Balanced development of the food industry in the post-war period: assessment, trends, management

Nataliia Korzh, Natalya Onyshchuk

Vinnytsia Institute of Trade and Economics of State University of Trade and Economics University, Vinnytsia, Ukraine.

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Corresponding author:

Nataliia Korzh
E-mail: norischuk067@gmail.com

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Abstract

Introduction. The aim of the study is to develop a methodology for evaluating the effectiveness of the management of the value chain of the food industry product at the regional level, which allows using a system of balanced statistical indicators to take into account the sectoral features of the links of the value chain, including agriculture, food industry and trade.

Materials and methods. The research was conducted on the materials of the food industry of Ukraine. The research methodology included a process approach, the concept of added value, a system of balanced statistical indicators and a taxometric method.

Results and discussion. There is no clear demarcation of industry affiliation in evaluation systems. This makes it difficult to determine the development factors of individual industries, which are specific in the formation of links of the value chain at the local level. A new term "regional product value chain" (RPVC) was introduced into the terminological apparatus. To manage such a chain, three main processes are identified, which reflect the organizational and economic features of the creation of the value of the final product of the food industry (locally approximated: raw material links, production links and distribution). At the output of the process management links of the RPVC, the gross added value appears.

Depending on the goals of forming the regional value chain of the food industry product, resources can be maneuvered on a partnership basis, while increasing the gross added value of individual links of the value chain, which acts as an effective indicator of the management process at the regional level.

A method of evaluating the effectiveness of the management of the value chain of the food industry product at the regional level has been developed based on the calculation of the three-component integral indicator and its interpretation on the Harrington scale. The methodology includes five stages: the formation of a dynamic series with a developed system of balanced indicators characterizing the effectiveness and efficiency of RPVC management in terms of links (raw materials, production and distribution); calculation of integral performance and efficiency indicators; visualization of assessment results to establish trends in regional management results; management of relevant RPVC links; determination of an integral three-component indicator of effectiveness and efficiency of management of RPVC links; forming a criterion assessment using the Harrington scale and interpreting the results.

Conclusion. A process approach to the management of the regional product value chain will allow a comprehensive assessment of the results and provide a criterion-referenced assessment of the activities of the RPVC links and the food industry as a whole; determine trends in their development and apply modern management methods; assess food security in the region, the standard of living of the population employed in the RRVC food industry, and food security.

Introduction

The growing uncertainty caused by the pandemic was complicated by Russia's war against Ukraine and radically changed the business activity of enterprises. For the second year now, Ukraine has been living without agricultural products in parts of the Kherson, Zaporizhzhia, and Mykolaiv regions. According to the results of 2022, the production of grain crops decreased by 37% (is 53.9 million tons), the production of oil crops decreased to 17.5 million tons (-24%), the production of meat amounted to 3 million tons (- 11%), milk – 7.7 million tons (-12%) and eggs – 11.6 billion units (-18%) compared to the previous year 2021 (Unian.ua, 2023). The decrease in production volumes was caused by the temporary occupation of territories, weather conditions, the energy crisis, the Kakhovka tragedy, the loss of agricultural machinery (2.9 billion dollars), the destruction of production facilities, the physical death of livestock and other factors.

If we consider the situation of food industry enterprises, then the situation correlates with their location. Thus, the Western and Central regions record growth against the background of panic buying of food industry products. Devastating losses of the industrial potential of enterprises in Eastern and Southern regions of Ukraine actualized the problem of relocation of production facilities to safer regions. Among the relocated enterprises of the processing industry, 30.2% have already resumed their activities at the new location (Ministry of Economy of Ukraine, 2022). Changes in the global distribution system and the outflow of labor force affected the formation of the food industry product value chain. Despite the negative changes, food industry enterprises quickly adapted to the changes and demonstrate relative stability compared to other types of activity (Figure 1).

