Contemporary trends in improvement of organizational-economic mechanism of environmental management

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Abstract. The article deals with the effective functioning of ecological and economic systems of various levels on the basis of an adequate organizational and economic management mechanism. The compliance matrix of the presented innovative elements in the structure of organizational and economic mechanism of environmental management is developed. The practical component of the conducted study can be recommended to municipal, regional and federal authorities, as well as industrial enterprises, to support effective, environmentally reasonable management decisions that are consistent with the global concept of sustainable development.

1. Introduction

Development of the real sector of economy determines the high level of technogenic impact on the environment, conditioning the need to address the problems of resource and nature saving with minimization of financial costs [1]. Increase in the effectiveness of environmental protection activities depends on the process of managing territorially distributed ecological and economic system with its unique features. In this case formation of an organizational and economic mechanism of management of environmental activities, which corresponds to high modern requirements caused by the international integration of enterprises and environmental law enforcement [2], is of a decisive importance here. This situation determines the relevance and practical significance of the present study.

2. Materials and methods

The object of the study is a system for managing a geographically distributed ecological and economic system. The subject of the study is the organizational and economic mechanism for managing environmental protection activities. The study is based on an analysis of domestic and foreign literary sources on this issue. Particular attention is paid to the study of innovative elements of organizational and economic mechanism of environmental management, which have practical significance. Verification of the adequacy of theoretical developments is based on the factual data from environmental reports of enterprises. Elements of system analysis and the results obtained by specialists in the field of management of ecological and economic systems are also used in the work.

3. Results and discussion

In the conditions of a region with environmental problems due to the presence of developed industry, the process of effective management of ecological and economic system, the simplified scheme of which is presented in figure 1 [3 - 6], is relevant.

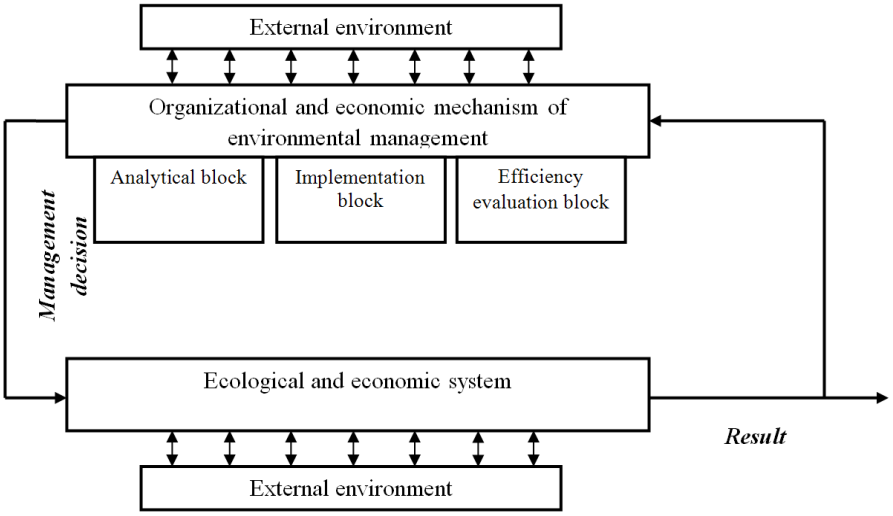

Figure 1. Simplified scheme of the management mechanism of ecological and economic system.

Figure 1 shows that the key element in the presented scheme of mechanism for managing the geographically distributed ecological and economic system is the organizational and economic mechanism of environmental management, in which three main elements are distinguished:

- analytical block;
- implementation block;
- efficiency evaluation block.

In order to identify the developed innovative elements of organizational and economic mechanism of environmental management, three main blocks have been identified, for which a compliance matrix presented in table 1 has been developed.

Table 1. Compliance matrix of the developed innovative elements to the structure of organizational and economic mechanism of environmental management.

Innovative elements	Analytical block	Block of implementation	Efficiency evaluation block
Reduced integrated indicator of the aquatic ecosystem state	+		
Penalization system of enterprises for providing unreliable information on the level of negative impact on the environment		+	
System of universal ecological and economic indicators of the enterprise operation	+		+
System of ecological and economic indicators of production and consumption wastes	+		+
Diversification of the enterprise production program due to environmental restrictions		+	

Table 1 shows that the largest number of the developed elements belongs to the analytical block, which additionally reflects its significance. To determine the practical feasibility in usage of the proposed innovative elements, it is necessary to study them in details [7, 8].

