

ECONOMIC REPRODUCTION OF THE NATURAL RESOURCE POTENTIAL OF AGRO-INDUSTRIAL PRODUCTION

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Purpose. The goal of the study is to develop scientific and methodological approaches and practical recommendations for improving the economic mechanism of reproduction of the natural resource potential of agro-industrial production (AIP).

Results. The article substantiates the priorities for improving the reproduction of the natural resource potential of agro-industrial production on the example of Ukraine. The conceptual foundations of forming an information system for ensuring the rational use and reproduction of natural resources in the agrarian sector are highlighted in detail. The conceptual foundations of forming a system of principles, goals and criteria for information support of the processes of reproduction of the natural resource potential of AIP, the environmental and economic mechanism for managing the features of environmental and innovative development of the state are considered in more detail. For optimal redistribution of the resource component of agro-industrial production, methodological recommendations for the economic assessment of natural resources in the agrarian sector are presented. In order to ensure the rational reproduction of natural resources of the agricultural sector, the features of the economic assessment of natural resources of agro-industrial production are analyzed. The essence and content of the concept of the natural resource potential of the agricultural sector is revealed, under which it is proposed to understand a complex system of natural objects, the users of which are enterprises of agro-industrial production with existing technology and socio-economic relations, a component of the environmental and economic potential of the state. This made it possible to develop a system of information support for the reproduction of the natural resource potential of AIP based on a systematic analysis of environmental and economic relations of nature management in the agrarian sector.

Scientific novelty. The economic category of the natural resource potential of the AIP is developed in the direction of reflecting the structure and relationships between its elements; the definition of the economic assessment of natural resource elements is deepened, which is considered in the study as a criterion indicator of the comparative economic efficiency of the use and reproduction of the natural resource potential of the AIP; scientific and practical foundations of information support for economic processes of reproduction of natural resources in the agricultural sector are improved on the basis of development of an information system for expert assessment of their quality, monitoring, audit, and

passport of the environmental management object.

Practical value. The results of the study are used to improve the economic mechanism of reproduction of natural resources of the agrarian sector in the region. The scientific and practical recommendations are used to determine the indicators of economic assessment of the elements of natural resources of the agrarian sector; to calculate the economic efficiency of conservation and reproduction of the natural resource potential of the agro-industrial complex; to provide financial support for regional reproduction programmes and processes; to develop tools and methods of agro-ecological regulation.

Key words: resource potential of agro-industrial production, economic reproduction, economic assessment of natural resources, environmental monitoring, environmental audit.

Introduction. The state policy in the field of potential resource reproduction in agro-industrial production (AIP) is aimed at solving problems in economic, social and environmental areas that significantly impact Ukraine's economic development process. Trends in the modern development of agro-industrial production in Ukraine are associated with the imperfection of the economic mechanism of nature management, equipment, machines and technology. It leads to the degradation of natural resources, reduces the possibility of providing production with raw materials, complicates technological cycles, and worsens the overall state of biogeocenosis [1; 2]. Best practices show that the modern development of the agriculture-based economy, regardless of the socio-economic focus of countries and the production method, is becoming more environmentally sensitive and requires the preservation and reproduction of the natural resource potential of AIP.

Review of literature. The agrarian sector's natural resource potential is considered a complex system of natural objects, the users of which are enterprises of agro-industrial production with existing technology and socio-economic relations, a component of the ecological and economic potential of the state [3–5].

Using the concept of natural resource potential enables assessing the dynamics and completeness of the qualitative and quantitative aspects of available natural resources. At the same time, we proceed from the traditional understanding of the concept of natural resources, when natural resources are understood as “elements and forces of nature that at this level of development of productive forces and learning can be used to meet the needs of human society in the form of personal participation in material activities” [6]. In modern interpretations of this concept, particular emphasis is placed on understanding natural resources as potential consumer values and on their territorial location.

The agrarian sector reform aims to improve the level of food security in Ukraine by increasing food production and improving the food quality and nutrient balance, which will create a competitive economy integrated into the global economic system, bringing agricultural production closer to the level of economically developed countries. Each country has different criteria for national food security, determines the ways to ensure it and develop agricultural production, depending on the natural and climatic features and economic situation. Further changes in the demographic situation of the world, which has a population of more than 7 billion people, are becoming

essential. By 2025, it will reach 8 billion people, of which 10 %, according to international experts, will remain on the verge of malnutrition [6]. Ukraine has significant reserves for increasing food production and the possibility of exporting it, improving the working conditions of agricultural producers and their social security. The state of natural resource potential directly affects the quality and life expectancy of the population. Thus, in particular, G. Kaletnik and S. Lutkovska [7] have stated that comparing economic and environmental comfort as components of the standard of living shows that the quality of the environment is a priority consumer good. This theoretical provision provides for the practical exercise of human rights to an ecologically balanced environment and the rights of future generations to use natural resource potential to support their development.

Materials and methods. The goal of the study is to develop scientific and methodological approaches and practical recommendations for improving the economic mechanism of reproduction of the natural resource potential of agro-industrial production.

The article uses the following research methods: a system-evolutionary approach to understanding the objective laws of ecological and economic development of ways to reproduce the natural resource potential of AIP, comparative and statistical analysis of the features of assessing the natural resource potential of AIP, a dialectical method and a method of logical generalization in the study of the development of a system of information support for the processes of reproduction of the natural resource potential of AIP, systematic approach and logical analysis in the formation of the economic mechanism of state management of the process of reproduction of the natural resource potential of AIP, methods of economic and mathematical modeling of the components of assessing the natural resource potential of AIP.

Results and discussion. The scientific and methodological foundations of the implementation of the environmental protection program of Ukraine consist of a new approach to the formation of the goal of environmental protection and systematic means of its achievement. A new goal in environmental protection activities is to create a system that can move from a scheme for responding to events that have occurred to the implementation of effective preventive control and actions. New systemic means to achieve this goal are as follows:

- the integrated solution to the problem of building a state system of environmental protection activities, which provides for the continuity of solving environmental and socio-economic problems of the state development;
- improving the efficiency of environmental protection activities through complete consideration of systemic factors of harmful impact on objects and organization of control over them at all stages of the life cycle;
- new approaches to the arrangement of environmental protection activities, which are implemented based on automated information systems;
- systematic methods for assessing the effectiveness of environmental protection activities of reproduction processes of the natural resource potential of the agrarian

sector.

The developed scheme of the conceptual model of reproduction of the AIP natural resource potential is shown in Figure 1.

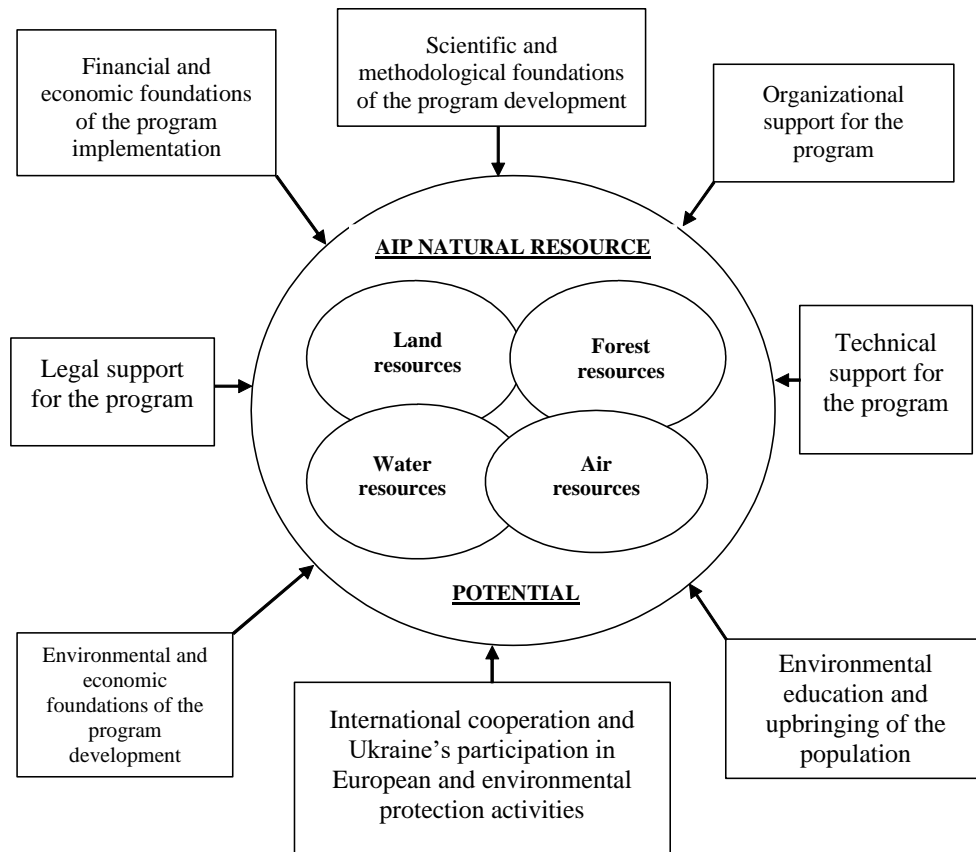


Figure 1. Scheme of the conceptual model of reproduction of the AIP natural resource potential

Source: authors' presentation.

