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Complex assessment of sustainable development of state regions with emphasis on ecological and dwelling conditions

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Ecology is one of the major aspects of economic and social development of state regions, and environmental problems are not incidentally considered in a separate section in annually published statistical reference books providing the relevant data. Quantitative evaluation of environmental conditions in particular regions of the country is of major importance in working out measures (investments and the like) aimed at reducing pollution. Analysis of the sustainable development of regions is complicated because the number of the criteria to be considered is usually large.

In this case, multicriteria evaluation methods allowing a structured system of criteria to be expressed by a single generalizing criterion should be used.

The proposed methods may be applied to a quantitative assessment of environmental conditions in a region. Calculations confirmed the practical value of the methods offered in the present paper.

Key words: regional development, structurization of a set of criteria, complex evaluation, ecology

INTRODUCTION

One of the main goals of sustainable development is economic and social development of the state regions (ESDR). It reflects the so-called regional policy aimed at smoothing the differences among the particular regions. The effectiveness of this policy is reflected in the annually published statistical reference books providing information on the economic and social development of Lithuanian regions in a systematic way (Counties of Lithuania, 2005). All indicators are subdivided into 21 groups according to various ESDR aspects, such as investments, ecology, housing, health care, education, etc. (Table 1).

As shown in Table 1, ESDR of Lithuanian regions is described by 162 criteria. For some regions their values are better, while for others they are worse. Therefore, it is hardly possible to determine in which region the overall situation is better and in which it is worse. This means that it is impossible to rate the regions based on the level of their economic and social development. Their rating is, however, required for developing the effective regional policy because, knowing the priority order of the regions, it would be possible to more effectively allocate money, to improve the environmental conditions, social (municipal) housing, etc. Therefore, the problem of comprehensive evaluation of economic and social development of the state regions,

Table 1. **A set of criteria used to describe economic and social development of Lithuanian regions in 2004**

No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
Criteria	**Name of the set**	Environment and climate	Population	Employment and unemployment	Labour	Household income and expenditure	Prices	Education and culture	Health and social security	Crime	Enterprise statistics	Agriculture	Industry	Construction	Dwelling	Investment	Domestic trade and services	Foreign trade	Transport and communication	Tourism	Municipal budgets	Gross domestic product	
The number of criteria		8	12	11	4	4	2	16	19	11	1	32	4	4	7	3	6	1	6	6	2	3	162

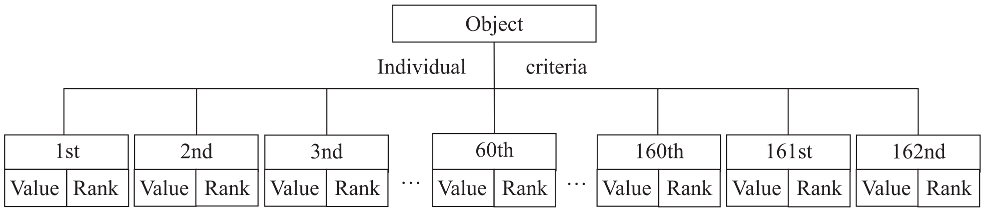

Fig. 1. Currently used multicriteria evaluation model

both from theoretical and practical perspectives, is of particular importance.

There are several approaches to solving this problem. One of them is to choose a single indicator integrating a number of others provided in a reference book and consider it to be the only criterion reflecting the economic and social development. Gross national product (GNP) per capita in a region (country, county, etc.) is usually chosen for this purpose (Armstrong, 1997). This indicator is extensively used in a comparative analysis of various countries.

It is clear that GNP provides a more general view of regional development. However, it can hardly reflect all ESDR aspects, including the environmental conditions, cultural and social factors, etc. because regional development is not restricted to the economic development of the state. For example, a region with a highly developed industry may be heavily polluted as well as have mediocre dwelling conditions. In this case, it is hardly possible to refer it to highly developed regions, particularly in the context of sustainable development. It follows that, in this case, a more complex criterion should be sought. An alternative method consisting in integration of the particular criteria describing an object from various perspectives into a single generalizing criterion could be effective.