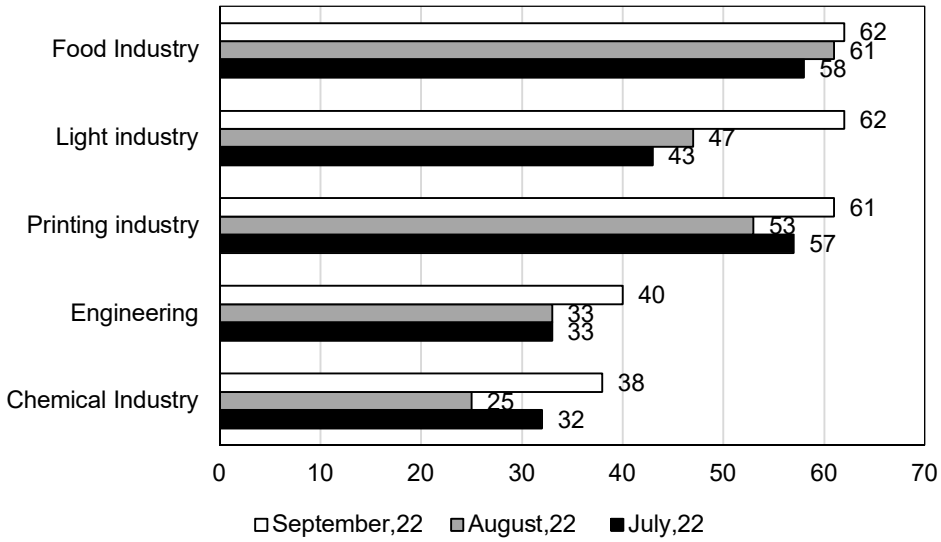

Figure 1. Share of industrial enterprises that restored their capacities and brought them to the level of the pre-war period in % of the surveyed industries (July, 2022)
(Ministry of Economy of Ukraine, 2022)

The graph clearly shows that despite the war, the food industry remains one of the most optimistic branches of the processing industry and demonstrates relative stability against the background of other types of activity, because it provides the basic needs of the population that have daily demand both in the country and abroad. However, the cost of living crisis has led to a dramatic shift in shopping baskets in favour of simple products.

The value system or industry value chain includes the suppliers that provide the firm with the necessary resources along their value chains. After a firm creates products, those products travel through the value chains of distributors (who also have their own value chains) all the way to consumers. At a time when global supply chains are being destroyed due to the pandemic and war, Ukrainian producers should build new, regional value chains for food industry products.

The analysis of the scientific literature records the lack of methodological developments regarding the evaluation of the effectiveness of the management of the value chain of the food industry product at the regional level and again actualizes the concept of the Value Chain, first mentioned in the late 1970s – early 1980s in the works of French scientists (Womack et al., 1997), and later M. Porter (1985). As for Ukrainian scientists, the evaluation of the effectiveness of management at the regional level is reduced to the management of a separate industry or a set of industries (Duginets, 2018; Kravtsova, 2016; Mostenska et al., 2018). At the same time, there is no clear demarcation of branch affiliation in the evaluation systems, and this makes it difficult to determine the development factors of individual branches, which have specificity in the formation of links of the value chain, which confirms the relevance of this study.

The aim of the study is to develop a methodology for evaluating the effectiveness of the management of the value chain of the food industry product at the regional level, which allows using a system of balanced statistical indicators to take into account the sectoral features of the links of the value chain, including agriculture, food industry and trade.

Materials and methods

In the process of preparing the article, scientific and analytical studies of statistical, financial and rating organizations of the world were used, as well as the results of the questionnaire of the Institute of Economic Research and Political Consultations, data of the Ministry of Economy of Ukraine regarding the development of the food industry during the war were processed. The research methodology included a process approach, the concept of added value, a system of balanced statistical indicators and a taxonometric method.

To choose the region, the author used such criteria as: the presence of a positive trend in the development of raw materials, production links and distribution links. According to statistical data, the Vinnytsia region, which is located in the center of Ukraine and despite the war, is showing breakthrough development.

