

Analyzing dairy industry development for Ukrainian and global food security during martial law

*Natalia Kovshun, Nina Kushnir, Diana Tsaruk**, Dmytro Snitko, and Oleksandr Slesarchuk

National University of Water and Environmental Engineering, 11 Soborna St., Rivne, 33028, Ukraine

Abstract. The study examines the development determinants of the dairy industry, a major component of global and national food security. Regarding production and trade factors affecting the whole agro-industrial complex and the dairy industry of Ukraine, the leading indicators of dairy products' availability and provision level were determined, and their dynamics were analyzed. Ukraine's dairy product consumption sufficiency indicator was defined as one of the food security criteria. It has been established that the production determinants of the dairy industry under martial law include the profitability cost level of milk production, the milking herd's number, raw milk quality and sufficiency, and the use of fodder in milk production. Trade determinants are sale opportunities, the price level for raw milk, the affordability of dairy products, and the current Ukrainian legislation in the trade sector. The developed linear multifactor model of the dairy products turnover by retail chains' dependence on the dairy products consumption level, the average monthly wage level, the inflation level and imports indicates a close relationship between the determined factors and allows to analyze the prospects of the market and the dairy industry, as GFCI components.

1 Introduction

Ukraine's confrontation with Russia's military aggression has caused global concerns about food security. Countries relying on Ukrainian grain and European farmers using Ukrainian feed felt a threat to their food security. The food security problem in Ukraine has become more urgent in connection with field mining, the territory occupation, the agricultural products exported by the aggressor country, farms and livestock destruction. These challenges have forced Ukraine to focus on strategic food security as measured by the Global Food Security Index (GFSI). GFSI assesses the following aspects: food affordability, availability, quality and safety, sustainability of production, and adaptation.

* Corresponding author: d.s.tsaruk@nuwm.edu.ua

These criteria are traditionally calculated by Economist Impact analysts with the support of Corteva Agriscience (informative data from 113 countries are taken into account) [1].

The martial law conditions in Ukraine have a negative impact on the food production, and the food security factors of the occupied regions and territories affected by hostilities is under threat. Barriers in supply and logistics in access to raw materials for agro-industrial production and to final food products cause a food prices increase. Thus, the key directions of achieving the Ukrainian food security in modern conditions should be aimed at maintaining a consistent chain from production, processing, storage to food products supply for the population.

Dairy products and their production industry infrastructure are important components of global and domestic food security, along with bread and bread products, meat and meat products, fish products, eggs, vegetables, fruits, berries, and oil. Since the beginning of the military conflict, the dairy complex of Ukraine has taken on the challenges faced by the entire national agro-industrial complex, as well as those countries that use its products.

Even though there is no dairy products shortage in the domestic market of Ukraine under current conditions, the dairy products consumption balance was maintained because of significant migration processes of Ukrainians abroad. Agricultural enterprises that produce raw milk largely maintained their production capacities, but households significantly reduced the supply of milk to processing enterprises due to the increase in the price of fodder for dairy cattle. The geography of dairy products sales on foreign markets has changed due to obstacles to the products transportation from Ukrainian seaports, which has strengthened international trade with European countries and increased the dairy products transit supply volume through the EU territory in 2022.

Taking into account the modern aspects of dairy industry functioning, it is worth considering its state not only at the current stage, but also to determine its ability for transformation in the long term under the influence of international production standards, market changes, and consumption differentiation. Therefore, the study of production and trade factors affecting the dairy industry requires research to determine reserves for its further development in the context of The National Economic Strategy until 2030 (NES-2030) [2].

2 Literature review

Global and national problems of achieving food security in the martial law conditions in Ukraine are widely considered and discussed at international and regional conferences, forums dedicated to the topic of supporting directions the agro-industrial complex of Ukraine in modern terms, measures to overcome food supply threats in regions affected by the military conflict. Economists of various countries are concerned with finding ways to regulate socio-economic relations at the global and local level within the framework of food policy.

The Food and Agriculture Organization of the United Nations (FAO) studies are strategic in the formation of programs for overcoming the food crisis in countries and regions. Its analytical reports, developed jointly with the Organization for Economic Cooperation and Development (OECD), also contain sections devoted to current data, forecasting the consumption and production level, trade, price trends in the world dairy products market, including Ukraine [3].

The Association «Dairy Entrepreneurs Union of Ukraine» examines current issues and forms the dairy market of Ukraine and the world analysis, conducts research on food security in the dairy industry context, studies the national dairy consumption balance and the war impact on the production volume, turnover and dairy products consumption [1].

Most of the research on the current food security level is presented specifically in the direction of studying the military conflict in Ukraine challenges and threats and identifying their impact on high-quality and safe food products availability [4, 5, 6, 7, 8]. Since the dairy sub-complex is affected by the same factors as the entire agro-industrial complex of Ukraine, such Ukrainian economists as T. Kurman [9] and M. Varlamova [10] devoted their research to the development of the agro-industrial complex in the food security context.

