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TRANSPORT SUFFICIENCY OF ADMINISTRATIVE DISTRICTS OF VOLYN REGION

В. Й. Лажнік, Л. О. Маковецька, Я. С. Сосницька. ТРАНСПОРТНЕ ЗАБЕЗПЕЧЕННЯ АДМІНІСТРАТИВНИХ РАЙОНІВ ВОЛИНСЬКОЇ ОБЛАСТІ. Проаналізовано транспортну забезпеченість адміністративних районів Волинської області з використанням різних кількісних параметрів та індикаторів. Наведено дані в розрізі адміністративних районів області по протяжності автомобільних і залізничних шляхів як головних компонентів транспортної системи області. Прослідковується певна залежність протяжності транспортних мереж від площі та конфігурації території районів і кількості населених пунктів. Розраховано густоту автошляхів і залізниць в адміністративних районах Волині на 1000 кв. км площі території і на 1000 жителів, а також індекси транспортної забезпеченості Е. Енгеля, Г. Гольца та Ю. Успенського. Виявлено особливості просторової диференціації показників транспортної забезпеченості адміністративних районів області. На основі сумування розрахованих часткових індексів транспортної забезпеченості та визначення їхнього середньозваженого значення за агломеративно-ієрархічною процедурою нормування вихідних параметрів отримано синтезований параметр, який може бути оцінений як інтегральний індекс рівня транспортної забезпеченості території районів Волині. Відповідно до значень інтегрального індексу, що відображає комплекс розглянутих характеристик транспортної мережі, виділено п'ять типів районів за рівнем транспортної забезпеченості їхніх територій. Встановлено, що найвищий рівень транспортної забезпеченості мають центральні і південні райони області з вигідним транспортно-географічним положенням й протяжною мережею автошляхів і залізниць. Найнижчий рівень транспортної забезпеченості мають північні поліські райони через лісистість, заболоченість та невисокий рівень господарської освоєності території. Виявлено проблеми розвитку транспортної інфраструктури в районах Волинської області та вказано перспективні шляхи оптимізації рівня їхньої транспортної забезпеченості.

Ключові слова: автошляхи, залізниці, густина шляхів сполучення, інтегральний індекс, транспорт, транспортна забезпеченість, транспортна мережа, район.

В. И. Лажник, Л. А. Маковецкая, Я. С. Сосницкая. ТРАНСПОРТНАЯ ОБЕСПЕЧЕННОСТЬ АДМИНИСТРАТИВНЫХ РАЙОНОВ ВОЛЫНСКОЙ ОБЛАСТИ. Проанализировано транспортную обеспеченность административных районов Волынской области с использованием различных количественных параметров и индикаторов. Приведены данные в разрезе административных районов области по протяженности автомобильных и железных дорог как главных компонентов транспортной системы области. Прослеживается определенная зависимость протяженности транспортных путей сообщения от площади и конфигурации территорий районов и количества населенных пунктов. Рассчитано плотность автодорог и железных дорог в административных районах Волины на 1000 кв. км площади территории и на 1000 жителей, а также индексы транспортной обеспеченности Е. Энгеля, Г. Гольца и Ю. Успенского. Вывявлены особенности пространственной дифференциации показателей транспортной обеспеченности административных районов области. На основе суммирования рассчитанных частных индексов транспортной обеспеченности и определения их средневзвешенного значения по агломеративно-иерархической процедуре нормирования выходных параметров получено синтезированный параметр, который может быть оценен как интегральный индекс уровня транспортной обеспеченности территории районов Волины. В соответствии со значениями интегрального индекса, отражающего комплекс рассматриваемых характеристик транспортной сети, выделено пять типов районов по уровню транспортной обеспеченности их территорий. Установлено, что высокий уровень транспортной обеспеченности имеют центральные и южные районы области с выгодным транспортно-географическим положением и протяженной сетью автодорог и железных дорог. Самый низкий уровень транспортной обеспеченности имеют северные полесские районы через лесистость, заболоченность и невысокий уровень хозяйственной освоенности территории. Вывявлены проблемы развития транспортной инфраструктуры в районах Волынской области и указаны перспективные пути оптимизации уровня их транспортной обеспеченности.

