ASERS

Journal of Environmental Management and Tourism

Quarterly
Volume XII
Issue 5(53)
Fall 2021
ISSN 2068 – 7729
Journal DOI
https://doi.org/10.14505/jemt

ASERS Publishing

Fall 2021
Volume XII
Issue 5(53)

ASERS Publishing
http://www.asers.eu/asers-publishing
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt

Table of Contents:

1 **The Implication of Transnational Communication Framework on Domestic Plastic Policy Understanding. A Study of Tourism's SMEs in Thailand** 1155
Ahmad Mujafar SYAH, Liou-Yuan LI, Muhammad SYUKUR, Tai-Ju WU, Viphawanee BOON

2 **A Study on Youth Behavior towards the North Vidzeme Biosphere Reserve in Latvia** 1171
Anda MEZGAILE, Kristine GRINBERGA, Nripendra SINGH, Agita LIVINA

3 **Sustainable Development: Trends in Ukraine and the World** 1179
Halyna ZELINSKA, Uliana ANDRUSIV, Nadiia DALIAK, Olena DOVGAL, Volodymyr LAGODIIENKO

4 **Development of Industrial Catering and Its Influence on Changing Climate Conditions** 1188
Svetlana GRISHKINA, Valentina BEREZYUK, Vera SIDNEVA, Irina SAFONOVA, Yulia SHCHERBININA

5 **Measurement of Competitiveness of Nature-Based Tourist Destinations: Application to National Parks in Brazil** 1204
Francisco Antonio DOS ANJOS, Sabrina DA ROSA

6 **Monitoring of the Ecological Condition of Regional Economic Systems in the Context of Sustainable Development** 1220
Svitlana TULCHYNSKA, Olha POPELO, Viktoriia MARHASOVA, Olena NUSINOVA, Zhanna ZHYGALKEVYCH

7 **The Ideation of Environmental Sustainability: Evidence from Phuket, Thailand** 1229
Kevin FUCHS

8 **The Impact of Covid-19 Pandemic on the Global Economy and Environment** 1236
Vilena Y. ZHILENKO, Elmira F. AMIROVA, Denis E. LOMAKIN, Nikolai N. SMOKTAL, Fatima Y. KHAMKHOEVA

9 **Management of Natural-Anthropogenic Complexes of Rural Territories in the Context of the Post-non-Classical Type of Scientific Rationality** 1242
Dmitry S. NARDIN, Svetlana A. NARDINA

10 **Influence of Environmental Factors and Impact on Financing Innovation of SMEs** 1248
Sayan SHAKEYEV, Serik DARIBEKOV, Lyailya MUTALIYEVA, Zhanat KHISHAUYEVA, Azhar KIZIMBAYEVA

11 **Planning the Food Estate for Community Development and Welfare** 1263
Maksum Syahri LUBIS, Zaini MUNAWIR, Saiful Anwar MATONDANG

12 **The Formation of the Concept of Smart Sustainable City with the Purpose of Environmental Protection** 1269
Suzana L. BALOVA, Judith J. Hernández García de VELAZCO, Irina V. POLOZHENTSEVA, Mikhail Y. CHERNAVSKY, Lyudmila V. SHUBTSOVA

13 **Features of the Main Processes of the Natural Population Movement in the Republic of Sakha - Yakutia** 1276
Ulyana M. LEBEDEVA, Elmira N. MINGAZOVA, Svetlana A. LOZOVSKAYA, Nataliia G. STEPANKO, Larisa A. LATYSHEVA

Fall 2021
Volume XII
Issue 5(53)

ASERS Publishing
http://www.asers.eu/asers-publishing
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt

14	**Management Effectiveness of Sheikh Baden National Park: Testing the Scope of Cultural Integrity** Waqar AHMAD, Asad ULLAH, Younas KHAN, Muhammad ARIF, Usama AHMAD	1290
15	**The Effect of Digitalization on Environmental Safety** Bakytzhan KALYMBEK, Lazzat YERKINBAYEVA, Sabigul BEKISHEVA, Daniyar SAIPINOV	1299
16	**Audit Efficiency and Influence of Environmental Factors to State Bodies: Evidence of Kazakhstan** Dauren SEMBAYEV	1307
17	**Soundscape Quality in Recreation Areas of Khao Yai National Park in Thailand** Waranya YIMPRASERT, Jiraporn TEAMPANPONG, Kwanjira SOMNAM	1324
18	**Legal Regulation of Kazakhstan's Transition to the Green Economy** Lazzat YERKINBAYEVA, Galym TELEUYEV, Bakytzhan KALYMBEK, Daniya NURMUKHANKYZY, Assiya KUDERINA	1335
19	**Collaborative Governance for Management of Water and Air Pollution caused by Industrial Activities in Lamongan Regency, East Java** Durrotun NAFISAH, Dewi Liesnoor SETYOWATI, Eva BANOWATI, Agustinus Sugeng PRIYANTO	1343
20	**Smart Specialization as a Comprehensive Territorial and Sectoral Approach to Determining Regional Development Priorities** Elena A. STRYABKOVA, Marina V. VLADYKA, Julia V. LYSHCHIKOVA, Anar Y. RZAYEV, Mikhail A. KOCHERGIN	1353
21	**Analysis of Biological Assets in Agriculture** Alida KANABEKOVA, Gulsagat ANDYBAYEVA, Roza TULEGENOVA, Aida AIMAGAMBETOVA	1371
22	**Analysis of Nature Ecotourism Attraction of Kedung Pedut River Flow as a Special Interest Leading in Yogyakarta** Azril AZAHARI, ISDARMANTO, DAMIASIH, Fitri Puji LESTARI, Syawal SUDIRO, Dwi Yoso NUGROHO	1386
23	**Analysis of Tourism Preferences to Tourism Object in North Sumatera: Examining the Environmental Attachment** T. TEVIANA, Dede RUSLAN, Dina Sarah SYAHREZA, Zulkarnain SIREGAR	1396
24	**Slow Tourism as a Tourism Alternative to Sustainable Development** Bruno SOUSA, Rossana SANTOS, Adrian LUBOWIECKI-VIKUK	1403
25	**Exploring the Sustainability of Taman Sari Water castle as a Heritage Tourist Destination of Indonesia** John Joi IHALAUW, Dwiyono Rudi SUSANTO, Joko TRIYONO, Aldi Wisnumurti SARWONO, Moch Nur SYAMSU, Nur ROHMAN	1409