The main directions of the new environmental and economic policy are the analysis of economic relations and patterns of involving natural resources in the process of creating material goods and the environmental and economic efficiency of this process, a new mechanism for economic regulation of nature management, and the gradual expansion of economic benefits [8–10]. The main objectives of the new environmental and economic policy are:

- study of links between production and economic activities and socially necessary costs for environmental protection and reproduction. Identification of new patterns at the nexus of natural (environmental) and social (economic) sciences;
- development of a mechanism for introducing a standard amount of environmental costs associated with environmental pollution into the costs of manufacturing products;
- development of methods for integrating environmental requirements into the economy;
- determination of criteria for environmental and economic efficiency of sustainable (environmental and balanced) development of society;

- identification of promising ways of structural adjustment of the economy, taking into account environmental imperatives;
- determination of environmental requirements for investment and economic activity;
- development of mechanisms for implementing environmental and economic development.

The organizational system of the AIP natural resource potential reproduction should be the constitutional responsibility of central and local state structures in developing and implementing long-term indicative resource use plans in the agrarian sector [11; 12].

The implementation of the organizational structure of the public management of the process of the AIP natural resource potential reproduction is proposed to be carried out under the development of the powers of the regional department of agriculture through the creation of an inspectorate, whose tasks should be forecasting, monitoring the state, software of the economic strategy for the AIP natural resource potential reproduction. The developed organizational structure of the regional inspectorate is shown in Figure 2.

The division for monitoring and information support of the process of the AIP natural resource potential reproduction may be part of the central office of public administration or act under it as a scientific and information center, with the right to engage in commercial activities in the field of environmental information management. At the same time, monitoring observations of reproduction processes in the agrarian sector are carried out following the functional tasks defined by the regulation of the State Environmental Monitoring System [13].

The main tasks of the Environmental and Economic Standardization Division are proposed to include the development and approval of limits and standards for the use of AIP natural resources: for emissions and discharges to the natural environment; for payments for pollution, for the use of limited natural resources; issuing appropriate permits for emissions, discharges of pollutants to the environment, for waste disposal, use of natural resources.

Environmental expertise, which is a comprehensive analysis of technology, materials, equipment, machinery, projects, plans, forecasts and other documentation, helps to analyze and evaluate the expected outcomes [6; 14; 15]. Experts carry out this expertise to determine the compliance of the submitted materials with the current legislation and develop constructive proposals for environmental protection.

The Division of Multifaceted Nature Management Issues should be engaged in the development of required plans and programs for the preservation and reproduction of the AIP natural environment, scientific and technical problems of resource use, coordination of the activities of state bodies and other organizations in the field of resource use; development of conservation; issues on international cooperation. This division may also employ specialists who provide legal support for the activities of the regional administration.

In addition to traditional activities, the Planning and Financial Division and Accounting Department should monitor the receipt of payments for discharges, emissions, and the use of natural resources to be collected as penalties.

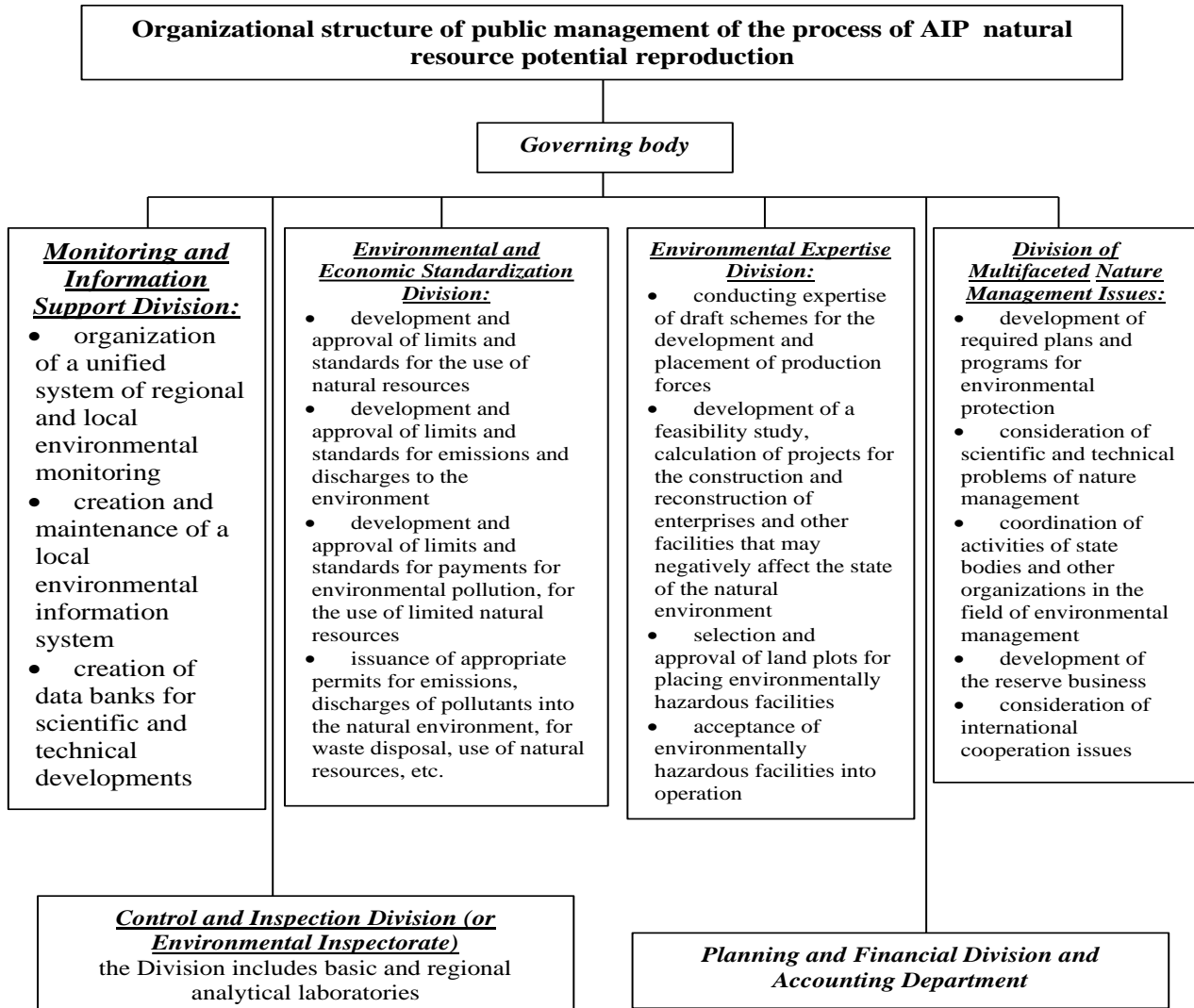


Figure 2. The organizational structure of public management of the process of AIP natural resource potential reproduction

Source: authors' presentation.

A system of economic, social and environmental interests and goals determines socio-economic responsibility and promotion of the AIP natural resource potential. Their regulation is carried out through an organizational and economic mechanism, the components of which are planning, management, financing and pricing.

Assessment of natural resources is a complex interdepartmental task, which is a priority in market conditions. The main problems in this issue arise due to the need for a coordinated methodology for economic assessments of resources and resource consumption processes and an appropriate legal and regulatory framework. The development of methods for monetary assessments of natural resources has long been hindered by insufficient validity of theoretical developments. Natural resources have been most often considered in isolation from the problems of assessing the elements of

national wealth and their reproduction. Therefore, an important task is to develop a general concept of economic (cost) assessment of natural resources, which would enable to develop a unified system of indicators for evaluating various nature-forming components that are optimal from the point of view of coordinating the interests of the economy and nature management.