Ключевые слова: автодороги, железные дороги, плотность путей сообщения, интегральный индекс, транспорт, транспортная обеспеченность, транспортная сеть, район.

Formulation of the scientific problem. The constant expansion of economic relations, the growing importance of international integration and economic cooperation is one of the major trends of the world economy. Contemporary development of Ukraine, oriented towards integration into European

and world structures, determines priority directions in foreign and national policy, envisages the creation of conditions for free movement of goods, services, capital, labor. The development of social and economic processes, stipulated by the growth of transnational flows and the international transit of goods

and passengers through the territory of the border regions of Ukraine, increase the importance of transport. Volyn region, the geographical location, and the transport communications system of which define it as a region with significant transit potential and objectively intended to play the role of a communication bridge in the transport and foreign economic relations that are formed on the main axes of European trade and traffic flows. Therefore, an important scientific issue is the social and geographical study of the features of transport sufficiency of the territory of Volyn region and its regions, since the developed transport system forms the “mainframe” of the region and determines the dynamism and effectiveness of its social and economic development.

Analysis of current research and publications. In modern scientific literature, transport is often analyzed as a factor of productive forces development. It creates spatial advantages in the functioning of different territories and economic objects, expressed in their transport and geographical position. According to V. Buhromenko, the specifics of the economic-geographical approach in its study is in the peculiarities of the spatial transport functioning, since the territorial organization of manufacturing is the result of partially or fully realized opportunities provided by transport, and the limits of spatial interaction of production are limited by the possibilities of transport infrastructure [1, p. 7]. In foreign scientific literature, there is a discussion on the strategic goals of transport. The discussion is launched in 2008 in the scientific journal “Transport Reviews” [2], where the systemic spatial indicator, such as transport sufficiency of territories, settlements, and various objects, is most often preferred. The concept of transport sufficiency and transport sufficiency of the territories was offered by V. Buhromenko in his work on the reliability of the territorial organization of society from the communication aspect [3]. This concept is based on the idea of transport-infrastructure reliability of territories and its measure - «integrated transport accessibility», which includes two types of reliability: technical and topological (configuration reliability of the transport network). Theoretical issues of the territorial organization of society and transport sufficiency are outlined in the works of such foreign scientists as V. Buhromenko [4], K. Geurs [5], T. Litman [6], A. Marcusen [7], D. Metz [2], R. Servero [8], S. Tarkhov & S. Shlikhter [9] and others. In particular, the works of T. Litman [6], D. Metz [2], U. Hansen [10] and other foreign scientists highlight the question of the study of the obtaining transport services potential from the position of transport sufficiency, which depends on the level of security of the territories using communication. In developed countries, transport networks are considered as an important

prerequisite for regional development, which determines the directions of the economic specialization, and the complex development of regions, the formation of territorial-industrial complexes. That is why it was decided to assess the transport sufficiency level, it is essential to analyze the level of transport sufficiency of the territories by the transport network, which determines the possibilities of obtaining transport services.

Many Ukrainian scientists consider the issues of transport infrastructure security as a key and basis for the economic development of territories in the context of Ukrainian integration into the European and world community. Most of the modern publications are dedicated to studies of the territorial organization of the transport system in the territories of different taxonomic levels of Ukraine, transport sufficiency of settlements, features of transport infrastructure functioning, etc. In particular, these issues are covered in the writings of M. Hryhorovych, V. Hrytsevych, E. Kachan, K. Kotsenko, N. Pashynska, L. Tarangul, O. Topchiiev, O. Shablii and others.

The peculiarities of the transport system functioning in Volyn region from the point of geographical science are considered in the publications of V. Lazhnik [11], A. Maister [12; 13], L. Makovetska, S. Puhach, and Ya. Sosnytska [14], L. Matviychuk [15], O. Pikulyk [16] and others. The problems of territorial differentiation of transport development levels in the territory of Volyn region and its districts are considered in the works of A. Maister. The grouping of administrative districts by the integrated index of transport development of the territory is made [12]. L. Matviychuk analyzed the main priorities of the transport system functioning in Volyn region in the context of ensuring European integration processes [15]. O. Pikulyk considered the problems of transport infrastructure provision of social and economic development of the regions of Western Ukraine, including Volyn region [16]. At the same time, the problems of complex assessment of the transport sufficiency level, security, and permeability of the territory of Volyn region are insufficiently considered in modern scientific works, which led to the choice of the topic of our research.

