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Tetiana Mirzoieva*
Doctor of Economic Sciences, Professor
National University of Life and Environmental Sciences of Ukraine
03041, 15 Heroiv Oborony Str., Kyiv, Ukraine
https://orcid.org/0000-0002-0034-6138

Inna Mykolenko
Doctor of Economic Sciences, Associate Professor
Poltava State Agrarian University
36003, 1/3 Skovorody Str., Poltava, Ukraine
https://orcid.org/0000-0003-3800-6136

Ludmila Stepasyuk
PhD in Economic Sciences, Associate Professor
National University of Life and Environmental Sciences of Ukraine
03041, 15 Heroiv Oborony Str., Kyiv, Ukraine
https://orcid.org/0000-0002-7258-9243

Tetiana Gutsul
PhD in Economic Sciences, Associate Professor
National University of Life and Environmental Sciences of Ukraine
03041, 15 Heroiv Oborony Str., Kyiv, Ukraine
https://orcid.org/0000-0002-1826-240X

Anastasiia Solop
Postgraduate Student
National University of Life and Environmental Sciences of Ukraine
03041, 15 Heroiv Oborony Str., Kyiv, Ukraine
https://orcid.org/0000-0002-7656-8829

Methodological aspects of economic study of the dairy market

Abstract. The aim of this study was to assess the effectiveness of the Ukrainian dairy market in conditions of economic instability and structural changes in the agricultural sector in 2021-2024. The study analysed the production, consumption, export, import and profitability of dairy products. The analysis revealed that during the period under review, total production decreased by 17% and there was a change in structure: the share of agricultural enterprises increased to 51%, exceeding households for the first time. It was found that consumption of dairy products decreased from

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*Corresponding author

201.5 to 196 kg per person per year, which is almost half the recommended norm. It was found that despite the decline in domestic demand, exports showed positive dynamics: as of the beginning of 2025, their volumes increased by 17% in physical terms and by 57% in value terms compared to the same period in 2024. A reorientation towards Western markets and growth in exports of butter and condensed milk were identified, which can be considered indicators of the competitiveness of individual segments. The results of the analysis of strengths, weaknesses, opportunities and threats highlighted the need for digital transformation of the market: in 2024, 72.3% of reports were already submitted online, and examples of the implementation of the latest technologies, such as by the private agricultural enterprise "Ukraine", proved the effectiveness of using information and communication technologies. The study confirmed the adaptability of the industry and outlined areas for strategic improvement in its monitoring. The practical significance of the study lies in the fact that its results can be used to develop effective tools for economic monitoring, forecasting the development of the dairy market, and forming state support for agricultural enterprises

Keywords: productivity; consumption; imports; profitability; efficiency; supply; methodological approaches

INTRODUCTION

The dairy market is a key segment of the agri-food market, which has strategic importance for ensuring the country's food security, forming the consumer basket and supporting agriculture. In the context of growing competition, the impact of globalisation processes, climate change and an unstable domestic environment, there is a need for a comprehensive economic analysis of this market using methodological approaches. The relevance of the study was determined by the need to improve state regulation tools, support Ukrainian producers and create conditions for the development of dairy farming. Rising costs, declining cattle population, disrupted logistics and unstable relations between producers and processors are hampering the development of the dairy market.

These phenomena are studied in the work of V.M. Ivchenko *et al.* (2024), which analyses the dynamics of cow productivity, the quality of milk raw materials, export-import changes, the structure of supply and regional differences. The authors found that productivity growth, herd reduction, and a decline in raw material supply have led to increased market dependence on certain regions and large enterprises. Declining consumer demand, price instability, and the declining role of small producers complicate the development of the dairy market. These issues were studied by N. Chebotarova (2024), who analysed changes in the structure of production, the growth of large enterprises, increased productivity and the impact of state support. The author also noted the development of domestic processing and changes in consumer preferences.

Declining consumption, the predominance of imports in certain segments, and weak integration into the European market complicate the development of the dairy complex. These aspects were analysed by C. Shikovets *et al.* (2023), who investigated imbalances in production and consumption, trade dynamics, price elasticity and the role of institutional support. At the same time, issues of adaptation to European Union (EU) requirements, forecasting price fluctuations and consumer behaviour remain unaddressed and require further study. Low levels of innovation, unstable government support, the lack of effective mechanisms to stimulate domestic demand, and imperfect logistics infrastructure are holding back the development of dairy production. I. Korman *et al.* (2022) analysed production dynamics, consumer behaviour patterns, the competitiveness of Ukrainian products, and the impact of government policy on the economic performance of enterprises. The authors emphasised the importance of improving resource efficiency, introducing a cluster approach, and developing public-private partnerships.

The decrease in the volume of milk sent for processing, technological backwardness in the private sector, and the weak participation of small producers in market processes

complicate the development of the industry. I. Svynous *et al*. (2020) analysed production dynamics, productivity, farm structure, and raw material supply. They emphasised the advisability of supporting large enterprises and innovative renewal. The issues of interaction between market participants, logistics efficiency and climate impact have not been sufficiently explored and require further study. Low investment activity, lack of technical re-equipment, non-compliance of products with quality standards, and uneven concentration of production capacities hinder the efficiency of dairy production. O. Bochko *et al*. (2023) examined consumption dynamics, distribution of production between regions, the impact of price factors, and access to resources. The focus was on the imbalances between supply and demand, as well as the importance of a comprehensive approach to modernisation.

