

## Ecological and economic efficiency of production and processing of milk on the example of enterprises of the Akmola Region

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### ABSTRACT

The article is aimed at disclosing statistical information on the production and processing of milk in the Akmola Region and Kazakhstan and drawing up a plan to improve the environmental and economic efficiency of dairy enterprises. The leading approach is the synthesis method, with the help of which a plan was developed to improve the environmental and economic efficiency of dairy enterprises in the Akmola Region. The results: statistics on the production and processing of milk for the period of 2016-2022 trends in the production and processing of milk in Kazakhstan and in the Akmola.

**Keywords:** *Statistical data; increasing the productivity of a dairy enterprise; lean consumption; production subsystems; import and export of dairy products; enterprise management.*

## 1 Introduction

The overall efficiency of milk production and processing is a combination of the social, environmental and economic efficiency of industry enterprises. The concept of environmental efficiency of an enterprise implies the establishment of production work based on lean consumption processes. These processes include optimizing the use of natural resources, prioritizing the use of renewable sources of materials and energy, organizing waste processing and recycling on the territory of an enterprise, if necessary, reducing production volumes to the demanded level. Economic efficiency includes actions aimed at reducing production costs by saving resources (electricity, gas, water, materials), cost optimization (improving the efficiency of logistics and management), and increasing the profitability of an enterprise (new contracts, expansion of product lines, marketing campaigns) (Tleppaev and Tovma, 2017; Shahini et al., 2023).

Improvement of the environmental and economic efficiency of dairy enterprises in the Akmola Region is a requirement for improving the overall efficiency of enterprises and is also required for drawing-up and implementing plans for the development of the dairy industry in Kazakhstan. In addition, identifying components of such efficiency can help manage the resilience of the dairy industry during times of crisis (Ye and Wang, 2019). Siddique and Jajja (2022) devoted their research to the problem of establishing and effectively operating a dairy farm. The authors identified and described the most advanced practices for establishing and managing a farm, including the use of modern technologies, actions aimed at caring for cows, the implementation and compliance with quality standards, as well as the prevention of environmental pollution. The issues of marketing promotion of dairy products in emerging markets were studied by Sahoo and Jena (2022). The results of the study describe various marketing strategies applicable to the sale of milk and dairy products in developing countries, which is an essential part of the economic component of the success of milk production and processing.

Mishra and Shukla (2022) devoted their study to the impact of the COVID-19 pandemic on the state of the dairy industry in India. The authors point to the great harm caused by the lockdown, which resulted in the reduction of supply chains. In this paper, the authors of the study identified ways to combat the impact of the COVID-19 pandemic on the dairy industry: since the main problem during the lockdown period was the delivery of dairy products to marketplaces (rather than reducing the ability to produce milk and dairy products), representatives of the Indian dairy market began to use various marketing strategies, the most effective of which was the strategy of teaming with manufacturers of other popular food products (bread, vegetables and fruits) and organizing the delivery of goods directly to the consumer, bypassing store shelves. The aspect of environmental efficiency of enterprises in the dairy industry was considered by Sharma et al. (2022). The study claims that the dairy industry accounts for up to 11 million tons of waste annually, which has an extremely negative impact on groundwater quality as well as other environmental indicators. Scientists have studied the important issue of dairy industry waste recycling and have described various waste treatment methods (chemical, physical and biological) that can reduce the negative impact of the dairy industry on the environment. Nurakhova et al. (2022) were involved in the study of the market for milk and dairy products in the Almaty Region of the Republic of Kazakhstan. The authors identified a lack of raw materials and government funding for enterprises, as well as recommended considering more modern approaches to marketing and building supply chains.

In this paper, two of the three existing components of the overall efficiency of milk production and processing were considered, namely environmental and economic. The research was focused on a specific region, namely the Akmola Region of the Republic of Kazakhstan. This is because no literature was found on the state of the dairy industry in this region when analyzing existing studies on a given topic.

This article analyses milk production and processing statistics in the Akmola Region and Kazakhstan to develop a strategy to improve their environmental and economic efficacy from 2016 to 2022. The article uses the synthesis method to identify patterns, diagnose regional and national milk production disparities, and propose dairy sector efficiency, environmental, and productivity improvements. The text's main goal is to update stakeholders on the dairy industry's current state, identify areas for improvement, and direct future research to mitigate external influences that could slow the sector.

## 2 Materials and Methods

The investigation of the environmental and economic efficiency of milk production and processing necessitates the application of sound scientific methods, statistical analysis, and theoretical frameworks. In this regard, the following methods were applied in this scientific article: system and logical analysis; synthesis, deduction, induction, visualization, classification and comparison methods; analysis of scientific literature.

