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## GIS analysis of the tourism attractiveness of Poltava District, Poltava Region

**The purpose of the article** is to assess the tourism attractiveness of Poltava District, Poltava Region, using GIS-based analysis, and to identify the spatial distribution of key tourism resources and infrastructure across the territorial communities.

**The main material.** The GIS-based methodology for analyzing tourism attractiveness involves a comprehensive approach with several stages: data collection and processing, thematic map creation, spatial analysis, and visualization of the results. To assess the tourism attractiveness of the Poltava district in Poltava region, we applied the criteria of scenic beauty, availability of tourist attractions, availability of accommodation facilities, and transport accessibility. The research was conducted in ArcGIS Desktop 10.8. To identify the most scenic areas, buffer zones were created around layers of water bodies, forests, and territories with high terrain dissection. To calculate the level of provision with tourist attractions, the number of attractions of each type within the district's communities was determined. For the analysis of accommodation facilities, 30 km service zones were generated around the respective objects. To assess the transport accessibility of the communities, distances were measured between their centers and the city of Poltava, which is the administrative center of both the district and the region. Relevant indices were calculated for each criterion, as well as an overall Tourism Attractiveness Index for each territorial community of Poltava District. Maps of natural and recreational resources, tourist attractions, and tourism attractiveness of the study area were compiled.

**Conclusions.** The territorial communities of Poltava District demonstrate varying levels of tourism attractiveness, combining rich natural and cultural resources with different degrees of transport accessibility and infrastructure development. The most attractive for tourism are the Poltavska and Shcherbanivska communities (due to their scenic landscapes and favorable transport accessibility), while the least attractive are Skorokhodivska, Drabynivska, Martynivska, and Nekhvoroshchanska (because of limited infrastructure and fewer tourist attractions). Overall, Poltava district has a solid foundation for tourism development, with significant opportunities to enhance its attractiveness through improved infrastructure and the promotion of local heritage.

**Keywords:** *GIS analysis, tourism attractiveness, regional tourism, recreational resources, spatial analysis, geoinformation systems, Poltava Region.*

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**Introduction.** Tourism experts predict a growing interest in the history and culture of Ukraine in the post-war period. Tourists will want to visit not only hero cities but also recreational sites, since after years of pandemic, stress, and the horrors of war, people will need moral recovery. Accordingly, the study of the tourism attractiveness of different regions of our country is becoming highly relevant.

The assessment of a territory's tourism attractiveness is a complex process that requires a comprehensive approach, which in turn should include the definition of criteria for tourism attractiveness, data collection, the creation of indices, cartographic representation, and the analysis of the results [3, 6].

Geographic information systems (GIS) are gaining increasing popularity across various fields of human activity, particularly in tourism. The ability of GIS to organize, analyze, and visualize spatial data based on specific criteria makes them an effective tool for assessing tourism attractiveness of a territory.

**The purpose of the article** is to assess the tourism attractiveness of Poltava District, Poltava Region, using GIS-based analysis, and to identify the spatial distribution of key tourism resources and infrastructure across the territorial communities.

**Initial conditions.** The general concept of tourism attractiveness is defined by a set of factors that influence tourists' interest in visiting a particular territory, due to its natural features, historical and cultural heritage, recreational opportunities, and other relevant characteristics.

According to scholar T. I. Bozhuk, the tourism attractiveness of a territory should be understood as encompassing all tourist resources that, by their characteristics, can attract visitors, evoke their admiration, and encourage them to visit a particular area [1]. O. V. Melnyk, on the other hand, notes [10] that a territory is considered tourist-attractive if it possesses the potential of tourism resources, a sufficiently developed tourism infrastructure, and accessible and comprehensive information for tourists about it. Accordingly, scholars distinguish between both potential and actual tourism attractiveness.

There is no single universal methodology for assessing the tourism attractiveness of a region. Therefore, it is necessary to develop recommendations that take into account all factors and their interrelationships affecting tourism attractiveness. Among the main components are tourism resources, which in turn include natural and historical and cultural resources, as well as tourism infrastructure.

The assessment of tourism attractiveness should be comprehensive and consider various aspects in order to ensure the full development of the tourism industry and meet the needs and expectations of tourists.

The main factors characterizing the tourism attractiveness of Ukraine's regions include:

- **Environmental** – the overall state of the surrounding environment in the region. This factor is characterized

by the availability of natural resources, ecological components and climatic conditions, the level of agricultural development, risks of disasters, emissions of pollutants into the atmosphere, and the discharge of untreated or insufficiently treated wastewater into natural surface water bodies.

- **Political** – includes indicators related to the legal regulation of tourism development in the country and the level of crime.