The reproduction of natural resources in the agrarian sector occurs with or without human intervention, can be narrowed (provided that the use of natural resources is preferable to their restoration), simple (the amount of resource use corresponds to restoration), and expanded (recovery exceeds use).

Only that part of social and production activities related to the production, distribution, exchange and consumption of goods is subject to economic assessment. The process of social production is associated with the involvement of material, labor, financial and information resources. The economic development of society is integral to the most extensive and direct involvement of elements of the natural environment in production. Without participating in the process of natural labor elements, natural conditions form an objective natural potential in their totality. It is a prerequisite, basis and necessary condition for human existence.

Producing natural resources by increasing capital investment for environmental purposes per unit of their measurement is expedient, which requires additional financial resources. The source of the formation of such reserves is the payment fund for using natural resources. The problem of restoring the ratio between different types of leases and the price of land, land tax, and rent payment is particularly relevant and, at the same time, needs to be solved. The economic assessment of the reproduction of natural resources should include the number and list of funds, their social value and economic, social, and environmental efficiency.

The economic assessment of reproduction records the directions of change or conservation of resources in physical and value terms. Assessing the reproduction of natural resource potential is an environmental measure, that is, an assessment of the preservation of natural resources in the agrarian sector.

In the economic assessment of natural resource potential, it is necessary to determine the criteria and system of indicators that characterize the level of return and use. Methodological approaches to the economic assessment of the effectiveness of the use, reproduction and protection of natural resource potential are based on comparing the results of nature management in combination with the reproduction and preservation of resource potential with the costs of their implementation in kind or value assessment.

The system for assessing the AIP natural resource potential is the basis for economic regulation of the use, protection and reproduction of natural resources, the totality of which may be reflected as follows:

$$NRP_{AIP} = P_{lr} + P_{fr} + P_{wr} + P_{ar}, \quad (1)$$

where NRP_{AIP} – natural resource potential of AIP;

P_{lr} – the potential of land resources;

P_{fr} – the potential of forest resources;

P_{wr} – the potential of water resources;

P_{ar} – the potential of air resources.

Economic assessment of natural resources of the agrarian sector is the determination of their value in monetary terms in fixed socio-economic conditions of production under specific environmental management regimes and environmental restrictions on economic or other activities. The economic assessment of natural resources is used for the following:

- determination of their cost;
- selection of optimal parameters for their use;
- determination of the economic efficiency of investments in the natural resource complex;
- determination of losses from irrational and non-comprehensive use of natural resources;
- reflection of the assessment of the share of natural resources in the structure of national wealth;
- establishment of payments and excise taxes for their use;
- forecasting and planning the use of natural resources;
- determination of the amount of compensation payments related to the disposal or change of their intended purpose;
- solving other problems related to their rational use.

The system of cost estimates of the AIP natural resources is required for solving a complex of important national economic tasks: creating a mechanism for accounting for and reproducing the national wealth of the country; developing principles for investing in natural exploitation industries; introducing methods for managing natural resource reserves and resource conservation; ensuring balanced development of territories; developing a unified system of payments for the use of natural resources. Certain tasks can be solved by applying specific cost estimates of both individual types of resources and their totality for integrated use [2; 13; 14].

Until now, there are no unified methodological approaches to the economic assessment of natural resources used in the economic turnover and the impact of this assessment on the macroeconomic level. The most significant development has been given to approaches to its definition based on:

- total economic value of the resource;
- cost approach and its modifications;
- reproductive approach;
- resource assessments based on differential rent.

Approaches are being developed intensively considering the indirect cost of using a natural resource, for example, by determining the effect of biodiversity conservation, “indirect cost of use”, or by determining the effect of afforestation and vegetation conservation (carbon credit) [8].

Economic assessment of land resources. As the natural and economic basis of any

production, the natural resource potential is the spatial basis for placing the productive forces of society. Economic assessment of natural resources is the conceptual basis for paid use of natural resources by enterprises of various forms of management. Therefore, natural resource cost and monetary assessment are significant [5; 15]. If any actions regarding the qualitative and quantitative characteristics of resources are an evaluation, then the result of such actions is an assessment. Considering the operation of the law of supply and demand, the assessment is transformed into the price of goods or services offered (in our case, these are natural resources). Rent is the income from the use of natural resources. It is absolute, meaning that a unit of any type of natural resource can bring profit no less than this level. This level is the absolute rent for a given type of natural resource. Differential rent depends on the location, quality of natural resources (differential rent I) and the intensity of investment in them (differential rent II), which takes into account the cost of developing this natural resource:

$$NRA_{d.r.} = E_s \cdot DR : E_d, \quad (2)$$

where $NRA_{d.r.}$ – natural resource assessment based on differential rent;

DR – differential rent;

E_s – efficiency standard;

E_d – expenses for the development of this natural resource.

The Cabinet of Ministers of Ukraine has approved the monetary valuation of agricultural land (Table 1), however, there is a problem regarding assessing the state's forest fund lands. The assessment of forest resources is carried out in the form of a forest tax, which should compensate for state expenditures on forestry. The assessment of subsurface resources has not been carried out. The problem of atmospheric air is highlighted separately.

Energy assessment of natural resources is the presence of a particular energy equivalent in natural resources, which depends on the internal potential and preliminary costs for their formation:

$$NRA_e = E_{nr} : O_e, \quad (3)$$

where NRA_e – energy assessment of natural resources;

E_{nr} – energy costs for the formation of a particular type of natural resources;

O_e – energy output obtained from a given resource when used.

Using the energy assessment of natural resources for minerals and other non-renewable depleted natural resources is advisable.

Theoretically, the indirect valuation of any natural resource can be determined through an additional volume of sales and/or an increased level of prices for the corresponding product in comparison with similar economic indicators in those places and at a time where and when there is no increased need for these natural goods. Schematically, this can be expressed by the formula:

$$V_{ic} = \sum_{i=1}^n (S'_i \cdot P'_i - S_i \cdot P_i), \quad \dots(4)$$

where V_{ic} – indirect valuation of a particular natural resource;

S'_i, S_i – sales volume of the i -th natural resource, respectively, with and without increased demand;

P'_i, P_i – the price of the i -th natural resource, respectively, with and without increased demand;

n – number of natural resources that can be used to realize the need for these natural goods.

Table 1

**Indicators of normative monetary assessment of agricultural land in Ukraine
as of 01.01.2022 (UAH per hectare)***

Regions of Ukraine	Arable land, fallows	Perennial plantings	Hayfields	Pastures
Vinnitsia	27,184	47,053	3,140	1,558
Volyn	21,806	41,350	6,039	4,479
Dnipropetrovsk	30,251	55,608	7,972	6,232
Donetsk	31,111	58,460	7,247	6,038
Zhytomyr	21,411	35,646	5,072	4,090
Zakarpattia	27,268	37,072	6,522	5,259
Zaporizhzhia	24,984	41,350	6,039	4,869
Ivano-Frankivsk	26,087	27,072	4,831	4,880
Kyiv	26,531	42,776	6,281	4,479
Kirovohrad	31,888	67,015	8,696	6,038
Luhansk	27,125	47,053	8,213	5,843
Lviv	21,492	27,091	5,798	4,090
Mykolaiv	27,038	47,053	8,213	5,843
Odesa	31,017	62,738	8,938	7,011
Poltava	30,390	64,163	5,556	4,285
Rivne	21,938	37,072	5,073	3,700
Sumy	26,793	49,905	6,522	4,674
Ternopil	29,035	57,034	6,281	5,648
Kharkiv	32,237	67,015	6,281	6,427
Kherson	24,450	37,072	5,315	4,285
Khmelnitskyi	30,477	52,757	6,764	5,259
Cherkasy	33,646	74,144	8,455	5,648
Chernivtsi	33,264	62,738	5,556	5,064
Chernihiv	24,065	55,608	8,696	5,064

Note. *Value of the normative valuation of agricultural land by the national (All-Ukrainian) normative monetary assessment of agricultural land. For information: Exchange rate (01.01.2022): 1 USD – 36.5 UAH.

Source: calculated by the authors according to the data of the State Geocadaster of Ukraine. URL: <https://tax.gov.ua/dovidniki--reestri--perelik/dovidniki-/325490.html>.

The growing rate of use of natural resources by the agrarian sector has led to the problem of rational use, expanded reproduction and protection of natural resources. The negative environmental consequences of mismanagement of the AIP natural resource potential are becoming more and more noticeable. Therefore, it is necessary to realize that we can take from nature not what we need but what nature can give not

to upset the balance. When studying the natural resource potential of a land territory, the starting point is the statement that we have not inherited the land from our ancestors but borrowed it from our descendants [16].