The first stage of this research was aimed at studying the issue of the overall efficiency of enterprises, defining the concepts of environmental and economic efficiency, as well as reviewing previous scientific papers on the topic of

improving the efficiency of dairy enterprises to determine the relevant topic of the paper. The following research methods were applied: scientific literature analysis and logical analysis. The author used the logical analysis method to define the concepts of such efficiency of an enterprise. Analysis of the scientific literature was used to examine previous research on a given topic. It helped to consider advanced methods of dairy management, marketing strategies for promoting dairy products to consumer markets, modern methods of recycling dairy production waste, as well as the current situation in the market of milk and dairy products in the Almaty Region of the Republic of Kazakhstan. A cost-benefit analysis model was developed to estimate the potential impact of proposed efficiency improvement activities. Key model parameters include expected cost savings from reductions in waste, energy, and water usage; expected increases in revenue from higher production; and costs of implementing proposed changes.

In the second stage of the paper, statistical data were collected and processed on the production and processing of milk in the Akmola Region and Kazakhstan, as well as information on the volume of imports and exports of milk and dairy products using the method of comparison, classification, deduction and visualization. Using the classification method, the statistics were sorted by years and categories. Further, the statistical data were conceptualized using the comparison method, which enabled identifying trends in the volumes of production of milk and dairy products, as well as determining the share of the contribution of the Akmola Region to the total milk production in the Republic of Kazakhstan. Using the deduction method, conclusions were drawn about the state of the dairy industry in the Akmola Region and Kazakhstan. With the help of the visualization method, the statistical data were properly organized into tables and charts.

In the third stage of the research, the author focused their attention on the need to clarify the factors affecting the efficiency of the functioning of dairy industry enterprises. The method of system analysis was applied for this purpose, which made it possible to consider and describe in detail all the elements of the previously defined concepts of the environmental and economic efficiency of dairy enterprises and to identify the main reasons for the decrease in such efficiency of enterprises.

The last stage of the research was aimed at developing recommendations for improving the environmental and economic efficiency of dairy enterprises in the Akmola region and was carried out using synthesis and induction methods. Using the synthesis method, all the information obtained during the study was collected together, which made it possible to describe ways to increase the productivity of enterprises, taking into account the organizational, technical, marketing and other components of the productivity component. A detailed step-by-step plan for improving the environmental and economic efficiency of milk production and processing at the enterprises of the Akmola region was developed. The induction method was used as an auxiliary method in developing a plan to improve the efficiency of enterprises.

### 3 Results

The Republic of Kazakhstan ranks 28th in the world and second after Uzbekistan in Central Asia in the production of cow's milk (World Milk Production..., 2021). The following statistics are intended to show the dynamics of milk production in Kazakhstan and the Akmola Region (Table 1; 2).

**Table 1.**

Data on the production of cow's milk in 2019-2022 in the Republic of Kazakhstan, thousand tons

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2019	238.7	278.5	395.2	509.7	632.2	825.2	669.4	592.5	555.3	414.2	351.2	358	5820.1
2020	246.3	289.1	407.7	524.3	650.3	849.6	688.9	610.3	575.3	428.7	364	369.7	6004.2
2021	255.5	297.9	422	541.5	666.3	880.5	714.2	829	392.4	441.7	376.3	380.7	6198
2022	259.3	301.8	427.4	547.7	672.4	889.2	726.3	653.2	610.4	-	-	-	5087.7

Source: compiled by the author based on Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (2022).

**Table 2.**

Data on the production of cow's milk in 2019-2022 in Akmola Region, thousand tons

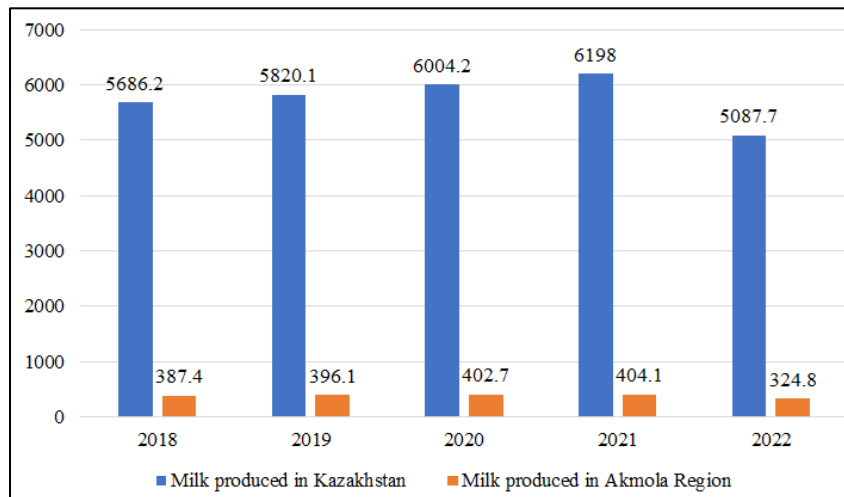
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2019	15.1	17.7	28.2	35	43.4	51.3	46.9	40	38.5	29	24.7	26.3	396.1
2020	15.8	18.2	28.7	35.4	43.9	51.7	47.9	40.4	39.1	29.6	25.1	26.9	402.7
2021	16.1	18.8	29.4	36.1	44.1	52	47.7	40	38.5	29.3	25.3	26.8	404.1
2022	16	18.9	29.8	36.4	44.1	52.4	47.6	40.6	39	-	-	-	324.8

Source: compiled by the author based on Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (2022).