However, some problems arise in using this approach. First, the values of some criteria can be better or worse for different regions. In addition, they may be oppositely directed, implying that in one case their higher values show a better situation (e. g., in investment, housing construction, etc.), while in another case their lower values are better (e. g., ecological conditions). Moreover, the significance of particular criteria to an object (ESDR) varies to some extent. In recent years, multicriteria evaluation methods have been used to solve such problems (Antuchevičiene, 2003; Figueira et al., 2005; Ginevicius, Podvezko, 2000, 2001, 2004a, 2007; Hwang, Yoon, 1981; Larichev et al., 2003; Nowak, 2005; Šaparauskas, 2003; Zavadskas, Antucheviciene, 2004; Zavadskas et al., 2003, 2004, 2006). In applying these methods, first, a set of criteria describing an object is generated. Second, the values and weights (significances) of these criteria are determined. Third, the weights and significances of the criteria are integrated into a single criterion by a particular multicriteria evaluation method.

Sometimes, a great number of individual criteria should be integrated into a single one. As shown in Table 1, 162 criteria are considered in this paper. This raises some problems associated with the lack of methods allowing to combine the above large number of particular criteria into an integrated one.

STRUCTURIZATION OF THE SET OF CRITERIA USED IN MULTICRITERIA EVALUATION

All currently used multicriteria evaluation methods are based on an assumption that the identified factors directly affect a study object. A model of evaluation based on this principle (Table 1) is shown in Fig. 1.

As shown in Fig. 1, the evaluation model under discussion may be effective if the values and weights (significances) of the criteria are precisely determined. No problems arise in determining the criteria values because they can be obtained from the available statistical data. The missing data can be elicited from experts.

Determination of the criteria weights is more complicated. These weights are usually elicited from experts who can compare and determine them rather accurately if the number of the criteria is small. However, the larger the number of the criteria, the more difficult it is to determine their weights. In this case, the reliability of evaluation and agreement of expert estimates are much lower and the results obtained can hardly be used in further calculations (Saaty, 1980; Ginevicius, 2006; Ginevicius et al., 2004). Recently, some more advanced multicriteria evaluation methods have been offered for determining the criteria weights. However, they cannot solve the problem caused by a large number of the criteria to be evaluated.

An effective solution would be to reduce the number of criteria. This may be achieved in two ways. The first approach is aimed at eliminating some criteria and retaining only key indicators in a set. However, the more criteria are eliminated, the less accurate is the description of an object. Therefore, this approach has limitations. The other method is associated with grouping the related criteria for their further treatment. The data presented in the set of criteria describing economic and social development of Lithuanian regions allow for using the latter approach. As shown in Table 1, all 162 criteria make 21 groups. In this way, a multicriteria evaluation model presented in Fig. 1 is transformed into a structured set of criteria, with the criteria presented at the first level and their groups provided at the second level.

A subdivision of the problem to be solved by experts (i.e. the determination of the significance of 162 individual criteria to ESDR) into 21 local problems has a number of advantages. First, experts are given 21 much simpler problems rather than one complicated task (with the number of evaluating criteria ranging from 1 to 32), implying that the agreement of expert estimates and, consequently, the accuracy of evaluation will increase. Second, the sets of criteria reflect various aspects of the object (ecology, housing, crime rate, investments, health care, agriculture, etc.). Therefore, grouping of the related criteria allows to make several groups of experts according to their professional interests and competence because one group of experts can hardly be competent in all problems. In other words, in this case the significance of the criteria will be evaluated by the number of expert groups matching the number of the criteria sets found at the first level. According to the model shown in Fig. 1, one and the same group of experts will have to determine the significance of 162 different criteria. The consistency of evaluation can hardly be expected in this case.

A structured set of criteria is considered in the following way. First, multicriteria evaluation of each subset of criteria is made. As a result, first-level generalized values of particular criteria are obtained. Then, experts determine the weights of these values and, by combining them with the above generalized first-level values and using multicriteria evaluation methods, an integrated criterion of the considered process (ESDR, in this case) is obtained.

Analysis of the data presented in Table 1 shows that the number of individual criteria in particular sets varies considerably (from 1 to 32), sometimes exceeding the critical number (of 12 criteria) which experts can assess (Saaty, 1980). This applies to criteria sets 7, 8 and 11 (Table 1). To avoid this, the sets are subdivided into smaller units, taking into account the relationships among the criteria.

