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Evaluation the Indicators of Environmental Capacity of Regional Economic System: Methodic and Practice

ABSTRACT

The goal of this research work is the formation of methodological approach of ecological factor assessment impact on the development level of territorial economic systems. This article presents the quality indicators of the development of socio-economic areas, which reflect total level and the extent of human impact on the natural environment characterizing the level of economy influence (economic activities) on the environment. This article had been suggested the approach to the calculation of ecointensity indicator and general air pollution dynamic in Ukraine, regarding regions, type of economic activities/industries had been conducted. In this research work had been given the comparative evaluation and the characteristics of the ecological status of the territories. It was determined that for the period from 2005 till 2012 the emissions of pollutants into atmosphere from stationary and mobile pollution sources are gradually reduced, this tendency is observed through the decline in the level of production enterprises, which were the main polluter of atmosphere. Estimate materials of ecointensity emissions of pollutants and carbon dioxide by types of economic activity indicated that the biggest index were energy distribution, mining and processing industries.

Key words: *ecological factor, natural environment, socio-economic development.*

Introduction. The assessment of the current position, the level of economic development and its impact on the natural environment requires the use of modern economic tools, particularly the construction and use of indicators with the aim of providing information support for planning processes and decision making in the regulation of sustainable socio-economic development at regional and sectoral levels. The currently proposed systems of indicator most closely reflect the general socio-economic trends, due to the transformation processes that occur in the economy. At the same time, the ecological component of the economic system in which the most pronounced negative impact of economic decisions long-term nature, particularly not taken into account during the development of policy documents. Therefore, the problems of environmental considerations of economic development focus on research areas to determine the basic parameters of quality assessment of socio-economic regions development in the context of sustainable growth. A number of resource-intensiveness indicators widely used in modern practice assess the level of sustainable development of territories (Granovska, 2008), which in some cases is defined as ecointensity or intensity of pollution, eco— and resource capacity. For example, on the basis of SEEA system of environmental-economic accounting (System of Environmental-Economic Accounting), included environmental indicators, characterizing the interaction of economy and environment in the study area. Also in the proposals of the OECD, World Bank and in analytical practice there are different interpretations of the indicator of natural capacity. Primarily, we may include: energy, water and material consumption, metal capacity, specific emissions and discharges, specific waste production and consumption, which reflect as a ratio to the value of output and population or land area of the region. At that emit, as a rule, two levels of indicators of environmental capacity: a macroeconomic level is considered in the framework of the national or regional economy; industry — which may be represented on national and regional levels. In addition, indicators of environmental capacity can be determined on the sub-regional level, but also on the micro level, we may say on the level of enterprises and other economic entities.

Material and Methods. Ecological-economic analysis and assessment of the territory was based on the methods of primary data collection and data processing, statistical, comparative geographical, mathematical, methods for systematic and logical generalization, settlement and constructive methods. In the work have been used materials of the State Administration of Ecology and Natural Resources and the State Statistics Service of Ukraine. The general research methodology is based on philosophical and ecological-geographical ideas and concepts, the foundation for which was the concept of sustainable development of the territory.

The Research Results and Their Discussion. From our point of view the indicator of natural capacity is consolidated (generalized) the quality indicator of socio-economic development of the territory, which reflects the general level and the extent of human impact on the natural environment. The indicators of ecointensity or intensity of pollution are determined by the volume of pollution per unit of output or square. Indicators of ecocapacity, to our opinion, present the strength of environment influence to economic activity, primarily on nature, including human. In general, the indicators of ecointensity as ecocapacity reflect the influence of all kinds of pollution or indicate a certain impact.

Indicators of resource capacity are the most informative indicators for determining anthropogenic pressures to all natural resources. They are expressed through specific indicators such as the proportion of disturbed land in total land area of the region or the proportion of space occupied by the wastes storage, including illegal ones, in a total land area of the region or the total amount (weight) of accumulated waste, including hazard class. Also, using resource capacity indicators we may fix the size of the total consumption of each resource output per unit.

In general, the indicators of environmental capacity characterize the efficient functioning of any economic system: type, level and quality of economic development. Among economic criteria to reduce the natural capacity of the economy is an effective criterion for sustainable development.

Figure 1 shows the indicators interrelation that characterized the impact level on the environment.

