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Environmental Management of Agricultural Enterprises in the Context of European Environmentally - Friendly Food System

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Abstract:

Strengthening international environmental regulation, implementation of a European strategy for a sustainable food system form new environmental requirements for producers and exporters of agricultural products. To meet new environmental requirements, avoiding environmental barriers to exports, agricultural enterprises must improve environmental management. The article improves environmental management in terms of the formation of the environmental strategy of agricultural enterprises in the context of the European environmentally-friendly food system. It was found that improving the efficiency of activities, the requirements of suppliers or customers and improving the company's image among stakeholders are the main incentives for the implementation of international environmental management standards in agricultural enterprises. It has been determined that in modern conditions the tasks of environmental management are expanding in terms of ensuring the competitiveness of agricultural enterprises by reducing the chemicalization of production processes and the carbon footprint. The stages of strategic planning in the environmental management system of export-oriented agricultural enterprises have been substantiated. An economic and mathematical model of production optimization, taking into account environmental factors, has been proposed for strategic planning in the environmental management system of agricultural enterprises.

Keywords: Environmental management; ecological strategy; agriculture enterprises; environmentally - friendly food system; ecological standards; management.

JEL Classification: M21; M11; Q12; O13; D20.

Introduction

In the context of the economic crisis, exacerbated by quarantine restrictions due to the COVID-19 pandemic, the agricultural sector plays an important role in achieving sustainable economic development goals. The European Union is actively developing a "Farm to fork" strategy to accelerate our transition to a sustainable food system. The goal of implementing this strategy is to reduce dependence on pesticides and antimicrobials, reduce excess fertilizers, increase organic farming, improve animal welfare and reverse the loss of biodiversity (Communication from the commission to the European Parliament, the council, the European economic and social committee and the committee of the regions A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system. Brussels. 2020). The implementation of the strategy involves the strengthening of environmental restrictions on

the use of pesticides, plant protection products, CO2 emissions, the quality of agricultural and food products, especially those that are imported. At the same time, it is envisaged to create targeted financial funds to support European agricultural producers and introduce additional customs barriers and tax instruments for the import of agricultural products.

The European Union is an important market outlet for agricultural products, including those produced in Ukraine. Thus, in 2020, exports from Ukraine to EU countries amounted to: fish and fishery products – $ 26 million or 62% of the export value, egg products – $ 12 million or 64%; honey – $ 115 million or 83%; fruits and berries – $ 184 million or 77%; rapeseed – $ 949 million or 94% (https://www.ukrinform.ua/rubric-economy/3201613-torik-eksport-ukrainskoi-agroprodukcii-do-es-skorotivsa-na-107-eksperti.html). The introduction of additional environmental requirements will negatively affect the export of the above-mentioned commodity items, lead to the loss of market outlets, and reduce the income of agricultural exporters.

For a timely response to current market and environmental challenges, it is necessary to develop and implement environmental management in the activities of agricultural enterprises. It acts as an effective management tool to reduce anthropogenic impact on the environment, improve product quality, and certify it for compliance with international environmental standards.

1. Literature Review

Theoretical and applied principles of environmental management as a tool for greening agricultural production were studied by E. Claver *et al.* (2007), H. Kupalova *et al.* (2010) and M.A. Massoud *et al.* (2017). Scientists in their research came to the unequivocal conclusion that the quality of agricultural products and their competitiveness can be improved through the implementation of environmental management. Some scientific studies are devoted to the rationale of organizational and methodological approaches to the introduction of environmental management in the system of corporate social responsibility of agricultural enterprises (O. Popova *et al.* 2019, I. Ivashkiv *et al.* 2020).

