

SUSTAINABILITY AND PERSPECTIVES OF THE NORTH MACEDONIAN DAIRY INDUSTRY

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Abstract: The subject of this review is the dairy industry in the Republic of North Macedonia. This industry can bring many economic and social benefits to society and the economy. The paper provides a description and analysis of the current situation within the dairy industry in our country. Milk production rates in our country are analyzed, with a comparative approach to production rates at global and European levels. In the Republic of North Macedonia, milk production is characterized by many traditional small farmers (80% of the total) with 1–3 cows and low annual milk productivity (2–3 thousand liters per cow). The number of large specialized farms with more than 15 cows (about 3% of the total) with annual milk production of about 5 thousand liters per cow is minimal. Only 1% of all farms have more than 50 cows. The Republic of North Macedonia is an absolute importer of milk and its products. The quantity and monetary value of imported milk and its products are many times higher than the quantity and value of exported milk. Today, the dairy industry faces various challenges in the three main pillars of sustainability: economic, social and environmental including fluctuating market prices, high labor costs, and demographic characteristics of the population in terms of age. In conclusion, for the dairy industry to be sustainable, all activities should be carried out in partnership with the industry (along the value chain), policymakers and a wide range of stakeholders, including consumers.

Key words: dairy industry, financial support, milk quality, dairy product standards.

Introduction

The dairy industry is a branch of the food industry that deals with the production and processing of milk and its products. Global milk production reached 906 million tons during 2020, registering a 2% increase compared to the 2019 data (FAO, 2021). As a branch of economic activity, it is based on livestock production which is also presented as the primary source of necessary raw

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materials. Dairy industry refers to the industry or business of production and processing of animal milk, in our case cow's, sheep's and goat's milk and in some cases other animals for daily consumption by humans. Augustin et al. (2013) and Von Keyserlingk et al. (2013) have highlighted concerns in the literature about the sustainability of the dairy industry in the face of climate change, globalization and a lack of multidisciplinary research initiatives. Developed countries, which represent the countries with the largest volume of fresh milk production, account for the largest number of studies. However, there are an increasing number of publications in some developing countries such as India and Turkey, possibly due to the presence of this industry in these countries (Feil et al., 2020).

Generally, the dairy farm is the one that produces milk, while the dairy factory is the one that processes it and converts it into a variety of dairy products. These enterprises, like farms or factories, are part of the global dairy industry of the food industry. Nowadays, more than 6 billion people worldwide consume milk, butter, cheese, yoghurt and other dairy products. Per capita milk consumption has almost doubled in developing countries since the early 1960s. Given that meat and egg consumption has tripled and quintupled, respectively, milk consumption has quiet grown (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>). Dairy products vary significantly from country to country in the same region, depending on cultural and social dietary habits, technology, and market demand. Demand for dairy products is increasing in developing countries with population growth, urbanization, rising incomes, and changing diets. The gap with many developing countries is narrowing, although the per capita consumption of dairy products is higher in developed countries. The increasing demand for dairy products provides a very good opportunity for producers and other players in the dairy chain to improve their standard of living through increased production. The most consumed dairy product in developing countries is fluid milk, but dairy products are also playing an increasingly important role in many countries (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>). As a fundamental part of the agricultural complex in the Republic of North Macedonia, the dairy industry occupies an important place in developing the country's overall economy and the international foreign exchange market. Despite the influence of imports of dairy products, there are opportunities for the progress of the Macedonian dairy sector. Significant improvement in the dairy sector is ensured by the modernization process of primary production and advanced training of dairy processors (Bojkovska and Petkovska, 2016). Codex Alimentarius defines a dairy product as a product obtained from the processing of milk and containing food additives and other ingredients functionally necessary for processing (<https://www.fao.org/fao-who-codexalimentarius/en/>).

The dairy industry in North Macedonia

The agricultural and agribusiness sectors are the most significant economic sectors of North Macedonia. Nearly 433,500 people, out of a population of 2,083,173, derive their livelihood or part of their income from agricultural services. The excellent natural conditions and the present heritage, enriched with new advanced skills offer diverse opportunities in agriculture, from pastures in the high mountains with an altitude of over 2000 meters to a rich Mediterranean climate with water valleys. One of the rapidly developing sectors in North Macedonia is the agribusiness sector. In view of the large European markets, the processing of high-quality agricultural products is one of the most important business areas. Organic production in North Macedonia is growing very fast. In the last four years, the area approved for organic production has increased. According to statistics, there are more than 800 organic farmers in our country, focused on the production of meat, milk and dairy products, honey, cereals, industrial oil crops, wine, fruits and vegetables (<https://investnorthmacedonia.gov.mk/export-agrobusiness-and-food-processing/>).

About half of the territory of the Republic of North Macedonia is agricultural, of which 44% is arable land and 56% is pasture land. North Macedonia has a significant raw material base from primary agriculture, which is the basis for the development of the agricultural and processing sector (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>).