The model of the base price of land as a natural resource adapted to domestic conditions, which is based on the factors of the capital value and anti-rent, taking into account the lost benefit from investing money capital in the land and not in the bank, is as follows:

$$P_l = C_l - AW(1 + i) \quad (5)$$

or:

$$P_l = C_l - (L + C_o)(1 + i), \quad (6)$$

where P_l – the base price of land;

C_l – cadastral value of land;

AW – anti-rent;

i – financial market standard;

L – losses;

C_o – owning costs.

Formula 6 reflects the cost pricing model based on the cadaster, the subtrahend of which is anti-rent, adjusted to the cost of losses of monetary capital invested in land ownership.

The economic assessment of land (EAL) in order to determine its value as national wealth and include it in fixed assets, as well as to compensate for the withdrawal of agricultural land for the needs of other industries, can be calculated by the formula [17]:

$$EAL = (DR I + DR II) \cdot C_{ii} \cdot C_{sm} \cdot C_{sd} \cdot C_{envir}, \quad (7)$$

where DR – differential rent;

C_{ii} – industrial impact coefficient;

C_{sm} – product sales market coefficient

C_{sd} – social development coefficient;

C_{envir} – environmental coefficient.

Indicators of pollution of the AIP natural resources are given in Tables 2 and 3 [17].

Table 2 shows that the largest changes occurred in soil contamination with the application of different types of fertilizers, in particular, zinc is 52.0 mg/kg in not fertilized soils; with mineral resources is 37.0 mg/kg; the highest is from sewage sludge is 130.0 mg/kg. Soils with compost from household garbage is 128.0 mg/kg and from sewage sludge is 130.0 mg/kg. Iodide is 2.0 mg/kg in not fertilized soils and 330.0 mg/kg is soil with organic substances, soils with compost with mineral resources is 393.0 mg/kg.

Table 2

Contamination of soils when applying various types of fertilizers, mg/kg

Chemical element	Soils			Soils with compost	
	Not fertilized (background)	With organic substances	With mineral resources	From household garbage	From sewage sludge
Mercury	0.009	0.009	0.009	0.3	0.087
Lead	26.0	29.0	36.0	92.0	55.0
Bismuth	0.3	-	-	1.02	1.24
Zinc	52.0	55.0	37.0	128.0	130.0
Silver	0.06	-	-	0.12	0.14
Tin	50.0	4.9	6.5	90.0	85.0
Molybdenum	0.8	1.0	1.0	1.24	1.2
Copper	27.0	32.0	23.0	33.0	42.0
Chrome	46.0	45.0	56.0	57.0	47.0
Cobalt	7.0	7.1	7.6	8.3	8.2
Strontium	28.0	30.0	42.0	33.0	32.0
Fluoride	20.0	330.0	393.0	-	-

Source: [5].

Table 3 shows that changes in the pollution of agricultural land by industrial toxicants, in particular, cadmium (the excess of the background level in Cherkasy region is 8.0; in Odesa region is 6.0; in Kharkiv region and Chernivtsi region are 4.0).

Table 3

Contamination of agricultural land with industrial toxicants

Regions	Lead, MPC		Cadmium		Zinc		Copper	
			Background level increase					
	average	maxim.	average	maxim.	average	maxim.	average	maxim.
Vinnitsia	-	-	1.6	2.4	-	-	-	-
Dnipropetrovsk	-	-	1.4	2.4	-	-	-	-
Zaporizhzhia	-	-	1.0	2.0	-	-	-	-
Kyiv	1–1.5	-	-	-	2.2	-	-	-
Kirovograd	1.9	-	-	-	-	-	-	-
Luhansk	2.3	-	-	-	1.3	-	1.3	-
Lviv	1.2	2.0	5.6	1.0	2.0	-	-	-
Mykolaiv	-	1.3	4.0	-	-	-	1.5	1.7
Odesa	-	1.4	-	6.0	-	1.4	-	-
Poltava (Kobeliakskyi district)	-	-	8.0	-	-	1.6	-	-
Rivne	1.6	-	-	-	-	-	-	-
Kharkiv	-	1.7	-	4.0	-	-	-	-
Kherson	-	-	-	-	-	-	2.2	2.3
Khmelnysk	2.1	-	-	-	-	-	2.2	-
Cherkassy	-	1.7	6.0	8.0	-	-	-	-
Chernivtsi	-	1.5	1.6	4.0	-	-	-	1.9

Source: [5].

The total amount of work performed to protect the land from erosion in the

example of the Sumy region is shown in Table 4.

Table 4

The total amount of work performed to protect the land from erosion on the example of Sumy region (as of 01.10.2022)

Name of districts and towns of regional subordination	Projects developed	Of these, fully developed	Antierosion earthen hydraulic structures built	Of these		
				terrace embankments (roads), water-retaining forest belts	ditches in flow regulating forest belts	arable terraces
Belopil'skyi	8	4	63.2	31.9	31.3	-
Buryn'skyi	-	-	-	-	-	-
Veyikopysarev'skyi	3	-	1.6	1.6	-	-
Hlukhov'skyi	4	1	39.5	39.5	-	-
Konotop'skyi	8	1	4.7	-	4.7	-
Krasnopolskyi	5	2	57.6	57.6	-	-
Krolevetskyi	3	2	41.0	41.0	-	-
Lebedyn'skyi	4	2	71.7	60.1	5.1	6.5
Lypovodolyn'skyi	6	3	30.2	21.8	7.5	0.9
Nedryhailiv'skyi	4	1	25.4	25.4	-	-
Akhtyr'skyi	5	2	63.3	54.2	7.1	2.0
Putyv'skyi	7	5	136.7	122.0	14.7	-
Romenskyi	5	4	65.3	44.1	19.4	1.8
Seredyno-Bud'skyi	-	-	3.5	3.5	-	-
Sum'skyi	8	4	81.2	80.2	1.0	-
Trostianetskyi	5	3	153.0	129.2	17.7	6.1
Shostkyn'skyi	2	-	-	-	-	-
Yampil'skyi	-	-	-	-	-	-
Sumy	2	-	-	-	-	-
Total for Sumy region	79	34	837.9	712.1	108.5	17.3

Source: authors' presentation.

Economic assessment of water resources. Water resources are free if the amount of water consumed is naturally compensated. However, water use for municipal and household needs requires costs for its extraction and supply. Fresh water sources require funds to maintain them in a suitable condition. Payment for water depends on the income that can be received from its use.

The economic assessment of water resources for water consumption is determined by the monetary expression of the maximum effect that can be obtained with full involvement in such use. Since water resources are renewable, they can have an economic effect for an indefinitely long time. Considering the time factor, the economic assessment of a water resource is determined by multiplying its annual economic assessment (rent) by the time factor accounting coefficient.

Prices for water as a natural resource, for which current tariffs are set, have been determined by the economic assessment of water resources, which takes into account the economic effect of using water as a natural resource in the sectors of the economy

and its social value as a commodity created at the expense of certain labor costs.

Continuation of Table 4

The total amount of work performed to protect the land from erosion on the example of Sumy region (as of 01.10.2022)

Name of districts and towns of regional subordination	Spillway structures built, pcs.	Protective forest stands created thsd ha	Of these		Antierosion ponds created, pcs./ha	Ravines flattened, ha	Grasslanding of slope and floodplain lands, thsd ha
			field-protected forest belts, ha	flow regulating forest belts, ha			
Belopil'skyi	4.0	0.1	71.9	26.0	8,373.7	2.3	2.2
Buryn'skyi	1.0	0.3	138.8	-	2,344.0	-	0.8
Veyikopysarev'skyi	-	0.2	167.0	3.5	169.3	-	1.4
Hlukhov'skyi	13.0	0.5	56.3	6.2	13.4	10.7	2.1
Konotop'skyi	-	0.5	385.8	40.7	-	-	2.9
Krasnopolskyi	19.0	0.2	90.1	28.3	267.3	4.4	3.6
Krolevetskyi	7.0	0.1	45.3	6.0	332.5	0.4	2.4
Lebedyn'skyi	5.0	0.9	44.9	20.1	163.3	8.3	3.1
Lypovodolyn'skyi	-	0.5	119.2	43.5	2,212.3	7.5	2.8
Nedryhailiv'skyi	-	0.2	50.1	2.9	251.0	4.7	2.8
Akhtyr'skyi	9.0	0.2	154.0	23.0	2,154.0	2.0	2.3
Putyv'skyi	22.0	0.3	210.3	21.7	446.2	13.3	1.9
Romenskyi	27.0	0.5	65.7	17.6	276.8	1.0	2.6
Sereddyno-Bud'skyi	1.0	0.2	7.6	-	-	-	0.1
Sum'skyi	8.0	0.8	102.6	35.2	7,111.8	18.5	4.2
Trostianetskyi	17.0	0.5	90.8	41.0	3,74.8	5.0	2.1
Shostkyn'skyi	-	0.1	-	2.2	2,107.0	-	0.2
Yampil'skyi	-	0.1	2.0	-	4,193.0	-	0.1
Sumy	-	-	-	-	-	-	-
Total for Sumy region	133.0	6.2	1,802.4	317.9	461,980.4	78.2	37.6

Source: authors' presentation.