Methodological approaches to the development of an environmental strategy of enterprises have also become the subject of the study of scientists. Thus, T. Pizniak *et al.* (2020) substantiated the importance of introducing an environmental strategy to ensure sustainable development of agricultural enterprises, reducing the anthropogenic impact of agricultural production. According to the results of a survey of representatives of 100 agricultural enterprises in Ukraine, scientists found that the implementation of an environmental strategy provides enterprises with the following advantages - preservation and renewal of biodiversity on arable land, restoration of ecosystems, introduction of production of environmentally friendly and organic products, implementation of quality management systems. A. Sumets, summarizing various business strategies, proposed a hierarchy pyramid of a “strategic set of strategies” for a diversified organization. The author has developed an analogue model for ensuring the competitive potential of a business through the implementation of a strategic set of strategies (Sumets 2018). Scientists B.A. Bryan *et al.* (2012) substantiated the feasibility of implementing a diversification strategy for the structure of an enterprise to reduce short-term economic risks associated with climate change. L.A. Joyce *et al.* (2013) analysed the types and application of different mitigation and adaptation strategies using livestock production in North America. A. Kucher (2017) substantiated the strategic priorities for the development of low-carbon agricultural land use. The measures proposed by the author are aimed at increasing the economic fertility of the soil to ensure the sustainability and adaptation of agricultural enterprises to climate change. S.P. Vorobyov *et al.* (2021) in their work argue that increasing the efficiency of sunflower cultivation is possible with scientifically based management systems focused on organic farming. The Polish scientist, J. Wysocki says it is necessary to move towards combining the classical management model with environmental innovation. This will reduce environmental pollution while bringing certain benefits to the companies that implement them, which is reflected in improved financial performance (Wysocki 2021). Environmental innovation (eco-innovation) is an ideal solution that allows business entities to achieve both environmental and economic goals. This view is supported by M. Yurdakul & H. Kazan (2020), who studied the impact of eco-innovation on Turkey's environmental and financial performance. Scientists have found that eco-innovation has a direct impact on pollution prevention, resource conservation and recycling, in addition, it has an indirect positive impact on cost savings and therefore on economic performance. K. Melvani *et al.* (2020) argue that policymakers should interact with farmers when planning sustainable agriculture under a changing climate scenario. A. Mottaeva *et al.* proposed the author's hypothesis about the existence of an image component of the economic effect when introducing an environmental management system at an enterprise. The introduction of the environmental management system at enterprises is due to the demand in the world market, the main prerequisites for which is the increased requirements for goods caused by the processes of globalization by foreign consumers (Mottaeva,

Ivashchenko and Ryattel 2020). Z. Gyori & A. Ócsai argued that environmentally oriented businesses have an intrinsic motivation to adhere to their environmental and ethical goals and that these enterprises determine success in many ways. Their definition of success includes addressing the prosperity of stakeholders, preserving and restoring the environment (Gyori and Ócsai 2014). O. Kneysler *et al.* (2020) says that agricultural development depends on the provision of energy resources, because land and its quality characteristics are the basis of agricultural enterprise. The food security of the state directly depends on the provision of energy resources, in particular, fuel and electricity, and the like.

Scientists (I.K. Arthur & F.A. Yamoah 2019; C.M. Keiver *et al.* 2005; E. Wall *et al.* 2001) in their studies studied the prospects and problems of implementation, industry-specific features of environmental management in agricultural enterprises.

Despite the thoroughness and comprehensiveness of the research carried out, environmental management in agricultural enterprises requires further improvement, taking into account current trends. In particular, when justifying environmental goals and objectives, it is necessary to take into account the strategic trends in regulation in the field of production and circulation of food products, the influence of environmental and climatic factors on the efficiency of economic activity.

Considering the above, the aim of the article is to improve environmental management in terms of the formation of an environmental strategy for agricultural enterprises in the context of the European environmentally friendly food system.

2. Case Studies

Agricultural production is accompanied by intensive use of natural resources and anthropogenic impact on the environment. The use of intensive farming technologies, ignoring the ecological balance have led to a significant decrease in the natural fertility of soils in most countries of the world. Despite the significant efforts of the governments of the countries, the volumes of carbon dioxide and methane emissions in the agricultural sector of most of the countries of the European Union and Ukraine are growing (Table 1).

Table 1. Dynamics of carbon dioxide and methane emissions in the agricultural sector of individual EU countries and Ukraine in 2009-2019, thousand tons

№	Country	Carbon dioxide, thousand tons				Methane, thousand tons			
		2009	2013	2019	2019 till 2013, %	2009	2013	2019	2019 till 2013, %
1	Germany	2590.3	2698.6	2913.8	112.5	1328.9	1342.0	1301.7	98.4
2	France	1875.9	1885.3	2018.6	107.6	1593.6	1537.1	1525.4	95.7
3	Great Britain	1503.7	1148.9	1266.3	84.2	1001.3	1000.2	1015.0	101.4
4	Turkey	592.2	807.3	1257.5	212.3	885.7	1210.4	1452.9	164.0
5	Poland	756.5	847.5	939.8	124.2	544.4	542.2	583.5	107.2
6	Ukraine	865.8	884.2	903.5	104.4	543.6	596.2	602.3	108.0
7	Denmark	186.8	246.5	244.2	130.7	235.6	237.0	239.6	101.7
8	Spain	455.0	494.9	498.6	109.6	1012.0	905.4	996.6	98.5
9	Italy	389.0	464.5	420.7	108.1	782.0	767.6	770.0	98.5
10	Romania	123.1	89.9	125.4	101.9	578.9	510.5	501.6	86.6

Source: Eurostat. https://ec.europa.eu/eurostat/data/database

The largest air pollutants are the agricultural sectors of Germany, France and the UK. During 2015-2018 carbon dioxide emissions increased the most in Poland – by 24.2%, Denmark – by 30.7%, Turkey – by 112.3%. In the same period, methane emissions decreased in Germany – by 1.6%, France – by 4.3%, while in Poland they increased by 7.2%, Ukraine – by 8.0%, in Turkey – by 64, 0%.