The agri-food sector is one of the most important sectors of the national economy, or the third most important sector after industry and services, accounting for 18% of the gross domestic product (GDP), with agriculture accounting for about 12% and the food industry accounting for 6% of GDP (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>). The dairy industry is the most significant agricultural industry in North Macedonia. White cheese is a brined cheese type with salty taste and firm texture. It is an indigenous dairy product with a long history and is the most consumed cheese in the country (Sulejmani et al., 2021). It is similar to the various country cheeses on the Balkan Peninsula, included in the category of indigenous dairy products depending on the area, production technology, name and quality (Mateva et al., 2019; Sulejmani et al., 2014). The production of brined cheeses has been practiced for centuries, with differences in technological processes, climatic conditions, and cultural habits. However, industrial standardized production has increased in the last decade of the century (Huppertz et al., 2006; Sulejmani, 2014). Little is known about Kashkaval cheese produced in Macedonia in terms of production methods and composition (Mijačević and Bulajić, 2004; Santa and Srbinovska, 2014). An exceptional contribution is made by the diversity of geographical conditions, which contributes to the diversity of types and recipes of dairy products. The milk and dairy industry

is one of the most important segments of the agro-industrial system, and its products belong to the group of food products that make up a significant part of the total food consumption of the average family in our country (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>).

To ensure the best quality of milk and its products, it is necessary to ensure high quality milk production. This is essential in view of the country's aspiration to accelerate its membership in the European Union (EU) with its high standards and rules in the dairy production chain. The European Union is a substantial producer of milk and dairy products, integrated into the standard market organization. Milk production takes place in all EU Member States and represents a significant part of the value of EU agricultural inputs. The dairy industry accounts for more than 12% of total EU agricultural production, making it the second-largest agricultural sector after vegetables and horticulture (Bas – Defosse et al., 2019a).

Milk production

The production of milk and dairy products in the Republic of North Macedonia has a long tradition, to which the diversity of geographical conditions makes a unique contribution, which in turn contributes to the diversity of types and recipes of dairy products. On the Macedonian territory, the administrative ban on goat breeding in 1947 had disastrous consequences; however, goat production increased again in 1989 (Dzabirski and Andonov, 1997). The milk and dairy industry is one of the most critical segments of the agro-industrial system, and its products belong to the group of food products that constitute a significant part of the total food consumption of an average family in our country.

Table 1. Total milk production over the last decade.

Year	Total milk production in'000 liters	Cow's milk		Sheep's milk	
		Total in'000 liters	Average per cow	Total in'000 liters	Average per sheep
2010	394.33	347.10	2.787	32.15	60
2011	417.23	376.29	2.866	25.38	51
2012	403.23	349.76	2.928	38.61	79
2013	429.40	380.73	3.009	34.27	70
2014	436.25	387.00	3.053	35.66	74
2015	417.38	361.07	2.828	40.74	77
2016	463.44	403.04	3.046	41.06	77
2017	448.75	394.14	2.867	35.36	69
2018	463.63	404.23	3.077	36.55	68
2019	442.85	390.90	3.438	35.08	68

The export strategy of North Macedonia for milk and products should expand the volume and improve the export configuration to increase the volume of international exchange and gradually reduce the deficit in the current account (Bojkovska, 2012). The situation of the dairy industry in North Macedonia is presented in Table 1 (SSO, 2020). The fluctuations in terms of total milk production from Table 1 show that the highest level of milk production was observed in 2018, which decreased in subsequent years with an increasing trend. High and low amounts are observed in the yield of cow's milk produced, with the production level being higher in the previous year. In terms of the amount of cow's milk produced per capita, Table 2 shows the overall stability of the amount of milk with a steady upward trend. The most considerable amount of milk per capita was observed in 2020, with a value of 3,648 liters, which is significantly lower than the European average (Table 2). Cow's milk production reaches a value of 405 thousand liters and marks an increase of 3.7% compared to the 2019 data (SSO, 2020). According to the most recent data, the amount of milk significantly decreased in 2021, reaching a total of 389,210 liters (https://ec.europa.eu/eurostat/databrowser/view/apro_mk_farm/default/table?lang=en).

Regarding the milk production from sheep and goats in our country, Table 2 shows a downward trend in the amount of milk produced, with the year of 2020 being exactly the lowest level of production of this milk over the last decade. There is a constant decrease in the amount of milk produced (per capita), with just the last year showing the lowest level of milk production from sheep and goats per capita.

While sheep milk production decreased by 23.3% compared to the previous year (2019), goat milk production decreased by 7.7% compared to 2019 (SSO, 2020).

Table 2. Cow, sheep and goat milk production in 2020.

	Number	Average (liters)	Milk production, in 000 liters	Productivity index (2020/2019)
Cow				
Business entities	3.663	6.426	23.539	123.5
Agricultural holdings	107.420	3.553	381.678	102.6
Total	111.083	3.648	405.217	103.7
Sheep				
Business entities	4.217	45	189	31.6
Agricultural holdings	446.894	60	26.735	77.5
Total	451.111	60	26.924	76.7
Goat				
Business entities	758	44	33	33.0
Agricultural holdings	69.374	224	15.534	92.7
Total	70.132	222	15.567	92.3

Cow's milk is the source of most dairy products in terms of production. With about 56.5 million cows, India tops the list of countries with the most dairy cows, while the European Union is the largest producer of cow's milk in the world, followed by the United States. However, China has tripled its milk production since 2000 (<https://www.statista.com/topics/4649/dairy-industry/#dossierKeyfigures>).

