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ASSESSMENT OF FOREST ENTERPRISES' PERFORMANCE: INTEGRATING ECONOMIC SECURITY AND ECOLOGICAL IMPACT*

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Abstract. At the stage of the strategic or tactical managerial decisions justification, it is important to choose the right approach, verify proper information sources, develop methods to identify the status of the enterprise. The mentioned prerequisites necessitate the development of methodological tools for the formation of appropriate information and analytical support. The *aim* of the study is to substantiate the methodology of assessing the ecological and economic security of forestry farms and to test this methodology basing on the data received from state forestry enterprises. The *subject* of the study is the methodological aspects of developing the methodic for assessing the ecological and economic security of forests, taking into account the peculiarities of their functioning as complex ecological-economic systems. The latter determines the essence of the hypothesis, which requires the use of an integrated indicator for assessing the security of forestry enterprises, taking into account interdependent and interconnected economic and environmental components. Methodic for assessing the ecological and economic security of forest holdings is a sequence of stages that ensure the formation of an information base for the research; selection of indicators; their processing using component, index, normative methods; interpretation of the results of calculations. The authors specify the content of the main terms: ecological, economic, financial, techno-technological, social security, safety of forest use, reforestation, forest protection activity. The methodic has been tested on the data from forest enterprises in Volyn and Rivne regions of Ukraine. The authors obtained adequate results, which indicate a high and satisfactory level of ecological and economic security of these enterprises in 2017. The strengths and weaknesses of the enterprises and the factors that influenced them were revealed. The methodology for assessing ecological and economic security is a tool for obtaining the necessary information about the status of the enterprise in order to substantiate practical recommendations for the further development of forestry as a coherent and stable system.

Keywords: assessment; ecological and economic security; forest resources; forestry

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1. Introduction

The current state of affairs in the world economy can be classified as openly anthropocentric. Consumer attitudes towards economic growth and macroeconomic equilibrium have become the cause of antagonisms in the system of "society – nature". In connection with this, the last decades have been marked with the intensive development of new scientific fields such as environmental economics, economics of natural resources, sustainable development economics, "green" economics, which form a modern view of the principles, forms and directions of enterprises development, economic spheres of activity, for individual territories and society in general in order to ensure economic and environmental security. The latter involves the development of methodological foundations for the study of the status of enterprises applying the aggregated criterion of ecological and economic security.

The need to develop methodological approaches to assessing the ecological-economical security of forestry enterprises is particularly urgent since their economic activity is based on the use of forest resources and includes very specific activities such as forest growing, reforestation and forest protection.

In our research, the essence of ecological-economic security of an enterprise is considered as a state of its protection from negative influences due to internal stability, self-identity, integrity, flexibility and adaptability, which provides the ability for stable development, realization of the set goals, achievement of desirable results without harm to the environment, preservation of resource and assimilation potential of the environment.

Ecological security in the enterprise management system should be considered as a criterion for making strategic decisions regarding a number of factors: ensuring compliance of all enterprise's operation aspects with the requirements of the current environmental legislation and national and international environmental standards; provision of ecological rehabilitation and reproduction of disturbed forest ecosystems; use of environmentally sound technologies; training of specialists who take ecologically-motivated management decisions; application of ecological management in the system of enterprises management; formation of an effective system of informational and analytical support for environmental safety management.

The aim of the study is to elaborate and substantiate the methodology of assessing the ecological and economic security of forest holdings. To achieve this goal, the following tasks are set: to review the existing approaches to assessing the economic and environmental security of the enterprise; clarify the conceptual apparatus of the research; to develop a methodology for assessing the ecological and economic security of forest enterprises; to carry out its testing; comment on the results.

2. Scientific sources review

The joined concept of ecological and economic security has not been studied. Most works are dedicated either to economic or environmental security separately. Environmental security is often considered as a component of the national security, and the research concerns certain spheres of activity (nature use, separate technologies,

enterprises, directions of economic activity, regions), therefore methodological approaches to the evaluation differ significantly.