Estimation of the quality of aquatic ecosystem can be carried out using an integral indicator, the main disadvantage of which is processing time due to the need to use multiple input data. The carried out sensitivity analysis allows us to conclude that a number of components of the complex indicator is of little informative value because of the use of strongly correlated components. Therefore, some of them can be neglected in order to simplify the integral indicator and its more effective practical application. As a result, the integral index was reduced [9].

The implementation block (figure 1, table 1) is represented by the development of a penalization system of enterprises for providing unreliable information on the level of negative impact on the environment [9]. Below there are different levels of penalties for providing unreliable data with differentiation according to hazard classes and depending on the range of deviations between the results of pollutants sampling performed by the officially authorized state environmental management body and the enterprise. In formulas (1) – (4), the percentage indicates the additional level of penalties relative to its base value for pollutants of different hazard classes.

$$P_{AD\_I} = \begin{cases} 10\ \%\ P_{BASE}\ , if\ \Delta D^{EX} > (1-5)\ \% \\ 15\ \%\ P_{BASE}\ , if\ \Delta D^{EX} > (5-10)\ \% \\ 30\ \%\ P_{BASE}\ , if\ \Delta D^{EX} above\ 10\ \% \end{cases} \quad (1)$$

$$P_{AD\_II} = \begin{cases} 8\ \%\ P_{BASE}\ , if\ \Delta D^{EX} > (2-10)\ \% \\ 15\ \%\ P_{BASE}\ , if\ \Delta D^{EX} > (10-20)\ \% \\ 20\ \%\ P_{BASE}\ , if\ \Delta D^{EX} above\ 20\ \% \end{cases} \quad (2)$$

$$P_{AD\_III} = \begin{cases} 6\ \%\ P_{BASE}\ , if\ \Delta D^{EX} > (3-10)\ \% \\ 10\ \%\ P_{BASE}\ , if\ \Delta D^{EX} > (10-20)\ \% \\ 15\ \%\ P_{BASE}\ , if\ \Delta D^{EX} above\ 20\ \% \end{cases} \quad (3)$$

$$P_{AD\_IV} = \begin{cases} 4\ \%\ P_{BASE}\ , if\ \Delta D^{EX} > (4-10)\ \% \\ 5\ \%\ P_{BASE}\ , if\ \Delta D^{EX} > (10-20)\ \%\ , \\ 10\ \%\ P_{BASE}\ , if\ \Delta D^{EX} above\ 20\ \% \end{cases} \quad (4)$$

where P_{AD} – additional value of penalties for provision of false information; P_{BASE} – base value of penalties for pollution of an element of environment;

$$\Delta D^{EX} = \left| \frac{C_{SEMA} - C_{ENT}}{C_{SEMA}} \right| 100\ \%\ , \quad (5)$$

where ΔD^{EX} – exceedance of pollutant concentration values according to the data of the state environmental management authority, %; C_{SEMA} –actual concentration of polluting substances according to sampling data of state environmental management authority; C_{ENT} – actual concentration of polluting substances according to sampling data of an industrial enterprise. The conducted calculations showed that the proposed incentive system allows the amount of penalties to be increased by an average of 18 %, which should motivate economic entities to provide the most reliable information in connection with the increase in costs included into the cost of production or attributed to the net profit of the enterprise.

The most important aspect of the analytical block is the development of a system of universal environmental and economic performance of an enterprise, which can also be used to formulate a comprehensive assessment of its environmental safety [10 - 13]. If we consider the current activity of the enterprise, then the developed schemes for production environmentalization, including the ecological and economic assessment of anthropogenic impact on the environment, can be used to

make an environmentally oriented economic decision [14]. Specialists working in this field have developed a system of criteria for environmental and economic sustainability of an enterprise, including the ecological efficiency of the enterprise as a complex characteristic of the effectiveness of nature management – resource, energy, and waste intensity, efficiency of using the consumed "external" and "internal" resources of the enterprise [15]. A number of authors identify environmental performance indicators that characterize negative impact on the environment [16].

In some cases it is advisable to adapt the environmental and economic indicators to a particular industry or sub-sector that has its own characteristics. For example, for coal mining and coal processing, the environmental performance indicators are divided into three groups: ecological, social and economic [17, 18]. Due to the fact that economic entities within the coal cluster have a significant burden on the soil cover, it is possible to calculate the economic damage from soil pollution by production and consumption wastes, including per unit of the production capacity of the enterprise [19].