One-fifth, or more precisely 21.5%, of the total amount of cow's milk produced at the European level is precisely collected from farms in Germany, and farms process an approximate percentage, or 22.4%, of the total European milk in Germany. Meanwhile, Germany and France, the Netherlands and Poland supplied about two-thirds or 65% of the total amount of raw cow's milk in 2020 (https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=Milk_and_milk_product_statistics).

Dairy production in our country is mainly characterized by low productivity and an incomplete identification system, which makes it difficult to monitor and control diseases in domestic animals and significantly affects the quality and safety of milk (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>).

Primary production also remains a fundamental problem: providing cheap food, more modern breeding conditions, improving the breed composition of livestock, improving the microbiological quality of milk and others. With this quality, the milk arrives at the dairy, where the problems are further aggravated. The particular nature of milk production, distribution and transportation makes the concept of milk control difficult to implement, and the nature of the control itself is quite expensive. Many dairies do not meet basic hygiene and sanitary requirements, and it is not uncommon to have unregistered processing plants. Existing standards and procedures for proper technological operations are not followed, and there is a lack of proper control of incoming material and control at the factory in terms of product quality and safety. The need to intervene in primary production stems from the introduction of standards that establish basic requirements for livestock production (good agricultural practices) and general hygiene rules in primary production (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>). It allows for strictly controlled production of raw milk, which must be purchased by processing plants, based on mutual agreements with predetermined conditions and certain rights and obligations of both partners. The overall milk production shows a decreasing trend. The milk produced is used fresh or processed into yoghurt, and cheese. By comparison, there are about 700,000 dairy farms in the European Union. There are about 12,000 production and processing stations. This industry creates about 300,000 jobs directly related to milk processing. The dairy industry generates about 10 billion euros in the EU trade balance. In addition, 10 of the world's top 20 dairy companies are from the European Union. With more than 300

registered cheeses and other dairy products, the dairy industry also contributes to the EU's cultural heritage (EDA, 2020).

About 20 million cows with an average of 7,300 liters of milk were in the EU in 2020 (https://ec.europa.eu/info/food-farming-fisheries/animals-and-animal-products/animal-products/milk-and-dairy-products_en). There are many differences in the quantity, form and size of farms involved in the production and processing of milk and its products. However, despite many challenges, it can be observed that the less developed producers of milk and its products are rapidly trying to converge with the producers who apply a more structured and modern approach to production when they are even more visible. Milk production produced by smallholder farmers contributes to the livelihood of families in most developing countries, as is the case with the processing of milk and its products in our country (Al Sidawi et al., 2021). Developing countries have increased their milk production worldwide in recent decades, more due to an increase in the number of animals than to an increase in productivity. This increase is mainly due to an increase in the number of productive animals rather than an increase in productivity per animal (FAO, 2009; Thornton, 2010). In many developing countries, milk productivity is constrained by inferior food sources, diseases, limited access to markets and services, and the low genetic potential of dairy animals for milk production, including our country. In some developed countries, milk production has a long tradition and its products play an important role in nutrition. Last year, raw milk production on farms in the EU amounted to about 160.1 million tons, an increase of 1.9 million tons compared to the previous year. This figure amounts to 154.4 million tons of cow's milk, 3.0 million tons of sheep's milk, 2.5 million tons of goat's milk, and 0.3 million tons of buffalo's milk. Most of the milk is used as fresh milk for beverages, while the rest is used for the production of cheese, milk powder, butter and ash. Last year, the amount of milk per capita increased, reaching 7,509 liters of cow's milk per capita. At the national level, the largest increase in the quantity of milk per capita is observed in Estonia, with about 10,063 liters and in Denmark with 10,028 liters per capita, while the lowest quantity of milk is recorded in Bulgaria (3,654 liters) and Romania (3,228 liters). However, Germany and the Netherlands are well above the European average (https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=Milk_and_milk_product_statistics).

Market and trade

Trade in milk and dairy products improves revenues, creates business in production, distribution, marketing, and food security. Globalization has resulted in milk and its products being consumed in every corner of the world. Each year, large volumes of milk, cheese and other milk products are marketed among

different countries. In 2020, milk and dairy products worth over \$55.75 billion were exported, marking a significant increase of nearly \$39 billion compared to 2015. With countries such as France, Ireland and Germany, the European Union controls 38% of the export market for milk and dairy products. Germany alone exports cheese worth about \$4.6 billion annually.

In recent years, there have been many creative and innovative efforts related to the processing, fermentation and consumption of milk and dairy products. In 2019, the value of the global market of milk and its products was estimated at \$720 billion, which is expected to reach the value of \$1,032 billion in 2024 (<https://www.statista.com/topics/4649/dairy-industry/#dossierKeyfigures>).

In developing countries, most milk is traded through informal channels, i.e., without regulation or licensing (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>). The situation is similar, especially in rural areas where consumers prefer to process milk by boiling. As a result, the variance between producer and consumer prices in the informal market is generally negligible.

The most controlled agricultural market is the dairy market. In developing countries, strategies usually focus on minimizing dairy imports and promoting national production, increasing domestic farm income, and minimizing import costs. However, it is likely that milk production will not be sufficient in the future and therefore more and more dairy products will have to be imported.

Because many dairy products are highly perishable, the percentage of dairy products traded internationally is low, usually 8% (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>).