Increased dependence on external suppliers, a lack of price stabilisation mechanisms, uneven development of production infrastructure and limited access to financing complicate the realisation of dairy production potential. I. Paska *et al*. (2023) studied structural market transformations, the distribution of resources between large and small producers, the impact of inflationary factors, and the assessment of institutional support opportunities. The authors emphasised the need to harmonise public policy with market mechanisms, develop logistics infrastructure, and develop technological potential. At the same time, the issue of assessing the long-term effectiveness of the decisions implemented, consumer behaviour patterns, and the impact of global risks on the domestic market remains insufficiently addressed and requires further research. Low effective demand, limited domestic investment, unstable state support, and lagging behind European standards complicate the formation of a balanced supply in the dairy market. N. Kosar *et al*. (2022) examined the characteristics of production system development, the effectiveness of pricing strategies, and the role of integration processes. The authors emphasised the importance of adapting to international requirements, strengthening the economic self-sufficiency of producers, and developing a competitive environment.

Key aspects of the development of the dairy market remain insufficiently explored, in particular the issues of effective cooperation, investment support, and the consequences of enterprise relocation; support for small producers and regional differences; forecasting the level of self-sufficiency and market fluctuations; long-term investment attractiveness, adaptation to climate challenges and digital transformation of production processes. The aim of this study was to identify the economic patterns of the national dairy market and to justify approaches to improving its efficiency in the context of structural transformations in the agricultural sector. The study set the following objectives: to analyse the dynamics of dairy production and consumption in Ukraine; to assess the impact of price, institutional and behavioural factors on the formation of supply and demand in the dairy market.

MATERIALS AND METHODS

The study was methodological in nature and covered the period from 2021 to 2024. In the course of the work, the characteristics of key economic categories and concepts related to the functioning of the Ukrainian dairy market were identified, in particular: total production volume, supply structure, consumption level, export activity, internal profitability and regional differences. The economic nature of these concepts was theoretically substantiated, and their interrelationships in the context of the agricultural economy were studied.

Based on statistical sources, analytical processing of data on the dynamics of total milk production in Ukraine for the period 2021-2024 was carried out (AgroPortal, 2023; 6.3 million tons of milk were milked..., 2023; AgroPortal, 2025b). In addition, materials related to the level of per capita consumption of dairy products (Milkua.info, 2023) were used as a basis for assessing domestic demand and analysing changes in consumer preferences. Considerable attention was paid to identifying the most popular categories of dairy products in Ukraine in terms of consumption volumes and export share (Ukrainian milk exports jumped by 25%, 2025). In addition, the study included a comparative analysis of economic analysis methods in the agricultural sector, which made it possible to assess their

suitability for the conditions of the Ukrainian dairy market (Carpentier *et al*., 2015; Korenjok *et al*., 2018). To study the state of foreign trade, data on export volumes for 2023 – early 2025 were used, as well as analytical materials on the geographical structure of supplies and the main countries importing Ukrainian dairy products (AgroReview, 2025; Yelanska, 2025).

To comprehensively assess the internal environment of the dairy industry, as well as its external context, the SWOT analysis method (Strengths, Weaknesses, Opportunities, Threats) was used. This method made it possible to systematise analytical observations, determine the structural characteristics of the market, and identify critical points and development potential. Within this approach, an analytical framework was developed for the further formation of strategic guidelines and the improvement of economic monitoring and forecasting tools. In particular, positive dynamics in the development of dairy farms in 2024 were identified (NISS, 2024). For international comparison, the following platforms were considered: the International Dairy Federation (IDF, n.d.), the European Dairy Association (EDA, n.d.), and the International Farm Comparison Network Dairy (IFCN Dairy, n.d.). Analytical reports from the Food and Agriculture Organisation of the United Nations (FAO, n.d.) and the Global Dairy Platform (n.d.) were also considered. These sources made it possible to correlate national indicators with international trends and assess the integration potential of the Ukrainian dairy market.

RESULTS AND DISCUSSION

Methodological approaches to studying the functioning of the dairy market

The dairy market represents a multi-component economic system that includes all stages of product movement – from primary production to final consumption. To ensure the validity of the economic analysis of this environment, it is advisable to identify the basic categories that determine the specifics of its functioning and provide a comprehensive understanding of the internal logic of market processes. The demand category plays a key role in determining development, as it reflects consumers' willingness to purchase relevant products at a certain price level. Demand sets benchmarks for producers in terms of product volume, structure and quality, and also influences investment decisions and the justification of production activities. Its functional purpose is to reproduce the priorities of the end consumer, determining the dynamics of pricing and strategic guidelines for economic entities. Supply plays the role of providing the market with goods. Small and medium-sized producers account for a significant share of milk supply, which determines varying levels of technological equipment, product quality and competitive potential. In methodological terms, supply characterises the sector's production capacity in the context of resource availability, the institutional environment and infrastructure provision. Its function is to maintain market equilibrium and prevent shortages or surpluses. The price on the dairy market is the result of the interaction between supply and demand, and therefore plays the role of the main regulator of economic interaction between market participants. It performs an accounting function, recording the value of products, as well as a stimulating function, encouraging increased productivity and innovation. In addition, the price has a distributive function, ensuring the redistribution of income between producers, processors and consumers. The informational function of the price makes it possible to navigate the market situation and make effective management decisions (Zhao *et al*., 2021).