The use of water resources in the water supply system has created conditions for a complete economic assessment of water use, which is equal to the sum of two payment rates:

- for the use of water as a natural resource and the formation of water resources available for use in the water supply system (R_s);
- for water intake, purification and distribution among water users in the water delivery system (R_d);

$$R_{wp} = R_s + R_d \quad (8)$$

Determining the size of these payment rates has certain features depending on the conditions for forming an economic assessment of water resources at different stages.

The economic assessment of water as a natural resource (W_r) in conditions of its limitation is equal to the rental assessment of the source's water according to the

economic efficiency of water use by the closing (socio-economic effect) water user.

An additional increase in available water resources due to increased water scarcity causes certain marginal (closing) costs ($C_{marg.}$). The study has found that the limit to increasing these costs is the rent assessment of the water source. That is, the marginal costs should not exceed the economic efficiency of water use by the closing water user, whose activity has made it necessary to increase the water resources available for use:

$$C_{marg} = W_r, \quad (9)$$

This indicator significantly affects the composition of water users, accelerating the introduction of technology that increases the economic efficiency of water resource use since, as an experience of the introduction of current standards for paying for water shows, the most conservative water users already have particular difficulties with paying at the full tariff.

The total economic assessment of water (W_t) in the water supply system is determined by the sum of direct (C_{dir}) current and marginal (C_{marg}) costs:

$$W_t = C_{dir} + C_{marg}, \quad (10)$$

In the water supply system, the economic assessment of water consists of production costs, or the cost of water, and the standard profit, which is currently determined for the water supply and sewerage industry in the amount of 30%. The Basic Provisions on the Composition of Production Costs and the Formation of Financial Results at Enterprises and Organizations of Ukraine determine the cost of water.

The full cost of services ($C_{full.wsss}$) of the water supply system includes the following expenses: materials (including reagents for water purification), fuel, electricity, depreciation charges, labor remuneration, salary accruals, reimbursement of maintenance costs for intra-House Networks and engineering structures, shop expenses.

Economic assessment of forest lands. The economic assessment of forest lands should correspond to the maximum national economic effect obtained from forest exploitation. Based on this, the objects of economic assessment of forest lands are wood reserves, resources of side and lifetime use of the forest, and its environmental protection functions. The sum of the components gives an overall assessment of the forest as a type of land with all its resources and valuable functions. Therefore, the assessment of forest lands consists of estimates of wood reserves, products of lifetime and side use of the forest, assessment of recreational function, and in protective forests –their environmental protection role, and is calculated by the formula:

$$R_f = R_{wr} + R_{lif} + R_{min} + R_{en} + R_r, \quad (11)$$

where R_f – economic assessment of forest lands;

R_{wr} – economic assessment of wood reserves;

R_{lif} – economic assessment of lifetime use reserves;

R_{min} – economic assessment of minor forest production resources;

R_{en} – economic assessment of environmental protection function;

R_r – economic assessment of recreational function.

In the case of withdrawal of natural (in this case, forest) resources from economic turnover, the amount of losses caused by the termination of exploitation of these resources is equal to their economic assessment. At the same time, it is necessary to consider only those components of the economic assessment that will be lost during the withdrawal. Losses associated with the conservation of forest lands equal to the economic assessment of the lost economic functions of the forest can be represented as follows:

$$R_f = R_{wr} + R_{lif} + R_{min} + R_{en} + R_r. \quad (12)$$

Formula (12) does not consider the loss of the environmental protection function of the forest since it is not lost in the conservation of forest lands.

The economic assessment of forest land is based on differential rent as the most affordable and universal indicator of the efficiency of using natural resources. Wood reserves are estimated using the following formula:

$$R_{st} = R_{st.ex.} + R_{st.ref.}, \quad (13)$$

where $R_{st.ex.}$, $R_{st.ref.}$ – assessment of wood reserves in the existing stands (in the first cutting cycle) and in the future reference plantings (in the second and subsequent cutting cycle).

The assessment of the existing $R_{st.ex}$ is carried out according to the effect expected at a mature age, reduced by the time of assessment using the following formula:

$$R_{st.ex.} = \frac{r_{dn}}{(1 + \varepsilon)^{T-t}}, \quad (14)$$

where r_{dn} – annual differential rent obtained from the estimated area;

T – cutting age;

t – actual age of stands at the time of assessment;

ε – reduction standard (0.02).

Tables of dynamics of taxation indicators determine the expected stock by the cutting age; taxation descriptions determine the actual age of stands.

The amount of differential rent, taking into account that the economic assessment is carried out not of particular areas (stratum) but of forest lands of the entire farm being evaluated, can be calculated using the following formula:

$$r_{dn} = (Z_w \cdot \gamma_n - I_w) \cdot M_n, \quad (15)$$

where Z_w – marginal costs for the production of 1 m³ of undressed wood;

γ_n – value coefficient of wood stock of the estimated area;

I_w – individual reduced costs for harvesting and growing of 1 m³ of wood;

M_n – actual or expected wood stock at the cutting age.

The value coefficient of wood stock is introduced because the methodology for determining the marginal costs of forest products is based on the assessment of a cubic meter of undressed wood consumed on the farm. The quality (use value) of individual varieties of evaluated stands is considered using value coefficients. The required value

coefficient is found in three inputs: breed, marketability class, and average tree diameter [17].

Individual reduced costs for wood production consist of the costs of harvesting and growing:

$$I_w = I_h + I_g, \quad (16)$$

where I_h – wood harvesting costs;

I_g – costs of growing a forest.

The initial data for determining individual reduced costs for harvesting are planned costs and specific capital investments for harvesting wood, reduced to a comparable form by the following formula:

$$I_d = C_h + E_s \cdot S_h, \quad (17)$$

where C_h – target cost of harvesting 1 m³ of wood;

S_h – specific capital investments;

E_s – standardized coefficients of economic efficiency of capital investments.

The cost of wood growing is not planned since there are no such standards for specific capital investments for wood growing. Therefore, these indicators are determined by calculation using the following formula:

$$I_w = \frac{A_o + E_s \cdot S_f}{\Delta m}, \quad (18)$$

where A_o – the average annual amount of operating expenses for forestry for the prospective period;

S_f – fixed capital stocks for forestry purposes;

Δm – total average annual growth of the stock.

The assessment of the future reference plantings will be as follows:

$$R_{st.ref.} = \frac{r_{dn}}{[(1 + \varepsilon)^{T_{ref}} - 1](1 + \varepsilon)^{T-t}}, \quad (19)$$

where $R_{st.ref.}$ – rent of wood for the reference stand;

T_{ref} – age of cutting the reference stand;

T – age of cutting the existing stand;

t – actual age of the existing stand;

ε – reduction standard.

The peculiarity of this approach to assessment is that the forest is considered from the point of view of future use. Formula (19) enables a total estimate of the wood stock in subsequent cutting cycles (in reference stands). In contrast, the denominator enables to take it into account periodically, once per cutting cycle, starting from the second one, and not consider the time required for growing to the age of cutting the existing plantings. Because forest taxation does not have the characteristics of reference stands for all zones and economic regions of the country and all types of forest-growing conditions yet, it is advisable to use data from tables of the growth rate of normal plantings in calculations.

The assessment of forest land for obtaining products of lifetime use of the forest

is estimated by the formula:

$$R_{lif} = R_{lif.ex.} + R_{lif.ref.}, \quad (20)$$

where $R_{lif.ex.}$, $R_{lif.ref.}$ – assessment of lifetime use resources, respectively, in mature (immature) and in the future, reference the pine stand.