The logic of the research is subordinated to the task of analyzing the effectiveness of managing the links of the regional value chain of the food industry product.

Results and discussion

A value chain is a series of sequential links that are added to create a finished product, from its initial design to its arrival at the customer. With ever-increasing competition for

unbeatable prices, exceptional products and customer loyalty, companies must constantly re-examine the value they create to maintain their competitive edge. A value chain can help a company identify inefficient areas of its operations and then implement strategies that optimize its processes for maximum effectiveness and efficiency (Cherkas, 2018). There are many approaches to evaluating the effectiveness of managing the effectiveness of the value chain of product value creation, but there is no single method.

Li et al. (2021) proposed a new sustainable value creation system consisting of three possibilities: operations in the value creation chain, internal and external integration.

Grassauer et al. (2022) presented a new eco-efficiency approach using data envelopment analysis (DEA) to assess the functional value of different models of dairy farms that perform several agricultural functions, but did not consider consumers.

There is a growing awareness that basing only one's own benefits in the business model is neither effective nor sustainable. Michael E. Porter and Mark R. Kramer (2019) introduced the concept of "shared value creation" to move from individual profit-seeking to value creation along the entire value chain. A new value proposition includes many aspects – customer value, economic value, social value and environmental value (Yu et al., 2021). All this leads to the co-creation of many values by combining the interests of economic and social actors, including customers and suppliers.

Moura et al. (2021) prove that overcoming barriers in value chain processes is important for establishing its sustainability and creating dynamic flexible opportunities. The unequal power of chain partners leads to asymmetric power relations that affect relationship commitment, relationship strength, compliance, cooperation, commitment, socialization and integration processes, value creation, and productivity.

To assess the effectiveness of food industry management at the regional and local levels, it is recommended to use the following criteria: increase in the production of food products, including from raw materials of local producers; increasing the number of jobs in food industry organizations; growth of the share of products of local producers in the total volume of sales (Yaroschuk, 2020).

Taking into account the well-known performance evaluation criteria (production, labour, finance and market (Wang et al., 2020), it is necessary to follow a balanced approach that takes into account the dynamics and the structural component, in order to establish the real contribution of each link of the value chain to the creation of the gross regional product. This approach will make it possible to monitor the dynamics of the development of industries at the regional level, as well as reserves for the growth of their productivity and efficiency.

Effective management of the value chain of the value creation of the food industry product only at the level of the region directly comes from its economic development and is based on a process approach that covers (Figure 2):

1. Management of raw material links of the chain (organizations of branches of agriculture);
2. Management of production links of the food industry;
3. Management of distribution links, aimed at the development of regional wholesale and retail trade in food products, the field of hospitality (restaurants).

The selection of three main processes of PVC management reflects the organizational and economic features of the creation of the value of the final product of the food industry, which consist in the need to involve in the management processes those regional resources, with the help of which the uniqueness and value of the product will be formed. At the output of the process management of the PVC links, the gross added value appears.