Cost price is a criterion for assessing production costs, forming the basis for economic diagnosis of resource efficiency and justification of pricing policy. In the dairy sector, the cost price is influenced by a wide range of factors, from the cost of feed and energy resources to technological innovation and management quality. Functionally, this category allows identifying internal reserves for improving the economic performance of enterprises. Efficiency acts as an integral indicator of the effectiveness of economic activity, characterising the degree of achievement of production and commercial goals within given resource constraints. Within the framework of the dairy market research, it is advisable to evaluate both resource efficiency (milk yield, labour productivity) and financial efficiency (profitability, return on investment),

which makes it possible to identify the most promising development models. The category of competitiveness is decisive for the positioning of enterprises in the market environment. It encompasses the ability of a business entity to create products that are capable of competing successfully in both domestic and foreign markets in terms of price, quality and other characteristics. Its functional purpose is to ensure the dynamic stability of the enterprise and increase its adaptive potential in changing external conditions (Fiorillo & Amico, 2024). A comparative analysis of economic analysis methods in the agricultural sector is a necessary step in forming an effective analytical basis in the process of researching the dairy market. Given the specifics of agricultural production – high risk, seasonality, dependence on biological factors – the choice of appropriate methods must be comprehensive and adapted to the specific conditions of the dairy sub-sector. Economic research in this area uses both classical tools and the latest approaches based on digital technologies and mathematical modelling. A substantive description of the main methods of economic analysis was presented in Table 1.

Table 1. Comparative analysis of economic analysis methods in the agricultural sector

Method name	Method essence	Advantages of use	Example of application in the dairy market
Comparative analysis	Comparison of indicators by period or between entities	Identification of deviations, assessment of dynamics	Analysis of changes in the cost of milk production in different regions
SWOT analysis	Identification of strengths, weaknesses, opportunities and threats	Strategic planning, formation of competitive advantages	Determination of market prospects for dairy cooperatives
Coefficient method	Calculation of ratios between economic indicators	Simplicity, versatility, quantitative assessment	Calculation of the profitability of milk production
Benchmarking	Comparison with market leaders	Identification of best practices, benchmark for improvement	Assessment of the efficiency of dairy plants according to EU standards
Economic and mathematical modelling	Building models to describe and forecast economic processes	Forecasting, modelling of development options	Forecast of milk purchase prices depending on costs and consumer demand
Factor analysis	Identification of factors affecting the target indicator	Identification of key reasons for changes in results	Identification of the impact of feed prices on the cost of dairy products
ABC analysis	Classification of products or customers by significance	Assortment optimisation, cost management	Determination of the most profitable types of dairy products
DEA analysis (Data Envelopment Analysis)	Analysis of manufacturer efficiency based on input and output parameters	Determination of technical efficiency without the need for prices	Assessment of the efficiency of farms in the production of raw milk

Source: compiled by the authors based on A. Carpentier *et al.* (2015), D.V. Korenjok *et al.* (2018)

The choice of analysis methods depends on the purpose of the study, the availability of source information, the level of detail of the object of analysis, and the expected result. For example, SWOT analysis and benchmarking would be appropriate for strategic assessment, while comparative and factor analysis would be appropriate for operational control. Modern approaches also involve the integration of digital technologies, including geographic information systems (GIS), business intelligence (BI), and artificial intelligence for big data processing. Assessing the efficiency of dairy production requires the use of a set of research methods that allow not only to analyse the current state of the enterprise, but also to identify the potential for improving its performance. The choice of methods should be based on the specifics of the dairy subsector, which combines the characteristics of agricultural production (biological cycles, seasonality, natural and climatic risks) with the characteristic features of industrial processing,

logistics and marketing of finished products. Therefore, relevant research methods should cover both production and economic, social and environmental aspects of efficiency.

The first key method is factor analysis, which allows determining the impact of individual factors on changes in a generalised efficiency indicator, such as production profitability or profit per unit of output. The methodology of such analysis makes it possible to identify both primary and secondary factors, in particular the productivity of the dairy herd, feed costs, depreciation of equipment, energy costs, logistics support, etc. The use of factor analysis allows the identification of internal reserves for growth in the economic performance of farms. In 2021-2024, a factor analysis of milk production efficiency was conducted for the limited liability company (LLC) "Galychyna Dairy Company" (Galychyna, n.d.). It was found that the company has the potential to improve the efficiency of financial resources, in particular by optimising costs and increasing labour productivity. The second method widely used in efficiency studies is Data Envelopment Analysis (DEA), a method of data envelopment analysis based on the construction of a generalised efficiency frontier. Unlike traditional approaches, DEA allows the efficiency of each enterprise to be evaluated based on a set of input and output indicators without the need to take into account monetary valuation. This is particularly important in the dairy sector, where productivity, milk yield, number of employees and pasture area can be more informative than purely financial metrics (Shrestha, 2021).