- **Economic** – determined by indicators reflecting inflation, unemployment, income and prices of tourism services and goods, investment volumes, and the share of the tourism sector in macroeconomic indicators.

- **Infrastructure** – reflects the condition of roads, communication systems, accommodation facilities, catering and leisure establishments, as well as the availability of Internet networks, computer technologies, and communication technologies.

- **Social** – characterized by indicators reflecting the demographic situation in the region and the country as a whole, including the rate of natural population growth, the presence of subcultures, and the share of unemployed population.

- **Cultural** – includes information on the number of general and higher education institutions, library book collections, seating capacity in cinema halls, and the number of places in club facilities.

The relevance and necessity of quantitatively assessing tourism attractiveness at the national or regional level are explained by the identification of those territories whose development stimulation would lead to the possibility of achieving the fastest economic results [3].

It should be noted that effective planning of the tourism sector, particularly the assessment of the tourism attractiveness of territories, requires the application of innovative approaches, including GIS analysis. In the studies on the assessment of tourism attractiveness using GIS [2, 5, 7, 8, 9], data on population size, tourist sites, their spatial density, tourist flows, and the availability of tourism infrastructure are usually taken into account. The authors apply methods such as Voronoi diagrams, density surfaces, heat maps, spectral clustering, synthetic mapping, and hierarchical analysis.

**Methods of the research.** The GIS-based methodology for the assessment of tourism attractiveness involves a comprehensive approach consisting of several key stages:

- *Data collection and processing* – gathering and processing cartographic, socio-economic, tourism-related, and other relevant data.

- *Creation of thematic maps* – based on the collected and processed data, various thematic maps are generated to illustrate the distribution of tourism resources, territorial accessibility, infrastructure development, and other relevant indicators.

- *Spatial analysis* – using GIS tools, the spatial relationships between different objects are analyzed. This enables the identification of areas with high

concentrations of tourism resources, assessment of accessibility to tourist sites, and determination of optimal routes.

- *Visualization of the results* – the outcomes of the analysis are visualized through maps, charts, and diagrams, providing a clear and accessible representation of the information for a wide range of users.

Taking into account both domestic and international experience, our study employed the following criteria for analyzing the tourism attractiveness of a territory: scenic beauty, availability of tourist attractions, availability of accommodation facilities, and transport accessibility. The GIS analysis was conducted using ArcGIS Desktop 10.8.

To identify the most scenic areas for tourism and recreational purposes in terms of landscape diversity, buffer zones were created around layers of water bodies, forests, and areas with highly dissected terrain. Buffer zones allow consideration not only of the core of the landscape complex but also of the adjacent areas that enhance its aesthetic value. The most attractive areas are considered those where these buffer zones intersect. It is in such locations that various landscape elements converge, creating unique and picturesque compositions [4].

To determine the level of availability of tourist attractions in the district's communities, a corresponding GIS layer was created, on which different types of objects were mapped. The number of tourist attractions of each type was calculated for each territorial community, including objects of national significance, regional landscape parks and reserves, local historical and cultural sites, and locally designated protected areas.

To determine the level of availability of accommodation facilities, service areas were created around the corresponding layer components with a 30 km radius using network analysis. This enabled the identification of territorial communities with existing accommodation facilities and those lacking them.

To analyze the transport accessibility of the district's communities, distances were calculated between their centers and both the administrative center and the main infrastructural hub of the region – the city of Poltava. Based on these distances, all communities were categorized into three groups: proximate, relatively proximate, and peripheral.

Following the analysis, indices were calculated for each criterion of tourism attractiveness, namely:

- Natural Scenic Beauty Index (NSBI);
- Tourist Attractions Availability Index (TAAI);
- Accommodation Facilities Availability Index (AFAI);
- Transport Accessibility Index (TI).

To determine the NSBI, the proportion of each territorial community's area occupied by scenic sites was calculated. Using the Intersect tool in ArcGIS 10.8, the corresponding layer was intersected with

the community boundaries layer, the area of these sites was measured, and their relative share within each community was calculated as a percentage. The resulting data were then normalized.

To determine the TAAI, it was proposed to use information on the number of tourist attractions of each type (objects of national and state significance; regional landscape parks and reserves; local cultural and historical sites; and objects of the Nature Reserve Fund of local significance) across the communities. For each category, weighting coefficients of 0.6, 0.5, 0.4, and 0.3, respectively, were applied, giving greater weight to those types of attractions that are considered more appealing to tourists.