In particular, the researchers of the Institute of Natural Resources and Sustainable Development of the National Academy of Sciences of Ukraine (Khvesik et al., 2014) elaborated the scientific basis for the study, carried out a comprehensive analysis and evaluation, grounded the strategic directions of ensuring ecological, natural and technogenic security of Ukraine and its regions in the context of European integration processes; defined priorities and developed financial and economic mechanisms for ensuring environmental security at the regional level.

A. Kubaenko (2018) considers the conditions and scenarios of changes in the national economy as a result of European integration in the context of Ukraine's economic security revitalization. N. Ilysheva, E. Karanina and others (2017) devoted their work to revealing the interdependence of economic development and environmental indicators in industry. L. Nikolenko, E. Jurakovskiy and others (2018) investigated the role of the managing investment policy of the Ukraine's agrarian sector economic security on the basis of the theory of fuzzy logic. V. Bogdanov, N. Ilysheva and others (2016) proposed a model for the ratio of economic development and environmental indicators using enterprise's non-financial reporting data. V. Artyushok (2012) has developed the criteria for the forestry enterprise's activities compliance with the strategic mission and the objectives that determine the environmental, economic, and social sustainability.

The methodology by S. Dovbnya, N. Gichova (2008) diagnoses the level of current security by identifying the bankruptcy symptoms based on the assessment of the financial and economic status of the enterprise in terms of financial independence, asset liquidity, cash flows, business activity and profitability of the enterprise. V. Prypoten (2013) proposed an approach to assess the threats to the ecological and economic security of an industrial enterprise on the basis of comparison of possible losses from the ecological-economic risk with marginal levels of risk. M. Domashenko et al. (2014) developed an approach to assessing the level of environmental and economic security of the enterprise's foreign economic activity on the basis of a comprehensive indicator that takes into account the value of the enterprise's potential for foreign economic activity, the level of country risk when entering the external market, the level of market opportunities of the enterprise, and the environmental friendliness of foreign economic activity. L. Hromushyna (2011) developed an integral-criterion indicator of the ecological and economic security of agricultural enterprises development, which envisages economic, ecological and social criteria for assessing the level of agricultural enterprises' security in points, allowing to refine the factors that determined the result. M. Nikitina et al. (2018) apply a systematic approach to the analysis of the impact of investment activity on economic security; offered indicators of the investment component in economic security. A. Kuklin, L. Kuklina, I. Korobkov (2018) developed criteria for the diagnostics of region's eco-economic security. J. Tagiltseva, N. Drozdov (2017) substantiated the indicators monitoring socio-ecological-economic security of management environmental.

J. Zemguliene, M. Valukonis (2018) conducted an analysis of scientific literature by the structured literature review method to identify business processes effective tools and methods of assessment and evaluation. J. Narkunienė, A. Ulbinaitė (2018); S. Hilkevics, V. Semakina (2019) studied and compared modern evaluating methods of the company's performance, and concluded that it was necessary to create a multi-criteria indicator evaluation method. A. Bilbao-Terol et al. (2019) had substantiated the need for multi-criteria methodology to integrate the corporate social responsibility assessments and companies' financial indicators in a unique dimension of global sustainability productivity; M. Yevdokimova et al. (2018), A. Hasanudin et al. (2019) have considered similar multi-criteria methodology on the basis of sustainable development.

The study of scientific works allowed to make a number of generalizations.

1. The main approaches that can be used to assess ecological and economic security are:

- indicator based, relies on a system of indicators which describe the status of various components and levels of ecological and economic security;
- resource based, where the main criterion for assessing ecological and economic security represents the efficiency of existing resources usage by the enterprise;
- efficiency based, where the main criteria are to reduce costs and losses, increase profitability;
- systemic, which allows to combine all the above, but has a significant advantage as a research tool, since it allows to consider ecological and economic security as a complex holistic system, to identify internal and external links, developmental problems.