Highlighting previously unsettled problem constituent. Analysis of the scientific research on transport sufficiency of administrative districts of Volyn region shows insufficient attention to the modern problems of territorial organization of its transport system, which is constantly being improved in different directions - technical, technological and organizational and in the context of improvement, problems identification, and functioning prospects.

In the current scientific literature, the transport sufficiency level of administrative districts in Volyn

region was carried out mainly based on the density of transport networks per unit of land. Also, the spatial differences in the levels of transport network development of districts are not sufficiently covered, because the modern parameters of their transport networks have not been determined using various security indices in the context of changes in the transport and geographical position of the region and in the conditions of our country's participation in the construction and formation of international transport corridors. That is why a comprehensive study of the transport sufficiency levels of the administrative districts in the border regions, as a result of the process of transport development of geo-space, is a topical trend of modern regional economic and geographical research.

Formulating the purpose of the article. The main purpose of the study is to carry out a comprehensive assessment of the spatial differentiation of the transport sufficiency levels of the administrative districts in Volyn region by land routes. There are the following objectives of the study:

- to determine the transport sufficiency level of administrative districts in the region using the basic indicators of transport system development in the region;
- to conduct grouping of administrative districts in the region by the integrated transport sufficiency index;
- to identify problems and prospects of the district transport system functioning in the region.

Outline of the main research material. In the socio-geographical studies of the transport systems in the districts, it is important to analyze the indicators characterizing the transport and infrastructure security of the territory, where the main basic element is the land routes network, which forms the linear elements of the transport system in the region.

In social geography, transport networks are considered as frameworks of territorial organization of population settlement and economy of a country or region. The types of territorial structures of economic complexes are determined by the mutual location of the main economic centers and transport highways and their configuration [17, p. 522]. The more sophisticated, diverse, and extensive the transport network, the more efficient vehicles operate, the more favorable the transport position of any site. The favorable transport and geographical position contribute to the socio-economic development and improves the conditions for the internal and external trade connections of the regions covered by transport corridors.

The transport network is formed in the process of economic development of a certain territory, an integral part of which is the creation of a transport communications network, which is embedded in the

understanding of “transport development of the territory”. The latter is often regarded as a necessary and paramount part of the overall economic development of the territory, which involves the creation of a large number of land structures, the arrangement of natural waterways for navigation and the subsequent exploitation of putting into operation routes [12, p. 107; 18, p. 22]. Besides, the “transport development of the territory” is interpreted as not just the technical provision of the territory by transport routes, but as the compliance of the transport network with the economic needs of a particular territory, and is a consequence of economic development, therefore reflects the main aspects of socio-economic development of the country or region [13, p. 123].

At present, there is no single system of indicators enabling a comprehensive assessment of the transport sufficiency of territories of different taxonomic levels. In the domestic literature, to assess the degree of transport infrastructure development, the transport development level of the territory and the characteristics of the basic transport-geographical relations, most often used block of traditional and alternative indicators, which are built based on linear and designed to assess the level of development of transport sufficiency of territories taking into account the economic activity – E. Engel, Yu. Kato, G. Goltz, Yu. Uspensky, L. Vasylevsky and others. [19; 20, etc.].

One of the simple quantitative indicators reflecting the features of transport development and security level of a certain area of the transport network is its density, which is expressed by the ratio of the connection length to a unit area or a certain number of inhabitants (calculated per 1000 km² or 1000 inhabitants of the territory). Both of these indicators can be combined, and calculated according to Engel's coefficient (Engel – Kato coefficient) [21, p. 40]:

$$Ke = \frac{L}{\sqrt{SP}}, \quad (1)$$

where L – length of the transport network, km; S – square of the studied land, km²; P – number of inhabitants, thousand people.

G. Goltz suggested to determine the transport sufficiency of the territory by comparing the length of interconnection routes with the square of the territory and the number of settlements [22; 23]:

$$Kg = \frac{L}{\sqrt{NS}}, \quad (2)$$

where L – length of the transport network, km; N – number of settlements; S – area of the study area, km². G. Goltz's coefficient is a modification of Engel's coefficient because it gives a more accurate

picture of the level of transport development of the territory, given that the same transport routes connect settlements with different populations.

