

ASSESSING OVERALL LEVEL OF ENTERPRISE'S ENVIRONMENTAL SECURITY: POSSIBILITIES OF APPLYING MODERN ECONOMIC AND MATHEMATICAL METHODS

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ABSTRACT

Effective stimulation of the activities of national enterprises related to environmental protection, reduction of the negative industrial impact on the environment, an increase in innovation and investment attractiveness, environmental image and improvement of environmental situation in Ukraine is possible if the methodology for assessing the overall level of enterprise's environmental security is developed and tested in practice. The relevance of solving this scientific problem is that it is important to take into account the overall level of enterprise's environmental security when calculating environmental tax and establish a certain differentiation in relation to eco-tax payers, in order to assess their environmental and social responsibility to the state and society. Research purpose is to study modern economic and mathematical methods for assessing a company's environmental safety level and substantiate the possibilities of their use to confirm the adequacy and relation between the components. Methodological basis of the research consists of fundamental principles of general economic theory, economics of nature management and environmental protection, statistics and econometrics. The article examines modern approaches to assessing an enterprise's level of environmental safety and summarizes the main economic, environmental and organizational factors for ensuring environmental safety of national enterprises. Research results can be useful for assessing overall level of environmental safety for any enterprise, regardless of the type of its ownership, organizational and legal form, type of activity, industrial characteristics and location.

Keywords: economic and mathematical methods, pollutants, environmental safety.

INTRODUCTION

Transition of economic relations to the principles of sustainable development is impossible without the transformation of management system at various levels of economic system, especially economic entities which are the main consumers of natural and human resources and, accordingly, the main pollutants of the environment. The effectiveness of management system transformation primarily necessitates the search for optimal analytical support systems. In fact, the system of modern economic and mathematical methods itself enables to evaluate the activities of an enterprise taking causality into account. Such identification makes it possible to determine the reserves which enable an increase in economic efficiency, environmental and social performance. Subsequently, it determines the relevance of scientific research related to the application of modern economic and mathematical methods for assessing enterprises' environmental activity.

Issues related to environmental problems, the need to protect the environment and use natural resources rationally are widely covered by Ukrainian and foreign scientists such as T. Akimova, R. Alen, H. Butko, V. Hlushkova, N. Ihnatieva, B. Commoner, M. Reimers, T. Rohova, I. Remizov, V. Haskin, and S. Yakovlev. In particular, research results related to the environmental component of an enterprise's sustainable development can be found in the works of I. Aleksandrov, L. Melnyk, O. Popova, O. Rodionov, O. Sadekov, O. Riumina, and others.

Analysis of the natural environment in Ukraine between 2001 and 2019 shows that harmful industrial emissions from stationary sources make up an average of 3837 thousand tons annually, including 72.8 thousand tons in Poltava region. At the same time, emissions from the coal industry in Ukraine make up almost 14% of total industrial emissions. Figure 1 depicts the amount of pollutants in Ukraine and its dynamics. The visual highlights a decrease in pollutants emission by Ukrainian enterprises in the end of 2019 [1].