Table 2 shows the volume of cow's milk production in the Akmola Region. Considering the period of January-September, milk production in 2022 is higher than that during the same periods in 2019, 2020 and 2021 by 2.7%, 1.1% and 0.7%, respectively, which amounts to 8.7, 3.7 and 2.1 thousand tons.

Akmola Region has dairy enterprises of various sizes, from individual and small farms to large enterprises. The most famous of them include LLP (limited liability partnership) "Rodina" Agricultural Company that produced 18.6 thousand tons in 2019 (which accounted for 4.7% of the volume of milk produced in the Akmola Region in 2019) and ranked second in terms of the volume of milk produced among all enterprises in the Republic of Kazakhstan (Buyanov, 2020). In addition, the following large milk production and processing enterprises are located in the Akmola Region: JSC (joint-stock company) "Astana Onim", IE (individual entrepreneur) "Aminov", IE "Kharsiev", PC (production cooperative) "Izhevsky", LLP "Aibat", LLP "Gormolzavod", LLP "Esil Agro", LLP "Esilsky MDK", LLP "Capital Natur product", LLP "Maksimovsky dairy zavod", LLP "Milk prozhekt", LLP "Moloko Sinegorye", LLP "Eco milk".

The diagram in Figure 1 shows that in 2018, Akmola Region accounts for 6.8% of all milk produced in the country, with 6.8% in 2019, 6.7% in 2020, 6.5% in 2021, and 6.4% in 2022. Milk processing and production of dairy products are also one of the activities of dairy farms in Kazakhstan (Table 3).



**Figure 1.** Milk production in Kazakhstan and Akmola Region, thousand tons

Source: compiled by the author based on Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (2022); Aidapkelov (2020).

**Table 3.**

Data on the production of cow's milk and dairy products in Kazakhstan in 2016-2020

Year	Milk, thousand tons	Dairy products, thousand tons
2016	5 341.6	729.4
2017	5 503.4	742.9
2018	5 686.2	808
2019	5 864.9	857.8
2020	6 051.4	925.6

Source: compiled by the author based on Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (2022).

According to the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (2022), milk production in the country increased by 10.5% in the first half of 2022, compared to the same period of the previous year, and 19% more kumis was produced during this period. The decline in the production of dairy products is noted for the following items: milk and cream by 10%, butter and spreads by 13%, shubat production has halved, and ice cream production has fallen by 4%. The production of yoghurt and other fermented dairy products fell by less than 2%, while the production of cheese and cottage cheese remained virtually unchanged.

Figures 2-3 show imports and exports of dairy products in Kazakhstan in 2018 and 2019. In 2019, it can be was a significant increase in the export of milk and non-condensed cream compared to 2018 (39443.6 thousand tons against 27424.2 thousand tons). Also, the volume of exports of whey increased 2.5 times (272.7 vs. 748.7). The volume of imports of all items has increased except for butter.