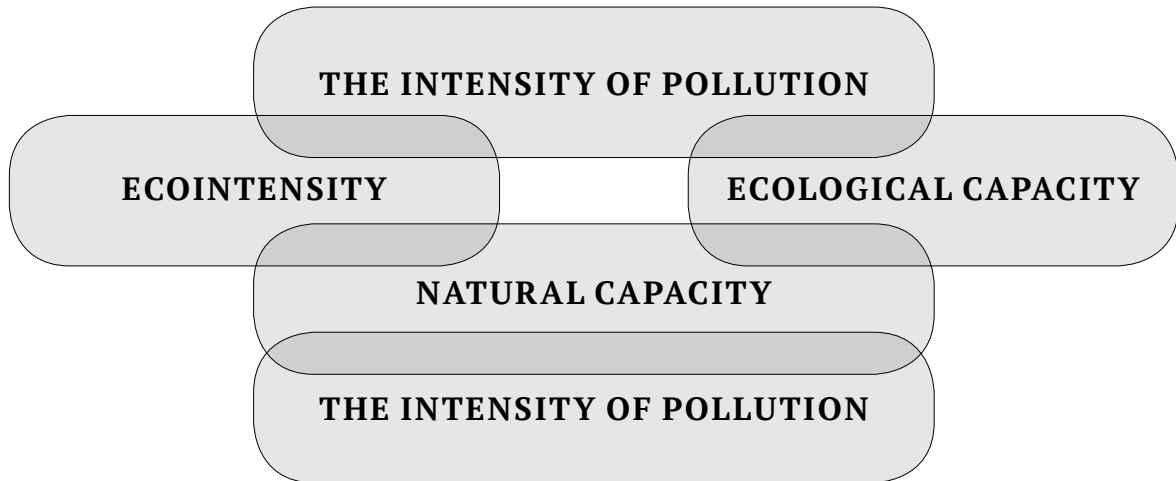


Figure 1. The Indicators of Environmental Interrelation Capacity of the Economy

Indicators calculation of environmental capacity, reflecting the pressure of the economy on the environment and on the human being can be determined on the basis of the following ratios:

- 1) Ecointensity E_i industries with regard to environmental pressure (p) is defined as the environmental pressure per unit of added value:

$$E_i = \frac{q_i^p}{v_i}$$

where v_i – added value, produced by industry i ;

where q_i^p – environmental pressure (p) industry (i).

Ecointensity reflects the specific amount of negative impact on the environment or unit area. As impurities, generally considered harmful contaminants contained in the emissions and discharges of enterprises, various gases, wastes of production and consumption. Indicator ecointensity allows to establish the interrelation between industries and the damage caused to the environment of the production and commercial operations of enterprises. The goal of this is to identify the most polluting types and sectors of economic activity in the region.

- 2) Eco productiveness of the region, taking into account the environmental pressure (p) is defined as the sum of value-added generated per unit cost environmental impact:

$$E_p = \frac{v_i}{q_i^p}$$

- 3) Eco capacity E_h is defined as the unit loading on one person:

$$E_h = \frac{q_i^p}{H}$$

where N is the population exposed to the polluted environment.

Ecocapacity as ecointensity indicates the relative load of negative effects on humans and the environment.

- 4) Resource capacity sets the amount of resources consumed per unit of output:

$$R_c = \frac{r_i}{v_i}$$

where r_i the amount of resources consumed in the production process.

So, the overall indicator of ecointensity can be calculated as the ratio of total air emissions, waste production and consumption, the volume of contaminated waste water generated in the area until an appropriate contribution to gross domestic product:

$$E_u = \frac{Q_i^a + Q_i^s + Q_i^o}{G_i}$$

where E_u – the intensity of waste formation in the i -industry, t/mln .;

Q_i^a – harmful emissions into the atmosphere of the i -industry, t ;

Q_i^s – waste water i -industry, that contain contaminants, t ;

Q_i^o – production waste; i -industry, t ;

G_i – the industry's contribution to gross domestic product, million.

Summary (general) indicator of "ecointensity" E_s is defined as the total volume of pollution produced by all kinds of production and economic activity of the region for the year gross domestic product in constant prices:

$$E_s = \frac{\sum_{i=1}^n (Q_i^a + Q_i^s + Q_i^o)}{G R P}$$

Summary (general) indicator of “ecocapacity” territory / region is calculated as the ratio of the total of all types of pollution in the region, total population, i.e. is determined by the average environmental load that falls on one person. If you want to set the degree of intraregional differentiation of these indicators, the calculation is carried out according to the same indicators, but within the administrative-territorial formations of the region.