O. Pavelko et al. [11] considers that the food security study covers the agro-industrial enterprises functioning issue in the sustainable development context, since one of its essential goals involves the implementation of tasks to ensure the optimal natural resources use, rational consumption and agro-industrial production, including dairy products [11, 12]. During monitoring the food security determinants, an important place is also occupied by the economy digitalization level, which affects the possibility of identifying the sustainable development factors on the world map, the possibility of researching global and regional food security indicators, research visualization and significant information arrays coverage, according to A. Shevchenko et al. [7] study. In turn, Ukraine has a large projects number in the direction of consumer protection and food safety digitization and digital transformation, which are provided for a new level of food quality and safety control [7, 13].

B. Mihalcova et al. [14] present tools for the management of poverty and food waste that can be extended to the optimization of resource utilization and wastage minimization in the dairy supply chain. In the same way, the authors present adaptation strategies in dynamic environments that could be useful for dairy sector, fostering resilience and sustainability during crises.

V. Hrosul et al. [15] propose frameworks for investigating organizational dynamics and strategic management that enable researchers to comprehend and improve the dairy sector mechanisms under martial law. L. Vilchynska et al. [16] analyze the crises effects on consumer behavior and market dynamics from a socio-economic standpoint, hence their findings are valuable for stakeholders that need to navigate rough waters. Moreover, A Kuczabski et al. [17] scrutinize the efficacy of regional development control, providing insights into the optimization of dairy-industry operations in certain geographical areas. Additionally, A. Shapovalova et al. [18] investigates the nexus among taxation, economic growth, and transition economies revealing policy implications for dairy sector development during martial law.

M. Dykha et al. [19] delve into agro-clustering and marketing strategies, respectively, hence providing more information relevant for dairy industry stakeholders in challenging socio-economic environments. T. Ustik et al. [20] elaborate approaches regarding socially responsible online marketing and advertising management that could be applied by dairy companies in order to target the consumers during crisis.

On the other side, I. Bashynska et al. [21] explore the evaluation of smartization projects in the industrial enterprises, with the focus on sustainability as the key part of their evaluation framework. By looking at how the digital initiatives outcome with sustainability in mind, this study adds to gaining insights about the possible links between digitalization and sustainability objectives. This study can be used by researchers as a basis for investigation of the relationship between digital innovation and sustainable development in industrial settings. The authors also study the investment and innovation perception of the regions in Ukraine through the perspective of sustainability. Their research provides a detailed discussion of the sustainability aspects of investment and innovation programmes and contributes to understanding the factors defining regional development policies.

In addition, M. Masyk et al. [22] provides guidance on governance effectiveness, as well as quality criteria in the context of sustainable development activities.

The analysis of their institutional effectiveness and governance structures gives an insight into what makes sustainable development agendas work, a more detailed insight. In specifying the criteria for evaluation of governance effectiveness in sustainable development activities, this research provides a useful tool for policy makers and leaders seeking to promote sustainability purposes.

Narrow studies of production and trade determinants affecting the Ukrainian dairy sector were also presented by scientists O. Popko et al. [23] and O. Bochko et al. [24] with the aim of detection economic processes in the dairy market and determining the strategic imperatives of the entities operating in this market [25]. However, issues related to the real dairy industry development factors, as an important global and national food security component, remain open and require further consideration. Given that the military conflict in Ukraine goes on, it is necessary to continue the strategic aspects study and form forecasts of food security in the conditions of an unstable political and economic environment.

3 Method

The food security aspects study in the research is carried out in the Ukrainian dairy industry context, the development of which is significantly influenced by production, logistics and trade determinants (Figure 1). European integration orientation of Ukraine lead to a reorientation to international requirements regarding the quality of dairy products and the safety of their production. European integration directions of Ukraine lead to a reorientation to international requirements regarding the dairy products quality and production safety.

The Economist Impact study conducted in 2022 states that Ukraine ranked 71st in the world and last among 26 European countries in terms of GFSI. The best indicator that demonstrated the food security level of Ukraine is food products «quality and safety», which was 71.3 points (on average for European countries, this indicator was 80.2 points), especially thanks to the high indicator of «protein quality». The lowest is the indicator that reflects «sustainability and adaptation» (43.5 points), in particular, underdevelopment concerns water resources for the agriculture needs. In comparison, this indicator, calculated on average for European countries, is 63.7 points. Although Ukraine has been implementing measures to adapt and protect its own natural resources over the past ten years, a large number of political efforts today are primarily aimed at the defense sphere. The armed conflict on the Ukraine's territory, political instability, the infrastructure and logistics destruction led to a low level of product availability in 2022, despite a sufficient food supply in the country.

The indicator, represented by the Food Security Index of Ukraine, for 2022 was 57.9 points that is a low indicator level for European countries. In comparison, Finland's GFSI is 83.7 points [1].

Russia's war against Ukraine has significantly increased uncertainty in the supply of energy, fertilizers and other agricultural goods and significantly slowed economic growth. The impact on the market can be felt in related sectors of the agro-industrial complex, such as the dairy industry, due to increased costs of dairy products. It may also increase interest in circular agriculture with an emphasis on using fewer external resources, which is available and widely used in milk production, as well as membrane technologies [26].