Call for Papers
Winter Issues 2021
Journal of Environmental Management and Tourism

Journal of Environmental Management and Tourism is an interdisciplinary research journal, aimed to publish articles and original research papers that should contribute to the development of both experimental and theoretical nature in the field of Environmental Management and Tourism Sciences.

Journal will publish original research and seeks to cover a wide range of topics regarding environmental management and engineering, environmental management and health, environmental chemistry, environmental protection technologies (water, air, soil), pollution reduction at source and waste minimization, energy and environment, modeling, simulation and optimization for environmental protection; environmental biotechnology, environmental education and sustainable development, environmental strategies and policies, etc. This topic may include the fields indicated above, but are not limited to these.

Authors are encouraged to submit high quality, original works that discuss the latest developments in environmental management research and application with the certain scope to share experiences and research findings and to stimulate more ideas and useful insights regarding current best-practices and future directions in environmental management.

Journal of Environmental Management and Tourism is indexed in SCOPUS, RePEC, CEEOL, ProQuest, EBSCO and Cabell Directory databases.

All the papers will be first considered by the Editors for general relevance, originality and significance. If accepted for review, papers will then be subject to double blind peer review.

Deadline for submission:	30th October 2021
Expected publication date:	December 2021
Website:	https://journals.aserspublishing.eu/jemt
E-mail:	jemt@aserspublishing.eu

To prepare your paper for submission, please see full author guidelines in the following file: JEMT_Full_Paper_Template.docx, then send it via email at jemt@aserspublishing.eu.

Volume XII, Issue 5(53) Fall 2021

DOI : https://doi.org/10.14505/jemt.v12.5(53).06

Monitoring of the Ecological Condition of Regional Economic Systems in the Context of Sustainable Development

Svitlana TULCHYNSKA
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Ukraine
tuha@ukr.net

Olha POPELO
Chernihiv Polytechnic National University, Ukraine
popelo.olha@gmail.com

Viktoriia MARHASOVA
Chernihiv Polytechnic National University, Ukraine
viktoriya.margasova@gmail.com

Olena NUSINOVA
IHE "Academician Yuriy Bugay International Scientific and Technical University", Ukraine
o.nusinova@istu.edu.ua

Zhanna ZHYGALKEVYCH
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Ukraine
zhygalkevych@gmail.com

Suggested Citation:

Tulchynska, S. *et al.* (2021). Monitoring of the Ecological Condition of Regional Economic Systems in the Context of Sustainable Development. *Journal of Environmental Management and Tourism*, (Volume XII, Fall), 5(53): 1220 - 1228. DOI:10.14505/jemt.v12.5(53).06

Article's History:

Received 8th of July 2021; Received in revised form 9th of July 2021; Accepted 6th of August 2021; Published 10th of September 2021.

Abstract

The article is devoted to monitoring the ecological condition of regional economic systems in the context of sustainable development on the example of the regions of Ukraine. Monitoring the ecological condition of regional economic systems makes it possible to monitor qualitative changes in the environment components and their compliance with the established requirements in terms of sustainable development in the direction of environmental safety, maximum efficient use of nature, preservation of the environment for future generations. The tasks of monitoring the ecological condition of regional economic systems in the context of sustainable development are singled out, which include: implementation of the systematic diagnostics of the ecological condition of regions; timely and complete informing of regional and local authorities on the real status of the environmental component of sustainable development; analytical decision-making to ensure environmental safety of regions; development of projects on environmental protection, as well as careful and rational use of regional resources. The main objective conditions, which should include monitoring of the ecological condition of regional economic systems in the context of sustainable development, are defined. A methodological approach for monitoring is proposed, which provides for: determination of indicators for the ecological status assessment; normalization of indicators and isolation of stimulants and destimulants from them; calculation of the integrated index of the ecological state of regional economic systems; grouping of regions by values of the integrated index of the ecological condition. Monitoring was carried out in accordance with the proposed methodological approach to the ecological condition of the regions of Ukraine and suggested directions for improving the ecological condition of regional economic systems.

Keywords: sustainable development; ecological condition; monitoring; regional economic system; region.

JEL Classification: O10; Q56; R11.

Introduction

Globalization challenges of the world economy in terms of sustainable development are increasingly raising the issue of rationalizing the natural resources use and environmental protection. This has led to multifaceted manifestations of trends in environmental conservation and care for natural resources and their depletion. Sustainable development has proclaimed the main direction of the world development which basis for achieving development goals is not to increase economic indicators, but to increase living standards, to overcome poverty, social discrimination by increasing economic efficiency and preserving the environment for future generations. Ensuring environmental security by all national economies has become an integral part of economic growth in the context of sustainable development. In turn, this determines the urgency of monitoring the environmental condition of regional economic systems in terms of sustainable development.