It is also advisable to use economic and statistical modelling, including regression, correlation and trend analysis. In particular, building models of the dependence of profitability on variable costs or the selling price of milk makes it possible to predict the economic consequences of certain management decisions. In the context of growing instability in the external environment – war, inflationary pressure, fluctuations in the currency market – modelling makes it possible to ensure flexible anti-crisis management of enterprises. Balance sheet methods are also used in efficiency studies, which allow comparing available resources with production volumes. For example, comparing feed costs with milk production volumes allows calculating the cost per unit of production and evaluating the effectiveness of the feed programme. In addition, the cost-output method provides an assessment of the full cost price, which is the basis for justifying the pricing policy and competitive position of the enterprise (D'Ecclesia *et al*., 2024). Thus, assessing the efficiency of milk production requires a multidisciplinary approach combining quantitative and qualitative methods of analysis, which allows for high accuracy in assessments, adaptation to dynamic conditions, and justification of management decisions based on objective data. Similarly, A. Parzonko *et al*. (2024) studied the sustainability of dairy farms in Germany, France, the Netherlands, Italy and Poland, with a much broader approach covering not only economic but also environmental and social factors. While in the Ukrainian context the main focus was on internal barriers, A. Parzonko *et al*. conducted a comparative international analysis focused on the integration of agricultural policy with the principles of sustainable development.

Another perspective on the issue is presented in a study by P. Madududu *et al*. (2024), which discusses the difficulties of developing Botswana's dairy industry in conditions of import dependency. Although both works emphasise the need to support domestic production, their approaches differ significantly: P. Madududu *et al*. studied the industry in terms of consumer choice and political strategy, while this work was based on an assessment of production efficiency. Similarly, E.K. Balirwa & E. Waholi (2024) examined the barriers to market entry for small farmers in Uganda, particularly access to finance and infrastructure constraints. At the same time, this study analysed the industry from the perspective of the profitability of large and medium-sized farms, without delving into the specifics of small farms. The dairy market is a complex economic system, the functioning of which is determined by the interaction of key elements such as demand, supply, pricing and cost. The efficiency of dairy production is determined not only by the level of resource provision, but also by the ability to adapt to market changes, introduce innovations and optimise costs. The use of comprehensive methods of economic analysis – from factor analysis to

economic and mathematical modelling – makes it possible to identify internal growth reserves and form a sound management strategy. In the face of growing challenges, the economic performance of the industry directly depends on the balance between production efficiency, government support and the ability to respond to demand dynamics.

Analytical assessment of the state and development trends of the dairy market in Ukraine

Total milk production in Ukraine in 2021-2024 experienced significant fluctuations due to a number of economic, social and military factors. In 2021, according to the State Statistics Service, 8.72 million tonnes of milk were produced, which corresponded to the stable production level of previous years. However, in 2022, the volume decreased to 7.7 million tonnes, which is a decrease of 12.1%. The main reason was the full-scale invasion, which caused the destruction of the dairy infrastructure, a reduction in cattle numbers, disruption of logistics and a decline in profitability for private households (AgroPortal, 2023). In 2023, the situation partially stabilised: 7.9 million tonnes, indicating a partial recovery from the previous decline (6.3 million tonnes of milk were milked..., 2023). In 2024, Ukraine produced about 7.2 million tonnes of milk (AgroPortal, 2025b). This again demonstrates a decline in production against the backdrop of prolonged hostilities, an unstable economic environment and high livestock maintenance costs. Figure 1 shows the overall dynamics of milk production in Ukraine for 2021-2024.

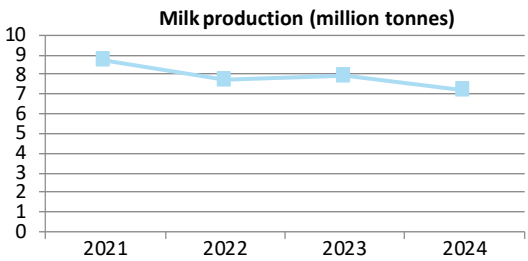

Figure 1. Milk production (million tonnes)
Source: compiled by the authors based on AgroPortal (2023), 6.3 million tons of milk were milked... (2023), AgroPortal (2025b)

Despite a slight temporary increase in 2023, the overall trend is negative, indicating a gradual decline in production. The structure of milk production in Ukraine by product type remained relatively stable during the period. Cow's milk accounted for over 98% of the total volume. Goat and sheep milk production is growing very slowly and is concentrated mainly in private farms and households, remaining a niche segment. Although demand for organic and alternative products is stimulating interest in goat milk, its share in the total volume still does not exceed 2%. Thus, despite a slight increase in interest in alternative types of milk, cow's milk remains the undisputed leader in the production structure (Ukrainian farms overtook private farms..., 2025).

The production structure by form of ownership proved to be more dynamic. In 2021-2023, households continued to account for a larger share of gross production (51-53%), but this share gradually decreased. The reasons for this were the economic unprofitability of keeping cattle in conditions of inflation, rising feed prices, limited access to markets and difficulties in complying with sanitary standards. In contrast, agricultural companies and farms showed positive dynamics thanks to the introduction of technologies, better organisation of production and a focus on processing industry standards. In 2024, the share of agricultural enterprises equalled that of households, and in 2025, it exceeded it for the first time – 51% versus 49%. This was a landmark moment, signalling a change in leadership in milk production in Ukraine. The quality characteristics of the products also shifted the focus in favour of enterprises. While households often do not comply with quality standards due to the lack of necessary equipment, farms mainly supply extra or higher grade milk that meets the requirements of the processing industry. As a result, the Ukrainian dairy industry is gradually transforming towards industrial production with a focus on quality and export potential (AgroPortal, 2025a).