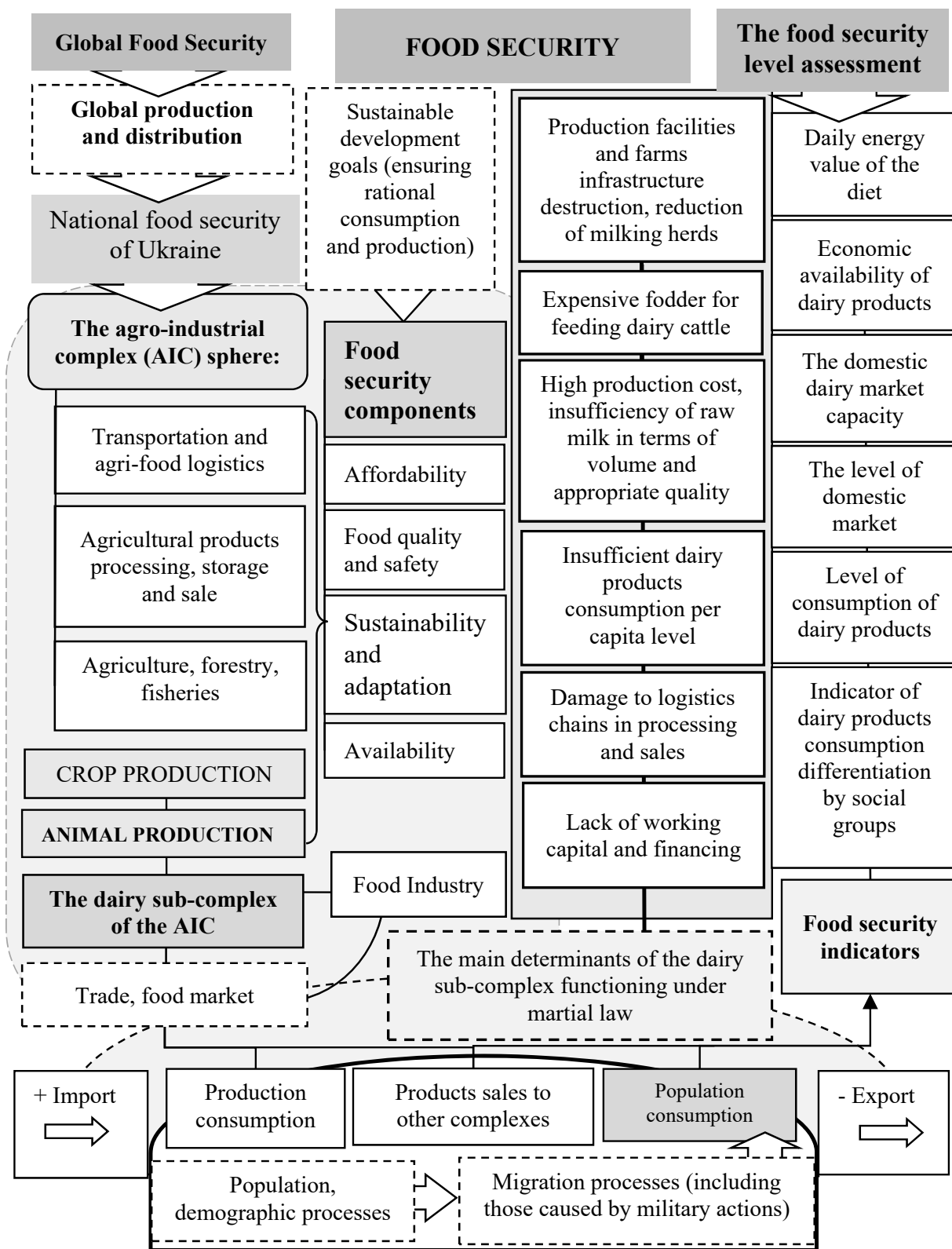


Fig. 1. Determinants of the dairy industry functioning as a food security component under the martial law conditions.

The products «availability», in particular dairy products, as the component of the Global Food Security Index, is formed under the influence of price trends, the purchasing power of the population and the household income level.

The entire marketing chain, which dairy products pass from the producer to the final consumer, has undergone significant changes in 2022 due to logistical problems.

The raw milk price, which forms the largest share of its cost, has a great influence on the dairy products final price. Many US and EU milk processing enterprises have long been implementing the practice of forming cooperatives with their raw milk suppliers, but in Ukraine milk production and processing activities are carried out separately. The price trends of the dairy market in 2021 and 2022 are radically different (Figure 2). In 2021 the raw milk prices were higher than in some EU countries, but in 2022 raw milk became cheaper than the average for European countries, despite the fact that in June 2022 the milk price in Ukrainian domestic market broke all previous yearly records (37.8 EUR/100 kg) [27]. A significant lack of milk processing enterprises working capital during the seasonal raw milk price increase period becomes a threat to their profitability. The milk production and processing profitability level by Ukrainian enterprises during 2012-2021 changes at an uneven pace. During this period, a significant decrease in profitability was observed in 2018 (16.1%) compared to 2017 (26.9%) by 10.8%, which was caused by a decrease in the raw milk selling price [27].