The assessment of lifetime resources in the existing coniferous stand is calculated using the formula:

$$R_{st.ex.} = \frac{r'_{oe} \cdot V'_n \cdot S_2}{(1 + \varepsilon)^{T-t-\frac{\alpha}{2}}}, \quad (21)$$

where r'_{oe} – rent from 1 ton of oleoresin in the existing stand;

V'_{ex} – the amount of oleoresin from 1 ha for the boxing period in the existing stand;

T – the return of cutting of the existing stand;

t – the actual return of the existing stand;

α – boxing period;

S_2 – the area of the existing coniferous stand.

Marginal costs for oleoresin are determined according to the same principles as wood. The initial data for determining the marginal costs of oleoresin are:

- the need for oleoresin;
- the volume of oleoresin consumption in the region;
- the area of forests that can be allocated for cutting;
- average yield of oleoresin per 1 ha of area in the region;
- capital investment to receive 1 ton of oleoresin;
- target cost of harvesting 1 ton of oleoresin.

The source [5] shows numerical values of the differential rent from 1 ton of oleoresin for the main areas of its harvesting. The latter is calculated as the difference between the estimate of 1 ton of oleoresin of the marginal area and the average individual reduced costs for its production in the estimated region. Using the formula (21), estimating the oleoresin contained in coniferous forests in one cutting cycle is possible. The denominator considers the period from the initial moment to the boxing and its duration.

The assessment of lifetime forest use in future reference coniferous forests is carried out using the following formula:

$$R_{lif.ref.} = \frac{r'_{oref} \cdot V'_{ref} \cdot S_1}{(1 + \varepsilon)^{T-t-\frac{\alpha}{2}} [(1 + \varepsilon)^{T_{ref}-\frac{\alpha}{2}} - 1]}, \quad (22)$$

where r'_{oref} – rent from 1 ton of oleoresin in the reference stand;

V'_{ref} – the amount of oleoresin from 1 ha for the boxing period in the reference stand;

S_1 – the area of the reference coniferous stand;

T – age of cutting the existing stand;

T_{ref} – age of cutting the reference stand;

t – actual age of the existing stand;

α – boxing period.

According to equation (22), the resin productivity of forests from the second and subsequent cutting cycles is estimated. The denominator enables to consider the total estimate of products received periodically once per cutting cycle, starting from the second one (in reference forests), and excluding the first cutting cycle.

The assessment of forest land by the output of minor forest products is carried out according to the formula:

$$R_{\min} = \frac{\sum_{k=1}^l r_{nk}}{\varepsilon} = \frac{\sum (Z_{pk} - I_{pk}) \cdot V}{\varepsilon}, \quad (23)$$

where r_{nk} – the annual size of the differential rent, products of the k -th type;

Z_{pk} – marginal costs for the procurement of a unit of production of the k -th type;

I_{pk} – individual reduced costs for the procurement of a unit of production of the k -th type;

V_k – the value of the operational yield of the k -th type;

ε – temporary reduction standard;

$k = 1, 2, \dots, l$ – the type of minor forest products.

Unlike wood stocks, minor forest resources with greater or lesser deviations are used annually, which is considered in the formula's denominator.

The most successful way to calculate the marginal costs for minor forest production is to rank the series by the productivity of forest land and, therefore, by the reduced costs for harvesting a unit of production.

Calculating the sum of possible volumes of harvesting of certain types of products, starting with the most productive land, one can find a marginal section, the inclusion of which in operation will ensure that the needs for this type of product are met. The cost of harvesting a production unit at this site will be marginal.

Local market prices are taken as marginal factors without data on the need for minor forest production. For the economic assessment of minor forest resources, it is advisable to use purchase prices in the region under study as marginal costs. The following formula can determine individual reduced costs for minor forest production:

$$I_m = \sum_{j=1}^m (C_{pj} + E_s \cdot F_{pj}), \quad (24)$$

where C_{pj} – target cost of procurement of the j -th type of minor forest products (current costs for procurement);

E_s – the standard of efficiency of production assets;

F_{pj} – production assets;

$j = 1, 2, \dots, m$ – product type.

Because simple equipment is used for collecting and processing minor forest products, mainly locally manufactured, the product ($E_s \cdot F_{pj}$) is too small, so it is practically not considered in calculations.

The operational yield is an economically available share of the biological yield (average long-term yield). The value of the operational yield, according to experts, is

50 % of the biological one [18].

The most controversial issue is the economic assessment of the recreational functions of the forest. It is proposed, for example, to evaluate them by the lost benefits of using weight as a raw material resource, marginal costs, the difference in the price of land located at different distances from the city, income from tourism, transport costs for visiting forests, reducing the cost of paying for sick leave.

The difference between the marginal and direct reduced costs of farming in recreational forests estimates the recreational function of the forest. The formula for economic assessment of the recreational function of the forest is as follows:

$$R_r = \frac{\left(\frac{C_z}{R_z} - \frac{C_i}{P_i}\right) \cdot P_i}{\varepsilon}, \quad (25)$$

where C_z – reduced costs per 1 ha of the marginal area;

C_i – reduced costs per 1 ha of the estimated area;

R_z – annual load per 1 ha of the marginal recreational area (man/hours);

P_i – annual load per 1 ha of the estimated recreational area (man/hours).

To calculate the marginal costs, it is required to perform the following actions:

- to determine the need for recreational forests for a given city (industrial center), taking into account the availability of other recreational facilities, the size of the urban population, and permissible load rates per unit area;

- to develop a draft of measures to bring certain areas of the forest into a suitable state for recreational purposes;

- to use the method of ranking land plots by the level of reduced costs per 1 person-hour visit to find the marginal area (with the maximum level of reduced costs).

The reduced costs are the sum of current (operating) and one-time (capital) costs, given in a comparable form. Capital expenditures include laying roads, building the most straightforward structures (playgrounds, parking lots for transport, swimming spots, shelters from the rain, and creating a stacked network).

Attendance data is set by calculation, taking into account the permissible loads per unit area or based on actual data.

Due to specific difficulties associated with obtaining the required information, another way to assess the recreational function of the forest is also possible. The assessment is based on the effect that can be obtained as a result of higher labor productivity of persons who use country holidays:

$$R_r = \frac{E_r \cdot N_r}{\varepsilon}, \quad (26)$$

where E_r – average additional effect of one visit to the forest (UAH);

N_r – number of visit days per year.

With an increase in labor productivity by 1 %, the average additional effect of one day of stay in the forest is UAH 1.5 [5]. Despite the approximate nature of such an assessment, because labor productivity depends on many factors, and suburban recreation is not leading and can be obscured by the influence of other factors, more

significant ones, this method enables to conduct of an oriented assessment of the recreational function of the forest, sufficient for planning and design calculations. Forest protection works in the forest fund are shown in Table 5.

Table 5

Forest protection works in the forest fund

Indicators	1990	1996	2016	2017	2018	2019	2020	2021
Total area of forest foci and diseases at the end of the year, ha	343,543	420,470	396,125	418,314	444,462	44,339	506,892	694,321
Protection of the forest from pests and diseases, ha	304,574	289,596	247,318	218,910	186,697	191,889	169,465	169,945
including: by biological preparations	277,994	228,514	199,142	175,619	156,748	178,402	15,098	153,542
chemical preparations	26,580	61,082	4,8176	43,291	29,949	13,487	10,367	16,425
Foci and diseases of the forest by control measures eliminated, ha	131,826	108,195	89,023	87,448	81,936	83,581	63,801	79,436
Death of forest stands, ha	4,020	7,468	18,742	9,552	6,513	8,411	13,630	11,562
including from: damage caused by harmful insects	48	536	721	785	745	544	4,186	392
damage caused by wild animals	192	73	54	25	27	44	43	44
forest diseases	323	1,252	1,301	1,117	1,535	923	2,085	2,050
anthropogenic factors	276	92	61	32	120	81	54	70
of these from: impacts of industrial emissions	15	4	23	-	12	5	2	-
adverse weather conditions	2,024	3,484	6,868	6,803	2,974	3,462	4,442	6,093
forest fires	1,157	2,031	9,737	790	1,112	3,357	2,820	2,913

Source: calculated by the authors according to the data of the State Statistics Service of Ukraine.

The implementation of theoretical and methodological approaches to the economic assessment of elements of the AIP natural resource potential makes it possible to form a system of economic indicators for assessing the economic effect of using natural resources in the agrarian sector.

Development of an information support system for reproduction of the AIP natural resource potential. Environmental monitoring.