2. The reliability of approaches to the assessment of ecological and economic security can be determined on the basis of criteria selected as the initial indicators, assessing the qualitative and quantitative parameters of the objects under study. Among such criteria are: general economic effect, level of profitability, financial independence and solvency; security of basic business processes; the level of competitiveness, an integral security criterion, which includes the most important resource components of the enterprise, the stability of ecosystems.

3. The most commonly used methods of assessing the ecological and economic security of an enterprise are: component (involves identifying factors that affect the level of environmental and economic security of the enterprise); index (allows you to apply different indicators in one set); expert; comparison based (comparison of the values of individual groups of similar security indicators among themselves); normative; estimated (provides a quantitative assessment of ecological and economic security on the basis of a system of indicators obtained both theoretically and empirically).

4. These methods are basic for assessing the level of economic security. Despite the differences in application of different systems of indicators, the fundamental difference is determined by the criterion underlying the methodology.

Scientific works analysis has shown that in each method of economic or environmental security study, the researchers should take into account the specifics of a particular sphere, the direction of activity, various aspect of security, the level of the object under research. Therefore, there is a need for the development of existing findings, taking into account the specifics of the forest holdings functioning.

3. Clarification of the conceptual apparatus

The study of various approaches to the definition of the economic entity's security, allows for the following generalizations: most often it is considered as a status of the enterprise; the result of effective management activity; condition of stable development. For the basis of this research we will adopt the following interpretation of the ecological and economic security: the internal ability of the object to withstand the threats, ensuring the realization of their own interests and goals while preserving the existing or achieving the desired parameters, without causing damage to other objects in the short and long term; a result of dedicated activity to preserve its identity, integrity, qualitative parameters and ability to purposeful development (L. Cherchyk, 2016).

The meaningful content of the ecological and economic security of the company is defined by its components, for the purpose of the specification, a functional approach has been applied. In our opinion, the economic security of forestry is most influenced by financial, technical and technological, social, nature-resource factors, which respectively form the financial, technical, technological, and social. We consider the financial security of an enterprise as its financial condition characterized by sufficient amounts of financial resources to provide effective and sustainable development. Technical and technological security is the status of production process' technical and technological component protection, which creates conditions for efficient and rational use of technics and

technology, their updating in order to ensure a high level of enterprise’s competitiveness.

We consider the social component of the enterprise’s economic security as a level of social and labor relations development, which ensures the interests of employees and the enterprise (its owners), achievement of the of professional and personal development goals on the basis of mutually beneficial partnerships, ensuring an adequate standard of living, income, working conditions etc.

Ecological security becomes especially relevant for environmental enterprises, since their economic efficiency in the long run is largely determined by the environmental policy of the enterprise, implementation of the principles of non-exhausting and reproducible use of forests. Its main components are forestry security, forest rehabilitation, forest protection. The essence of forest use security can be formulated as a state of ensuring the economic activity of the enterprise with natural resources, which allows achieving the goals of development in the conditions of their rational use. Forest regeneration security is determined by the faster pace of artificial and natural reforestation of forest areas in comparison with the rates of forest cutting. The security of forest protection activities relies on the ability to preserve the quality of the forest ecosystem in which the enterprise operates (A. Cherchyk, 2016).

4. Research methodology

The ecological and economic security assessing methodology includes the following steps:

- 1) definition of indicators’ groups to be included in the assessment;
- 2) definition of approaches to indicators standardization;
- 3) standardization of indicators for the purpose of transition to indices (for each group);
- 4) determination of approaches to the calculation of group indexes;
- 5) assessment of the ecological and economic security of the enterprise by its main components (groups of indicators);
- 6) determination of the integral index of ecological and economic security;
- 7) formation of a scale of ecological and economic security levels;
- 8) determination of the level of ecological and economic security on the established scale;
- 9) interpretation of the results of the evaluation, verification of their reliability and formulation of conclusions.

