



## **The Indicative System of Assessing the Level of Ecologization in the Context of the Region’s Sustainable Development**

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### **ABSTRACT**

The article over views the evolution of the term “ecologization” and provides the authors’ interpretation; it discusses basic aspects of creating the indicative system of assessing the level of ecologization of the region’s economy as an elem’ of assessing the region’s sustainable development. The dependence obtained by the authors enables one to easily determine the state of the region’s ecologization. The analysis provides the possibility to track the progress of both positive and negative changes. The ranges of integrated indicators will signal about the qualitative condition of the level of ecologization of the region. If there are negative tendencies, regional development programs require revision in order to improve the situation and reach the reference value of the indicator.

**Keywords:** Ecologization, Economy Ecologization, Assessing the Region’s Sustainable Development, The Indicative System of Assessing Ecologization, The Level of Ecologization of the Region’s Economy

**JEL Classifications:** Q01, Q5

### **1. INTRODUCTION**

Ecologization pushes the society to create new spheres of activity, such as recreational, sanitary-ecological, environmental remediation, ecological and recreational tourism.

Special attention has been given to the works of the authors who performed a thorough investigation of the researched problem - Daly and Farley (2010), Farley et al. (2005), Speth (2010), Heinberg (2011) and others.

A new scientific area named ecological economy which is based on the sustainable development concept is presented in research works of Meadows et al. (2004), Stobaugh (1969), D. Korten (2010), Costanza (1999) and others.

Differences in defining the term “ecologization” are due to differentiated objects and features of the methodological

base. During the research approaches to defining the term “ecologization” have been grouped according to their basic areas: Process, phenomenon, action, accounting area, science, philosophy of thought (Table 1).

All these approaches don’t consider the fact that a person is a subject of any activity. The level of education and ecologization of a human thought directly influence their future and present through their actions. According to the concept to sustainable development society has to find balance between its need sand the harm it causes to the environment in order to minimize it for further harmonious development.

The authors propose the following definition of ecologization:

Ecologization is a complex in targeted process of incorporating ecology-oriented thin king into the concept to various spheres and types of human life, connected to the growing level of ecological

education, competence and self-awareness, directed towards creating the fundamentals of the civilization noosphere.

Achieving goals and objectives of the region's sustainable development requires constant monitoring of the current situation, which is impossible without a certain system of indicators.

The sequence of selecting indicators can be as follows:

- Formulating the sharpest contradictions of development and problems in the region;
- Selecting one or a limited number of indicators that fully characterize the objective in progress;
- Conducting analyses in order to determine the way to solve the tasks (Bobylev and Hodzhaev, 2001; Bobylev, 2007).

Constructing the system of indicators is based on the method by Bobylev for the system of indicators of sustainable development in the RF in general.

To select indicators of the regional level the following conditions should be met:

- Possibility of application on a regional level on a national scale;
- An ambiguity of interpretation for persons who make decisions;
- Indicators must have quantification;
- Clarity of construction;
- Information must be based on the national statistics system that doesn't require any considerable expenditures to collect data and perform calculations;
- Comprehensiveness, indicators reflect various aspects to the extent possible (ecological, economic, social);
- Possibility of assessment over time course;

**Table 1: Evolution of approaches to defining the term "ecologization"**

Approach	Year of research	Author (s) of the term
Ecologization as a process	1990	N.F. Rejmers
	1993	V.I. Kormilitsin
	1997	V.G. Ignatov, A.V. Kokin, P.T. Sidorov
	1998	V.R. Bganba-Tserera
	2002	I.N. Remizov
Ecologization as a phenomenon	2010	E.R. Razumova
	1993	A.P. Banin
	2008	E.N. Hisamutdinova
Ecologization as an action	1996	A.F. Porjadin, A.D. Khovansky
	1997	S.J. Bezdina
	1999	V.V. Muratkina
	2000	T.F. Efremova
	2001	S.N. Bobylev, A.S. Hodzhaev
Ecologization as a science	1974	I. B. Novik, V.A. Los
	1980	A.G. Isachenko
	2004	O.G. Litovka, M.M. Fyodorov
Ecologization as an accounting area	2003	K.P. Arent
	2007	D.J. Savon
Ecologization as a philosophy of thought	1975	V.R. Bganba-Tserera
	1983	B.V. Borovsky
	1998	T.A. Akimova, V.V. Haskin

- Applicability to assessment of progress in sustainable development;
- Clarity and simplicity for non-specialists;
- Use of a limited number of indicators (Stobaugh, 1969).