The TAAI was calculated using the following formula (1):

$$TAAI = X_1 * W_1 + X_2 * W_2 + X_3 * W_3 + X_4 * W_4 \quad (1),$$

where:

- TAAI – Tourist Attractions Availability Index;
- $X_1$  – number of attractions of national and state significance;
- $X_2$  – regional landscape parks and reserves;
- $X_3$  – local cultural and historical sites;
- $X_4$  – objects of the Nature Reserve Fund of local significance;
- $W_1, W_2, W_3, W_4$  – weighting coefficients for the respective categories.

To determine the AFAI, information on the location of accommodation facilities and the area of their service zones was used. The areas of the service zones of accommodation facilities were calculated and their share in the total area of the district's communities was determined. Weighting coefficients were then applied: 0.6 were assigned to the communities where accommodation facilities are present, and 0.3 to those where they are absent.

The AFAI was calculated using the following formula (2):

$$AFAI = X * W \quad (2),$$

where:

- AFAI – Accommodation Facilities Availability Index;
- $X$  – the share of the territory covered by the service zones of accommodation facilities relative to the total area of the community;
- $W$  – weighting coefficient.

To determine the TI, information on the proximity of community centers to the district center was used. Proximal territorial communities were assigned an index value of 1, relatively proximal communities – 0.5, and peripheral ones – 0.

To calculate the overall Tourism Attractiveness Index (TAI) for the territorial communities of Poltava District, it was proposed to assign weighting coefficients to each previously calculated index: natural scenic beauty – 0.6, availability of tourist attractions – 0.5, availability of accommodation facilities – 0.3, and transport accessibility – 0.4, in accordance with the importance of each factor for tourists.



