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## Integrated Assessment of the Level of Socio-Economic Security of Food Industry Enterprises

*This article presents a comprehensive study of the level of socio-economic security of food industry enterprises in Ukraine over the period 2020–2024. Based on an in-depth analysis of academic literature, official statistics, and practical challenges of wartime management, the author proposes a methodology for integral assessment of enterprise security that combines financial, social, and production-related factors. The core indicators include: the share of unprofitable enterprises in the industry, the average monthly wages of employees, and the industrial production index in the food sector. The methodological foundation relies on min-max normalization and integral index calculation using equal-weight aggregation.*

*Using statistical data from the State Statistics Service of Ukraine along with expert estimations, the article outlines the dynamics of the security index over five years. It was revealed that in 2022, the integral index reached a critically low level (0.167), driven by the destructive consequences of full-scale war, including a sharp rise in the number of unprofitable enterprises and a significant decline in production volumes. However, the period of 2023–2024 demonstrated a clear positive trend: a reduction in enterprise losses, rising wages, and recovery in industrial output. The integral index in 2024 rose to 0.978, indicating substantial sectoral resilience and the ability to adapt to exogenous shocks.*

*The study proves the effectiveness of the proposed method as a quantitative tool for monitoring enterprise security and supporting decisions in public policy, strategic planning, risk management, and investment evaluation. The article emphasizes the importance of integrating social indicators into security monitoring frameworks, particularly in crisis and post-crisis contexts. The developed model has both scientific and practical significance, making it applicable at both macroeconomic and enterprise levels.*

**Keywords:** socio-economic security, integral assessment, food industry, indicators, normalization, resilience, risk

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## Problem Statement

In the current context of economic instability, increasing competition, and strengthened regulatory requirements, the issue of ensuring the socio-economic security of food industry enterprises has become particularly relevant. The food industry plays a key role in ensuring the country's food security and the stability of the national economy. However, enterprises in this sector face numerous challenges, such as the volatility of raw material markets, fluctuations in energy prices, social tensions among employees, and growing environmental demands from both the state and consumers.

Traditional approaches to assessing the economic security of enterprises often fail to take into account the complex influence of social and economic factors, which limits their effectiveness. Therefore, there is a need to develop integrated assessment methodologies that combine various aspects of enterprise activity and provide an objective picture of its socio-economic security.

Studies by domestic scholars indicate growing attention to the assessment of enterprise economic security. In particular, the work of Yaroshevych N. and Dubravskyi A. presents an approbation of a methodology for assessing the level of economic security of a bank based on a resource-functional approach, highlighting the importance of a comprehensive evaluation of the security of financial institutions [1].

The development of an integrated methodology for assessing the socio-economic security of food industry enterprises is a pressing scientific task, the solution to which will contribute to enhancing the resilience and competitiveness of enterprises under modern economic conditions.

## Task Statement

The purpose of this study is to develop and apply an integral methodology for assessing the socio-economic security level of food industry enterprises in Ukraine, with the aim of identifying risks and enhancing their stability. To achieve this goal, the following research tasks were set:

1. To define the conceptual basis of socio-economic security in the food industry context.

2. To review existing assessment approaches and select relevant indicators.
3. To develop and apply a model for integral evaluation using normalized and weighted indicators.
4. To interpret results and provide recommendations for strengthening enterprise security.

## Literature Review

In the current conditions of dynamic economic development and growing challenges faced by food industry enterprises, the issue of assessing their socio-economic security is gaining particular relevance. Various scholars propose different methodological approaches to this issue.

Bespalko O.V. et al., in their textbook, address current issues in the practice of decision-making related to the socio-economic security of enterprises [2]. They stress the need to implement active learning methodologies to apply acquired knowledge in practice, which contributes to the development of analytical and calculation skills and prepares future professionals for independent decision-making in matters of socio-economic security.

Zubko T.L., in her monograph, explores the theoretical and practical foundations of enterprise economic security formation and identifies the main influencing factors. Special attention is given to the fundamental principles of forming an enterprise's economic security strategy [3].

Ovcharenko O.V. analyzed existing approaches and methods for assessing regional economic security [4]. Certain features were identified in the assessment process, particularly the existence of diverse definitions of "regional economic security" and the lack of a unified methodology for its evaluation. As a result of the analysis, a comprehensive approach to assessing regional economic security was proposed. This approach includes several stages, such as clustering Ukrainian regions using cluster analysis methods and calculating an integral indicator of regional economic security through a fuzzy logic-based approach.