The first of 16 related criteria refers to education and culture. It may be subdivided into two subsets separately representing education and culture and comprising 12 and 4 criteria (the second subset including libraries, cultural centres, cinemas and museums).

The second set of 19 criteria refers to health care and social security. It is hardly possible to subdivide it into two subsets (health care and social security) because the first subset will include 15, while the second subset will have only 4 criteria. Therefore, it is more logical to subdivide the first subset into two parts representing, for example, medical treatment and material resources (1st subset) and diseases (2nd subset). In this way, the first subset will have 7 criteria and the second will include 8 criteria.

The third set of 32 criteria refers to agriculture. It can be subdivided into three subsets: seed fund, crop capacity and cattle breeding, the first subset including 12, the second 8 and the third 12 criteria. The ultimate set of criteria describing the economic and social development of Lithuanian regions, applicable to multicriteria analysis is shown in Fig. 2.

DETERMINING THE VALUES AND WEIGHTS OF CRITERIA IN STRUCTURED SETS

The criteria making the first level of the hierarchical structure usually have no numerical values (e. g., population, education and culture, etc.), though they make a basis for multicriteria evaluation and rating of the regions (Fig. 2). Individual criteria (Counties of Lithuania, 2005) have the numerical values allowing us to determine the values of criteria sets.

The evaluation will be based on the well-known multicriteria SAW (Simple Additive Weighting) method (Hwang, Yoon, 1981). The criterion of the method S_j is used to assess the effectiveness of the j^{th} object performance and is calculated as follows:

$$S_j = \sum_{i=1}^{m} \omega_i \tilde{r}_{ij}, \qquad (1)$$

where $\tilde{r}_{ij}$ denotes normalized (non-dimensional) i^{th} criterion values of the j^{th} object (alternative), ω_i is the weight of the i^{th} criterion ($i = 1, 2, ..., m$; $j = 1, 2, ..., n$; m is the number of criteria; n is the number of the objects compared).

The values of the criterion S_j calculated by SAW may be treated as a generalized normalized j^{th} object value, i.e. the sum of all S_j values is equal to unity:

$$\sum_{j=1}^{n} S_j = \sum_{j=1}^{n} \sum_{i=1}^{m} \omega_i \tilde{r}_{ij} = \sum_{i=1}^{m} \omega_i \sum_{j=1}^{n} \tilde{r}_{ij} = 1. \qquad (2)$$

This result is not sensitive to the number of criteria m (and to the number of individual criteria).

A comprehensive evaluation of first-level criteria can be performed as follows:

1. Calculations by formula (1) commence with the structured last k_I level of the I^{th} criterion. The values of the criterion $S_{Ij}^{(k_I-1)}$ calculated by SAW are generalized estimates of a higher level ($k_I - 1$) criterion for the j^{th} object.

2. In a similar way, the values $S_{Ij}^{(k_I-2)}$, $S_{Ij}^{(k_I-3)}$ of the criterion S_j are calculated for the levels ($k_I - 2$), ($k_I - 3$), etc. until the first-level values $S_{Ij}^{(1)}$ are obtained.

3. The general evaluation of the j^{th} object $\bar{S}_j$ integrating M first-level criteria is calculated by the formula

$$\bar{S}_j = \sum_{I=1}^{M} \alpha_I S_{Ij}^{(1)}, \qquad (3)$$

where α_I is the weight of the first-level I^{th} criterion.