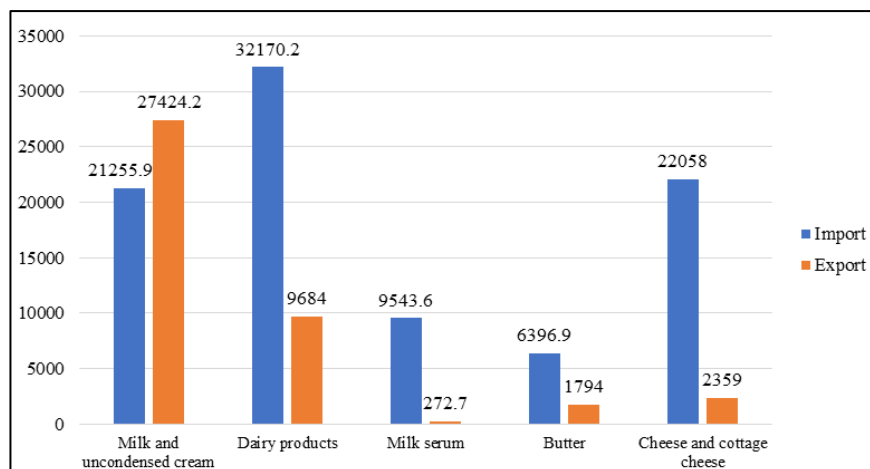


Figure 2. Import and export of dairy products in Kazakhstan in 2018

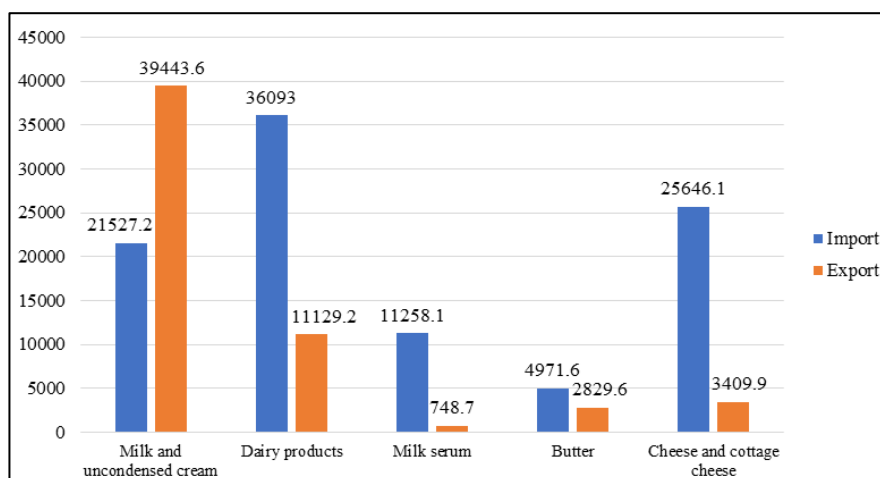


Figure 3. Import and export of dairy products in Kazakhstan in 2019

The market of dairy products in Kazakhstan in the first half of 2022 shows mainly its production of milk with cream (over 95%), dairy products (85%), yoghurt and other fermented dairy products (84%), ice cream and edible ice (78%), as well as cheese and cottage cheese (54%). A large share of the structure of the dairy products market during this period is occupied by solid milk (up to 77%) and condensed cream (59%) imported to Kazakhstan (Bureau of National..., 2022).

The environmental performance of a dairy enterprise is directly related to the creation of a safe environment for dairy cattle, employees, the territory, on which the enterprise is located, as well as the surrounding areas and their residents. Such an environment, in addition to focusing on preserving the environment (prevention of soil, groundwater and atmosphere pollution), guarantees long-term conduct of business without the need to relocate an enterprise (Fang et al., 2020). The following is necessary to create and develop environmental efficiency:

1. Optimize supply chains.
2. Organize the sorting, disposal, and recycling of waste at an enterprise (Singh et al., 2020).
3. Introduce the practice of using recycled materials in production.

The economic efficiency of milk production and processing is an activity aimed at identifying processes that can be optimized and their further transformation. Manufacturing processes can be divided into two types: primary and secondary (Gichohi, 2020). The primary ones include:

1. Delivery of materials to the production area and their storage (this can be feed for dairy animals, equipment, laboratory reagents, veterinary drugs, packaging materials).
2. Production of products (milk and dairy products).
3. Delivery of products from the production area and related processes (packaging, storage, collection, loading).
4. Activities aimed at selling goods (marketing, sales).

The main processes are carried out on the territory of the enterprise and, apart from delivery services, cannot be performed by contractors. Supporting processes:

1. Administration and accounting.
2. HR management (HR department).
3. Procurement and installation of new equipment; repair and modernization of existing equipment.
4. Procurement of materials.

Auxiliary processes (except for the process of installation/repair/modernization of equipment) can be performed by contractors outside an enterprise. Production subsystems are an important component for understanding the concept of environmental and economic efficiency. Production subsystems are objects, processes and operations unique to each enterprise, which are used, implemented and established by the employees from different units (departments) and with different functions (Nandy et al., 2021). The lack of high-quality interaction between representatives of various units (departments) of an enterprise can lead to destructive processes in production subsystems. With a decrease in milk production, it is necessary to determine the cause of this negative phenomenon. Provided that the reason for the decrease in production is not a breakdown of equipment or external factors beyond the control of an enterprise, the cause should be sought in one or more of the following points:

1. Critical decline in the economic, environmental or social efficiency of an enterprise;
2. Depletion of resources, which are irreplaceable for an enterprise;
3. Changes in consumer demand.

It is important that the decrease in the social efficiency of an enterprise, as well as points 2 and 3, also negatively affect the environmental and economic efficiency (Lamjahdi et al., 2020). Each of the above critical issues is an area of responsibility for the production subsystems existing in an enterprise. Based on the need for early detection of possible negative phenomena, the management of dairy enterprises needs to bring the indicators and reporting of an enterprise to a single standard, as well as to establish an unhindered transfer of information between units (departments) that are part of the same production subsystems (Ferto et al., 2021). Increased productivity of an enterprise is the result that all managers strive for (Miao et al., 2022). It is important to note that increasing the productivity in an enterprise is the final stage in the process of increasing the environmental and economic efficiency of milk production and processing. Some or all of the following should be implemented to increase the productivity of a dairy enterprise:

1. Conduct an audit of documentation on labor and product safety. Update it if necessary.
2. Inform the population of nearby areas about the type of activities of an enterprise. This can be both a way to market products without the need to ship long distances or to attract the necessary labor force to an enterprise.
3. Obtain an ISO (International Organization for Standardization) 14001 certificate confirming the implementation of the Environmental Management System (EMS) at an enterprise.
4. Obtain an ISO 9001 certificate confirming the implementation of the Quality Management System (QMS) at an enterprise.
5. When opening new production facilities, focus should be made on the location of suppliers to reduce logistics costs.
6. Personnel development is an element of the social efficiency of enterprises. However, it significantly affects economic efficiency. This means that training and career opportunities for staff should not be neglected in the process of improving the environmental and economic efficiency of an enterprise.
7. Revise and, if necessary, change the packaging of the goods to be more attractive/convenient for the consumer. Rebrand.
8. Develop a system of communication and information exchange between units (departments) with different functionalities to establish high-quality and uninterrupted operation of production subsystems.
9. Reduce the noise level from some equipment by installing acoustic panels. This activity aims to achieve two goals at the same time: compliance with ISO 14001 environmental standards and reducing stress levels in dairy cattle (which also contributes to an increase in milk yield).
10. Purchase and install a system of dust and gas cleaning of air by a dry method at an enterprise.
11. Purchase and install a production automation system at an enterprise; install automatic measuring equipment.
12. Carry out mandatory regular maintenance of equipment, which will help prevent major breakdowns that entail costly repairs and business downtime.
13. Conduct regular surveys of consumers to identify the dynamics of demand and obtain the possibility of an early response to its decline.
14. Use best practices in marketing (e.g., social media optimizing campaigns).
15. Take into account the possibility of force majeure in the procurement process (Jack et al., 2021; Pisma and Iskandar, 2021).

Increasing the environmental and economic efficiency of milk production and processing at the enterprises of the Akmola Region should be implemented as follows:

1. At the initial stage, it is necessary to identify and describe in detail all elements of the value chain of milk and dairy products.
2. The next step requires representatives of the dairy industry of the Akmola Region to determine the situations and conditions for interaction between enterprises in the region.
3. From the information obtained as a result of stage 2, it is required to determine systemic interactions (i.e., those that are required to be performed permanently for the stable operation of the dairy industry of the region and the country) as well as to implement the stable and high-quality implementation of these interactions.
4. The fourth step in the process of improving the environmental and economic efficiency of milk production and processing requires the identification or creation of mechanisms responsible for increasing the quality of the activities of enterprises.
5. The last stage is aimed at finding or creating opportunities to increase milk production and processing volume.

Dairy efficiency can be substantially impacted by factors such as livestock inputs, climatic conditions, farm management practices, and operational processes. The nutrition and breed of cattle are critical factors influencing milk production (Gritsienko et al., 2021; Nandy et al., 2022). L. Miao et al. (2022) found that heat stress caused by temperature extremes, droughts, and floods can have a negative impact on milk production. Efficiency is also influenced by management decisions concerning breeding schedules, technology adoption, and herd health protocols. On selective farms, the adoption of advanced feeding systems resulted in a notable increase of 11-15% in milk production per cow (Sharma et al., 2022). In addition, regional factors such as infrastructure, labor costs, climate patterns, and feed availability have a significant impact on efficiency metrics. When evaluating efficiency, it is crucial to consider these contextual factors. Incorporating data on feed prices, climate, cattle inputs, and management strategies into a multivariate analysis may offer supplementary context when evaluating the efficiency of dairy sources.

## **4 Discussion**

### **4.1 Automation of production processes and control quality**

One of the methods to improve the environmental and economic efficiency of milk production and processing is the automation of production processes. This aspect of the dairy industry was studied by Heema et al. (2022). Scientists have identified the benefits that automation provides for dairy enterprises. They include consistently high product quality, compliance with product safety standards, and optimization of production and control processes. The authors call automated milking equipment the most important for the dairy industry since it can be used to guarantee the highest standard of purity and quality of milk. In addition, milk processing also requires precision and stability, which means that these processes need to be automated (Moroz, 2023). As noted in this paper above, economic efficiency strongly depends on the technological equipment of an enterprise. New technologies and equipment greatly facilitate, speed up and help optimize farm processes, which is a competitive advantage and contributes to the development of an enterprise (Anand et al., 2022; Atanelishvili et al., 2020).

Riu et al. (2021), in their paper on new technologies available to farmers to promote the development of the dairy industry, explored miniature analyzers as a method to maintain the quality of milk and dairy products. The authors of the reviewed article discuss the prospects for using miniature analyzers on private dairy farms or in individual farms since the quality of the results of the analysis of macronutrients (fats, proteins and carbohydrates) of this type of analyzers is comparable to the results of laboratory studies. In addition, it is possible to detect counterfeit results of miniature analyzers (Oliinychuk et al., 2023). Considering miniature analyzers as part of the necessary equipment for farms that are not equipped with laboratories and are far from professional laboratories, it can be stated that such technologies are another way to increase the environmental and economic efficiency of milk production and processing (Gritsienko et al., 2022; Karatieieva and Posukhin, 2023). By reducing the cost of equipping and operating the laboratory on the territory of an enterprise, as well as transporting samples and paying for the services of a professional laboratory on an ongoing basis, such a miniature analyzer can become indispensable equipment for small dairy enterprises in Kazakhstan.

