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Abstract. The article presents own evaluation methodology of the tourism infrastructure development at the state level. To obtain data on the state and trends of national tourism development the authors chose economic diagnosis based on an evaluation of industry infrastructure provision. The following objects were selected for study: sanatoriums and resorts, guest houses and lodges, hotels, child resort and health centers. Their state, features of their use and their material and technical base were evaluated. Using own evaluation methodology of level of tourism resource provision the indicator of objects density was calculated and the results of calculations were summarized. According to the results of determined partial indicators the integrated evaluation of tourism infrastructure provision was made and the dynamics of integral index of infrastructure provision according to the Ukrainian regions was presented.

1. Introduction

Tourism is one of the most dynamic sectors of the global economy. Despite the global crisis, tourism has shown almost uninterrupted growth. The number of international arrivals increased globally from 25 million in 1950, 278 million in 1980, 527 million in 1995 to 1.18 billion in 2015 which allowed tourism to enter the top five most profitable industries in the world [1].

Ukraine has one of the leading positions in Europe according to the availability of natural, historical and cultural resources. Resorts and recreational territories in our country occupy about 9.1 million hectares that is about 15% of the state territory. However, according to the World Economic Forum Ukraine currently uses less than a third of its existing tourist and recreational potential. According to the tourism competitiveness index ranking of 2016 Ukraine received 3.5 points out of seven possible and got 88th place in the ranking of 136 countries [2].

One of the problems that hinders the development of tourism in Ukraine, in our opinion, is the low infrastructure level of the industry [3]. That is why the need for information on trends in the

development of national tourism industry is becoming more relevant. One of the instruments of getting such information is economic diagnosis which allows to evaluate the features and problems of the tourism industry and to identify the patterns and trends of its development.

The world scientific society is also interested in the studies of tourism development evaluation. There are some works that study structural models in general. For example, Hamish Low and Costas Meghir contrast the treatment effects approach with structural models, and present an example of how a structural model is specified and the particular choices that were made [4]. There are also some methods designed specifically for tourism development evaluation. Hong Zhang, Chao-lin Gu, Luwen Gu, Yan Zhang applied the Technique for Order Preference by Similarity to Ideal Solution to evaluate the tourism destination competitiveness of the Yangtze River Delta in China [5]. Paul Suman studied the tourism infrastructure as well as seasonal arrival of tourists in the Gangtok city and tried to develop the probabilistic travel model on the basis of tourist perception which will help the tourism department for the further economic development of the area [6].

The materials of authors' research indicate that scientists offered different methods of evaluating the tourism development, but they mostly focus on the recreational attractiveness of the territories where there are tourist objects. The authors believe that more complete diagnosis of current development trends, in particular, on the basis of the infrastructure evaluation, is needed for better information support of the tourism sector management.

The purpose of the study is to develop a method of evaluation of tourism infrastructure provision, to apply such method for the tourism industry in Ukraine and to represent the evaluation results.

The main hypothesis of the study is the introduction of the indicator of objects density in the proposed methodical approach in the evaluation of the tourism infrastructure provision, which allows to determine the availability and accessibility of objects in one value, and the use of taxonomic method with the possibility to determine the sustainability of the development indicators trends and sustainability of series levels.

2. Method of infrastructure provision evaluation for tourism industry

A measurement system which takes into account simple indices was prepared in order to allow evaluation of the state and development of tourism facilities. Firstly, we used index method, coefficients method, summary and grouping method, indicators standardization, construction and analysis of time series, integral indices, comparative analysis and others. Secondly, we collected the analytical data, which indicates the trends of tourism infrastructure provision. We took the following indicators for this analysis: number of sanatoriums, number of resort, guest houses and lodges, the number of hotels and other accommodation facilities, and the number of beds in all these types of accommodation facilities.

In the work [7] the following indicator is offered for the social sphere objects density evaluation:

$$X_{ik} = \frac{x_{ik}}{\sqrt{N_i \quad P_i}}, \tag{1}$$

where x_{ik} – k-th indicator in the i-region;
P_i – the area of i-region;
N_i – population in i-region.

In the formula the density indicator is an average geometric number of the indicators of availability and provision, that is:

$$X_{ik} = \sqrt{d_{ik} Z_{ik}} = \sqrt{\frac{x_{ik}^2}{N_i P_i}} = \frac{x_{ik}}{\sqrt{N_i P_i}}. \tag{2}$$

The use of these indicators will enable us characterize more accurately the specific material and technical support of tourism industry in Ukraine, make conclusions about the saturation territory with these objects.