Yu. Uspensky introduced another indicator in Engel's formula – the number of transported goods (in tons) [21, p. 40]:

$$Ku = \frac{L}{\sqrt[3]{SPT}}, \quad (3)$$

where L – length of the transport network, km; S – area of the study area, km²; P – number of inhabitants, thousand people; T – the number of transported goods, ths. t. This formula often estimates the transport sufficiency of the countries or regions territories.

L. Vasylevsky modified Yu. Uspensky's formula by replacing the volume of goods transported in tones by the total weight of the output [19]. Such an indicator also does not characterize the degree of security of the territory by transport, since it does not reflect the features of either the network itself, neither the production and consumption of the products produced nor the transport-geographical relations. When transporting goods and passengers, some modes of transport may be replaced by others, so one of them cannot be judged on the degree of transport sufficiency of the territory of the region. For the calculation of the transport network security indicator, the indicators should be comparable. L. Vasylevsky offered joint equivalents for different types of transport, reduced to the capacity of railways: 1 km of railways – 1.0, paved roads – 0.15, motorways – 0.45, natural soil roads – 0.01, oil pipelines and waterways – 1.0, gas pipelines – 0.3 [24, p. 34].

The offered formulas, however, do not allow to establish a true degree of the transport sufficiency of the territory due to the non-equivalence of different routes in the absence of a comparable indicator, not taking into account the quality of roads and passengers, the peculiarities of the location of productive forces and their transport and economic connections, etc. Therefore, the main criterion for assessing the transport sufficiency of the territory is the correspondence of the directions of transport and economic connections and their capacity of the configuration of the transport network taking into transport permeability, and connectivity of the territory, accessibility of economic centers to the transport network. Regions, where transport and economic relations do not meet this criterion, are considered to be unsecured or insufficiently secured transport routes [21, p. 42].

The indicator of the total length of routes in the studied area gives only a general idea of the level of its transport sufficiency. Table 1 presents data in the section of administrative districts in Volyn region on the length and density of roads and railways, as the

main components of the transport system in the region. The analysis of indicators traces a certain dependence of the length of transport routes on the area and configuration of districts territories and the number of settlements in them.

The calculation of the density of the communication routes, taking into account the areas and population of the territories, does not quite correctly reflect the level of security of the territories by the communication routes. Therefore, it is advisable to make calculations based on other methodological approaches, in particular, by the coefficients of E. Engel, G. Goltz, and Yu. Uspensky (see formulas 1–3), with the reduction of all paths of conjugation to a comparable value and the methodological approach proposed by L. Vasylevsky [24, p. 34]. We calculated the total length of land routes for Volyn region (Table 2) according to the method of L. Vasylevsky. The length of the communication paths is used, given in Table 1.

Calculations of the total length of all land routes, bringing them to the capacity of the railways more accurately reflect the degree of provision of the territory of the districts with transport infrastructure and make it possible to compare them with each other. Thus, Kovel district has the largest length of roads, occupying a central transport and geographical position in the region. Manevychi, Horokhiv, Kivertsi, Lutsk and Volodymyr-Volynskiyi districts are relatively well provided with transport routes, as there are international and national highways and railways through their territories. Shatsk, Lokachi and Liubeshiv districts are insufficiently provided with a transport network since they have a small length of highways and no railways (Table 2).

The calculations of the roads density and the values of E. Engel, G. Goltz and Yu. Uspensky coefficients on the reduced length of transport communications to the capacity of railways, although they do not reflect the sufficiency or optimality of the transport network, are still important comparative indicators of transport sufficiency of districts in Volyn region. In essence, the transport sufficiency level of the territory is an integrated (synthetic) indicator, the quantitative value of which is a procedure for reducing various sizes and scales of partial indicators to a single value by the procedure of rationing (standardization) of selected indicators, which ensures their comparability. The normalization of the initial indicators was carried out according to the agglomerative-hierarchical procedure of standardization, which is often used in the classification of various geographical objects [25]. The standardization procedure for indicators was performed according to the following formula:

$$\overline{X_{ij}} = \frac{X_{ij} - X_{\min}}{X_{\max} - X_{\min}}, \quad \begin{matrix} i = 1, 2, 3, \dots, n; \\ j = 1, 2, 3, \dots, m, \end{matrix} \quad (4)$$