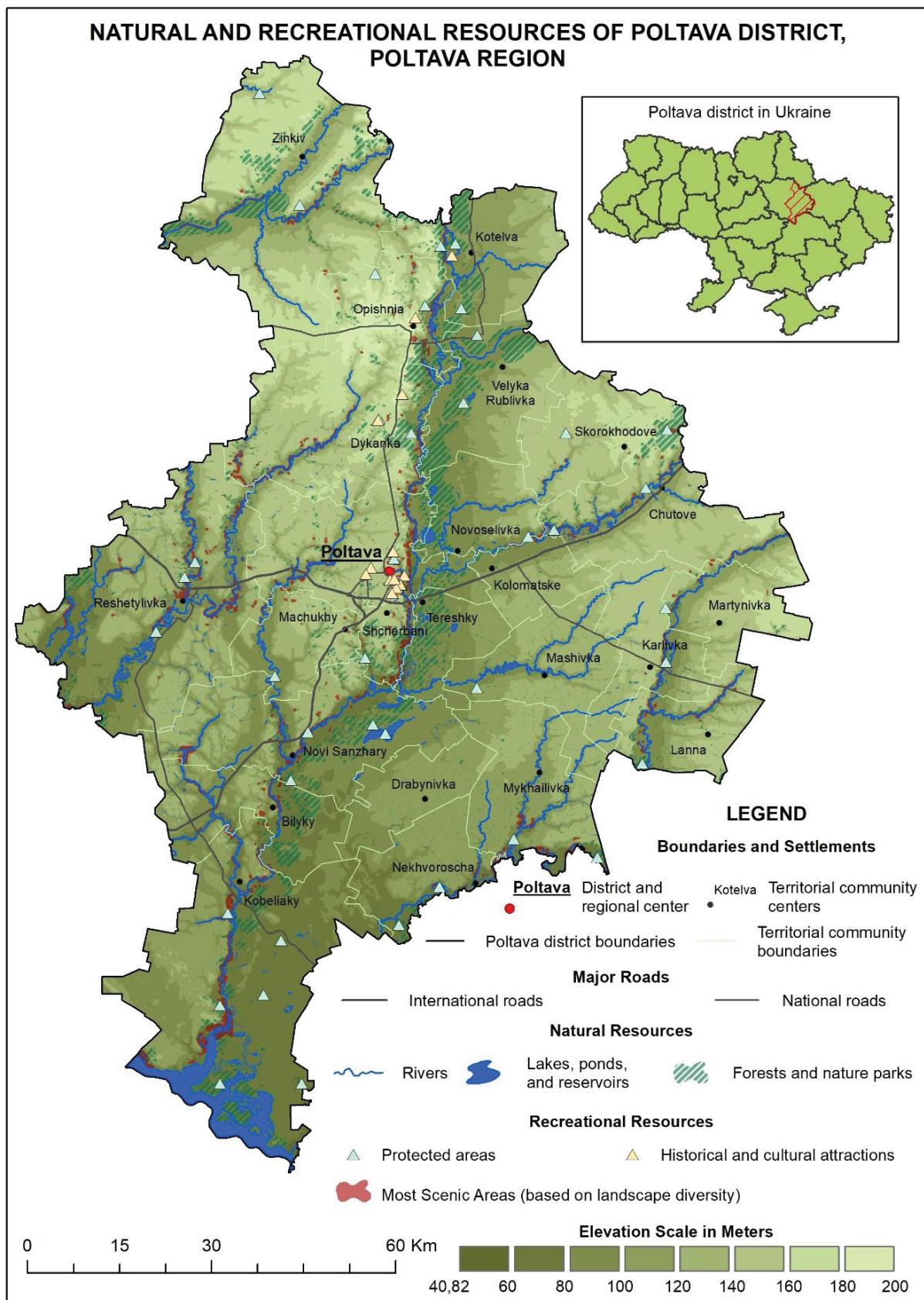


Fig. 1. Natural and recreational resources of Poltava District, Poltava Region

The TAI was calculated using the following formula (3):

$$TAI = NSBI * W_{NSB} + TAAI * W_{TAA} + AFAI * W_{AFA} + TI * W_{TA} \quad (3),$$

where:

- TAI – Tourism Attractiveness Index;
- NSBI – Natural Scenic Beauty Index;
- $W_{NSB}$  – weight coefficient for natural scenic beauty;
- TAAI – Tourist Attractions Availability Index;
- $W_{TAA}$  – weight coefficient for tourist attractions availability;
- AFAI – Accommodation Facilities Availability Index;
- $W_{AFA}$  – weight coefficient for accommodation facilities availability;
- TI – Transport Accessibility Index;
- $W_{TA}$  – weight coefficient for transport accessibility.

The normalized Tourism Attractiveness Index (NTAI) was calculated using the following formula (4):

$$NTAI = (TAI - I_{min}) / (I_{max} - I_{min}) \quad (4),$$

where:

- NTAI – Normalized Tourism Attractiveness Index;
- TAI – Tourism Attractiveness Index;
- $I_{min}$  – minimum value of the Tourism Attractiveness Index;
- $I_{max}$  – maximum value of the Tourism Attractiveness Index.

**The main material.** The territory of Poltava District, Poltava Region, which is the subject of our study, has significant potential for tourism and recreation. This is facilitated by its advantageous geographical location, historical features, cultural diversity, valuable natural sites, and protected areas.

The studied district is the largest in terms of area among all districts of Poltava Region. Its total area is 10,858.6 km<sup>2</sup>, accounting for 37.8% of the region's total area. Some of the oldest and most well-known settlements in the district include Poltava (the administrative center), Dykanka, Opishnia, Bils'k, and their surroundings. These locations host the most popular and significant tourist attractions of Poltava District.

The district consists of 24 territorial communities, including 5 urban, 8 settlement, and 11 rural communities. The analysis of tourism resources and infrastructure in Poltava District was conducted specifically at the level of these territorial communities.

For the GIS-based analysis of tourism attractiveness in Poltava District, the following data layers were used: administrative boundaries, settlements, community area data, roads, accommodation facilities, relief, hydrography, forest resources, protected natural areas, and historical and cultural landmarks.

To identify *the most scenic areas* of the territory, an analysis of terrain ruggedness was carried out, along with buffer and overlay analyses. The most picturesque locations, in terms of landscape diversity, were

determined as areas where the buffer zones of water bodies, forests, and zones with high terrain ruggedness values intersect. Based on the results of the analysis, a map of the natural and recreational resources of Poltava District, Poltava Region, was created (Fig. 1). As can be seen, most of the scenic areas are located along riverbeds within the Kobeliatska, Shcherbanivska, Poltavska, Reshetylivska, and Dykanska territorial communities.

The largest share of scenic sites relative to the community area is found in Shcherbanivska (12.5%), followed by Poltavska (5.3%) and Reshetylivska (4.53%) territorial communities, while the smallest shares are in Velykorublivska (0.26%) and Skorokhodivska (0.38%), as reflected in the NSBI values (Table 2).

For the analysis of *the availability of tourist attractions* in the district's communities, a corresponding point data layer was created, containing a total of 61 objects: 20 historical and cultural sites and 41 protected natural areas (including 8 of national significance and 33 of local significance). These include: 4 natural monuments (1 geological, 1 botanical, and 2 complex); 28 nature reserves (3 general zoological, 6 botanical, 3 hydrological, 14 landscape, 1 forest, and 1 ornithological); 3 protected tracts; 4 parks-monuments of landscape art and 2 regional landscape parks. The number of tourist attractions in each community of the district is shown in Fig. 2.

