzed parameters further. In the case of the analysis of nine indicators, the benchmark vector is 9.

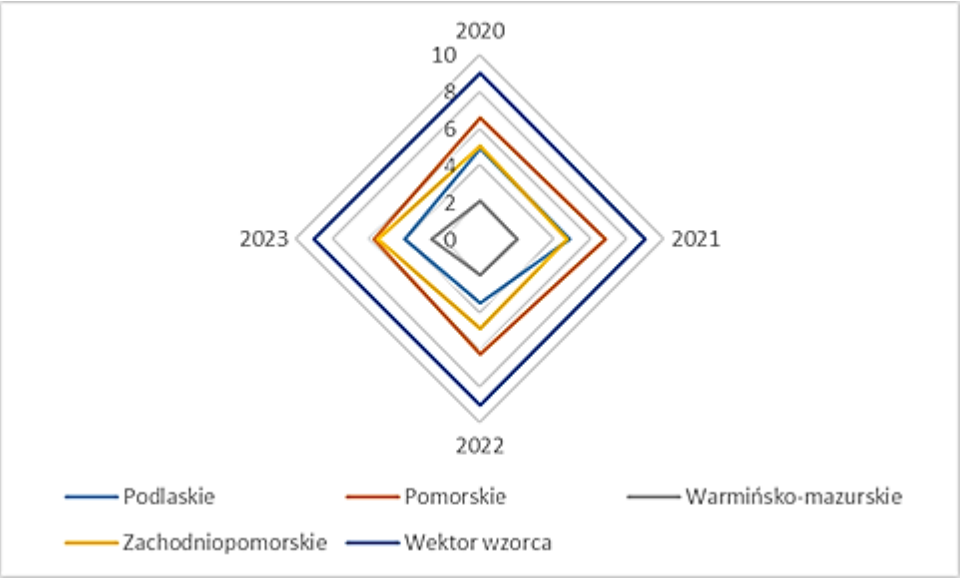

Figure 1. Total utility value compared to the benchmark vector.

Source: own study

The Pomeranian Voivodeship exhibits the highest values, close to the 6-7 range, which places it closest to the benchmark and indicates its relatively highest quality for the analyzed parameter. Values in the West Pomeranian Voivodeship range around 4.7-5.5, while the Podlaskie Voivodeship exhibits lower values, ranging from 3.5-4.9. The lowest values were recorded in the Warmian-Masurian Voivodeship, where values were around 2.

Analysis of time trends indicates that the Pomeranian Voivodeship remains at the highest level for most years, although a slight decline was observed in 2023. The West Pomeranian Voivodeship is characterized by an initial decrease in values in 2021, followed by an increase. The Podlaskie Voivodeship recorded a decline in 2022 with a subsequent rebound, while the Warmian-Masurian Voivodeship maintained relatively stable and low values, with a slight increase in 2023.

In summary, the Pomeranian Voivodeship stands out as the best in terms of the analyzed indicator, consistently achieving the highest results throughout the study period. The remaining voivodeships show lower values and a significantly greater distance from the adopted benchmark, which may indicate the need for further action to improve their results.

Voivodeships characterized by low road infrastructure usability, such as the Warmian-Masurian Voivodeship and the West Pomeranian Voivodeship, require priority modernization of their district and municipal road networks. Asphalting existing dirt surfaces is particularly important, significantly improving road accessibility and user comfort. Furthermore, increasing the density of the public road network per unit area will shorten distances to key service points, positively impacting residents' mobility in these regions. In parallel, passenger and public transport options should be developed, especially in voivodeships with low per capita ridership, such as Podlaskie and Warmińsko-Mazurskie. Expanding urban and inter-municipal transport connections, particularly in rural and peripheral areas, along with the introduction of more

frequent services, better connections with other modes of transport, and modern information solutions, such as mobile apps with timetables, is a necessary step towards increasing the attractiveness of public transport. Increasing the availability of discounted tickets and promotions is also essential to encourage residents to use these services.

Voivodeships with high road fatality rates should focus on intensifying preventive and educational initiatives aimed at all road users, including drivers, pedestrians, and cyclists. Safety campaigns and training, along with modernizing dangerous road sections by introducing additional signage, speed bumps, lighting, and safety barriers, aim to reduce the number of accidents and fatalities. Considering increased traffic police patrols and implementing monitoring and automatic enforcement systems is essential to the safety improvement strategy.

In the context of developing cycling infrastructure, regions with a low number of cycle paths per 10,000 inhabitants, such as the Warmian-Masurian Voivodeship, should plan and implement a network of safe, coherent, and well-marked cycle routes that will connect residential areas with places of work, education, and recreation. Introducing bicycle subsidy programs and promoting cycling as a healthy and ecological transport alternative can significantly increase the share of this mode of transport. Integrating cycling infrastructure with public transport, for example, by installing bicycle racks at stations and stops, further enhances the functionality of the transport system. Expanding the Park & Ride (P&R) system is a key element in improving urban mobility. Voivodeships with a few P&R parking lots should plan the location of new parking lots on the outskirts of cities and at transportation hubs to encourage drivers to leave their cars and use public transportation. Facilitating the integration of public transportation tickets with P&R services and introducing real-time information systems on parking space availability are critical solutions supporting this system. Promoting Park & Ride as an ecological way to reduce car traffic in city centers can improve residents' quality of life.

