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SUSTAINABLE DEVELOPMENT INDICATORS AND POSSIBILITIES OF THEIR MAPPING

The article deals with the sets of sustainable development indicators and sustainable development indexes. Among approaches used in indicators design the author has identified geosystemic, target, problematic, sectoral and functional ones. It is denoted that the most widely used indicator sets are the OECD programme on ecological indicators and the system of indicators created by the UNO Division for Sustainable Development.

The author analyzes the integral indexes of sustainable development, such as Living Planet Index, Human Development Index, Human Poverty Index, Adjusted Net Savings and the Ecological Footprint. It is emphasized that integral indicators and indexes are rarely used in sustainable development strategies (the reason for this could be some methodological limitations or lack of statistical data).

The analysis of national sustainable development strategies of European countries has showed that the target approach is mainly used in the development of indicators and their number vary from 32 (Estonia) to 610 (Latvia). Sustainable development strategies indicators are expressed in the text and table forms; charts and graphs are commonly used in the monitoring reports, whereas cartographic works are hardly represented.

The author has presented the following key recommendations for mapping indicators for sustainable development strategies: to use component system of indicators as the basis for integral indicators design; to use either territory or population as a «common denominator» for indicators; to give users the most complete picture of the territory development applying the least possible number of maps; to use collation and diagram maps which are the most appropriate way of cartographic representation.

Keywords: sustainable development, sustainable development strategy, sustainable development indicators, mapping provision for sustainable development strategies.

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ПОКАЗНИКИ СТАЛОГО РОЗВИТКУ ТА МОЖЛИВОСТІ ЇХ КАРТОГРАФУВАННЯ

У статті розглядаються розроблені на даний момент індикатори та індекси сталого розвитку, історія та підходи до їх формування. У формі таблиці подано порівняльний аналіз систем індикаторів сталого розвитку, розроблених міжнародними організаціями та установами, а також наведено опис інтегральних індексів сталого розвитку, що набули найбільшого поширення. Автор аналізує індикатори, що застосовуються у стратегіях сталого розвитку країн Європи. Подано рекомендації щодо картографування індикаторів для стратегій сталого розвитку.

Ключові слова: сталий розвиток, стратегія сталого розвитку, індикатори сталого розвитку, картографічне забезпечення стратегій сталого розвитку.

Наталия Попович

ПОКАЗАТЕЛИ УСТОЙЧИВОГО РАЗВИТИЯ И ВОЗМОЖНОСТИ ИХ КАРТОГРАФИРОВАНИЯ

В статье рассматриваются разработанные на данный момент индикаторы и индексы устойчивого развития, история и подходы к их формированию. В форме таблицы представлен сравнительный анализ систем индикаторов устойчивого развития, разработанных международными организациями и учреждениями, а также дано описание интегральных индексов устойчивого развития, которые получили наибольшее распространение. Автор анализирует индикаторы, применяемые в стратегиях устойчивого развития стран Европы. Даны рекомендации по картографированию индикаторов для стратегий устойчивого развития.

Ключевые слова: устойчивое развитие, стратегия устойчивого развития, индикаторы устойчивого развития, картографическое обеспечение стратегий устойчивого развития.

Introduction. For the successful transition to the practical implementation of sustainable development (SD) concept in Ukraine and the world a fundamentally important issue is the development of appropriate indicators that would allow to assess the level of regional development, to monitor the implementation of sustainable development strategies objectives and to effectively present the information to the politicians and the public. These indicators can serve a recommendatory basis for making management decisions. The complexity of developing such indicators is caused by the complexity of relationships in the «nature-society-economy» system, and there is no generally accepted set of sustainable development indicators in the world.

The development of indicators is also important in terms of cartographic products creation for sustainable development strategies. According to the researchers, «problems and indicators of sustainable development should be geographically located in such a way that they could be done with tools like GIS» [5]. SD Indicators underlie the system of parameters and characteristics for cartographic works for sustainable development strategy at any territorial level.

Initial conditions. In Chapter 40 of Agenda 21 (document of the United Nations Conference on Environment and Development held in Rio de Janerio in 1992) all the countries and the international community were encouraged to develop indicators of sustainable development [9].

Since that time, some countries and international organizations that deal with sustainable development issues, have gained valuable experience in the design

of sustainable development indicators. In particular, in countries such as Great Britain, Canada, the United States there are special institutions involved in development of indicators and indexes of sustainable development. Also this question is actively explored by international organizations and agencies, such as World Health Organization (WHO), the United Nations Organization (UNO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Bank, Organisation for Economic Cooperation and Development (OECD), Scientific Committee on Problems of the Environment (SCOPE) and some others [2].