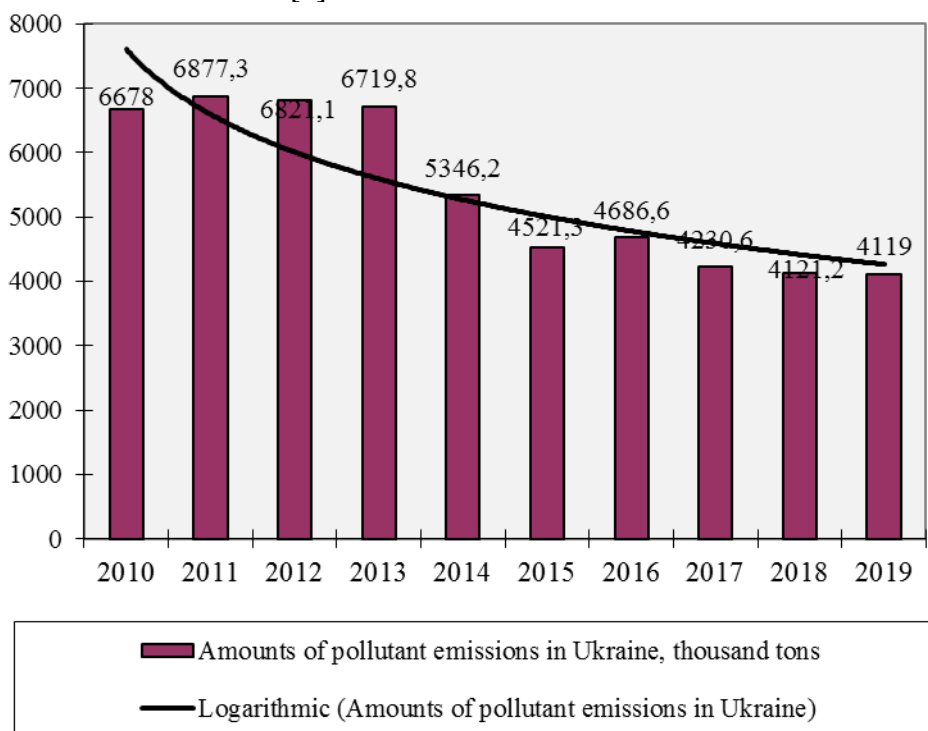


Figure 1. Dynamics of pollutants amount in Ukraine, 2010-2019 [1]

The main pollutants of atmospheric air are stationary sources, which include industrial enterprises, thermal power plants and furnaces. A large amount of pollutants that cause persistent air pollution penetrate Ukrainian airspace every year from these sources (Fig. 2). A positive tendency related to the reduction in the amount of emissions from stationary sources was noticed during the researched period.

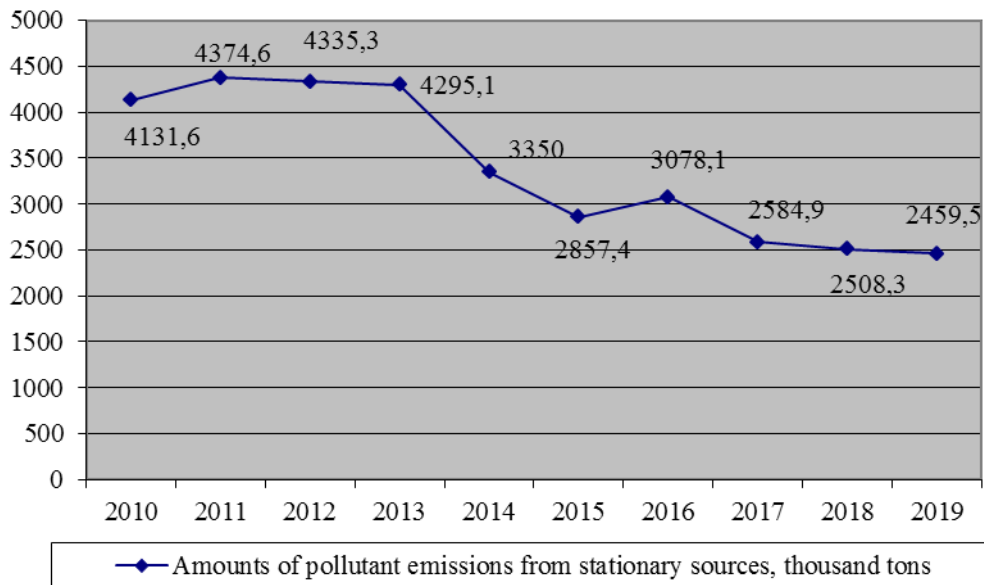


Figure 2. Dynamics of pollutants amount from stationary sources, 2010-2019 [1]

After analyzing the main trends and factors of ecological safety in Ukraine, it can be concluded that given further depletion of land, water, mineral and biotic resources, retaining high capacity of energy resources in Ukrainian economy will inevitably lead to the emergence of large-scale threats to national security in ecological, natural and technogenic spheres [2].

In this regard, ensuring a guaranteed security rate is a very important task of the state policy related to the protection of population and economic facilities from natural and man-made threats. This requires a comprehensive analysis of current natural and man-made threats, as well as the development of reasonable measures that would be aimed at preventing and minimizing negative consequences in case such threats are imposed.