The method proposed by Ovcharenko is valuable in terms of its adaptability to the enterprise level. The combination of cluster analysis with fuzzy logic interpretation allows not only for formalizing the security level but also for accounting for the uncertainties typical of transi-

tional economies. This method is especially relevant under conditions of high market parameter volatility, unstable inflation, limited access to resources, and external threats related to the geopolitical situation.

Moreover, contemporary academic literature increasingly focuses on integrated and adaptive approaches to assessing economic security. There is an opinion that it is advisable to apply multifactor models that include both financial-economic and socio-organizational parameters. The author notes that integral indices should consider the influence of internal management decisions, the external environment, the level of technological development, and the human resource potential of the enterprise, rather than being limited solely to traditional profitability indicators.

Additionally, mention should be made of the approach proposed by Cherniak O.I., which emphasizes scenario modeling of the security level [5]. This method enables the forecasting of changes in the integral index depending on shifts in key risk factors. This, in turn, enhances the practical value of economic security assessments, as it allows enterprises not only to register their current state but also to develop preventive threat management strategies in the short- and medium-term perspective.

## Research Methodology

The research methodology is based on an integral approach to assessing the socio-economic security of food industry enterprises. It is grounded on the consideration of three groups of indicators: economic (the share of unprofitable enterprises), social (average monthly wage level), and production (index of industrial production volumes in the sector). All data were obtained from open sources provided by the State Statistics Service of Ukraine for the period 2020–2024 [6].

This system of indicators aligns with the concepts of other authors regarding the assessment of economic security of enterprises and allows for a comprehensive measurement of the integral level of socio-economic security. To calculate the integral indicator, all selected indicators were normalized to a dimensionless comparative scale using the min–max normalization method. This approach transforms the values of

each indicator  $x_{ij}$  (where  $i$  is the indicator and  $j$  is the year or evaluation object) into normalized scores  $Z_{ij}$  ranging from 0 to 1. The best value of the indicator corresponds to 1, while the worst corresponds to 0. Depending on the nature of the indicator (stimulator or de-stimulator), the corresponding mathematical formulas are used (1)(2). Stimulators are indicators whose increase reflects an improvement in the state of security (e.g., average wage).

Formally, for stimulators (indicators for which an increase positively affects security), normalization is performed using the formula:

$$Z_{ij} = (x_{ij} - \min(x_j)) / (\max(x_j) - \min(x_j)) \quad (1) [7]$$

For de-stimulators (2) (indicators whose increase deteriorates the state of security), the following formula is used:

$$Z_{ij} = (\max(x_j) - x_{ij}) / (\max(x_j) - \min(x_j)) \quad (2) [7]$$

De-stimulators are indicators whose increase indicates a worsening situation (e.g., the share of unprofitable enterprises). After the normalization of each of the three indicators, their average value is calculated, which serves as the integral index of the socio-economic security of enterprises for the corresponding year. The resulting integral indicator makes it possible to compare security levels over time, as well as to perform interregional or intersectoral comparisons.

## Results

In the current environment, marked by external threats, macroeconomic instability, war, and structural transformations of the economy, the development of effective tools for monitoring and assessing the level of socio-economic security of enterprises becomes particularly urgent. Given the strategic importance of the food industry as a component of national food security, the analysis of its security dynamics is critical for both public economic policy and managerial decision-making at the business level.

The results of security assessments for food industry enterprises should not only capture the current state but also identify risks, forecast destabilization trends, and support the formation of well-founded development strategies. In this context, integral approaches are preferable, as

they enable the combination of heterogeneous indicators — financial, social, and production-related — into a unified measurement system. Therefore, within the framework of this study, an original methodology for assessing the level of socio-economic security has been developed based on min–max normalization of indicators and the construction of a weighted integral index.

For a comprehensive assessment of the socio-economic security of food industry enterprises, a system of indicators has been formed, encompassing both economic and social aspects. The selection of indicators is based on scientific approaches and previous research. In particular, many scholars distinguish three key groups of security indicators: technical-technological (reflecting production potential), financial-economic (characterizing solvency, financial stability, profitability), and social (describing labor potential, age, and qualification structure of personnel). In this study, the primary focus is placed on financial-economic and social indicators, as they most directly reflect the level of enterprise protection from internal and external threats.