Most agricultural enterprises take a passive position on improving the efficiency of environmental management as well as introducing environmental management, taking into account foreign experience. This is especially true for small and medium-sized enterprises, which account for up to 80% of the total number of economic entities in agriculture.

According to a survey of the heads of 217 small and medium-sized enterprises in the Poltava region, within the framework of the Better Policies for Better Lives project, it was found that in 2019 only 4.1% of enterprises met international environmental standards. At the same time, 42.4% adhered to national environmental legislation and did not plan to introduce international environmental standards. The remaining 44.2%, although they adhered to the national environmental legislation, nevertheless planned to introduce international environmental standards (Table 2).

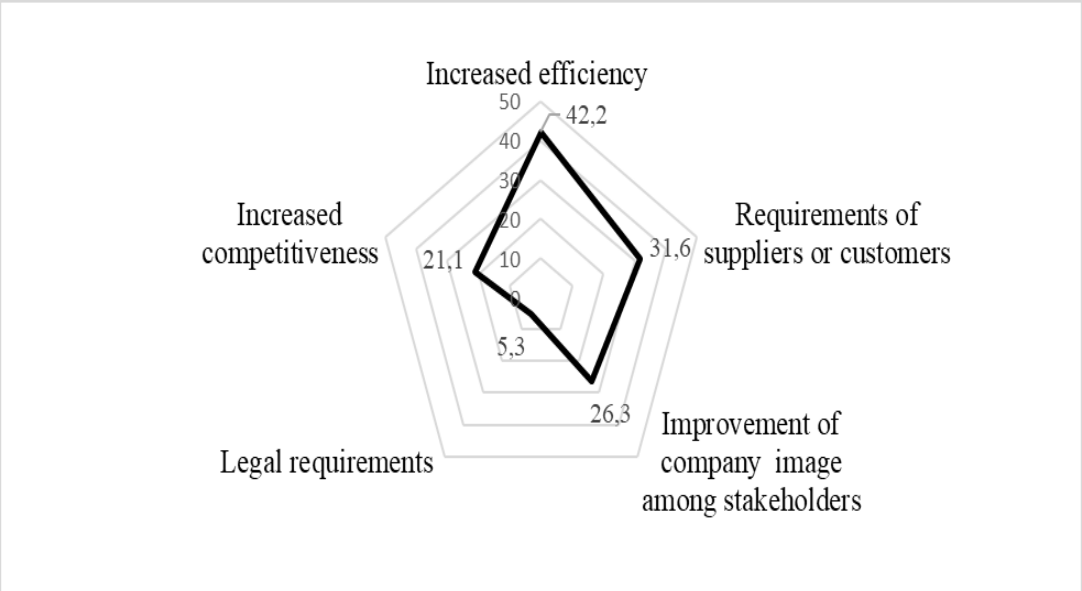
Table 2. Compliance with environmental legislation and the priority of the implementation of international environmental standards by small and medium-sized enterprises of the Poltava region, by type of economic activity, 2019, % of responses

№	Question	Agriculture	Food Industry	Non-food processing industry	Construction	Restaurant and hotel business
1	Adhered to national environmental legislation and did not plan to implement international standards	42.4	40.0	35.3	31.3	40.3
2	Adhered to national environmental legislation and plan to implement international standards	44.2	55.0	58.8	54.6	53.2
3	Complied with international standards, but this was not a priority	2.3	5.0	5.9	10.9	3.9
4	Complied with standards that exceeded the requirements of national legislation and this was a priority	4.2	-	-	1.6	-
5	Experienced difficulties in complying with national environmental legislation	6.9	-	-	1.6	2.6
	Total:	100.0	100.0	100.0	100.0	100.0

Source: Promoting the improvement of environmental performance of small and medium enterprises (SMEs).