Voivodeships with a low ratio of railway lines per 10,000 inhabitants should consider investing in revitalizing and expanding local railway lines, which can provide a fast and environmentally friendly alternative to car transport. Supporting the integration of rail with other modes of transport, such as buses, bicycles, and cars, by creating multimodal transfer hubs allows for efficient transport infrastructure. Establishing a system for regular, annual monitoring and analysis of infrastructure utility indicators in individual voivodeships is also essential. Such activities will enable the rapid identification of trends and areas requiring intervention and the optimization of financial allocation for infrastructure development and safety improvements.

Finally, supporting interregional cooperation, particularly promoting the exchange of experiences and best practices, as exemplified by the Pomeranian Voivodeship, can contribute to the more coherent and effective transport infrastructure development. Joint planning and implementation of transport projects fosters the harmonization of activities and the exploitation of regional synergies.

4. Conclusions

The analysis of partial and total utility for nine indicators related to transport exclusion allowed us to assess the degree of sustainable development of public transport and road infrastructure in selected voivodeships of northeastern and northwestern Poland in 2020-2023. The results indicate significant variation in the level of utility between the studied regions. The highest values of total utility were observed in the Pomeranian Voivodeship, which in 2021 reached a value of 6.83, closest to the benchmark value (9). Pomerania stands out for its favorable indicators regarding the length of public transport lines, the number of passenger cars, and the availability of the Park & Ride system, which indicates effective transport infrastructure management. In contrast, the Warmian-Masurian Voivodeship consistently recorded the lowest utility values (e.g., 1.99 in 2022), which may indicate significant transport exclusion and insufficient infrastructure and public transport development. The conclusions from the conducted research allow us to formulate several key observations:

- A high value of total utility is closely linked to a well-developed public transport infrastructure and low traffic hazards (destimulants).
- There is a clear need to redress regional disparities through investments in public transport, improved road accessibility, and the development of alternative modes of transport (bicycles, rail).
- Continuous monitoring of utility indicators can effectively manage regional development, enabling data-driven decision-making.

In summary, the analysis results confirm the thesis that the varying levels of transport infrastructure development in Poland impact the quality of life of residents and the degree of their transport exclusion. They also point to the need for a coherent, long-term transport policy based on indicator-based assessment of the effectiveness of public actions.

This method can therefore be an effective diagnostic tool for public policymakers, urban planners, and researchers of regional development.

5. Summary

Improving the quality of life remains the primary development goal of local government units, and its growth must be consistent with the principles of sustainable development. However, the lack of access to efficient means of transportation limits residents' social and economic functioning. This article aims to analyze the impact of transport exclusion on residents' quality of life in northern Poland's voivodeships. A diagnosis of the problem, its leading causes, and possible countermeasures are presented. The accessibility of public

transport is identified in the context of the region's demographic and geographic conditions, and proposals for transport policies aimed at improving the situation are presented.

As information carriers, indicators play a key role in analyzing and evaluating various aspects of voivodeship development. Their popularity stems from multidimensionality, accessibility, clarity, readability, and the ability to compare results across spatial and temporal contexts. Numerous indicators and comprehensive indicator systems exist that allow for assessing the degree of implementation of sustainable development objectives for local government units.

However, the growing number of indicators in use poses challenges related to their analysis, interpretation, and use in decision-making processes. Public and local government officials responsible for planning and monitoring city and district policies often encounter challenges related to analyzing large data sets and processing multidimensional indicators. Therefore, a key research issue is the selection of appropriate indicators and the development of tools enabling their practical use. The system for monitoring activities included in development strategies should serve as an advanced strategic management tool, enabling effective planning, rational allocation of financial resources, and ongoing assessment and optimization of undertaken activities in the context of dynamically changing socio-economic conditions. Using a standardized and repeatable evaluation methodology is crucial, ensuring consistency of analyses and enabling comparison of results over time and across space.

One approach used in the analysis of indicator data is the total and partial utility method, which transparently allows for the assessment of the degree of achievement of established strategic goals. Its use becomes particularly important when the analyzed set of indicators is extensive and multidimensional, as it allows for aggregating results and their more straightforward interpretation. The transparency and clarity of this method support decision-making processes, contributing to more effective management of the development of local government units.

Partial utility refers to the relative value of individual indicators about a specific voivodeship and its position relative to other units. This approach allows for identifying strengths and weaknesses in the analyzed area and identifying priority areas for intervention. As a result, implementing sustainable provincial/city policies can be more effective and tailored to actual socio-economic needs, particularly when monitoring the quality of life in local government units and verifying planning and strategic assumptions.

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