The following key indicators were taken into account:

- Share of unprofitable enterprises, % — a financial de-stimulator indicator that reflects the risk of losing financial stability (the lower the share of unprofitable enterprises in the industry, the higher the level of its economic security). During crisis periods, this indicator rises sharply: for example, in 2020 (COVID-19 crisis), the share of unprofitable food industry enterprises exceeded 30%, while in the pre-crisis year 2019, it was about 20%.
- Average monthly wage of industry employees, UAH — a social stimulator indicator characterizing the level of employees' material well-being. A higher average wage contributes to greater social security and reduces staff turnover. According to official data, in October 2021 the average wage in food production amounted to 13.055 UAH, which is 14.4% higher than the previous year. This indicates a positive income trend among industry workers prior to the war.
- Industrial production index of the food industry, % compared to the previous year — an economic stimulator indicator

reflecting the dynamics of output volumes. Growth in this index signals improved economic resilience of enterprises, while a decline indicates emerging threats (e.g., reduced demand, and disrupted production chains). For instance, in 2020, food industry output slightly declined (index ~99.2% compared to 2019) due to the pandemic, but by 2021, a modest recovery was expected (over 100%). During the full-scale war in 2022, this indicator sharply declined, but in 2023 the industry demonstrated rapid recovery.

The next stage involved determining the weighting coefficients for each indicator in the integral assessment. The scientific literature offers various methods of weight factor calculation. One objective approach is the application of the Principal Component Analysis (PCA) method or factor analysis. For example, in the study by M. Z. Pikh, the weights of enterprise economic security indicators were calculated based on the PCA model using the Statistica software package [9].

The proposed system of indicators provides a holistic coverage of the key aspects of socio-economic security in food industry enterprises. It reflects the interrelationship between economic resilience, social stability, and production potential — all of which are critically important for a comprehensive security assessment under crisis conditions and external threats.

The integration of indicators of various types (economic, social, and production-related) within a single methodology is carried out by converting them to a dimensionless comparative scale. Due to min–max normalization, each indicator value is assigned a standardized score within the range of 0 to 1, ensuring comparability across different measures. These values are then aggregated into an integral index that represents the overall level of socio-economic security of an enterprise or sector over a given period.

Importantly, all indicators in their normalized form are interpreted according to a unified logic: the higher the value, the higher the level of security. This eliminates conflicts between stimulators and de-stimulators and allows for objective ranking of the analyzed entities. Therefore, the proposed methodology provides a reliable foundation for quantitative analysis, strategic planning, and the development of crisis-re-

sponse solutions in the management of food industry enterprises.

Below is a summary of the indicators used in the calculation of the integral index of socio-economic security, along with their classification by impact type and orientation.

To test the proposed methodology, an integral index of socio-economic security for the sector was calculated for the period 2020–2024 based on actual data from the State Statistics Service of Ukraine, analytical reports, and expert estimations. Table 1 presents the values of the selected indicators for each year and their corresponding normalized scores. The year 2020 was chosen as the baseline for determining minimum and maximum benchmarks, while the years 2022–2024 are characterized by the impact of wartime conditions.

As shown in Table 1, the pre-crisis year 2021 demonstrated an improvement in most security indicators compared to 2020: the share of unprofitable enterprises decreased (approximately from 30.6% to 25%), while the average wage increased from ~11,000 to ~13,000 UAH. This resulted in an increase of the integral index from 0.375 to 0.667, indicating a transition from an unsatisfactory to a satisfactory level of security (on a scale from 0 to 1, values  $\geq 0.6$  can be conditionally interpreted as sufficient).

The most critical year was 2022 when full-scale military aggression caused a sharp deterioration in the situation. Food production declined significantly (the estimated index was ~85%, indicating a drop of ~15% or more), and businesses experienced considerable losses, which was reflected in a spike in the share of unprofitable enterprises (up to ~40%). Despite wage indexation amid inflation and wartime risks, the real incomes of industry workers may have also

declined. The combined effect of these negative factors led to a drop in the integral index to its lowest value of 0.167 in 2022 — indicating a crisis state of socio-economic security.