Table 1

The length and density of communication routes in administrative districts of Volyn region on 01.01.2018 *

Administrative districts	Length of highways of all categories, km	Length of railways, km	Density of highways, km on 1000 km ²	Density of highways, km on 1000 inhabitants	Density of railways, km on 1000 km ²	Density of railways, km on 1000 inhabitants
Volodymyr-Volynskyi	397,7	53	376,6	6,27	50,2	0,84
Horokhiv	489,0	52	435,6	9,61	46,3	1,02
Ivanychi	284,2	20	428,3	3,24	30,2	0,23
Kamin-Kashyrskyi	352,8	26	201,9	5,48	14,9	0,4
Kivertsi	449,0	40	317,5	7,09	28,3	0,63
Kovel	517,4	176	292,3	4,75	99,4	1,62
Lokachi	314,4	-	441,6	14,30	0	0
Lutsk	441,1	39	249,9	1,58	38,4	0,14
Liubeshiv	330,7	-	228,1	9,23	0	0
Liuboml	384,6	32	259,7	9,90	21,6	0,82
Manevychi	479,8	49	211,8	8,87	21,6	0,91
Ratne	454,9	18	316,6	8,73	12,5	0,35
Rozhyshe	341,2	28	367,7	8,79	30,2	0,72
Stara Vyzhivka	363,8	31	324,5	12,10	27,7	1,03
Turiisk	377,3	29	313,1	14,50	24,1	1,11
Shatsk	217,4	-	286,4	13,00	0	0
Volyn region	6195,3	593	307,6	6,00	29,4	0,57

* Calculated by the authors according to the Roads Service in Volyn region and Lviv Railway.

Table 2

The duration and less efficiency of the roads connecting the districts of Volyn region are given *

Administrative district	The total length of transport routes, reduced to the capacity of railways, km	Engel's coefficient, K_e	Goltz's coefficient, K_g	Uspensky's coefficient, K_u	Integral index of transport sufficiency, I_{ts}
Volodymyr-Volynskyi	141,5	0,55	0,49	0,31	0,577
Horokhiv	157,6	0,66	0,49	0,51	0,707
Ivanychi	85,1	0,35	0,42	0,28	0,377
Kamin-Kashyrskyi	109,6	0,33	0,33	0,37	0,218
Kivertsi	148,6	0,50	0,46	0,28	0,437
Kovel	296,6	0,68	0,73	0,56	0,877
Lokachi	67,5	0,54	0,34	0,46	0,475
Lutsk	145,4	0,27	0,49	0,12	0,340
Liubeshiv	92,5	0,41	0,35	0,68	0,294
Liuboml	118,7	0,49	0,37	0,68	0,486
Manevychi	167,7	0,48	0,42	0,43	0,412
Ratne	120,9	0,44	0,38	0,54	0,400
Rozhyshe	109,3	0,58	0,43	0,68	0,600
Stara Vyzhivka	117,3	0,64	0,51	0,83	0,702
Turiisk	127,5	0,72	0,42	0,54	0,662
Shatsk	34,0	0,30	0,22	0,58	0,278
Volyn region	2061,0	0,45	0,44	0,32	0,405

* Calculated by the authors.

where \bar{X}_{ij} – normalized value of the indicator; X_{ij} – partial indicators of transport sufficiency of the districts; X_{min} – the worst values for each indicator of all taken for calculations; X_{max} – the largest values of indicators; n – the number of studied territorial units; m – the number of indicators taken for calculations. Obtaining an integral characteristic is performed on the basis of a vector of dimension D (m). It shows the degree of remoteness (proximity) of all

administrative units from the conditional one, which has the worst evaluation indicators, in our case – from the conditional “worst provided” area. For calculations, the values of 7 partial indicators such as the density of roads and railways per 1000 km² of territory and 1000 inhabitants, the values of the coefficients of E. Engel, G. Goltz and Yu. Uspensky were taken.