Managing the process of reproducing the AIP natural resource potential requires information support – a set of documents, data, methods and means of obtaining them, organizing storage and processing. Economic regulation of the reproduction of the AIP natural resource potential, considered as the management of financial resources of nature management with the help of market economic regulators, provides for the adoption of reasonable specific measures regarding the economic impact on their sources. The types of such influence are diverse: financial, credit, tax, price, etc. This leads to the issue of choosing the most acceptable ones for the existing conditions. However, the solution of this issue is accompanied by difficulties due to the lack of information necessary to justify it. The existence of various concepts and approaches to the development of an economic mechanism for environmental management

generally complicates the work of regional government bodies. There are many situations when the information required to make the right decisions is missing or there is a shortage of it.

The management of information, which is required for the regional environmental and economic system when solving strategic and tactical (operational) tasks, can be carried out using the information support system [2]. This system is created as a means of making decisions at each level of management and helps to identify the production features of a given site occupied by solving a specific problem.

Monitoring provides the removal, collection, transmission and reception of primary information about the state of the environment and the impact of production facilities, the population, and natural processes on it. Monitoring, depending on the purpose, goals, and capabilities of the system, can be continuous, periodic, or episodic. It assumes the availability of methods and means of observation, sources of information, objects and subjects of observation, channels for transmitting and processing information [19].

The state regulation of environmental and economic processes should be based on data from the environmental monitoring. In essence and content, it is the current form of implementation of environmental activity processes using informatization tools, which provides current, long-term assessment and forecasting of the condition of the natural environment, the life of society, the conditions of operation of ecosystems in order to make effective managerial decisions to ensure the environmental safety of society [17]. The state environmental policy provides for:

- rational use of natural resource potential;
- preservation of a favorable human life environment;
- solving a complex of environmental, social and economic problems;
- international environmental cooperation;
- other environmental positions.

The state environmental monitoring system is an integrated information system for collecting, storing and systematizing environmental Information for assessing and predicting the condition of the environment. It serves as a basic basis for developing scientifically based recommendations on the rational use and expanded reproduction of natural resources, making effective managerial decisions at various levels of government, and improving legal and regulatory acts.

It is advisable to carry out environmental monitoring according to a long-term state program that defines coordinated actions of departmental authorities, enterprises and institutions of all forms of ownership. The objects of informatization of the state system of environmental monitoring of the natural environment are the processes of environmental activity, integration at the local (micro) and national (macro) levels.

Enterprises, institutions and organizations that monitor the environment to varying degrees are required to collect and store primary data on the ecological state of the territory indefinitely, process, summarize and provide free of charge in addition to statistical reporting forms, observation data, and other environmental information at

the request of the relevant executive authorities. Based on monitoring data, short- and long-term environmental forecasting is carried out.

An important role in the environmental protection management system is assigned to state cadasters of natural resources. It is impossible to create a single cadaster of all natural resources due to the diversity of natural resources in terms of qualitative and quantitative characteristics. The following cadasters are maintained: state land, water, forest, and wildlife. State registration of minerals, protected and other special objects (natural monuments, nature reserves, national natural monuments, etc.) is also carried out.

Among the main groups of exogenous processes that are a significant subject of observations in the land monitoring system, the following can be distinguished [18]:

- natural (karst, solifluction weathering, waterlogging, etc.);
- natural and economic (erosion, deflationary);
- flooding, overgrowth of meadows and arable land, eutrophication of reservoirs, etc.;
- economic (soil mineralization, destruction of the soil structure, dehumification of upper soil horizons, changes in their pH, degradation and destruction of vegetation, laying down in grass, land pollution by emissions and waste from industrial enterprises; changes in the nature of land use, borders).

Regulations on the functions, competencies, information support of governing bodies, control and monitoring of land at various levels should be legally regulated, and any amendments to them may be made only after mutual settlement, and not unilaterally.

The information base is used for the implementation of environmental expertise, which is regulated by the norms of experts' activities regarding the analysis, verification and evaluation of documentation of objects and decisions on their compliance with the rules and requirements of environmental protection and environmental management in order to prevent possible negative impacts on the environment and ensure its favorable condition. The purpose of environmental expertise is, firstly, to ensure scientifically based compliance of design solutions with modern environmental requirements before their approval in the competent state bodies; secondly, to prevent possible negative impacts of objects on the ecological system; thirdly, to maintain a dynamic natural balance and a favorable state of the environment in the implementation of economic plans of both state and local significance.

Environmental audit. For a successful practical solution to the problems of sustainable economic and environmental development of the regions of Ukraine, it is essential to expand and enrich the funds of the mechanism of economic nature management based on the introduction of new elements of environmental regulation. An environmental audit is one of the most effective tools for economic and environmental control in market conditions. It was developed in economically developed countries (USA, Canada, Great Britain, Germany and the Netherlands) in

the 70s of the twentieth century as a mechanism for managing the environment. At the same time, environmental audits began to develop as a branch of business activity in the environmental industry. These countries have developed environmental audit concepts and adopted national standards and regulations in this area, which is inextricably linked with environmental management.

Environmental audit refers to the business activities of environmental auditors or environmental audit organizations to carry out independent qualified analysis and evaluation of economic activities that affect the environment and develop recommendations for reducing the negative impact on the environment and public health [12; 19].

The audit makes it possible to check the degree of compliance of the process, nature of the activity, procedure, products, and management system with specific criteria – environmental requirements, quantitative or qualitative indicators established by regulatory legal acts of Ukraine in the field of environmental protection. Conducting an environmental audit involves consideration of the following:

- types of activities related to environmental protection, nature management;
- environmental conditions at a production or natural facility;
- environmental management systems;
- compliance with environmental legislation and established environmental requirements;
- use of natural resources;
- waste conservation and recycling process;
- financial risks associated with liability for violation of permissible influence;
- assessment of environmental damage in changing ownership to determine liability for the damage caused.

Environmental audit is carried out to assist business entities in determining their environmental policy, forming priorities for the implementation of measures, including preventive ones, aimed at meeting established environmental requirements, and creating a mechanism for implementing effective regulation of environmental management and ensuring sustainable development.

The objectives of the environmental audit are the justification of the environmental strategy and policy of the enterprise; determination of priorities in planning environmental activities of the enterprise, identification of additional opportunities for its implementation; verification of compliance by the business entity with environmental legislation; improving the effectiveness of regulating the impact of the business entity on the environment; reducing the risk of emergencies related to environmental pollution. The main principles that ensure the effectiveness of environmental audits are shown in Figure 3.

Priority tasks in the development of environmental audit are forming an appropriate regulatory framework, training environmental auditors, organization of work on mutual recognition of environmental auditors in Ukraine and other countries [19–21].

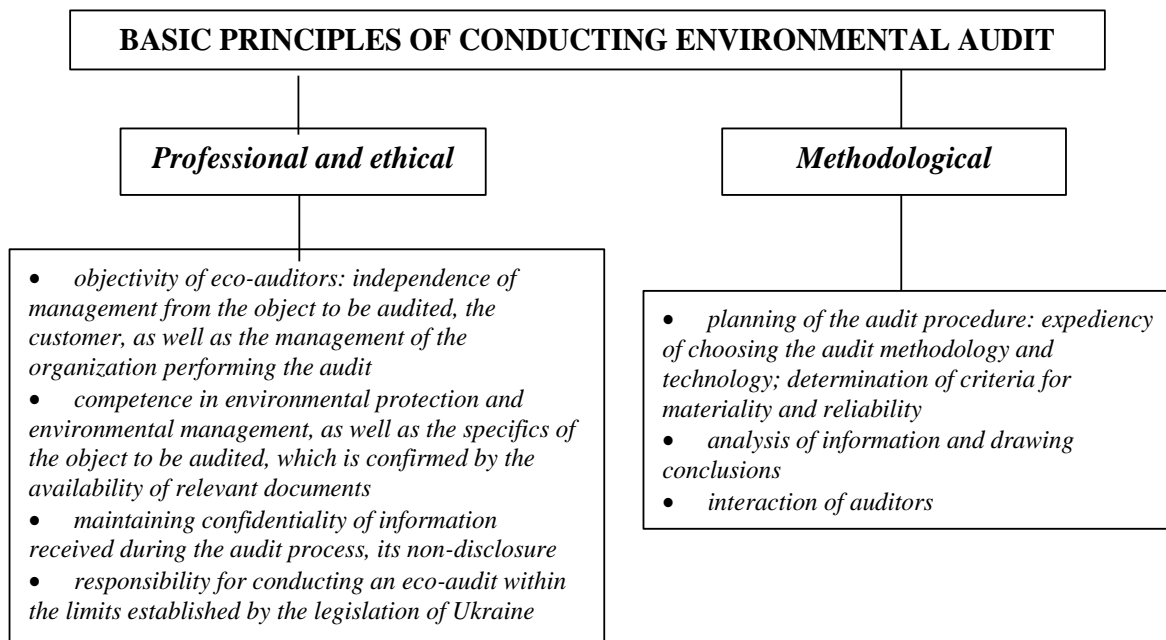


Figure 3. Basic principles of conducting an environmental audit

Source: authors' presentation.