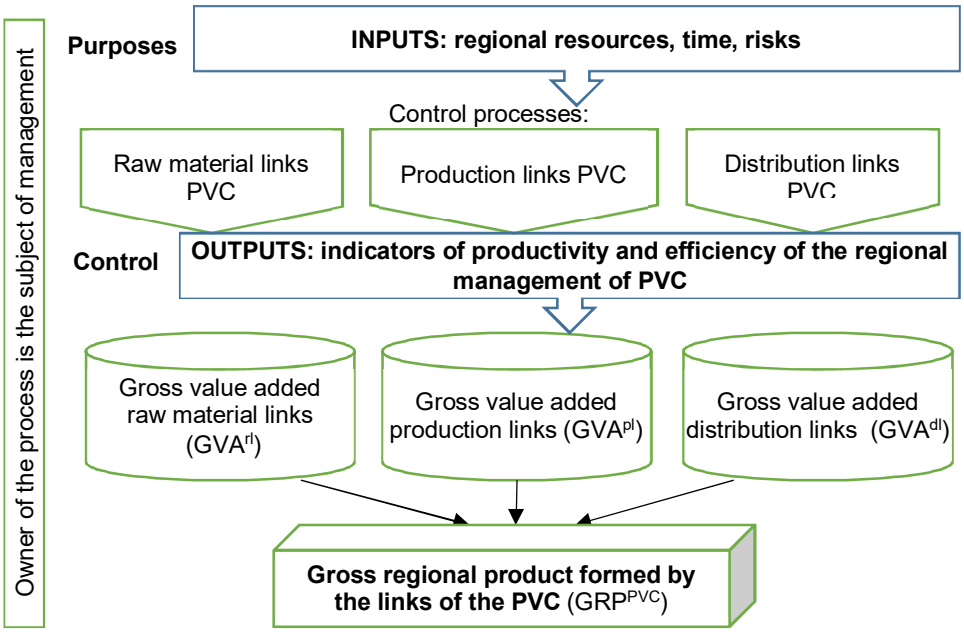

Figure 2. Characterization of the process approach to the management of the PVC at the regional level [author's model]

The massive formation of regional clusters and the local community of PVC participants determined the possibility of designing regional product value chains (regional product value chain – RPVC). Management of such value chains involves a sequence of actions to create added value by the relevant raw materials, production links and distribution links that carry out their activities in the territory of one region. Depending on the goals of forming the regional value chain of the food industry product, resources can be maneuvered on a partnership basis, while increasing the gross added value of individual links of the value chain, which acts as an effective indicator of the management process at the regional level.

The effectiveness of the management of the regional product value chain (RPVC) of the food industry can be realized by the method of calculating the integral three-component indicator (Figure 3).

The proposed method is based on a process approach, the concept of added value, a system of balanced statistical indicators in terms of determining links of the value chain.

The basis of the methodology is the taxonometric method of multidimensional comparative analysis, which allows to obtain the most accurate integral assessment of indicators that are not equal (stimulators and destimulators). It is proposed to interpret the results of the integral assessment using Harrington's scale of desirability (Trautmann and Weihs, 2006).