The procedure of calculating the level of tourism development in Ukraine is based on the taxonomic indexes calculation and is the following:

1. Formation of indicators that characterize tourism infrastructure availability in terms of the regions within the country.

2. Identification of the elements of X matrix observations. The matrix will look like:

$$
X = \begin{bmatrix}
X_{11} & X_{12} & ... & X_{1k} & X_{1k} \\
X_{21} & X_{22} & ... & X_{2k} & ...X_{2n} \\
... & ... & & & \\
X_{i1} & X_{i2} & & X_{ik} & ...X_{in} \\
... & & & ... & ... \\
X_{w1} & X_{w2} & ... & X_{wk} & ...X_{wn}
\end{bmatrix},
\tag{3}
$$

where w is the number of regions; N is number of indicators that characterize the level of tourist objects development; Xik is an indicator k for the i-region.

3. Differentiating of the observations matrix features. The matrix features are divided into stimulators and non-stimulators. The feature that has a positive effect on the level of tourist infrastructural provision is added to stimulators. It should be noted that during calculations the authors took into account such non-stimulators of tourism development as depreciation of fixed assets in tourism; number of sanatorium and health centers that did not work; number of sanatoriums and health centers that need repair or are in dangerous condition.

4. Standardization of observations matrix. The authors suggest using the following formula:

$$
Z_{ik} = \frac{\tilde{X}_{ik} - \overline{X}_k}{S_k},
\tag{4}
$$

$$
\overline{X}_{k_{k_k}} = \frac{\sum_{i=1}^{w} \tilde{X}_{ik}}{w},
\tag{5}
$$

$$
S_k = \sqrt{\frac{\sum_{i=1}^{w} \left(\tilde{X}_{ik} - \overline{X}_k\right)^2}{w}},
\tag{6}
$$

where: Z_{ik} is a standardized k-indicator for the i-region; - $\tilde{X}_{ik}$ is a k-indicator for the i-region; $\overline{X}_{ik}$ is a arithmetic average of k-indicator; S_k is a standardized deviation of k-indicator; w is a number of regions.

As a result of standardization of matrix observations features the matrix is the following:

$$Z = \begin{bmatrix} Z_{11} & Z_{12} & ... & Z_{1k} & ... & Z_{1n} \\ Z_{21} & Z_{22} & ... & Z_{2k} & ... & Z_{2n} \\ ... & ... & ... & ... & ... \\ Z_{i1} & Z_{i2} & ... & Z_{ik} & ... & Z_{in} \\ ... & ... & ... & ... & ... \\ Z_{w1} & Z_{w2} & ... & Z_{wk} & ... & Z_{wn} \end{bmatrix}. \tag{7}$$

The conducted standardization procedure erases differences in the importance of individual features, and all features are considered equivalent, that distorts reality. Mitigation of this adverse event can be achieved by the introduction of the hierarchy coefficients that will allow to divide the features according to their importance. These coefficients characterize the position of each feature, its role and importance in the study. The calculation of hierarchy coefficients is offered to be conducted basing on the so-called critical distances, the greatest distance ρ between neighboring features (α_i, α_j):

$$p(a_i a_j) = \sqrt{\sum_{k=1}^{27} (a_i^{(l)} - a_j^{(l)})}, \tag{8}$$

where α_i – is an i vector-indicator according to the regions in a given year;

α_j is a j-indicator according to the regions in the same year;

I is a number of the region;

$K = \max - \min \rho (\alpha_i \alpha_j)$ is a critical distance.

The sequence of calculating the hierarchy coefficients is the following:

- determination of the distances that are not higher than the critical distances for the each feature of observations matrix according to the formula:

$$Q_i = \{(i, j) \mid p(a_i, a_j) \le k, j = 1, 2, ... n\}, \tag{9}$$

where n is a number of the indicators

- the authors sum up the obtained distances for each element:

$$\omega_i = \sum_{(i,j) \in Q_i} p(a_i, a_j), \tag{10}$$

- choice of the feature, for which the calculated sum of the distances is the highest:

$$\omega_m = \max_i \omega_i, \tag{11}$$

- hierarchy coefficients calculation:

$$\lambda_i = \frac{\omega_i}{\omega_m}, \tag{12}$$

Then the indicator λ_k is multiplied at the corresponding indicator in the corresponding year z_i. Adjusted features are used for taxonomic research.