The problem of cartographic and GIS support for sustainable development was explored by Russian researchers V. S. Tikunov and D. A. Tsapuk [5]. The Department of Physical Geography and Cartography in the process of creating maps for Kharkiv region Development Strategy to 2020 has formed a number of recommendations for mapping the subject [6].

The purpose of this paper is to analyze and compare the indicators used in sustainable development strategies of European countries and develop recommendations for their mapping.

The main material. To assess the development of any territory, economic, social and environmental indicators should be taken into account. However, these conventional statistical indicators, taken separately, do not give a proper idea of balanced development. Therefore, for over 25 years the international community has worked to develop specific indicators for sustainable development. In 2007 the «Beyond GDP» conference was held and acted as a catalyst of active work on the development of indicators that focus on environmental and social aspects of development [7].

Analyzing the indicators of sustainable development, it is necessary to give a definition of the terms «indicator» and «index». Organization for Economic Cooperation and Development (OECD) defines sustainable development indicators as «a parameter, or a value derived from parameters, which points to, provides information about, describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value» [3]. In other words, indicators play a role of assessment tools for sustainable development. Sustainable development indexes are the sets of aggregated or weighted parameters or indicators [3].

Analysis of the literature has allowed to identify a number of basic approaches to the design of sustainable development indicators:

1. *Geosystemic*. It allows to identify indicators for each of the subsystems of the system «nature-society-economy». Sometimes institutional subsystem (subsystem of law and government) is added to these components. In fact, this approach appeared the first, because it was used in the development of the indicators set proposed by the UNO Division for Sustainable Development in 1996.

2. *Target.* The essence of this approach lies in orienting indicators on the implementation and monitoring of sustainable development objectives. As an example of this approach 10 national goals of sustainable development in the US (1994) could be remembered. This approach is a priority in the design of indicators for sustainable development strategies.

3. *Problematic.* This approach is close to the target, but it is aimed not at monitoring the implementation of the objectives but at solving problems (challenges) of sustainable development.

4. *Sectoral.* This approach is advisable only at the regional level, because its special feature is that certain segments of the community or researchers may offer different, sometimes specific groups of indicators they consider important according to achieving the objectives of sustainable development.

5. *Functional.* This approach is used in the «Pressure-State-Response» model proposed by the OECD in 1994 within the programme on ecological indicators.

Classification of sustainable development indicators can be carried out on several grounds: purpose, object or phenomenon which is described, the use level. There are sets of sustainable development indicators of different scales: global, regional, national, local and sectoral. By **the way of receiving** individual indicators (key and integral) and sets (systems) of indicators can be distinguished [5]. We would like to analyze the sets of sustainable development indicators used by international organizations and agencies (Table 1).

As we see, the sets of sustainable development indicators, proposed in different time periods, differ in approach to design as well as the number and themes of indicators. The most widely used sets of indicators are the OECD programme on ecological indicators based on «Pressure-State-Response» model and the set of indicators created by the UNO Division for Sustainable Development, in which the main point is decision-making.

For the strategic decisions making it is necessary to develop integral indicators of sustainable development, which would give principled and comprehensive evaluation of balanced development. They could be divided into the following groups: socio-economic; environmental and economic; social and environmental; ecological and socio-economic [2]. At present there is a number of integral indicators, and each of them focuses on a specific topic.

The Living Planet Index is a measure of the state of global biological diversity proposed by World Wildlife Fund (WWF).

The Human Development Index is proposed by the UNO summary measure of average achievement in key dimensions of human development. This index is often complemented by **the Human Poverty Index,** which concentrates on the deprivation in the three essential elements of human life.

The Adjusted Net Savings Index (proposed by the World Bank) measures the true rate of savings in an economy after taking into account investment in

Table 1

Sustainable development indicators sets

Set of sustainable development indicators	Organization or agency, which proposed the set	Year of creation	Number of indicators	Special features
1. OECD programme on ecological indicators	Organization for Economic Cooperation and Development	1994	Basic set includes 40-50 indicators	Based on the «Pressure-State-Response» model
2. The UNO DSD set of indicators	UNO Division for Sustainable Development	1996, revised in 2006	134 indicators, in 2006 the number was limited to 96 (50 key indicators)	Indicators are divided in 4 dimensions: economic, social, environmental, institutional
3. A system for integrated environmental and economic accounting	United Nations Statistical Commission	1993	-	Takes into account environmental factors in national statistics
4. Indicators of world development («The little green data book»)	World Bank	2007	49 indicators	All indicators are grouped in 8 topics, environmental indicators are in focus
5. EECCA Indicators (Eastern Europe, Caucasus and Central Asia)	The Statistical Division of UNECE	2003	118 indicators	Indicators are divided into priority areas of environmental policy and economic sectors
6. Energy indicators for sustainable development	International Atomic Energy Agency (IAEA)	2005	30 key indicators	Indicators are grouped in 8 topics, within which subtopics are marked
7. EEA environmental indicators	European Environment Agency	Since 2005	129 indicators	Indicators are divided into descriptive, display, performance indicators and indicators of well-being

human capital, depletion of natural resources and damage caused by pollution.