## 2. METHODS

The selected indicators must meet as many conditions mentioned above as possible. In general, a set of indicators of economy ecologization must comply with the following requirements. They must:

- Have a limited number of factors;
- Reflect the progress of the phenomenon in question;
- Be understandable, clear, useful;
- Be based on official statistical data.

Selecting indicators can come with the following problems:

- Lack of information from the quality and quantity point of view;
- Non-compliance of the information with reality due to communication between different agencies;
- Incomplete coverage of observation;

**Table 2: Term used within the method of assessing the level of ecologization of the region's economy**

Term	Definition
Level of ecologization	An aggregative quantitative indicator characterizing qualitative development of ecologization
Aggregative indicator	An indicator of assessing the level of ecologization of the region's economy obtained in the course of aggregation (unification) of several integrated indicators with each other or with other data
Integrated indicator	A complex indicator obtained in the course of aggregation (unification) of several sub-indicators with each other within one selected assessment area
Sub-indicator	An indicator demonstrating changes in environment overtime and providing a direct assessment of the situation when over viewing a specific phenomenon and obtained from initial data

**Table 3: Dependence of sub-indicators of assessing the level of ecologization of the region's economy**

Name	Symbol	Dependence characteristics	Dependence description	Expert relevance, points
Substitute indicators	SI	Changing one sub-indicator in appear directly influences the value of the other	Directly proportional	1
Complementary subindicators	CS	Increasing one sub-indicator in a pair leads to decreasing the other	Inversely proportional	2
Independent subindicators	IS	Changing one sub-indicator in doesn't influence the other	-	3

**Table 4: Matrix of assessing a random set of subindicators to assess the level of ecologization of the region (fragment)**

Name of a random subindicator	Serial number of a subindicator	1	2	3	4	5	Total number of points on a subindicator
1	2	3	4	5	6	7	8
Coefficient of ecological compatibility of production	1	-	CS=2	IS=3	...	...	5 points
Coefficient of ecologically safe goods	2	CS=2	-	SI=1	...	...	3 points
Index of eco-branding development	3	IS=3	SI=1	-	...	...	4 points
...	...	...	...	...	...	...	...

**Table 5: Range of values of the aggregative indicator of assessing the level of ecologization of the region's economy**

Level name	Characteristics	Value
Level 0 "Zero"	Absence of ecologization in all spheres of life	[0-0.05]
Level 1 "Elementary"	Inclination towards introducing the process of economy ecologization	[0.051-0.08]
Level 2 "Basic"	Presence of the most common and essential spheres of economy ecologization for development	[0.081-0.1]
Level 3 "Intermediate"	Development of economy ecologization	[0.11-0.2]
Level 4 "High"	Active integration of economy and ecology	[0.21-0.3]
Level 5 "Progressive"	Assessing the real development of economy ecologization as a process	[0.31-0.4]

**Table 6: Results of expert ranging the areas of assessing the level of ecologization of the region's economy**

No	Name of the assessment area	Rating	Points out of 10
1	Economic development	1	10
2	Ecological activity	2	9.8
3	Social development	3	9.1
4	International activity	4	8.9
5	Innovation development	5	8.6
6	Political situation	6	7.6

**Table 7: Groups of indicators according to ecologization are a sand types of economic activities to assess the level of ecologization of the region's economy (fragment)**

7	Healthcare	7	7.2
8	Civil engineering	8	6.8
9	Telecommunication service development	9	6.3

- Non-compliance of parameters with international requirements (Bobylev and Hodzhaev, 2001; Bobylev, 2007).

The system of assessing the level of ecologization on the regional level must be aimed at performing the impartial assessment of the region's development in order to develop a complex of recommendations on further development.

The indicative system of assessing the level of ecologization of economy on the regional level must provide the possibility of:

1. A complex impartial assessment of the region's ecologization;
2. Assessing the level of ecologization by the main spheres of activity in the region;
3. Forecasting further development of the region's economy basing on the indicators in question.

A set of indicators must be developed individually for each region, considering their peculiarities, types of manufacturing and producing industries. Indicators must cover all areas of the region's activities as an integral system.