As it was noted, the main groups of indicators are: financial, technical and technological, social, forest resources restoration and use, forest protection activities. Consequently, the assessment of the company’s environmental and economic security implies the use of the hierarchical system of indicators: local (unit), group, integral, presented in Table 1.

Table 1. Indicators for assessing the economic security of forest holdings

Group	Single Indicators	Formula of calculation
Financial security	Absolute liquidity ratio	Cash / current liabilities
	Turnover rate of current assets	The ratio of net income from sales to the value of current assets
	Coefficient of financial stability	The ratio of own funds to borrowed
Technical and technological security	Fixed assets suitability ratio (FA)	Amount of FA wear / initial value of FA by the end of the year)
	Material return	The ratio of net income from sales to the amount of material costs
	Return on assets	The ratio of the cost of products to the annual average cost of FA
Social security	Coefficient of the staff’s material needs satisfaction	The ratio of the average monthly salary of an employee to its minimum level in the country
	Personnel stability factor	Fluidity coefficient (the ratio of the number of abandoned

		workers due to disrespectful reasons to the average number of staff members)
	Rate of security from injuries and occupational diseases	The ratio of the number of workers who received injuries and the diagnosis of occupational disease due to harmful working conditions to the average number of employees
Forest Resources Recovery Indicators	Indicator of artificial reforestation	The share of artificial reproduction of forest areas in the total felling area
	Indicator of natural reforestation	The share of natural forest renewal in the total felling area
	Forest care indicator	The share of care cuttings in the total felling area
Forest Resources Use Indicators	Coefficient of actual use of the estimated forest sector	The ratio of the actual volume of harvested wood to the volume of the established felling area
	Indicator of output of harvested liquid wood within the limits of main use cuttings, cubic meter. m / ha	The ratio of volumes of harvesting of liquid wood to the area of cutting of the main use
	Coefficient of cutting of the main use	The ratio of the area of the main cuttings to the total felling area
Indicators of forest-protective activity	Indicator of loss of timber due to illegal logging	The ratio of illegal felling (in cubic meters) to the estimated forest felling area
	Indicator of loss of wood due to fires	The ratio of burned and damaged forest (in cubic meters) to the estimated forest area
	Indicator of forests revitalization	The share of sanitary felling in the total felling area

Source: Developed by A. Cherchyk (A. Cherchyk, 2016).

We propose the standardization of individual indicators as the definition of comparative indices within each subgroup. For indicators-stimulants, the index is calculated by the formula:

$$I_{nc} = X_i / X_{max}, \quad (1)$$

where X_i – i-is a value of the indicator in the sample;
 X_{max} – maximum value of the indicator in the sample.

For indicators of disinfestation, namely the indicator of loss of wood due to illegal logging and the loss of wood due to fires, the index is calculated by the formula:

$$I_{nd} = 1 - X_i, \quad (2)$$

where X_i – i-is a value of the indicator in the sample.

Such an approach ensures the transformation of disinfestant indicators into a positive status, which allows us to calculate the total index of forest activities security. Logically, if $X_i = 0$, the index is taken equal to 1, because there was no negative event. The model for determining the integral indicator of ecological and economic security will be as follow: the group indices are defined as the sum of the individual, divided by their number; Integral index of ecological and economic security of an enterprise is defined as the sum of groups, divided by their number.

Interpretation results of the evaluation involve the transfer of quantitative indicators to qualitative security features (high, sufficient, low, critical). The higher is an integral index value, the higher is the level of ecological and economic security of the enterprise. Based on Harrington's desirability function, the threshold values of the levels of ecological and economic security are set forth. Harrington's classic scale provides for the allocation 5 levels attribute quality: very high 1,00-0,81; high 0,80-0,64; sufficient 0,63-0,38; low 0,37-0,21; critical 0,37-0,21; S. Dovbnya, N. Gichova (2008) applied the scale of the four levels that we took as a basis (Table 2).