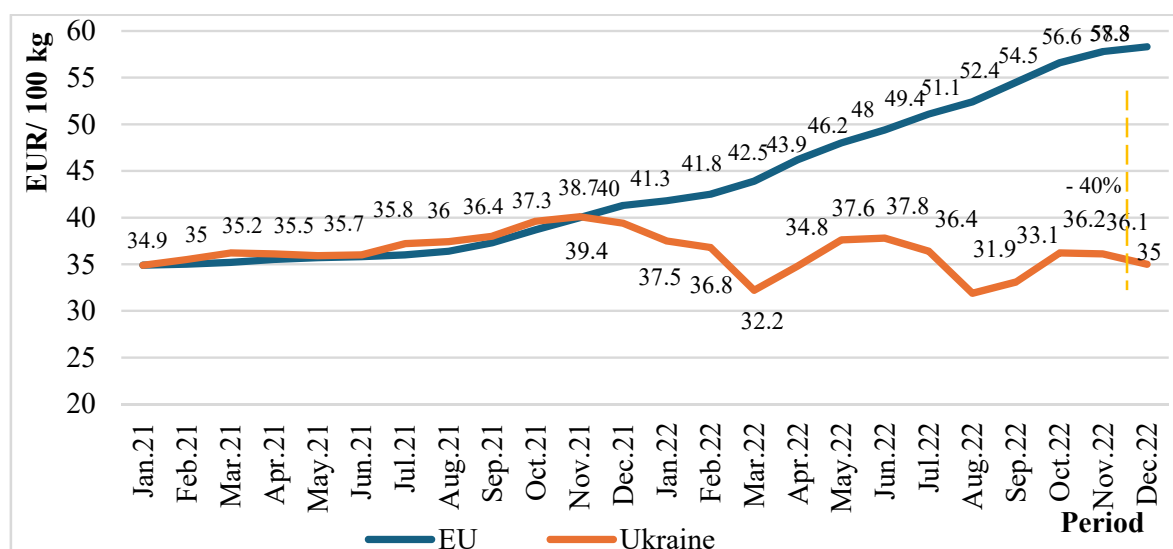


Fig. 2. Comparison of average milk prices (4% fat, 3.4% protein) in the EU and Ukraine, 2021-2022, [27].

In 2021, the milk processing entities profitability was quite high (25%), which allowed large manufacturing enterprises to have a financial strength margin in 2022 (Figure 3). Before the full-scale invasion, about 40% of enterprises producing raw milk were unprofitable, and after that their share is about 60%. The milk and dairy production profitability in modern conditions is reduced due to the influence of the increase in the fodder for dairy cattle price, fuel and electricity, and the logistics costs growth.

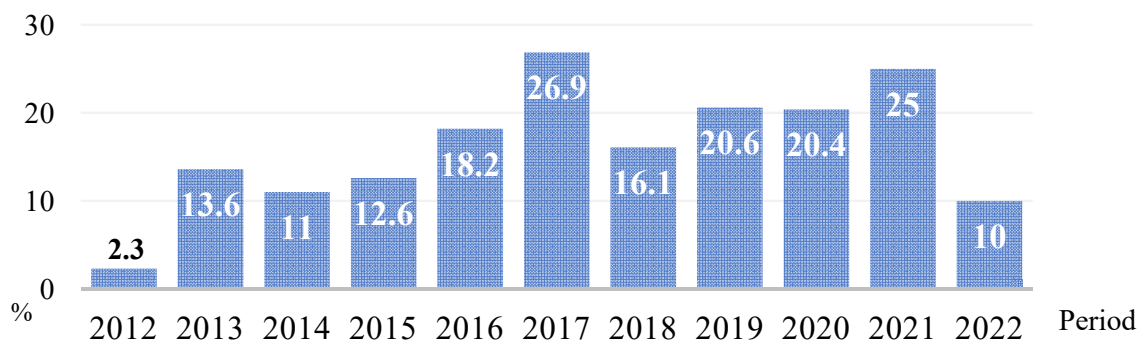


Fig. 3. Milk production profitability level in Ukraine, 2012-2022, %, [27].

The highest use of fodder units per ton of milk in Ukraine in 2022 were in Zakarpattia (1.66 tons), Donetsk (1.27 tons), and Ivano-Frankivsk (1.14 tons) regions (Figure 4). This production determinant during the production intensification significantly affects the final milk price, as the feed costs make up about 60% of the variable milk production expenditures. In this regard, milk production by households in 2022 decreased (by 13.8%) compared to production at agricultural enterprises.