At the same time, the dynamics of dairy consumption per capita in Ukraine has also undergone significant changes. In 2021, consumption was 201.5 kg per person per year, which was relatively close to the recommended norm. In 2022, as a result of the war, migration processes, the economic crisis and a reduction in

supply, consumption fell to 183-185 kg per person. This reflects both the physical unavailability of products and a decline in purchasing power. However, in 2023, the situation partially normalised, with consumption reaching 190-196 kg per person, corresponding to a 7% increase in the total domestic milk market compared to 2022 (Milkua.info, 2023). In 2024, the indicator stabilised at 196 kg. Despite the positive dynamics, this level remains almost half the recommended norm (380 kg), which indicates structural problems in the milk consumption market in Ukraine (Ukrinform, 2024). The largest categories of consumed products are drinking milk, cheese, butter, yoghurt and ice cream. Cheese accounts for a significant share of both the domestic market and imports – up to 64%, which puts pressure on Ukrainian producers. Butter, in turn, is actively exported: at the beginning of 2025, its exports grew by 464%, which indicates the high quality and competitiveness of the product (Ukrainian milk exports jumped by 25%, 2025).

In 2024, Ukraine exported 118,000 tonnes of dairy products worth 296.8 million USD, which is 16% more than in 2023. As of early 2025, exports already amounted to 58,000 tonnes worth 179.3 million USD, indicating a higher average unit price and potential growth in volumes by the end of the year. Compared to the same period in 2024, this represents a 17% increase in volume and a 57% increase in value. Butter accounts for the largest share of exports (40%), followed by condensed milk (26%), ice cream (16%) and cheese (12%). Imports of dairy products in 2024 amounted to about 60 thousand tonnes worth 290.3 million USD, and in January-May 2025 – 25.61 thousand tonnes (+11%) worth 128.63 million USD (+14%). Cheese accounts for the largest share of imports (up to 78%), occupying approximately 47% of the domestic market. This figure is a challenge for Ukrainian producers, who are forced to compete with imported products, mainly from EU countries, in particular Poland. Despite attempts to discuss import restrictions, Poland remains a key partner, and import bans are unlikely (Yelanska, 2025).

The foreign trade balance varied depending on the month. In January 2024, there was a negative balance (-11.7 million dollars), but overall for the year, exports almost doubled imports in physical terms and remained at approximately 295-297 million dollars in value. This indicates that imported products have higher added value, while exports have a larger volume but a lower price per tonne. Regional analysis shows that the Khmelnytskyi, Poltava, Vinnytsia, Ternopil, Cherkasy and Zhytomyr regions are the leaders in milk production in 2024-2025. For example, the Khmelnytskyi region produced over 540,000 tonnes in 2023 and is showing 17% growth in 2025. Other regions show similar dynamics, which indicates the development of the dairy industry in the central and western regions of Ukraine. Despite not being a typical dairy region, Zakarpattia region showed a 50% growth in 2025 (Skoryk, 2025).

The war has had a serious impact on the dairy industry. The fighting has caused livestock losses, destruction of farms, and disruption of supply and distribution chains. The frontline regions, which accounted for about 43% of the industrial cattle population before the war, have been particularly affected. Despite this, the industry continues to function, adapting to the new realities. Producers are focusing on Western markets, exporting across land borders, and the domestic market is demonstrating its adaptability to the new conditions (EU Dairy Forecast for 2025, 2025). Thus, the period 2021-2024 has been a test for the Ukrainian dairy industry, but also a stage of rethinking and transformation. Despite the decline in production and consumption, there has been an increase in product quality, a reorientation of exports, and a strengthening of the role of agricultural enterprises. A striking example of adaptation to wartime conditions is the activity of the "Milk Alliance" group of companies (Milk Alliance, n.d.), whose factories in Pyriatyn, Zolotonosha, Yahotyn, Zgurivka and Bashtanka continued to operate even under the difficult conditions of military operations. The enterprises optimised production by reducing their product range and focusing on goods with a long shelf life (milk, butter, cheese), while fermented milk products were produced exclusively to order for retail chains. The factories did not stop even in the frontline regions, demonstrating flexibility in responding to changes in demand and logistical challenges. All this testifies to the viability of the industry and its ability to develop further even in conditions of

military instability (Latifundist Media, 2022). The research by I. Brkić & N. Puvača (2024) and this work had a common goal – to explore ways to improve the efficiency of milk production, but differed in their approaches and emphases. I. Brkić & N. Puvača focused on internal production factors: feed quality, genetic potential of cows, precise management and the implementation of digital monitoring systems. They used bioeconomic models and standardised performance indicators to assess the efficiency of farms. In contrast, this study examined the dairy market as a holistic economic system, covering analysis of demand, supply, pricing, cost, competitiveness and the institutional environment.

In contrast, G. Mattarello *et al.* (2024) investigated the impact of dairy production on the environment in Italy, focusing on assessing greenhouse gas emissions using the LCA (life cycle assessment) approach. The authors conducted an analysis from an environmental perspective, while this study focused on economic aspects. Both studies shared an understanding of the need for innovation to improve efficiency, but while G. Mattarello *et al.* focused on digital technologies for assessing environmental impact, this study focused on analytical and management approaches to improving the functioning of the dairy market. At the same time, E. Kanire *et al.* (2024) investigated the efficiency of small dairy farms in East Africa in the context of climate change using a stochastic frontier analysis (SFA) approach. However, the studies differed in terms of the scope of analysis, methods and context: E. Kanire *et al.* focused on climate adaptation and small-scale farming, while this study focused on the dynamics of the dairy market in Ukraine. Unlike the study by S.G.H. Meyerding & A. Seidemann (2024), which focused on the behavioural motives of milk consumers in Germany – including the influence of packaging, animal welfare and pricing transparency – this study focused on the economic characteristics of production, such as cost price, resource efficiency and state funding of the industry. While the German authors investigated perceptions of a sustainable approach to consumption, this study focused on the challenges faced by producers in the context of structural market transformations.

