

THE DEVELOPMENT OF REGIONAL ECO-ECONOMIC RELATIONS UNDER THE CONDITIONS OF SUSTAINABLE DEVELOPMENT

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Abstract

The requirement to meet environmental needs started to take center stage in the economy and the human consumer value system in the last two decades of the twenty-first century. At all stages of its development, society relies on the use of natural resources to produce goods and services. This makes it difficult to simultaneously maintain the rate of economic growth and minimise the negative consequences of anthropogenic impacts on nature. In this respect, the aim of state management authorities is to create a reliable and efficient mechanism ready to provide a balanced solution to economic and environmental protection problems in order to meet the vital needs of the population. This becomes particularly important for ensuring the sustainable social development of any country, including the Republic of Moldova. In this context, the subject of the scientific article is the issue of preserving the environment and assuring the growth of the eco-economic systems.

Keywords: *eco-economic system; environment; subsystem; sustainable development;*

JEL Classification: *M2, N5*

I. INTRODUCTION

In modern science, the ecological and economic systems should be viewed as one living organism rather than as separate components. A person can only alter the system within the confines of sustainable development, which means taking into account future generations. Failure to do so could result in the system's irreversible change, its transition into a state of crisis, which, in turn, could result in the irreversible destruction of the entire system. The present scientific image of the ecological and economic system (hereafter SEE), which is strongly tied to notions of nature and human interaction, contains some essentially novel ideas.

These concepts run counter to the conventional view of the environment as a human-indifferent system. In our opinion, any system, including the eco-economic one, is not so much a series of elements such as interconnections, interdependence, interpenetration, and mutual qualitative conditioning. The same category "eco-economic system" as an important component in the interaction between society and the natural environment is a set of relations (environmental, economic, and social), the purpose of which is the effective use of natural benefits to ensure both economic growth and the maximization the well-being of man and society. Additionally, these relationships ought to guarantee the highest level of environmental protection against the negative effects of social production's side effects. In this context, within the SEE, it is possible to achieve a simultaneous solution of three major problems: economic, environmental, and social which form the basis of their institutional regulation.

However, the study of the interpretations of the concept of an "eco-economic system" shows that most authors either do not consider the institutional component of the SEE or do not pay due attention to it. Some researchers consider the economic and ecological subsystem as the main structural elements of the SEE, while others believe that it is necessary to highlight the social subsystem. Some scholars in the analysis of SEE distinguish material, technical and informational flows, as well as its energy flows, others limit themselves to the consideration of territorial aspects of the organization of the eco-economic system.

II. MATERIALS AND METHODS

The term "eco-economic system" has been interpreted in the works of many scientist, including Dixon J. F. (1995) Capra F., and Jakobsen O. D. (2017), Daly H. E. and Farley J. (2004), Chandavarkar N. (2008), Newton A. C., and Cantarello E. (2014), Newell P. (2012), UNDP (2021), Burkart K. (2021), etc. The systematization of scientific opinions on the concept of an "eco-economic system" is given in table 1,

The first approach to the interpretation of the SEE concept, whose adherents are Dixon et al (1995) considers two functional subsystems, the ecological and the economic. Examining the SEE within only two subsystems is not complete, because its operation depends on the state, characteristics, and development trends of the social subsystem. In this context, the second approach is developed, which considers the ecological and economic system from the point of view of the three subsystems: ecological, economic, and social. Proponents of this approach are Daly H. E. and Farley J. P. (2004), Petrescu I. (2005), Sheldon, C. and Yoxon, M. (2006), and others.

The third approach refers to considering SEE in a broader sense, complementing previous definitions and including natural, technical, health, and other subsystems. An understanding of the eco-economic system is proposed by UNDP (2021), Newell P. (2012), Burkart K. (2021) and others.

The generalisation and systematisation of the theoretical provisions and the development on their basis of favourable conditions for the development of eco-economic relations were achieved through the use of empirical and theoretical research methods, including a systematic, normative, and comparative analysis approach.