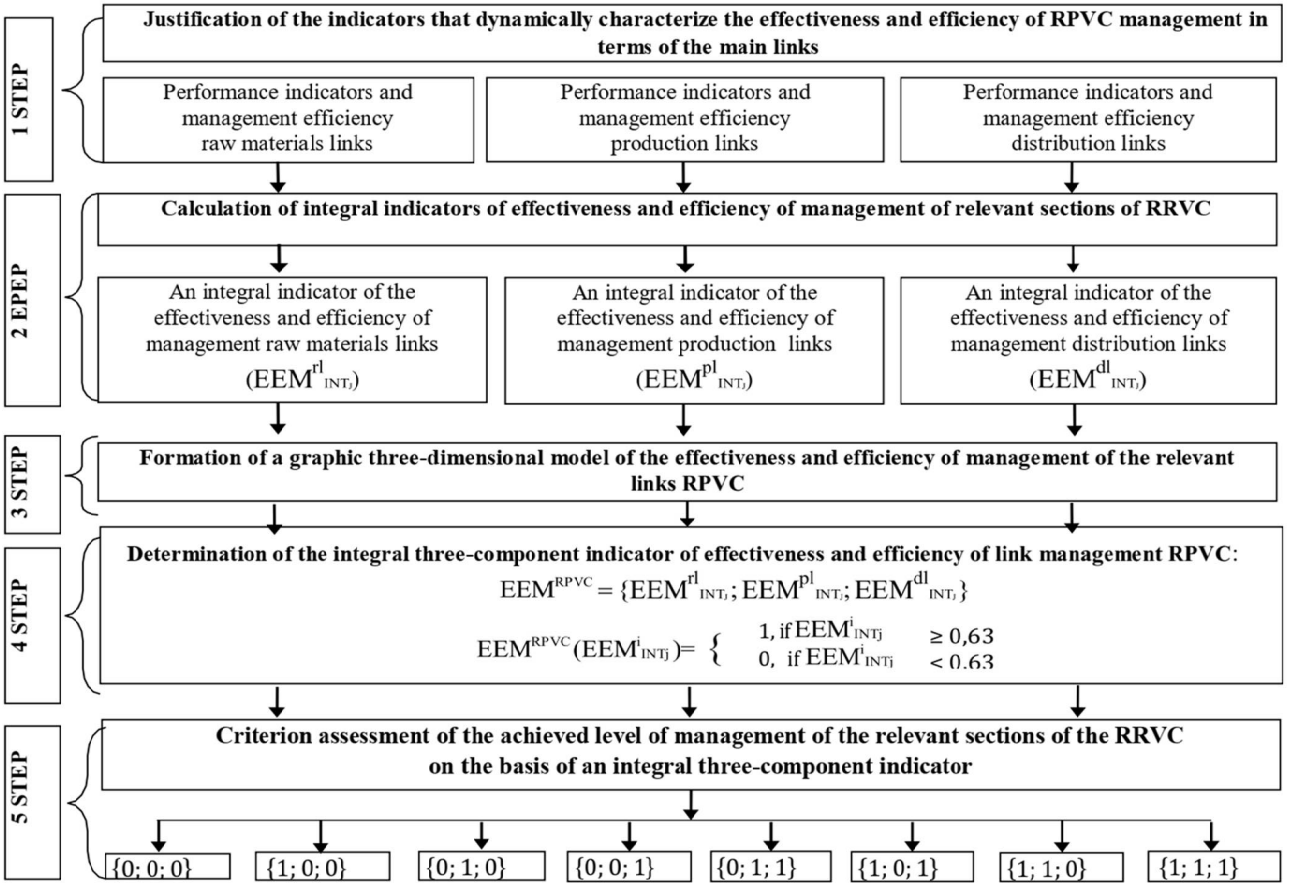

Figure 3. Methodology for evaluating the effectiveness of management RPVC of t food industry [author's model]

The methodology for evaluating the effectiveness of management of the regional product value chain (RRVC) of the food industry includes five stages. At the first stage, a dynamic series of indicators characterizing the effectiveness and efficiency of RRVC management in terms of links (raw materials, production and distribution) is formed. Indicators of effectiveness and efficiency of raw materials management, production units and distribution units of RRVC should optimally take into account the sectoral features of business entities. So, according to the indicators of the efficiency of the management of raw materials units that carry out activities in the branches of agriculture, it is possible to evaluate:

- The efficiency of regional land and labour resources use, employed in agricultural production;
- Degree of renewal of basic agricultural funds in the region;
- Profitability of investments and targeted financing of state programs invested in the development of agriculture in the region;
- The actual standard of living of the population of the region engaged in agricultural production;
- Ensuring the needs of the population and the regional market with agricultural products, including meat and dairy products;
- The level of growth (decrease) in prices for agricultural products in the region;
- The overall effectiveness of the functioning of regional raw material links through the ratio of gross added value to the gross regional product.

Indicators of the effectiveness and efficiency of the management of the RPVC production link take into account the peculiarities of the functioning of business entities in the food industry and allow to evaluate:

- The level of food security in the region due to the provision of its population with food products;
- Ensuring the needs of the regional market with food products on a national scale;
- The efficiency of the use of all types of resources in the production of food products;
- The effectiveness of the regional policy aimed at the development of small entrepreneurship in the food industry;
- Degree of innovative development of food production;
- Level of change in food prices;
- The actual standard of living of the population of the region engaged in the production of food products;
- Profitability (loss) of regional food producers;
- Profitability of investments and targeted financing of state programs aimed at the development of the food and processing industry in the region;
- The degree of renewal of the main funds of the food industry in the region;
- The overall effectiveness of the functioning of regional production units through the ratio of gross added value and gross regional product.