We would like to pay special attention to **the Ecological Footprint** which is a measure of mankind impact on Earth's ecosystems. It should be noted that because the territorial component is mostly presented in this index, it is particularly appropriate to use it in geographic research for sustainable development [1].

These indicators are the most commonly known and widely used in practice. Typically, the indexes are regularly calculated by those organizations and institutions which developed them, and the results are published in special reports. In sustainable development strategies such integral indicators are used rarely and the reason for this could be some methodological limitations or lack of statistical data.

On the issue of developing indicators for sustainable development strategies EU countries are most experienced, as most of them (such as the UK, Germany, Sweden, Lithuania) have not only approved but revised national strategies [8]. The analysis of European strategies leads to the following conclusions about the use of sustainable development indicators:

1. The approach to the design of indicators for sustainable development strategies is mainly target: indicators are developed during certain tasks to be able to assess the degree of their implementation. Geosystemic approach is also widely used (indicators are divided into economic, social, environmental, institutional dimensions according to the UNO model).

2. The number of indicators of sustainable development strategies range from 32 (Estonia) to 610 (Latvia). Number of indicators used for monitoring SD tasks also considerably varies, from 12 (France) to more than 100 (Denmark, Italy, Latvia) [8].

3. The most common objectives and indicators of sustainable development are related to the preservation of natural resources, climate change, alternative energy issues. Some Mediterranean strategies are focused mostly on environmental issues while neglecting social indicators (for example, Greece, Malta).

4. Most similarities in strategies are observed in environmental indicators and major differences — in social. This fact could be explained by different socio-economic models of European countries.

5. Sustainable development strategies indicators are expressed in the text and table forms; charts and graphs are commonly used in the monitoring reports, whereas cartographic works are hardly represented.

As we can see, Europe is far from unity in the selection of indicators for sustainable development strategies, and because of the low level of mapping provision for strategies the necessary experience of justification of indicators sets for cartographic works for SD strategies has not been worked out yet [4]. Using the experience of developing cartographic works for Kharkiv region Development Strategy to 2020 we could present such basic recommendations on mapping SD indicators:

1. The selection of sustainable development indicators have to be affected by the special features of the area, the possibility of calculating the indicators, the mapping tasks.

2. In strategies it is necessary to use a component system of indicators as the basis for integral indicators

design. Accordingly, we should present environmental, social and economic maps as well as synthetic maps showing the general level of development.

3. As international experience shows, the use of only statistical data to design indicators of sustainable development is not always sufficient, and to measure many indicators of socio-economic dimension it is necessary to conduct polls. Based on the collected data, it is advisable to create cartographic works that will clearly demonstrate the quality of life.

4. As a «common denominator» for indicators we should use either territory (to calculate indicator per square km) or population (to calculate indicator per person) [5]. Using relative, not absolute indicators simplifies comparison of balanced development of different scale areas.

5. It is important to give users the most complete picture of the territory development applying the least possible number of maps. It is appropriate to use a limited number of complex synthetic indicators not to overload strategies with statistical data and cartographic works.

6. Since the indicators are used first of all to assess the development of the areas, the most appropriate way to represent this information is collation and diagram maps which, as the analysis of mapping experience shows, need to be improved and visualization should be unified.

It should be emphasized that during the technological and social development of mankind new indicators and indexes of sustainable development will appear as well as new mapping parameters. It makes mapping for sustainable development an important direction in thematic mapping and opens prospects for further research in justification of indicators for cartographic works for sustainable development strategies.

Conclusions. The international community has made significant progress in the development of indicators and integral indexes of sustainable development. The most commonly used systems of indicators are the OECD programme on ecological indicators and the system of indicators created by the UNO Division for Sustainable Development, but they have their shortcomings and are constantly improved.

At the moment in the sustainable development strategies of the EU countries the emphasis is shifted to environmental indicators which could be explained by traditionally developed environmental policies in the region. When developing indicators most European countries use the system according to which all indicators are divided into four subsystems: social, economic, environmental, institutional.

The indicators for cartographic works for sustainable development strategies have not been fully worked out yet which could be explained by the low level of mapping support for SD strategies as well as by the «youth» of this area of thematic mapping. Since the indicators are used first of all to assess the development of the areas, the most appropriate way to represent this information is collation maps and diagram maps.