III. RESULTS

According to the first method, the SEE structure is an outline created by two hierarchical substructures. The economic subsystem has an impact on the ecological subsystem, and the ecological subsystem also has an impact on the economic subsystem. As a result, we can discuss the hierarchy of ecological and economic systems as a whole: the economic subsystem as a managed one and the ecological subsystem as a controllable one. However, from the standpoint of natural consequences, the influence on society and the environment is more substantial (Daly&Farley, 2004). The diagram in Figure 1, makes it easy to think about how ecology, environmental management, and economy interact.

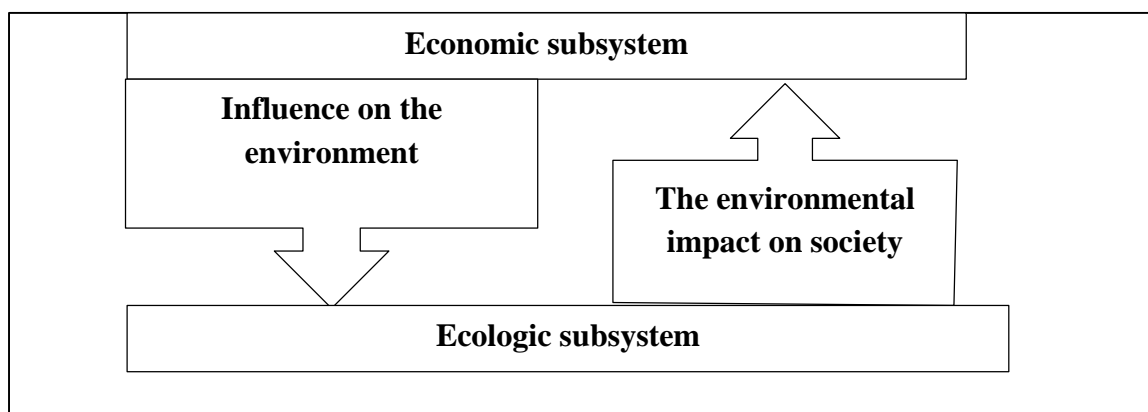


Figure 1 - The structure of the eco-economic system

Source: Daly H. E. & Farley J. P., 2004

Also, SEE includes the following subsystems and aspects:

- the economic subsystem;
- the ecological subsystem;
- the impact of the natural environment on society;
- what effect society has on the environment.

The economic subsystem includes the following elements and connections:

- 1) Economic activities (enterprises, branch industries, and their interaction);
- 2) The population (localities, demographic processes, etc.);
- 3) Legal and administrative regulation (environmental legislation, normative acts in the field of environmental protection and quality control organizations, and prudent use of natural resources).

The effects of society on the environment take the following forms:

- Using up (extracting) natural resources and altering the landscapes;
- Environmental pollution;
- Environmental protection and conservation of its resources.

In particular, the issue of assessing the effects of human activity on the environment is crucial to the development of the eco-economy and is at the center of the system of relationships between society and the environment. Thus, environmental impact assessment refers to activities aimed at identifying and predicting the

results of human intervention in the ecosystem and the impact of these interventions on human health and well-being, as well as activities aimed at compiling and disseminating information in the respective field.

The interaction of SEE components determines the dynamics of its development (Newton&Cantarello E.,2014). The author believes that the term ecological-economic system refers to a holistic education that integrates not only economic and ecological subsystems, but also social and institutional ones, which interact and are interconnected through exchange processes between human activity and the environment (Figure 2). In our opinion, such an approach to SEE analysis allows us to consider a set of basic elements that determine its functioning and structural relationships.