1. Literature Review

Many scientists have devoted their research to the study of various issues of sustainable development and its environmental component in particular, among which are: Chvátalová V. (2021); Dergaliuk B., Tkachenko T. (2021); Dzhidzhelava D., Fedina A. (2020); Lazarenko Yu., Garafonova O. (2020); Melis C., Wold P.-A., Bjørgen K., Moe B. (2020); Prasad A., Mogla R. (2016); Seddon A.W.R. (2021); Shkarlet S., Ivanova N. (2020); Sorokoumova E.A., Cherdymova E.I. (2021); Teixeira L., Tisovec-Dufner K.C., Marin G.D.L. (2021); Tropea E., Hynds P., McDermott K. (2021); Veilleux H.D., Misutka M.D., Glover C.N. (2021); Zamula I.V. (2015) and others.

Scientists from Canada and Ireland Tropea E., Hynds P., McDermott K., Brown R.S. and Majury A. monitor the groundwater quality by testing for Escherichia coli. Studies show that Escherichia coli can multiply in the environment, including soil and surface water. As a result of the study, the authors emphasize the need for further characterization of ecologically adapted Escherichia coli in groundwater and potential implications for the water quality policy, legislation and determinants of risk to human health at both regional and international levels (Tropea E. *et al.* 2021).

Authors Veilleux H.D., Misutka M. D. and Glover C.N. argue that traditional approaches to environmental biomonitoring have limitations on the identification of species and their ability to take into account spatial and temporal changes. The study outlines the current and future use of nucleic acid-based biomonitoring regimes, with an emphasis on fish and aquatic invertebrates and their usefulness for water quality, biodiversity and species-specific monitoring (Veilleux H.D. *et al*. 2021).

The researcher from The Czech Republic Chvatalova V. emphasizes that the EU legislation sets requirements for post-marketing environmental monitoring (PMEM) of a genetically modified (GM) organism, even if the previous risk assessment indicated minor risks. The results of this study combine previous criticism and note that current PMEM practice limits the goal of identifying unforeseen adverse effects of maize cultivation on the environment (Chvatalova V. 2021).

The aim of the study by Norwegian scientists Melis C., Wold P.-A., Bjorgen K. and Moe B. was to study children's knowledge about the impact of our actions on the environment and the self-proclaimed sense of belonging to nature. The study showed that garbage removal, deforestation and air pollution by vehicles are environmental issues that children were most aware of (Melis C. *et al.* 2020).

The authors of the article Dzhidzhelava D. and Fedina A., substantiating the importance of construction projects, pay special attention to the environmental component and emphasize the synthesis of such aspects as social, economic and environmental in the formulation of the concept of "sustainable development". The authors summarized the results of the analysis of causation, revealed the direction of eliminating the negative impact of factors on the environment and developed environmental measures for the inclusion of the construction project in the project documentation (Dzhidzhelava D. *et al*. 2020).

Scientists Prasad A. and Mogla R. from India note that the ultimate goal and decisive role of education is the formation of human behavior. Environmental awareness is an understanding of the vulnerability of our environment and the importance of protecting it. The authors argue that you must be aware of your duties and responsibilities in order to work effectively and protect the environment. The main goals of environmental education are to deepen students' participation in the environment and science, and to take sensitive measures to improve the quality of life (Prasad A. *et al.* 2016).

Within the article of the Ukrainian scientists, the importance of providing the infrastructure in the economic reproduction system at the present stage of the world economy development, taking into account the transformation of social relations and the peculiarities of sustainable development, is analyzed. The principles substantiated in the article, identification of the points of infrastructural growth, strategic directions of the

infrastructural sphere modernization in regional economy and the model of management of its implementation, which has considerable influence on sustainable development of regions, have practical value (Shkarlet S. 2020).

The article by the Ukrainian scientist Zamula I.V. defines the term "environmental obligations", which describes their types, the classification of which can be used as a basis for their accounting. The scientist's proposals are aimed at improving management of environmental obligations, optimizing their composition and volume, gaining competitive advantages in foreign and domestic markets, as well as attracting additional investment through the disclosure of information on environmental obligations in the reports of enterprises (Zamula I.V. 2015).

The authors from Brazil and The United Kingdom developed a model that integrates environmental and human components of humans and wildlife to investigate how the amount of residual native forest affects human experience with wildlife, and how such experience affects tolerance through beliefs, emotions, and attitudes. This model can help identify more effective exposure points to minimize impacts on humans and wildlife (Teixeira L. *et al.* 2021).

The article by Sorokoumova E.A. and Cherdymova E.I. examines the development of structural components of the ecological consciousness for the civic identity formation. The psycho diagnostic research was conducted using then data collected from first- and fourth-year students. Based on the obtained results, it is concluded that ecological consciousness and its structural components are closely related to the civic identity of the individual (Sorokoumova E.A. *et al.* 2021).

The aim of the article by scientists Yulia Lazarenko, Olga Garafonova, Victoria Margasova, Natalia Tkalenko and Svetlana Grigashkina is to understand as deeply as possible the main components of the local innovation ecosystem in the mining industry, including the role of key actors involved in development and commercialization. The study is a set of recommendations that focus on strategic areas that need to be considered to develop an effective and efficient local innovation ecosystem and to improve the level and quality of innovation in the industry (Lazarenko Yu. *et al.* 2020).

According to the Norwegian scientist Seddon A.W.R., environmental sustainability has become a key concept in the ecosystem management. Paleoecological records (*i.e.* excavated remains preserved in sediments) are useful archives for addressing environmental sustainability, as they can be used to reconstruct long-term temporary changes in ecosystem properties. The authors concluded the following: multiproxy studies reveal ideas about the presence and mechanisms of alternative conditions; the components of environmental sustainability can be identified in long-term environmental data; paleoecological records can also give an idea of the factors that affect the resilience of the ecosystem (Seddon A.W.R. 2021).