Indicators of effectiveness and efficiency of management of RPVC distribution links take into account the peculiarities of the functioning of economic entities in the field of public catering, wholesale and retail trade in food products and allow to evaluate:

- Development of regional trade networks that provide the population with food products;
- Ensuring the population of the region with food products through catering organizations and retail stores;

- Level of change in consumer prices for food products in the region;
- The actual standard of living of the population of the region engaged in wholesale and retail trade in food products;
- The level of average monthly purchasing power of the resident of the region;
- Effectiveness of regional foreign trade in food products and agricultural raw materials (integration of rrvc into global food supply chains);
- The efficiency of the use of labor resources in the field of food trade
- Products and public catering;
- Profitability (unprofitability) of the activities of regional organizations of trade in food products and catering;
- Profitability of investments in fixed capital aimed at the development of regional trade in food products and catering;
- The overall effectiveness of the functioning of regional distribution links through the ratio of gross added value and gross regional product.

The second stage is the calculation of integral indicators of the effectiveness and efficiency of management of the relevant links, in particular raw materials, production and distribution. Using the taxometric method of multidimensional comparative analysis, the set of actual values of indicators of the relevant links is compared. The need for such an action is due to the multidirectionality of evaluation indicators (stimulators and destimulators), the heterogeneity of their calculation methods and measurement units. The calculation of comparable values of indicators is carried out according to formula (1):

$$Z_{ij} = \frac{x_{ij} - \overline{X}i}{\sigma_i} \quad (1)$$

where Z_{ij} – is the relative value of the i-th indicator for the j-th reporting period; Xij – the actual value of the i-th indicator for the j-th reporting period; ¯Xi is the average value of the i-th indicator for the entire period; σ_i – mean square deviation (2).

$$\sigma_i = \sqrt{\frac{\sum_{j=1}^{n}(x_{ij} - \overline{X}i)^2}{n}} \quad (2)$$

n – the number of periods included in the analysis.

By comparing relative values for each evaluation indicator in the dynamics, the «reference value of the indicator» (Zi^e), is determined, for the stimulator – the maximum, for the destimulator – the minimum. The calculation of the integral indicator of effectiveness and efficiency of management of the *i-th* link of RPVC is carried out according to the formula (3):

$$EEM_{INTj}^{i} = \sum_{i=1}^{n}(Z_{ij} - Z_i^e)^2 \quad (3)$$

EEM_{INTj}^{i} – integral indicator of the effectiveness and efficiency of the regional management of the i-th link of the RPVC for the j-th period;

Z_j^e – the reference value of the i-th indicator.

At the third stage of the analysis, it is necessary to form a graphic three-dimensional model of the effectiveness and efficiency of management of the relevant sections of the RPVC for the reporting period. The continuous segment [0; 1], which requires a recalculation of the values of integral indicators in the range from zero to units, and a three-dimensional model of the effectiveness and efficiency of the management of RPVC links is built for each reporting period along three coordinate axes:

EEM_{INTj}^{rl} – integral indicator of effectiveness and efficiency of management of raw materials links of RPVC for the j-th reporting period;

EEM_{INTj}^{pl} – integral indicator of effectiveness and efficiency of management of production links of RPVC for the j-th reporting period;

EEM_{INTj}^{dl} – is an integral indicator of the effectiveness and efficiency of management of RRVC distribution links for the j-th reporting period.

The three-dimensional model of the effectiveness and efficiency of the management of RPVC links allows:

- To clearly demonstrate the level of management achieved in the region for each of the links of the value chain;
- Compare the results of the study over several reporting periods, in particular with reference values that are equal to 1;
- To establish the dynamics of evaluation indicators and the trend of changes in the results of regional management.