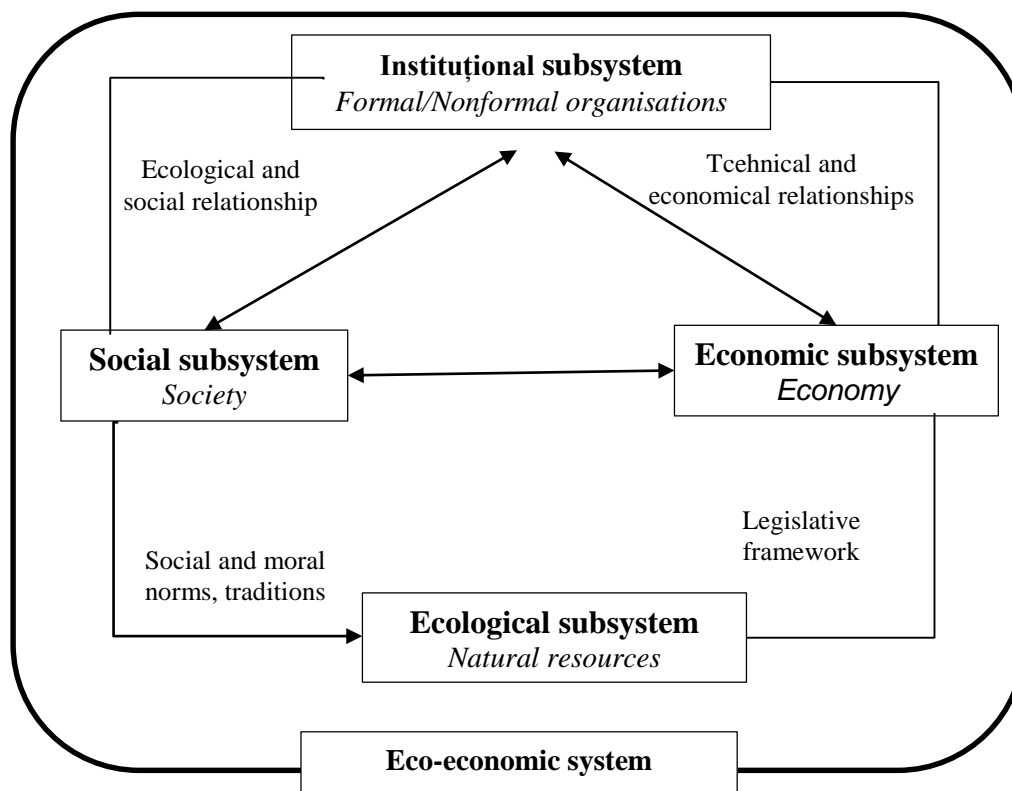


Figure 2. The eco-economic system model

Source: Adapted by the author according to Newton&Cantarello E.,2014

The ecological subsystem as the natural habitat of society is an organic product of the evolution of nature, while society, economy and enterprises are artificial structures created by man. Over time, they became part of the ecosystem, influencing its balance.

Both natural and human forces cause simultaneous changes in the ecological system's status. The interactions between the ecosystem's natural and man-made parts intended to keep the system's overall stability. Thus, the ecological subsystem as part of the SEE is an open, biologically complex subsystem with living organisms that live in their habitat due to the circulation of matter and energy. The coherence of the anthropogenic and natural components of the ecological subsystem defines the overall balance of the eco-economic system's natural component.

The economic foundation of the eco-economic system is the economic subsystem. The economic subsystem consists of the components of the regional economy that ensure the production, distribution, exchange and consumption of material goods and services. The main purpose of the operation of the economic subsystem is to ensure economic growth, increase GDP and real income per capita.

A growing economy has a greater capacity to respond to new needs. The core of the economic subsystem is the sectoral and intersectoral complexes that determine the structure of the region's economy, the region's internal and external relations and its place in the national economic complex (Petrescu, 2005). Therefore, the regional eco-economic system's economic subsystem can be visualized as a collection of closely coupled sectoral and intersectoral complexes that link the region's economic actors and assure the growth of the regional eco-economic system as a whole. In turn, industrial complexes as a set of organizations and industries that transform natural raw materials and material resources into finished products can be considered meso-level ecological and economic systems, adjusted for organizational and technological dependence.

The economic subsystem encompasses all environmental elements in addition to production processes. Accordingly, "social production produces not just means of production and consumer goods, but also a specific standard of the natural environment".