Table 3. The volume of purchases of milk and its products during the last decade (expressed in tons).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Fresh cow's milk, in '000 liters	83.997	106.466	105.711	113.760	135.996	137.467	148.381	140.055	153.068	148.786
Fresh sheep's milk, in '000 liters	2.350	5.376	3.617	6.752	8.941	6.955	8.297	5.924	8.031	6.096
Kaçkavall (trapist)	46	122	6	7	10	103	470	351	176	124
Other cheeses	2.017	302	786	824	1.216	635	1.397	711	401	435
Other dairy products	91	615	248	83	520	265	628	436	113	63

Butter, cheese and milk powder are the most traded dairy products on the world market. In our country, according to the State Statistical Office, the total amount of purchases of milk and dairy products during the last decade is shown in

Tables 3, 4, and 5 (SSO, 2015–2020). The total value of purchases of milk and dairy products over the last decade is shown in Table 4.

Table 4. The total value of purchases of milk and dairy products during the last decade (expressed in '000 denars).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Milk and dairy products	1.565.789	2.216.384	2.369.203	2.761.345	3.321.302	3.035.684	3.296.076	2.945.747	3.387.310	3.244.401
Fresh cow's milk	1.426.372	1.930.492	2.076.314	2.362.653	2.775.787	2.648.019	2.652.916	2.489.998	2.999.419	2.936.380
Fresh sheep's milk	68.343	152.578	108.310	210.391	268.007	208.829	262.936	181.635	254.887	193.628
Kačkaval (trapist)	18.010	41.447	2.346	3.138	2.802	29.690	124.800	103.182	48.767	33.265
Other cheeses	45.123	55.038	167.840	177.573	251.167	133.336	224.846	145.558	76.969	77.791
Other dairy products	7.941	36.829	14.393	7.591	23.538	15.810	30.577	25.374	7.270	3.336

The total amount of milk and its products purchased by each producer over the last decade is shown in Table 5. The increase of about 100% in the total volume and quantities of milk purchased by 2018 shows the intensification of the production system in this sector in the last decade, which could be attributed to the use of improved genetic material (Koutouzidou et al., 2022).

Table 5. Total amount (expressed in tons) and value (expressed in '000 denars) of purchases of milk and dairy products.

	2010	2011	2012	2013	2014
Fresh cow's milk, in '000 liters	70.173	90.829	88.793	101.507	113.409
Fresh sheep's milk, in '000 liters	2.122	5.287	3.173	6.407	8.713
Kačkaval (trapist)	5	1	-	-	-
Other cheeses	3	2	47	63	134
	2015	2016	2017	2018	2019
Other dairy products	3	22	3	1	4
Fresh cow's milk, in '000 liters	118.240	127.093	116.465	132.604	128.993
Fresh sheep's milk, in '000 liters	6.749	7.575	5.538	7.261	5.705
Kačkaval (trapist)	22	50	8	13	12
Other cheeses	267	291	32	39	20
Other dairy products	-	-	56	19	-
Value (expressed in '000 denars)					

Continuation Table 5. Total amount (expressed in tons) and value (expressed in '000 denars) of purchases of milk and dairy products.

	2010	2011	2012	2013	2014
Milk and dairy products	1.269.141	1.788.073	1.811.636	2.300.008	2.583.093
Fresh cow's milk	1.203.563	1.636.314	1.711.802	2.088.628	2.285.489
Fresh sheep's milk	62.618	149.822	95.115	200.311	260.460
Kaçkavall (trapist)	2.160	197	-	-	-
Other cheeses	500	287	4.454	10.986	36.957
Other dairy products	300	1.454	265	82	186
	2015	2016	2017	2018	2019
Milk and dairy products	2.513.069	2.542.706	2.190.149	2.772.714	2.686.492
Fresh cow's milk	2.252.878	2.230.780	2.013.829	2.532.382	2.499.999
Fresh sheep's milk	200.335	240.103	167.113	227.492	179.724
Kaçkavall (trapist)	6.443	15.094	2.205	3.497	3.339
Other cheeses	53.414	56.728	5.891	7.295	3.429
Other dairy products	-	-	1.112	2.047	-

This trend indicates that dairy farms have increased the use of capital in modern buildings and equipment. Strengthening production structure through increasing herd size and optimal feeding as a persistent strategy for modern dairy farms was also confirmed by Wilson (2011), Mitsopoulos et al. (2011) and Pocza et al. (2020).

The trade balance of the dairy industry and milk and dairy products is shown in Table 6. As stated by the available data, we assume that the quantity and monetary value of milk and its imported products are many times greater than the quantity and value of exported milk (Table 6) (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>).

Table 6. Trade balance of milk and dairy products in North Macedonia.

Year	Export		Imports	
	Quantity in tons	Value in \$	Quantity in tons	Value in \$
2010	3.274.670	7.387.682	25.132.352	36.853.570
2011	3.727.166	9.904.373	31.472.780	52.515.519
2012	3.878.254	9.863.601	38.804.369	52.407.890
2018	5.602.300	11.402.658	36.459.259	50.326.948

The Republic of North Macedonia is an importer of milk and its products. The main importers of milk and dairy products in our country are Germany, Serbia, Slovenia, Bosnia, Greece, Bulgaria, Croatia, Montenegro, Czech Republic and France. (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>).