2. Methodology

To carry out the study, the authors used a variety of general and specific methods of scientific knowledge. Thus, among the methods used by the authors, the following ones should be noted: analysis, synthesis and formalization - to substantiate conceptual provisions of monitoring the environmental condition of regional economic systems in terms of sustainable development; economic-mathematical modeling and statistical method - for monitoring the ecological condition of regional economic systems; monographic and comparative method - for the development of practical recommendations for environmental safety of regional economic systems and the development of methodological principles for monitoring the environmental condition. To substantiate the conceptual basis for monitoring the environmental condition of regional economic systems in terms of sustainable development, a systematic approach was used, which allows to combine diverse, multifaceted processes of sustainable development and explore one of its components, namely environmental.

Monitoring the environmental condition of regional economic systems has become a mandatory form of research and forecasting of sustainable development. Without it, it is impossible to make any management decisions on the further direction of sustainable development of regional economic systems. In addition, the monitoring of the ecological condition provides the directions of observance of ecological safety, rational use of nature, preservation of the natural environment. In turn, monitoring makes it possible to determine not only the situation and dynamic changes in the ecological state of regional economic systems, but also to identify areas of deviation of the state and indicators that characterize it from the planned indicators. Monitoring the ecological condition of regional economic systems makes it possible to monitor qualitative changes in the environment components and their compliance with the established requirements in terms of sustainable development.

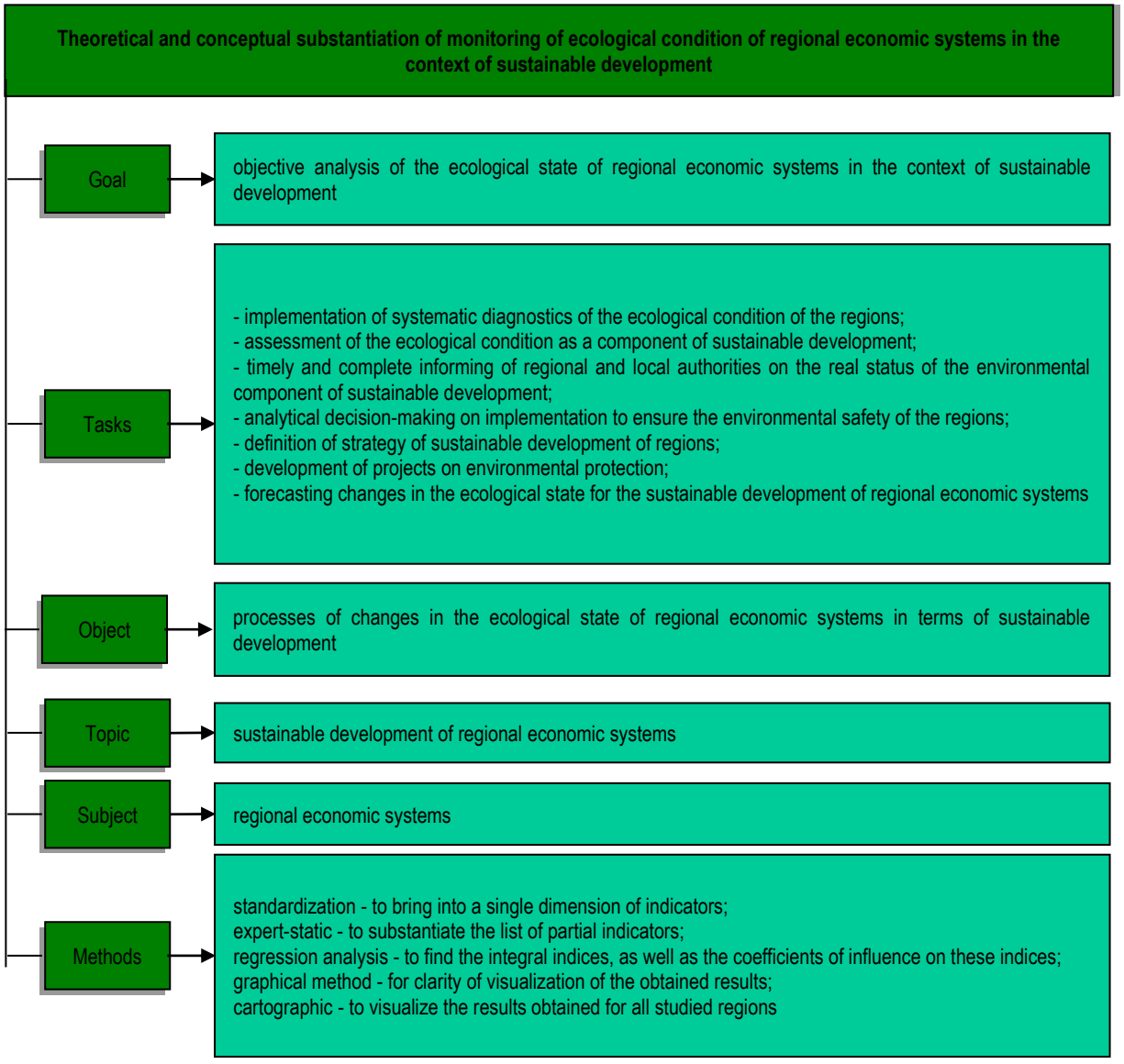
The main tasks of monitoring the ecological condition of regional economic systems in terms of sustainable development are:

- implementation of systematic diagnostics of the ecological condition of the regions;

- assessment of the ecological condition as a component of sustainable development;
- timely and complete informing of regional and local authorities on the real status of the environmental component of sustainable development;
- analytical decision-making on the implementation of decisions by regional and local authorities to ensure the environmental safety of the regions;
- on the basis of the obtained results of definition of the sustainable development strategies of regional economic systems;
- development of projects on environmental protection, as well as careful and rational use of regional resources;
- forecasting changes in the ecological state for sustainable development of regional economic systems.