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Список використаних джерел:

1. Гречко Т.К. Публічне управління в забезпеченні сталого (збалансованого) розвитку: [навч. посіб.] / Т.К. Гречко, С.А. Лісовський, С.А. Романюк, Л.Г. Руденко. — Херсон: Грінь Д.С., 2015. — С. 94—106.

2. Зеркалов Д.В. Проблеми екології сталого розвитку [Електрон. ресурс]: монограф. / Д.В. Зеркалов. - К.: Основа, 2013. — С. 30-37. — Режим доступу: http://www.zerkalov.kiev.ua/sites/default/files/

3. Наукові засади розробки стратегії сталого розвитку України [Текст]: монограф. / ІПРЕЕД НАН України, ІГ НАН України, ІППЕ НАН України. — Одеса: ІПРЕЕД НАН України, 2012. — С. 418—429.

4. Пересадько В. Использование картографического метода в исследовании стратегий устойчивого развития стран Европы / В. Пересадько, Н. Попович // Scientific Letters of Academic Society of Michal Baludansky. — 2016. — Vol. 4. — № 1. — P. 136—139.

5. Тикунов В.С. Устойчивое развитие территорий: картографо-информационное обеспечение [Текст] / В.С. Тикунов, Д.А. Цапук. — М. — Смоленск: Изд-во СГУ, 1999. — С. 92—109.

6. Уткіна К.Б. Стан і перспективи поводження з відходами в рамках розроблення стратегії розвитку Харківської області до 2020 року / К.Б. Уткіна, В.А. Пересадько, А.Н. Некос, Н.В. Попович // Український географічний журнал. — 2015. — № 4 (92). — С. 58—63.

7. European Comission. Beyond GDP [Electronic resource]. — Available at: http://ec.europa.eu/environment/beyond_gdp/2007_conference_en.html

8. Steurer Reinhard, Hemetner Markus. Objectives and Indicators in Sustainable Development Strategies: Similarities and Variances across Europe [Text] / Reinhard Steurer, Markus Hemetner // Sustainable Development. — 2013. — Vol. 21. — P. 224—241.

9. UNCED. United Nations Conference on Environment and Development. Agenda 21. — United Nations Organization: New York, 1992 [Electronic resource]. — Available at: https://sustainabledevelopment.un.org/

References:

1. Grechko, T.K., Lisovs`ky`j, S.A., Romanyuk, S.A, Rudenko, L.G. (2015). Publichne upravlinnya v zabezpechenni stalogo (zbalansovanogo) rozvy`tku [Public administration in sustainable development]. Xerson: Grin' D.S., 94-106.

2. Zerkalov, D.V. (2013). Problemy` ekologiyi stalogo rozvy`tku [The problems of sustainable development ecology]. Ky`yiv: Osnova, 30-37. Available at: http://www.zerkalov.kiev.ua/sites/default/files/

3. Naukovi zasady` rozrobky` strategiyi stalogo rozvy`tku Ukrayiny` [Scientific principles of creating sustainable development strategy of Ukraine] (2012). Odesa: IPREED NAN Ukrayiny`, 418-429.

4. Peresad'ko, V., Popovych, N. (2016). Ispol'zovanie kartograficheskogo metoda v issledovanii strategij ustojchivogo razvitija stran Evropy [The use of cartographic method in the study of sustainable development strategies of European countries]. Scientific Letters of Academic Society of Michal Baludansky, 4 (1), 136-139.

5. Tikunov, V.S., Capuk, D.A. (1999). Ustojchivoe razvitie territorij: kartografo-informacionnoe obespechenie [Sustainable development of territories: cartography and GIS support]. Moskva — Smolensk: Izd. SGU, 92-109.

6. Utkina, K.B., Peresad'ko, V.A., Nekos, A.N., Popovy`ch, N.V. (2015). Stan i perspekty`vy` povodzhennya z vidxodamy` v ramkax rozroblennya strategiyi rozvy`tku Xarkivs`koyi oblasti do 2020 roku [The current state and prospects of waste management in the framework of preparation of the development strategy for Kharkiv oblast for the period until 2020]. Ukrainian geographical journal, 4 (92), 58-63.

7. European Comission. Beyond GDP. Available at: http://ec.europa.eu/environment/beyond_gdp/2007_conference_en.html

8. Steurer, R., Hemetner, M. (2013). Objectives and Indicators in Sustainable Development Strategies: Similarities and Variances across Europe. Sustainable Development, 21, 224-241.

9. UNCED. United Nations Conference on Environment and Development. Agenda 21. United Nations Organization: New York, 1992. Available at: https://sustainabledevelopment.un.org/