Model of Sustainable Development of the Region

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Abstract

Assessment and analysis of the main characteristics of the socio-economic development of regions are among the most important ones that allow to solve strategic issues of the choice of optimal solutions in the sphere of regional governance and development prospects. As a rule, the division of groups and corresponding to them types (classes) of districts, each of which has significant, qualitative differences, is the result of such studies. Such division into groups objectively exists in any regional system, regardless of the level of organization. We offer to consider adaptation changes of the integral potential capacity, which includes essential components, such as natural resources, production, social units, assessment of their compliance with each other, as one of the variants of the possible approach for the balanced territorial development and performance of territorial systems.

Keywords: stable development, stochasticity, spatial differentiation, potential, territory.

1. Introduction

Stochasticity [1] that provides the mode of mixing and leads to fluctuations on the micro level, because of which the level of sustainability of systems of the higher ranks reduces, but which also provides the possibility of their transition into a new balanced state, is the basic principle of operation of such units [2,3].

The authors developed the method of modeling and simulation of assessment of the performance sustainability level [6,7,8] and the prospects of the balanced development of both the individual subsystems, as well as the system as a whole [9], on the materials of evaluation of the production and territorial potentials [4,5]. The model allows for the retrospective, current and prospective state of the natural resources, demographic, agro-resource, industrial and infrastructural capacity potential of the area [10], involves determination of the predictive scenarios of the regional organization of the society, depending on the changes of external and internal conditions and it may serve as a basis for making well-founded reasonable regulatory decisions in the changing economic, social and political conditions. [11] Its use is capable, if necessary, to build a forecast scenario of economic development and the system of population displacement in the region, as well as to become operational and effective tool for management and prediction of social-economic processes in the region, in particular, to identify the areas and sectors of the economy which are the most favorable for the application of capital for the nearest, as well as for the longer-term prospect[12].

In this case, the regional socio-economic priority should be analyzed and estimated according to the following scheme-model (Figure 1):
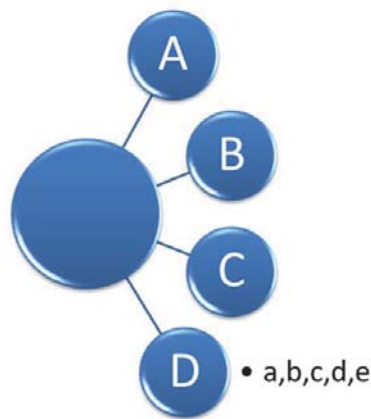
Fig.1 Algorithm of assessment of the regional socio-economic priority

A. Assessment of the integrated resource potential of the area and its components which takes into account the current condition and possibilities of the natural resources, demographic, agro-resource and infrastructural potential of the region.
B. Assessment of the current state of the productive capacity of the region, its size and distribution throughout the territory (industry, agriculture, construction).
C. Assessment of correlation of the current level of development and the location of production to the resource potential of the area. This assessment should identify (for the region and its individual parts) the level of efficiency of the level and allocation of the economic sectors from the perspective of resource capabilities, as well as the degree of influence of external – in relation to the region – conditions on its economy.
D. Development of methods of identification and evaluation of possible prospects of economic development and the system of settlement (or wider – the territorial organization of society – TOS). These methods are the parts of the model that allows to solve the following problems:
    a) Determination of the elements of the resource potential, the lack of which sets back the social and economic development of cities and districts of the region
    b) Assessment of the situation which should be in the future, with the possible placement of various industries in definite locations (areas) of the enterprises.
    c) Determination of the most favorable points (areas) for each potentially located enterprise (industry).
    d) Assessment of sustainability of economic development of cities and regions and the social standard of living in the region.
    e) Determination of options of forecast scenarios of the development and economic location of the region depending on the prevailing internal and external conditions (growth poles, possible socio-economic situations and expected socio-economic areas).

2. Method

The authors propose the following algorithm for integrated assessment of the territory and determination of rational variants of the balanced territorial organization.
1. Background information is given in the table 1, where

Table 1

$k\backslash 1$	V_1	V_2	. . .	Vi	. . .	V_m
1	V_{11}	V_{12}	. . .	V_1i	. . .	V_{1m}
2	V_{21}	V_{22}	. . .	V_2i	. . .	V_{2m}
:	:	:	:	:	:	:
K	V_{k1}	V_{k2}	. . .	V_ki	. . .	V_{km}
:	:	:	:	:	:	:
N	V_{n1}	V_{n2}	. . .	V_ni	. . .	V_{nm}

k – number of evaluation object (OTE), $k = \overline{1, n}$

i – number of evaluation factor (aspect), $i = \overline{1, m}$

$V_k i$ – rank of k OTE for the 1st factor

q_i – rank of the 1st factor that reflects its comparative significance

V_i - designation for the 1st of Table 1 (if that is the same – the vector of ranks of the 1st evaluation factor).