Based on summing up partial indexes of trans-

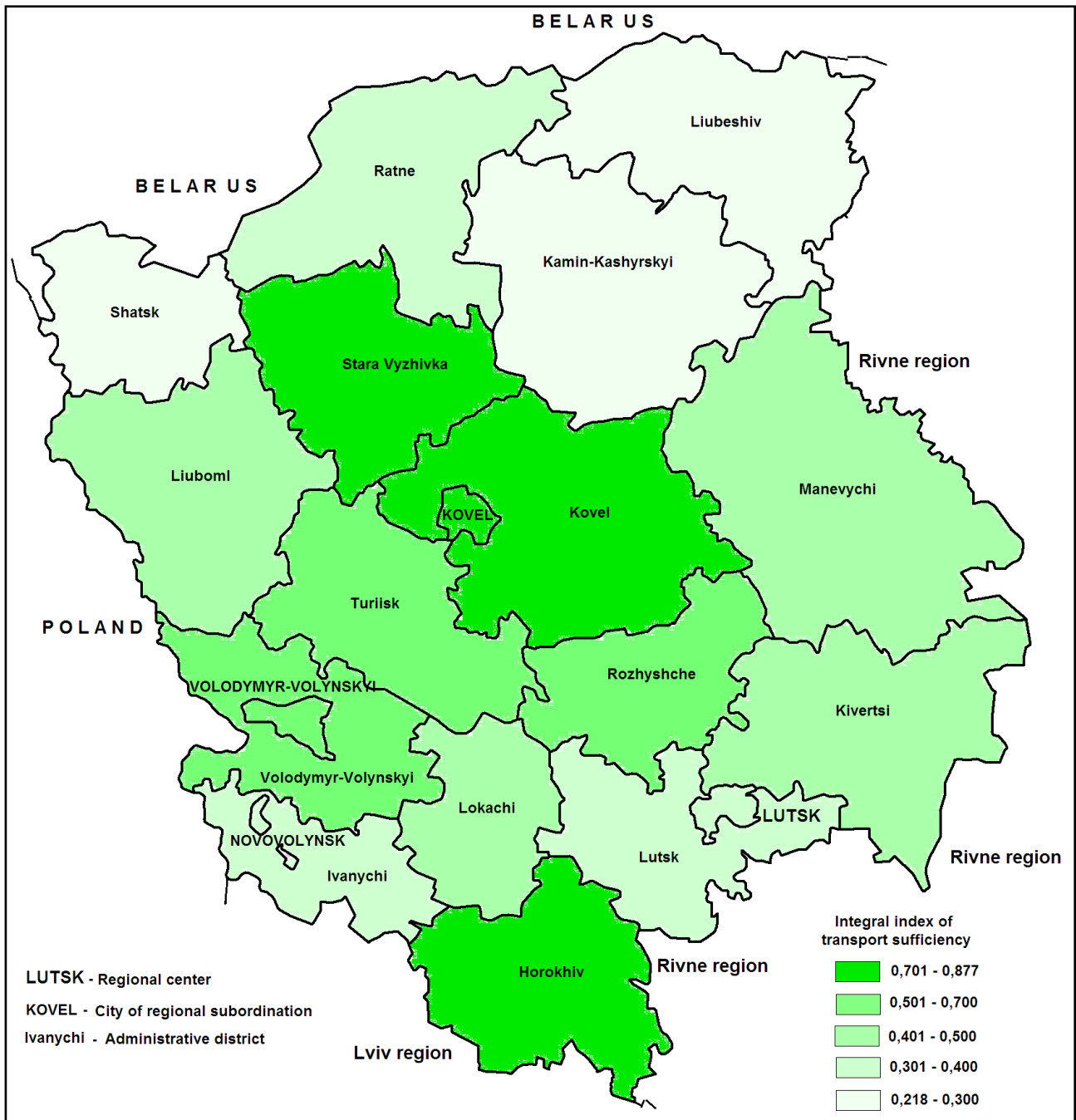


Fig. 1. Integral index of transport sufficiency of districts of Volyn region

port sufficiency and determination of their weighted average value, a synthesized parameter I_{ts} was obtained. It can be estimated as an integral index of the level of transport sufficiency of the territory of a

separate district in Volyn region (Fig. 1). The value of the integrated transport sufficiency index of the I_{ts} areas ranges from 0.22 to 0.88 (Table 2) and is dimensionless, which expresses the cumulative ef-

fect of taking into account partial indicators of transport sufficiency.