Table 2. The scale of indices intervals for the levels of the enterprise's ecological and economic security

The level of ecological and economic security of the enterprise	Indicators Value
High	1-0,75
Sufficient	Less than 0,75 till 0,5
Low	less than 0,5 till 0,25
Critical	less than 0,25

Source: Developed on the basis of Harrington's desirability function (Harrington, E. C., 1965; Dovbnaya, S., Gichova, N. 2008).

Therefore, the developed methodology allows determining the level of ecological and economic security of the enterprise in general and in terms of its components, which will enable to identify weaknesses and effective tools for managing ecological and economic security.

5. The approbation of the methodology for assessing the ecological and economic security of forest holdings. Results. Comments.

The approbation of the methodology for assessing ecological and economic security was carried out on the data from two forest farms in Volyn region (state enterprise "Kamin-Kashyrsk forestry", SE "Manevychi forestry") and two in Rivne region (SE "Klesiv forestry", state enterprise "Sosniv forestry").

The main criteria for choosing forest holders were the area and forest cover of their territory, since, in our opinion, these are objective indicators for the development opportunities of these enterprises, which determine the starting conditions for economic activity. The mentioned companies have the largest area (about 50 hectares) and forest areas (30-36%) among forestry enterprises in these regions.

The forests of these state forestry enterprises are located within the Northern geographical and climatic zone of Ukraine and on the border of the transition to the forest-steppe. The main species are Scots pine, oak, English oak, birch. In addition, forest crops of black spruce and alder, birch and Northern oak are being developed. The main activities of forestry enterprises are reforestation, forestry and logging; provision of services in forestry; sawmill and production planing, wholesale trade in wood. Economic activity of these enterprises is aimed at rational and efficient use of forest resources, as well as maintenance and improvement of soil protection, sanitary and hygienic, health, aesthetic and useful functions of the forest.

More than 60% of the forestry products are exported. In actual prices in percent of the total amount in Ukraine the production volume of forestry constitute: in Volyn region – 6%, in Rivne region – 14%.

Output data which described activities of the forestry and are used to calculate ecological and economic security are displayed in Table 3.

Table 3. Criteria for selection of forestry enterprises to assess the level of ecological and economic security

Forestry indexes	Kamin-Kashyrsk	Manevychi	Klesiv	Sosnivsk
Area of land permanent use, thousand, ha	49,9	52,2	54,6	49,8
Cash, thousand hrn	46	7973	4040	3685
Current liabilities, thousand hrn	10143	7049	6510	12039
Net income from sales, thousand hrn	62611	124735	231345	126267
Value of current assets, thousand hrn	7378	16872	6601	5332
Own funds, thousand hrn	9531	38101	18718	8174

Borrowed, thousand hrn	10194	8518	14822	17013
Cost of fixed assets, thousand hrn	8817	28011	26569	17943
Amount of material costs, thousand hrn	13952	24298	95734	43637
Average number of staff members, persons	176	421	517	470
Average monthly salary of an employee, thousand hrn	7,914	9,1	12,587	9,523
Total felling area, hectares	2119	2571	2829	2037
Artificial reproduction of forest areas, hectares	157	253	459	479
Area of the natural renewal of the forest, hectares	251	409	414	97
Actual volume of harvested wood	106628	156830	166472	157874
Illegal felling, cubic metres	29	52	286	40
Area of the main cuttings, hectares	147	383	379	230
Volume estimated forest felling area, cubic metres	45340	89230	78800	64180
Volumes of burned and damaged forest, cubic metres	0	0	0	0
Area of sanitary felling, hectares	1504	1731	1643	1087
Net profit, thousand hrn	193	4631	1765	1523

Source: According to the company's reporting documentation.

The data for assessing the ecological and economic security of forest enterprises is based on the reporting documentation. The evaluation results are shown in Table 4.