The approach used by S. Sahara *et al.* (2022) was aimed at studying the market behaviour of farmers in Indonesia in response to external shocks, including climate change and price instability. The authors focused on adaptation mechanisms, market barriers, and sociocultural characteristics. In comparison, this study focused on a more rational macroeconomic analysis without delving into the behavioural aspects of individual producers. On the other hand, the study by C. Onishi *et al.* (2025) revealed the reactions of Japanese consumers to changes in the fat content of dairy products, highlighting aspects of labelling, perceptions of health benefits and price sensitivity. This contrasts with the approach of this study, which focuses on production and economic parameters and systematic market analysis. Despite this, both studies reflected the complex interaction between different elements of the dairy industry, from production to consumption. Total milk production in Ukraine in 2021-2024 showed negative dynamics due to the impact of military operations, economic instability and a decline in the profitability of private farms. At the same time, the industry gradually transformed towards industrial production with an emphasis on quality, efficiency and export potential. Despite the decline in consumption, there has been growth in the export structure and a reorientation towards Western markets. Overall, Ukraine's dairy industry has demonstrated adaptability and the ability to develop even in times of crisis.

Identification of factors influencing the efficiency of the dairy market and areas for improvement of analytical methods

The functioning of the Ukrainian dairy market in the context of current challenges, in particular full-scale war, economic instability and a decline in the rural population, has become particularly relevant. In 2021-2024, the market underwent profound transformations: there was a gradual decline in production volumes, a decrease in the share of households in the milk supply structure, a change in logistics routes and an increase in the role of the processing industry. At the same time, the industry is showing resilience, maintaining its export potential and responding

to domestic demand through the development of agricultural enterprises. In order to develop effective mechanisms for improving the methods of analysing the efficiency of the dairy market, it is necessary to comprehensively assess its current state, identify its strengths and weaknesses, external opportunities and threats. To this end, it is advisable to conduct a SWOT analysis as a basic tool for strategic assessment of the situation in the industry (Table 2).

Table 2. SWOT analysis of the dairy market of Ukraine (2021-2024)

Strengths	Weaknesses
■ High share of cow's milk in production structure – stable technological base ■ Development of agricultural enterprises, growth of their share in production ■ Improvement of milk quality on industrial farms ■ Growing exports (butter, cheese, condensed milk)	■ Overall decrease in milk production volume ■ Reduction in cattle population, especially in households ■ Low profitability of keeping farming in the private sector ■ Significant dependence on cheese imports
Opportunities	**Threats**
■ Expansion of organic production (goat and sheep milk, niche products) ■ Reorientation of exports to the EU, Asian and Middle Eastern markets ■ Stimulation of domestic demand through information campaigns ■ Use of digital technologies to improve analytics and market management	■ Military action and destruction of infrastructure ■ Blockade of logistics routes (especially seaports) ■ Decline in purchasing power of the population ■ Demographic decline and labour migration, reducing consumer demand

Source: compiled by the authors

A SWOT analysis (Table 2) of the Ukrainian dairy market for 2021-2024 indicates the need for systematic improvement of approaches to its regulation and support. Despite strengths such as the development of agricultural enterprises, improved product quality and growing export potential, internal weaknesses – a decline in cattle population, reduced profitability in the private sector and high import dependence – weaken the market's resilience. External opportunities, in particular digitalisation, entry into new markets and the development of organic production, can be used to compensate for these imbalances. At the same time, current threats, primarily related to the war, logistical barriers and falling consumer demand, require a proactive response.

An effective system for economic monitoring and forecasting of the dairy market in Ukraine should be based on a combination of rapid collection of reliable data, digital information processing, and analytical tools. The implementation of such a system is only possible with the full electronicisation of reporting, the active involvement of producers in the exchange of information, and the formation of forecast models based on actual market dynamics. In this context, the available examples and statistical trends of recent years are indicative. In 2023, total milk production in farms of all categories decreased by 5% compared to 2022. In contrast, in 2024, positive dynamics were recorded in the work of dairy farms, in particular an increase in milk yields in agricultural enterprises, which is associated with the modernisation of technologies and better accounting (NISS, 2024). A successful example of the digital transformation of dairy production is the activities of the private agricultural enterprise "Ukraine" in the Zhytomyr region, where voluntary milking systems (VMS) and electronic productivity control have been introduced. Such technologies provide accurate real-time milk yield accounting, automatic detection of cow productivity problems, and enable quick decisions on veterinary care or changes in diets. The successful operation of such farms demonstrates the real benefits of using electronic tools in dairy farming (Ruban *et al.,* 2024).

Another important area for improving monitoring is digital reporting. As of 2024, the reporting rate of respondents for the third quarter was 72.3% (in total for reporting forms to the State Statistics Service), and all reports, including form No. 24-sg (livestock production), are

submitted exclusively in electronic form. This was made possible by the updated reporting procedure, which came into force on 23 June 2023, and integration with the State Agrarian Register (SAR), which allows reports to be generated and sent automatically. Thus, even without accurate public data on the number of farms submitting reports, it is possible to conclude that the monitoring process in the agricultural sector is highly digitised. At the same time, the low level of digital literacy among the rural population remains a barrier to the widespread adoption of technology: only 15-20% of farmers have a high level of awareness of digital services. This requires a separate programme of training, information support and advice for households and small farming cooperatives, especially in border and war-affected regions (Report on the results of the activities of the State..., 2024).