According to the values of the integral indicator *I_{ts}*, which reflects the set of considered characteristics of the transport network of Volyn region, we can distinguish five types of administrative districts according to the level of transport sufficiency of their territories. Thus, Kovel, Horokhiv and Stara Vyzhivka districts have the highest level of transport sufficiency, which is characterized by a favorable transport and geographical position and a long network of roads and railways. Turiisk, Rozhyshe and Volodymyr-Volynskiy districts have above-average levels of transport sufficiency. Areas with average levels of transport sufficiency include Liuboml, Lokachi, Kivertsi and Manevychi districts. Ratne, Ivanychi and Lutsk districts have an insufficient level of transport sufficiency. The poorly provided with transport network districts are Liubeshiv, Shatsk and Kamin-Kashyrskiy (Fig. 1).

The territory of Volyn region is heterogeneous in terms of economic development, formed settlement, transport network, and natural conditions. Accordingly, the level of transport infrastructure in different parts of the region is diverse. The central and southern districts have the best transport sufficiency of the territory, while the northern districts are insufficiently provided with transport infrastructure due to forest cover, swamps, and low level of economic development.

The main problems of the transport system development in Volyn region are: 1) poor condition of the transport infrastructure, compared to the neighboring countries and regions of Ukraine, which reduces the volume of transit cargo and passenger traffic; 2) considerable deterioration of the rolling stock of transport, which leads to a decrease in its speed and quality of rendering of transport services; 3) low share of the first category roads in the network of all public roads (less than 1%); 4) extremely unsatisfactory condition and insufficient roads in the Polissia districts of the region; 5) a sharp decrease in the share of the railway network in freight and passenger traffic; 6) unsatisfactory capacity of checkpoints on the state border with Poland and Belarus and the need to modernize them in order to speed up the procedure of customs and border control; 7) underfunding of the road sector and untimely repair works, both on public roads and communal roads, which leads to the destruction of their coverage, etc.

The inconsistency of the operational characteristics of public roads with modern requirements for equality and rigidity, the inconsistency of their development with the pace of motorization in the region remains an essential problem. It has a drastic effect on the reduction of the main highways capacity, transport connectivity, and accessibility of espe-

cially peripheral territories and settlements. Currently, the worst situation is on the highways M-19 “Domanove–Kovel–Chernivtsi–Terebleche”, R-15 “Kovel–Volodymyr-Volynskiy–Zhovkva”, “Mayunychi-Velyka Osnysia–Kolky–Rozhyshe–Torchyn–Shklin”, “Lviv–Radekhiv–Lutsk”, M-07 “Kyiv–Kovel–Yagodyn”. There are areas affected by inflows, ruts, unevenness, and sagging of the roadway. Therefore, there is an urgent need to repair the road surface, especially on highways of territorial and local importance. In rural areas, the level of transport and road infrastructure development is of insufficient quality, especially in Polissia districts of the region, where some villages do not have a stable bus service.

Border infrastructure at international checkpoints on the borders with Poland (Yagodyn–Dorogusk and Ustyluh–Zosin) and with Belarus (Domanove–Mokhrany and Dolsk–Mokhro) also needs to be developed. There is a need to build new checkpoints on the border with Poland near Novovolynsk and Shatsk. All this would significantly improve the level of transport sufficiency of Ivanychi and Shatsk districts as border districts and the region in general.

The transport system of Volyn region due to insufficient development requires a separate comprehensive and systematic approach to its improvement and reform, optimization of its functioning, and increase the level of transport sufficiency of districts and settlements of the region. A promising direction in the context of optimizing the functioning of the transport system of the region is the implementation of an investment project for the reconstruction of highways M07 “Yagodyn–Kovel–Kyiv” and M19 “Domanove–Kovel–Chernivtsi–Mamalyga”, which are included in the system of European ITCs, which will increase the transit potential of the region and the capacity of roads in the future.