### **4.2 Lean production and environmental efficiency**

Kumar and Shankar (2022) studied methods of lean production and subsequent environmental efficiency in the dairy industry in their paper. The authors focused their attention on a detailed consideration of the product value chain. In their opinion, if due attention is paid to this element when developing a business model, it is possible to optimize production even at the stage of theoretical design, as well as eliminate or reduce processes that do not create value. The research results showed increased environmental and overall production efficiency: a reduction in waste, an increase in plant throughput, as well as a 34.79% increase in production speed. Considering environmental efficiency not only as a matter of environmental protection but also as an element of the overall efficiency of an enterprise, it is possible to see and implement activities useful for business with simple methods (Idrysheva et al., 2019; Ospanov et al.,

2020). This approach guarantees the comprehensive development of an enterprise, its integration into modern management concepts (Tovma et al., 2013). It will positively affect the economic and social elements of the overall efficiency of an enterprise.

#### **4.3 Consumer perceptions and crisis management**

Chen et al. (2022) studied the Chinese dairy industry in terms of consumer perceptions of industry crises and the way dairy producers deal with them. The authors found a direct correlation between consumer intentions and how wrong potential buyers perceive the actions of companies in the industry during the fight against the crisis. In addition, the authors note that consumers often perceive various sectors of the economy (including the dairy industry) as institutions, which means that citizens are more skeptical about the government that allowed a crisis in the industry because the functioning of an entire sector of the economy is impossible without state regulation. The results of a study by Chen et al. point to the increased value of ethical business conduct for buyers, as well as the apparent responsibility of the government for the crisis of the industry or the misconduct/unethical behavior of its representatives. Public dialogue or coverage of a company's environmental (or any other ethical from a buyer's point of view) activities in the media can be a promising marketing strategy for developing the economic efficiency of an enterprise or the entire industry (Kozhakhieva et al., 2018; Tokysheva et al., 2022).

#### **4.4 Free Trade Agreements, cooperatives, and small producers**

In his research, Basu (2022) conducted a quantitative analysis of the Free Trade Agreement between India and the European Union, as well as tried to assess its potential impact on the Indian dairy sector. The author concluded that the adoption of such an agreement would have a positive impact on domestic imports and the well-being of Indian consumers, and the reduction of tariff rates would increase the share of imported dairy products in this sector of the economy. However, despite the obvious benefits for consumers and the country's economy, the author also points out possible problems for producers of certain types of dairy products in India, since these products make up a large share of imports from Europe. The author's research emphasizes the importance of effective interaction between representatives of the dairy industry sector and the government to build productive communication and prevent political decisions that are detrimental to the industry.

Kaur and Singla (2022) studied the association of individual farmers and dairy farms with cooperatives and the consequences of such association for business in their research. In the course of this research, scientists found that cooperatives provide significant advantages for small producers: farmers get the opportunity to create their supply chains to deliver materials to the enterprise and finished products to consumers, facilitate monetary transactions, as well as stimulate support and improve product quality, which ultimately allowed to increase the cost of finished products for the consumer without losing (and in some cases even increasing) production volumes. Thus, thanks to the association of small entrepreneurs with dairy cooperatives, they managed to increase the marginality of milk production and processing, which is a target indicator for any type of production (Ismayilov et al., 2023). The author also found that members of cooperatives are often younger, more educated, and more motivated than employees of large manufacturing companies. The results of this research show the importance of links and cooperation between representatives of the same industry and indicate that the goods of small producers (despite often higher costs than goods from large industries) also have their niche in the dairy products market. Thus, by building horizontal links with other players in this niche, it is possible to increase the recognition of goods by increasing the quality of products, creating additional demand for dairy products and, as a result, increasing the economic efficiency of milk production and processing throughout the cooperative.

## **5 Conclusions**

This study of the environmental and economic efficiency of milk production and processing provided information on the volume of production of milk and dairy products in the Akmola Region and the Republic of Kazakhstan in the form of diagrams and tables with statistical data. The data provided in the paper cover the period of 2016-2022. and is aimed at highlighting the dynamics of the production and processing of milk in the Akmola Region and the Republic of Kazakhstan with comparison. The analysis of statistical data showed a steady growth in the production of milk and dairy products in Kazakhstan. The data for the Akmola Region indicate a modest increase in milk production, which, however, has not kept pace with the increase in milk production in the country. Thus, the research revealed a reduction in the share of milk produced by the enterprises of the Akmola Region in the total volume of milk produced by all enterprises in Kazakhstan (the decrease in the share amounts to 0.1-0.2% annually).

Based on the above statistical data, the author made recommendations aimed at improving the environmental and economic efficiency of dairy industry enterprises in the Akmola Region. The recommendations include theoretical information aimed at deepening the understanding of the structural functioning of food processing enterprises, as well as practical recommendations, the implementation of which increases the environmental and economic elements of



the overall efficiency of enterprises. In the course of the research, such an element of increasing the environmental and economic efficiency of an enterprise as productivity was considered in detail. The methods of increasing productivity presented in the paper cover all possible areas of the enterprise's activities: marketing and increasing sales volumes, HR development, raising environmental and industrial safety standards, the operation of equipment and auxiliary systems, and management. The author recommends focusing further studies of the dairy industry in the Akmola Region on identifying external factors that negatively affect the overall efficiency of milk production and processing. This will allow planning and implementing activities aimed at the development of the dairy industry in the region, taking into account the obstacles of a political, general economic or any other nature.