5. Choice of the benchmark point for each of the indicators of tourism infrastructure provision. The benchmark point was found for each feature. The integrated level will be calculated according to the distance to the point. The highest stimulators and the lowest non-stimulators form the coordinates of the benchmark development of Z_{ok} :

$$Z_{ok} = \max_{t}, if, k \in I,\ \ (13)$$

$$Z_{ok} = \min_{t} Z_{tk}, if, k \in I; (k = 1,..., n),\ \ (14)$$

where I is a set of stimulators;

Z_{0k} is a standardized feature k in the period t.

Thus, we obtain the vector of benchmark numbers of the features which is a point P_0 with coordinates (number n): $Z_{01}, Z_{02}, \quad Z_{0n}.$

The distance between the individual points-units (regions according to the studied feature) and point P_0 (benchmark one) is calculated according to the formula:

$$C_{i0} = \sqrt{\sum_{S=i}^{n} (Z_{ik} - Z_{0k})^2} \ (i = 1,..., w) \ \ (s = 1,..., n).\ \ (15)$$

Calculation of such indicator as a level of material and technical support development in the country's tourism industry is done.

On the basis of all previous transformations and calculations the integral indicator can be calculated according to the formulas:

$$\overline{C}_0 - \frac{\sum_{i=1}^{w} C_{i0}}{w},\ \ (16)$$

$$S_0 = \sqrt{\frac{\sum_{i=1}^{w} (C_{i0} - \overline{C}_0)^2}{w}},\ \ (17)$$

$$C_0 = \overline{C}_0 + 2S_0,\ \ (18)$$

$$D_i = 1 - \frac{C_{i0}}{C_0},\ \ (19)$$

where D_i is an indicator of development;

C_{i0} is a distance between individual points-units and benchmark ones.

Development of the industry the authors understand as a change in the chosen indicators. The proposed method involves the evaluation of the sustainability development trends. Sustainability indicator will look like:

$$i_{\overline{T}} = \frac{\overline{T}auspicious}{\overline{T}adverse},\ \ (20)$$

where $\overline{T}auspicious$ is an average annual growth rate of the integrated indicator of the material and technical support of the social sphere during "auspicious" years when the growth rate exceeds the average of this rate for the entire period $T_{gen.}$;

$\overline{T}adverse$ is an average annual growth rate of the integrated indicator of the material and technical support of the social sphere during "adverse" years, when the growth rate is lower than the average annual rate T_{gen}

The closer the indicator of sustainable development $i_{\overline{T}}$ is to one, the less are fluctuations and, consequently, the higher is sustainability. The authors understand sustainability as increasing of the indicator's rate growth.

3. Main results of the study

The calculations were done according to the proposed methodology. It should be noted that the distinguishing feature of the proposed method is the calculation of such indicator, which, in author's opinion, allows determining the accessibility and provision by specific tourism industry objects in one value. The results of the analysis of infrastructure provision calculations for Ukrainian tourism industry are shown in Table 1.

Table 1. The accessibility of tourist facilities and their regional availability in Ukraine [a]

Region	Main indicators [b]					
	2016	2016	2016	2016	2016	2016
Ukraine	0,086	23,985	0,424	52,219	0,603	29,390
Crimea	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Vinnytsia	0,101	23,527	0,019	1,523	0,221	9,217
Volyn	0,042	9,427	0,484	17,282	0,318	11,060
Dnipropetrovsk	0,052	6,238	0,403	40,467	0,433	25,273
Donetsk	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Zhytomyr	0,031	7,275	0,046	2,967	0,246	10,699
Zakarpattia	0,158	33,328	0,261	13,483	1,257	54,816
Zaporizhia	0,072	20,529	0,811	116,258	0,525	27,591
Ivano-Frankivsk	0,079	12,318	0,051	5,437	2,491	62,325
Kyiv	0,059	10,195	0,277	36,958	0,255	14,371
Kirovohrad	0,019	2,165	0,217	11,711	0,204	8,266
Luhansk	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Lviv	0,200	67,226	0,183	7,278	0,969	53,490
Mykolaiv	0,059	23,513	1,057	147,786	0,411	15,243
Odesa	0,113	45,407	1,351	135,827	0,769	33,709
Poltava	0,063	17,972	0,034	4,106	0,417	17,686
Rivne	0,053	8,036	0,046	4,635	0,269	12,986
Sumy	0,024	3,744	0,097	10,785	0,290	8,569
Ternopil	0,082	13,882	0,033	2,948	0,377	17,395
Kharkiv	0,051	10,336	0,392	26,503	0,351	16,317
Kherson	0,046	8,975	0,928	174,313	0,421	18,643
Khmelnytsk	0,085	10,472	0,006	0,218	0,364	19,046
Cherkasy	0,055	10,662	0,282	28,411	0,428	15,368
Chernivtsi	0,047	5,454	0,047	4,087	0,782	38,408
Chernihiv	0,038	7,111	0,150	15,160	0,236	9,547
Kyiv (city)	0,316	60,296	0,527	49,843	3,288	388,90
Sevastopol (city)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