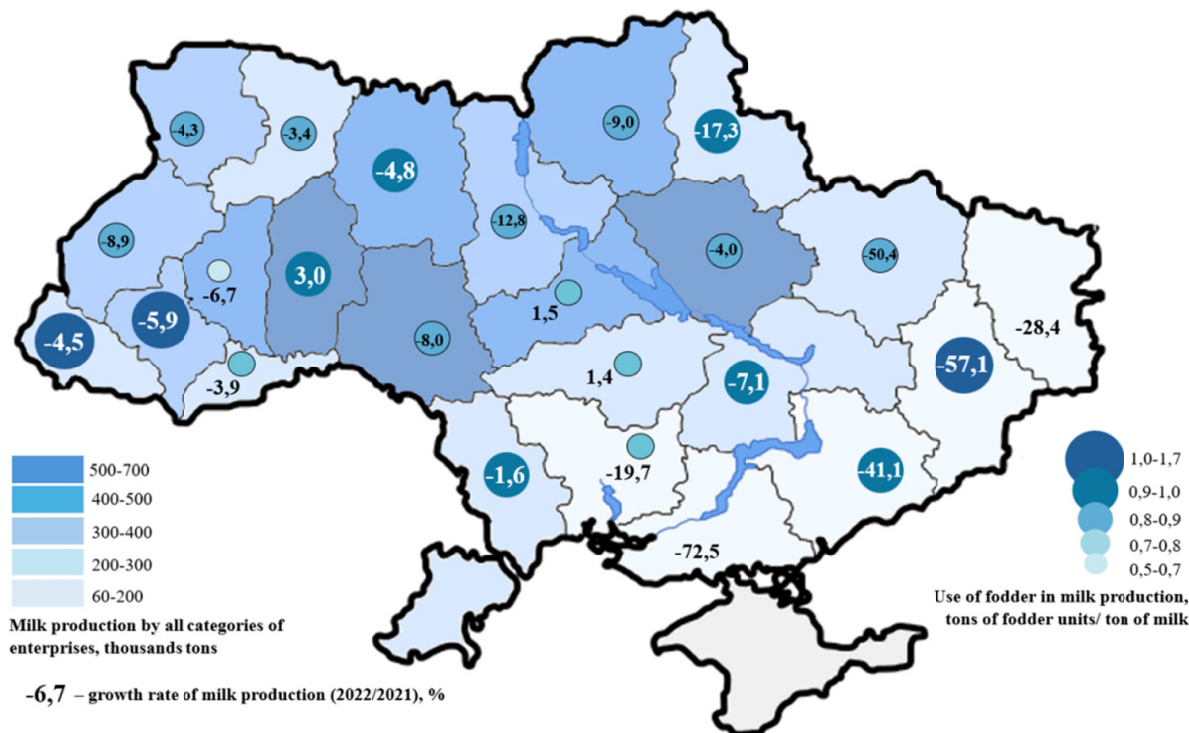


Fig. 4. Milk production by all categories of enterprises in Ukraine by regions, 2022, [27].

The enterprises and households that produce raw milk production capacities regional distribution in Ukraine is presented in Figure 4. Since the beginning of the full-scale invasion (in 2022 compared to 2021), the production growth rates have been positive only in a few regions – Khmelnytskyi region (where the volume of milk production increased by 3%), Cherkasy region (by 1.5%) and Kirovohrad region (by 1.4%). The regions most affected by the hostilities consequences showed a significant reduction in milk production (Kherson, Donetsk, Luhansk, Kharkiv, Mykolaiv and Chernihiv regions) due to occupation, livestock destruction, damage to infrastructure and also production technical base. Raw milk production in 2022, as it was in 2021, is concentrated in Khmelnytskyi, Vinnytsia and Sumy regions, which provides the needs of the largest dairy producers in Ukraine, which are located precisely in these regions.

The raw materials shortage in 2021, which caused large dairy products imports flows, was also observed in 2022 and was intensified by the military conflict. However, simultaneously with a decrease in the population purchasing power and due to migration processes, the deficit did not have a major impact on the Ukraine’s domestic market [8].

The dairy products consumption sufficiency indicator in Ukraine (S_d), the dynamics of which is shown in Figure 5, demonstrates the ratio of the actual average annual milk and dairy products per capita consumption (C_{pc}) and the their normative consumption rate determined by the Ministry of Health (C_n):

$$S_d = \frac{C_{pc}}{C_n} \tag{1}$$

The calculated indicator for the 2003-2022 period shows an insufficient dairy products consumption level in Ukraine, taking into account the annual rate of consumption 380 kg per capita, and is less than 60%, which affects the quality calories level in the Ukrainians diet. Since this situation did not arise due to a dairy products shortage on the domestic market, but due to a decrease in the purchasing power of citizens and migration processes, it is worth investigating other trade determinants that affected the dairy products sales volume in Ukraine, such as inflationary processes and the average level of households income, which determine the dairy products availability level.