The highest value of the TAAI (Table 2) is observed in the Poltavska community, followed by Kobeliatska, Novosanzharska, Dykanska, and Kotelevska communities. This is explained by the fact that these communities host the largest number of tourist attractions. In addition, they include sites of national importance, regional landscape parks and a nature reserve (Kobeliatska, Dykanska, and Kotelevska), as well as local historical and cultural sites (Poltavska and Dykanska), which were assigned the highest weighting coefficients.

The lowest TAAI values are observed in Bilytska, Drabynivska, Tereshkivska, and Kolomatska communities (where tourist attractions are absent), as well as Martynivska, Machukhivska, Karlivska, Shcherbanivska, Skorokhodivska, Mashivska, and Lannivska communities. This is due to the fact that these communities have the smallest number of tourist attractions – mainly protected areas of local importance, which were given the lowest weighting coefficient.

For the analysis of *the availability of accommodation facilities* within the district's communities, a separate GIS layer was created to mark the locations of accommodation facilities (hotels, hostels, guest houses, apartments, campsites, and recreation centers – a total of 90 facilities). Service areas with a radius of 30 km were generated around them using network analysis. This distance was chosen as it represents the optimal range that tourists are generally willing to travel by car without significant inconvenience, taking into account the often unsatisfactory condition of the roads.

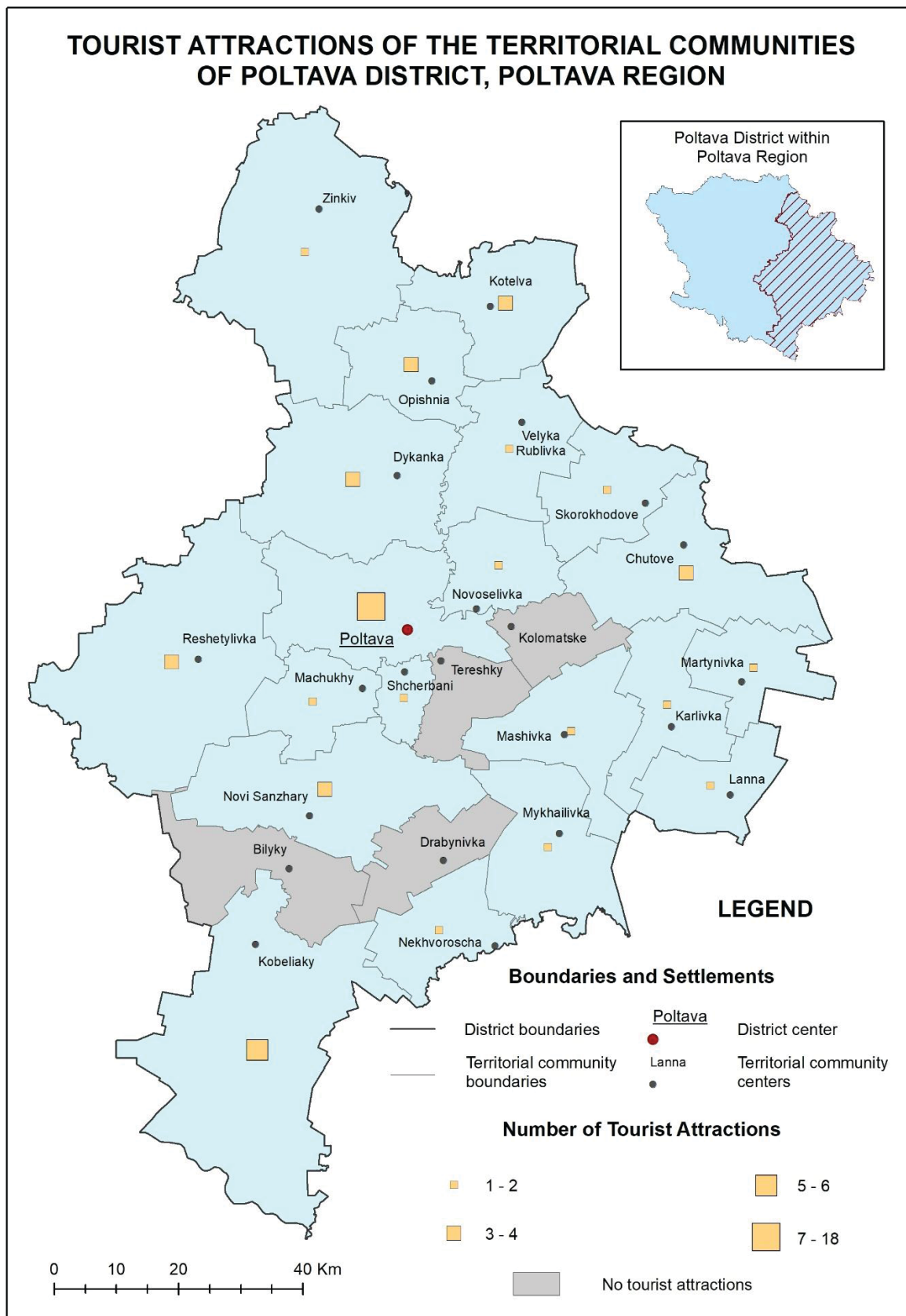


Fig. 2. Tourist attractions of the territorial communities of Poltava District, Poltava Region