(Column headers, reading vertically: Density of sanatoriums | Density of places in sanatoriums | Density of resort, guest houses and lodges | Density of places in resort, guest houses and lodges | Density of hotels and other accommodation facilities | Density of places in hotels and other accommodation facilities)

[a] authors' calculations based on [8]

[b] objects density (m[2] per 1 person/ ths. km[2])

According to the calculations the accessibility of tourist facilities and their regional availability in Ukraine is different. The most accessible tourist facilities for the population are resort, guest houses and lodges. The least accessible ones are sanatoriums. After determining the density of hotels and other places for temporary residence the authors found out that this indicator is the highest in the capital of Ukraine, Ivano-Frankivsk and Zakarpattia regions. The lowest density of hotels and other places for temporary residence is in Kirovohrad and Vinnytsia regions.

Changes of the integral index of tourism facilities development in Ukraine are shown in Table 2.

Table 2. Changes of the integral index of tourism facilities development in Ukraine in 2010-2016[a]

Region	2010	2011	2012	2013	2014	2015	2016
Ukraine	0,247	0,306	0,246	0,247	0,244	0,251	0,211
Crimea	0,481	0,586	0,437	0,372	n. d.	n. d.	n. d.
Vinnytsia	0,118	0,120	0,127	0,123	0,125	0,138	0,159
Volyn	0,212	0,310	0,230	0,231	0,223	0,221	0,183
Dnipropetrovsk	0,153	0,261	0,146	0,145	0,147	0,164	0,218
Donetsk	0,273	0,538	0,295	0,310	n. d.	n. d.	n. d.
Zhytomyr	0,110	0,140	0,108	0,104	0,103	0,110	0,135
Zakarpattia	0,139	0,193	0,121	0,159	0,168	0,197	0,190
Zaporizhia	0,344	0,412	0,330	0,340	0,346	0,350	0,385
Ivano-Frankivsk	0,129	0,141	0,126	0,122	0,123	0,137	0,155
Kyiv	0,223	0,363	0,202	0,202	0,198	0,201	0,222
Kirovohrad	0,156	0,162	0,149	0,148	0,144	0,150	0,151
Luhansk	0,157	0,227	0,144	0,144	n. d.	n. d.	n. d.
Lviv	0,180	0,183	0,194	0,200	0,207	0,226	0,209
Mykolaiiv	0,396	0,531	0,366	0,384	0,385	0,391	0,439
Odesa	0,405	0,461	0,406	0,411	0,407	0,434	0,431
Poltava	0,121	0,137	0,124	0,120	0,119	0,130	0,152
Rivne	0,131	0,172	0,121	0,118	0,117	0,124	0,146
Sumy	0,134	0,218	0,128	0,124	0,119	0,123	0,151
Ternopil	0,114	0,134	0,119	0,113	0,113	0,128	0,152
Kharkiv	0,183	0,227	0,177	0,175	0,173	0,175	0,199
Kherson	0,331	0,298	0,344	0,289	0,262	0,237	0,300
Khmelnytsk	0,100	0,115	0,107	0,112	0,114	0,120	0,144
Cherkasy	0,195	0,255	0,196	0,193	0,187	0,186	0,200
Chernivtsi	0,097	0,129	0,097	0,102	0,102	0,118	0,139
Chernihiv	0,144	0,202	0,143	0,135	0,133	0,141	0,162
Kyiv (city)	0,245	0,298	0,254	0,307	0,298	0,305	0,308
Sevastopol (city)	0,369	0,356	0,422	0,465	n. d.	n. d.	n. d.