Partial indicators of ecointensity determined by the contribution of each type of pollution of atmosphere, waste and wastewater in the gross national product (in relation to the country as a whole) or gross regional product (relative to the region), and “ecocapacious” – according to the influence on human and on environment.

In the international system of environmental-economic accounting these indicators (pollution intensity or ecointensity) for different types of environmental loads are calculated as indicators of environmental capacity per unit of value added. The dynamics of these indicators suggests the possibility of sectors to have the greatest impact on the environment and on the economy in general, increasing the value added per unit and costs for environmental impact or reduce these costs per unit of value added. This is a very important factor in the decision of environmental problems of the regions with the unique natural resources and rich natural resource base, primarily on economic development and social welfare it depends on the intensity of natural resources use.

In the works of foreign scientists, especially Vaitzeker E., Vozniak V., Kena Y., Lemesheva M.Y., Medoyza D., Oldaka P.G., Forrester J., Hachaturova T.K., as well as a number of leading scientists and specialists of Ukraine: Burkinskiy B.V., Veklich O.A., Galyskhina T.P., Gerasymova S.V., Grabynskiy I.M., Grechanovska I.G., Danylyshyna B.M., Dorogyntseva S.I., Kashenko O.L., Melnik L.G., Mishenina Y.V., Cherniaka V.K. and other researchers their indicators of environmental capacity developed with consideration of the peculiarities of the national economy. For example, according to S. Bobyliova, natural capacity is an important indicator of efficiency of functioning of natural-food system. This figure is well characterized by the type and level of ecological and economic development (Bobylev, Zakharov).

Research evaluation of quality indicators of socio-economic development at the regional level has its own specificity, especially for areas with environmental regulations.

The problem of finding a path to sustainable development with the aim of preserving the unique natural objects reflected in many works of scientists-economists (Granovska, 2008; Danilishin, 1999; Khlobystov, 2008). However, research aimed at the analysis and evaluation of the quality balanced with socio-economic development of the territory with the help of indicators characterizing features of the existing relationship in ecological-social-economical system of the region with the aim of identifying priorities and criteria development, is becoming increasingly popular.

To relate the efficiency of economic activity and the level of its impact on the natural environment, you must determine how big is the intensity of the pollution of the main types of production placed on the site, and how ambiguous the contribution of existing enterprises in the existing scale of pollution in the environment.

Researchers of the World Bank noted that excessive aerosol pollution has a negative effect on people’s health, causing respiratory system diseases, aggravation of cardiovascular diseases and it may cause premature death. Their assessment conducted in 18 cities in Eastern and Central Europe, with the normative values significant excess of the aerosols content in the atmospheric air. The obtained results of this study showed that the concentrations decreasing of dust and soot in these cities` air reached the maximum allowable standards adopted by the European Union annually would save the 18,000 people lives and get 1.2 billion dollars income due to the morbidity reduction and the associated loss of working time (Urbanization and Pollution of air in the garden).

In Ukraine annually in air pool get about 7 million tons of different substances, each of which is hazardous to humans and other living organisms and causes damage to property (buildings, structures, pavement, etc.) and causes large economic losses. For example, according to official data of the State Statistics Committee of Ukraine, in 2012 the environment were found 6821,1 thousand tons of harmful substances (State Statistics Service of Ukraine). Although in recent years there has been some fluctuation in the values of this index, however, the steady trend towards a reduction in emissions has been observed.

Ecointensity indicator of Ukraine economy for the period from 2005 till 2012 with according to the emissions of pollutants into atmospheric air from stationary and mobile sources of pollution (Emissions of pollutants into the air from stationery and movable pollution sources) decreases (Figure 2), which is associated mainly with the reduction of the production enterprises level, which were the main air pollutants.