## References

- Aidapkelov, N. (2020). *Agriculture, forestry and fisheries in the Almaty region for 2015-2019: Statistical Compilation*. Nur-Sultan, Ministry of National Economy of the Republic of Kazakhstan.
- Anand, P., Husain, D., Prakash, R. (2022). Sustainable integrated system for rural development: A case study. *Insights into Regional Development*, **4** (3): 96-109. [http://doi.org/10.9770/IRD.2022.4.3\(6\)](http://doi.org/10.9770/IRD.2022.4.3(6))
- Atanelishvili, T., Silagadze, A., Silagadze, L. (2020). Some economic problems of the post-soviet states after the global financial crisis. *Bulletin of the Georgian National Academy of Sciences*, **14** (3): 149-154. Available at: <http://science.org.ge/bnas/vol-14-3.html>
- Basu, A. (2022). The India-EU FTA and its potential impact on India's dairy sector: A quantitative analysis. *Foreign Trade Review*, **57** (1): 7-26.
- Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. (2022). Available at: <https://www.gov.kz/memleket/entities/stat?lang=ru> (accessed on January 11, 2023).
- Buyanov, S. (2020). *TOP-69 largest milk producers in Kazakhstan in 2019*. Available at: <https://eldala.kz/rating/3219-top-69-krupnejshih-proizvoditelej-moloka-v-kazahstane-v-2019-godu> (accessed on January 14, 2023).
- Chen, Sh., Gao, H., Zhang, J.A. (2022). *Consumers' Responses to corporate normalised misconduct during an industry-wide crisis: An investigation in the Chinese dairy industry*. <https://doi.org/10.1177/18393349211065193>.
- Fang, Z., Chiu, Y.H., Lin, T.Y., Chang, T.H. (2020). Economic, social, medical, work injury, and environmental efficiency assessments. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, **57**: 1-16.
- Ferto, I., Bojnec, S., Fogarasi, J. (2021). The investment behaviour of dairy farms in transition economies the investment behaviour of dairy farms in transition economies. *Baltic Journal of Economics*, **21** (1): 60-84.
- Gichohi, P. (2020). The role of record keeping and maintenance in enhancing decision making among smallholder dairy farmers in Gitugi Ward in Murang'a County, Kenya. *Information Development*, **36** (4): 535-545.
- Gritsienko, Y.V., Gill, M.I., Denisyuk, L., Gorbatenko, I.Yu. (2021). Polymorphism of genes of the protein and lipid exchanges in modern Ukrainian breeds of cattle bred for dairy productivity. *Journal of Clinical Rheumatology*, **74** (6): 373-380. <https://doi.org/10.2478/prolas-2020-0056>
- Gritsienko, Y., Gill, M., Karatieieva, O. (2022). Connection between gene markers with milk production traits of Ukrainian dairy cows. *Online Journal of Animal and Feed Research*, **12** (5), 302-313. <https://doi.org/10.51227/ojafir.2022.41>
- Heema, R., Sivaranjani, S., Gnanalakshmi, K. (2022). An insight in to the automation of the dairy industry: A review. *Asian Journal of Dairy and Food Research*, **2**: 125-131.
- Idrysheva, Z., Tovma, N., Abisheva, K.-Z., Murzagulova, M., Mergenbay, N. (2019). Marketing communications in the digital age. *E3S Web of Conferences*, **135**: 04044. <https://doi.org/10.1051/e3sconf/201913504044>
- Ismayilov, V., Safarov, G., Sadigova, S., Asadov, Z., Muradova, S. (2023). Technology of production and primary processing of milk in farm conditions. *Scientific Horizons*, **26** (10): 138-149. <https://doi.org/10.48077/scihor10.2023.138>
- Jack, C., Adenuga, A.H., Ashfield, A., Mullan, C. (2021). Understanding the drivers and motivations of farm diversification: Evidence from Northern Ireland using a mixed methods approach. *The International Journal of Entrepreneurship and Innovation*, **22** (3): 161-176.
- Karatieieva, O., Posukhin, V. (2023). The use of entropy and information analysis to estimate the milk productivity of the Black-and-White dairy breed cows depending on their lineal affiliation. *Ukrainian Black Sea Region Agrarian Science*, **27** (3): 80-89. <https://doi.org/10.56407/bs.agrarian/3.2023.80>