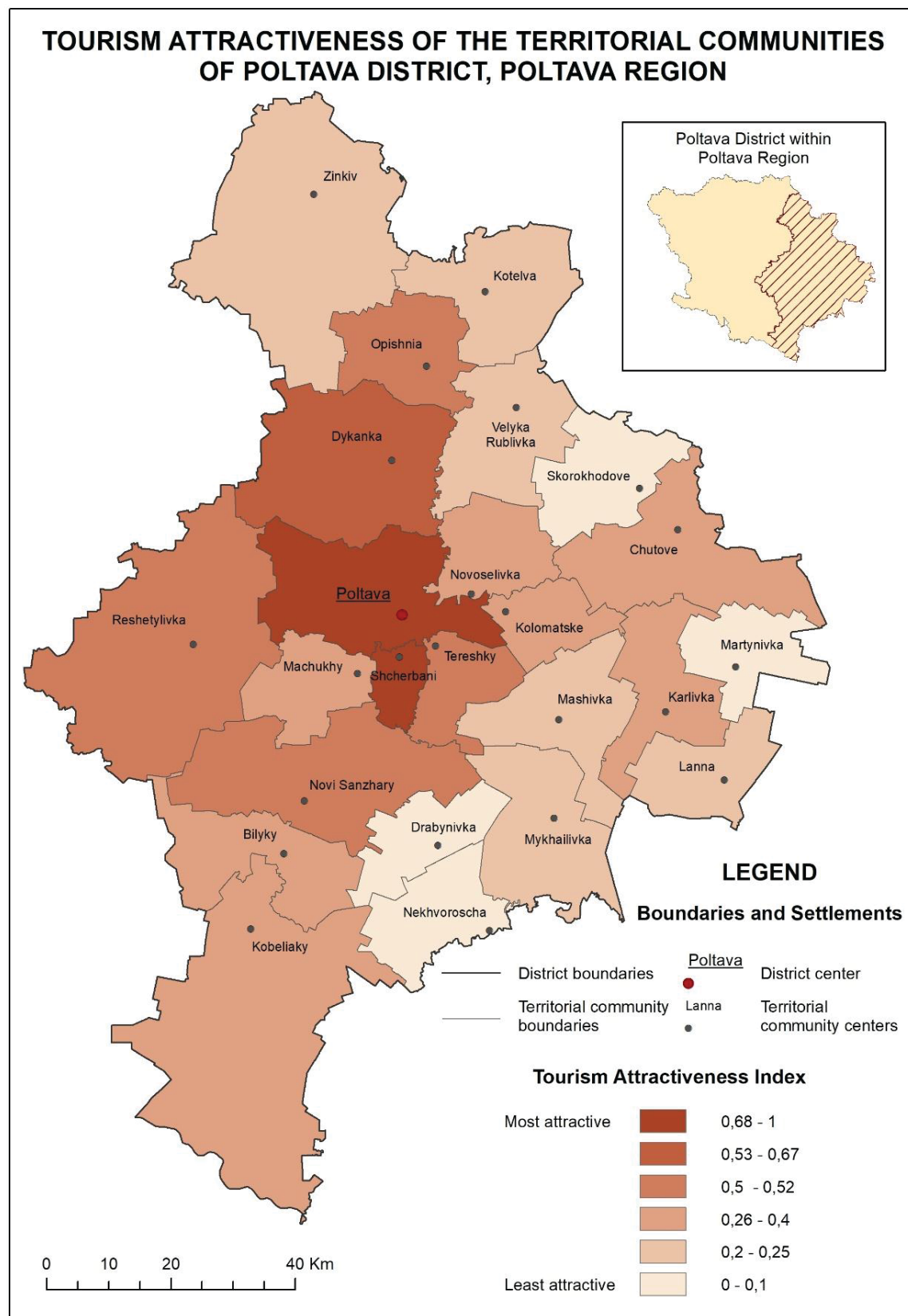


Fig. 3. Tourism attractiveness of the territorial communities of Poltava District, Poltava Region