Enterprise's environmental security is an integral part of the national security in a country. The point of environmental security is to ensure sustainable development of vital human, societal and environmental needs. It happens through the implementation of managerial decisions regarding potential threats that arise in the course of functioning of anthropogenic, natural and man-made systems. Environmental security of Ukraine provides for the introduction of conceptual framework of the general strategy regarding environmental management and protection. Such strategy ensures sustainable economic and social development of the country. At the same time, it is supposed to form new types of technological processes, social organization and management that can help to resolve environmental problems and reduce any environmental hazards that pose a threat to the national security of Ukraine [3].

These days, legal regulation of environmental activities by business entities in Ukraine is conducted through various legal documents, which often do not correlate

with each other and, unfortunately, do not contain a single methodology for assessing the overall level of an enterprise's environmental security. In addition, scientific and economic literature does not provide for consistent approach regarding the system of indicators that can characterize the overall level of an enterprise's environmental security.

As regards the pollutants amount, the algorithm for ensuring environmental component of economic security provides for such sequential actions as are shown in Figure 3:

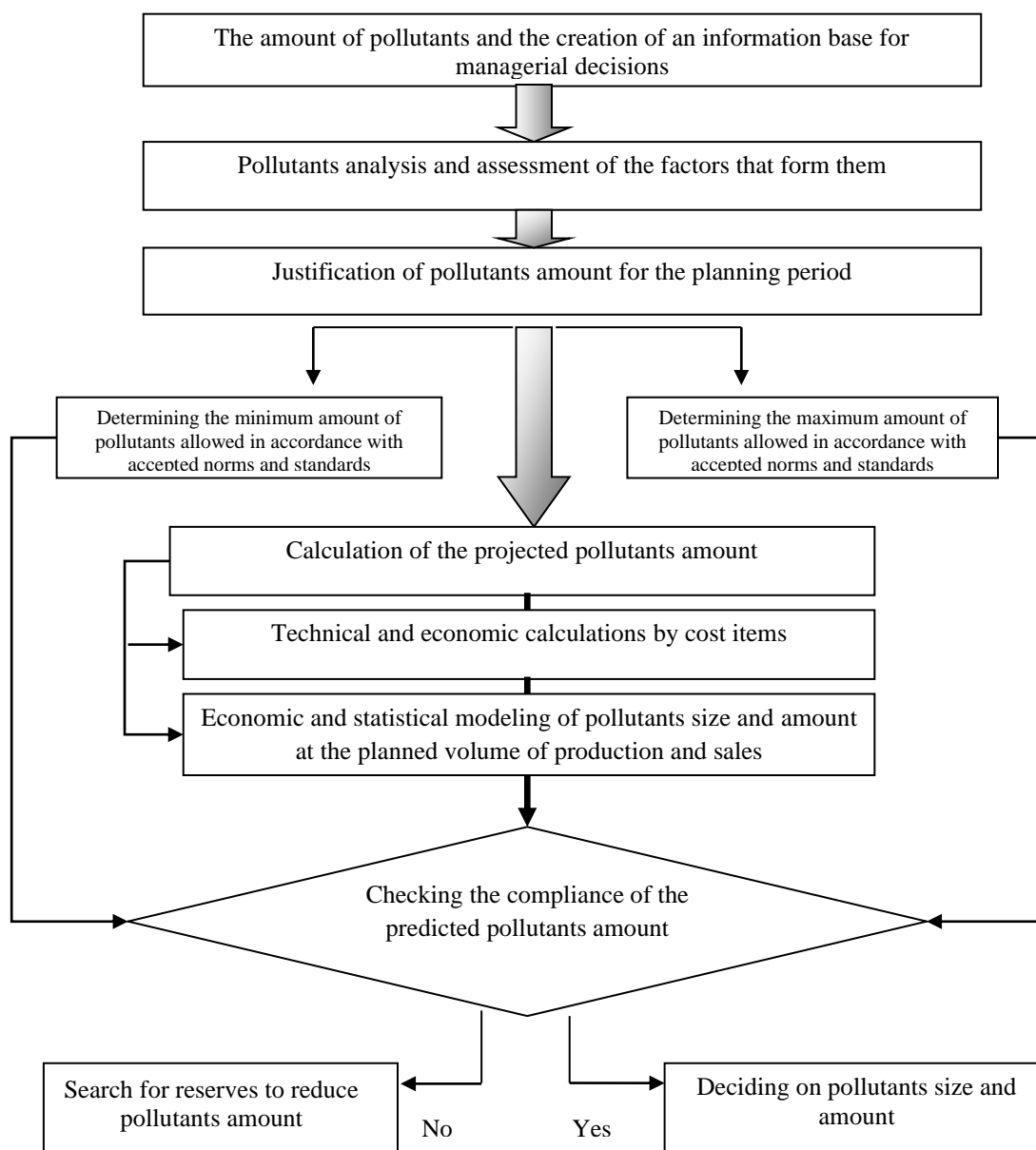


Figure 3. Algorithm for ensuring environmental component of economic security in terms of pollutants amount [developed by the authors]

Consequently, creating environmental security system along with the improvement in social and economic security systems is a new element of national security. A number of mechanisms should serve as the basis of this system, in particular: organizational, legal, social, political and economic mechanisms for managing natural resources, based on the results of mathematical modeling and forecasting, modern information technologies and countering anthropogenic and natural destruction of the biosphere.

In this regard, the use of contemporary economic and mathematical methods is impossible without comprehensive accounting, analysis and evaluation of enterprise's economic and environmental activities. Economic and environmental analysis (EEA) of entrepreneurial and industrial activities makes it possible to implement an environmental policy that should be based on solving economic and environmental problems in the course economic reformation. At the same time, EEA represents a comprehensive study of the company's activities, taking into account environmental impact for the implementation of enterprises' long-term plans related to their sustainable development.

Given the complexity of the problem, there are various approaches to EEA and its tools in scientific environment.

A number of authors suggest considering EEA in the context of the following components: environmental expertise, environmental diagnostics and situational analysis, environmental marketing analysis and eco-audit [4].

EEA also includes the following tools: chance/risk analysis, eco-audit, eco-balance sheets, assessment of the consequences of technology use, ABC/XYZ analysis, and formalized methods [5, 6].

There is also no single approach to defining EEA indicator system.