Among the reasons that motivated agricultural enterprises to implement international environmental standards, the respondents noted (% of responses from the number of respondents who answered this question): increased efficiency – 42.2%, requirements of suppliers or customers – 31.6%, improvement of company image among stakeholders – 26.3% and legal requirements – only 5.3% (Figure 1).

Figure 1. Motivation of small and medium agricultural enterprises of the Poltava region to implement international environmental standards, %, 2019



Source: Promoting the improvement of environmental performance of small and medium enterprises (SMEs).

Thus, according to the heads of enterprises, the introduction of international environmental standards will improve the efficiency of economic activities, improve the image in the market. At the same time, the implementation of standards is a long, systematic process and requires balanced management decisions based on a sound information and analytical base.

Environmental management is a direction of management, which includes a set of actions to form an environmental strategy of an agricultural enterprise, the implementation of which will contribute to the

achievement of environmental and economic benefits (reducing anthropogenic impact and environmental costs, improving product quality, increasing sales, etc.).

With the introduction of the European environmentally friendly food system for export-oriented agricultural enterprises, the tasks of environmental management are expanding, namely:

- Assessment of the intensity of the use of chemical fertilizers and plant protection products. Determination of the risk of complications or rise in prices for the export of agricultural products due to non-compliance with the requirements for the use of chemical fertilizers and plant protection products.
- Assessment of the company's carbon footprint and development of ways to reduce it, taking into account the requirements of European environmental and commercial legislation.
- Identification of lands suitable for organic production in the near future. Development of measures to limit the use of chemical fertilizers and plant protection products in order to meet the requirements of organic production.
- Determination of the volume of waste suitable for recycling. Implementation of measures to establish logistics and trade chains for the recycling of organic waste.
- Identification of environmental factors that will provide competitive advantages in the context of a preferential policy for the protection of European agricultural producers.
- Identification of funding sources for the implementation of environmental activities.

Taking into account these tasks, environmental management of agricultural export-oriented enterprises includes the following stages:

1) Planning:

- determination of strategic environmental and economic goals and objectives, which will ensure the compliance of production and products with the requirements of international and European environmental standards. The strategic objectives should also promote the smooth export of agricultural products to ensure the competitiveness of enterprises in international markets (Dovgal *et al.* 2020).
- Development of the Program, which determines the action plan and the time frame for achieving strategic environmental and economic goals.

2) Organization of financial, material and personnel support of events (Dovgal *et al.* 2020) planned in the Program.

3) Control over the implementation of planned activities;

4) Adjustment of the action plan taking into account the intermediate results.

The most difficult and time-consuming process is the substantiation of strategic environmental goals and objectives. It includes diagnostics of the external and internal environment of the enterprise, assessment of the actual anthropogenic impact and environmental characteristics of the main factors of production, management efficiency and financial stability. It requires from specialists' deep professional knowledge and skills in applying various methods of processing primary information and management tools – economic and environmental analysis, forecasting, environmental audit, management, etc.

To address current environmental and trade challenges, strategic planning in the environmental management system of export-oriented agricultural enterprises should include:

1. Determination of national and international environmental requirements (including potential ones) for imported products by sales markets.

2. Diagnostics of the intensity of anthropogenic impact, the state of soil, water resources and other means of production in agriculture (pesticides, chemical and biological plant protection products, veterinary drugs, etc.).

3. Diagnostics of the financial and economic condition of the enterprise.

4. Development of a set of alternative strategies for enterprise development by modelling scenarios of possible events.

6. Choosing a development strategy for the enterprise, taking into account potential sales markets, changes in environmental regulation, financial and economic capabilities of the enterprise.

7. Determination of the economic and environmental goals of the enterprise, taking into account the selected environmental strategy and long-term tasks of other functional strategies (competitive, commodity, marketing, production, etc.).