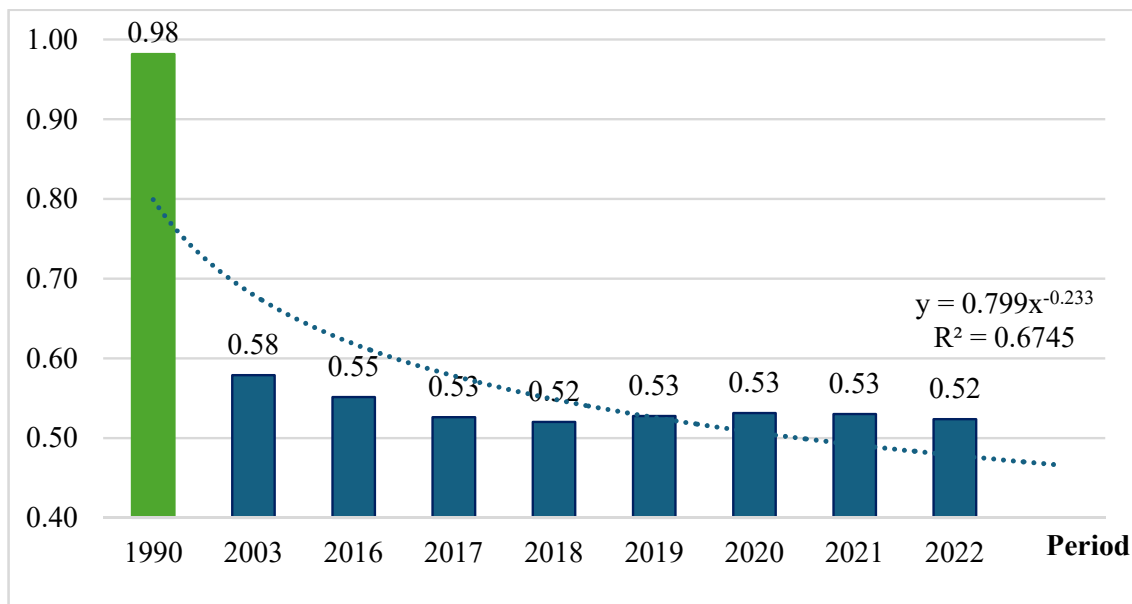


Fig. 5. Dynamics of the dairy products consumption sufficiency indicator level in Ukraine, 1990-2022, [27].

Global and national food security is also assessed basing on the «food availability» level. To define the national producer’s ability to ensure the real level of dairy products consumption, it is determined the ratio dairy production per capita volume (C_{pp}) and dairy products consumption per capita (C_{pc}), which is calculated as follows:

$$I_{pc} = \frac{C_{pp}}{C_{pc}} \times 100\% \tag{2}$$

An important criterion in the indicators system characterizing the food security level is the individual products domestic market capacity (in particular, dairy products), which is monitored in dynamic during 2016-2022 and is determined in natural units. This indicator is calculated as a product of the dairy products per capita consumption (C_{pc}) and the average annual population number (N_p):

$$Q_d = C_{pc} \times N_p \tag{3}$$

The difficult economic situation in Ukraine leads to a reduction in food imports in order to support national production. In 2022, the imports volume was a record low compared to the values of 2019-2021. The domestic dairy products market dependence on the import level is calculated as the share of the dairy product imports in natural units (I_d) in the total domestic dairy market capacity (Q_d) [6]:

$$I_i = \frac{I_d}{Q_d} \times 100\% \quad (4)$$

The results of food security in Ukraine indicators calculation in terms of dairy products provision are presented in Table 1.

The population internal displacement in Ukraine and the some trade networks destruction, which is related to military actions, led to dairy products demand and supply imbalance on regional markets. In the central and eastern regions, retail chains began to reduce their activities due to limited consumption and disruptions in the goods delivery. The dairy production and consumption per capita ratio during the studied period (2016-2022) $I_{pc} > 1$, which indicates that the dairy products volume from Ukrainian producers, considering the level of its consumption, was sufficient (Table 1). The domestic dairy market capacity decreased sharply in 2022, as it was affected by a significant population in Ukraine reduction (by 12%) [27].

Table 1. Ukraine's food security indicators in terms of dairy products providing, 2016-2022, [27].

Indicators	Period							Growth rate, %	
	2016	2017	2018	2019	2020	2021	2022	2022/ 2020	2022/ 2021
Dairy products production and consumption per capita ratio (I_{pc}), %	116.1	121.0	120.4	114.7	109.9	104.5	108.5	-1.3	3.8
Domestic dairy market capacity (Q_d), ths. t	8940	8497	8357	8427	8428	8338	7562	-10.3	-9.3
The level of domestic market dependence on the dairy products import (I_i), %	1.17	1.55	2.15	4.00	8.20	9.37	3.24	-60.5	-65.4

The Ukrainian legislation in the trade field is imperfect and cannot regulate relations between processing enterprises and trade networks. At the same time, the dairy industry, suffering from a lack of working capital during the war, faced the growing receivables problem due to the failure of retail chains to fulfill their obligations on payment terms, which negatively affects the milk processing enterprises financial results. The downward imports volume dynamics in 2022 is explained by the high dairy products price in Europe. The Ukrainian dairy industry can take advantage of this situation and increase the production of the appropriate assortment to replace previously imported goods. Although under the low level of own working capital and insufficient investment, this will be a difficult task [1].

Since there is a relationship between the factors of dairy production, consumption, affordability, and availability, it is worth conducting a study to identify the influence closeness and direction of the main determinants and analyze the dairy production and sales growth reserves to improve the food security level (Table 2) [24].

Table 2. Dynamics of the main dairy industry determinants in Ukraine, 2011-2022, [24].

Period	Retail turnover of dairy products, mln. UAH (y)	Annual milk production per capita, kg	Annual milk consumption per capita, kg (x ₁)	Average monthly wage level, UAH (x ₂)	Milk price indices (x ₃)	Dairy products import, ths. t (x ₄)
2011	6157.0	242.5	204.9	2633	103.4	257
2012	7471.0	249.5	214.9	3026	86.7	410
2013	8511.0	252.5	220.9	3265	125.0	548
2014	8360.0	258.9	222.8	3480	106.5	357
2015	9899.0	247.8	209.9	4195	120.8	78
2016	12455.0	243.3	209.5	5183	126.1	105
2017	27016.7	242.0	200.0	7104	131.0	132
2018	33568.3	238.1	197.7	8865	104.6	180
2019	38311.4	229.9	200.5	10497	107.5	337
2020	44317.7	221.9	201.9	11591	107.9	691
2021	49053.8	210.6	201.5	14014	116.2	781
2022	45570.9	215.9	199.0	14577	105.9	245

In order to construct a correlation-regression model that demonstrates the production and trade determinants influence on the dairy products trade turnover by retail enterprises, the following influencing factors were selected (x_i): annual milk consumption per capita (x₁); average monthly wage level (x₂); the price growth factor (milk and milk products price indices – x₃); the volume of dairy products imports to Ukraine (x₄) [24].