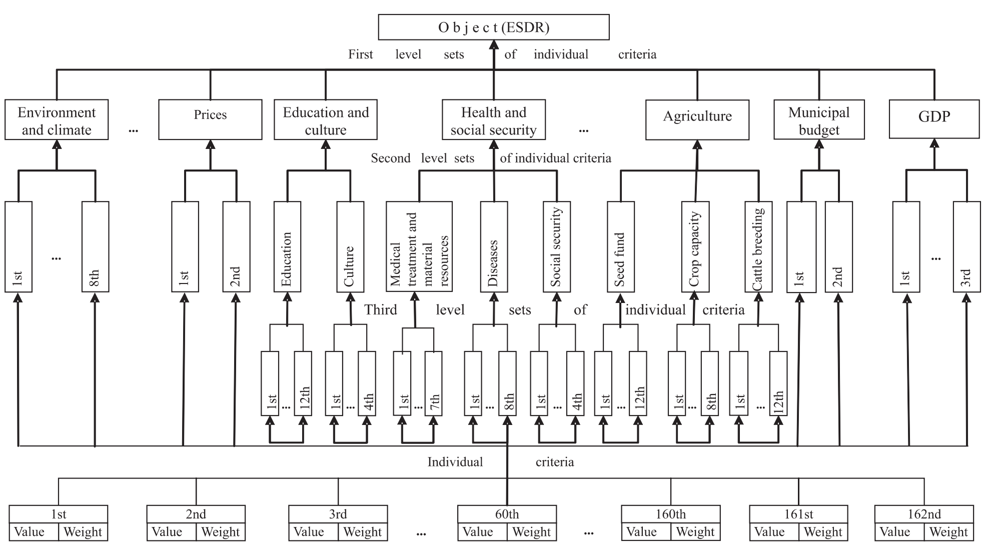

Fig. 2. A structured set of criteria describing economic and social development of Lithuanian regions

COMPLEX EVALUATION OF ECONOMIC AND SOCIAL DEVELOPMENT OF LITHUANIAN REGIONS (COUNTIES) BASED ON THEIR ECOLOGICAL AND DWELLING CONDITIONS

Since a huge amount of calculations would be needed for a comparison of Lithuanian regions, the analysis is restricted to only two sets of criteria embracing climate and the environment (ecology) and dwelling conditions. These sets include a small number of criteria (8 and 3, respectively), so their structurizing is not required. General assessment based on all criteria of the 21 sets differs only in much higher labour expenses and the involvement of experts of all specialties in determining the weights of the criteria. Ten regions of Lithuania were evaluated: 1. Alytus; 2. Kaunas; 3. Klaipėda; 4. Marijampolė; 5. Panevėžys; 6. Šiauliai; 7. Tauragė; 8. Telšiai; 9. Utena; 10. Vilnius. Statistical data representing the values of particular criteria were obtained from an account provided by the Statistical Department of Lithuania in 2004 (Counties of Lithuania, 2005).

ASSESSING THE ECOLOGICAL CONDITIONS IN LITHUANIAN REGIONS (COUNTIES)

Six criteria (Counties of Lithuania, Section 1) given in Table 2 describe the ecological conditions in the regions. The criteria values are recalculated taking into account the region's area. Therefore, they can be compared.

In the case considered, only one criterion (No 2, Table 2) is maximized. The values of other (minimized) criteria given in Table 2 should be converted into maximized criteria by the formula

$$\bar{r}_{ij} = \frac{\min\limits_{j} r_{ij}}{r_{ij}}. \quad (4)$$

The criteria weights ω_i ($i = 1,..., m$), where m is the number of criteria, were determined by experts (specialists from the Ministry of the Environment Protection of Lithuania). Various methods of determining weights, ranging from the ranking of the criteria to pairwise comparison, AHP, developed by T. Saaty are available (Saaty,1980; Ginevicius et al., 2004). In the present analysis, a direct method of weight determination (Ginevicius, Podvezko, 2004b) was used, implying that each expert determines the weight of each criterion in percentage so that the sum of the criteria weights would be equal to 100. The average value of each criterion, as well as the criteria weights ω_i (as 1/100 of their average values) were calculated. In this case, the sum of the criteria weights ω_i is equal to unity: $\sum_{i=1}^{m} \omega_i = 1$.

The values of the weights are given in Table 3.

The values of the criterion S_j of the method SAW calculated by the formulas (1), (3) and the respective ranks (positions) of the regions according to their ecological conditions are presented in Table 4.

As could be expected, the ecological situation was worst in the Telšiai region because the 'Mažeikių nafta' oil refinery is lo-

Table 2. **Criteria characterizing the ecological conditions in Lithuanian regions (counties) in 2004**

Criteria	Units of measurement	County (region)									
		1	2	3	4	5	6	7	8	9	10
1. Improperly treated sewage	m^3/km^2	202	3638	48	16	1454	1320	92	1528	477	71
2. Sewage treated according to AAP* standard	m^3/km^2	954	540	4760	1638	448	206	251	892	717	5071
3. Total amount of pollutants released into the atmosphere	kg/km^2	278	2010	2516	447	1003	735	377	7690	226	1172
4. Sulphur dioxide released into the atmosphere	kg/km^2	48	259	121	87	65	22	90	3549	38	388
5. Nitrogen oxide released into the atmosphere	kg/km^2	33	258	131	44	132	258	23	784	27	210
6. Volatile organic compounds released into the atmosphere	kg/km^2	13	367	1470	35	41	129	15	2698	8	283

AAP* is the highest admissible amount of pollutants.