Table 1

**Classification of territorial communities  
based on their proximity to the district center**

Group	List of territorial communities
Proximate	Shcherbanivska Tereshkivska Novoselivska Machukhivska Dykanska Kolomatska
Relatively proximate	Chutivska Opishnianska Novosanzharska Mykhailivska Mashivska Karlivska Velykorublivska Bilytska Reshetylivska
Peripheral	Drabynivska Zinkivska Kobeliatska Kotelevska Lannivska Martynivska Nekhoroshchanska Skorokhodivska

Table 2

**Results of the calculations of the overall TAI**

№	Community name	NSBI	TAAI	AFAI	TI	TAI	NTAI
1	Bilytska	0.256541	0	0.412185	0.5	0.47758	0.310278
2	Velykorublivska	0.021129	0.082192	0.329222	0.5	0.35254	0.221897
3	Drabynivska	0	0	0.352479	0	0.105744	0.047458
4	Dykanska	0.319317	0.260274	0.895249	1	0.990302	0.67268
5	Zinkivska	0.134107	0.082192	0.649525	0	0.316418	0.196366
6	Karlivska	0.150652	0.041096	0.995901	0.5	0.609709	0.40367
7	Kobeliatska	0.30417	0.315068	0.531036	0	0.499347	0.325664
8	Kolomatska	0.076068	0	0.443701	1	0.578751	0.381788
9	Kotelevska	0.078189	0.232877	0.690284	0	0.370437	0.234548
10	Lannivska	0.360028	0.041096	0.306121	0	0.328401	0.204836
11	Martynivska	0.12534	0.041096	0.21115	0	0.159097	0.085169
12	Machukhivska	0.075023	0.041096	0.460059	1	0.603579	0.399337
13	Mashivska	0	0.041096	0.421459	0.5	0.346986	0.217972
14	Mykhailivska	0.204541	0.123288	0.003399	0.5	0.385388	0.245116
15	Nekhoroshchanska	0.167115	0.082192	0.111954	0	0.174951	0.096375
16	Novosanzharska	0.274209	0.205479	0.984241	0.5	0.762537	0.511691
17	Novoselivska	0.067478	0.082192	0.33681	1	0.582626	0.384527
18	Opishnianska	0.291158	0.164384	0.999549	0.5	0.756751	0.507602
19	Poltavska	0.42232	1	1	1	1.453392	1
20	Reshetylivska	0.362805	0.164384	0.79337	0.5	0.737886	0.494267
21	Skorokhodivska	0.030089	0.041096	0	0	0.038601	0
22	Tereshkivska	0.107915	0	0.999635	1	0.76464	0.513177
23	Chutivska	0.308283	0.123288	0.06974	0,5	0.467536	0.303179
24	Shcherbanivska	1	0.041096	0.999031	1	1.320257	0.905898



Analyzing the obtained results, it can be stated that accommodation facilities are present in 11 out of 24 territorial communities of Poltava District, while their service areas extend across all communities. The territories of the Karlivska, Shcherbanivska, Opishnianska, Tereshkivska, Poltavska, and Machukhivska communities are almost fully covered by these service areas. In contrast, the least provided with accommodation facilities are the Skorokhodivska and Mykhailivska communities, where the service areas of accommodation facilities cover only 14–15% of their total area, which is reflected in the values of the corresponding index (Table 2).

To assess the *transport accessibility* of the territorial communities of Poltava District, Poltava Region, they were classified based on their proximity to the main infrastructural hub – the district and regional center, the city of Poltava. Three categories were identified: proximate, relatively proximate, and peripheral communities. For this purpose, distances along the main highways from community centers to the district center were calculated.

According to the results, communities located within 31.4 km or less from the district center were classified as «proximate», those between 31.4 km and 55.9 km as «relatively proximate», and those between 55.9 km and 80.4 km as «peripheral» (Table 1). As was said before, proximal territorial communities were assigned a Transport Accessibility Index value of 1; relatively proximal communities – 0.5; peripheral ones – 0 (Table 2).

Thus, the closest communities are Shcherbanivska and Tereshkivska (6.9 km from Poltava), while the most distant one is Zinkivska (80.4 km from Poltava).

The final stage of the study involved the calculation and cartographic visualization of the Tourism Attractiveness Index (TAI) for the territorial communities of Poltava District. The results of the calculations are presented in Table 2. Based on the overall index, a map of the tourism attractiveness of the territorial communities of Poltava District was created (Fig. 3).

According to the results obtained, the most tourism-attractive communities in Poltava District are the Poltavska and Shcherbanivska communities, while the least attractive are the Skorokhodivska, Drabynivska, Nekhvoroshchanska, and Martynivska communities. These communities exhibit some of the highest and lowest values, respectively, across most assessment criteria.