According to economic and environmental indicators, they are conditionally divided into 4 groups:

1) indicators that reflect strategic effectiveness of environmental activities (in particular, an increase in environmental value);

2) indicators that reflect the effectiveness of operating environmental activities (demonstrating the results of the company's activities to meet customers' interests regarding environmental characteristics of products, waste processing and sales of associated products, reducing environmental costs and increasing environmental productivity);

3) indicators that reflect the effectiveness of investment and environmental activities (showing profitability of investment projects aimed at cleaner production and the improvement of corporate environmental image);

4) indicators that reflect the effectiveness of financial environmental activities (indicating the results of work related to attracting various sources funding for an enterprise's environmental activities and management of environmental assets).

With respect to the specifics of the activities at enterprises and industrial facilities and their significant negative impact on the environment, it is possible to identify the following groups of indicators for assessing environmental component of sustainable development:

1) environmental indicators of the production system (reflecting environmental performance of an enterprise and the impact of production activities on the environment);

2) effectiveness of environmental management system indicators (provide for the availability of information on compliance with legal requirements, effective use of resources and regulation of environmental management costs).

In terms of current economic conditions, enterprises face uncertainty and dynamism of the external environment and unpredictable behavior of other entities. It encourages them to carry out forecasting and planning and constantly improve methodology and methods to develop their forecasts and plans.

It should be noted that the concepts of forecasting and planning cannot be equated. Forecasting is more important because it takes into account not only enterprise's performance indicators, but also environmental factors. A forecast is a prediction of the future state of internal and external environment based on scientific methods and intuition. In other words, it is the process of justifying quantitative and qualitative changes in the future.

On the one hand, forecasting is ahead of planning. On the other hand, it is a component used at different stages of planning, such as analyzing the environment and determining strategic prerequisites for plan implementation. Being an important part of management, planning is a special form of management that is aimed at developing and studying the strategy of economic development of the enterprise as a whole and its departments in particular for a certain period of time in accordance with the goals of its activities and resources. Planning is a specialized type of managerial activity. Planning plays a leading role among five main functions of management. Being based on plans, an enterprise is created, its activities are organized, staff is motivated to perform tasks and achieve goals, results are monitored and evaluated. Various methods are used when planning enterprises' activities. Planning methods should correspond to external economic conditions, take into account the various stages of market relations formation and development, the specifics of object planning, and various means and ways to achieve the main business goals – increasing profits.