Thus, data on dairy products turnover in retail enterprises were analyzed for 12 periods (n=12) from 2011 to 2022. As the analysis result, four-factor (x₁, ..., x₄) regression dependence models of various types were built using statistical data. The obtained models accuracy level was checked by the determination coefficient value, and their adequacy was verified by the Fisher's and Student's tests.

The method of calculating the correlation-regression analysis elements of consumption, import dependence and population purchasing power determinants influence (x_i) on the retail enterprises dairy products turnover is presented below.

An indicator that reflects the relationship between the factors selected for analysis (x_i) and the resulting indicator (y) closeness is the correlation coefficient (r):

$$r = \frac{\sum[(x-\bar{x}) \times (y-\bar{y})]}{\sqrt{(x-\bar{x})^2 \times (y-\bar{y})^2}}, \quad (5)$$

where \bar{x} – the average value of the independent variable;

\bar{y} – the average value of the dependent variable.

The correlation coefficient value in the range of 0.66-0.99 indicates a significant and direct connection between analyzed factors [28].

The determination coefficient (R²) characterizes the dependence degree of the resulting characteristic (y) on the factors variation (x_i) in a dynamics series and reflects the model accuracy:

$$R^2 = \frac{\sum_{t=1}^n (\hat{y}_t - \bar{y})^2}{\sum_{t=1}^n (y_t - \bar{y})^2}, \quad (6)$$

where \hat{y}_t – the theoretical value of the dependent variable

The determination coefficient critical value for the significance equation with $\alpha = 0.05$ and $k_1=4, k_2=7$ degrees of freedom is 0.702.

The adjusted determination coefficient (R_a^2) is calculated for the possibility of comparing models with different regressors (x_i) numbers:

$$R_a^2 = 1 - \left[\frac{n-1}{n-k-1} \right] \times (1 - R^2), \tag{7}$$

where k – the number of explanatory variables.

To determine the multicollinearity between the factor indicators (x_i) absence, there are calculated the paired correlation coefficients for each of them in Table 3.

Table 3. Paired correlation coefficients matrix.

	x_1	x_2	x_3	x_4
x_1	1			
x_2	-0.528	1		
x_3	-0.013	-0.006	1	
x_4	0.094	0.365	-0.186	1

The calculations results indicate that there is no close relationship between the analyzed determinants (x_i) (since $|r_i| < 0.66$), which allows building a reliable multifactor economic-mathematical model that will reflect indicators influence on the resulting characteristic (y).

With the use of correlation, descriptive statistics, regression tools, various models types of the studied factors regression models were built. With the coefficients indicated reliability of the model use (coefficients of determination, Fisher's and Student's tests) (Table 4) it was found that a linear function the most accurately reflects the dynamics in the resulting indicator changes (y), which is represented by the corresponding equations of a straight line (Figure 6). The relationship closeness between the economic indicators and the statistical significance of the model was verified by comparing the coefficients threshold values with their calculated value (with a reliability level of 95%).

Table 4. The correlation-regression model results interpretation.

Indicator	Calculated value	Results interpretation
Multiple r	0,991	The calculated correlation, determination coefficients and adjusted determination coefficient indicate a significant dependence of the resulting variable – the retail enterprises dairy products turnover on the independent variables selected for analysis.
R²	0,982	
Adjusted R²	0,973	
t-test		The regression coefficients Student's statistic (t-Stat) does not fall into the critical zone $ t\text{-Stat} > 2.18$ for x_1 and x_2 factors ($n = 11$) and for a given probability of 0.95.
x_1	-2,28	
x_2	8,27	
x_3	0,38	
x_4	2,02	
F-test	98,59	The estimated value of Fisher's criterion significantly exceeds the quantile of the Fisher's distribution $98.59 > 4.12 (F > F_T)$ with degrees of freedom for larger and smaller variance (4 and 7). This indicates the regression model adequacy.
Significance		The probability of zero hypothesis (Significance F) is less than the given hypothesis significance level (0.05), which indicates the adequacy of the model with a reliability level of 0.95.
F	0,000003	

As a result of the correlation-regression analysis, the following linear multifactorial economic-mathematical model was obtained:

$$\hat{y}_t = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 \tag{8}$$

$$\hat{y}_t = 78274.0 - 401.16 x_1 + 3.05 x_2 + 27.08 x_3 + 10.08 x_4,$$

where a_0 – parameter showing the average influence level of factors not taken into account in the model on the resulting indicator; $a_1 \dots, a_i$ – regression coefficients, which show each factor influence degree on resulting indicator.