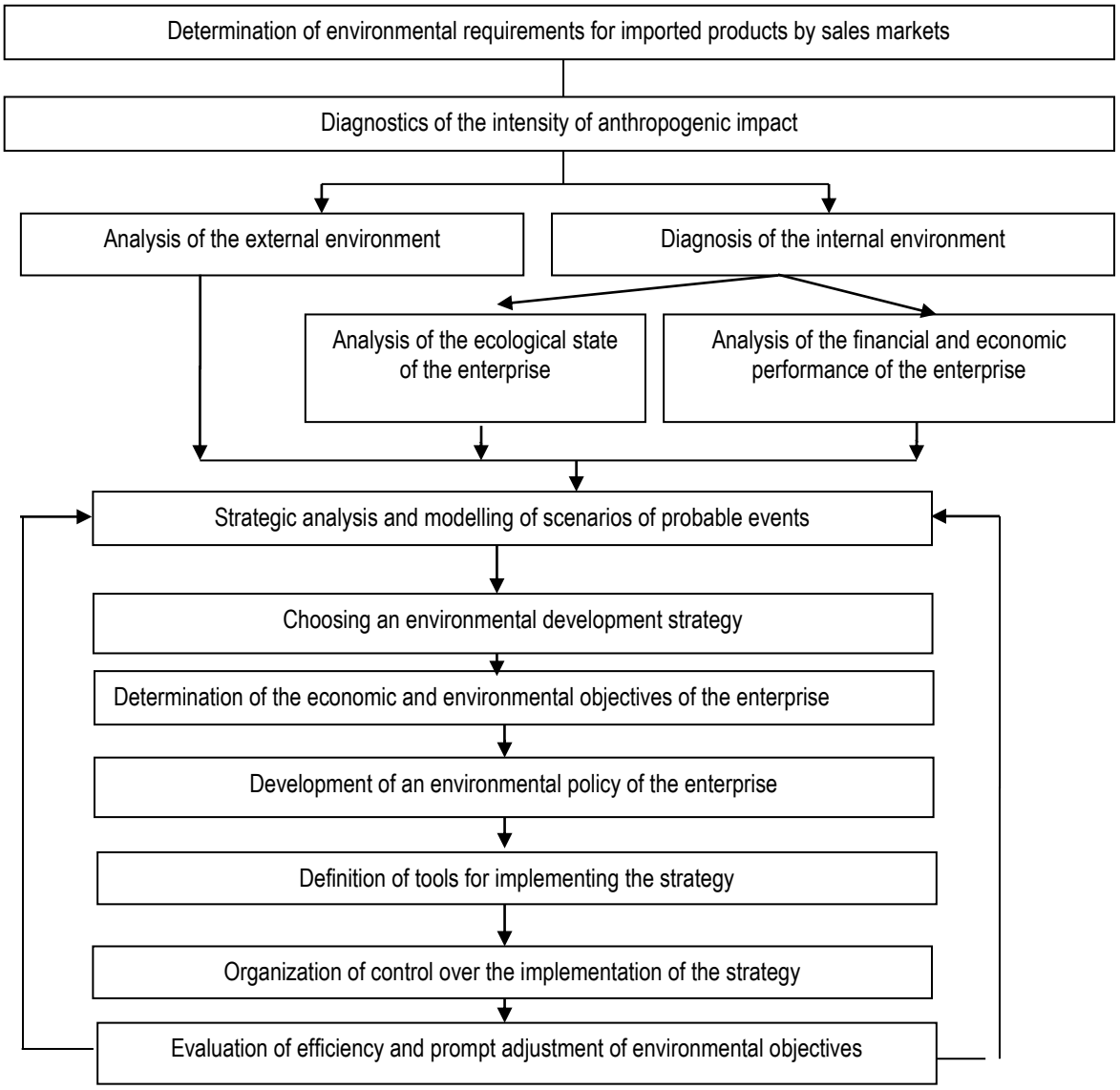
8. Development of an environmental policy, taking into account the strategic environmental goals and organizational structure of the enterprise.

9. Determination of tools for the implementation of environmental development strategy and environmental policy of the enterprise.

9. Organization of control over the implementation of the environmental development strategy of the enterprise.

10. Evaluation of the effectiveness of the environmental development strategy and the search for ways to improve it (Figure 2).

Figure 2. Stages of strategic planning in the environmental management system of export-oriented agricultural enterprises



Strategic planning in the environmental management system of agricultural enterprises is complicated by unfavourable macroeconomic conditions:

1. Economic and market instability through quarantine, disruption of international supply chains due to the global Covid-19 pandemic.

2. Weak institutional and economic development of environmental entrepreneurship in developing countries, as the basis for innovative changes in the environmental activities of agricultural producers. Currently, the size of funds for crediting environmental protection measures, technical modernization of production processes, scientific research in the field of ecology is decreasing; the cost of certification and environmental consulting is rising; the markets for environmentally friendly plant and animal protection products are shrinking, etc.

In the short term, agricultural enterprises in developing countries, in contrast to European producers, should rely primarily on internal reserves for increasing economic efficiency by improving the management of environmental parameters of economic activity. This approach is supported by the low ecological and energy

efficiency of production due to long-term extensive tillage and ignorance of the anthropogenic impact on the environment.