[a] authors' calculations

Taking into account the specifics, problems, and interests of each region of the state in the development of tools aimed at the successful tourism management, the reasonable grouping of the regions in terms of their development is needed. The calculated data show that in general there is an unstable growth trend of the tourism industry development indicator in Ukraine. The authors conducted the grouping of the regions according to the sustainability of the development indicators trends (Figure 1).
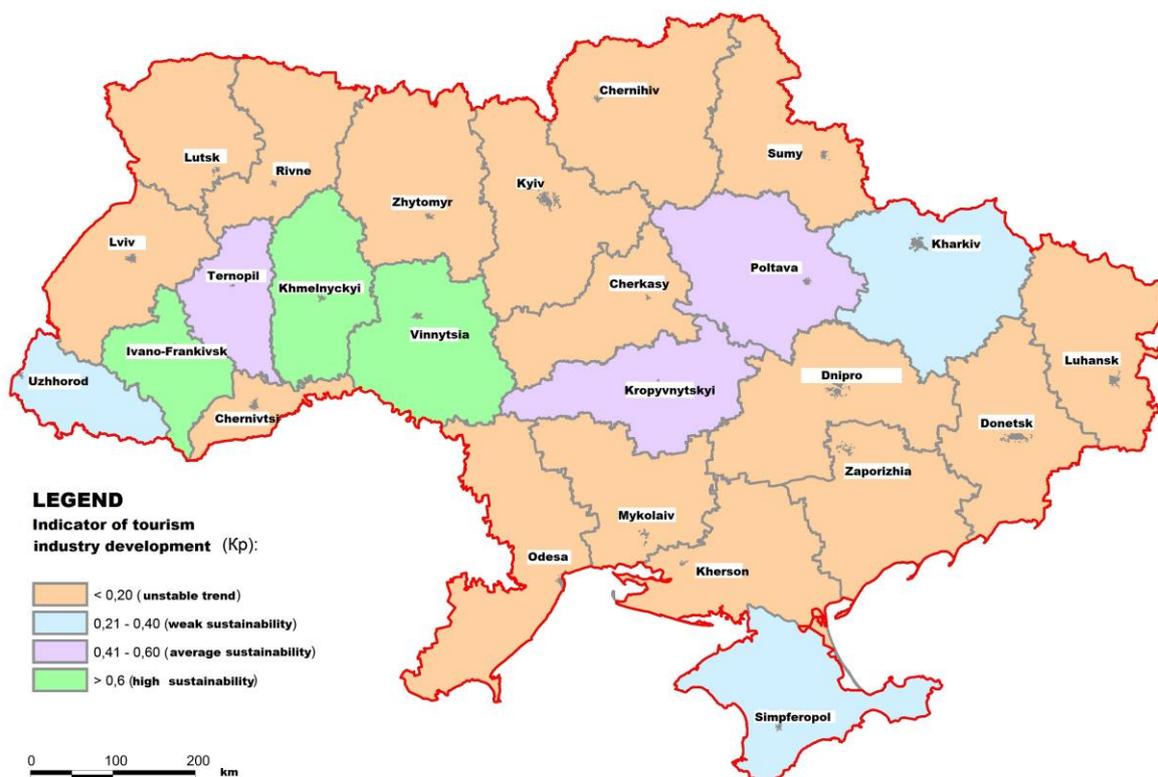
Figure 1. Grouping of the regions according to the sustainability of the development indicators trends

4. Conclusions and prospects for further research

Nowadays Ukrainian tourism industry is developing and is in a state of quantitative and qualitative changes. The methodological approaches of Ukrainian and foreign scientists to the analysis and evaluation of tourism infrastructure provision were summarized. According to the advantages and disadvantages of existing methodological approaches the own method of tourism development evaluation was developed. The distinguishing feature of the proposed method is the calculation of the density indicator that allowed determining the accessibility and availability of material objects in the single value. The proposed hypothesis of the study on the feasibility of the introduction of the indicator of objects density confirmed.

The methodical approach to determining the integral indicator of tourism infrastructural provision of country was proposed. The use of the taxonomic method allowed determining the sustainability of the development indicators trends of the studied industry and sustainability of series levels. It revealed the disparities in the state of such provision in the chosen industry. The obtained results indicate that there is a slowdown in the growth rate of the integral indicator of tourism infrastructure provision in Ukraine. Identified patterns and tends of its development and results of the infrastructure provision evaluation require further research in the field of justification of mechanisms of the tourism industry development that will facilitate the implementation of the proposed public policy directions in the tourist resorts on the vector of tourism infrastructure development.

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