An important priority in the context of optimizing the functioning of the transport system of the region is the introduction of high-speed rail and electrification of heavy railway lines. There is a need to create a transport and logistics center in Kovel, which is the largest transport hub in the region, to increase the logistics efficiency of the transport system and the transit potential of Volyn [26, p. 8]. Among other promising priorities for the transport system development and improving the transport sufficiency of the region there are the following:

- ensuring a high level of transport sufficiency of districts and settlements and the quality of transport services for the population of the region by increasing and improving the network of roads and the structure of the fleet;
- improving the operational condition of roads

and creating modern highways of regional and local importance through the reconstruction and modernization of old roads, as well as increasing the number of paved roads, especially in the northern districts of the region;

– integration into the European and world transport system in the context of the development of international transport corridors based on the opening of new checkpoints on the Ukrainian-Polish border Adamchuky–Zberezhe near Shatsk and Krichiv–Kryliv near Novovolynsk;

– development of plans for capital and current repairs of roads of local significance depending on the degree of wear of their transport and operational properties, etc.

To solve these problems, it is necessary to develop a clear list of specific programs at the state and regional levels, to attract European investment for their implementation. Therefore, to achieve success, it is necessary to make a lot of efforts aimed at improving all components of the transport potential of the region to improve the transport sufficiency of the districts of the region.

Conclusions. The conducted analysis of the transport sufficiency level of the administrative districts in Volyn region shows that the central and

southern districts of the region have the best transport sufficiency, while Polissia districts are not sufficiently provided with transport infrastructure due to forest, swamps and low level of economic development of the territory. The calculated integral index of the level of transport sufficiency, taking into account several partial indicators, made it possible to group districts of the region by the level of transport sufficiency and to distinguish five types of them: high level (3 districts), above-average level (3 districts), medium level (4 districts), with insufficient level (3 districts) and the lowest level (3 districts). The presence of certain problems and disparities in the transport system functioning in the region, especially Polissia districts, hinders the growth of the transit value of the region and increase the level of its socio-economic development. Volyn region, having a fairly extensive transport network, can in the future optimize the level of transport sufficiency of districts based on efficient use of transit potential with the integration of the transport complex into the European transport and communication system. Prospects for further research are to assess the degree of transport permeability and connectivity of Volyn region.

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TRANSPORT SUFFICIENCY OF ADMINISTRATIVE DISTRICTS OF VOLYN REGION

The purpose of the study. The purpose of the study is to analyze the level of transport sufficiency of administrative districts in Volyn region mainly landlocked routes using different quantitative parameters and indicators.

Research methods. The following methods were applied in our research: statistical, comparative, cartographic, method of classification, and system analysis.

Academic novelty. The academic novelty of the study is a comprehensive approach to assessing the transport sufficiency level of administrative districts in Volyn region using the integrated transport sufficiency index, which takes into account simultaneously the density of transport networks per unit of territory and population and security indices calculated by E. Engel, G. Goltz, Yu. Uspensky.

Practical significance. The practical significance of the research results is determined by their further use for optimization and modernization of transport infrastructure in Volyn region.

Research results. The analysis of the transport sufficiency of administrative districts in Volyn region using different quantitative parameters and indicators showed that there is a clear dependence of the land routes length on the area and the configuration of the district's territory and the number of settlements. We calculated the density of roads and railways in the administrative districts of the region per 1000 square kilometers and 1000 inhabitants, as well as indexes of transport sufficiency of E. Engel, G. Goltz, and Yu. Uspensky. The above-mentioned data showed ambiguity in determining the levels of transport sufficiency of districts in the region. For more informative expression of this indicator of transport system functioning in districts, the weighted average value was determined using the agglomerative-hierarchical procedure of nor-

malization of these 7 output parameters. We obtained the synthesized parameter, which can be estimated as an integral index of the transport sufficiency level in Volyn districts. The integral index reflects the cumulative effect of taking into account partial indicators of transport sufficiency and shows the presence of significant spatial differentiation in the transport sufficiency level of the region. According to the values of the integral index of the transport sufficiency level, five types of districts are distinguished by the level of transport sufficiency of their territories. It is established that the highest level of transport sufficiency has the central and southern districts of the region with favorable transport and geographical position and a long network of roads and railways. The northern districts of the region have the lowest level of transport sufficiency due to the forest, swamps, and low level of economic development. The problems of development of transport infrastructure in Volyn region are revealed and the perspective ways of optimizing the level of their transport sufficiency are indicated.

Keywords: motorways, railways, traffic density, integral index of transport sufficiency, transport sufficiency, transport networks, district.

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