To date, scientists have developed and proposed a number of models describing the behavior of various indicators of economic entities. In particular: A. Horkunenko, S. Lupenko, H. Osukhivska, and M. Stadnyk developed new technologies for modeling, analyzing and forecasting cyclical economic processes, which are based on new mathematical models: polynomial and cyclic linear random process. V. Khobta, V. Lavryk, A. Popova, and O. Shylova improved methodological provisions regarding justification of development indicators and integrated assessment of environmental and economic qualities of economic decisions. S. Kozmenko, T. Vasyliieva, and S. Leonov predicted further development of credit and stock markets in Ukraine, taking into account expected cyclical fluctuations of various lengths in the economy's development using Fourier series. D. Smahin and T. Horlova described the choice of a regression model, evaluating its parameters, testing statistical hypotheses and building confidence intervals for these parameters, and many other aspects.

However, such a variety of approaches to analyzing trends in indicators makes it necessary to compare them in order to choose those approaches that would make it possible to model a specific situation, taking into account the factors and circumstances that directly affect an indicator under study.

CONCLUSION

We believe that the most common models for modeling and forecasting environmental indicators are linear regression models due to the simplicity of their calculation and interpretation. However, scientists believe that the lack of accounting for the nature of cyclical economic processes is a disadvantage of this model. This cannot be clearly agreed, since the duration of the oscillation cycle can be significantly longer or shorter than one year. The term "seasonality" can be applied to any systematic fluctuations in forecasting process.

As a result, there are different approaches to assessing the level of enterprise's environmental security. At the same time, no regulatory document contains a single methodology to determine it. In addition, there is no coordinated approach of scientists in scientific economic literature regarding the system of indicators that can characterize the overall level of enterprise's environmental security. In our opinion, the overall level of enterprise's environmental security should be determined taking into account the influence of various economic, environmental and organizational factors using an integral indicator of the overall level of enterprise's environmental security. We are convinced that taking into account the above-mentioned factors, the integral indicator of the overall level of enterprise's environmental security should be based on three partial integral indicators: integral ratio of environmental damage; integral ratio of the influence of economic factors; and integral ratio of the influence of ecological and economic factors. These indicators are interrelated and mutually dependent. They make it possible to assess the impact of environmental, economic and environmental-economic factors on the level of enterprise's environmental security as a whole. The use of modern economic and mathematical methods makes it possible to confirm the adequacy of strategic development directions drawn up by an enterprise, as well as economic feasibility of linkages and interdependence between selected areas of enterprise's environmental security.

REFERENCES

- [1] Economic statistics / Environment, State Statistics Service of Ukraine, Ukraine, 2020. - <http://www.ukrstat.gov.ua>.
- [2] Bert Scholtens. Why Finance Should Care about Ecology, *Trends in Ecology & Evolution*, USA, vol. 32/issue 7, pp 500-505, 2017.
- [3] Visser H. De Bruin S, Martens A, Knoop J, Ligtvoet W. What users of global risk indicators should know, *Global Environmental Change*, Netherlands, vol. 62, pp 1-11, 2020.
- [4] Wenyi Chen, Beste Kucukyazici, Maria Jesus Saenz. On the joint dynamics of the economic and environmental performances for collective take-back systems, *International Journal of Production Economics*, Netherlands, vol. 218, pp 228-244, 2019.
- [5] Yu Ma, Xin-Yu Wang, Xiang Song. Study on Impact of the Development of Rural Formal Finance and Informal Finance on Rural Ecological Environment – Based on Panel Quantile Regression Analysis, *Journal of Environmental Protection and Ecology*, Greece, vol. 20/issue 3, pp 1536–1543, 2019.
- [6] Christopher Krapu, Mark Borsuk. A spatial community regression approach to exploratory analysis of ecological data, *Methods in Ecology and Evolution*, GB United Kingdom, vol. 11/issue 5, pp 608-620, 2020.