Largest milk producers/processors

According to the latest data published by the Food and Veterinary Agency of the Republic of North Macedonia, the dairy industry in our country consists of 75 local legal entities that deal with the production, collection, and processing of milk and its products (FVA, 2021). Although it was a “Covid” year, 20 dairies managed to achieve a turnover of more than one million euros last year. The local dairy industry has survived the crisis caused by Covid-19 and has emerged stronger from the great challenge posed by the most dangerous health pandemic. Last year, 20 companies turned over more than one million euros in our market for milk and dairy products. The revenues of these enterprises amounted to 120 million euros last year. In terms of market shares, there were no major and significant changes last year, although in the first place is undeniably the largest dairy enterprise – Bitola Dairy, which has a market share of more than one-third of the total revenue from sales of the 20 largest dairy companies in the country. At the same time, it has the highest profit in absolute terms and is the only dairy enterprise with more than one million euros. The biggest player in the market last year was Trnica Dairy, which increased its sales by 98% and ended last year with a profit. The second-largest market player, Zdravje Radovo, lost the direct fight with the competitor from Kumanovo – Bučen Kozjak, which recorded a 13% increase in revenues. The subsidiary of the Croatian “Dukat”, Lactalis from Bitola, is among the four industries with the highest relative profit growth, compared to its competitors. Of the 20 companies listed in real terms, the company Deni Milk from Kocani, which, thanks to a 44% increase in revenues, has seen the greatest growth in its market share, has the smallest.

Dairy animals

The world’s milk production comes almost entirely from cows, buffalo, goats, sheep, and camels. Other less common milk animals are yaks, horses, reindeer and donkeys (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>). There is considerable variation among countries and regions, as the occurrence and importance of each species vary considerably. The main factors determining the cultivation of dairy species for the dairy sector are feed, climate and water. However, socioeconomic characteristics of smallholder farmers, dietary (food) traditions, and market demand can also affect dairy cattle species. The

sustainability of farm livelihoods, communities, and ultimately water and soil resources is affected by livestock production, which is a major driver of environmental change (Pelletier and Tyedmers, 2010; Koneswaran and Nieremberg, 2008; Steinfeld et al., 2006). Globally, 81% of milk production comes from cows (81%), buffalo (15%), goats (2%), sheep (1%), and camels (0.5%). However, in developing countries, about one third of milk production comes from buffalo, goats, camels and sheep (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>). In our country, milk production is mainly based on cows, sheep and goats (State Statistical Office of the Republic of North Macedonia, News Release – Livestock Production 2020, No. 5.1.21.06, dated 29.04.2021).

Table 7. Number of livestock over the last decade.

Year	Total	Cows and heifers	Total	Sheep for breeding
2010	259.887	135.004	778.404	568.301
2011	265.299	164.537	766.631	545.214
2012	251.240	161.012	732.338	520.767
2013	238.333	154.487	731.828	530.760
2014	241.607	155.432	740.457	531.160
2015	253.442	156.699	733.510	580.840
2016	254.768	160.603	723.295	555.932
2017	255.036	153.618	724.555	565.063
2018	256.181	163.514	726.990	579.747
2019	217.790	133.740	684.558	533.393

Production systems and milk chain

In developing countries, it is estimated that 80% to 90% of milk is produced on small farms. The production of dairy animals is relatively small, and based on low income. Smallholder dairy farming is part of a mixed farming system in which fertilizers are used to produce the first crop, dairy animals feed on grass, plant residues and cultivated fodder and supplemental feed are used only when feasible. Milk production on pastures is based on the soil and is the most important asset for existence. Milk production is usually linked to harvest, but nomadic ranchers do little or no farming and roam the countryside in search of pasture and water. Non-urban dairying is a fully market-oriented system located in or near the city limits. Peri-urban dairy producers benefit from proximity to markets, but their production is based on purchased inputs and may face difficulties with food supply and waste (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>).

Big producers do not make up a great part of national milk production. In our country, milk production is characterized by many small farms – traditional farmers (80% of the total) with a low annual milk production of 2–3 thousand liters per cow. Only 1% of farms have more than 50 cows, and these are considered as carriers of the production of high quality genetic material for the remaining farms (breeding centers) (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>). However, the importance of small dairy farms has declined precisely because of the giant corporations that control significant portions of the global dairy market and their products. The Nestlé Association, one of the major food and beverage companies globally, earned about 11 billion Swiss francs from the sale of milk in 2020. This makes milk and its products the third largest category for this multinational giant (<https://www.statista.com/topics/4649/dairy-industry/#dossierKeyfigures>).

Milk chains connect companies that distribute dairy products to the last customer, and thus, with each service, the price of the product increases. Each actor in the chain must provide the maximum added value to the product at the lowest possible cost. Creating a productive, healthy and profitable milk chain is a strong challenge in many countries, including ours. The reasons are problems in organizing a manageable milk collection and transportation system due to the small amount of milk per farm and the distance of production, seasonality, poor infrastructure, knowledge and technology deficits; lack of standard of raw milk and difficulties in setting up refrigeration facilities (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>).