The following dependence should also be highlighted: the enterprise is a subsystem of the economy, the economy is a subsystem of society, and society is a subsystem of the ecological system. The regions of various subsystems will always partially overlap, which in particular dictates the multifunctional nature of each element's activity.

There are two main approaches to the concept of eco-economic system: - global and regional-territorial or local. According to the first approach, the ecological and economic system is interpreted as a socio-economic formation oriented towards the environment, the goal of which is sustainable development. For a particular country, region or industrial complex (enterprise), a more specific formulation of the ecological and economic system may be applicable.

According to the regional-territorial interpretation, an SEE is a part of the technobiosphere, limited to a certain territory, where natural, social and production structures and processes are connected by mutual flows of raw material, energy and information.

In our opinion, the totality of enterprises, households and the natural environment, interconnected by the flows of resources, energy, waste and information at the global, regional, local level, can be considered as an SEE.

From the above interpretations, it can be seen that SEE is a complex hierarchical structure consisting of a larger number of components, subsystems, elements or parts that interact with each other, have unique properties and function at different levels. Its management process requires the systematization and formalization of the hierarchy levels, which make it possible to study various aspects of the operation of the SEE and its management.

The institutional subsystem determines the development of SEE and functional subsystems. The institutional possibilities of eco-economic regulation presuppose the improvement of the public management system for. The following directions (Sheldon&Yoxon, 2006):

- Improvement of macro- and microeconomic indicators taking into account the average factor;
- Determination of property rights over resources;
- Formation of resource conservation policies oriented towards use;
- The formation of economic instruments on the greening of production;
- Encouraging the market for ecological services to grow.

The emergence of SEE has an impact on social processes, such as shifts in the population's illness prevalence and living conditions. It is equally evident, nevertheless, that the growth of the social subsystem has a negative impact on the eco-economic system. One of the SEE indicators is population quality of life, and the epidemiological and sanitary conditions have an impact on both its dynamism and stability.

A social subsystem is understood as an interconnected set of social elements that are in certain relationships and form a certain social integrity. Integrity is a prerequisite for the social subsystem's proper operation and growth. The components of the social subsystem are individuals, social groups, and communities, and how they behave is determined by their social standing. Hierarchical linkages can be distinguished between the elements as a result of the subordination of the subsystem's components and accountability for the distribution of management responsibilities. The social subsystem, like other components of the eco-ecological system, has a territorial organization. There is no single social subsystem and it does not function without being tied to a certain territory. The social subsystem is spatially organized, and its organization depends on certain economic activities. Reproduction is at the heart of the activity of the social subsystem. The activity is inevitably related to a certain time and space, which means that the very organization of the social subsystem for such an activity. Additionally, this territory and its quirks are linked to this organization's forms and structures (Newell, 2012).

Due to the fact that there are direct and feedback links between system components, subsystem interactions can generally be thought of as simultaneous processes. In the specialized literature on the issues of ecological and economic development, the focus is mainly on the study of the impact of the production activities of enterprises, sectors of the economy on the state of the environment. More than that, the negative impact is studied to a greater extent. But it should be noted that the concepts of "impact" and "interaction" are fundamentally different. Considering the meanings and connotations of these words, it should be emphasized that impact implies a unilateral influence of one component on another, while interaction is a mutual relationship between two or more subjects (Daly&Farley, 2004). Thus, the study of interactions occurring in the process of extraction and use of natural raw materials; for the production of goods, it should include:

- Processes that reflect the direct impact of the elements of the economic subsystem on the elements of the ecological subsystem: pollution of the atmosphere, water; the soil; changes in the hydrogeological regime of rivers; relief infringement; extraction, transport and processing of minerals, etc.;

- Processes that reflect the reverse reaction of the ecological subsystem to the economic intrusion: the increase in morbidity, the decrease in labor productivity as a result of the influence of the contaminated environment on the population; depletion and quality of raw material reserves; changes in the material conditions of production; increased costs for pollution prevention and elimination, etc.