- Kaur, M., Singla, N. (2022). *Comparative performance of cooperatives and producer companies in member producer's income enhancement: A case study of the milk sector in Indian Punjab*. <https://doi.org/10.1177/09763996221091654>.
- Kozhakhiev, M., Dragoev, S., Uzakov, Y., Nurgazezova, A. (2018). Improving of the oxidative stability and quality of new functional horse meat delicacy enriched with sea Buckthorn (*Hippophae Rhamnoides*) fruit powder extracts or seed Kernel Pumpkin (*Cucurbita Pero L.*) flour. *Comptes Rendus de L'Academie Bulgare des Sciences*, **71** (1): 132-140.
- Kumar, U., Shankar, R. (2022). *Application of Value Stream Mapping for Lean Operation: An Indian Case Study of a Dairy Firm*. <https://doi.org/10.1177/09721509221113002>.
- Lamjahdi, A., Bouloiz, H., Gallab, M. (2020). *Toward a model to apprehend the complexity of manufacturing firm's overall performance*. <https://doi.org/10.1177/1847979020901982>.
- Miao, L., Zhuo, Y., Wang, H., Lyu, B. (2022). *Non-Financial Enterprise Financialization, Product Market Competition, and Total Factor Productivity of Enterprises*. <https://doi.org/10.1177/21582440221089956>.
- Mishra, A., Shukla, A. (2022). *Gyan Fresh: Digital transformation of dairy business with resilience and technology innovation*. <https://doi.org/10.1177/23197145221113374>.
- Moroz, I. (2023). Determination of calcium in milk by titrimetric method. *Tovaroznavchiy Visnik*, **1** (16): 63-72. <https://doi.org/10.36910/6775-2310-5283-2023-17-5>
- Nandy, A., Singh, P., Singh, A. (2021). Systematic Review and meta- regression analysis of technical efficiency of agricultural production systems. *Global Business Review*, **22** (2): 396-421.
- Nurakhova, B., Nurpeissova, A., Baizhaxynova, G. (2022). Market of milk and dairy products in Almaty region of Kazakhstan. *Problems of AgriMarket*, **2**: 169-178.
- Oliinychuk, O., Muravska, Y., Kolesnikov, A., Savka, N., Oliinychuk, R., Moskaliuk, N. (2023). Fighting counterfeit as a threat to the economic security of the state on the basis of criminology research. *Law, Policy and Security*, **1** (1): 26-40.
- Ospanov, A.A., Muslimov, N.Z.H., Timurbekova, A.K., Mamayeva, L.A., Jumabekova, G.B. (2020). The effect of various dosages of poly-cereal raw materials on the drying speed and quality of cooked pasta during storage. *Current Research in Nutrition and Food Science*, **8** (2): 462-470. <https://doi.org/10.12944/CRNFSJ.8.2.11>
- Pisma, A., Iskandar, R. (2021). Branding Lasi dairy farm. *Judiciary: Journal of Creative Communication Design*, **3** (1): 6-8.
- Riu, J., Gorla, G., Giussani, B. (2021). Miniaturized near-infrared instruments in dairy products or dairy industry: First steps in a long-distance race? *NIR News*, **32** (1-2): 17-19.
- Sahoo, K., Jena, L. (2022). Story of milk mantra: Growth and sustenance in a complex emerging market. *Business Perspectives and Research*, **10** (3): 396-414.
- Shahini, E., Misiuk, M., Zakhodym, M., Borkovska, V., Koval, N. (2023). Analysis of the economic efficiency of growing pigs for meat and its improvement. *Scientific Horizons*, **26** (6): 110-120. <https://doi.org/10.48077/scihor6.2023.110>
- Sharma, S., Giri, A., Bhagat, N.R., Kumar, R., Raj, T. (2022). The treatment of dairy industry waste. In: S. Dhull, A. Singh, P. Kumar (Eds.), *Food Processing Waste and Utilization*. Boca Raton, CRC Press, pp. 285-300.
- Siddique, M., Jajja, M. (2022). *Jamal Dairy Farm: Technology Adoption Challenges*. <https://doi.org/10.1177/09728201221107784>.
- Singh, A., Tiwari, R., Joshi, P., Dutt, T. (2020). Insights into organic waste management practices followed by dairy farmers of Ludhiana District, Punjab: Policy challenges and solutions. *Waste Management & Research*, **38** (3): 291-299.
- Tokysheva, G., Makangali, K., Uzakov, Y., Kakimov, M., Vostrikova, N., Baiysbayeva, M., Mashanova, N. (2022). The potential of goat meat as a nutrition source for schoolchildren. *Potravinarstvo Slovak Journal of Food Sciences*, **16**: 398-410. <https://doi.org/10.5219/1763>
- Tleppaev, A.M, Tovma, N.A. (2017). Prospects of the development of the green economy at the global level. In: *Proceedings of the 30th International Business Information Management Association Conference, IBIMA 2017 - Vision 2020: Sustainable Economic development, Innovation Management, and Global Growth, 2017-January*. Available at: <https://ibima.org/accepted-paper/prospects-development-green-economy-global-level/> (accessed on January 10, 2023)

- Tovma, N., Torgaeva, B., Mamyrbayev, A. (2013). Methodology for statistical research of social partnership in the Republic of Kazakhstan. *Actual Problems of Economics*, **145** (7): 493-497.
- World Milk Production by Country. (2021). Available at: <https://www.atlasbig.com/en-gb/countries-by-milk-production> (accessed on January 10, 2023)
- Ye, F., Wang, Y. (2019). The effects of two types of environmental regulations on economic efficiency: An analysis of Chinese industries. *Energy & Environment*, **30** (5): 898-929.