Table 3. **Weights of criteria describing the ecological conditions in Lithuanian counties (regions)**

Criterion	1	2	3	4	5	6	Total
Weight	0.15	0.20	0.05	0.30	0.20	0.10	1.0

Table 4. **Values of SAW criterion S_j and the respective ranks of regions (counties) according to their ecological condition**

Region	1	2	3	4	5	6	7	8	9	10
Values of criterion S_j	0.132	0.022	0.116	0.168	0.058	0.108	0.121	0.015	0.162	0.098
Rank	3	9	5	1	8	6	4	10	2	7

cated there; then follow the Kaunas region with the Jonava nitrogen fertilizer plant, and the Alytus and Vilnius regions with a great number of industrial enterprises.

COMPLEX EVALUATION OF HOUSING DEVELOPMENT IN LITHUANIAN REGIONS

The values of the three most representative housing criteria (living space per head in a region; the number of people in a waiting list for social (municipal) housing per 1000 inhabitants in a region; the percentage of young families in a waiting list for getting municipal (social) housing from the total number of such families) used in the analysis will be calculated based on the data contained in the annual statistical reference book (Counties of Lithuania, Section 14) (Table 5).

The values of the 1st criterion 'living space per head in a region' were calculated as the ratio of the total value of regional housing resources (thous. m^2) to the respective number of inhabitants, i.e. the relationship between lines 1 and 2 in Table 2. For example, the first value of region 1 r_{11} = 4648.5/182.851 = 25.42, and this is the first number in Table 6.

The values of the 2nd criterion 'the number of people in a waiting list for social (municipal) housing per 1000 inhabitants in a region' are equal to the relationship between the respective values of lines 3 and 2 (Table 5). For example, the value of region 1 is r_{21} = 569/182.851 = 3.112.

The values of the 3rd criterion 'the percentage of young families in a waiting list for municipal housing (per 1000 inhabitants) from the total number of such families' are calculated as the percentage of the 4th row (Table 5) values from the respective 3rd row values. For example, the criterion value for region 1 is r_{31} = 246·100/569 = 43.23.

In a similar way, other values of the criteria are calculated. The results obtained are presented in Table 6.

As shown in Table 6, only one criterion, 'living space per head', is maximized, implying that a higher criterion value correlates with a higher evaluation of the situation. The 2nd criteria are minimized, i.e. their lower values reflect a better condition.

The estimates of three criteria elicited from 10 experts are given in Table 7. Based on these estimates, the average values of each criterion as well as the criteria weights ω_i (as 1/100 of the average value), were calculated. The sum of the criteria ω_i is equal to unity (see the last column in Table 7).

The criteria weights can be used in further multicriteria analysis, if the expert estimates are consistent. The consistency level can be determined by Kendall's concordance coefficient

Table 5. **Data provided by the Statistical Department of Lithuania for the year 2004**

Region (county) / Criterion	1	2	3	4	5	6	7	8	9	10
1. Total amount of housing resources in a region (thous. m^2)	4648.5	15501.3	8134.0	4188.7	7460.7	8214.9	2957.3	3954.8	5074.9	20078.9
2. The population of a region (thous.)	182.851	685.723	382.179	185.419	292.376	360.755	131.481	177.008	178.977	848.555
3. The number of people in a waiting list for social (municipal) housing (units)	569	2648	1125	495	604	876	396	654	514	3249
4. The number of young families in a waiting list for getting municipal (social) housing (units)	246	939	380	222	215	305	137	257	211	1141

Table 6. **Values of the criteria reflecting housing development in Lithuanian regions in 2004**