In addition, the emphasis that researchers put on the effects of different types of pollution leaves out of sight such important aspects of the interaction of the ecological and economic subsystem as the social and institutional ones. Meanwhile, as practice shows, studying and evaluating these types of interactions is currently very relevant and necessary, as it increases the validity of management decisions and reduces investors' risks in the implementation of investment projects.

So, the ecological, social, institutional and economic subsystems of the eco-economic system are represented by a set of mutually interacting components. Their interaction leads to a change in the state of both individual components, subsystems, and the system as a whole. The development of SEE is manifested through a set of changes that take place in its elements and subsystems, and their dynamics and direction of development are determined by the character of the interactions. According to the systems approach, the essential characteristics of the system are the characteristics of a "whole" that none of the parts of the system possess. A new feature "... appears and can exist only due to the interaction of parts (due to internal connections, that is, due to the structure of the system)" (Ciubota-Rosie & Macoveanu, 2008). So, the SEE develops a form of sustainable state "... if, as a result of the interaction of natural, industrial, social, economic and other interests, a certain compromise is reached in the process of achieving the individual goal of each listed subsystem" (Chandavarkar, 2008). In addition, the trade-off can be achieved both naturally and through the use of regulatory instruments of the institutional component.

Sustainable development of SEE becomes possible when all changes in components and interactions are compatible with the biosphere.

It should be noted that the consequences of the interactions can go far beyond the regional SEE, limited by the administrative-territorial body. Taking into account the free movement in space of certain ecological resources (eg air), transboundary pollution outside the administrative region should also be taken into account. The use of watershed resources, which cover the territory of several regions, also contributes to the spread of the consequences of the interaction of ecological, social, institutional and economic subsystems carried out within a certain administrative region. The development of interregional economic links strengthens the interconnection of regional ecological and economic systems and, consequently, increases the limits of spreading the consequences of their interactions.

The operation of SEE is determined by certain production criteria, and the capacity to alter natural objects. The working mechanism of the SEE can be described by the following types of relationships between its components:

- Economic and ecological, including the use of natural resources and other types of impact of economic activities on the natural environment, which involves both environmental pollution through production waste, extraction and irrational use of natural resources, as well as measures to improve it and prevent damage to the environment;
- Ecological, aims at direct connections from nature;
- Ecological and economic, reflecting the impact of the natural environment on social production conditions, revealing the role of nature in ensuring the economy with natural resources, in the formation of the raw material base of production;
- Socio-economic, defining society as a source of labor resources, engine of scientific and production processes, creator of technologies and means of production;
- Economic, which derive from the operation of the laws of the economy, which describe the features and development models of economic processes and relations;
- Social rules and stages of social interactions development are characterized by social phenomena that emerged during the operation of society.;
- Socio-ecological, which represents how society and the environment interact, how nature affects social development, and how society affects nature;
- Institutional, which emerged during the historical development of the socio-economic environment between the interests of the growth of social groups and economic units. These goals were attained through formal and informal environmental institutions as well as the moral and legal dimensions in relation to the potential of the territory's natural resources (Arijit et al., 2017).

One of the important aspects of researching relationships in SEE is determining its spatial dimensions. The SEE's borders, within which its subsystems and components interact through natural, industrial, institutional, social, management, and other linkages, establish its geographical dimensions. Consider the fact that for various kinds of interactions, the boundaries will be different, and therefore the SEE boundaries of the region are quite arbitrary, having a "vague" character.

Professor Common M. (2009) state that although the boundaries are blurred, they are still real. The "blurring" of borders is due to: firstly, different areas of distribution of natural and social relations in different territories; secondly, by the concentration of economic and socio-demographic blocs, which often "cut" the natural territorial complexes that function within the limits of their own geographical space; thirdly, through episodic connections in border areas with socio-economic nodes of adjacent areas (Common, 2009). It should be