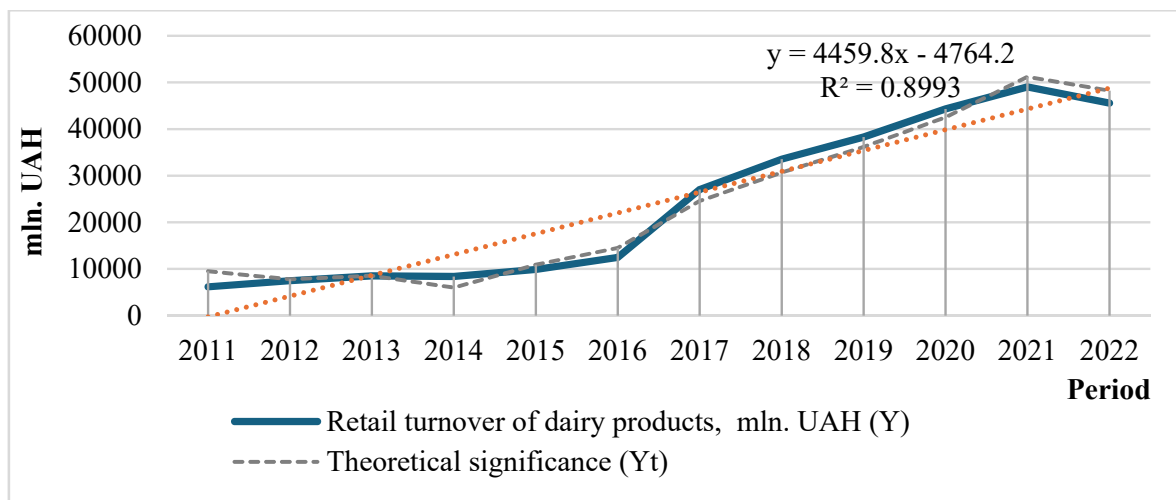


Fig. 6. Actual and theoretical values of dairy products turnover at retail enterprises in Ukraine, 2011-2022, mln. UAH, [27].

Based on the correlation-regression analysis, it is possible to assert a close relationship between the dependent and independent variables and the high model reliability with a correlation coefficient value of 0.99. Thus, the developed four-factor economic-mathematical model can be used to analyze and forecast the level of dairy products commodity reserves in the market depending on the capacity of the domestic market, the level of households income, the inflation factor and dependence on the dairy products import. Using the proposed regression equation, it is possible to determine the possibilities and reserves of achieving turnover at the level of the pre-war period, as well as to evaluate the dairy products availability and affordability as components of the food security indicator system.

4 Conclusions

Dairy industry sustainable development, especially during wartime, depends on many determinants. First of all, it depends on raw milk suppliers, sufficient milk volume, price trends. In turn, the raw materials volume production in Ukraine is affected by the cost of fodder for dairy cattle, transport logistics, problems with uninterrupted energy supply, which leads increasing in the production cost. According to data, the profitability of milk production in 2022 decreased by 15% compared to 2021. Considering the destruction of a significant cattle number as a result of military operations, the development of dairy farming should be a priority in Ukraine and serve as a driving force for the growth of other sub-complexes of the agricultural sector and related industries [1].

The raw milk production growth determinant will contribute to the milk processing industry development and increase export prospects. The Global Food Security Index [29] indicates high «protein quality» in food produced in Ukraine. Given the global shortage of animal protein, this predicts the prerequisites for the dairy farming in Ukraine development, which can become a participant in solving this problem. Cooperation between raw milk producers and processing enterprises will have a positive effect on the production costs and logistics chain and will be able to ensure centralized raw milk procurement and supply.

Optimizing and adopting the Ukrainian legislation in the trade field will allow to ensure sustainable dairy products consumption and will contribute to the relations between dairy producers and trade networks regulation. This will protect manufacturers from debts and critical shortage of working capital. The factor «sustainability and adaptation» of dairy production and sales is influential during the war period, as a national food security component. In this direction, the support of the government and authorities is important, which should focus their efforts on stabilizing agrarian policy and supporting exports. Among the components of food security: availability, affordability, quality, safety, sustainability, and adaptation, it is important to single out the parameters of affordability, sustainability and adaptation of dairy production, which depend on the dairy herd stabilization [30].

The low Ukrainian population purchasing power in 2022 leads to significant sensitivity of consumption to inflationary processes and income levels. Despite the production deficit since the war started, the dairy production and consumption balance has stabilized due to the large number of refugees who have left Ukrainian territory.

To assess the impact of production and trade determinants on the dairy production and sales, the study conducted a correlation-regression analysis based on statistical data for 2011-2022 period. The dairy products annual per capita consumption, the average monthly salary, the annual inflation index for milk and dairy products, and the imported dairy products volume were selected as independent variables. The resulting four-factor linear model can be used to analyze and forecast the situation on the dairy market. The increase in the dairy products consumption and the households income growth in the post-war period will contribute to the turnover in the domestic market.

Therefore, in order to support the effective milk processing enterprises activity, increasing raw milk production will allow maintaining the dairy industry stability as an important food security element, and further research in this direction should be related to the study of the reserves for reducing the dairy products cost chain using up-to-date production technologies.

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