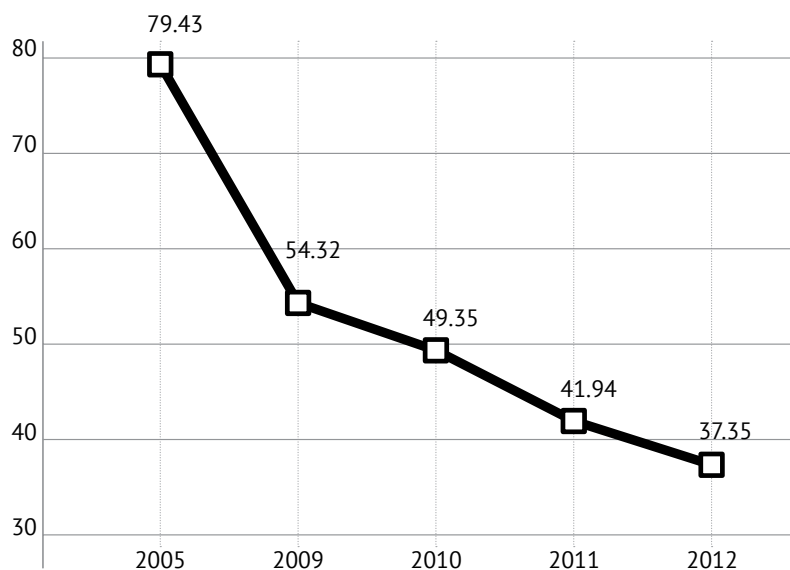


Figure 2. Air Pollution Ecointensity, Million/Tons in 2005, 2009-2012

Among of Ukraine regions, the highest level of ecointensity, according to the calculations have Kirovograd, Ternopil, Zakarpattia, Chernihiv regions (which have the lowest volume of gross regional product in 2012) and Dnepropetrovsk region, which is characterized by high levels of industrial development (Figure 3) (State Statistics Service of Ukraine).