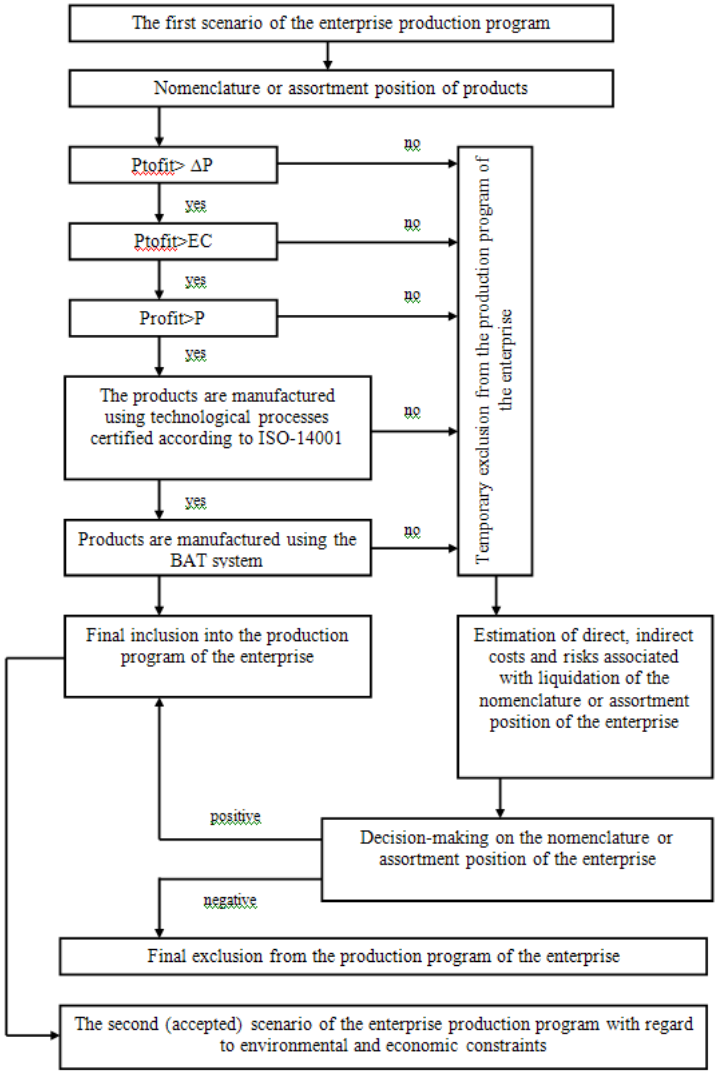

Figure 2. Formation scheme of the enterprise production program with regard to environmental and economic constraints.

The authors of this study have developed a system of environmental and economic indicators, which also takes into account the features of the enterprise under investigation [6, 20]. The final innovative element of this block is the system of ecological and economic indicators of production and consumption wastes [21, 22].

The implementation block of the organizational and economic mechanism of environmental management is also shown by the diversification of the enterprise production program due to environmental restrictions, it is schematically depicted in figure 2, where it is seen that after the formation of a first scenario of environmentally safe production program, the main technical and economic indicator (profit) is compared with various environmental and economic components (ΔP – increase of payment for negative impact on the environment; EC – economic costs of environmental pollution; P – penalties). The decision on the final inclusion into the production program is made on the basis of the best available techniques (BAT) criterion, which is conditioned by modern environmental requirements [23].

The considered innovative elements of organizational and economic mechanism of environmental management can be used in the construction of an economic and mathematical model that ensures the selection of an optimal complex of management decisions, the implementation of which will reduce the negative impact of enterprises on the environment, reduce the prime costs of primary and secondary products through recycling of production and consumption wastes and minimization of environmental payments [24].

4. Conclusions

The study of the development of innovative architecture of organizational and economic mechanism for environmental management allowed the following conclusions to be made:

- the necessity of improving the organizational and economic mechanism for managing environmental activities is substantiated, taking into account external requirements and environmental law enforcement;
- a simplified scheme for management of ecological and economic system with differentiation of the blocks of organizational and economic mechanism for environmental management is developed;
- a compliance matrix of the developed innovative elements in the has been the structure of organizational and economic mechanism of environmental management is formed;
- • the analysis of various approaches to the assessment and interpretation of environmental and environmental-economic indicators of an enterprise is performed, including the study of negative impact on all elements of the environment;
- the verification of the developed innovative elements of the organizational and economic mechanism of environmental management for the adequacy was performed in order to implement it in practical activities.

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