At the international level, Ukraine is an active participant in global monitoring systems. Data on production volumes, exports, consumption and price dynamics are regularly published on a number of authoritative platforms (External Sector Statistics, n.d.). In particular, the International Dairy Federation (IDF) (IDF, n.d.) provides summary analytical reports on the state of the global dairy industry, including technological innovations, product quality and international standards. The European Dairy Association (EDA) (EDA, n.d.) highlights consumption dynamics, export and import trends, and regulatory changes within the EU, allowing Ukrainian indicators to be compared with European ones. The International Farm Comparison Network Dairy (IFCN Dairy) platform provides a comparative analysis of dairy farms in different countries around the world, focusing on efficiency, cost structure and global price trends (IFCN Dairy, n.d.). At the same time, the Food and Agriculture Organisation of the United Nations (FAO) (FAO, n.d.) is a source of comprehensive information on the development of agricultural markets, food security levels and international trade prospects. The Global Dairy Platform (Global Dairy Platform, n.d.) brings together leading companies in the industry and focuses on innovation, sustainable development and shaping global demand for dairy products. Together, these resources make it possible not only to track current changes in the global market, but also to adapt national policies to international standards. In 2024, in particular, annual export figures were updated for types of dairy products – dry and condensed milk, casein, butter, and ice cream. These platforms allow Ukraine not only to track global trends but also to adapt national policy to international standards. International analytical reviews also include data on potential markets: countries in the Middle East, North Africa, Asia, the Caucasus, and Central Asia (INFAGRO, 2025). Thus, existing cases indicate a gradual digital transformation of the industry, particularly in the dairy farm and electronic reporting segments. At the same time, to improve the effectiveness of the monitoring system, three key limitations must be overcome: insufficient regionalisation of analytics, weak integration of digital data with predictive models, and limited availability of quality public analytics for businesses and consumers. The introduction of monthly interactive dashboards based on data from the SAR, the expansion of electronic monitoring in small farms, and the development of visualisations for communities and analytical services would all contribute to making the Ukrainian dairy market more predictable, transparent, and resilient to external shocks.

The study by G.K. Deshwal *et al.* (2024) examined the digital transformation of the dairy sector in India, in particular the impact of information and communication technology (ICT) solutions on transparency, logistics and cooperative interaction. This study also took digitalisation into account, but as one element of a broader macroeconomic analysis of the Ukrainian dairy market in 2021-2024. Thus, both studies share a common focus on innovation, but differ in their methodological focus: G.K. Deshwal *et al.* focus on technology, while this study focuses on economics. A similar difference can be seen when compared to the study by S. Richter *et al.* (2025), which focused on the application of advanced digital technologies – sensors, blockchain solutions, automated quality control systems – using the Swiss market as an example. In this study, the subject of analysis was economic parameters: profitability, cost price, institutional barriers, foreign trade activity, which leads to

the conclusion that there are different areas of research interest with a common goal – to increase the efficiency of dairy production. The study by L. Tulush *et al*. (2023) focuses on financial support and the development of dairy farming in Ukraine, emphasising the role of state policy. In contrast, this study analyses the market, focusing on declining production, structural changes, export growth and digitalisation. Both studies point to the need to improve the efficiency of the industry, but the first through support mechanisms and the second through adaptation to market conditions. The work by Z. Berezvai & M. Konya (2025) analyses the price transmission process in the milk supply chain in Hungary, focusing on the uneven distribution of profits between producers, wholesale suppliers and retail chains. This study focused on the structure of the market, the peculiarities of its transformation under martial law, and changes in consumption, production and exports. The study by B. Keitshweditse *et al*. (2024) dealt with the creation of added value in the dairy sector in Botswana, in particular through logistical innovations, the development of the donkey milk market and the search for new consumer niches. This study focused on the economic aspects of the industry: profitability, costs, government regulation and institutional challenges. Despite the difference in approaches, both studies emphasised the importance of innovation for the development of the industry – in the first case, functional and product innovation, and in the second, managerial and strategic innovation. The work of A. Chen *et al*. (2024) analyses the factors influencing the choice of dairy products among older consumers in China. The study focused on product characteristics – texture, bioactive components, taste qualities, as well as the potential for using biotechnology to increase the attractiveness and functionality of dairy products. These aspects were not considered in this study; attention was paid to the macro level assessment – market structure, industry performance, and factors affecting the competitiveness of producers. Thus, both studies reflect current trends but are in different planes – micro-consumer and macroeconomic.

In conclusion, the present study revealed profound transformations of Ukraine's dairy market under the influence of military, demographic and economic challenges in 2021-2024. Despite the decline in production volumes and profitability in the private sector, the industry is demonstrating adaptability and maintaining its export potential thanks to the development of agricultural enterprises and digitalisation. The SWOT analysis conducted revealed the need for systematic improvement of monitoring and forecasting mechanisms based on electronic reports, interactive analytics and international standards. Further efficiency gains are only possible if regional analytics are strengthened, digital literacy is improved and modern solutions are actively used in livestock farming.