In particular, the Shcherbanivska and Poltavska communities were identified as the most scenic and the most accessible in terms of transport. As noted earlier, they also rank among the highest in terms of accommodation availability. Tourist attractions are present in both communities, although the Shcherbanivska community has one of the lowest values for the corresponding index.

**Conclusions.** The study presents an analysis of the tourism attractiveness of the territorial communities of Poltava District using GIS tools. The criteria for evaluating tourism attractiveness included scenic beauty, availability of tourist attractions, availability of accommodation facilities, and transport accessibility.

During the analysis, indices were calculated for each of the criteria, as well as an overall Tourism Attractiveness Index for each of the territorial communities in Poltava District. This area demonstrates a diverse level of tourism attractiveness, combining rich natural and cultural resources with varying degrees of accessibility and infrastructure. The most attractive communities, such as Poltavska and Shcherbanivska, stand out due to their favorable transport accessibility, scenic landscapes, and concentration of accommodation facilities and tourist attractions of both national and local significance. At the same time, peripheral communities (such as Skorokhodivska, Drabynivska, Nekhvoroshchanska, and Martynivska communities) often remain less attractive because of limited infrastructure and a smaller number of points of interest, though they retain potential for the development of rural and ecological tourism. Overall, the district possesses a solid foundation for tourism development, with significant opportunities for enhancing its appeal through the improvement of infrastructure and promotion of local heritage.

It should be noted that the level of tourism attractiveness of a particular area may vary depending on the type of tourism considered and the factors used as the basis for analysis. For a more accurate assessment of tourism attractiveness, both at the district level and for individual territorial communities, it is important to consider not only the presence but also the condition of tourism infrastructure and attractions, which could be a focus for further research.

The results of this analysis can be useful for enterprises and organizations involved in tourism development and promotion in Poltava Region, for local government authorities, or for potential investors, while the methodology employed can also be applied to assess the tourism attractiveness of other areas.

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## ГІС-АНАЛІЗ ТУРИСТИЧНОЇ ПРИВАБЛИВОСТІ ПОЛТАВСЬКОГО РАЙОНУ ПОЛТАВСЬКОЇ ОБЛАСТІ

**Метою цієї статті** є оцінка туристичної привабливості Полтавського району Полтавської області за допомогою ГІС-аналізу та визначити просторовий розподіл основних туристичних ресурсів та інфраструктури в розрізі територіальних громад.

**Основний матеріал.** Методика ГІС-аналізу туристичної привабливості передбачає комплексний підхід з низкою етапів: збір та обробка даних, створення тематичних карт, просторовий аналіз, візуалізація результатів. Для аналізу туристичної привабливості Полтавського району Полтавської області нами використано критерії мальовничості, забезпеченості туристичними атракціями, забезпеченості засобами розміщення та транспортної доступності. Дослідження виконано у середовищі ArcGIS Desktop 10.8. Для ідентифікації найбільш мальовничих ділянок території використано буферні зони навколо шарів водних об'єктів, лісів та територій з високою глибиною розчленування рельєфу, а для розрахунку рівня забезпеченості туристичними атракціями – визначено кількість туристичних атракцій кожного типу в громадах району. Для аналізу рівня забезпеченості засобами розміщення створено зони обслуговування на 30 км навколо відповідних об'єктів. Щоб проаналізувати транспортну доступність громад, знайдено відстані між їхніми центрами та містом Полтава, яке є адміністративним центром району та області. Розраховано відповідні індекси по кожному з критеріїв та загальний індекс туристичної привабливості кожної з територіальних громад Полтавського району. Укладено карти природно-рекреаційних ресурсів, туристичних атракцій та туристичної привабливості території дослідження.

**Висновки.** Територіальні громади Полтавського району демонструють різний рівень туристичної привабливості, поєднуючи багаті природні та культурні ресурси з різним ступенем транспортної доступності та розвитку інфраструктури. Найбільш туристично привабливими є Полтавська та Щербанівська громади (як найбільш мальовничі та транспортно доступні), а найменш привабливими – Скороходівська, Драбинівська, Мартинівська та Нехворощанська (через обмежену інфраструктуру та меншу кількість туристичних атракцій). Загалом, Полтавський район має міцну базу для розвитку туризму, зі значними можливостями підвищення туристичної привабливості шляхом покращення відповідної інфраструктури та популяризації місцевої спадщини.

**Ключові слова:** ГІС-аналіз, туристична привабливість, регіональний туризм, рекреаційні ресурси, просторовий аналіз, геоінформаційні системи, Полтавська область.

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