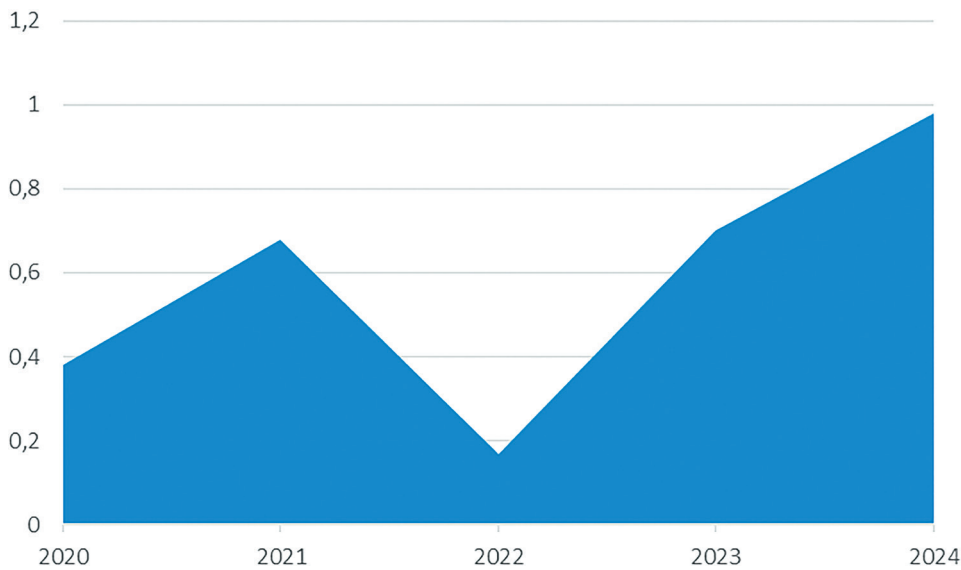
However, in 2023 the situation improved significantly. The food industry became one of the leading sectors in recovery among manufacturing industries due to the demand for essential goods. According to data from the State Statistics Service, production volumes began to grow rapidly in 2023 (the index returned to ~100% of the previous year's level) and accelerated notably in the first quarter of 2024.

The share of unprofitable enterprises, according to preliminary estimates, decreased to ~28% in 2023, approaching pre-war levels. The average nominal wage continued to grow (~17,000 UAH in 2023, roughly in line with inflation). As a result, the integral index rose to ~0.683 in 2023, exceeding the 2021 level and reaching a sufficient security threshold. A continued positive trend is projected for early 2024, with the integral security index approaching 0.98 — nearly the maximum level — driven by further industry growth and improvements in social indicators (see Figure 1).

The analysis of the obtained results allows for several important conclusions. First, Ukraine's food industry demonstrates significant resilience and the ability to recover under crisis conditions. Following the shock of 2020, the industry had already restored its security level by 2021. The most destructive factor was the military aggression in 2022, which simultaneously affected both the economic and social components: production volumes declined, supply chains were disrupted, producers' costs rose, and some enterprises were located in occupied territories or suffered destruction. This

**Table 1.** Key Indicators of Socio-Economic Security of Ukraine's Food Industry in 2020–2024

Year	Share of Unprofitable Enterprises, %	Norm.	Average Wage in the Industry, UAH/month	Norm.	Industrial Production Index (Food Industry, % of Previous Year)	Norm.	Integral index I
2020	30.6	0.626	11,000	0.000	99.2	0.500	0.375
2021	25.0	1.000	13,100	0.250	103.3	0.750	0.667
2022	~40.0 (estimated)	0.000	~15,000 (estimated)	0.500	~85.0 (estimated)	0.000	0.167
2023	~28.0 (estimated)	0.800	~17,000 (estimated)	0.750	~100.0 (estimated)	0.500	0.683
2024	~26.0 (estimated)	0.933	~19,000 (estimated)	1.000	~110.0 (estimated)	1.000	0.978



■ Fig. 1. Dynamics of the Integral Indicator of Socio-Economic Security of Food Industry Enterprises in Ukraine in 2020–2024  
*Note. Constructed by the author based on statistical data from the State Statistics Service and expert estimations.*

is confirmed by official data: in 2022, Ukraine's real GDP fell by approximately 29% [8], while industrial production declined by nearly 37%. Against this backdrop, the food sector performed slightly better than the overall industrial average, as demand for food products remained stable. Nevertheless, the integral index for 2022 indicated an extremely low level of security, close to the critical threshold.

Within the structure of the index decline, the production component suffered the most. Many enterprises in regions affected by active combat halted operations or lost production capacities. In addition to direct destruction, critical disruptions included logistics failures, rising energy costs, and raw material shortages. At the same time, enterprises that retained control over their assets had to operate under conditions of limited demand, a transformed consumer environment, and frequent supply interruptions. All of this negatively impacted production volumes and economic outcomes.