Collection and transportation

Milk is an essential food with high nutritional value that requires careful handling due to its short shelf life. It is not stable, being a perfect environment for the development of microorganisms – especially pathogenic bacteria – that cause spoilage and diseases. Processing milk makes it possible to store it and reduce the number of foodborne diseases. The shelf life of milk is affected by processes such as refrigeration (the factor most likely to affect the quality of raw milk) or fermentation. Pasteurization is a heat treatment process that can extend shelf life to several days and kill pathogenic microorganisms to the point where they do not pose a significant health risk. It can be further processed into high-quality, concentrated and easily transportable dairy products with a long shelf life, such as butter and cheese. In developing countries, small-scale producers produce most of the milk that is distributed from rural areas, and marketed in urban areas, which is challenging because of the high perishability of milk. Milk is transported by producers themselves or by milk collectors in large churns or cisterns. The milk in the large containers is not adequately cooled, so the duration of transport is of

paramount importance to ensure the delivery of quality milk. On large farms, milk is usually transported in cisterns where the milk is fresh and unlikely to sour before it reaches the processing plant. Milk collection and transportation costs represent a significant portion of milk processing costs, often more than 30% (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>).

Institutions, associations and organizations of producers

Food production is of strategic interest in every country. Therefore, it is important to organize food producers and represent their interests to ensure and promote food production. Dairy institutions involve dairy producer associations, regulators, service providers, market agents, nongovernmental organizations, and development partners (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>). Associations benefit producers, processors, and traders through improved revenues, market access and trading power, which results in improved production and quality of products. The dairy industry in our country lacks a variety of institutions that address the problems of developing this industry.

The milk production, collection, and processing associations have been established and operate within the Chamber of Commerce of North Macedonia. The members of associations for milk production, collection, and processing are legal entities whose primary activity is the production, collection, and distribution of milk and dairy products. The main tasks of the association are: representation and presentation of common interests before the relevant institutions and bodies, liaison with sister companies from countries in the region, review of the possibility of joint procurement of raw materials and raw materials in the production process, joint presentation at trade fairs and business forums, compliance and adaptation to EU regulations (<https://www.mchamber.mk/Default.aspx?mId=19&id=29&lng=1>).

Dairy producers can be organized into processor associations to increase their income and efficiency and to support milk collection, transportation, technology, and trading capacity. Associations are essential in enabling dairy farmers to take full advantage of milk production. The business of dairy organizations includes marketing, collection, processing, expediting access to services (e.g., finance), and providing inputs (e.g., food, loans, etc.). These organizations are critical to small-scale milk production because they provide many benefits, and improve communication and knowledge. Dairy producers' organizations have played a significant role in developing the dairy industry worldwide, but there are few such associations and organizations in our country.

Animal health, food sources, and husbandry

Animal mortality due to diseases causes productivity losses in dairy herds worldwide, leading to significant financial losses. Mastitis and parasitical diseases reduce the system efficiency. Low milk yield or reduced milk, fertility, quality, and food processing are affected by poor animal health, which can also threaten human health (e.g., tuberculosis, brucellosis). Several factors contribute, including low knowledge of disease prevention and management, increased incidence of pathogens, and adequacy of animal health services (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>). The loss of animals can have a significant impact on the family finances of a small milk producer, who usually invests little in the health of the animals, which have numerous health problems. Dairy animals adapted to local environmental and climatic conditions can significantly reduce animal welfare and health problems and are resistant to endemic parasites and diseases. One of the most important factors limiting milk production is poor digestibility and nutrition of animals, mainly due to plant residues and poor pasture quality with few vitamins, minerals and nitrogen (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>).

Moving livestock to pasture is a common practice in all developing countries. The use of supplementary feeds (foods rich in energy and protein) is essential for dairy animals because milk production is a process that consumes much energy and availability is low. Small-scale milk producers usually cannot feed. Small-scale milk producers depend mainly on seasonal quantity and quality of natural forage due to the high cost of conventional supplemental feeds such as minerals, oilseeds and grain-based concentrates. Through selective breeding and reproductive control, dairy producers can improve productivity and income from milk production (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>). Breeding success is influenced by factors such as genetic characteristics and suitability, production system and environment, socioeconomic conditions of producers, and feed. Reproductive performance (conception rates and birth intervals) can be improved by using appropriate genotypes, valuable traditional knowledge of breeds and their management for breeding practices, and also by using knowledge of genetics and breeding from scientific institutions. Even if these are not formalized or written down, they have breeding objectives and strategies. In developing countries, large-scale dairies routinely use artificial insemination by producing breeding males or by having small-scale farmers or individual producers use artificial insemination, paying increasing attention to the breeding process. Kumar and Meena (2021) reported that the socioeconomic status of farmers is mainly responsible for their decision regarding animal health services.

Financial support for the dairy industry

The Ministry of Agriculture, the Agency for Financial Support to Agriculture and Rural Development and the Government of the Republic of North Macedonia, through their policies, continue to create favorable measures and policies that will support the growth and development of the agricultural sector in the country, including the production of milk and its products. Regarding financial support to the dairy industry, the latest data show that the Agency for Financial Support to Agriculture and Rural Development transferred 255.9 million denars to the accounts of 7,347 entities (http://www.ipardpa.gov.mk/Root/mak/default_mak.asp). It refers to the payment to farmers who produced and supplied sheep's, goat's and cow's milk. Farmers who produced and delivered cow's milk received a support of 3.5 denars per liter, while all those who produced goat and sheep milk received a financial support of 4.5 denars per liter of delivered milk. According to the Regulation on Direct Payments for 2021, the criteria for direct charges related to livestock production include: consumers, milk producers and deliverers of cows, sheep and goats. It establishes the requirements for direct payments related to livestock production (Regulation 2021, Official Gazette of RNM No. 12/2021).