Table 4. Indicators of ecological and economic security of forest farms in 2017

Indexes	Kamin-Kashyrskyi	Manevycke	Klesivske	Sosnivske
Indicators of financial security				
Absolute liquidity ratio	0,005	1,131	0,621	0,306
Turnover rate of working capital	8,486	7,393	35,047	23,681
Coefficient of financial stability	0,944	4,473	1,263	0,480
Indicators of technical and technological security				
Fixed assets suitability ratio	0,49	0,478	0,44	0,57
Return on assets, ths. UAH	6,39	4,387	7,89	7,30
Material return, ths. UAH	4,49	5,13	2,42	2,89
Forest holdings social security indicators				
Coefficient of staff's material needs satisfaction	2,473	2,844	2,7	2,976
Personnel stability factor	0,784	0,86	0,8	0,655
Rate of safety from injuries and occupational diseases	1	1	1	0,998
Indicators of forest resources restoration				
Indicator of artificial reforestation	0,074	0,098	0,162	0,235
Indicator of natural reforestation	0,118	0,159	0,146	0,048
Forest care indicator	0,212	0,111	0,280	0,292
Indicators of forest resources use by forest enterprises				
Coefficient of the estimated actual use of the forest sector	0,634	0,875	0,930	0,863
Indicator of the harvested liquid wood output within the limits of main use fellings, cubic meter. m / ha	195,69	203,83	193,30	265,60
Coefficient of fellings of main use	0,069	0,149	0,134	0,113
Indicators of forest protection activities by forest enterprises				
Indicator of timber loss due to illegal logging	0,0006	0,0006	0,0036	0,0006
Indicator of timber loss due to fires	0,0000	0,0000	0,0000	0,0000
Indicator of forests improvement	0,710	0,673	0,581	0,534

Source: Calculations A. Cherchuk.

The absolute liquidity ratio should be in the range of 0,2-0,35, the optimal value was observed only in Sosnivsk forestry. In the Kamin-Kashyrsk region, this indicator was significantly lower than the normative value meaning

that enterprise is not able to liquidate short-term debt at the expense of cash; in Manevychi and Klesiv forestries the indicator is much higher than normative value. Turnover of circulating assets is low, which can be explained with peculiarities of forestry business. The value of financial stability ratios should be higher 1; the financial status of Klesiv and Manevychi forest enterprises was stable, and in other two cases it was not.

The technical condition of the main production assets by the coefficient of fitness is low due to the expiration of the normative term of use. Return on assets is low throughout the industry. Of the enterprises under investigation, the best indicators are in Klesiv forestry. However, the material output of products is also low, which indicates the inefficient use of harvested forest resources.

The coefficient of staff's satisfaction with material needs, which indicates how many times the wages of forestry employees are higher than the minimum, was the highest in the Sosnivsk forestry. The staff stability rate is high enough, despite the seasonality of the work, which involves the adoption, and then the release of staff, mostly labor workers. The security of working conditions in the most critical form is characterized by the indicators of injuries and occupational diseases due to the influence of negative productive factors. In most of the forest enterprises, the security factor from injuries and occupational diseases was 1, which indicates the absence of the latter. One traumatized worker was reported by Sosnivsk forestry.

The Indicator of artificial reforestation characterizes the level of the total area of felling coverage thanks to the planting and sowing of the forest. In the analyzed period, it is low in all forestry enterprises and is, on average, 15-20%. The indicator of natural reforestation characterizes the level of the total area of felling coverage by means of natural regeneration of the forest promotion. This indicator was higher than the artificial restoration index in Kamin-Kashyrsk and Manevychi forestry's. In sum, these types of works ensure the reproduction of forests by 25-30%. The indicator of forest care characterizes the share of cuttings, desalination, landscape formation, etc. in the total areas of felling. These works contribute to the creation of conditions for better growth and the formation of forest stands. The indicators are quite high and indicate a large amount of work on forest care. They cover an average of 30% of the total felling area.