The social component was also affected, though its changes were less drastic, partly due to existing mechanisms of state support, such as employment retention programs, compensation schemes, and subsidies. Some enterprises implemented internal strategies to retain personnel despite declining revenues, recognizing the importance of preserving labor potential. Still, 2022 witnessed a decline in real wages, which impacted the overall security index.

Despite these negative trends, gradual stabilization was observed by the end of 2022 and throughout 2023. Some enterprises resumed operations in the western regions, relocation processes intensified, and several targeted support programs for critical infrastructure were launched. In 2023, trends such as a decrease in the share of unprofitable enterprises, wage indexation, and increased production volumes became evident. As a result, the integral security index improved, approaching the level recorded in 2020.

It is important to emphasize that the pace of the industry's recovery largely depended on domestic demand. Food remains a basic necessity, providing inherent stability to the sector even amid deep crises. Coupled with the adaptive capacity of enterprises and systematic state support, this allowed the food industry not only to preserve core production and workforce capacity but also to lay the foundation for transitioning to post-crisis development strategies.

The prompt response and adaptation of food industry enterprises in 2022–2023 enabled a swift return to growth. As noted in the analytical report by the Institute for Economic Research and Policy Consulting (IER), the food industry was among the first to recover production after the onset of the war. Enterprises were able to reconfigure logistics, partially compensate for the loss of export markets through domestic demand, and utilize government support pro-

grams for critically important production. This was reflected in improved economic indicators in 2023.

The social subsystem also benefited from relative stabilization and income indexation: despite some labor migration abroad, a severe labor shortage was avoided. Nevertheless, labor shortages still pose a challenge — the government has introduced training and reskilling programs to strengthen the sector's human capital. In 2023, the industry entered the year with a significantly higher level of socio-economic security than immediately after the outbreak of war.

The growth of the integral index in 2024 reflects the further strengthening of the resilience of food industry enterprises. This was facilitated by several factors: macroeconomic stabilization, active investment in production modernization, expansion of the domestic market, and a reduction in the share of unprofitable enterprises through cost optimization and increased operational efficiency. At this stage, the role of state policy in supporting food security proved crucial, encompassing tax incentives and preferential loan programs for industry enterprises.

Particular attention should be paid to the growing importance of human capital as a factor of long-term stability. In 2024, average wages increased, employee turnover decreased, and worker motivation improved. Enterprises are increasingly adopting elements of corporate social responsibility, investing in labor safety, internal training, and digital transformation. This creates the foundation for building a sustainable development model based not only on financial but also social and organizational security parameters.

The findings confirm that the social component is no less important than the economic one for ensuring enterprise resilience. Even in cases of production decline, the security index can be maintained at a certain level if labor potential is preserved and critical wage or social standard cuts are avoided. In the case of 2022, nominal wages continued to grow (by an average of +7% across the economy), which partially softened the blow to the integral index (the social indicator did not fall to zero). This aligns with approaches that treat social security as an essential component of a company's economic security. Thus, supporting employees in difficult times is an investment in faster operational recovery.

Overall, the conducted assessment enabled the quantitative measurement of the socio-economic security level of food industry enterprises and tracking its dynamics over the past five years. Based on the integral index, the industry's security levels can be classified as follows: 2020 — risk zone (around 0.4), 2021 — satisfactory level (~0.67), 2022 — crisis level (~0.17), 2023 — return to satisfactory (~0.68), early 2024 — transition to a high-security level (~0.98). The conclusions confirm the hypothesis about the high adaptive capacity of the food industry and highlight the importance of timely monitoring of relevant indicators.

Going forward, efforts to strengthen socio-economic security should focus on reducing the share of unprofitable enterprises (through financial recovery and investment support) and enhancing worker social guarantees. Key issues such as stable energy supply, cost containment, and workforce development remain highly relevant — solving these will determine the future security level of the sector.

Additionally, the study's findings highlight the need to enhance systemic government support for the industry, particularly in the areas of technical modernization and innovation-driven transformation. Enterprises that quickly implemented digital solutions, automation, logistics planning, and predictive analytics showed higher levels of resilience and adaptability. Therefore, a key task in the coming years will be the development of digital infrastructure and information security as part of a broader socio-economic security paradigm.