The beneficiaries of this measure are agricultural cooperatives – producers of cow's, sheep's and goat's milk registered as breeders of cattle, sheep and goats in the Register of breeders of certain animal species (cattle, sheep and goats). The investments and financial support are of particular interest in shaping the policies of the Government and the Ministry of Agriculture, Forestry and Water Economy as the milk and dairy industry is one of the most critical segments in the agro-industrial complex. Financial support for the livestock supply measure was significantly increased. Furthermore, nearly 1.5 million euros were allocated for this purpose

(<http://www.mzsv.gov.mk/Events.aspx?IdRoot=50&IdLanguage=3&News=504>). This measure is essential to improve the genetic potential, which will ultimately affect the quality of the final product, while other measures are foreseen to support this sector. However, the measures are also available from the IPARD2 program, which provides an opportunity for investments in the construction or reconstruction of dairies, farms and the supply of equipment (<http://www.mzsv.gov.mk/Events.aspx?IdRoot=50&IdLanguage=3&News=504>).

Numerous mechanisms are used within the EU to preserve the dairy industry in times of widespread trade turmoil. These intervention measures aim to address the possible market imbalance by protecting consumers, producers, and processors within the dairy industry. The European Union is estimated to be the largest exporter of milk and dairy products globally. However, there are numerous policies within the Union, to promote research, innovation, and improve dairy product

standards. Past and current trends at the European and global levels in the dairy industry are analyzed by European authorities on issues such as production costs and market prospects for dairy products (https://ec.europa.eu/info/food-farming-fisheries/animals-and-animal-products/animal-products/milk-and-dairy-products_en).

Economics of the dairy industry

Daily milk production provides a systematic financial income and is based on the quality of milk composition, hygienic standards and seasonality. Additionally, income includes the sale of slaughtered animals and other income from dairy farming, such as the sale of manure. The dairy industry provides numerous financial gains that are not traded, including manure for farm use as organic manure (in some agricultural systems, manure is the only source of nutrients for plant productivity). Dairy animals are viewed as a form of capital investment or a means of savings to sell in times of need, despite the risk of theft or death. Since small-scale dairy producers generally use domestic labor, small-scale milk production costs (per unit of milk produced) are often similar to those of large-scale dairies. Retail milk production depends little on family labor, and labor is occasionally hired. Small-scale milk production provides business opportunities through the dairy industry, including small-scale processing plants and other direct and indirect services, with particular emphasis on feed having a significant impact on the dairy economy. Between these strategies and solutions, sustainable intensification and agroecology in ruminant farming systems have been proposed as environmentally safe, economically feasible, and socially just (Dumont et al., 2018).

Social and gender issues and the dairy industry

In developing countries, more than 80% of milk is produced on small farms that provide employment to more than 750 million people worldwide (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>). Less labor-intensive production systems and a more technology-intensive dairy sector provide less employment per milk production unit in developed countries, while farm income increases in developing countries due to market-oriented opportunities. In addition, the dairy sector provides more employment opportunities than other food chains (<https://www.fao.org/dairy-production-products/socio-economics/dairy-development/en/>).

In many rural communities, as in our society, women traditionally play an important role in the production of milk – feeding and milking – processing and marketing dairy products. While they usually do not earn money from their work,

the milk they sell allows them to buy food, clothing and other necessities and to pay for their children's education and basic needs. Nevertheless, women's participation in milk production is generally decreased because milk production plays an important role in providing family income. Basically, strategies for sustainable farming practices have been proposed as an innovative process to increase animal welfare and social acceptance of the dairy sector (Padel et al., 2015).

Challenges of the dairy industry

Today, the dairy industry faces various interrelated challenges in the three main pillars of sustainability: economic, social and environmental. The dairy sector within the EU faces various socioeconomic challenges, including market price fluctuations, high labor costs, and demographic characteristics of the population in terms of age. All farm systems are directly related to the climate and the function of a healthy natural environment. The European dairy industry is both a victim and a cause of climate change (Alvez et al., 2013). Farming within the EU is responsible for about 10% of greenhouse gas (GHG) emissions coming from the economy (Bas-Defosse et al., 2019). Social understanding and recognition of environmental impacts, animal welfare and health issues are constantly increasing, resulting in growing consumer demand for standards of healthy, sustainable products and high levels of animal welfare.