At the fourth stage, taking into account the average value on the Harrington scale (desirability) – 0.63, an integral three-component indicator of the effectiveness and efficiency of management (EEM) of the RRVC links is determined (formulas 4–5):

$$EEM^{RPVC}=\{EEM^{rl.}_{int\ j}\ ;\ EEM^{pl.}_{int\ j}\ ;\ EEM^{rl.}_{int\ j}\ \} \quad (4)$$

$$EEM^{RPVC}(\ EEM^{i.}_{int\ j}) = \begin{cases} 1, if\ EEM^{i.}_{int\ j} \geq 0.63 \\ 0, if\ EEM^{i.}_{int\ j} < 0.63 \end{cases} \quad (5)$$

EEM^{RPVC} – integral three-component indicator of effectiveness and efficiency of management of RRVC links. It allows you to generalize the results of the analysis of the effectiveness and efficiency of the management of RRVC links and give them a criterion evaluation at the final stage of the study (Table 1).

The developed methodology for evaluating the effectiveness of managing the regional product value chain (RRVC) of the food industry was tested on the example of the Vinnytsia region based on statistical data for 2020–2022.

On the basis of the actual and comparative values of the indicators characterizing the effectiveness and efficiency of the management of the raw materials RPVC links of the food industry of the Vinnytsia region, integral indicators were determined, which are presented in Table 2.

Table 2 presents the actual values of the integral indicators of the effectiveness and efficiency of the management of RRVC links of the food industry of the Vinnytsia region for 2020–2022, the analysis of which revealed that a positive trend in the development of raw materials, production links and distribution links has emerged in the region. The growth of integral indicators testifies to the correctly chosen methodological toolkit of RPVC management both on the part of regional authorities and business entities.

Figure 4 presents three-dimensional models of the actually achieved level of effectiveness and efficiency of management of the relevant links of the RPVC of the food industry of the Vinnytsia region for the years 2020–2022.

Table 1

Criterion assessment of achieved level of management of the relevant links of RRVC of food industry

(R – Raw material; P – Production; D – Distribution)

Value of integral three-component indicator (EEM^{RPVC})			Result management links RPVC	Characteristics of the result
R	**P**	**D**		
0	0	0	K1- extremely low level of regional management of links	The needs and potential opportunities of RPVC links are unbalanced
1	0	0	K2 – low level of regional management of production links and distribution	RPVC raw material units provide the needs of production links and the regional market due to the effective use of all types of resources
0	1	0	K3 – low level of regional management of raw materials and distribution	Production links of RRVC cover the needs for raw materials mainly at the expense of external supplies, fully provide the regional market with food products
0	0	1	K4 – low level of regional management of raw materials and production links.	Distribution links provide the population of the region with food products mainly at the expense of external supplies from other regions and imports of food products
0	1	1	K5 – low level of regional management of raw materials	The volume of agricultural production is not able to meet the needs. Production links cover the needs of raw materials with the help of external supplies and fully supply the regional market with food products. Distribution links provide the population of the region with food products at the expense of supplies from local producers
1	0	1	K6 – low level of regional management of production links.	Food industry enterprises work inefficiently and are unable to provide the population of the region with locally produced food products. Raw material links of RRVC are able to fully meet the needs of the regional market and production links, however, due to the underdevelopment of the latter, agricultural products are sold in other regions and/or exported. Distribution links provide the population of the region with food products mainly due to external supplies from other regions and imports of food products
1	1	0	K7 – low level of regional management of distribution links	The network of retail food trade in the region is not developed.
1	1	1	K8- high level of regional management of RPVC units	The needs and potential opportunities of RPVC links are balanced

Table 2

Dynamics of integral indicators of effectiveness and efficiency of management of relevant links of the regional value chain of the food industry in Vinnytsia region during 2020-2022

Integral index								
Raw materials links			**Production links**			**Links of distribution**		
2020	2021	2022	2020	2021	2022	2020	2021	2022
0.574	0.878	0.850	0.685	0.691	0.744	0.591	0.791	0.680