It is also important to consider the external economic context, which will increasingly influence the functioning of the food industry. The recovery of export potential, diversification of external sales markets, and import substitution of critical raw materials will all play a significant role in shaping the future security landscape of the sector. The effectiveness of these efforts will determine not only the industry's stability but also the overall level of national food security.

Thus, under conditions of multidimensional challenges, the socio-economic security of Ukraine's food industry should be seen as a dynamic category requiring constant monitoring, updates to the indicator framework, and adaptive management. The approach to assessing the integral index developed in this study can

be used not only as a diagnostic tool but also as an analytical foundation for making strategic managerial decisions.

## Discussion and Conclusions

The results of the integral assessment have made it possible to identify key trends in the transformation of the socio-economic security of Ukraine's food industry enterprises over five crisis and post-crisis years. The analysis showed that the sector undergoes clearly defined phases — from heightened vulnerability to gradual recovery and increasing stability. During the period from 2020 to 2022, a critical decline in the integral security index was recorded — a consequence of the pandemic-induced downturn, disrupted supply chains, and the impact of full-scale military aggression. At the same time, a notable improvement was observed in 2023–2024, indicating the industry's significant adaptive capacity in response to destructive factors.

The study confirms the effectiveness of using a comprehensive approach to security assessment, which incorporates economic (profitability, share of unprofitable enterprises, solvency), social (wages, workforce stability), and production (industrial output index) indicators. This approach allows for a more complete picture of enterprise security compared to unidimensional financial assessments, which often overlook structural imbalances or the social vulnerability of enterprises. This aligns fully with the views of leading researchers (such as Zharkova L. V., Pikh M. Z., and Bespalko O. V.), who emphasize the necessity of an interdisciplinary approach to assessing economic security as a systemic category.

The resulting dynamics reveal three main phases in the transformation of security levels:

- Deterioration phase (2020–2022): Characterized by the active influence of external shocks — the COVID-19 pandemic, global economic instability, logistical disruptions, and the onset of full-scale war. The integral index experienced a significant decline due to a surge in unprofitable enterprises and decreased production volumes.
- Stabilization phase (2023): Marked by gradual recovery of operations, wage indexation, partial restructuring of production, and adaptation to new conditions. The in-

tegral index rose to a satisfactory level, indicating the beginning of crisis recovery.

- Recovery phase (2024): Demonstrates a substantial increase in all security indicators to levels close to or exceeding pre-war benchmarks. This reflects a transition to active development and the restoration of enterprise resilience.

The findings confirm the hypothesis that Ukraine's food industry possesses built-in mechanisms of crisis resilience. This adaptive capacity can be explained by several factors: consistent domestic demand for food products, the sector's social importance, and lower dependence on imported raw materials compared to other manufacturing sectors.

It is important to highlight that in 2022, the economic subsystem of enterprises proved to be the most vulnerable: profitability and production volumes experienced the sharpest decline. At the same time, social parameters (primarily wages and employment levels) showed relative resilience, indicating the effectiveness of state support programs, social protection measures, and enterprise-driven efforts to retain personnel as a foundation for rapid post-crisis recovery.

In 2023, the food industry demonstrated signs of structural recovery, particularly due to adaptation to new economic realities. This included rethinking logistics routes, diversifying raw material suppliers, and increasing the share of locally produced auxiliary components. These changes reduced vulnerability to external shocks and ensured continuity of production processes even in an unstable environment. Alongside technological adaptation, enterprises also enhanced internal risk management, built inventories, strengthened distribution channels, and accelerated the digitalization of their marketing strategies.

Social stability in the sector was largely driven by steady product demand and high labor market engagement. Workers in the food industry remained among the least mobile segments of the labor force, allowing enterprises to retain skilled staff. At the same time, there is a growing trend toward enhancing internal motivation and non-material incentives for personnel. In 2023–2024, more enterprises adopted flexible work schedules, internal upskilling programs, and tools to engage employees in decision-making processes.

Looking ahead, maintaining a high level of socio-economic security will depend on striking a balance between economic efficiency and social responsibility. This requires not only continued government support but also the active implementation of innovations in production and management processes. This includes expanding digital services for resource management, demand forecasting, and risk monitoring, as well as attracting investment in “green” technologies to reduce reliance on critical resources.