To analyse the influence of environmental factors on the economic efficiency and market position of the enterprise, it is advisable to use the method of mathematical or optimal programming. Mathematical programming is the basis of the formal apparatus for the analysis of strategic problems of management, planning and design. The purpose of this method is to form a set of control parameters that ensure the optimum of a certain function while limiting the operating conditions of the system.

The main task of strategic planning in the environmental management system of agricultural enterprises is to increase economic benefits and improve market positions by reducing anthropogenic impact on the environment. To solve this problem, it is necessary to develop an economic and mathematical model for optimizing the production program, taking into account environmental restrictions. The development of a mathematical model will allow:

- to balance the contradictions between the economic and environmental interests of business entities in the agricultural sector. On the one hand, the company is interested in maximizing profits (income) from the production and sale of products, and on the other, in minimizing the cost of resources, operating environmental costs and tax payments, reducing capital investments in environmental facilities, etc.
- to take into account the impact of the totality of environmental aspects (water use, emissions of pollutants into the air, waste generation, etc.) on the efficiency of the enterprise's economic activity. By acting on one environmental aspect, you can get a positive or negative effect on others. In particular, when installing solid fuel boilers to improve energy efficiency and save heating costs, it is necessary to take into account the increase in emissions of pollutants into the air and, accordingly, an increase in the cost of purchasing pollution-control equipment and an increase in the environmental tax.

Thus, using the economic and mathematical model of production optimization, one can get a set of alternative ways to increase income, incl. from the export of agricultural products, through the management of various types of anthropogenic impact. Analysing each individual option, the company's specialists can assess the costs required to manage a specific type of anthropogenic impact, potential risks (associated with the peculiarities of regional development, natural and climatic conditions, duration of projects, etc.), that is, conduct strategic analysis and modelling scenarios of probable events. Based on the results of such an analysis, the optimal scenario for long-term development is selected and further stages of strategic environmental management are carried out.

The general economic and mathematical model for optimizing the production program, taking into account environmental restrictions, is as follows:

$$z = c_1 x_1 + c_2 x_2 + \ldots\ldots + c_n x_n (\max), \quad 2.1$$

where $x_1, x_2 \ldots\ldots x_n$ stand for a set of controlled variables, the value of which is subject to optimization. Various permissible combinations of variable values correspond to possible solutions to the problem. For agricultural enterprises, the controlled variables are the planned production volumes

z is the criterion on the controlled variables. In the optimization of production activities, taking into account environmental restrictions, the criterion of optimality can be the profit from product sales, profitability, etc

$g \quad (x_1, x_2 \ldots\ldots x_n)$ are the conditions or restrictions imposed on the values of variables, or the relationship between them.

$$\begin{cases} a_{11} x_1 + a_{12} x_2 + \ldots + a_{1n} x_n \{\leq, \geq, =\} b_1; \\ a_{21} x_1 + a_{22} x_2 + \ldots + a_{2n} x_n \{\leq, \geq, =\} b_2; \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ a_{m1} x_1 + a_{m2} x_2 + \ldots + a_{mn} x_n \{\leq, \geq, =\} b_m. \end{cases} \quad 2.2$$

with restrictions: $\sum_{k=1}^{r} x_{ik} \leq a_i, \quad i = 1, 2, \ldots, n, \quad 2.3$

$$\sum_{k=1}^{r} y_{ikj} = b_{ij}, \quad j \in B_i, \quad i = 1, 2, \ldots, n, \quad 2.4$$

$$\sum_{i=1}^{n} x_{ik} = \sum_{i=1}^{n} \sum_{y \in B_i} y_{ikj} \leq d_k, \quad k = 1, 2, \ldots, r, \quad 2.5$$

$$x_{ik}, \quad y_{ikj}, \quad \geq 0, \quad \forall i,k,j, \qquad 2.6$$

For the proposed optimization model, the restrictions may include physical or cost indicators reflecting the use of natural resources, anthropogenic impact on the environment:

a_1, a_m – the expenses for the purchase of the i-th type of resources (water), energy (electric and thermal energy, natural gas), expenses associated with environmental pollution (water disposal, emissions of pollutants into the air, waste generation, etc.) per unit of produced products, UAH

b_1, b_m – the restrictions on the total costs of purchasing resources, as well as costs associated with environmental pollution.

So, for agricultural enterprises specializing in crop production, the target function can be:

Z_1 – average annual income of an agricultural enterprise, thousand $.

Z_2 – average annual income of an agricultural enterprise from the export of products, thousand $.