Indicators of the forest resources use by the forest enterprises, characterizes the productivity of logging activities in natural terms. The coefficient of actual use of the estimated forest plot indicates its almost full use in the Klesiv forestry. The lowest indicator is in Kamin-Kashyrsk forestry. The rate of harvested liquid wood output within the framework of the main use was the lowest in the Klesiv forestry, and the highest is Sosnivsk forestry. The main use cutoff factor, which characterizes their share in the total volume, was the largest and accounted for almost 15% in Manevychi forestry.

Indicators of forest protection activities by forest enterprises, contains two indicators of ecological-economic security stimulants (loss of wood, loss of forest stands), and the index of forests improvement. As we see, there were no significant losses from illegal logging and fires. The worst situation was due to the loss of timber due to illegal logging in Kamin-Kashyrsk forestry in 2015, Olevsk – in 2016-2017, Klesiv – in 2017. As a result of fires, Kamin-Kashyrsk forestry in 2015 achieved the largest loss of wood, Manevychi – in 2015, Klesiv – in 2014. Indicators for improving the forests were very different even in some forest farms within five years. In particular, in Kamin-Kashyrsk forestry this indicator ranged from 0,249 in 2015 to 0,710 in 2017, Manevychi – from 0,175 in 2015 to 0,673 in 2017. The most stable and high indicators were in Nizhyn and Klesiv forestries.

Indices of forestry companies' ecological and economic security indicators for 2017 are shown in Table 5.

Table 5. Indices of forestry companies ecological and economic security indicators in 2017

Indexes	Kamin-Kashyrskiyi	Manevycke	Klesivske	Sosnivske
Indices of financial security				
Absolute liquidity ratio	0,004	1,000	0,549	0,271
Turnover rate of working capital	0,242	0,211	1,000	0,676
Coefficient of financial stability	0,211	1,000	0,282	0,107
Indicators of technical and technological security				
Fixed assets suitability ratio	0,860	0,839	0,772	1,000
Return on assets	0,810	0,556	1,000	0,925
Material return	0,875	1,000	0,472	0,563
Forest holdings social security indicators				
Coefficient of staff's material needs satisfaction	0,831	0,956	0,907	1,000
Personnel stability factor	0,912	1,000	0,930	0,762
Rate of security from injuries and occupational diseases	1,000	1,000	1,000	0,998
Indicators of forest resources restoration				
Indicator of artificial reforestation	0,315	0,417	0,689	1,000
Indicator of natural reforestation	0,742	1,000	0,918	0,302
Forest care indicator	0,726	0,380	0,959	1,000
Indicators of forest resources use by forest enterprises				
Coefficient of the estimated actual use of the forest sector	0,682	0,941	1,000	0,928
Indicator of the harvested liquid wood output within the limits of main use fellings, cubic meter	0,737	0,767	0,728	1,000
Coefficient of fellings of main use	0,463	1,000	0,899	0,758
Indicators of forest protection activities by forest enterprises				
Indicator of timber loss due to illegal logging	0,999	0,999	0,996	0,999
Indicator of timber loss due to fires	1,000	1,000	1,000	1,000
Indicator of forests improvement	1,000	0,948	0,818	0,752

Source: Calculations by A. Cherchyk.

The results of the indices calculations indicate their significant differences in the structure of financial security of forests and the restoration of forest resources.

The calculation results of the group and integral indices of ecological and economic security are reflected in the table 6.

Table 6. Calculation results for the group and integral indices of ecological and economic security in specified forestries in 2017

Indexes	Kamin-Kashyrskye	Manevycke	Klesivske	Sosnivske
Financial security group index	0,153	0,737	0,610	0,351
Technical and technological security group index	0,848	0,798	0,748	0,830
Social security group index	0,914	0,985	0,946	0,920
Forest resources renewal group index	0,594	0,599	0,856	0,767
Forest resources use group index	0,627	0,903	0,876	0,895
Forest protection activities group index	0,999	0,982	0,938	0,917
Integral index of ecological and economic security	0,689	0,834	0,829	0,780

Source: Calculations by A. Cherchyk.