emphasized that while the influence of the production activities of the economic units much surpasses the boundaries of the administrative-territorial unit, the intentional action of the governing bodies reaches inside the administrative boundaries of the region. The boundaries of an administrative-territorial unit at the regional level, as a rule, do not coincide with the boundaries of homogeneous (complex) natural systems. Individual natural complexes can be part of natural ecological systems that go far beyond the borders of the administrative region. Due to the peculiarities of the manifestation of pollution in space, the effects of anthropogenic impact in the form of various types of pollution also extend far beyond the boundaries of a territory. As a result of human impact, rivers are polluted, which due to the geographical limits of the basin can target several regions. Polluted air from pollution sources in a certain region moves to another or others, thus, transboundary pollution exists. The determination of the borders of the SEE is directly related to the determination of the boundaries of the region, as the main form of organization of society. The formation of SEE takes place on the basis of some natural-territorial complexes, which serve as the basis of natural resources for the socio-economic development of the region. The development of regions depends primarily on their own natural, economic, institutional and social potentials, the use of which is aimed at ensuring an environment favorable to human activity and maintaining the quality of the natural environment. According to the Law (2001): "The territory of the Republic of Moldova is organized, from an administrative point of view, into administrative-territorial units: districts, cities and villages...which in their totality form the territorial unit of the country", and "the district is a unit administrative-territorial made up of villages (communes) and cities, united by territory, economic and social-cultural relations" Thus, the regional SEE must be considered as an integral territorial system that unites a set of heterogeneous elements (ecological, social, economic and institutional) interconnected and interdependent.

A particular administrative-territorial unit is an open SEE, "whose administrative borders represent the perimeter of the area of the localities included in its composition" within which their own subsystems interact, which have individual properties and systemic organization (Law, 2001). The links between the SEE components determine the architecture of the system, allow the research of its spatio-temporal structure, reflect the functional dependence between the source of influence and various components of the ecological and economic environment, and as a whole – allow forecasting the behavior of the basic elements and the system as a whole.

Both persistent expansion and the loss of stability are characteristics of eco-economic system development: one structure gets eliminated under the influence of one set of causes, while a second, qualitatively different, stable structure emerges in its place. The law of transitioning from quantitative to qualitative changes has a real-world application.

The driving forces that modify the SEE, determine its nature and individual characteristics, represent the sustainability factors of the system. They determine the speed and direction of development of the system in the case. The weighting factors of ecological and economic system sustainability by origin are subdivided into factors of ecological, economic, social and institutional subsystems. Each type of SEE sustainability factors changes the stability of a certain SEE subsystem, affecting a set of its indicators. The factors influencing the change of the SEE and its subsystems do not affect sustainability in isolation and independently of each other, but act in close connection and dependence. Therefore, the distinctive features of these ecological and economic system sustainability factors are interconnected and interdependent.

Interacting with each other, the subsystems synthesize this effect and determine the sustainability of the SEE. Thus, the sustainability of each subsystem is determined by the factors that influence the change in the sustainability of the SEE as a whole.

In the specialized literature (Capcelea & Capcelea, 2013; Ariji et. Al., 2017), it is mentioned that the sustainability factors of the ecological subsystem include the geographical location of the region and its natural conditions. This group of factors affects not only the sustainability indicators of the ecological subsystem, but affects the formation of conditions for the economic and institutional development of the territory. The sustainability of the economic subsystem is determined by the volume of investments, innovations and greening of production which are closely related to each other. The strength of the action of one factor depends on the action of the other and vice versa. Although the sustainability factors considered refer to the economic subsystem, their influence affects the indicators of all subsystems of the eco-economic system.

The demographic situation refers to the stability factor of the social subsystem. The demographic situation is understood as the state of demographic processes and the structure of the population at a certain moment or period of time. The following parameters of the demographic situation are important for SEE: population size, gender-age structure and composition, population reproduction, migration balance. The demographic situation affects the indicators of the stability of the social subsystem: the quality and standard of living of the population, the sanitary and epidemiological situation. Determining the quality and volume of labor resources, the demographic situation affects the stability of the economic subsystem.