Variables:

x_1 – gross yield of crops of the i-th type, thousand tons.

x_2 - export of the i-th type of agricultural products, thousand tons.

x_3 – gross yield of organic crops of the i-th type, thousand tons.

c_1 – profit per 100 hectares of agricultural land, thousand $.

c_2 – profit from export, which accounts for 100 hectares of agricultural land, thousand $.

c_3 – profit from organic products, which accounts for 100 hectares of agricultural land, thousand $.

The restrictions in the model should be understood as the types of anthropogenic impact: the use of pesticides per hectare of agricultural land, water use, wastewater disposal, the volume of waste generation, their recycling, emissions of pollutants into the air (CO2, CH4) and electricity consumption (Table 3).

Table 3. The model of optimization of the production program for strategic planning in the system of environmental management of agricultural enterprises

Type of anthropogenic impact on the environment or technological operation	Indicator
Fertilizers of crops	Use of mineral fertilizers, t / ha
Plant protection	Use of plant protection chemicals, t (l) / ha
Water use	Water use per 100 hectares of agricultural land
Wastewater disposal	Operating expenses for ensuring the operation of the water disposal system per 100 hectares of agricultural land
Waste management operations	The volume of organic waste per 100 hectares of agricultural land
	The volume of inorganic waste per 100 hectares of agricultural land
Emissions of pollutants into the air	The volume of emissions of pollutants into the air, waste per 100 hectares of agricultural land
Power consumption	Energy intensity of products (by product type)

Optimality criteria can be:

1) maximum profit;

2) minimum costs for purchasing resources (water and electricity) or costs for purchasing resources (water and electricity) within the technological and / or environmental standards;

3) minimum costs associated with the impact of the enterprise on the environment (wastewater disposal, waste management operations, emissions of pollutants into the air) within the established environmental standards.

In order to identify the most profitable direction for the enterprise, which will ensure optimal production under the condition of minimum resource consumption and maximum economic and market benefits, it is advisable to use a set of alternative environmental development strategies. To do this, one should use modeling of scenarios of possible events, namely, combinations of variables and objective functions (Table 4).

Table 4. Combination of variables and target functions for building an economic and mathematical model of production optimization taking into account environmental factors

Variable	Function	Limiting the cost of managing environmental aspects	Resulting function
The area under the agricultural crop of the i-th type, ha Agricultural land area in organic production, ha	The volume of mineral fertilizers Water consumption Waste Emissions of pollutants into the atmosphere	Requirements of international standards Minimum Minimum Standard	Profit per 100 hectares, UAH Export volume per 100 hectares, thousand UAH
	The volume of mineral fertilizers Wastewater disposal Emissions of pollutants into the atmosphere Energy consumption	Standard Standard Requirements of international standards Standard	
	Water consumption Wastewater disposal Waste Emissions of pollutants into the atmosphere Energy consumption	Standard Standard Minimum Standard Requirements of international standards Standard	

Source: development of authors.

Application of the proposed economic and mathematical model of production optimization taking into account environmental factors will contribute to the improvement of information and analytical support for strategic planning in the environmental management system. Due to the combination of variables and target functions, managers can develop a set of development scenarios. Taking into account the macroeconomic situation and financial capabilities, a priority development strategy is determined, which is the basis of the management system.

Conclusion

A stable trend of modern world development is the intensification of efforts to decarbonize the economy, reduce the anthropogenic impact on the environment, and introduce a sustainable food system. In order to achieve ambitious environmental goals, defined in the 2015 Paris Agreement, many countries are increasing environmental regulation, creating additional environmental and trade barriers to international trade. The European Union, which is an important sales market for developing countries and Ukraine, is developing a "Farm to fork" strategy for the transition to a sustainable food system. The implementation of the strategy involves the introduction of strict environmental requirements for the production, sale and marketing of agricultural products. For producers, this will significantly complicate the export of food products.

To maintain the volume of exports of agricultural products, to enhance competitiveness in the face of severe environmental restrictions, agricultural enterprises must improve environmental management. It is important to develop an environmental strategy for adaptation to international environmental standards, in particular, on the use of chemical fertilizers and plant protection products, reduction of carbon dioxide emissions, and waste recycling.

To address current environmental and trade challenges, strategic planning in the environmental management system of export-oriented agricultural enterprises should include the following steps: determination of environmental requirements (including potential ones) for imported products by sales markets; diagnostics of the intensity of anthropogenic impact and the financial and economic performance of the enterprise; development of a set of alternative strategies for enterprise development by modelling scenarios of possible events; selection of a development strategy for the enterprise, taking into account potential sales markets, changes in environmental regulation, financial and economic capabilities of the enterprise; determining the economic and environmental goals of the enterprise, taking into account the selected environmental strategy and long-term tasks of other functional strategies (competitive, product, marketing, production, etc.).