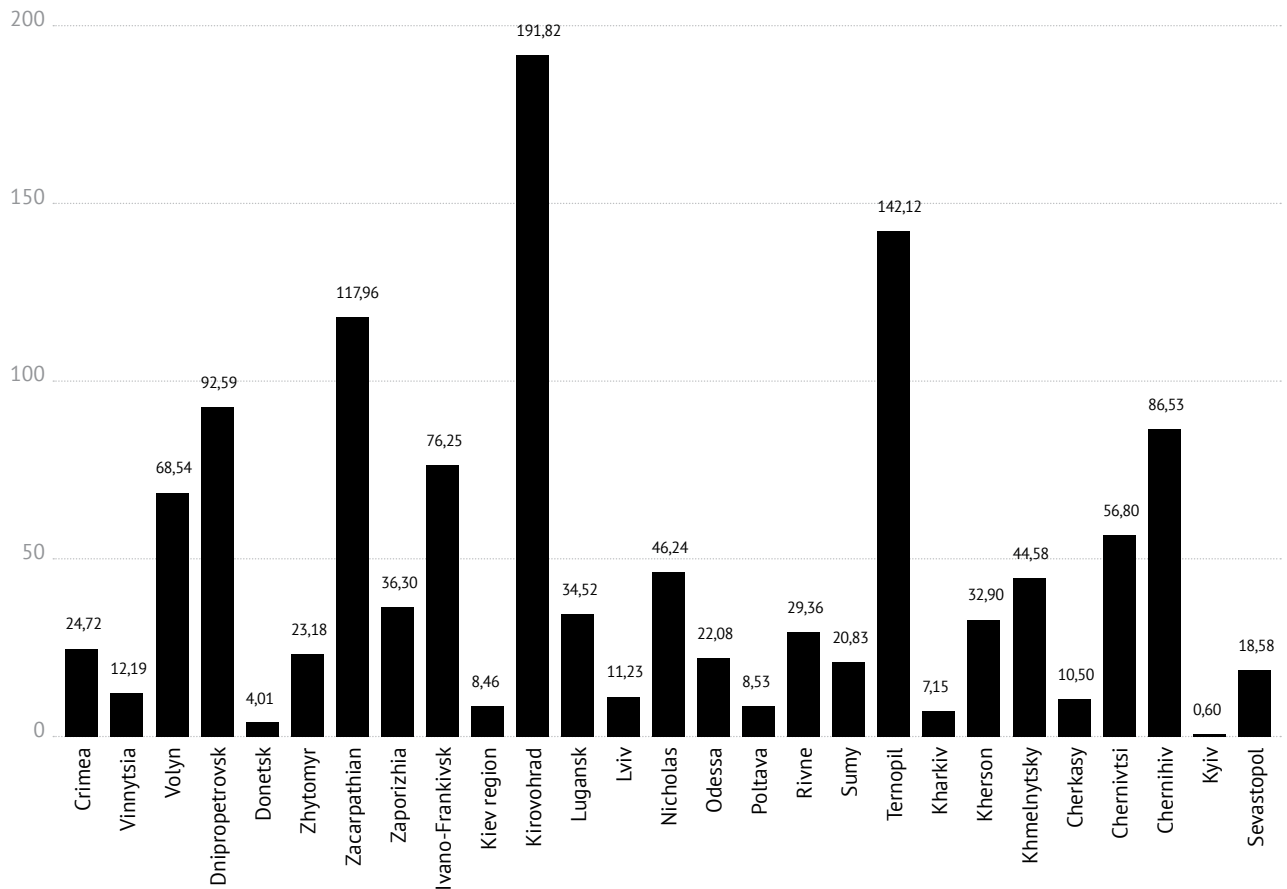


Figure 3. Air Pollution Ecointensity in Regions for 2012, Million/Tons

Generally we can say that ecointensity reduction have some positive aspects in the improvement of the ecological situation and the decrease of anthropogenic loads, since the important factor here is the production, which consists in changing the dynamics of macroeconomic indicators (output).

The main pollutants in Ukraine there are enterprises producing and distributing electricity, gas and water, which accounts for 45 % of emissions (excluding carbon dioxide). Enterprises of the same industry accounts for 54 % of carbon dioxide emissions that may cause the negative affect of climate changing. 30 % of pollutants and 42 % respectively of carbon dioxide emitted into the atmosphere from facilities processing industry (enterprises of ferrous metallurgy, chemical, oil refining, oil and gas industries, cement production) (State Statistics Service of Ukraine).

Estimates data intensity of emissions of pollutants and carbon dioxide by types of economic activity showed that the highest values were the production and distribution of energy (harmful pollutants – 104 t / mln., for carbon dioxide – 5841,89 t / mln.), primary processing industries (harmful pollutants – 47,68 t / mln., for carbon dioxide – 232,2 t / mln.), processing industry (harmful pollutants – 10,35 t / mln., for carbon dioxide – 666,37 t / mln.) (table 1).

Table 1. Indicators of Ecointensity of the Economy of Ukraine for the Emissions of Pollutants and Carbon Dioxide Into the Atmosphere in 2012.

	GDP, mln dollars	Emissions of harmful pollutants and carbon dioxide to the atmospheric air from stationary pollution sources by types of economic activity in 2012, thousand tons		Ecointensity of economy, t/mln dollars	
		harmful pollutants	carbon dioxide	harmful pollutants	carbon dioxide
Agriculture, hunting, forest management	33588,6	82	918,3	2,44	27,34
Mining industry	18505,1	882,4	4296,8	47,68	232,20
Processing industry	122916,4	1272,5	81908	10,35	666,37
Production and distribution of electricity, gas and water	18102,5	1882,7	105752,9	104,00	5841,89
Construction industry	16544,1	20,7	613,2	1,25	37,06
Transport and communication activities	32920,7	164,3	3886,5	4,99	118,06

In Ukraine implemented conservation measures for revenues reduction of hazardous substances into the atmosphere. So, in 2012 with the purpose of atmosphere protection and climate change mitigation, the domestic enterprises have spent 4671,9 million USD for the implementation 449 environmental measures. These are improvement of technological processes; construction and commissioning of new gas-cleaning installations and structures; improving the efficiency of existing wastewater treatment plants due to their modernization, renovation and repair; elimination of pollution sources. This helped in 2012 reduce the amount of hazardous substances in air swimming pool on 146,9 thousand tons, however, the difficult situation in the sphere of atmospheric air protection indicates a failure and low efficiency of such events (Law of Ukraine).

Conclusions. The sustainable development purpose of the region is the life population quality, preserved nature and prosperous economy. The process of achieving sustainable development, management and regulation of this process, effectiveness evaluation of the using means and the achievement level of objectives can be possible in condition when corresponding systems of indicators will be built. The integral indicators of sustainable development permit to characterize state economy changes, social sphere and environment in time and space. Improving the quality of people's lives and making the society more stable is necessary to find and keep a balance between the needs, the problems of economic development and opportunities of the environment. Therefore, one of the main tasks that can be solved through the use of indicators in practice is the determination of changes of state of one or another sphere with regard to possible directions for future work. So, the main advantages of LEDs are that they allow you to assess the situation, its change in positive or negative direction; give time to adjust the integral development of the system.

In the research process the study of the indicators of ecointensity had been proved the testifies dynamics to the quality of economic development of the region as a whole for individual activities / sectors and also gives the opportunity to compare the industry for the level of anthropogenic load on the environment and conduct inter-regional analysis had been proved. For government agencies, this information is set from the point of view of identifying industries that define strategic directions for economic development of the region and increasing the welfare of the population. This enables you to determine the bottlenecks that require primarily the application of preventive measures and informed management decisions.

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