When creating the system of indicators to assess the level of ecologization of economy the authors used the following terminology (Table 2).

A set of indicators, according to the authors, should be formed based on the expert selection from the main set of sub-indicators by identifying the dependence between them (Table 3).

The set of indicators must be revised annually. The quantity of sub-indicators in a matrix is determined independently by regional authorities, the sub-indicators which have gained maximum points when ranging by the degree of independence and conformity to the purposes of the regional ecologization program will be the most significant. Taking into account the identified dependences a matrix is designed to assess the dependence of the sub-indicator set (Table 4).

Based on the subindicator values the value of the integrated indicator is calculated within the studied area. The higher the value of the integrated indicator, the higher the level of economy ecologization.

To calculate the aggregative indicator for the assessment of the level of the region's economy ecologization the following formula can be applied:

$$L_{ge} = \frac{I_{ec} + I_{ecg} + I_{im} + I_s}{4},$$

Where:

$L_{ge}$  – The aggregative indicator "The level of ecologization of the region's economy;"

$I_{ec}$  – The integrated indicator "Economic indicator;"

$I_{ecg}$  – The integrated indicator "Ecological indicator;"

$I_{im}$  – The integrated indicator "Indicator of international and innovation activity;"

$I_s$  – The integrated indicator "Social indicator."

Using the suggested aggregative indicator along with the recommendations on assessing the dependence of subindicators allows us to conduct the comparative assessment and select the most impartial subindicators to assess the level of ecologization of the region's economy.

In addition to the proposed system a criteria-based assessment has been developed to identify the level of ecologization of the region's economy (Table 5).

A model area for testing the proposed indicative system was Tyumen region, consisting of the three main parts: Tyumen oblast (excluding AO), KMAO-Ugra, YNAO. The choice is conditioned by the unique resource-producing role the region plays in the country.

Experts conducting the assessment were scientists in the field of sustainable development, representatives from government, local authorities and Federal State Statistics Service in Tyumen oblast.

The results of expert enquiry formed the rating of areas for assessing the level of ecologization of the region and the most valuable ones were selected (Table 6).

The initial set of subindicators is formed based on indicators use various international methods of assessing sustainable development grouped according to them a in areas of assessing the level of ecologization of economy and types of economic activity (Table 7).

The authors proposed a set of sub-indicators for each area of assessing the level of ecologization of the region's economy, from which experts selected the most valuable ones (Table 8).

The system of indicative assessment of the level of ecologization of economy includes subindicators presented in Table 9.

The suggested system of indicative assessment of the level of ecologization of economy is made up of 42 sub-indicators allowing for a comprehensive assessment of this process, from which 15 are proposed by the authors.

### 3. MAIN RESEARCH RESULTS AND DISCUSSION

According to the conducted assessment of economy ecologization in Tyumen region the "elementary" level of ecologization has been observed (in general a cross Tyumen region as of 2011, 0,05,799), characterized by inclinations towards introducing the process of economy ecologization (Figure 1).

The results obtained by the authors' method of assessing the level of ecologization of the region's economy can contribute to the most significant results of assessing sustainable development of the Russian Federation regions ("Ecological-economic rating of the RF regions" and the ecological rating of the Russian public organization "GreenPatrol").

The resulting set of indicators for assessing the level of ecologization of the region's economy can be integrated if necessary with the reviewed methods to make the assessment procedure more impartial.