The level of financial security in the Kamin-Kashyrsk region was critical; in Manevychi and Klesiv forestries it was sufficient, and in Sosnivsk forestry it was low. The level of technical and technological security of forest holdings is high. In our opinion, this is due to the same type of provision of forestry facilities by main means, their approximately the same structure, the same rate of wear. This led to a low discrepancy in the indicators, and hence high indices. The level of social security is steadily high. This is due to relatively high wages, low levels of injuries and satisfactory working conditions.

The Group Forest Resources Recovery Index shows a high level of security in the Klesiv and Sosnivsk forestries and satisfactory levels in Kamin-Kashyrsk and Manevychi forestries. The Group Forestry Use Index indicates a high level of security in all, except for Kamin-Kashyrsk forestries, where it was satisfactory. This result is due to small differences in actual data on logging, as well as a fairly high level of productivity of logging operations. Group indices of forest protection activity at all forestry enterprises were high. In 2017, the integral index of ecological and economic security showed a high level in Manevychi, Klesiv, Sosnivsk forestries, and satisfactory level at Kamin-Kashyrsk forestry.

Thus, approbation of the methodology allowed to determine the integral level of ecological and economic security of enterprises in general and in terms of its components, which makes it possible to identify the strengths and weaknesses in terms of enterprises' activities. The obtained results can be used to substantiate the strategy of providing ecological and economic security of the enterprise and substantiate tactical management decisions.

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Conclusions

The achievement of the enterprise development goals depends to a large extent on the correctness of the chosen strategy, the effectiveness of its implementation, the timeliness of making managerial decisions to adjust the strategy. At the stage of the strategy or tactical managerial decisions justification, it is important to choose the right approach, sources of information, methods of its processing in order to identify the status of the enterprise. This is ensured by assessing the company's ecological-economical security in order to provide early warning and response to changes and further adjusting actions, developing measures to prevent the development of negative changes.

An overview of existing scientific approaches to assessing the ecological and economical security of an enterprise indicates that they vary significantly, depending on the research objectives, the scope of the company's operation, the established criteria and development priorities. It is established that the main approaches are indicative, resourceful, productive, and systemic. Thus researchers use corresponding methods of evaluation such as component, index, expert, comparison, normative, estimated. In the elaborated techniques several of these methods are combined.

Forestry enterprises have a distinct specificity of functioning, since they combine economic activity based on the use of woody and non-woody forest resources, forestation, reforestation and forest protection. Thus it was necessary to take into account these features in determining the components of ecological-economical security and indicators of its evaluation.

To elaborate the methodology of assessing the ecological-economic security of forest enterprises and substantiate the choice of indicators the authors clarified the main terms concerning the ecological and economic security and its components – financial, techno-technological, social security of forest use, reforestation, forest protection activities. The methodology for assessing the ecological-economic security of forest holdings was formed as a sequence of stages that ensure the formation of the information base of the study, substantiate the choice of indicators, allow for the processing and interpretation of the calculated results.

The developed methodology was tested on the data from four forest holdings. Adequate results have been obtained, which indicate a high and satisfactory level of ecological-economic security at these enterprises in 2017. Based on the comparison of individual indices the index method allowed, to identify the strengths and weaknesses of the enterprises and the factors that influenced them. The low financial security indicators were revealed, necessitating the adoption of appropriate management decisions to improve financial performance and financial position of enterprises, increase the efficiency of the available resources use, increase the enterprises' production potential. The main problem found is the inefficient export structure, namely the predominance of low value added products.

The studies carried out by the authors make it possible to conclude that the assessment of the company's ecological-economic security should be used as a preventive tool of permanent action, regardless of how successfully the company operates and at what stage of development it is.

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