Agricultural enterprises in developing countries are limited in financial resources for the development and implementation of environmental management in order to comply with international environmental standards. In

the short term, such enterprises can rely only on internal reserves for increasing economic efficiency by improving the management of environmental parameters of economic activity.

To form a set of alternative environmental strategies, it is advisable to use an economic and mathematical model for optimizing agricultural production, taking into account environmental factors. This will make it possible to determine a set of scenarios for increasing economic efficiency due to the environmental management of the anthropogenic impact of the enterprise. The developed scenarios are the basis for further determining the development strategy, taking into account the financial capabilities, trade and economic goals of agricultural enterprises. The use of the proposed model will contribute to improving the information base of strategic planning in the environmental management system of agricultural enterprises.

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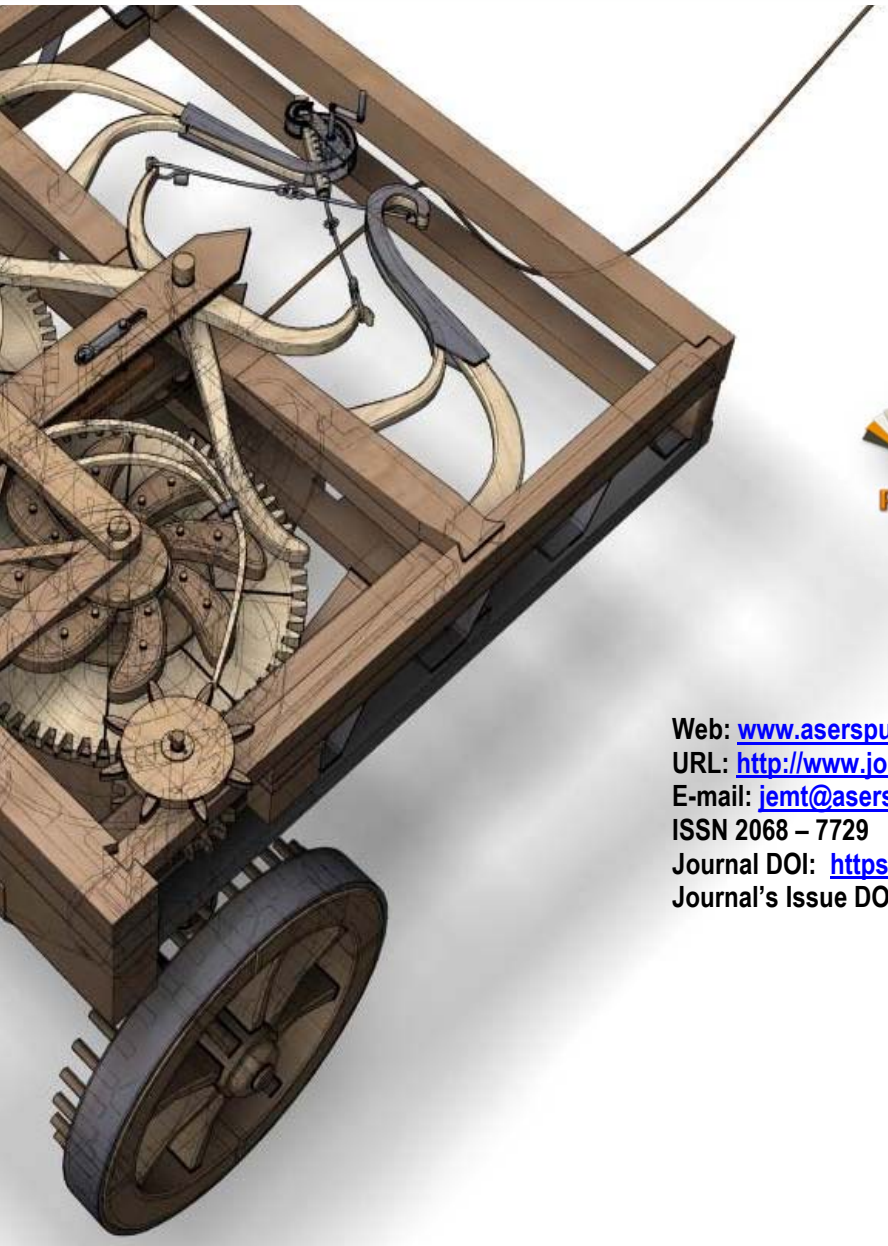

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