In Figure1, a theoretical and conceptual justification for monitoring the ecological condition of regional economic systems in the context of sustainable development is presented.

Figure 1. Theoretical and conceptual substantiation of the ecological condition monitoring of regional economic systems in the context of sustainable development



Source: suggested by the authors.

To monitor the ecological condition of regional economic systems in the context of sustainable development, taking into account the available statistical data presented by the statistics of Ukraine by region, the authors selected the following indicators:

- current costs for environmental protection in actual prices, UAH million (x1);

- discharge of polluted return waters into surface water bodies, million m³ (x2);
- capacity of treatment facilities, million m3 (x3);
- emissions of pollutants into the atmosphere from stationary sources of pollution, thousand tons (x4);
- total amount of waste accumulated during operation at waste disposal sites at the end of the year, thousand tons (hazard class IV) (x5).

At the same time, the selected indicators for monitoring the ecological condition of regional economic systems in the context of sustainable development can act as stimulators and disincentives. Thus, indicators x1, x3 are stimulants and have a positive effect on the ecological state, while other indicators, on the contrary, characterize negative effects on the environment and are classified as disincentives.

Of course, because the indicators have different values and units of measurement, rationing is applied to them. By creating a single scale of measurement, the standardization of all indicators leads to a commensurate measurement. This makes it impossible to influence the selected partial indicators for monitoring with a larger numerical order on the calculation results and preserves the functional dependencies between the indicators (stimulants or disincentives) by the formula:

$$X_{ij} = \frac{x_{ij-x_{min}}}{x_{max-x_{min}}} \quad 2.1$$

where xij, xmax , xmin – respectively, the actual, maximum or minimum value of the i-th partial indicator of the j-th element of the region.

The integrated indicator of the ecological state of regional economic systems (Ie) is determined by the formula:

$$I_e = \sum_{i=26}^{5} e_i X_i \quad 2.2$$

where ei is the weighting factor of the ecological state of regional economic systems:

$$e_i = (Z * Z^T)^{-1} * Z * I_e \quad 2.3$$

Z is a matrix of standardized indicators for a certain period (seven years, r = 7) for monitoring the ecological status of regional economic systems, which has the form:

$$Z = \begin{pmatrix} x_{11} & x_{12} & x_{13} & x_{14} & x_{15} & x_{16} & x_{17} \\ x_{21} & x_{22} & x_{23} & x_{24} & x_{25} & x_{26} & x_{27} \\ x_{31} & x_{32} & x_{33} & x_{34} & x_{35} & x_{36} & x_{37} \\ x_{41} & x_{42} & x_{43} & x_{44} & x_{45} & x_{46} & x_{47} \\ x_{51} & x_{52} & x_{53} & x_{54} & x_{55} & x_{56} & x_{57} \end{pmatrix} \quad 2.4$$

Monitoring the environmental condition of regional economic systems in the context of sustainable development implies that:

- it is necessary to organize constant monitoring and analysis of the results obtained on the ecological condition of the regions in terms of sustainable development;
- objects of monitoring under the influence of heterogeneous factors of influence, including negative ones, are in constant motion;
- monitoring results can be used for further forecasting of the state and changes in the ecological state of the regions;
- monitoring should be focused on the needs of regional and local authorities, which would provide them with the opportunity to guide the development of the environmental component and sustainable development of regional economic systems as a whole;
- reasonable selection of indicators to assess the environmental component.

3. Case Studies

The novelty of scientific research includes the authors' monitoring of the ecological condition of regional economic systems in the context of sustainable development, which, unlike the existing ones, provides theoretical and conceptual justification, is based on a methodological basis, which involves the use of such methods of economic and mathematical analysis, regression analysis, graphical, cartographic and grouping, and provides an opportunity to suggest the ways to improve the environmental condition of regional economic systems.

4. Results

In accordance with the proposed rationale for monitoring the ecological condition of regional economic systems in the context of sustainable development, the authors conducted testing on the basis of statistical data of the regions of Ukraine. The results of the calculations are presented in Table 1.

Table 1. Integral index of ecological condition of regions of Ukraine for 2014-2020

Regions	$I_{ecl.}$							$I_{ecl.avg}$
	2014	2015	2016	2017	2018	2019	2020	The average
Vinnytsia	2.297	2.257	2.059	2.188	2.178	2.356	2.366	2.243
Volyn	1.040	0.941	0.950	0.921	0.970	0.792	0.842	0.922
Dnipropetrovsk	1.901	1.931	2.079	2.099	2.079	2.119	1.980	2.027
Donetsk	0.683	0.545	0.584	0.762	0.505	0.436	0.426	0.563
Zhytomyr	0.762	0.792	0.990	1.188	1.307	1.366	1.267	1.096
Transcarpathian	0.792	0.842	0.891	0.941	0.693	0.594	0.644	0.771
Zaporizhzhia	1.683	1.733	1.713	1.881	1.832	2.772	1.733	1.906
Ivano-Frankivsk	3.158	2.317	1.337	1.871	1.802	1.812	1.762	2.008
Kiev	5.257	4.366	4.178	4.019	3.970	4.356	4.990	4.448
Kirovohrad	1.426	1.525	1.742	1.485	0.990	0.891	0.911	1.281
Luhansk	0.683	0.416	0.455	0.356	0.386	0.307	0.287	0.413
Lviv	2.970	2.871	2.525	2.277	1.931	1.881	1.782	2.319
Mykolaiv	0.980	1.089	1.317	1.752	1.584	1.881	1.634	1.462
Odesa	2.168	2.030	1.931	1.881	1.683	1.634	1.683	1.858
Poltava	1.782	1.931	1.832	2.079	2.534	2.970	3.069	2.314
Rivne	1.584	1.366	1.465	1.683	1.584	1.535	1.634	1.550
Sumy	1.148	1.139	1.040	0.980	0.960	0.842	1.000	1.015
Ternopil	1.040	1.059	1.099	1.089	1.109	1.119	1.139	1.093
Kharkiv	1.871	1.921	2.000	2.049	1.980	1.940	1.861	1.946
Kherson	0.941	0.891	0.861	0.891	0.921	0.980	1.010	0.928
Khmelnytsky	1.980	2.030	1.980	1.881	1.683	1.733	1.782	1.867
Cherkasy	0.950	0.911	0.911	0.970	0.921	0.941	0.980	0.941
Chernivtsi	2.079	2.089	2.030	1.980	1.931	1.940	1.960	2.001
Chernihiv	0.693	0.743	0.713	0.792	0.822	0.842	0.871	0.782
Kyiv city	5.247	4.386	4.198	4.059	4.010	4.356	4.901	4.451
The arithmetic mean value of the integrated index of the sustainable development component for all regions (Iecl.avg)	1.805	1.685	1.635	1.683	1.614	1.696	1.700	1.688