The ecological culture traditions factor, which originates from the institutional subsystem, implies ecological ideas, habits, skills and skills of practical ecological activity of the population. This factor has no numerical expression. The specifics of managerial implications on SEE are directly related to the vision of the population in the region about the cleanliness of the environment and the sustainability parameters of the ecological

subsystem, which is reflected in the factor of ecological culture traditions. In addition, this factor influences consumer perceptions and demands for green, safe products and their production technologies. The speed of implementation of innovations and the level of greening of production also depends to a large extent on the impact of the considered factor.

Thus, SEE is determined by factors that influence its functioning. Factors are the driving force behind changes in subsystems and the system as a whole, which determine the nature and direction of subsystem interactions, describe the strength and speed of their impact.

It is important to realize that the eco-economic system's sustainability variables operate concurrently but inequitably. This is due to the uneven distribution of natural and anthropogenic components and conditions in space (Willis, 2013). The degree of manifestation of one or another sustainability factor and, in some cases, its presence or absence, is of great importance. This influence is reflected in the circulation of substances and energy within the subsystems of the eco-economic system and the interconnections in the intersubsystems.

The factors affecting the sustainability of the SEE determine the capabilities of the functional subsystems in sustainably achieving the goals and objectives of their own development, while maintaining the ecological and economic balance. Thus; the sustainability factors of the SEE affect not only the sustainability itself, but also the sustainability potential of the eco-economic system. In the general sense of the word, the potential of the system is usually understood as the possibilities, abilities, hidden, unrealized reserves of the studied object, which, when the surrounding conditions change, can go from possibility to reality.

The sustainability potential of the ecological subsystem is understood as the ability of the natural environment to ensure that human economic activity satisfies its natural resources and material and spiritual needs, while maintaining its state of dynamic balance. It is based, on the one hand, on the quantity of natural resources used in industrial processes and on the level of anthropogenic load on the subsystem's landscape as measured by the amount of pollution emissions and discharges into the environment. On the contrary, the sustainability potential of the ecological subsystem determines the extent to which the use and neutralization of pollutants at local businesses and during human activity, the population's ecological culture, and the level of economic development.

The sustainability potential of the social subsystem is the unrealized opportunity of society to create the necessary conditions for raising the standard of living, increasing the life expectancy of the population with a decrease in the rate of illness, creating optimal living conditions, while maintaining a favorable environmental situation. The stability potential of the social subsystem is influenced by the population in the region, its quality and standard of living, as well as the sanitary and epidemiological situation as an indicator of the reaction of the state of health to the ecological changes of the natural environment.

The economic subsystem's undeveloped capacity to provide positive economic growth (while preserving the ecological balance) with the least amount of environmental harm is known as its sustainability potential. The sustainability potential of the economic subsystem includes factors such as the level of regional economic development, the use of raw materials by economic units, and the financial and budgetary situation. Each of the listed indicators can be decomposed into separate components, showing a detailed picture of the analysis of the stability of the economic subsystem.

Therefore, the sustainability potentials of each analyzed subsystem reflect the possibility of the operation of the SEE components while maintaining the ecological balance. The value of the stability potential of the subsystems depends on the characteristics of the factors and sustainability indicators of the SEE.

By the sustainability potential of an SEE, the author means the unrealized capacity of the system to ensure the satisfaction of the growing material and spiritual needs of society while protecting the natural environment. This definition reflects a complex approach to the sustainable development of the SEE and its operational possibilities, which allows considering the system as a whole, composed of a unit of functional subsystems, which are influenced by the sustainability factors of the SEE.

IV. CONCLUSION

It was feasible to get the conclusion that it is necessary to differentiate between the concepts of "sustainability" and "sustainable development" or "sustainable development" after analyzing the SEE's sustainability in its essence. The system's and its subsystems' sustainability varies and is dependent on the variables that can modify sustainability. The factors influencing the change of SEE sustainability act in close connection, and their distinctive features are interconnectedness and interdependence. To change the sustainability of SEE, the factors trigger a system of sustainable management mechanisms. To determine the level of sustainability of the SEE, the sustainability potential of the SEE should be used.

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