2. Table 1 is converted into Table 2 of ranks "with weights", where

Table 2

k\1	R_1	R_2	$\cdots$	R_i	$\cdots$	R_m
1	r_{11}	R_{12}	$\cdots$	$r_1 i$	$\cdots$	r_{1m}
2	r_{21}	R_{22}	$\cdots$	$r_2 i$	$\cdots$	r_{2m}
:	:	:	:	:	:	:
K	r_{k1}	R_{k2}	$\cdots$	$r_k i$	$\cdots$	r_{km}
:	:	:	:	:	:	:
N	r_{n1}	r_{n2}	$\cdots$	$r_n i$	$\cdots$	r_{nm}

$r_k i = (m + 1 – q_i) V_k i$

3. Matrices of pairwise comparisons are constructed for all $i = 1, m$

$\lceil 1$, if $r_{ki} < r_{j1}$

$B_i = \| b_{ikj} \|_{n*n}$, where $b_{ikj} = \{0$, if $r_{ki} = r_{j1}$

$\lfloor -1$, if $r_{ki} > r_{j1}$

Matrices B_i have the property of antisymmetry, i.e. $b_{ikj} = -b_{ikj}$

for all $1 = \overline{1, m}$ and j, k $= \overline{1, n}$, that is why it is enough to calculate only the elements that are above the main diagonal.

4. Matrix of coherence of factors is constructed, and generalized coefficients for all factors are calculated.

Matrix of coherence of factors is as follows:

$E = \| \varepsilon_{il} \|_{m*m}$, where:

$\varepsilon_{il} = \varepsilon(R_i \cdot R_1) = 1 – S_{il}$ - measure of closeness of vectors R_i and R_l ;

$S_{il} = S(R_i \cdot R_1) = n(n-1)$ – normalized distance between the vectors R_i and R_l ;

$\Delta_{il} = \Delta(R_i \cdot R_1) = \sum_{k=1} \sum_{j>k} | b_{ikj} - b_{ikj}$ – distance between the vectors R_i and R_l .

Symbol $j>k$ means that only the elements of the matrices B_i and B_l, that are above the main diagonal are involved in calculations.

For all $1 = \overline{1, m}$ generalized coherence coefficients are calculated:

$\varepsilon_l = \sqrt[m-1]{m} \varepsilon_{il}$

Matrix E and coefficients ε_i^* ($l = \overline{1, m}$) are printed out.

5. Coefficient of concordance is calculated:

$$\alpha = \frac{\sum_{k=1} r_k}{m^2 (m+1)^2 (n^2 - 1)_n}, \text{где } r_{ki} = \sum_{i=1} r_{ki}, k = \overline{1, n} \quad \overline{r} = 1/n \sum_{k=1} r_k .$$

Then the value $x^2 = \alpha_m(n-1)$.

Values α and x are printed out.

6. Determination of compromise ordering.

Min $r_{k^*} = r_{k1^*}$ is determined. Then the number $r^*_{k1} = 1$ is attributed to OTE with index k_1 $^{1 \leq k \leq n}$.

Then, *min $r_{k^*} = r_{k1^*}$* is calculated. Then the number $r^*_{k2} = 2$ is attributed to OTE with the index k_2 $^{1 \leq k \leq n}$ $^{k \neq k1}$.

Min $r_{kx} = r_{k3^*}$ is determined. Then the number $r^*_{k3} = 3$ is attributed to OTE with the index k_3 $^{1 \leq k \leq n}$ $^{k \neq k1, k2}$, etc., unless all OTE are ranked.

If any *min r_{k^*}* is not the only one, then the same number equal to arithmetic average of seats, divided among

themselves these OTE, is attributed to corresponding OTE.

It is possible to verify the correctness of the ranking:

$\sum_{t=1} r_{kt}^{*}$ should be equal to $\frac{n(n+1)}{2}$

Vector $R=(r^{*}, r^{*}, r^{*}, ..., r^{*})$, where $r_{k}^{*} = r_{k}^{*}$, when $k=k_{t}$, is the result of item 6. Vector R^{*} is printed out.

7. Matrix of pairwise comparisons that corresponds to the vector R^{*}, is constructed

$B^{*} = \| bkj^{*} \| n^{*}n$, where $bkj^{*} = \begin{cases} 1, \text{ if } rk^{*}<rj^{*} \\ 0, \text{ if } rk^{*}=rj^{*} \\ -1, \text{ if } rk^{*}>rj^{*} \end{cases}$

Matrix B^{*} possesses the property that $b^{*}ki = -b^{*}ki$ for all k and i, so only elements above the main diagonal are calculated.

8. Values are calculated for all $i = \overline{1,n}$

$\varepsilon^{*}i = 1 - Si^{*}$, where Si^{*} - normalized distance between the vectors Ri and R^{*}, (ref. item 4).

Then the value $\varepsilon^{*} = \sqrt[m]{\prod_{i=1}} \varepsilon_{i}^{*}$ is calculated.

Valued $\varepsilon^{*}i(i=\overline{1,m})$ b ε^{*} are printed out.

9. Values $p_{k} = \sum_{i=1}^{m} \varepsilon_{i}^{*}r_{ki}$ are calculated for all $k = \overline{1,n}$ and then printed out.

Max pk is calculated for all k = $\overline{1,n}$

1<k<n

$\lambda_{k} = \frac{\max p_{k}}{p_{k}}$. Values $\lambda_{k} (k = \overline{1,n})$ are printed out.

3. Conclusions

The rank 1 corresponds to the most preferred alternative;

The rank n corresponds to the least preferred alternative;

$1-\varepsilon_{il}=1$ means that there is complete coincidence of preferences assigned by the vectors R_{i} and R_{l};

$1-\varepsilon_{il}=0$ says about maximum discrepancy of comparable preferences;

λ – coefficient of concordance – consistency of all factors;

P_{k} – quality measure of OTE from the position of compromise that reflects its place in the set of values of the required assessment (the less P_{k} is, the higher the quality is);

λ_{k} - transformed quality measure (the higher λ_{k} is, the higher the quality is).

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