Source: calculated by the authors.

The results of monitoring the ecological condition of regional economic systems in the context of sustainable development have shown that the regions of Ukraine have a fairly large scope in the values of integrated indices. Thus, the difference between the city of Kyiv (Iecl.avg = 4.451) and Luhansk region (Iecl.avg = 0.413) is 10.8 times. It is impossible to name any region where for negative 7 or on the contrary, positive dynamics was traced for the investigated 7 years. However, in Zhytomyr, Poltava and Mykolayiv regions we can note a positive trend in the value growof the integrated index for the period under study. It should also be noted that in general, the values of the integrated index do not show significant dynamics over the years. This is confirmed by the data given in Table 2.

According to the value of the arithmetic mean integrated index for all regions, it can be stated that its greatest value was in 2014 and generally tended to decrease the value of the arithmetic mean index until 2018. In 2019-2020 there is a positive dynamic of growth of the arithmetic mean of the index.

The ranks of the regions according to the results of monitoring the ecological condition of regional economic systems in the context of sustainable development in the regions of Luhansk (25th position by rank) and Donetsk (24th position by rank) oblasts did not change during the studied seven years. No more than one step occurred during the study period changes in rank in Kyiv (1-2 position by rank), Kyiv (1-2 position by rank), Vinnytsia (4-5 position by rank) and Rivne (13- 14 position by rank) regions. Negative trends in the decline of the ranks of the regions by the value of the integrated index were observed in Volyn (from 16 to 22 positions), Ivano-

Frankivsk (from 3 to 10 positions), Kirovohrad (from 14 to 20 positions) and Odessa (from 6 to 12 positions). Significant positive trends in the change of ranks took place in Zhytomyr (from 22 to 15 positions), Mykolaiv (from 18 to 13 positions), Poltava (from 11 to 3 positions), as well as a slight positive change in the rank of Chernihiv region (from 23 to 21 positions).

Table 2. Ranks of regions according to the values of the integrated index of ecological status for 2014-2020

Regions	$R_{ecl.avg}$							$R_{ecl.avg}$
	2014	2015	2016	2017	2018	2019	2020	The average
Vinnytsia	5	5	5	4	4	4	4	5
Volyn	16	18	19	21	18	18	22	21
Dnipropetrovsk	9	9	4	5	5	5	5	6
Donetsk	24	24	24	24	24	24	24	24
Zhytomyr	22	22	18	16	15	15	15	16
Transcarpathian	21	21	21	20	23	23	23	23
Zaporizhzhia	12	12	12	9	9	9	11	10
Ivano-Frankivsk	3	4	14	12	10	10	10	7
Kiev	1	2	2	2	2	2	1	2
Kirovohrad	14	13	11	15	17	17	20	15
Luhansk	25	25	25	25	25	25	25	25
Lviv	4	3	3	3	7	7	8	3
Mykolaiv	18	16	15	13	13	13	13	14
Odesa	6	7	9	10	11	11	12	12
Poltava	11	10	10	6	3	3	3	4
Rivne	13	14	13	14	14	14	14	13
Sumy	15	15	17	18	19	19	18	18
Ternopil	17	17	16	17	16	16	16	17
Kharkiv	10	11	7	7	6	6	7	9
Kherson	20	20	22	22	20	20	17	20
Khmelnytsky	8	8	8	11	12	12	9	11
Cherkasy	19	19	20	19	21	21	19	19
Chernivtsi	7	6	6	8	8	8	6	8
Chernihiv	23	23	23	23	22	22	21	22
Kyiv city	2	1	1	1	1	1	2	1

Source: calculated by the authors.

Monitoring the ecological condition of regional economic systems in terms of sustainable development makes it possible to group regions by the level of value of the integrated index into four groups.

The first group with a high level in terms of the value of the integrated index of ecological status are Kyiv, Kiev region.

The second group with a fairly high level of the values of the integrated index are four regions, namely: Lviv, Poltava, Vinnytsia, Dnipropetrovsk regions.

The most numerous is the third group with an average value of the integrated index, which includes ten regions, namely: Ivano-Frankivsk, Chernivtsi, Kharkiv, Zaporizhia, Khmelnytsky, Odessa, Rivne, Mykolaiv, Kirovohrad, Zhytomyr regions.