The EU assumes that by 2050 the EU dairy industry will have found the balance between the three pillars of sustainability: environmental, economic and social (Bas-Defosse et al., 2019). This will enable the industry to operate safely and meet consumer needs and demand for healthy and sustainable products supported by high standards of animal welfare. The dairy sector will be profitable, with capital distributed across supply and value chains, and a large attractive employer. In many developing countries, dairy progress is limited by livestock issues, transportation, processing, refrigeration, and marketing. In addition, small-scale dairy farmers cannot manage their farms as businesses. They have little access to services such as training, education, health, and lending, and have little or no investment capital due to the small size of their herds. This is the case with small-scale dairy producers in our country. As the modern dairy sector in Europe occupies one third of the agricultural land in the EU and increases its dependence on concentrated feed, the adoption of new technologies in nutrition, genetics, and herd management is accelerating, and cows are mostly located in modern facilities with limited or no access to pasture (EC, 2021; Zorn and Zimmert, 2022; Bórawski et al., 2020; Barkema et al., 2015).

Conclusion

Depending on cultural and social circumstances, market demand, available milk processing technologies and dietary habits, dairy products vary considerably from region to region in the same area. Factors driving the development of the dairy industry include changes in production, demand, communication and transportation technology, improved on-farm productivity, and a more effective dairy production chain. It is essential to add merit to every activity in the dairy production chain. Establishing active producer associations and credible milk chains is vital for sustainable development. In the Republic of North Macedonia, milk production is characterized by many traditional farmers with small farms (75% of the total) with low productivity (1–3 cows) and low milk production annually (2–3000 liters per cow). Insignificant is the number of farms with annual milk production of about 5 thousand liters per cow or more than 20 cows (about 3% of the total) and that of farms with more than 50 animals is around 1%. Therefore, we can conclude that milk production in our country has an overall downward trend. Dairy production in our country is characterized by low productivity and an incomplete identification system that makes it challenging to monitor and control diseases in domestic animals, which significantly affects the quality and safety of milk.

Primary production is still a fundamental problem that concerns the provision of cheap food, more modern breeding conditions, improving the breed composition of livestock, improving the microbiological quality of milk and others. The specific way of milk production, distribution and transportation makes it difficult to implement the concept of milk control, and the method of control itself is quite expensive. Many dairies do not meet basic hygienic and sanitary requirements, and it is not uncommon to encounter unregistered processing plants. There is a violation of existing standards and procedures for proper technological methods, inadequate control of incoming material and performance in its factory in terms of product quality and safety. Most milk is traded through informal channels without regulatory licensing. In our country, the situation is similar, especially in rural areas. The dairy trade improves revenues, creates jobs in processing, marketing and distribution, and contributes to food security.

To achieve poverty alleviation, food security and economic growth, the success of dairy farming due to milk production is a powerful tool. It contributes with a systematic source of food with nutritional value, increases resource utilization, creates jobs inside and outside the farm, opens opportunities for women and the most affected social groups, and provides financial stability and social status. The Republic of North Macedonia is an absolute importer of milk and its products. The quantity and monetary value of imported milk and its products are many times higher than the quantity and value of exported milk. Today, the global

dairy industry faces various interrelated challenges in the three main pillars of sustainability: economic, social and environmental. The dairy sector faces multiple socioeconomic challenges, including fluctuating market prices, high labor costs, and demographic characteristics of the population in terms of age. All farm systems are directly related to the climate and the functioning of a healthy natural environment. Social understanding and awareness of environmental impacts, animal welfare and health issues are constantly increasing, resulting in growing consumer demand for standards of healthy, sustainable products and high levels of animal welfare. In conclusion, for the dairy industry to be sustainable, all activities should be carried out in partnership with the industry (along the value chain), policymakers and a wide range of stakeholders, including consumers themselves.

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ODRŽIVOST I PERSPEKTIVE INDUSTRIJE MLEKA U SEVERNOJ MAKEDONIJI

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R e z i m e

Predmet ovog pregleda je industrija mleka u Republici Severnoj Makedoniji. Ova industrija može doneti mnoge ekonomske i socijalne koristi društvu i privredi. U radu je dat opis i analiza postojećeg stanja u industriji mleka u našoj zemlji. Analiziraju se stope proizvodnje mleka u našoj zemlji, uz uporedni pristup stopama proizvodnje na svetskom i evropskom nivou. U Republici Severnoj Makedoniji proizvodnju mleka karakteriše veliki broj tradicionalnih malih poljoprivrednika (80% od ukupnog broja) sa 1–3 krave i niskom godišnjom produktivnošću mleka (2–3 hiljade litara po kravi). Broj velikih specijalizovanih gazdinstava sa više od 15 krava (oko 3% od ukupnog broja) sa oko 5 hiljada litara godišnje proizvodnje mleka po kravi je minimalan. Samo 1% svih gazdinstava ima više od 50 krava. Republika Severna Makedonija je apsolutni uvoznik mleka i mlečnih proizvoda. Količina i novčana vrednost uvezenog mleka i mlečnih proizvoda višestruko su veće od količine i vrednosti izvezenog mleka. Danas se industrija mleka suočava sa različitim izazovima u okviru tri glavna stuba održivosti: ekonomskom, socijalnom i ekološkom, uključujući fluktuirajuće tržišne cene, visoke troškove rada i demografske karakteristike stanovništva u pogledu starosti. Da bi mlečna industrija bila održiva, sve aktivnosti treba da se sprovedu u partnerstvu sa industrijom (duž lanca vrednosti), kreatorima politike i širokim spektrom zainteresovanih strana, uključujući potrošače.

Ključne reči: industrija mleka, finansijska podrška, kvalitet mleka, standardi za mlečne proizvode.

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