Region / Criterion	1	2	3	4	5	6	7	8	9	10
1. Living space per head in a region (m^2)	25.42	22.61	21.28	22.59	25.52	22.77	22.49	22.34	28.36	23.66
2. The number of people in a waiting list for social (municipal) housing per 1000 inhabitants in a region (units)	3.112	3.862	2.944	2.670	2.066	2.428	3.012	3.695	2.872	3.829
3. The percentage of young families in a waiting list for getting municipal (social) housing from the total number of such families	43.23	35.46	37.78	44.85	35.60	34.82	34.60	39.30	41.05	35.12

W (Kendall, 1970; Ginevicius et al., 2006; Podvezko, 2005, 2007; Zavadskas et al., 2004; Zavadskas, Vilutiene, 2004). To calculate the concordance coefficient, the ranking of the criteria with respect to all expert estimates is required. This means that the highest value equal to one should be assigned to the most important criterion. The next most significant criterion should be given the value equal to 2, and so on. The least important criterion is given the value *m*, with *m* denoting the number of the criteria. Similar estimates are assigned the same rank which is an arithmetical mean of the respective ranks.

Table 4, presenting expert estimates, may be easily rearranged into a ranking table (Table 8).

The concordance coefficient $W = 0.43$ is calculated from the data presented in Table 8. The value $\chi^2 = 8.6$ (Kendall, 1970) exceeds the critical value $\chi^2_{kr} = 5.99$, with the significance level $\alpha = 0.05$ and the degree of freedom $\nu = 3 - 1 = 2$ (Fisher, Yates, 1963). This indicates that expert estimates agree among themselves and the criteria weights presented in Table 4 may be applied to multicriteria evaluation.

The values of the SAW criterion S_j calculated by formulas (1), (3) based on the data taken from Table 6, as well as the respective ranks (positions) of the regions under study are presented in Table 9.

The calculation results revealed some interesting facts and relationships (see Table 10).

As shown in Table 9, a close relationship exists between a region's (county's) ecological conditions and housing development. It may be expressed as follows: the worse the ecological conditions, the fewer inhabitants are inclined to dwell in this area. This situation can arise for two reasons: first, efforts are made to attract people who have already had dwellings; second, the number of people who would like to live in a harmful environment is decreasing.

Table 7. **Expert evaluation of the criteria weights**

Expert / Criterion	1	2	3	4	5	6	7	8	9	10	Average values	Criterion weight
1. Living space per head in a region (m²)	30	10	40	20	20	15	15	25	35	10	22	0.22
2. The number of people in a waiting list for social (municipal) housing per 1000 inhabitants in a region (units)	20	30	25	35	30	30	50	35	25	50	33	0.33
3. The percentage of young families in a waiting list for getting municipal (social) housing from the total number of such families	50	60	35	45	50	55	35	40	40	40	45	0.45
Sum of estimates	100	100	100	100	100	100	100	100	100	100	100	1.0

Table 8. **Ranking of the criteria based on expert evaluation**

Expert / Criterion	1	2	3	4	5	6	7	8	9	10	Average rank	Sum of ranks
1. Living space per head in a region (m²)	2	3	1	3	3	3	3	3	2	3	2.6	26
2. The number of people in a waiting list for social (municipal) housing per 1000 inhabitants in a region (units)	3	2	3	2	2	2	1	2	3	1	2.1	21
3. The percentage of young families in a waiting list for getting municipal (social) housing from the total number of such families	1	1	2	1	1	1	2	1	1	2	1.3	13
Sum of expert-determined ranks											6	60

Table 9. **Values of SAW criterion Sj reflecting housing development in Lithuanian regions and their ranking**

Region	1	2	3	4	5	6	7	8	9	10
Values of criterion S_j	0.094	0.094	0.098	0.095	0.119	0.110	0.102	0.090	0.102	0.096
Rank	8–9	8–9	5	7	1	2	3	10	4	6

Table 10. **Ranking of regions according to housing development and ecological conditions**

Region (county)	Rank (position) of region (county) according to multicriteria evaluation results	
	Ecological condition	Dwelling
Telšiai	10	10
Kaunas	9	8–9
Alytus	8	8–9
Vilnius	7	6