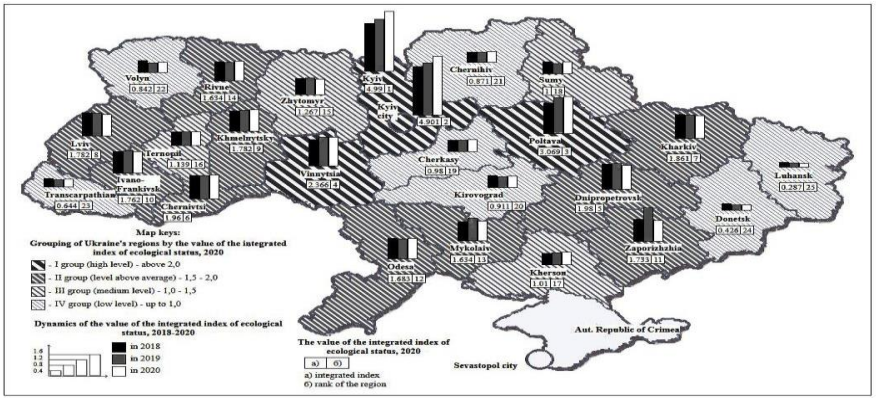
The fourth group with a low level of the integrated index value is: Ternopil, Sumy, Cherkasy, Kherson, Volyn, Chernihiv, Transcarpathuan, Donetsk, Luhansk regions. Grouping of regions is presented in Figure 2.

Thus, monitoring the environmental condition of regional economic systems in the context of sustainable development makes it possible to conclude that to ensure sustainable development it is necessary:

- to ensure the improvement of the legal framework and the implementation of European directives to ensure environmental protection;
- signing multilateral environmental protocols and agreements to increase the environmental efficiency of regional economic systems to achieve sustainable development goals;
- ensuring the implementation of strategic regional programs and projects to ensure the achievement of sustainable development goals, including in the direction of environmental security of sustainable development;
- modernization of production by stimulating innovative and knowledge-intensive industries that can displace industries that pollute the environment and involve irrational use of natural resources;
- implementation of measures to increase the environmental responsibility of business;

- stimulation of the widespread introduction of environmental technologies aimed at resource and energy conservation, utilization and low-waste industries;

Figure 2. Visualization of grouping of Ukraine's regions by the integrated index values of the ecological condition of regional economic systems in the context of sustainable development



Source: built by the authors.

- creation of departments or selection of specialists at the united territorial communities and regional authorities to carry out analytical research of monitoring of the ecological condition of economic systems, forecasting of ecological risks of regional economic systems and development of measures for their prevention;
- development of effective measures to eliminate the consequences that have already caused environmental damage;
- development and implementation of measures to improve ecological culture of the population through the formation of ecological consciousness of the population and the formation of the need for careful development of the environment.

Conclusion

The authors' monitoring of the ecological condition of regional economic systems in the context of sustainable development was tested in accordance with the regions of Ukraine. The results of calculations in accordance with the theoretical and conceptual justification of monitoring the ecological condition of regional economic systems in the context of sustainable development and the developed methodological approach showed that:

- firstly, that the difference in the values of integrated indices of the ecological status between regions is 10.8 times (between Kyiv and Luhansk region) and tends to increase asymmetrically;
- secondly, during the studied seven years, only in four of the twenty-six regions there was a tendency to improve the ecological situation (Zhytomyr, Poltava, Mykolaiv and Chernihiv regions);
- thirdly, in six regions for seven years the positions by ranks according to the integrated index of ecological condition (Kyiv, Kiev, Vinnytsia, Rivne, Donetsk, Luhansk regions) did not change (or the change was not more than one step);
- fourthly, in four regions there were significant negative changes in the rankings of the integrated index (Volyn, Ivano-Frankivsk, Kirovohrad, Odessa regions).

The monitoring of the ecological condition of regional economic systems in the context of sustainable development made it possible to suggest practical directions for improving the ecological condition of regional economic systems.

In further scientific research, the results obtained can serve as a basis for developing strategies to improve the environmental safety of regional economic systems in terms of sustainable development.

References

[1] Chvátalová, V. 2021. The post-market environmental monitoring of GM maize in the EU has a limited capacity to identify adverse effects. *Environmental Science and Policy,* 121: 11-17. DOI:https://doi.org/10.1016/j.envsci.2021.03.013

[2] Dzhidzhelava, D. and Fedina, A. 2020. The environmental component of construction projects in the aspect of sustainable development. Paper presented at the IOP Conference Series: Materials Science and Engineering, 890(1): 012178. DOI: https://doi.org:/10.1088/1757-899X/890/1/012178

[3] Lazarenko, Yu. *et al.* 2020. Exploring Strategic Directions for the Local Innovation Ecosystem Development in the Mining Industry. Paper presented at the Vth International Innovative Mining Symposium. E3S Web Conf., 174: 02001. DOI: https://doi.org/10.1051/e3sconf/202017402001

[4] Melis, C., Wold, P.-A., Bjørgen, K. and Moe, B. 2020. Norwegian kindergarten children's knowledge about the environmental component of sustainable development. *Sustainability,* 12(19): 1-16. DOI:https://doi.org/10.3390/su12198037

[5] Popelo, O., *et al.* 2021. Systemic Approach to Assessing Sustainable Development of the Regions. *Journal of Environmental Management and Tourism* (Volume XII, Summer), 3(51): 742-753. DOI:https://doi.org:/10.14505/jemt.v12.3(51)

[6] Prasad, A. and Mogla, R. 2017. Environmental education: Component of sustainable development. Paper presented at the IEEE Region 10 Humanitarian Technology Conference 2016, R10-HTC 2016 – Proceedings 20 April 2017, 7906788. DOI: https://doi.org:/10.1109/R10-HTC.2016.7906788