As a result of the conducted study, the research objective has been achieved — an integral methodology for assessing the level of socio-economic security of food industry enterprises in Ukraine has been developed and tested. This methodology is based on objective statistical indicators and can be applied to evaluate security dynamics under unstable environmental conditions. The proposed approach enables a comprehensive consideration of financial, social, and production components, while the use of the min–max normalization method ensures comparability of indicators and allows for aggregation into a single integral index.

The methodology was tested using official data from 2020 to 2024, which confirmed its effectiveness and its ability to reflect not only the current state of security but also its changes under the influence of exogenous shocks. In particular, a critical decline in the integral index to a level of 0.167 was recorded in 2022, reflecting a deep socio-economic crisis caused by military aggression. At the same time, the following years showed a gradual recovery in indicators, and by 2024 the index reached 0.978, indicating a high level of adaptability and recovery capacity among enterprises in the sector.

The study paid special attention to the role of the social factor in maintaining the overall level of security. It was found that preserving labor potential, indexing wages, and minimizing personnel losses were key elements of resilience under crisis conditions. This confirms the need to expand the understanding of socio-economic security as a multidimensional phenomenon, in which the social component is no less important than financial parameters.

The proposed model has not only scientific but also high practical value: it can be used for risk monitoring, evaluation of managerial decision effectiveness, internal audits, and strategic

planning at the level of enterprises, sectors, and regions. The methodology also shows promise for application in the system of public administration of food security.

Further research should focus on improving the indicator system, particularly by including environmental, logistical, and technological factors, as well as applying more complex models of weight ranking and forecasting. This will enable the creation of more accurate and flexible security assessment tools, which are especially relevant in a period of multifaceted socio-economic transformations. Moreover, the integral index developed in this study provides a reliable analytical tool for identifying vulnerabilities and setting priorities in policy and managerial decision-making. Its dynamic nature allows for regular updates and adaptation to the evolving economic environment, making it particularly useful in times of uncertainty. The ability to track changes in the security level over time provides a solid foundation for proactive risk management and strategic foresight, both at the enterprise and national levels.

Importantly, the approach outlined in this research may be adapted for use in other sectors of the economy, especially those that are strategically significant and sensitive to external shocks. By adjusting the set of indicators to reflect the sectoral specifics, the methodology can serve as a universal model for evaluating socio-economic security in diverse contexts. Its interdisciplinary nature, integrating financial, social, and production metrics, aligns with the modern requirements of sustainable development and holistic governance in crisis-prone environments.

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### Інтегральне оцінювання рівня соціально-економічної безпеки підприємств харчової промисловості

У статті здійснено ґрунтовне дослідження рівня соціально-економічної безпеки підприємств харчової промисловості України у 2020–2024 роках. На основі аналізу наукових джерел, офіційної статистики та практики управління в умовах воєнного стану автором запропоновано методику інтегрального оцінювання рівня безпеки, яка враховує фінансові, соціальні та виробничі чинники. Основними індикаторами виступають: частка збиткових підприємств галузі, середньомісячна заробітна плата працівників, а також індекс промислового виробництва у харчовому секторі. Методологічною основою оцінки обрано нормалізацію показників за допомогою методу мінімаксного перетворення та обчислення інтегрального індексу на основі рівноважного вагового підходу.

У статті на прикладі реальних статистичних даних Держстату України та експертних оцінок показано динаміку змін у рівні безпеки протягом досліджуваного періоду. Встановлено, що у 2022 році інтегральний індекс сягнув критично низького рівня (0,167), що зумовлено деструктивним впливом повномасштабної військової агресії, різким зростанням частки збиткових підприємств і скороченням обсягів виробництва. Разом із тим, у 2023–2024 роках виявлено позитивну динаміку: зниження частки збиткових підприємств, підвищення заробітної плати, стабілізація виробничої активності. Показник інтегрального індексу у 2024 році досягнув рівня 0,978, що свідчить про суттєве відновлення галузі та її здатність до адаптації в умовах екзогенних загроз.

У роботі доведено ефективність запропонованого підходу до кількісного вимірювання безпеки як аналітичного інструменту для державної політики, стратегічного планування, управління ризиками та інвестиційного аналізу. Обґрунтовано важливість інтеграції соціальних індикаторів у системи моніторингу безпеки, зокрема у кризових і посткризових періодах. Стаття має значну наукову і прикладну цінність, результати можуть бути використані у практиці управління як на макро-, так і на мікрорівнях.

**Ключові слова:** соціально-економічна безпека, інтегральна оцінка, харчова промисловість, індикатори, нормалізація, відновлення, ризики