**Table 8: Expert matrix of assessing the subindicators from the final selection (fragment)**

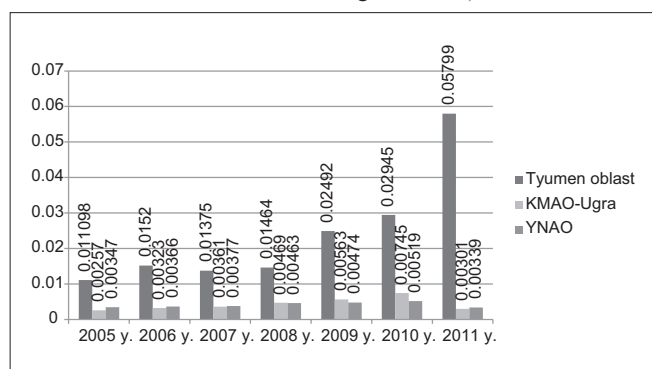
Name of a sub-indicator	Serial number of a sub-indicator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total points on a sub-indicator (score)
Specific weight of ecologically compatible business in the region	1	-	CS	CS	CS	SI	SI	SI	IS	CS	CS	IS	IS	IS	IS	IS	IS	34 (7.56)
Specific weight of the region's population engaged in the environmental sphere	2	CS	-	CS	CS	CS	CS	CS	IS	IS	IS	IS	CS	CS	CS	CS	IS	35 (7.78)
Index of environmental costs	3	CS	CS	-	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	IS	31 (6.89)
Index of ecology economization	4	CS	CS	CS	-	CS	CS	HC	SI	CS	CS	SI	SI	SI	SI	IS	IS	26 (5.78)
Coefficient of ecological compatibility of production	5	SI	CS	CS	CS	-	CS	SI	HC	CS	CS	CS	SI	SI	SI	IS	IS	26 (5.78)
Coefficient of ecologically safe goods	6	SI	CS	CS	CS	CS	-	CS	CS	CS	SI	SI	SI	SI	SI	IS	IS	24 (5.33)
Index of eco-branding development	7	SI	CS	CS	IS	SI	CS	-	CS	CS	CS	SI	SI	SI	SI	IS	IS	25 (5.56)
Coefficient of ecological policy development	8	IS	IS	CS	SI	IS	CS	CS	-	SI	SI	SI	SI	SI	SI	IS	IS	26 (5.78)
Coefficient of eco-innovations	9	CS	IS	CS	CS	CS	CS	CS	SI	-	CS	SI	SI	SI	SI	IS	IS	26 (5.78)
Index of international cooperation in the sphere of ecologization	10	CS	IS	CS	CS	CS	SI	CS	SI	CS	-	CS	SI	SI	SI	IS	IS	26 (5.78)
Index of existing or developing eco-oriented strategies in the region	11	IS	IS	CS	SI	CS	SI	SI	SI	SI	CS	-	IS	IS	IS	IS	IS	32 (7.11)
Coefficient of environmental activity of citizens living in the region	12	IS	CS	CS	SI	SI	SI	SI	SI	SI	SI	IS	-	CS	CS	CS	IS	33 (7.33)
Coefficient of ecological literacy of citizens living in the region	13	IS	CS	CS	SI	SI	SI	SI	SI	SI	SI	IS	CS	-	CS	CS	IS	26 (5.78)
Coefficient of ecological education, upbringing of citizens	14	IS	CS	CS	SI	SI	SI	SI	SI	SI	SI	IS	CS	CS	-	CS	IS	26 (5.78)
Coefficient of people's awareness of the environmental situation, events, etc., in the region	15	IS	CS	CS	SI	SI	SI	SI	SI	SI	SI	IS	CS	CS	CS	-	IS	26 (5.78)
Ecological-economic index of the region's development	16	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	IS	-	45 (10)

SI: Substituteindicators - 1 point, CS: Complementary sub-indicators - 2 points, IS: Independent sub-indicators - 3 points

**Table 9: Hierarchy of the indicator levels in the system of assessing the level of the region's economy ecologization**

Aggregative indicator	Integrated indicator	A set of sub-indicators	
		Sub-indicators selected by experts	Sub-indicators suggested by the authors additionally
level of the region's economy ecologization $L_{ge}$	Economic indicator $I_{ec}$	GDP per capita; GNP per capita; Share of GNP allocated to environment protection; Share of GDP allocated to environment protection; Environmental taxes and subsidies; Size of additional funding for sustainable development after 1992; Corrected net national income per capita; National product per capita corrected for environmental damage	Specific weigh to ecologically compatible busines sin the region (Seb); Specific weight of the region's population engaged in the environmental sphere (Ses); Index of environmental costs (Iec); Index of ecology economization (Iee)
	Ecological indicator $I_{ecg}$	Cost of the ecosystem rehabilitation; Cost of supporting agriculture and research in this field; Expenditure on decreasing the atmospheric pollution; Fines for contaminate on by priority pollutants; Nature conservation investments; Environmental funds expenditures	Coefficient of ecological compatibility of production (Cep); Coefficient of ecologically safe goods (Cesg); Intext of eco- branding development (Ieb)
	Social indicator $I_s$	Index of innovations; Review of the World Economic Forum on environmental management; The number of the IUCN member organizations; Creating environmental awareness in science, politics and education; The number of ISO 14001 certified companies per billion dollar GDP; Ecological innovations of the World Economic Forum in the private sector	Coefficient of environmental activity of citizensliving in the region (Cea); Coefficient of ecological literacy of citizens living in the region (Cel); Coefficient of ecological education, upbringing of citizens (Cee); Coefficient of people's awareness of the environmental situation, events, etc., in the region (Cesa)
	Indicator of international and innovation activities $I_{im}$	Contribution to international and bilateral projects on financing nature conservation projects and assistance in development; Participation in international environmental and nature conservation agreements; Ratification of international agreements, related to sustainable development; Approval of methods of assessing the environmental damage; Availability of the national statistics programs on environment and adoption of sustainable development indicators; Availability of the national strategy of sustainable development; Availability of the national council on sustainable development	Coefficient of ecological policy development (Cepd); Coefficient of eco-innovations (Cei); Index of international cooperation in the sphere of ecologization (Iic); Index of existing or developing eco-oriented strategies in the region (Ies)