[7] Seddon, A.W.R. 2021. Special feature: measuring components of ecological resilience in long-term ecological datasets: Palaeoecology and ecological resilience. *Biology Letters* 17(1): rsbl20200881. DOI:https://doi.org:/10.1098/rsbl.2020.0881

[8] Shkarlet, S., Ivanova, N., Popelo, O., Dubina, M. and Zhuk, O. 2020. Infrastructural and Regional Development: Theoretical Aspects and Practical Issues. *Studies of Applied Economics* 38-3(1). DOI:http://dx.doi.org/10.25115/eea.v38i4.4002

[9] Sorokoumova, E.A. and Cherdymova, E.I. 2021. Developing structural components of ecological consciousness to promote civic identity formation. *Psychological Science and Education* 26(1): 102-112. DOI: https://doi.org/10.17759/pse.2021260107

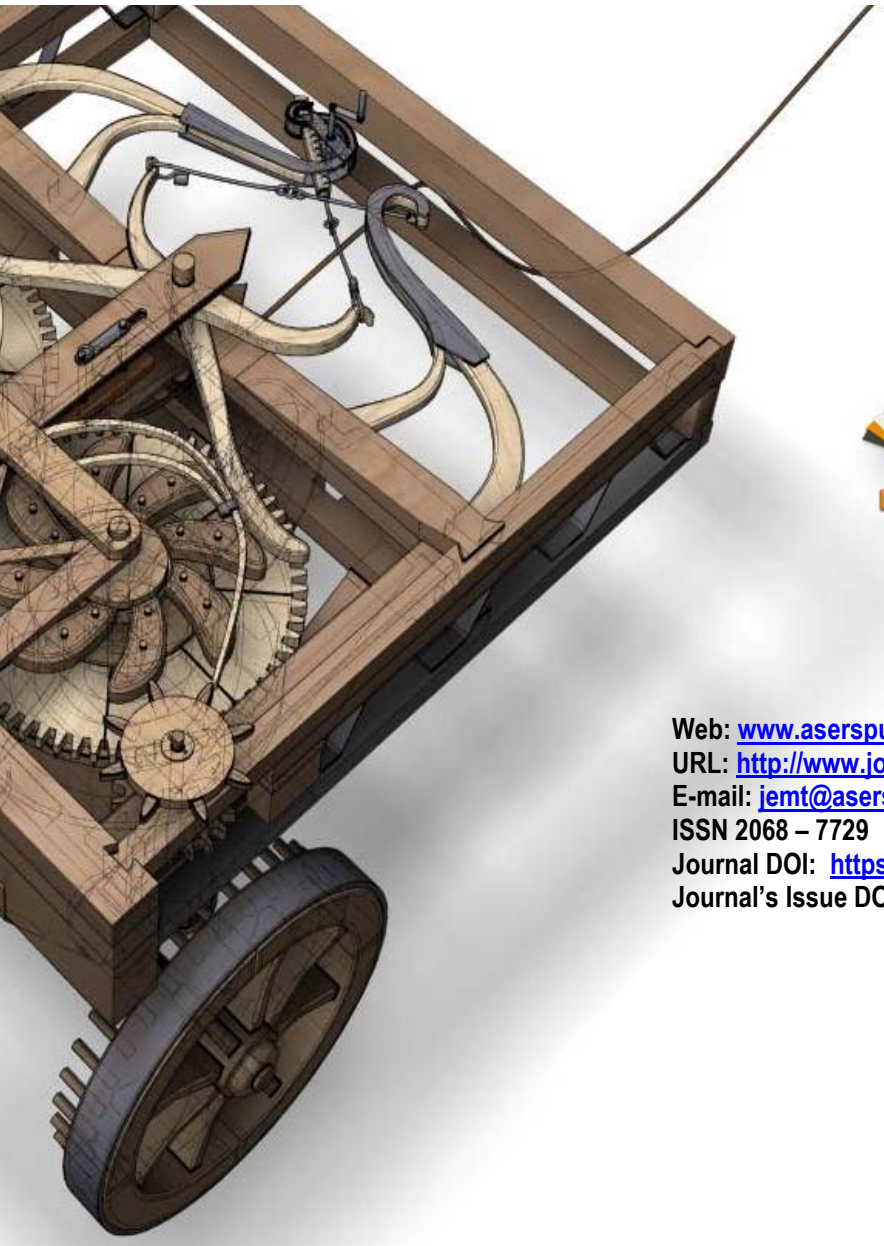
[10] Teixeira, L. *et al.* 2021. Linking human and ecological components to understand human–wildlife conflicts across landscapes and species. *Conservation Biology,* 35(1): 285-296. DOI:https://doi.org:/10.1111/cobi.13537

[11] Tropea, E., Hynds, P., McDermott, K., Brown, R.S. and Majury, A. 2021. Environmental adaptation of E. coli within private groundwater sources in southeastern Ontario: Implications for groundwater quality monitoring and human health. *Environmental Pollution* 285 (2021): 117263. DOI:https://doi.org/10.1016/j.envpol.2021.117263

[12] Veilleux, H.D., Misutka, M.D. and Glover, C.N. 2021. Environmental DNA and environmental RNA: Current and prospective applications for biological monitoring. *Science of the Total Environment,* 782: 146891. DOI:https://doi.org:/10.1016/j.scitotenv.2021.146891

[13] Zamula, I.V. 2015. Accounting component of environmental liabilities management according to the principles of sustainable development. *Actual Problems of Economics,* 166(4): 261-267.

ASERS



ASERS Publishing

Web: www.aserspublishing.eu
URL: http://www.journals.aserspublishing.eu/jemt
E-mail: jemt@aserspublishing.eu
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt
Journal's Issue DOI: https://doi.org/10.14505/jemt.v12.5(53).00