The solution of these promising tasks requires joint partnership efforts of all interested parties to ensure that the directors of business entities realize the feasibility and appropriately assess the advantages of using the environmental audit as a basis for determining and implementing the environmental policy of the enterprise; identification of priorities of environmental protection activities, reproduction of the AIP natural resource potential; identification of additional opportunities for its implementation; efficient and rational use of raw materials and energy while minimizing costs and reducing the risks of emergencies; associated with environmental pollution.

Environmental audit, like any activity, should be considered from the point of view of a systematic approach and a systematic process centered on an independent eco-audit firm or service. Based on a systematic approach to managing environmental audit activities, it is advisable to divide all management stages, depending on the functions performed, into the main blocks: planning, organization, operational management, control and motivation. Environmental audit activity management provides for [15]:

- planning: defining the goals and objectives of an environmental audit, choosing a strategy; developing plans that provide it; defining tactics, policies, rules and techniques, and forming a budget;

- formation of the organizational structure of the service (firm), selection and training of personnel, creation of information, regulatory and material and technical base.

An integral stage of any activity is monitoring its implementation and evaluating the results obtained. In monitoring environmental audit activities, standards, measurements of actual results achieved, fundamental indicators and adjustments are

used if the results obtained differ significantly from the standards [22–25]. At the same time, possible deviations are recorded, results are measured, and information is evaluated. In managing environmental audit activities, it is advisable to use the following main types of control: preliminary, current and final.

Comprehensive control should timely identify the quality of economic and environmental managerial decisions even before losses occur since excess production costs (including due to environmental pollution) or the output of environmentally polluted products lead to the loss of sales markets.

Information passport for an environmental facility. The information passport for an environmental facility may be either in the form of an output document that systematically describes this facility and contains specific values of indicators or in the form of an initial input form intended for collecting information on a facility not previously collected at all or partially collected. Each section of the passport should not only characterize the facility's state at a given time but also provide an opportunity to assess the prospects for changes in specific indicators based on statistics of changes in indicators for previous years, which are contained in the passport. The data reflected in passports are mainly intended for medium- and long-term decisions and, therefore, should be stable over time (aggregated). Their content should correspond to the available indicators of annual statistical reporting.

The subject of certification may be any element of the hierarchy of the nature management system. At the same time, it is necessary to consider one of the essential principles of creating a passport system, which consists of the fact that a set of subsystem objects of the same level defines an object (system) of a higher level. According to the system approach, the transition from one hierarchical level to a higher one leads to the appearance of new qualities of the facility, aggregated indicators and parameters inherent in this level. All passports of facilities of the nature management system shall be linked by their data at all levels of management [26].

To ensure regular periodic updating of information that is contained in the passports of facilities of the nature management system, it is necessary to develop an organizational structure for collecting information and passport forms, determine the provisions that fix the procedure for collecting data and maintaining passports, the degree of responsibility of persons involved in drawing up passports. Updating the information contained in the passports of higher-level facilities should be combined with the introduction of these passports at lower-level facilities.

The legality of documents used in the collection of information for passports, as well as forms for issuing the results of its processing, is drawn up by the relevant legal acts.

For regional regulation of nature management and making informed decisions in managing financial resources of natural resource use, the information basis is the environmental and economic passport of the territory, the content of which should reflect the range of issues and problems that are most acute in this region. However, the basic principles and methodological approaches to forming a territory passport

should be uniform. This package of documents should reflect the following information:

- industrial and production potential and infrastructure of the region;
- natural resource potential;
- anthropogenic load on the environment, its component structure (atmosphere, water, land, forest resources), sources and nature of the impact, recipients;
- regional development prospects;
- environmental protection measures, resource conservation and rational use of natural resources, prevention of deterioration of their quality;
- regulatory framework for nature management, including economic standards (payments, tax rates, prices for certain types of natural resources); environmental standards for emissions, discharges and placement of harmful substances in the natural environment; sanitary standards, principles for establishing sanitary protection zones and placement of harmful industries;
- economic, legal and other conditions for the functioning of the natural and economic system of the region;
- special conditions, the significance of individual facilities and features of the region.

The environmental and economic passport of the region, in its essence, is a strategic program for the development of the territory, the implementation of which is maximally adapted to the conditions when goals, tasks, activities, sources of funding, and performers are connected in an integral unit. A territory's environmental and economic passport should consist of three main blocks: information, organizational and economic, and problem-based.

1. *The information block* contains the entire system of environmental and economic parameters and fixed annual values of the required indicators. The initial data for forming this block may be the results of environmental monitoring, weather climate observations, a study of pollution sources and their certification, data from environmental services, projects of maximum permissible emissions (MPE), maximum permissible discharges (MPD) and other documents.

2. The basis of *the organizational-and-economic block* consists of two sections: cost assessment of production and economic activities of enterprises and their impact on the environment; analysis of financial and economic activities of enterprises and regional infrastructures, which includes the main environmental and economic indicators of their production and economic activities. An independent division may be information about payments of enterprises to the regional environmental fund, the mechanism for determining their amount, and the procedure for determining them.

3. *The problem-target block* of the passport reveals, evaluates and enables to rank environmental problems in the region by their degree of urgency. It should clearly define goals for future periods. Goals are formed based on the results of the expert examination analysis. When compiling this block, special attention is paid to market methods of managing the program's implementation and, above all, an economic

interest in the performance of specific tasks by all parties and participants.

Conclusions. The AIP natural resource potential category is further developed in the study. The state of natural resource potential is one of the most critical factors for the effective development of agro-industrial production. The main types of AIP natural resource potential include land resources, forest lands, water resources, and mineral resources. The predominant types of nature management in AIP are land and water use. The primary, non-alternative way to solve the problems of preserving and reproducing the AIP natural resource potential is the greening of agro-industrial production, the main tasks of which are to introduce resource-saving technology in the processing complex, alternative farming systems with a restriction on the use of chemical methods to increase fertility and protect plants, taking into account the assimilation capabilities of the agrarian sphere.

The research outcomes show that it is advisable to introduce indicators of the rational use of resources and their reproduction for the main components of natural resources and structural elements of the AIP production potential. They can reflect the ratio of the actual size of resources to the maximum calculated size of their reserves, considering the possible use of alternative raw materials. The study proves that economic assessments of the agrarian sector's production potential should consider priority assessments of the existing territorial natural resource potential, considering the formation of its component – the natural and man-made potential of resource use.

The principles and methodological bases of economic reproduction of the AIP natural resource potential are generalized, scientific and practical aspects of the formation and operation of the organizational and economic mechanism for stimulating the reproduction of the AIP natural resource potential as a system of organizational, economic and environmental levers and methods have been further developed. One of the directions of implementing the structure of state management of the process of reproduction of the AIP natural resource potential is proposed to develop the powers of the regional agricultural department through the creation of an inspectorate, whose tasks are forecasting, monitoring the state, software for the economic strategy for the reproduction of the AIP natural resource potential.

The mechanism of financial and economic incentives for agricultural land users to implement land protection measures should be based on a system of methods of direct and indirect incentives. A siding system of economic incentives for land protection should be developed based on a preferential tax regime, various types of soft credit, and other methods that enable one to perform work without allocating funds from the budget due to the accumulation of agricultural producers' resources. In the context of a budget deficit, such a system should be the leading one; with the improvement of the economic situation in the practice of agricultural and environmental management, it is necessary to actively involve methods of direct economic incentives based on the provision of subsidies, compensation on an irrevocable basis and provide agricultural land users with a level of income sufficient not only to organize the next production cycle but also to capitalize a certain part of

them.

It is established that an integrated approach to the reproduction, preservation and strengthening of the AIP natural resource potential will contribute to improving the efficiency of agricultural production and the standard of living of citizens; improving the financial results of agricultural enterprises, their competitiveness that requires further research.

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