**Figure 1.** Progress of the aggregative indicator  $L_{ge}$  assessing the level of ecologization of economy in Tyumen region, unit fraction. (Tyumen oblast, KMAO-Ugra, YNAO)



Main problems identified during testing this method and requiring solution in order to increase the level of ecologization of the region

towards sustainable development of Tyumen region are presented in Table 10.

For a valid interpretation of the test results and proposed indicative system the following ratings were analyzed: The “Ecological-economic rating of the RF regions” and the ecological rating of the Russian public organization “GreenPatrol.” Comparison of the results obtained during testing with the results of the ratings is presented in Table 11.

Consistency of the results produced by the above mentioned methods proves the credibility of testing the authors’ indicative system of assessing the level of ecologization of the region’s economy.

The identified problems in the sphere of economy ecologization can be solved by revising or creating programs on the region’s sustainable development.

**Table 10: Main problems identified when assessing the level of ecologization of economy in Tyumen region**

No	Integrated indicator	Sub-indicator	Problem
1	Economic indicator	Index of environmental costs	Insufficient budget funding of ecologization
2	$I_{ec}$ Ecological indicator	Index of eco-branding development	Low level of promoting "environmentally friendly life style"
3	$I_{ecg}$	Coefficient of ecological compatibility of production	Low specific weight of non-polluting production in the region
4		Coefficient of ecologically safe goods	Low specific weight of non-polluting goods in comparison with the total amount of goods produced in the region
5	Indicator of international and innovation activities	Coefficient of eco-innovations	Insufficient investment in innovation development in the sphere of ecologization
6	$I_{im}$	Index of international cooperation in the sphere of ecologization	Low involvement of the region in the international programs on ecologization development
7		Index of existing or developing eco-oriented strategies in the region	Insufficient elaboration of the region's development strategy considering the economy ecologization

**Table 11: Comparison of the results of assessing the region's sustainable development**

No	Method	The RF entity	Assessment results
1	Ecological-economic rating of the the RF regions	Tyumen region (Tyumen Oblast excluding AO, KMAO-Ugra, YNAO)	Negative index values characterize region's development as unbalanced, not directed towards sustainable development and ecologization
2	Rating of the Russian public organization "GreenPatrol"		KMAO-Ugra and YMAO are characterized as regions with a catastrophic condition of environment and nature management, tyumen oblast in general, excluding AO, has been ranked as a relatively favorable region of the RF
3	Indicative system of assessing the level of ecologization of the region's economy (author's method)		"Elementary" level, characterized by inclinations towards introducing the process of economy ecologization

Using the proposed approach will allow regional authorities to timely monitor and simulate scenarios of the region's economy ecologization development.

#### 4. CONCLUSIONS

The dependence obtained by the authors enables one to easily determine the state of the region's ecologization. The analysis provides the possibility to track the progress of both positive and negative changes. The ranges of integrated indicators will signal about the qualitative condition of the level of ecologization of the region. If there are negative tendencies, regional development programs require revision in order to improve the situation and reach the reference value of the indicator.

The value of the highest aggregative indicator "Level of ecologization," proposed by the authors, allows for a quality assessment of the trajectory of the region's sustainable development, as well as determining the importance and necessity of creating interconnected regional development programs in the sphere of ecologization. The aggregative indicator enables assessing, monitoring and evaluation of the region's rate of achieving the set goal.

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