CONCLUSIONS

In 2021-2024, the Ukrainian dairy market underwent a period of profound structural transformation, driven by both internal and external challenges. Total milk production during this period decreased from 8.72 million tonnes in 2021 to approximately 7.2 million tonnes in 2024, indicating an overall negative trend and a loss of more than 17% of production capacity. The main reasons were military actions, disruptions in logistics chains, a reduction in cattle population, especially in households, and economic instability. At the same time, there was a decrease in the role of households in the production structure: their share in 2021-2023 was 51-53%, but in 2025, for the first time, agricultural enterprises took a larger share of the market – 51%, which indicates the gradual industrialisation of the industry and a shift in priorities in favour of technologically advanced producers. This process was accompanied by an increase in product quality: industrial farms provide a supply of higher-grade milk that meets the standards of the processing industry and export requirements.

Per capita milk consumption fell from 201.5 kg in 2021 to 183-185 kg in 2022, as a result of reduced purchasing power, physical inaccessibility of products and population migration. In 2024, consumption stabilised at 196 kg, but this figure is still almost half the recommended norm of 380 kg, indicating a structural problem in food consumption and potential for domestic market development. Imports of cheese, which

account for about 47% of the domestic market, remain a significant threat to Ukrainian producers, despite the gradual growth of the industry's export potential. In 2024, exports of dairy products amounted to 118 thousand tonnes worth 296.8 million USD, which is 16% more than in 2023. As of early 2025, exports had already reached 58,000 tonnes worth 179.3 million USD, which is 17% more in volume and 57% more in value compared to the same period in 2024. The largest share in the export structure is occupied by butter, condensed milk, ice cream and cheese, which indicates the competitiveness of certain segments of Ukrainian dairy products.

The war has been a decisive factor in destabilising the dairy sector: the frontline regions, which accounted for 43% of the industrial cattle population in 2022, suffered the greatest losses. At the same time, regions in central and western Ukraine, in particular Khmelnytskyi, Poltava, and Vinnytsia, are showing growth in production, indicating a regional reorientation of production. The efficiency of the market largely depends on the level of digitalisation. The introduction of voluntary milking technologies, electronic productivity accounting and online reporting, as in the private agricultural enterprise "Ukraine" (Zhytomyr region), demonstrates opportunities for improving management accuracy and economic performance. Already in 2024, 72.3% of agricultural reports were submitted in electronic format, indicating a high level of automation of management processes. Prospects for further research lie in the development of integrated forecasting models that take into account regional characteristics, the digitalisation of farms and changes in consumer preferences.

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Тетяна Мірзоєва
Доктор економічних наук, професор
Національний університет біоресурсів і природокористування України
03041, вул. Героїв Оборони, 15, м. Київ, Україна
https://orcid.org/0000-0002-0034-6138

Інна Миколенко
Доктор економічних наук, доцент
Полтавський державний аграрний університет
36003, вул. Сковороди, 1/3, м. Полтава, Україна
https://orcid.org/0000-0003-3800-6136

Людмила Степасюк
Кандидат економічних наук, доцент
Національний університет біоресурсів і природокористування України
03041, вул. Героїв Оборони, 15, м. Київ, Україна
https://orcid.org/0000-0002-7258-9243

Тетяна Гуцул
Кандидат економічних наук, доцент
Національний університет біоресурсів і природокористування України
03041, вул. Героїв Оборони, 15, м. Київ, Україна
https://orcid.org/0000-0002-1826-240X

Анастасія Солоп
Аспірант
Національний університет біоресурсів і природокористування України
03041, вул. Героїв Оборони, 15, м. Київ, Україна
https://orcid.org/0000-0002-7656-8829

Методологічні аспекти економічного дослідження ринку молока

Анотація. Метою даного дослідження було оцінити ефективність функціонування молочного ринку України в умовах економічної нестабільності та структурних змін аграрного сектору у 2021-2024 роках. У межах дослідження було здійснено аналіз виробництва, споживання, експорту, імпорту та рентабельності молочної продукції. У ході аналізу виявили, що за досліджуваний період загальний обсяг виробництва скоротився на 17 % і відбулася зміна структури: частка аграрних підприємств зросла до 51 %, вперше перевищивши домогосподарства. Встановлено, що споживання молочної продукції знизилось з 201,5 до 196 кг на особу на рік, що залишається майже вдвічі нижчим за рекомендовану норму. З'ясовано, що попри зменшення внутрішнього попиту, експорт демонстрував позитивну динаміку: станом на початок 2025 року його обсяги зросли на 17 % у натуральному виразі та на 57 % у вартісному порівняно з аналогічним періодом у 2024 році. Виявлено переорієнтацію на західні ринки, зростання експорту масла та згущеного молока, що розглядаємо як конкурентоспроможність окремих сегментів. Результати

аналізу сильних і слабких сторін, можливостей і загроз підкреслили необхідність цифрової трансформації ринку: у 2024 році 72,3 % звітів уже подавались в онлайн-форматі, а приклади впровадження новітніх технологій, як-от приватним сільськогосподарським підприємством «Україна», довели ефективність використання інформаційно-комунікаційних технологій. Дослідження підтвердило адаптивність галузі та окреслило напрями стратегічного вдосконалення її моніторингу. Практичне значення дослідження полягає в тому, що його результати можуть бути використані для розробки ефективних інструментів економічного моніторингу, прогнозування розвитку молочного ринку та формування державної підтримки аграрних підприємств

Ключові слова: продуктивність; споживання; імпорт; рентабельність; ефективність; постачання; методичні підходи