Table 11. **Data obtained by complex evaluation of Lithuanian regions**

Region	1	2	3	4	5	6	7	8	9	10
Estimates of ecological conditions S_j	0.132	0.022	0.116	0.168	0.058	0.108	0.121	0.015	0.162	0.098
Estimates of dwelling conditions S_j	0.094	0.094	0.098	0.095	0.119	0.110	0.102	0.090	0.102	0.096
Geometrical mean	0.112	0.046	0.107	0.126	0.083	0.109	0.111	0.037	0.129	0.097
Rank	**3**	**9**	**6**	**2**	**8**	**5**	**4**	**10**	**1**	**7**
SAW	0.113	0.058	0.107	0.132	0.089	0.109	0.112	0.052	0.132	0.097
Rank	**3**	**9**	**6**	**2**	**8**	**5**	**4**	**10**	**1**	**7**
TOPSIS	0.720	0.053	0.640	0.851	0.329	0.611	0.678	0	08816	0.528
Rank	**3**	**9**	**5**	**2**	**8**	**6**	**4**	**10**	**1**	**7**
Average estimate	0.315	0.052	0.285	0.370	0.167	0.276	0.300	0.030	0.0381	0.241
Rank	**3**	**9**	**5**	**2**	**8**	**6**	**4**	**10**	**1**	**7**

COMPLEX EVALUATION OF THE SUSTAINABLE DEVELOPMENT OF LITHUANIAN REGIONS (COUNTIES)

Now, it is possible to assess the development of Lithuanian regions (counties) from various perspectives. The values of the criterion S_j obtained by applying the SAW method make the base of the calculation. They are the generalized and normalized values of the j^{th} alternative. At this stage of calculation, the same weights $\omega_1 = \omega_2 = 0.5$ are specified for each set of criteria. At the final stage of evaluation, the methods of the geometrical mean (Ginevicius, Podvezko, 2000) and TOPSIS (Hwang, Yoon, 1981; Opricovic, Tzeng, 2004; Ginevicius et al., 2006; Zavadskas et al., 2002, 2003, 2004, 2006; Zavadskas, Antucheviciene, 2006) were also used in addition to the SAW approach. The calculation data consist of the previously calculated values of the criterion S_j for determining the ecological and dwelling conditions, as well as of the values of the criteria of the methods applied and the respective ranks of the regions given in Table 11. The last two lines present the average estimates obtained by using various evaluation methods.

Thus, a possibility of integrating several criteria belonging to a lower hierarchical level (Fig. 2) into a single criterion, and thereby reducing the number of evaluation criteria to be used at the higher evaluation level was demonstrated by the analysis of cases based on the assessment of the region's ecological and dwelling conditions.

CONCLUSIONS

1. It is hardly possible to make a comprehensive evaluation of economic and social development of regions (counties) because of a large number of multidimensional evaluation criteria to be considered. The solution of the problem can be found, if a set of criteria is subdivided into several subsets, thereby subdividing the problem into some local problems.

2. Given a structured set of criteria, lower level sets of generalizing criteria can be defined. Then, by combining them in a similar manner, an integrated criterion describing the object is obtained.

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ŠALIES REGIONŲ DARNIOS PLĖTROS KOMPLEKSINIS ĮVERTINIMAS AKCENTUOJANT EKOLOGINĘ SITUACIJĄ IR BŪSTĄ

Santrauka

Vienas svarbiausių šalies regionų ekonominės ir socialinės plėtros aspektų yra ekologija. Neatsitiktinai Statistikos metraštyje, skirtame šiai plėtrai, aplinka išskirta į atskirą skyrių. Numatant užterštumo mažinimo priemones (investicijas ir pan.) labai svarbu kiekybiškai įvertinti ekologijos būklę regionuose. Kompleksinis regionų darnios plėtros vertinimas yra labai komplikuotas dėl didelio rodiklių skaičiaus. Tokioje situacijoje tikslinga taikyti daugiakriterinius vertinimo metodus, kurie leidžia į vieną apibendrinantį rodiklį traukti netgi struktūrizuotą rodiklių sistemą. Pasiūlyta metodika leidžia kiekybiškai įvertinti ekologinę būklę regione. Atlikti skaičiavimai patvirtino jos praktinio taikymo galimybę.

Raktažodžiai: regionų plėtra, rodiklių sistemos struktūrizavimas, kompleksinis vertinimas, ekologija