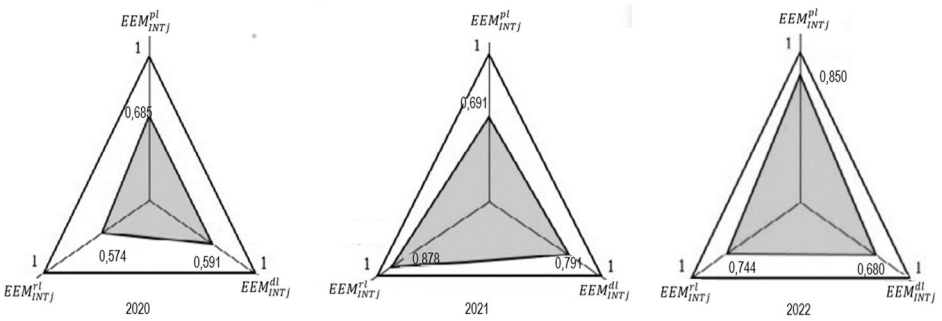

Figure 4. Three-dimensional model of the effectiveness and efficiency of the management of the links of the regional value chain of the food industry product in the Vinnytsia region during 2020-2022

Table 3

Achieved level of management of RRVC links of food industry of Vinnytsia region for 2020–2022

Date	Value of the integral three-component indicator (EEM^{RPVC})			Result of the management of RPVC links
	Raw material	Production	Distribution	
2020	0	1	0	K3 – low level of regional management of raw materials and distribution
2021	1	0	1	K6 – low level of regional management of production links.
2022	1	1	1	K8- high level of regional management of RPVC units

The area of the three-dimensional model allows you to visualize the achieved level of effectiveness and efficiency of management in terms of the main links of the regional chain of value creation of the food industry product, which, based on the example of the capacities of the Vinnytsia region, is improving annually. An isosceles triangle built on the coordinate axes displays reference values of integral indicators equal to one. The area of the isosceles triangle characterizes the maximum efficiency of management of each of the links of the regional value chain of the food industry product. Over the analyzed period, the values of the

integral indicators of the effectiveness and efficiency of the management of raw materials in 2021 (0.878) and production units in 2022 (0.850) approached the reference level.

Criterion assessment of the achieved level of management of the RRVC links of the food industry of the Vinnytsia region for 2020–2022 are given in Table 3.

Conclusions

The approbation of the methodology for evaluating the effectiveness of managing the regional product value chain (RRVC) of the food industry on the example of the Vinnytsia region made it possible to determine its main differences from existing methodological tools:

- Provides a quantitative assessment of the management level of RRVC of the food industry in general and in terms of performance indicators based on the definition of an integral three-component indicator. This allows you to summarize the results of the analysis and give them a criterion evaluation;
- Evaluates food security in the region, the standard of living of the population employed in the RRVC of the food industry, and food security;
- Provides visibility of the obtained results with the help of a three-dimensional graphic model, which allows to present the level of management actually achieved in the region for each of the relevant goals of the links of the value chain;
- Provides an opportunity to determine the effectiveness and efficiency of the management of the RRVC of the food industry in dynamics with the aim of identifying the development trends of the relevant links and developing measures aimed at ensuring the growth of evaluation indicators;
- Use the indicator of added value as a result, which allows you to comprehensively evaluate the results of the activities of RRVC links of the food industry as a result of the use of resources (land, material, labor, financial) and apply modern management methods;
- Includes a system of balanced statistical multi-vector indicators (stimulators and destimulators) that reflect the sectoral features of the RRVC links of the food industry;
- Is based exclusively on calculations of relative indicators, which allow providing regional authorities with comprehensive information about the results of business entities in terms of raw materials, production links and distribution links;
- Makes it possible to identify factors (causes) that disrupt the development of RRVC of the food industry, and provides regional management bodies with information for the development of measures to influence the determining events.

The given technique is universal and can become the basis for the development of methodological tools for evaluating the effectiveness of product value chain management in other branches of the production sphere.

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